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TAYLOR'S AMERICAN FIELD PIECE.

First successfully employed during our late war, and more recently in the struggle between France and Prussia, the battery gun, like the submarine torpedo, may be safely predicted as designed to exert no small influence in the determination of future conflicts. Even in the crude forms in which, as necessity demanded, it has been hurried to the field, its terrible execution has proved it a most formidable and deadly arm: and as in late years improvements have been made in its construction, all tending to increase its power, the fact has become more clearly apparent that the mitrailleuse forms still another link in that chain of weapons of human destruction, which, beginning with the bow of the savage, the world believed forged and complete when the needle gun at Sadowa brought to a sudden ending a short though bloody war.

With the general principles upon which the construction of the battery gun is based, we presume our readers to be reasonably familiar. Explanations and illustrations of the Imperial, the Gatling and others, have already found place in our columns; so that, in illustrating the new mitrailleuse of Mr. Taylor, description of the minor details will be dispensed with. A short brass cylinder, containing twenty-four barrels, together with a quantity of machinery, is mounted on an ordinary gun carriage. Such is the general appearance of the invention. The length of the piece is about 28 inches, and its weight, with its appurtenances, is in the neighborhood of a thousand pounds. We begin our description with the loading mechanism. A is a magazine consisting of 24 tubes, each of which contains nine cartridges of size suitable to the caliber of the barrels. The tubes are confined between heads. The entire receptacle can be instantly removed from its position when its charge of ammunition is exhausted, and another similar filled magazine substituted, so that the gun may be thus kept almost continually supplied with cartridges. A suitable number of these charged reservoirs are designed to be carried in the ordinary caisson. At B is a cylindrical case, which encloses the feeding apparatus, consisting of 24 steel rods, which are intermittently moved forward into the magazine tubes through the medium of the rack shown above the casing, actuated by suitable mechanism in connection with the lever, D. At each movement of the rods one cartridge is forced out of every magazine tube, and into corresponding cavities in a rotating chamber plate, a portion of which is shown projecting at C. This plate consists of four wings, and revolves in the slotted breech piece into which the barrels are screwed. In each wing are 24 cartridge chambers circularly arranged. Of course all four wings or sets of chambers are on the same plane, and rotate on a common axis, so that one after the other, as each is charged from the magazine, is revolved so as to come into exact line with the barrels of the piece.

The same lever, D, that actuates the feeding apparatus, also communicates motion to the volley firing plunger or piston, E. F is a movable latch fixed longitudinally upon the top of the latter, holding it out of action when a fusillade discharge is desired. The details of the mechanism which explodes the cartridges are necessarily unrepresented in our engraving. We need, in reference thereto, only allude to a number of spring spindles which are either simultaneously thrown against all the cartridges, in the wing that is in position, by the piston E, or which are caused to strike their corresponding cartridges separately by means of a cam arrangement, within the breech and rotated by the steel crank, G. The first system causes a volley; the second, a fusillade.

When firing on the latter plan, as soon as each wing of the chamber plate is exhausted, a spring catch, H, automatically stops further rotation of the crank until another filled wing is revolved into position by the lever, D. Between the wings are arranged brushes and sponges which, in passing, clean the rear of the barrels between the discharges.

The lever, D, performs three offices; it works the feeding apparatus, rotates the wings, and operates the shell ejector. This last mentioned apparatus is contained in the case, I. The movement of the lever which brings up a filled wing necessarily turns away the one that has just been fired and which still contains the empty cartridge shells. The cylinder, I, however, is so situated as to be exactly in the path of the discharged chambers, and besides other mechanism, encloses 24 rods, which, as above intimated, by the action of the lever, D, are caused to enter the chambers and push out the discharged shells, which fall to the ground.

The arrangement of the barrels is clearly indicated in the gun to the left of the engraving. It will be noted that their muzzles are placed in the form of an ellipse, while at the breech they are circularly disposed, the object of the former configuration being to give a wider dispersion to the balls. J is the water casing, into which water may be introduced through the orifice, K, and the barrels thus continually kept cool. But three men are necessary to operate the piece, one at the crank and lever to fire, another at the rear to point, and a third to renew the magazines; and it will be remarked that all vulnerable portions are carefully so placed as to be out of danger from damage by rifle shots from the front.

At Sand's Point, L. I., a series of interesting experiments were made by the inventor, which proved quite satisfactory. At a range of 100 yards the target was pierced by a broadside which described an elongated horizontal ellipse, 2 feet wide at center and 12 feet long. At a range of 200 yards the width of this ellipse remained nearly the same, but the length increased in the same proportion as the increase of range. This was repeated, both by broadside and fusillade, a great number of times, the effect being uniform throughout the experiments. The piece was discharged several times over the waters of Long Island Sound, and the effect was quite interesting. A volley or broadside of shot striking the water 1,200 yards away produced a noise like that of beating the surface with the flat side of a board, the projectiles covering a line of about 144 feet. The effects of the fusillade were equally curious. The missiles would fall in quick succession, producing the same sharp sound, and for more than

TAYLOR'S AMERICAN FIELD PIECE.

a second after ceasing fire this would continue, so that a charged wing could be brought up to the lever, the shells ejected, and the fire reopened by the time the last missile of the previous charge had struck. The inventor concludes that, virtually, a continuous and unceasing stream of bullets may be kept up by the crank fire, for any desired length of time.

To Mr. J. P. Taylor of Tennessee is due the credit of this very ingenious weapon, of the successful operation of which we have assured ourselves by personal observation. In the experimental battery, an excellent piece of mechanical work from the shops of the Holske Machine Works in this city, from which our engravings were made, we remarked but few points that were susceptible of simplification, and we could suggest nothing which had not been anticipated by the inventor and fully provided for in a second gun which we learn he is about to construct. The piece has already attracted no small degree of attention in military circles, and we do not doubt but that it will excite even a greater interest when it appears, as we understand it will, according to the intention of the inventor, at the Vienna Exposition. Further and more detailed particulars may be obtained by addressing J. P. Taylor, patentee, or D. Hockett, attorney, Knoxville, Tenn.

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(Illustrated articles are marked with an asterisk.)

THE SOURCES OF OUR MODERN KNOWLEDGE.

In the uncertain prehistoric ages during which the ancient human civilization was evolved, Science, which regulated the social relations, did not rise above the purely material purposes which occupied the minds of men. The small number of truths, of which Science then consisted, were only empirical deductions from facts; but she advances with the progress of humanity, and from Thales to Archimedes immense scientific labors extend her limits and tend to generalize human knowledge.

Thales, who lived twenty-six centuries ago, is one of the first philosophers, known to us, who brought his knowledge to a systematic whole. He was the founder of the Ionic school in Greece, and was equally successful as a mathematician and an astronomer. The school founded by him was afterward split up into different sects, which embraced in their researches all branches of human knowledge.

Pythagoras then appeared; this philosopher, who by grateful mankind of his age was called "divine," extended the domain of the mathematical sciences, and the tradition that he sacrificed one hundred oxen to the gods, from gratitude for the discovery of the famous problem which bears his name, is a proof of his trust in the guidance of a superior power. He had clearer notions than his successors; he taught the globular form of the earth, of which Anaximander had not the least idea, and he described the earth's motion around the sun; but mankind was not yet able to grasp this truth, and it had to be elaborated for two thousand years before general recognition of it was obtained.

After Plato, who, 2,200 years ago, had above the door of his lecture room the words "Nobody can enter here who is no geometrician," came the great Euclid, and then the illustrious Archimedes, the greatest philosopher of his time, who solved the most advanced problems with all the might of genius. The works of Apollonius, Hipparchus, Ptolemy, Diocletian, etc., fill up this earlier period of scientific history; but the authors are more specialist than universal philosophers; however, they contributed powerfully to the progress of knowledge.

At the beginning of a second period, Science seems to have been suddenly arrested, and ceases to appear as an element in the regeneration of humanity. She sheds, however, some of her light in the school of Alexandria; but after Diophantes her lamp appears to be everywhere extinct. Several centuries later, Science revives and is given back to the world by the same people that once slew her in her last asylum and surrendered the celebrated library of Alexandria to the flames, a library which contained all the philosophical works of preceding ages.

If the Arabs gave back to Europe, during the middle ages, some of the sciences, the records of which they destroyed in Alexandria, Europe in her turn became not only a rival, but a far superior master in the advancement of philosophy. It was then that Science took possession of certain grand theories, of which the preceding ages had scarcely any presentiment; the war which thus far had only existed in the moral world was carried into the scientific field; and human intelligence had begun to crave the discoveries developed by examination and discussion in the realm of positive sciences. It was then that Luther defended freedom in the examination and discussion of moral principles, and Copernicus defended freedom in scientific research, and established the true astronomical system. Then a galaxy of great men appeared: Italy produced Galileus Galileo; Germany, Gottfried Leibnitz; Holland, Christian Huyghens; England, Isaac Newton; and France, Rénate Descartes. Since that time discoveries have succeeded discoveries with the most unexampled rapidity; and thanks to their practical tendency, the appearance of the surface of our earth has changed during the two centuries since the time of these great men more than in the two thousand years previously. The number of discoverers and promoters of progress of the present day is indeed too great to enumerate, and what is a most striking fact, it has been steadily increasing during this century. In regard to the discoveries themselves, it appears to be reserved for the end of this century to place the crown on the now magnificent edifice of human knowledge, the labor of so many centuries, by a mighty doctrine which reunites all the isolated and various phenomena, by deducing them from a single absolute principle, the main object of modern research: The conservation of force or motion, which is founded on the principle of universal gravitation.

THE BROADWAY UNDERGROUND RAILWAY.

The bill for an underground railway beneath the great thoroughfare of New York city, known as Broadway, has finally passed both branches of the State legislature, received the Governor's signature, and become a law. The wonder is, in a community like this, so noted for the number of its intelligent, active, and vigorous men, that such an important enterprise should have been so long postponed. No city in the world has more pressingly needed the facilities for rapid transit than New York.

It has always been conceded that the best route for a fast railway was under the surface of Broadway. The peculiar formation of the metropolis, very narrow, surrounded on two sides by deep rivers, permits the movement of its population along one general line only—towards the north. The splendid thoroughfare of Broadway, seventy-five feet in width, lies in the very center of this movement, forming in fact the backbone of the city. Business of all kinds has Broadway for its focus, and probably no other street in the world is so constantly thronged with passengers and vehicles. The value of property on Broadway has become very great, and it is lined with many noble and costly edifices. Its peculiarly central position, the ease of its grades, the firmness of its soil, to say nothing of its enormous traffic, have always marked it as the natural route for an underground railway; and many different companies of railroad builders have vainly attempted to secure it as a prize. The property owners on the street, comprising many of our most wealthy and influential citizens, have always, until recently, opposed the railway, and nobody appears to have had wit or power enough to overcome their opposition.

The grounds for their hostility were plain and simple. They alleged that the operation of digging for the railway would endanger the water mains, break up the sewerage, set the gas pipes leaking, and tumble down every building on the street; causing a thousand times more damage and mischief than all the underground railways in the world were worth. This idea, in whole or in part, has pervaded the minds of owners and so united them in purpose that whenever any persons made a movement for the railway, they met with formidable opposition and signal defeat. Many and memorable have been the contests in the State legislature on the subject, and immense the sums of money expended; but the property owners invariably triumphed. In vain were they told that London had built such a railway and property, instead of being injured by it, was improved. To this it was replied that New York was not London, and that a road built here would certainly destroy the houses. For fifteen years has this sort of nonsense been allowed to bear sway, while the people suffered for want of the railway; and by reason of its lack thousands of families and business establishments were driven out of the State into New Jersey.

Our readers are familiar with the details of the construction of the short experimental section of railway under Broadway, by the Beach Pneumatic Transit Company. They will remember how this tunnel was bored by mechanism, under the surface of the pavement, below the water pipes, sewers, gas pipes, and foundations of adjoining buildings, the enormous traffic of the streets going on as usual, directly over the heads of the diggers. The public had no knowledge of the work until it was finished, and were greatly pleased with the quiet but effective manner in which it was done. That tunnel has been in existence and the experimental railway has been in operation for three years, presenting at all times an unanswerable argument in favor of an enlarged railway, and a practical refutation of the frivolous reasoning of the property owners. Meantime the company asked from the legislature the privilege of enlarging and extending the work, so as to provide a first class underground railway, and the public gladly seconded their request. For three years the company have pressed their enterprise upon the attention of legislature, and have at last succeeded. Their charter is secured. Their aim now is to make the work the model of its kind. The railway is to extend under Broadway, Madison avenue, and Harlem river to Westchester county, nine miles, with an additional lateral branch. The work of construction is to be done under the supervision of State engineers. Stringent provisions are made by law to guard all public and private interests.

We shall, from time to time, present such information concerning the progress of the work as may be of interest to our readers. The office of the company is at No. 260 Broadway, corner of Warren street, and all communications should be addressed to the Secretary, Joseph Dixon, Esq.

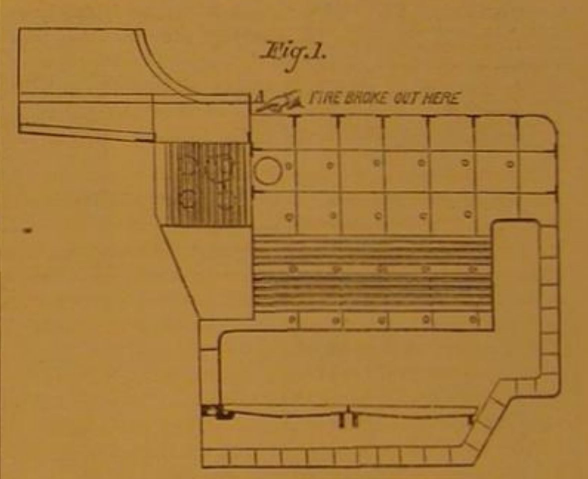
THE FIRE ON BOARD THE STEAMER ALASKA.

We recently published a communication from Mr. Norman Wiard, giving us the particulars of the ignition, by "over heated steam" as he alleged, of the felting of one of the boilers of the United States steamer Alaska. The report of this fire was sent to us by Mr. Wiard for the purpose of vindicating his theory of "ignition by superheated steam" from the charge of being "absurd," as criticised in the Scientific American, and also for the purpose of placing before our readers a positive example of such ignition, the facts concerning which might be examined and verified by any one who so desired: the previous examples referred to by Mr. Wiard not being open to such examination.

It appeared to us when we published Mr. Wiard's last letter that the fire on board the Alaska could not have been caused by overheated steam, and we then gave our reasons for so thinking. We will now present further information concerning the fire in question, derived from an authentic source, which completely upsets Mr. Wiard's superheated steam theory.

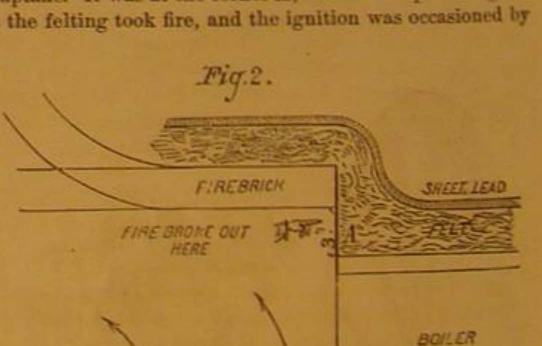
We give a diagram showing the general form of the boilers of the Alaska, and the arrangement of the super-

Fig. 1.



heating tubes. The steam passes from the boiler into the superheater and thence to the engine in the usual manner. We also give a diagram on an enlarged scale of the upper portion of the boiler and superheater at the junction with the uptake. It was at the corner *A*, where the uptake begins, that the felting took fire, and the ignition was occasioned by

Fig. 2.



the contact of the felting with the uptake. The felting had very improperly, been packed against the uptake, the heat of which finally produced ignition. Neither the boiler proper, the superheater, nor "overheated steam," had any thing to do with the fire, and so Mr. Wiard's superheated steam theory is again shown, by the facts in the very example he adduces, to be absurd.

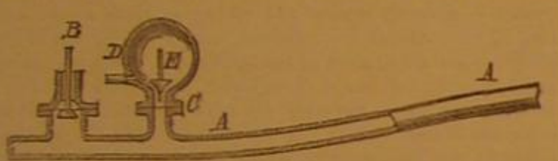
We trust that the fire on the Alaska will serve as a warning to engineers, and others who are charged with the duty of clothing boilers, to use proper care in such matters. The felting should never be packed against the uptake or chimney, as in this case. We are glad to know that since the fire the proper precautions have been taken on board the Alaska to prevent a recurrence of a similar disaster. The felting around the uptakes of the boilers has been removed a distance of twelve or fifteen inches, and cement substituted.

In relation to the superheating of steam, we have frequently shown that it was always difficult to bring up the vapor to a temperature sufficient to cause ignition, and, practically, impossible to do so in any of the boilers ordinarily used. In the case of the Alaska, if we are correctly informed, the ordinary boiler pressure is 30 pounds, and at this pressure the ordinary heat of the steam, on issuing from the superheater, as shown by the thermometer, is from 276° to 278° F. Every intelligent person knows that this heat is not sufficient to ignite combustibles such as felting or wood. On the occasion of the fire referred to, the engineer reports that the fires in the furnaces were low, indicating that the pressure and temperature of the steam were not as high as usual.

THE HYDRAULIC RAM.

We have received a number of communications, recently, from readers who desired information relative to the construction and efficiency of the hydraulic ram, and take pleasure in giving them a brief account of it.

This ingenious piece of apparatus is generally said to have been invented by the French aeronaut, Montgolfier, and improved by his son, but the earliest recorded accounts of the apparatus indicate that it was built in a ruder form, and still earlier, by an English watchmaker, Whitehurst, of Derby, in 1772. It consists simply of a pipe, A, large enough to convey the whole required volume of water from the upper to the lower level, and fitted at its lower extremity with a check valve, B, so weighted that it will remain open until the water, rushing out around it at nearly the maximum velocity due to the hight of fall, lifts it and suddenly closes the orifice. The long column of water contained in the pipe A, is thus, while in rapid motion, refused egress at B, and its great inertia and its almost perfect inelasticity compel it to seek some other outlet; and if that were not found the heavy shock of such a mass of water, instantaneously checked, would burst a very strong pipe unless it were "cushioned" by an air chamber. In the hydraulic ram the new outlet is at C, and the water forces its way up through the air chamber, D, lifting the check valve, E, without difficulty, and is finally delivered by a properly arranged pipe, leading to a reservoir which may be at a considerably higher level than the original source.



This action is one of those whose effects are estimated by reference to the principles stated in an article which we recently published on the laws of impact. Were there no friction, the energy due to the weight of water and the hight of fall would all be expended in raising a part of the water to the reservoir. One hundred gallons falling ten feet would be capable of raising ten gallons to a hight of one hundred feet, or twenty gallons fifty feet. As soon as the work done in throwing water into the reservoir has equaled the energy of the whole moving mass, the stream ceases flowing and the valve, C, closes, B opens and the stream starts again, its velocity accelerating until B is again thrown up to its seat, and the operation just described is repeated.

The friction of the pipe and the tortuous course of the water prevents the full realization of the effect as above estimated. This machine where well designed and properly made gives, on the average, about sixty per centum of the perfect result. We have, in our replies to correspondents, assumed forty per centum as the more common measure of its efficiency. It evidently is not as efficient a means of raising water as a good turbine or overshot wheel and pumps, as the latter should be capable of throwing nearly twenty per centum more water into the reservoir than the ram, with the same available quantity of water. The ram is, however valuable where the quantity of water is too small to justify the use of the wheel. The fact that small wheels are not as effective as large ones is also a fact telling strongly in favor of the ram.

ESTIMATING POWER BY SIZE AND SPEED OF BELTS.

We have already complied with the request of some of our readers who desired us to state how the proper width of belting to transmit a given power was estimated.

We have now before us a request from others that we should give the rules adopted in determining the power actually transmitted by belts of given widths and speeds.

The rule already given was expressed by a formula which can be readily transformed into another, which shall meet the wants of the present case. It would be $HP = \frac{W\ S\ V}{7{,}000}$, that is: Multiply the width of the belt by its speed and by the length of that portion of the circumference of the smaller pulley which is in contact with the belt, and divide the product by 7,000. The result is the power which the belt is proportioned properly to drive.

Or, accepting the common millwrights' rule of 1,100 feet per minute on a belt one inch wide, for a horse power, we should state it thus: Multiply the speed of belt in feet per minute by its width in inches, and divide by 1,100. The result is, as before, the proper amount of power to be driven by the belt. The first rule is the most exact, the latter the most convenient for rough estimation. It must be remarked, however, that it by no means follows that the belt, in any particular case, transmits this estimated power. It may drive much less or, if running very tight, it can be made to carry more than the proper amount.

It is evident that, where power is rented, its amount cannot be accurately computed from the size and speed of belts. The policy of those who have power to rent to others is always to charge for the maximum capacity of the belts, and those who use the power and pay for it will use the smallest belts and drive them at the highest power possible. The only satisfactory method of settling disputes between landlord and tenant is by the application of the dynamometer, thus measuring precisely the power used. Every one dealing in power should keep a dynamometer of good construction on hand, and should use it more frequently than a good engineer uses his steam engine indicator. There are several good dynamometers in the market; and if those directly interested cannot use them, or do not find time, they can always find reliable consulting engineers to do the work for them. We know manufacturers who understand this, and who send hundreds of miles for an engineer and his apparatus, to give them trustworthy information regarding the amount of power which their machinery is using.

ZIRCONIUM.

This metal takes its name from zircon, the mineral in which it was discovered by Klaproth in 1789. Although the metal is rarely met with and has no use in the arts, the mineral zircon is comparatively plentiful. It is found in many parts of the United States, among which the localities nearest to New York city are in Orange and Essex counties, N. Y., and at Trenton and Franklin, N. J. It is usually of a reddish brown color, and is very hard. The colorless and yellowish zircons of Ceylon have long been called *jargons* in jewelry, in allusion to the fact that, while resembling diamonds in luster, they are comparatively worthless. Zircons occur in crystaline rocks, especially in granular limestone and granite. They are infusible before the blowpipe. If pulverized and fused with soda on a platinum wire, the product when dissolved in dilute muriatic acid, gives a characteristic orange color to turmeric paper. Zircons are almost pure silicate of zirconium, containing less than 2 per cent of oxide of iron. The finer specimens of zircon have been used for ornaments, resembling, as we have said, the diamond. Zircons have also been employed, on account of their hardness, for axles and bearings.

Metallic zirconium was first prepared in the amorphous form in 1824, by Berzelius; Troost prepared crystallized zirconium in 1865. The former obtained it by heating a mixture of the double fluoride of zirconium and potassium with metallic potassium. It can also be prepared by conducting the vapor of chloride of zirconium through a red hot porcelain tube containing metallic sodium; or by heating the chloride of zirconium and sodium in a crucible with sodium or magnesium. The amorphous metal prepared in this way burns with a bright light at a temperature below redness. *Aqua regia* and the ordinary acids have but little effect on it; although it dissolves in hydrofluoric acid.

Crystallized zirconium was prepared by Troost by heating 2 parts of the double fluoride of potassium and zirconium with 3 parts aluminum to the melting point of iron in a plumbago crucible, and dissolving out the aluminum with hydrochloric acid. In this state it is easily attacked by *aqua regia*, but resists the ordinary acids. It is less fusible than silicon, and burns only at the temperature of the oxyhydrogen blow pipe.

A metal possessing such a remarkable power of resisting the action of acids and heat will one day become invaluable in the arts, if methods of preparing and working it with some degree of facility are ever discovered. Let those inventors who wish that they had been born a century or two earlier, before everything had been invented, take heart, for wide fields of usefulness as well as glory await those who possess real genius and talent. To-day metallic zirconium is of no use, and only exists as a curiosity in a few cabinets.

Oxide of zirconium, or zirconia, is more easily prepared and better known, for Tessie Du Motay and others have proposed to employ it instead of lime or magnesia for the oxyhydrogen lamp. It is prepared by Du Motay for this purpose by mixing the finely pulverized zircons with charcoal and exposing to the action of a current of dry chlorine gas, which decomposes it into the volatile chloride of silicon and the basic chloride of zirconium, which latter is sublimed, and may be dissolved in hydrochloric acid and the zirconia precipitated by ammonia. The precipitate is dried, ignited, and mixed with borax, clay, etc., and pressed into cylinders the size of a pea. When these cylinders are heated in a jet of oxygen and hydrogen gas, they become intensely luminous, giving a steady white light fourteen times brighter than street gas. The advantage which it possesses over lime and magnesia are its perfect infusibility and its non-attraction for moisture from the air; it crumbles as lime does by air slaking. The great difference in cost has, however, overbalanced the advantages on the side of zirconium, and it seems doubtful at present whether it will ever meet with extended use.

When perfectly pure oxide of zirconium is required, the above method cannot be employed; for although the chloride of silicon is much more volatile than the chloride of zirconium, it is practically very difficult to separate them completely in this way. A better method is that of Marignac. The mineral is broken in small pieces and ignited in a platinum dish with 2 or 3 parts of the acid fluoride of potassium. The mass, which consists of the double fluoride of potassium and zirconium, mixed with the double fluoride of potassium and silicon, is boiled with water containing a little hydrofluoric acid, filtered, and the residue washed with a small quantity of hot water. On cooling, the fluoride of potassium and zirconium crystallizes out. After purifying by recrystallization, the crystals are evaporated to dryness with concentrated sulphuric acid, and the sulphate dissolved in water. From this solution the hydrated oxide is precipitated by ammonia.

As to the salts of zirconium, the preparation of the chloride and fluoride has already been described. Bromide of zirconium was first prepared in 1869 by D. E. Melliss of New York, then a student of Professor Wöhler at Göttingen. The oxide of zirconium was mixed with charred sugar, and kneaded into pellets by means of starch paste and dried. These were then introduced into a tube of hard Bohemian glass. The tube was heated to redness, while a current of bromine vapor was conducted through it by means of dry carbonic acid. The bromide of zirconium is a white crystaline powder. It has a great affinity for water, with which it forms an oxybromide of zirconium, by exchanging two atoms of bromine for one of oxygen. The sulphide of zirconium is prepared by heating the metal with sulphur in a vacuum or in hydrogen gas. Zirconium forms double fluorides resembling the fluorsilicates. Its oxide also combines with bases after the manner of silica.

Zirconium, then, may be said to stand intermediate between silicon and aluminum, being willing to combine with either: with this difference, that no compound of silicon and zirconium has been prepared without oxygen, while its union with aluminum more nearly resembles an alloy. At all events, until it has been more thoroughly studied, we must class it among the metals.

PATENT MEDICINES.

The German scientific papers are accustomed to publish the results obtained by analyzing the various quack medicines and nostrums that come under their notice, thus exposing humbugs and warning their readers against wasting money and endangering their lives by the use of such compounds. Of course our American patent medicines are often subjected to the same test. Recently the Berlin *Industrie Blätter* published the composition of Mrs. Allen's "World's Hair Restorer." In a recent number of the same journal the following is given as the composition of the stuff sold as Dr. Sage's "Catarrh Remedy":

It contains 7 grains carbolic acid, 7 grains camphor, and 2·57 drams common salt. The whole is colored with a little Prussian blue, and sold at 50 cents per bottle, which affords a nice little profit above the expense of labels, advertising, etc. The same number of this journal exposes an eye balsam sold by a widow Müller in Berlin, which is warranted to cure every form of eye disease. It consists simply of 3 grains oxide of mercury (red precipitate) and 2·5 drams strong, unsalted butter. This old and well known salve is sold in boxes holding about 3 cents worth for the modest sum of 15 cents. From this statement it will be seen that the German quacks are satisfied with smaller profits than our people; for it is not long since a Philadelphian firm had the audacity to put up less than a cent's worth of carbolic soap and sell it for 25 cents as a sure protection against small pox.

The composition of the article called Dr. Pierce's alterative extract or "Golden Medical Discovery" is given as follows: 4 drams purified honey, 15 grains extract of poisonous lettuce, 30 grains tincture of opium, 3·5 ozs. dilute spirits tasting like fusel oil and wood spirits, and about 3·5 ozs. of water. Ten cents worth of this trash sells for $1.00.

The Cincinnati Industrial Exposition.

The fourth yearly Industrial Fair will open in Cincinnati on the 3rd of September and close on the 4th of October. We take this early opportunity of calling to it the notice of our readers generally, and of suggesting that they prepare their contributions in due season. The exhibition, we are informed will be one of the largest and most extensive yet held in the West, and will form an excellent medium for Eastern manufacturers to introduce their new products to the people of that great section of the country. Rules, premium lists, etc., may be obtained upon application.

New British War Steamer.

An event of interest recently took place at Chatham, Eng., in the launch of the Raleigh, a ship built, not, as the majority lately constructed, to offer great resistance to shot and shell, but with a view to combine great speed with a very heavy armament. She is therefore built of iron, sheathed with wood and coppered, and lined with brown cardboard, as being less likely to splinter, and also less inflammable than timber; and her dimensions are: Length, 298 feet; breadth, 48 feet 6 inches; draft of water, forward, 20 feet; aft, 23 feet; tunnage, 3,210 tuns; armament, upper deck, two 12½ tun guns, four 64-pounder guns; main deck, fourteen 90 cwt. guns, two 64-pounder guns; horse power, 800; crew, 530; and she is estimated to cost, when entirely finished, about $1,000,000.

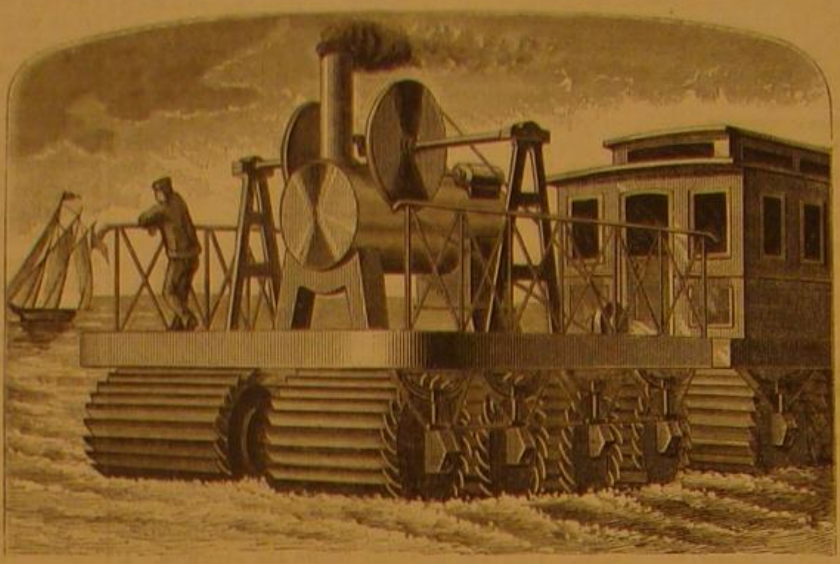
A SHELL which exploded recently at the shell foundery at the Royal Arsenal, Woolwich, when placed in a cupola for being melted down, is believed to have been a 600 pounder for the 11 inch gun, a conical projectile constructed on the Palliser system which had been returned from the practice ground at Shoeburyness. The roof and skylights of the adjacent buildings were damaged more or less by fragments of coke and chalk thrown up from the furnace by the force of the explosion, but the mischief done is comparatively trifling.

A GENIUS in New York has notified the Post Office department that he has applied for a patent for printing two or more advertisements on the new postal cards. He wishes he may get the patent, but probably he won't.

A NOVEL MODE OF MARINE PROPULSION.

M. A. Huet, a Dutch civil engineer, has invented a marine carriage; or, in other words, he proposes to propel a locomotive, with its train of cars, over the surface of a canal or river at as great a speed as upon a railway on land. How this result is to be accomplished our engraving illustrates. The locomotive and cars are separate vehicles, and each rests on a number of cylinders placed as represented, and arranged to revolve freely on axles. Each cylinder is a paddle wheel, the buckets of which are placed parallel to its axis, and are bent upwards so that the lower portion of the curve strikes the water nearly parallel to its surface, thus tending to lift the superstructure upwards as well as propel it forwards. The inventor suggests that some of the paddle wheels may be constructed with floats arranged spirally: those on one side of the car being inclined in one direction, and those on the opposite side in the other, so that the water may be thrown obliquely outwards to the rear.

The motive power is supplied by a small double cylinder engine placed horizontally upon the boiler upon the platform of the locomotive. The machine is of the simplest form. The piston rod actuates a shaft on which are driving pulleys, from which, by means of a belt, motion is communicated to the two rear paddle wheels. These are connected by an endless belt with pulleys situated on the inner ends of the other cylinders which are thus rotated. Steering is accomplished by going ahead with the paddle wheels on one side, and, if necessary, reversing the others, according to the direction to be taken up. A number of rudders may also be arranged, one in front of the locomotive and the others in rear of the cars. The platforms of the vehicles have rounded ends to admit of their turning curves, and springs are provided above all the axles to lessen the vibration caused by the paddles striking the water.



A NOVEL MARINE PROPELLER.

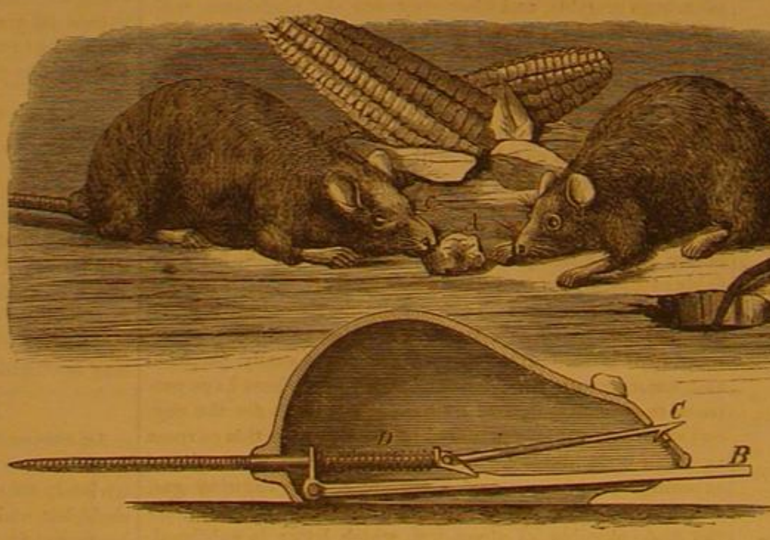
The inventor states that the machine can be quickly stopped by arresting the motion of the engine. The train, which when moving is slightly lifted up by the downward action of the paddles, then increases its draft of water, becoming more submerged, and so opposes a larger surface of resistance to the fluid. Consequently its momentum is quickly overcome. For sudden stoppage, broad boards are to be dropped at right angles to the line of advance, and the same are also to be used at either side of the vehicles when they are running with the wind abeam, in order to prevent lee way.

The plan, we think, would be plainly impracticable in a sea way, while the probability of the cars remaining upright, even in smooth water, during a strong wind seems to us very slight. The practical feasibility of the idea remains yet to be demonstrated.

NOVEL RAT TRAP.

The Spanish Inquisition, among its other diabolical implements of torture, had a life sized figure, sumptuously dressed to represent some female saint. After a victim had been put through the usual course of rack, hot pincers, etc., he was requested to kiss the image. The moment, however, he began his osculatory performance, the dummy extended its arms, enfolded him in an embrace which was lined with dagger points, and then, a convenient trap door opening, dropped him into unfathomable depths below.

This rat trap is something on the same principle, only the rodent is drawn to his doom through his unquenchable appetite for cheese. A dummy rat is constructed of any material to closely imitate the real animal. From his nose extends the rod, B, to which the bait, A, is affixed. D is another rod surrounded by a coiled spring, one end of which catches in a projection in the rod, B, and the other emerges *à posteriori*, and serves for a tail. C is one of two long needles barbed at the ends, fastened to the rod, D, and protruding from the eyes of the imitation animal. The genuine rat, smelling the bait, perceives it under the nose of a rival. He immediately prepares to capture it, collects his energies, makes a rush, and springs the trap. The keen points shoot forth from the eyes of the artificial monster, bury themselves in his body, and the barbed ends hold him fast. Then he remains and absorbs the cheese at his leisure. J. W. Ellis, patentee, of Pittsburgh, Pa.



A NOVEL RAT TRAP.

The Spontaneous Ignition of Oiled Cotton or Silk Waste.

Major Majendie has communicated to the Royal Artillery Institution the results of certain experiments, instituted to ascertain the relative degree of risk accompanying the presence of oiled cotton waste and oiled silk waste in buildings and stores.

Mr. Galletly, who made the investigation referred to, read a paper at the Brighton meeting of the British Association for the Advancement of Science in August last, on a series of experiments carried on by him, with a view of determining precisely the conditions under which spontaneous combustion takes place in cotton and other combustible material, when impregnated with animal or vegetable fatty oils. Mr. Galletly found that cotton waste soaked in boiled linseed oil and wrung out, if exposed to a temperature of 170°, set up oxidation so rapidly as to cause actual combustion in 105 minutes in the case where the action is slowest. The quantity in this instance was sufficient to fill a box 17 inches long by 17 inches broad, and 7 inches deep, but unfortunately it is by no means necessary that the waste should exist in any such bulk, a common lucifer match box full igniting in an hour in a chamber at 166° Fah.

Raw linseed oil ignited less readily. The experiment was made in a smaller case than the first one above mentioned. Active combustion took place in four or five hours. Rape oil and Gallipoli olive oil ignited somewhat less readily, taking at least five hours, though generally a good deal more. Rape oil, in fact, took over six hours at 170°. The temperature of 130° was employed in the case of the Gallipoli oil, and also in the following instances: Castor oil took over a day before ignition; lard oil took four hours; salad oil, one hour and forty minutes; and sperm oil refused to char the waste at all.

Mr. Galletly considers that the heavy oils from coal and shale tend remarkably to prevent the oxidation described, by protecting the tissue from contact with the air. It appears that the so-called spontaneous action of oiled cotton waste proceeds from the substance being exposed in a finely divided condition to the oxidizing action of the air. In point of fact it is the same action that causes the bloom in some of the direct processes for the reduction of iron to revert to the oxide when exposed in a heated state to the air, and the still more remarkable action that is said to have taken place in the iron removed from the Mary Rose, which had lain at the bottom of the sea till it became eaten into a porous condition. It appears to have been hoped that silk waste might have offered greater security, but this proves not to be the case: a little powder in the center of silk waste igniting in an hour, while under the same conditions powder enveloped in cotton only fired in an hour and a half. The silk of course did not itself fire like the cotton, but this would be a matter of little moment, unless the quantity of powder in its immediate locality was very small indeed. It is important to note results which may be of such importance to shops, and other factories than those for powder. It is to be regretted that nothing more encouraging can be drawn from them than the caution not to leave oiled waste about, even in the smallest quantities, especially in warm places.

THE ONEIDA COMMUNITY has, according to the *Circular*, been recently exercised by the posting upon its bulletin of the following conundrum: "Why does a spinning top, at the close of its whirl, apparently go into a motion in the opposite direction from that in which it started?" This inquiry set all tongues in motion, men, women, and children, and the discussion is doubtless still in progress.

THE new railway from Joppa to Jerusalem conveys passengers through in two hours. The romance of traveling in the Holy Land is forever gone.

How to make Good Butter.

Philadelphia butter is a luxury which probably a very large number of our readers know only by name, and which, like the Devonshire cream of England, is believed unattainable save in the immediate neighborhood of the place of its production. Although this idea is doubtless correct regarding the latter delicacy, still it is not true of the far famed "gilt edged" butter of our sister city; at least so says a a correspondent of the *Practical Farmer*, from whose letter we extract the following hints, by observing which, we are assured, the genuine article may be made:

Premising that good cows—Jerseys are the best—and excellent feeding and management are secured, the following essential points must be noted. Stable, milking sheds, and spring house must be clean, well ventilated and free from all noxious odors. The milk must be skimmed soon enough after milking to obviate all danger of moldiness or absorption of the results of fermentation. This must depend largely upon the experience, judgment, and observation of the person in charge, though perhaps the best rule is to skim at the precise earliest moment when all the cream can be procured from the milk. Keep the vessel containing the cream down to a low temperature, stirring it daily with a long handled wood spoon. This low temperature for the cream, so as to avoid all dangers of fermentation, is very important. Avoid what is called washing the butter, as the fine flavor is thus carried off. Churn the cream at such a low temperature that, at the point of turning into butter, it will come hard; and this is entirely within the control of the dairyman, by throwing in either lumps of ice or pounded ice at the critical moment, and giving the churn a few more turns, so as to lower the temperature of the mass, and allow the butter to be taken out hard. If this is not done, and the mass of butter is soft or oily, it cannot be properly worked and will never make a good article. Two workings are required, one on taking out of the churn, to get rid of most of the buttermilk, when it is salted and laid away for two or three hours. The final working is then done on the butter table, ten or twelve pounds at a time, or on the butter worker. A fine muslin cloth is wrapped around a fine sponge, with which the flattened out surface of each lump is patted till everything like buttermilk or water is absorbed. The sponge and cloth are, of course, from time to time, wrung out as needed. The sponge is a powerful and thorough absorber—nothing equals it in this respect. The salting is at the rate of two thirds of an ounce to each pound. Butter may be worked too much, and it may be worked too little. It must be solidly and neatly printed, have a fine white muslin wrapper around each pound or half pound, and be delivered in market as solid as when it left the spring.

An Air Well.

A correspondent, G. W. G., asks the opinion of the scientific world on the following:

A tube well was driven to the depth of 53 feet for water, but instead of obtaining the object, a strong current of air came rushing out of the tube with such force that the noise could be heard at a distance of several rods. Fire at the bottom of the tube burned brightly, and the air came out with a steady flow. This continued for about five days, when the current changed, and air flowed into the tube at about the same velocity. The location is on a divide—the highest point of land between Toledo and Chicago; the country is generally level, but somewhat rolling. Professor Foster, of Chicago, has been written to for his opinion; he thought the current of air might have connection with a subterranean cave, and thence rose to the surface; but the reversal of the current, without any change of temperature above, exploded that theory. If it was in the vicinity of coal, instead of pure air, gas would naturally escape. The soil is sand and gravel, with blue clay beneath. The tube was with withdrawn and sunk in another place to the depth of 70 feet, when rock was struck, but no water was found.

The "Scientific American" Cubically Considered.

C. J. F. writes to say that he has collected his numbers of our journal, from its birth, from his shelves, and finds that the pile measures forty-three inches in hight. He could not but be gratified to think how considerable was the knowledge he had acquired by reading such a mass of information, obtained at so small a cost.

Treating Hardened Leather.

A. J. B., a practical man, says: "Mineral and vegetable oils are of no use on leather, and fish oils destroy leather when used pure. One part fish oil to three parts neats' foot is good for common half finished leather: but for highly finished leather, pure neats' foot is best. The white or yellow neats' foot oil is the proper sort; the reddish is adulterated. Sheep's foot oil, nearly white, is better still. If leather valves, etc., are made of half cured hides, they become converted into horn, and will stay in that condition. To soften hardened leather: Wash in lukewarm water with a little soap, use a wooden-backed brush with short bristles, as used for washing horses; scrape off the dirt and outer skin with a blunt knife. Keep on this treatment till the hide is half saturated; then twist, turn and roll the leather with both hands till all the pores are open, and work them well; if you see small cracks on the surface, good; if the leather splits, it is rotten. While the leather is damp, begin to rub in the oil with a brush as before described; use a little oil at a time and apply four or five times, and work the leather well with the hands after oiling. Set it in a hot sun for half an hour, and then put in a damp place with a wet sack over it. To keep off rats, invert a wooden box over the heap. Oil and work again the next day, and for many days after; and then compare with an old pump valve, and observe the difference."

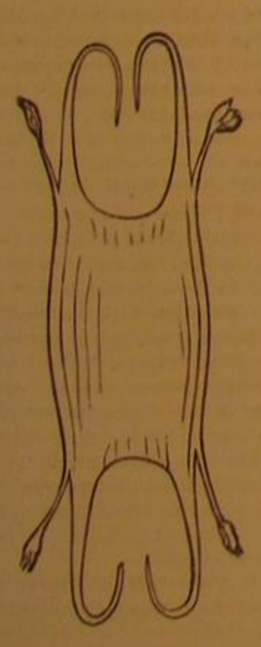
THE WONDERS OF THE EGG.

Professor Agassiz recently delivered a most interesting lecture at the Museum of Comparative Zöology, Harvard University. It was profusely illustrated by specimens from the shelves of the museum. We take the following report from the New York *Tribune*:

The Professor said: The formation and growth of the egg and its fecundation prior to the formation of the new being are among the most mysterious processes of the organic world. The eggs laid by different kinds of animals are themselves so various in size, form and appearance that it is difficult to believe they are all one and the same thing. Look at this huge egg, for which a man's hat would be too small a cup. It is the egg of an extinct bird found at Madagascar (the epiornis), the largest bird's egg known. Compare it with the egg of the humming bird, smaller than a hazel nut, scarcely larger than a small pea. In form and general aspect the difference, even among birds' eggs, is endless. Some are elongated, some are spherical, some are dull on the surface, some are polished, some are dark, others gray or white, others very bright. The number known is large. Ornithologists are acquainted with about 5,000 different kinds of birds' eggs. While they differ in detail, the general pattern of birds' eggs seems the same. The outside shell is brittle, and within there is a lining membrane covering the white, while in the center is the yolk, differing in dimensions in different species of birds as much as the eggs themselves. Quite otherwise, seemingly, is the egg of the mammalia. Those which are developed are never laid. As eggs they are microscopically small, and they undergo all their transformations within the mother. Yet their structure at some time or other, in an early stage of their growth, is the same as that of the egg in all other classes of animals.

Among reptiles the eggs exhibit great variety. The eggs of alligators are elongated, almost cylindrical, evenly rounded at both ends, and about the size of an ordinary duck's egg. The eggs of the sea turtle are about as large as a small apple, rounded, and have a flexible shell. Those of the snapping turtle are much smaller, but also rounded. Those of our terrapins are oblong, as are also those of lizards. Snakes' eggs are oblong and sometimes cylindrical in shape. Frogs and toads lay numbers of small eggs. They are dropped in the water like fish spawn, in large clusters or strings. The Surinam toad (pipa) carries her eggs soldered together like a honeycomb on her back. The alytus carries them between its legs, rolled up in a bunch.

Among fishes the eggs of different kinds differ amazingly in external appearance. Some of them would hardly be believed to be eggs at all. Take, for instance, the skate's egg. It looks like a flattened blackish leather bag, with four horns or handles at the four corners. The yolk in such an egg is the size of a walnut, or larger or smaller according to the species. All skates and sharks have eggs like these, though not all lay them, the young in many instances undergoing their development within the mother. The chimera has a still more curious egg. It is like a leaf made out of parchment. In the center is an oblong cavity containing the yolk.



THE SKATE'S EGG.

The number of eggs laid by animals belonging to the same class is again singularly different. The eggs (or, as we call them, the spawn) of some fish are exceedingly small and are laid in large masses. The spawn of a single herring is made up of hundreds of thousands of eggs. Other fishes lay only a few dozen at a time, and in some kinds they are of considerable size. Some fishes let their spawn fall into the water; others make nests for their eggs, and others carry them until the young are fully developed. Some catfish carry their young in the mouth till they can provide for themselves. Certain fishes carry their young along the gills and they go in and out at will through the gill cavity. Some carry them attached to the surface of the belly or under the tail, and among the pipe fishes, strange to say, this office devolves upon the males (syngnathus).

In the higher vertebrates the young are less numerous. A great many mammalia bear but one at a time.

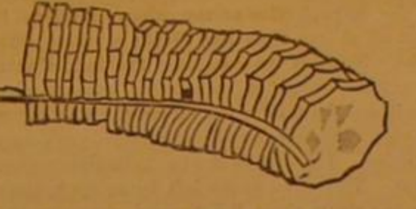
Insect eggs are, as a general thing, too small to be perceptible at a distance. The egg of a day butterfly is attached by a string to a twig. Those of certain water insects are kept floating by string-like appendages. The eggs of the pearl wing fly are fastened by the frailest possible threads to the margins of leaves [*a*, *a*, *a*, in diagram]. Those of the seventeen year locust lie side by side in rows in the branches of trees. Those of the so-called soothsayer (mantis) are deposited in large, elongated clusters which might be mistaken for a caterpillar at rest.

THE EGGS OF THE PEARL WING FLY (CHRYSOPA).

In the two other classes of articulates, in the crustacea, (crabs, lobsters, shrimps, and the like), and in worms, the eggs vary less than in insects. In the crustacea they are always small, and are carried under the tail.

In the type of mollusks we find great variety among the eggs. There are mollusk eggs which might easily be mistaken for birds' eggs, some of which are larger than most birds' eggs. At first sight one would be quite sure that the egg of a bulimus was a humming bird's egg. Others again are very different from the eggs of any animal belonging to other types.

Here, for instance, is the long string of



EGG CASES LAID BY THE PYRULA,

every such case containing from 15 to 20 eggs, and sometimes more. Others lay clusters of eggs surrounded by an egg case. The periwinkle lays an immense mass of eggs, larger than the shell itself. Here are what are called sand saucers formed by the eggs laid by the natica. The mass of eggs is pressed out between the shell and the soft parts of the animal, which at the moment are so expanded and protruded as to cover the whole surface of the shell. The mass of eggs thus laid is molded as it were to the external form of the shell; and being laid while the animal is buried in the sand, the sand accumulates upon them and forms the disk like shape. If you cut such a so-called sand saucer across, you will find minute eggs the size of a pin's head laid side by side throughout it, every egg containing, perhaps, from six to seven individuals.

Among bivalves there is not so great a diversity of eggs as among univalves. They are usually small, like spawn, and generally retained by the mother.

THE CONFIGURATION AND DIMENSIONS OF BLAST FURNACES.

We extract the following description and illustrations from Stölzel's work on metallurgy:

In building a blast furnace, it is usual to make the exterior either in the form of a quadrilateral pyramid, or a truncated cone; sometimes, however, a conical superstructure is placed upon a pyramidal base. The shell, in many furnaces, rests on four corner pillars, the tops of which are connected by arches, or the pillars are surmounted by iron girders set in form of stairs. In other cases, the shell is supported by a ring wall and boshes, with a cast iron crest resting on pillars. In this latter arrangement, commonly used in Scotland, the hearth is free and accessible in all parts. Sometimes the construction is varied by setting only the ring wall and boshes on pillars, the outer shell resting on a solid wall. In the truncated conical furnaces it is often customary, especially in England, to use a sheet iron mantle instead of one of masonry; the mantle then consists of rings or riveted iron plates, and is lined with stone.

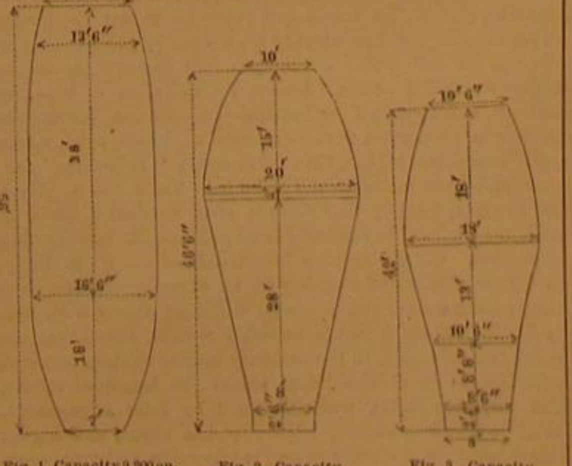


Fig. 1. Capacity 9,900 cubic feet, Schneider, Hannay & Co., Barrow-in-Furness, Lancashire.

Fig. 2. Capacity 8,000 cubic feet. Ebbw Vale, Wales.

Fig. 3. Capacity 6,160 cubic feet. Dowlais, Wales.

But the variations in the form of the interior of the blast furnaces are still more important. The differences which exist in this may be seen in Figs. 1 to 12, in which the sections of various blast furnaces are represented.

Either these changes are made to suit the different processes and the diverse natures of the raw materials, or else the different forms have been brought about by the absence of any well known rules. In some instances the latter deficiency is easily seen; and so various are the forms employed, that we cannot attach much importance to uniformity in these structures.

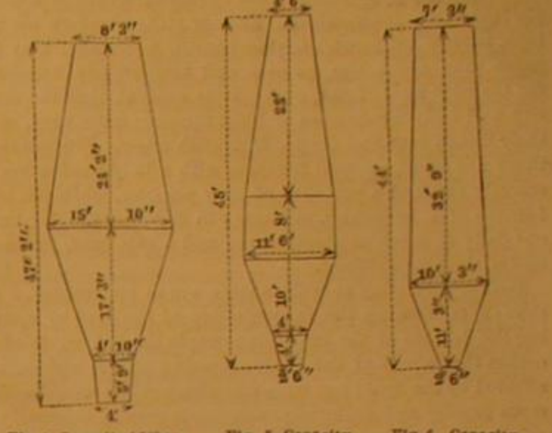


Fig. 4. Capacity 4,540 cubic feet. Nithsdale, Scotland.

Fig. 5. Capacity 2,600 cubic feet. Madeley Wood, Shropshire, Eng.

Fig. 6. Capacity 2,300 cubic feet. Low Moor, Yorkshire, England.

The hight of the shaft is, in charcoal furnaces, from thirty to forty feet, and in stone coal and coke furnaces, from forty to fifty feet, rarely more or less. Higher shafts are especially suitable for fuel (with the exception of anthracite) requiring a strong blast, for uncalcined and refractory ores and for unburned limestone; this is owing to the fact that the heat is better utilized in a tall furnace. Yet there is a certain limit to the hight, because (1) the materials forming the lower courses would be weakened by the superincumbent weight, and (2) on account of the resistance which a high column offers to the passage of blast and gases, a sort of

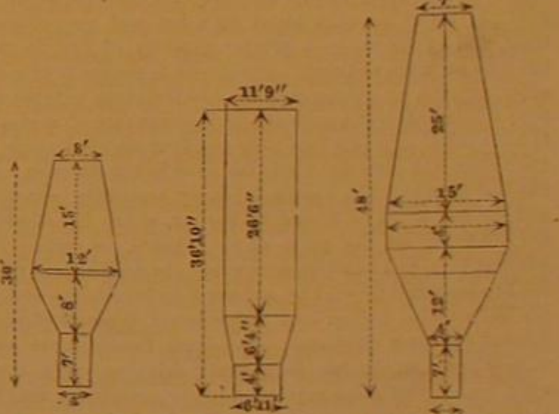


Fig. 7. Capacity 3,440 cubic feet. Muirkirk, Scotland.

Fig. 8. Capacity 4,211 cubic feet. Königshütte, Upper Silesia.

Fig. 9. Capacity 1,720 cubic feet. Watney's anthracite furnace, South Wales.

back pressure. Hence, in order to increase the capacity of a furnace, it is preferable to increase the width rather than the hight. The diameter of the furnace at its belly, or widest part, is from one fifth to one third of the entire hight of the stack; in charcoal furnaces it is from five to eight feet, in coke furnaces, from ten to sixteen feet, or even more; and the belly is set higher or deeper in the length of the shaft according to the time which the materials require to be subjected to heat before smelting, and according to the pressure of the blast. In recent times, the belly or largest part has often been constructed in a cylindrical form, or in a slightly bent curve.

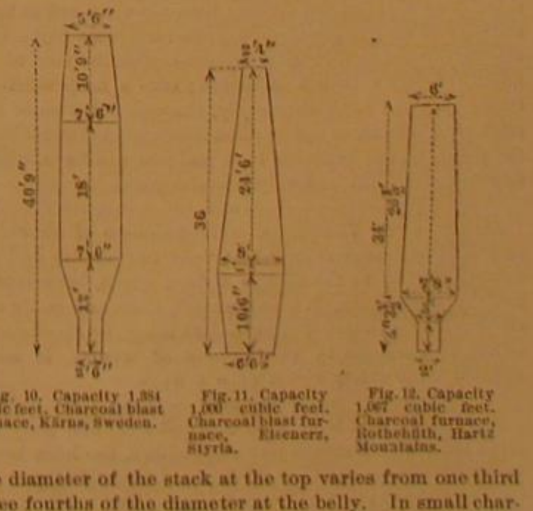


Fig. 10. Capacity 1,881 cubic feet. Charcoal blast furnace, Kärns, Sweden.

Fig. 11. Capacity 1,000 cubic feet. Charcoal blast furnace, Eisenerz, Styria.

Fig. 12. Capacity 1,067 cubic feet. Charcoal furnace, Rothehütte, Hartz Mountains.

The diameter of the stack at the top varies from one third to three fourths of the diameter at the belly. In small charcoal furnaces, it is often not more than three feet, while in coke furnaces, it may be twelve feet or more. In general, it is considered advantageous to use wider tops than was formerly the practice; in the Hartz and in Sweden, the change has done excellent service. By narrowing the tops, the rate of outflow, as well as the tension, of the ascending gases is increased, and the heat is also drawn more to the point of exit; in consequence thereof, a part of the fuel is consumed where it is entirely wasted, and ores as well as fuel are not sufficiently prepared. This is especially objectionable where refractory unroasted ores, poor fuel, and crude fluxes are used. Another drawback is that the narrow exits facilitate unequal sinking of the charge and prevent a quick combustion. Baranzoff, Truran, and more recently Rachette, have widened the top of the stacks so much that the dimensions of the furnace, contrary to the form generally in use, gradually increase from the base upwards; but how this extraordinary construction can be of use is a question which has called forth various views, and which can only finally be settled by practical experience.

For easily fusible charges and the manufacture of a white pig iron, free from silicon, Tunner still considers narrow tops, narrow belly, and a wide hearth, necessary, that the gases may reach the tension and temperature necessary for the reduction of the ores. It is evident that the capacity and daily production of blast furnaces must vary, with their dimensions and forms, from each other. For instance, there are small charcoal furnaces with a daily production of scarcely two and a half tuns of gray pig iron, while the coke furnace of A. Schneider, at Barrow in Furness (Fig. 1.), turns out daily as much as ninety-seven and a half tuns, the maximum thus far obtained.

Boshes deviating at wide angles are to be avoided. Although facilitating the carbonization of the iron by retarding the descent of the intervals towards the hearth, it often occurs that a part of the charge remains on the boshes, unaffected by the heat; but with steep boshes the charges sink more rapidly and uniformly, and smelt sooner, especially if coke and a hot blast are employed.

The construction of the hearth, or that part of the furnace in which the carbonized iron is brought to a liquid, is of essential importance, as on it depends the quantity as well as the quality of the pig iron produced; and it must be adapted to the nature of the materials as well as to the blast, and in proper proportion to the capacity of the boshes. Narrow and high hearths concentrate the heat more than wide ones, hence they are especially used in smelting gray cast iron and difficultly reducible ores, and with light coal and weak blast; while wide and low hearths are found to be more suitable for white pig, readily fusible and easily reducible ores, dense coal, and strong blast. As the charges fall more rapidly in the latter, they are used wherever a large production is needed, the temperature necessary for the production of gray pig being brought about by a hot and concentrated blast, and by the use of a greater quantity of fuel, in case the ores need the addition. The hearth is generally of a circular, square, or oblong section, and it widens towards the top; and, as already mentioned, it is either free of access or is built solid, in which case only the four arches leading to the tweer and the side where the door is remain open. In the first instance, the hearth is easily accessible in case of repairs, and it can be cooled by the air, which is desirable, for it has, of all the parts of the furnace, to endure the greatest heat, and hence is most subject to destruction. Cooling is sometimes effected by surrounding its sides as well as the boshes with hollow iron water boxes, through which a current of water circulates; sometimes the sides are kept merely moist on the outside by slowly dripping water. However, such a protection requires a larger quantity of coal for maintaining the necessary temperature in the interior of the furnace, and is likely to cause explosion if the water, by accident, penetrate through into the melting mass.

In many furnaces, especially in those for making white pig, a hearth is not used; and other conditions being equal, the temperature in the melting zone is thus decreased; the boshes are here made steeper and the belly higher up the shaft. We find this construction especially in many blast furnaces in Wales and Scotland, using ores found in the coal formation; and sometimes also in the furnaces of Styria, which use readily fusible spathic ores and brown iron ores.

To Train Fuchsias.—When a slip has grown six or eight inches high, nip out the top down to the last set of leaves; it will then throw out branches on each side. Let these grow eight or ten inches; then nip them out as before; the tops of each branch, when grown the same hight as the others, nip out again; then procure a stick the size of your finger, eighteen inches in length; take a hoop skirt wire, twine back and forth alternately, through holes made in the stick equal distances apart; place this firmly in the pot back of the plant, tie the branches to it, and you will have, when in flower, a beautiful and very graceful plant.

Ammonia for Verbenas.—The sulphate of ammonia is an excellent manurial liquid to apply to verbenas and other flowers, giving to the foliage a dark green, luxuriant and healthy appearance. It is economical, clean and easily applied. Prepare it in the evening before using, by dissolving one ounce of ammonia in two gallons of water. It may be applied with safety about once a week.

A fish, 3½ feet long, with a slender eel-like body and a large head with a mouth like a crocodile's, has been brought to San Francisco, says the *Mining and Scientific Press*. The teeth are sharp and transparent, sloping backwards from the jaws. Immediately back of the head commences a large wing-like fin, about six inches high when erect, which runs the length of the back. The fish was found dead at Humboldt Bay, and is preserved in alcohol.

An old lady said to her sons: "Boys, don't you ever speklerlate or wait for something to turn up. You might as well go and sit down on a stone in the middle of a medder, with a pail twixt your legs, and wait for a cow to back up to you to be milked."

Correspondence.

Working Steam Expansively.

To the Editor of the Scientific American:

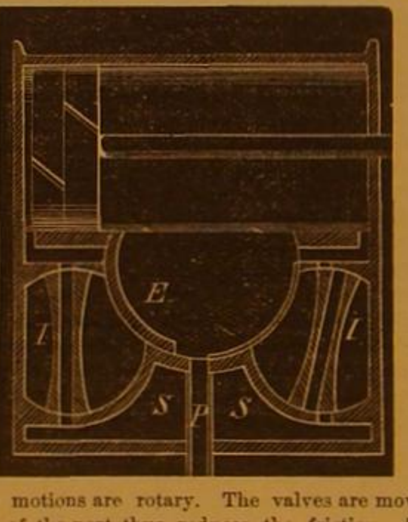
I have a few ideas in regard to steam engine economy which I wish to be made public through the columns of your valuable paper.

There are but few, if any, steam engines in use that utilize the full expansive force of the steam; nearly all use steam expansively to some extent, but in most cases there is but a small percentage of its force utilized. For the purpose of showing the great waste of power in nearly all of our machine shops, manufacturing establishments, saw mills, etc., I submit the following table, showing the comparative power of engines using the same amount of steam, steam pressure at 100 lbs. and an engine cutting off at full stroke being taken as giving a unit of power:

Cutting off	at	full stroke	will	develope	1	unit	of force.
"	"	$\frac{7}{8}$	"	"	1·13	"	"
"	"	$\frac{3}{4}$	"	"	1·28	"	"
"	"	$\frac{5}{8}$	"	"	1·40	"	"
"	"	$\frac{1}{2}$	"	"	1·71	"	"
"	"	$\frac{1}{3}$	"	"	2·23	"	"
"	"	$\frac{1}{4}$	"	"	2·71	"	"
"	"	$\frac{1}{6}$	"	"	3·60	"	"
"	"	$\frac{1}{8}$	"	"	4·48	"	"

An engine cutting off at less than one eighth of its stroke will not utilize as much force as an engine cutting off at one eighth of its stroke, as steam at 100 lbs. pressure, expanded into more than eight times its volume, will be at less than atmospheric pressure.

In a common slide valve engine, the pressure on the valve and the imperfection of the exhaust render it impracticable to cut off at less than two thirds or three quarters of the stroke. Now, if we can have the induction and exhaust valves independent of each other, we may change the cut-off without deranging the exhaust. The engraving represents a vertical section of the interior working parts of such an engine. I I represent the induction valves, and E the escape. The valve at the left being open, the steam passes from the steam chest, S S, through the valve to the cylinder, and the escape, being open on the other side, allows the steam to pass from the other end of the cylinder, through the valve, E, and the escape pipe, P. The valves move in orbits, and



hence the motions are rotary. The valves are moved, but the width of the port thus reduces the friction. There is but a portion of the valve (equal to the area of the port) exposed to steam pressure, and this is partially balanced by the pressure on the same amount of surface from the cylinder. Now if by a certain mechanism the induction valves may be made to open and cut off at one eighth, one sixth, one quarter, or one half of the stroke, and the escape remain open during the whole of the stroke, would there not be a great increase of power? I have a mechanism by which these ends may be accomplished. I have written this for the purpose of eliciting the criticism of some one of experience, as my knowledge is wholly theoretical. C. H. C.

Remarks by the Editor:—Our correspondent has fallen into an error, which has already led to the fruitless expenditure of vast amounts of time, thought, and money. Although his statement of the relative powers developed by steam of the different degrees of expansion noted is, in the abstract, correct, he would find (were he to test the matter experimentally, as has already been done by others) that in practice the anticipated economy never follows the use of highly expanded steam. Losses by radiation of heat, by leakage, and above all by internal condensation, become far greater in proportion to the quantity of steam used, where great expansion occurs, than with steam "following" further, and these losses do not enter into his account. They are so great, finally, that there is soon reached a limit, in ordinary engines, beyond which no gain results from further expansion. Chief Engineer Isherwood, of the U. S. Navy, in whose ability and accuracy as an experimenter we have the greatest confidence, although differing widely with him in our deductions from his recorded results, found that the maximum economy, in the ordinary marine engine, occurred with the cut-off at about four tenths the length of stroke, and this conclusion was confirmed by later experiment. With jacketed cylinders, higher piston speed, and higher steam pressure, a shorter cut-off is allowable, and great economy is realized, as is seen in the "compound" or "double cylinder" engines now so rapidly coming into use.

Our correspondent, were he to build his engine, would therefore be likely to find himself sadly disappointed in the result expected from a short cut-off. Again, the best engines in the market, if of sufficiently large size to justify the expense of such valve gear, are now invariably provided with independent steam and exhaust valves, and are capable of expanding to any desired extent. In first class engines, the point of cut-off is adjusted by the governor, a requisite which has escaped the attention of our correspondent.

The most intelligent, practical, and best educated engineers in the country have been studying the use of steam for many years, and are now far ahead of our correspondent in both theory and practice. They understand the requisites of economy and the methods of securing it, and, as a consequence, the American stationary engine leads the world, and is copied by all the most enterprising builders of Great Britain and the continent of Europe.

A Pennsylvania Gas Well.

To the Editor of the Scientific American:

I wish to give you some description of a gas well here in the Butler county oil fields. It is situated about two miles from the village of Fairview, and was drilled last June in search of oil. It was put to the depth of 1,200 feet and was abandoned on account of a strong flow of salt water and gas; so much came out that the boiler that made the steam had to be moved to a distance of 25 rods. After the well had been abandoned about two months, the pressure of gas became so strong that it forced the water entirely out of the hole, and last fall a company was formed here to utilize the gas, which was done by bringing it through 3½ inch pipe here to Fairview and thence to Petrolia, three miles from Fairview. The gas will be used to light and warm both places. I visited the well in company with two other gentlemen; the gas is taken out of the well through 3 inch pipes into an old fashioned two flued steam boiler; upon the boiler is placed a steam gage which indicates a steady pressure of 80 lbs. The boiler has also upon it two safety valves steadily blowing off, also a cock in the boiler of one inch in diameter open all the time. This well has also an escape through a 6 inch pipe, the noise of the escaping through which can be heard readily for a distance of two miles. I was told by a gentleman here that the main discharge was closed for a second of time, when the indicator on the steam gage instantly flew around to its utmost capacity, which is 250 pounds. This well is a great curiosity to the neighborhood. W. E. P.

Lens Fires.

To the Editor of the Scientific American:

On page 193 of the current volume of the Scientific American, appears an article on lens fires, which reminds me of an affair that was reported in the daily papers eighteen or twenty years ago; and believing the subject is entitled to more consideration than most people imagine, I send you the substance of the event alluded to.

A legal gentleman, in one of our large eastern cities, upon entering his office one summer morning, found the loose papers on his table just starting into a light flame, which surprised him greatly, as there was no fire in the room at that time, neither was it apparent how they could have ignited from any external cause, the windows being closed. This happened several mornings in succession, but one day he arrived at his office earlier than usual and succeeded in detecting the origin of the fire. Sitting at his table, he felt a burning sensation upon one of his hands, which gradually increased until it became insupportable; and on looking at the window through which the sun was shining, he noticed that one of the panes of glass had a bubble or flaw in it which served to concentrate the rays of light in the same manner as a burning glass, and with sufficient power to ignite paper in a few minutes. The dangerous pane was at once removed, and with it the cause of a "mysterious conflagration."

J. H. L.

Sugar Manufacture in the Sandwich Islands.

To the Editor of the Scientific American:

The sugar planters of the Sandwich islands have had, and many of them are now having, a hard struggle for life. Many of us had had no experience in the sugar business when we commenced our plantations; and what little knowledge we have now has been attained only at great expense and loss of time and material. I have received many valuable hints from your paper, and would like to see more upon the subject of plantation sugar making. My plant consists of 500 gallon clarifiers, precipitators, an open train, a steam leach and a vacuum pan. I want to know how best to apply sulphurous acid gas to the cane juice in order to check fermentation and bleach the sugar. Also, whether sulphate of baryta is used for precipitating the dirt in the cane juice? If so, how should it be applied, and in what quantity?

S. L. Austin.

Onomea Plantation, District of Hilo, Hawaii, Sandwich Islands.

Low Water in Steam Boilers.

To the Editor of the Scientific American:

Reading the many articles in your paper on boiler explosions, and especially on the low water question, I venture to give my views and experience which, perhaps, may benefit some of your readers. I once attempted to raise steam and pump up a two flue 40 inch boiler with water only just up to bottom of the flues; but before I got 15 lbs. steam, I heard a report like a pistol shot; and on looking under the boiler, I saw the third sheet cracked from about two inches below the water, running up about a foot, and the water squirting out like a saw blade. The sheets were not overheated, for I had fired very slowly and carefully. I claim that it was caused by the expansion of the flues. I think that a boiler, with water enough in it to protect any considerable part of it and yet let the flues become hot, must be subjected to a strain sufficient to open any weak places in it without the aid of internal pressure.

I am now running a boiler, similar to the one above referred to. The feed water enters through an ordinary stand pipe, near the back end. The engineer let the water get low and then crowded on the pump. The result was that one of the flues cracked for about 4 inches across its bottom just where the feed water strikes it. A boiler maker repaired it by putting on a soft patch, that is, a plate screwed on with red lead under it and it does very well. But on one occasion since, the water was low again, and it leaked as at first, but the pump was kept going, and when the flues were covered it stopped. These cases, and others of the same nature which I have known to occur, lead me to believe that a large per cent of explosions are due to expansion.

East Pascaquola, Miss. P. BERGER.

Discriminating Flax and Cotton Fibers.

To the Editor of the Scientific American:

On page 194 of your current volume, Mr. C. R. Stodder says: "No chemical tests are known to distinguish flax from cotton fiber." Allow me to refer Mr. Stodder to the SCIENTIFIC AMERICAN, Vol. XIII, No. 3. "These two fibers are distinguished by rosanilin, or fuchsin. Loosen one end of a piece of linen so as to separate the woof and warp, and dip it into an alcoholic solution of fuchsin; wash in water as long as it colors the water, and then put it in weak ammonia. The ammonia will discharge the fuchsin from the cotton fiber but not from the flax, so that the cotton thread will become nearly white, while the flax retains its red color." This is Böttger's test. H. M. WILDER.

Philadelphia, Pa.

AMERICAN LOCOMOTIVES.--THE BALDWIN WORKS.

Let a man stand beside a railway when an express train thunders past at forty miles an hour, with its ten or twelve heavy coaches and sleeping cars; and, if he does not feel mingled sentiments of awe and admiration, he must be very unimpressible. Grade or level, straight line or curve, all are alike; it whirls over one and round the other, never ceasing in its energy for a moment.

The modern locomotive is truly the most wonderful of all man's inventions; and though many may gainsay this, and point to another triumph of ingenuity as its peer, we think, when all its complex parts and the functions they are called on to discharge under trying circumstances are considered, the locomotive engine will stand out as one of the greatest of man's works. It is not alone required that it shall be powerful and capable of drawing great loads, but it must be enduring; it must adapt itself to the work required of it; it must be rigid and yet capable of a certain flexibility in its parts. It must ride on its springs and yet hold firmly on the track; its driving machinery must be permanently attached to its boiler and yet in a certain sense entirely independent of it; and the whole of the vast machine, although exercising the most varied and opposite powers, must be so designed as to work harmoniously together. One end of it—the furnace—generates the most intense heat while the other end is comparatively cool. One half, so to speak, the boiler, is undergoing tremendous internal and external pressure from the force of expansion and the steam within it, while the other portions have no strain whatever, except when in actual operation. When it is in operation, suddenly the driving machinery is called upon to not only carry and withstand the burthen of the boiler and its duties, but to transmit force in an entirely different direction; to do it economically and constantly, in all temperatures and all atmospheric changes; through dust and drought, and at a velocity of twenty or forty miles an hour as the case may be. It has not only to withstand its own internal forces, which tend to derange it, but also encounter others which it would seem impossible to provide against. Think of a mass of intricate machinery, thirty tuns in weight, in motion all over, hurled at the rate of forty miles an hour over the face of the country, and then consider whether our claim is extravagant.

If such a specification as the foregoing were handed to an inventor at the present day, and he were requested to provide a machine to comply with the conditions, he might be pardoned for some incredulity as to the sanity of the man who drew it. It is a thing of slow growth, the modern locomotive.

From the rude germ of the first high pressure boiler and engine mounted on wheels has sprung, piece by piece and detail by detail, the present magnificent and wonderful machine, a piece of mechanism, capable of drawing—in the case of the heaviest machines fifty tun engines—forty times its own weight. Without apostrophizing the locomotive further, let us look into a modern locomotive shop—the largest of its kind in the country—and see what is being done there, and follow hastily the details necessary to produce such machines.

The Baldwin Locomotive Works of Philadelphia has a world-wide reputation for its engines; and, being recently in that city, we were accorded permission to visit them. The concern has been in existence nearly forty years, and in that time has built engines for nearly all quarters of the civilized globe. At the present time the average rate of production is nine complete engines per week. Of these, some are for home use and some for foreign countries, but the essential character of them remains the same. All are built according to well known plans and specifications, such as have been proven and found reliable. Respecting those for foreign countries, the works are now just finishing a number for Russia, which are of the usual American type of wood burning engines. Some months ago the company sent a number of engines to Russia to show engineers in that country how to use their anthracite coal, of which large veins exist in the southern part. Until the advent of these machines, the Russian capitalists had become quite skeptical as to the possibility of utilizing the coal, for their own mechanics had essayed the solution of the problem in every conceivable type of boiler and grate, only to abandon them all. The intense heat generated burned out all their appliances, and it remained for American engineers to put the American locomotive in successful operation. The result is that large orders may be in time expected from the country, and it is to be hoped that the Baldwin Works, who, if we are not in error, were the pioneers in this enterprise, will reap some profit, the first venture being quite unprofitable. The Russian mechanics were so dilatory and slow to comprehend that a force had to be sent out from the Baldwin Works to erect the machines and put them in operation.

Of course, in making such a number of engines as these works turn out—over 450 annually—the greatest exactness and rigid attention to system must be observed, else all would be confusion. Therefore, as the first step toward getting machines undef way, systems of "cards" or specifications are provided for the guidance of the foremen in charge of the several departments. For example, the superintendents, or parties immediately in charge, decide that engines of such a type must be ready on the 20th day of May. Immediately upon this decision, the schedule for so many crossheads, so many feed pumps, so many guide bars, rocker arms, links and reverse levers is made out and handed to the foremen in charge of the shops where these parts are made, and the date is mentioned when they are to be delivered to the company—say for April 5th. The same plan is observed with all the other details, parts, and appurtenances; and it is found to work harmoniously and satisfactory. It has the great merit of reducing every foreman to his own place, or, more properly, of confining his attention to his own affairs. It will readily be seen that the foreman knows nothing as to whether the parts he makes are needed now or next year, but that all he has to do is to make them out of the material furnished. He cannot say, as some might: "Why, they don't want these now; the boiler ain't made yet," and then give his attention to what he thought most satisfactory; but he does the work he came to do, and leaves the direction of it to the persons who undertook that department. This is really the secret, if it is a secret, of the possibility of making nine or more engines per week. Without it the other vast capabilities of the works would go for nothing.

The usual routine of machine work is so well known and familiar that we shall not attempt to describe any "ponderous shears that bite cold iron as a cat does cheese." These and kindred machines have no especial novelty in them, but there are some points about the system employed in duplicating work which are worthy of attention. A routine similar to that observed in the manufacture of sewing machines and pistols is practiced wherever possible. For example: All engines of a certain type have their details exactly alike. For such machines a system of "jigs," or cast iron frames, are provided, which have holes in them wherever the part under execution at the time should have them. These jigs are, therefore, merely bolted on to the rough casting—the crosshead for example—and the drill operated through the hole in the jig. There is no marking off or "laying out," and no possibility of making any mistakes. Similarly in regard to the jaws of the crosshead. A gage or templet is put over the end, clamped in its place, the whole put into the planer together, and the surfaces reduced until the tool comes down to the gage. In this way, or by this plan, the matter of executing each piece exactly alike is reduced to a certainty. Every bolt, taper or straight, has its gage, merely a hole drilled in a block of cast iron, the exact length of the part the bolt goes into. Men don't run up and down stairs in the Baldwin Locomotive Works, trying bolts in holes in the frames, so anxious to make a good fit of them that they fail after all; but they save their own shoe leather and the company's time, and fit the bolts to the gages on their lathes; if they are right by them, they fit the holes the rimmers make.

"So all things work together for good." All things that possibly can be, are tested before they leave the works. The pumps, on which so much depends and which have so much to perform, are all tried before they are attached to see if their joints are perfect. Nothing is left to chance. Everything is looked after and seen to, and nothing is left to supposition. As our informant, Dr. Williams, remarked: "We can't run on reputation one day; we try every day to do better work than the day before." And he is right. A locomotive is a machine which will not build itself or run itself, but if not carefully made will soon show it in all its parts.

We specially noticed the boilers in these works, and can testify to their excellent and thorough construction. Every one is caulked inside as well as out, and we noticed, as we passed through the works, one man caulking the rivet heads in the bottom of the firebox frame. The engines made by this company are all "outside connected," that is to say, the cylinders are outside of the frames. This practice is exclusively American in its universal application for all kinds of traffic, and seems well adapted to our wants. It is safe to say there are no inside connected engines built in the country today.

Also it is interesting to note how opinions vary with experience gained. In 1838 a locomotive with cylinders $12\frac{1}{4} \times 16$, weighing, loaded, 26,000 lbs., was believed to be as heavy as would be needed! It causes a tendency to smile now, in the mind of a railway man, to note this and the weights of even switching engines. The heaviest engines the Baldwin Locomotive Works build are sent to South America, or, rather, the railways of that country demand the heaviest, which have cylinders 20 inches diameter and 24 inches stroke. They have four pairs of drivers of 48 inches diameter, and a total wheel base of 21 feet 10 inches. The weight on drivers is 87,000 lbs. and about 9,000 lbs. on the pony truck, the total weight being 96,000 lbs. An engine of this class will draw 2,000 tuns, gross, on a level, beside itself and tender, and they have in actual use taken 150 gross tuns of cars and load up a grade of 145 feet to the mile, with sharp curves, at a speed of ten miles an hour and with a steam pressure of 110 lbs.; also 268 gross tuns and load up a grade of 116 feet to the mile with 120 lbs. steam and at a speed of one mile in $7\frac{1}{4}$ minutes. Engines of this class can run around curves of 400 feet radius, and even less.

The force employed in these works now amounts to 2,800 men of all trades. The pay roll will average $14 per head.

It is also interesting to note that, where American engines are brought in competition with foreign ones, they are at once able to prove their superiority, not only in point of workmanship, but in design and practical working. Many instances might be cited of the truth of this assertion, but we content ourselves with only one, the Dom Pedro Railway of South America, where both English and American machines were employed, but the latter proved so superior that none others have been bought since 1863.

The thinker may well ask: "What becomes of all the locomotives?" There is one factory in Philadelphia which makes 450 annually. There are three more factories in Paterson, N. J., which do not turn out less than 500 more. At Taunton, Mass., there are two which may make 200 more. One in Boston produces, or could produce, 200 more, and one in Manchester, N. H., 200 more; in Providence, R. I., 200 more; in Schenectady, N. Y., 200 more: to say nothing of smaller concerns scattered all over the country, and the repair shops of the railways, which also make no small proportion of their own work—an average of at least 1,500 locomotives turned out yearly from the shops alone.

Preparation of Sewage and Stable Refuse.

Millions of dollars worth of valuable material yearly finds its way, from the sewers of our great cities, into the sea, serving no purpose except to contaminate adjacent waters, while sums, equally large, are expended by agriculturists for the regeneration of worn out soil by artificial fertilization. The collection of sewage presents no special points of difficulty, but its transportation to desired points is by no means readily accomplished. For this purpose an effective plan is greatly needed. One system, which we believe has recently been made the subject of a patent, consists in compressing the manure into cakes with dry peat, and covering the mass with soft clay or equivalent substance to prevent fermentation and evaporation. The idea seems to be a feasible one, though we have no record of its being successfully put in practice.

Other patents have been granted for the preparing and baling of stable manure. This substance, in order to prevent its otherwise too large accumulation, it is necessary to remove from city stables before the straw contained in it is in a sufficiently decayed state for fertilizing purposes. Consequently, the straw must be got rid of, and as it can be utilized for bedding for horses, or for the manufacture of coarse varieties of paper, it is suggested to winnow it out of the mass by means of a suitable machine. Then the residuum is compressed so as to exclude the air, to which the heat and steam of manure is due; and finally the whole is covered with a coating of clay, plaster, or cement. Handles of wisps of straw for convenience in carrying and packing may be compressed with and so attached to the bale. The cakes can thus be readily stored in vessels with sufficient air space between them to obviate all danger of heating, while the use of forks and shovels is necessarily avoided.

Edible Earths.

Dr. C. Schmidt has made analyses of the comestible earths of Lapland and Persia. One hundred parts of the substance obtained on the coasts of the White Sea have been found to contain

Water, left at 100°	0·269
Water, left at red heat	0·835
Aluminum	40·797
Oxide of iron	0·310
Magnesium	0·618
Lime	traces.
Soda	1·829
Potassium	9·845
Silicic acid, traces of fluorine, loss, etc.	45·506

The inhabitants of the country mix this earth with the flour from which they make their bread.

The edible earth found in Persia, and termed Gheli-Giveh, contains

Carbonate of magnesium	66·963
Carbonate of lime	23·634
Chloride of sodium	3·542
Sulphate of soda	0·298
Carbonate of soda	0·598
Hydrated magnesia	1·311
Oxide of iron	0·092
Aluminum	0·227
Silicic acid	0·765
Water combined at 120°	1·153
Water	1·422

ANTHRACEMINE.—This new base is one of the products of the action of nitric acid on anthracene. It appears as a very pale yellow pulverulent body, forming soluble and crystallizable salts with hydrochloric and sulphuric acids. Its composition is $C_{28}H_{11}N$.

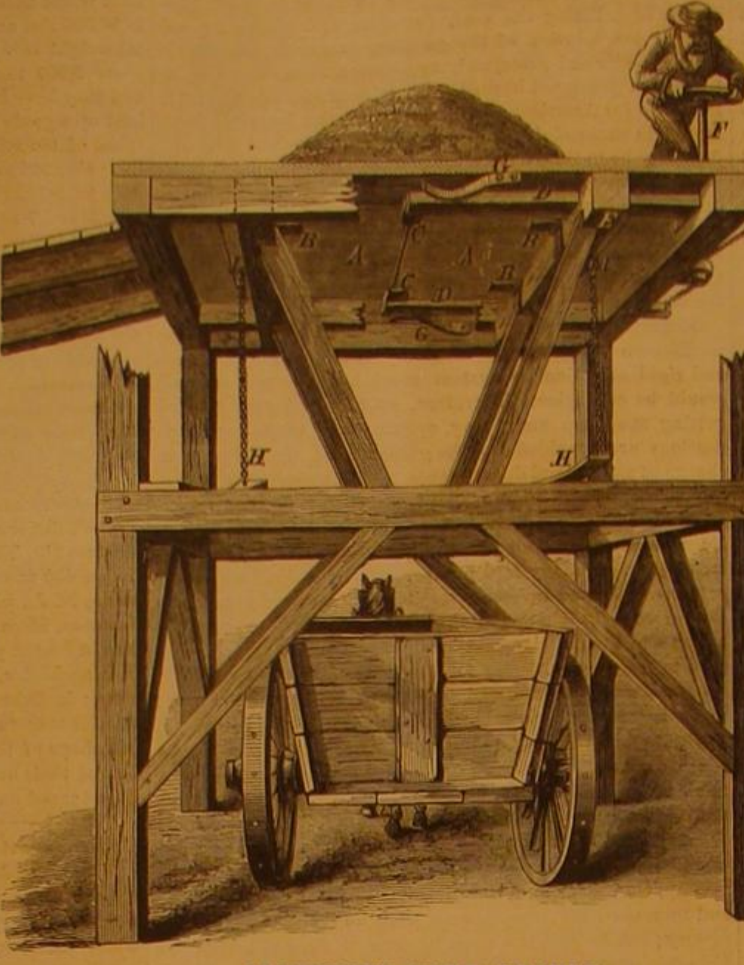
CART LOADER.

The object of the invention represented in our engraving is to obviate the hand labor of throwing the earth removed in grading down hills, excavating cellars, or making roads, into carts or wagons, and to substitute therefor a convenient means of discharging the scrapers or other first receptacles directly into the vehicle.

The frame of the device is of wood, and portions are broken away in the drawing to show parts otherwise obscured. A A are two trap doors in the upper platform, which are hinged at B, and which, when horizontal, are supported by props, C C. These props are attached to levers, D D, which are pivoted at E. To the outer ends of the levers are fastened chains which communicate with an upright shaft, F, surmounted by a hand wheel. G G are springs pressing against the levers, D, and serving to hold the props under the trap doors.

The earth is transported to the upper platform and then dumped, and the receiving cart is placed directly under the doors. The operator then turns the hand wheel so as to wind the chain around the shaft, F, thereby pulling aside the props, C. The weight of the load then pushes down the doors, falls through, and is deposited in the cart. The doors are then returned to their place by the action of the springs, H, through the chains attached to them, at I, and are thus kept closed unless opened by a superincumbent weight. As soon as the chains are removed from the shaft, F, the props will be re-applied under the doors by the springs, D. Any convenient means may be employed to transport the load to the upper platform, either by wheelbarrows or through suitable machinery.

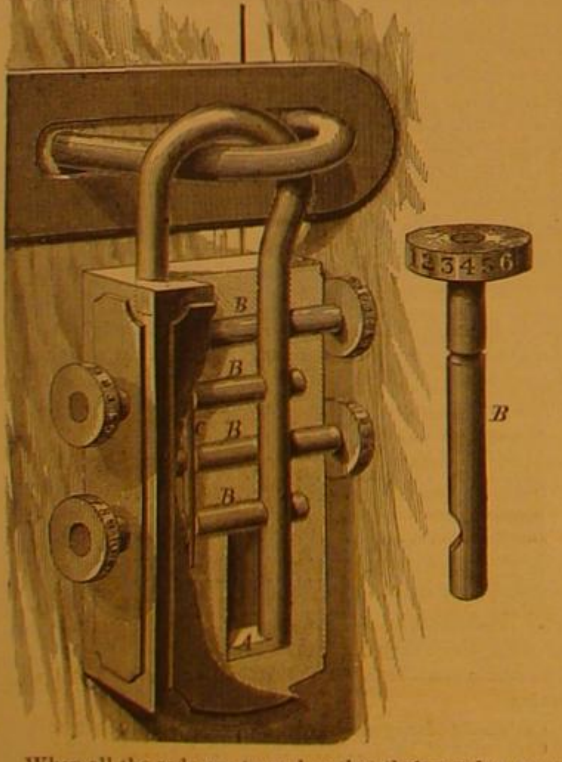
Patented through the Scientific American Patent Agency, February 11, 1873. For further information address the inventor, Mr. Jesse Atkinson, Cameron, Milam county, Texas.



ATKINSON'S CART LOADER.

COMBINATION PADLOCK.

Mr. Joseph Kittle, of East Bend, N. C., is the inventor of the new combination padlock, represented in our illustration. The device consists in a box and staple, the latter made with arms of unequal length, as shown. Upon the end of the long arm is formed a toe, A, which works in a recess in the body to prevent the staple being drawn out any further than is necessary to allow the short arm to be passed through the thing to be locked. B B are a number of rods which are inserted in transverse holes in the box in which they are swiveled in the vertical piece, C. In the side of the long arm of the staple, at points where it crosses the rods, B, when it is pushed in, are formed semicircular notches, which correspond with similar indentations in said rods.



When all the rods are turned so that their notches are toward the long arm, the staple is unlocked and may be readily drawn out as far as the toe, A, will permit. This, however, cannot be done unless the operator knows how to make the proper adjustment, for it is evident that unless each rod is placed in exactly the proper position, the staple will continue to be held. To afford a means of indication, a disk marked with numbers or letters is attached to the outer end of each rod, by turning which, so as to bring one of the marks which is opposite the notch in a previously known position, the rod may be correctly placed.

Patented through the Scientific American Patent Agency, Feb. 18, 1873.

A Lightning Catastrophe.

J. P. says: "The strangest effect of lightning that ever fell under my observation happened on March 31, 1873. About 4 P. M., the sky was covered with broken and detached clouds, somewhat charged with electricity, giving off occasionally what I will call randon shots, sounding like the firing of cannon; a few drops of rain fell at the time. I was walking in the field with a bundle of small apple trees under my arm, when a vivid flash of lightning occurred, producing, as I thought, a rattling noise on the twigs of the trees under my arm. I turned round, but saw nothing unusual. In a few seconds a heavy report of thunder took place from about a quarter of a mile distance, passing over head near to where I stood, but so high that I was quite sure it did not come to the ground. I was soon called to come to the house; when I got there I found a colored man, in my employ, in a kneeling position on the ground and unable to stand up. From him I learned that, when the flash took place, he was walking through the yard near a large spreading elm with a wooden pail (with iron hoops and a wire bale) filled with water in his left hand. He felt a strange sensation, and staggered round in a circle; unable to let go of the pail, he found that his fingers would not open. All this took place before the report. He staggered along for about twenty steps, and then set down his vessel he knew not how. His left side received the heaviest part of the shock; he was not able to work the remainder of the day, but next morning he had nearly recovered. From the observations of myself and others, it is clear that the electricity did not come to the earth. Am I right in supposing that there were currents of electricity ascending from the earth to the clouds, and that this man had become charged with the same and consequently received a shock when it left him? A similar thing has happened to others in cases when the lightning struck. Is it the case that ascending currents are active when lightning strikes the earth?"

The Canal Navigation Problem.

E. B. says: In your article on canal navigation, volume XXVIII, page 97, you speak of the desirability of improvements in the manner of working boats. I would suggest that the main propelling power be exerted by the screw in the stern, but that two smaller screws be placed at the bows working independently. By working one of the bow screws, faster than the other, or by working one forward and the other backward, the boat may be readily turned. Boats should certainly follow each other in trains when possible, as a dozen boats in a train would meet with very much less resistance than as many singly.

Water Lined Cupolas.

E. T. S. states that cupola furnaces with water linings have been used in California for smelting ores of the carbonate and oxide of copper with very economical results; but the decline in the price of copper put a stop to the business. The furnaces would slag up about four inches thick and remain so, requiring no other lining; and very little steam was made, except above the melted part of the charge.

Monster Cannon.—Herr Krupp is to send to Vienna two cannons, which are the largest yet produced at his factory. Both are of bronze; one is 22·1 feet deep, interiorly, 4·8 feet in diameter, and weighs 41·8 tuns; and the other is 13·2 feet in length, 4·9 feet in diameter, and weighs 50·5 tuns.

Colored Dresses—An Item for the Ladies.

It is not often that we find scientific items of any especial degree of interest to the members of the fair sex who may, perchance, glance over our pages; but now we believe we have got one which must be simply absorbing. Probably, madame or miss, you are the possessor of a summer dress, made from some white diaphanous material; and it may also be imagined that during your shopping you have inspected goods of similar nature, only of varying colors, from which you have purchased sufficient material to construct a number of those bewildering garments, in comparison with the intricacies of which the most elaborate works of modern engineering furnish no parallel. Now, a learned German professor has invented a plan whereby your single white dress may be changed as often as you desire to any color you may fancy, and this in your own laundry, so that hereafter the money which you would devote to several robes of varying hues may be entirely saved, while you may appear daily, if you choose, in toilettes of totally different complexion.

The process is very simple, and consists in merely coloring the starch used in the "doing up." Suppose a white dress is to be tinted a beautiful crimson: three parts of fuchsin, an aniline color which any chemist can readily procure for you, are dissolved in twenty parts of glycerin, and mixed in a mortar with a little water. Then ordinary starch, finely pulverized, is stirred in, and the thick mass obtained is poured out and dried on blotting paper. The powder thus obtained is used just the same as common starch, and so applied to the fabric. When the latter is dry, it is slightly sprinkled and pressed with a moderately warm iron.

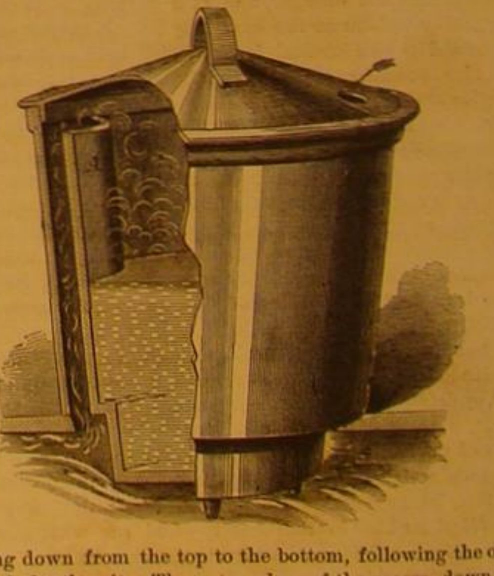
By means of other coloring materials, mixed as above described, any desired tint may be obtained. We should counsel, however, an avoidance of damp localities, and strongly deprecate going out in the rain, as we doubt the "fastness" of the dye, and would not be at all surprised to behold the garment shortly assume a rather streaked and zebra-like appearance.

Noisy Sewing Machines.

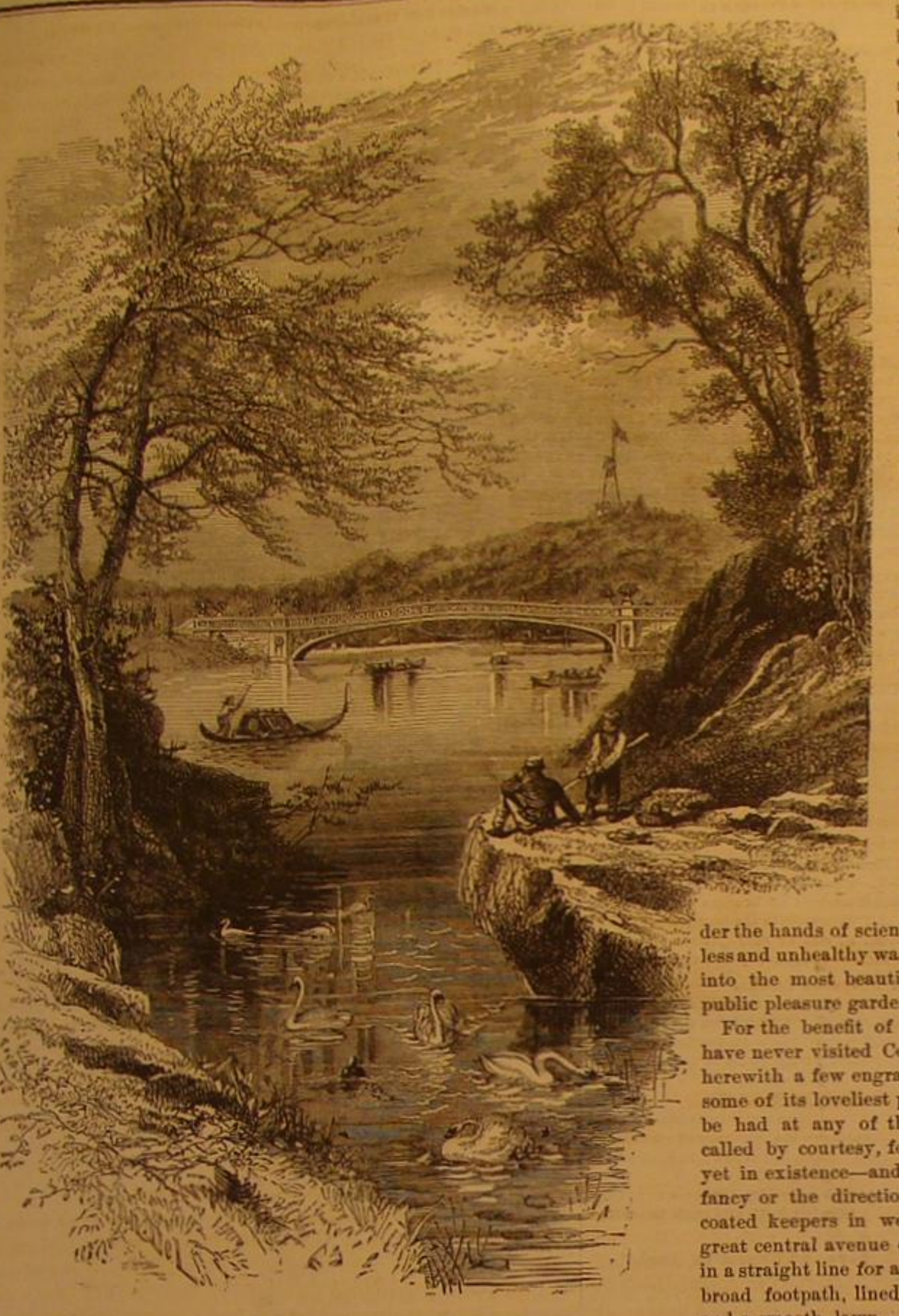
A. C. B. sends the following hint to the owners of sewing machines: Having a Wheeler & Wilson, which I thought made more noise than necessary, although it is one of the most quiet, I examined it and found that one half the noise proceeded from the recoil of the feed works after making the stitch. In five minutes I filed a dovetail in the end of the feed and inserted a thin slip of soft wood, which entirely kills the sound. If any one else wishes to reduce the rattling of their sewing machines to a minimum, let him try my plan.

CULINARY BOILER.

Mr. Israel Kinney, of London, Canada, is the inventor of the novel form of culinary vessel represented in our illustration. The object sought is to provide a means of conducting away vapors arising from the cooking article, so that they will pass into the stove and up the chimney, and thus not be disseminated through the house. This is effected by casting the side wall of the pot with a vertical recess, extending down from the top to the bottom, following the offset made by the pit. The outer edges of the recess, down to the plane of the offset for the pit, are formed with flanges to receive a sheet metal slide, A, which closes the recess and preserves the circular form of the vessel, and at the same forms a flue. The vapors rising are drawn down through the latter, and thence into the stove. This improvement is applicable to all vessels used in cooking. Patented August 27, 1872.



Saccharine Matter in Mushrooms.—A. Muntz says that mushrooms yield a sirup, readily crystallizable, which presents all the properties of the sugar obtained from the manna of the East.



BOW BRIDGE, FROM THE NOOK ON THE SHORE OF THE LAKE.

CENTRAL PARK, NEW YORK CITY.

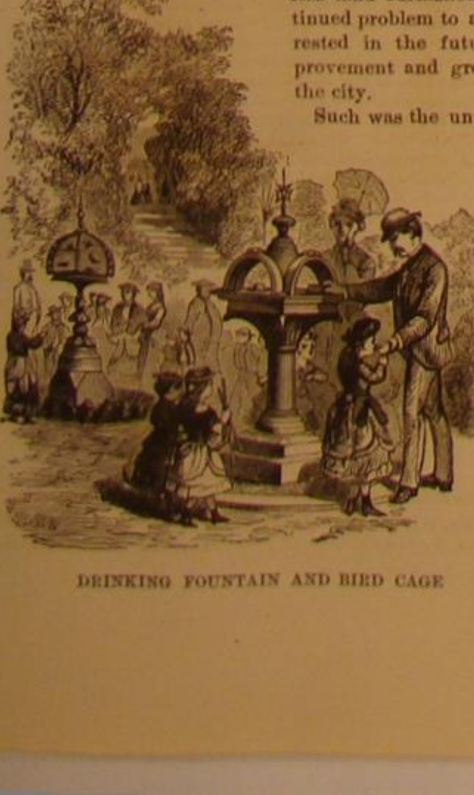
It is not very many years since the central portion of Manhattan Island was a wilderness of swamp, relieved only by great masses of arid and jagged rock. The inhabitants, principally emigrants from the Emerald isle, lived in a state of primeval simplicity and dirt, in ricketty sheds and cabins, which at once did duty as dwelling houses and as stables for an occasional cow and innumerable pigs and goats. A more dreary and desolate neighborhood it would be difficult to find; pools of stagnant water bred myriads of mosquitoes, miasmatic diseases raged unchecked, vegetation was poor and scanty; in short, the ultimate disposal of so large a tract of apparently valueless land furnished a continued problem to all interested in the future improvement and growth of the city.

THE BOAT HOUSE.

Such was the unpromising material from which it was decided to produce a park which should rival the celebrated pleasure grounds of England, and overtop in magnificence the Parisian Bois de Boulogne. Engineers were engaged, the ground was surveyed, and the itinerant population driven from its fastnesses. For years an army of laborers made the great area, of 862 acres, a scene of continuous labor. Bogs and marshes were drained, beautiful lakes replaced fetid pools, substantial roads took the place of muddy cow paths, and graceful bridges were thrown across precipitous ravines. Then followed the landscape gardener, and the dry places became carpeted with velvety turf, the bare rocks covered with creeping vegetation; walks were laid out, trees and shrubs innumerable planted, rustic arbors of exquisite design built in romantic spots, and, finally, under the hands of science and of art, the valueless and unhealthy waste became transformed into the most beautiful, if not the largest, public pleasure garden in the world.

For the benefit of our many readers who have never visited Central Park, we present herewith a few engravings from sketches of some of its loveliest portions. Entrance can be had at any of the numerous gates—so called by courtesy, for no actual portals are yet in existence—and we can follow our own fancy or the directions of one of the gray coated keepers in wending our way to the great central avenue or Mall. Here, leading in a straight line for a quarter of a mile, is a broad footpath, lined with rows of tall elms and a smooth lawn. On Saturdays, during summer, an excellent band plays for several hours in the afternoon in a beautiful pavilion erected for the purpose, and thousands of people gather to listen. Leading from the Mall to the Lake Level is the Terrace, a fine architectural work of Nova Scotia stone, covered with elaborate carving. There are finely executed bas reliefs, emblematic of Night and Morning, the Seasons, and other artistic designs, all exquisitely chiseled from the massive blocks. The stairs down which we pass lead to an arcade under the main Drive, the ceiling of which is inlaid with tile in mosaic work, the design and coloring beautiful in effect, and thence we step out on the Esplanade, a broad plateau on the shore of the lake. In the center is a great fountain, the bronze group belonging to which has not yet been placed in position.

RUSTIC SEAT AND FOUNTAIN.

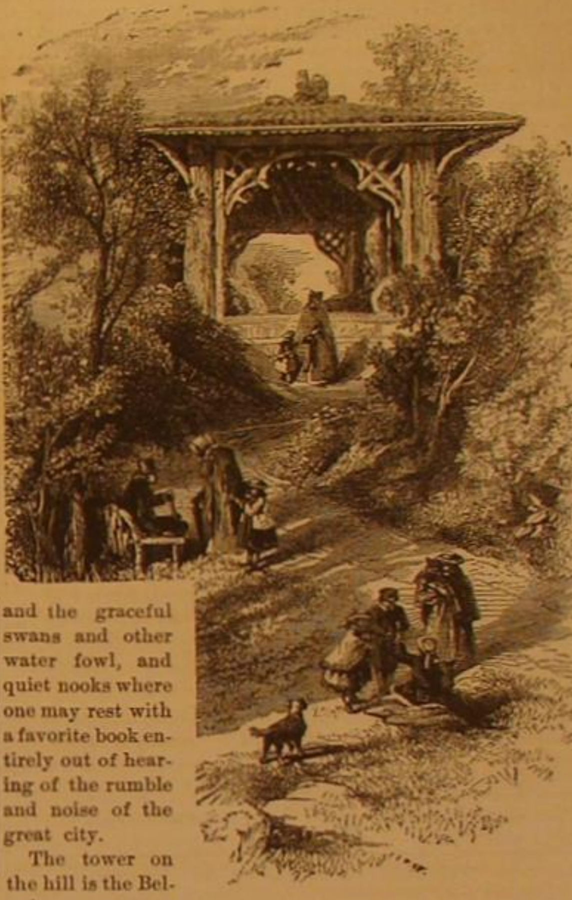


DRINKING FOUNTAIN AND BIRD CAGE.

The lake is of almost entirely artificial construction, and covers twenty acres; and to see its beauties we must avail ourselves of one of the numerous gaily painted boats which glide over its surface. Now we pass a bold jutting rock which changes into a grassy slope, spreading far up the hill, then a clump of willows, the overhanging bows of which extend far over the water; then we shoot by an ornamental boat house, with its steps leading down to the water's edge; perhaps we glide in among a flock of swans and ducks, that tamely crowd around to catch bits of bread that we may throw to them. Then as we skirt the shore we catch glimpses of romantic arbors half buried in the trees, and just before our row is over we run under Echo Bridge, the concave form of which indefinitely multiplies every sound.

The finest piece of architecture in the Park—we may add one of the most elaborate of its kind in existence—is Bow Bridge, shown in our larger illustration. It is made entirely of iron, and the span, in addition to being quite long, is of the beautiful bow shape indicated by the name. We pass over it to get to the Ramble where the paths are all curves, and crooks, and intricate windings, which we can follow, and retrace again and again, finding new beauties each time. There are vine covered arbors, from which occasional glimpses may be had of the lake and the graceful swans and other water fowl, and quiet nooks where one may rest with a favorite book entirely out of hearing of the rumble and noise of the great city.

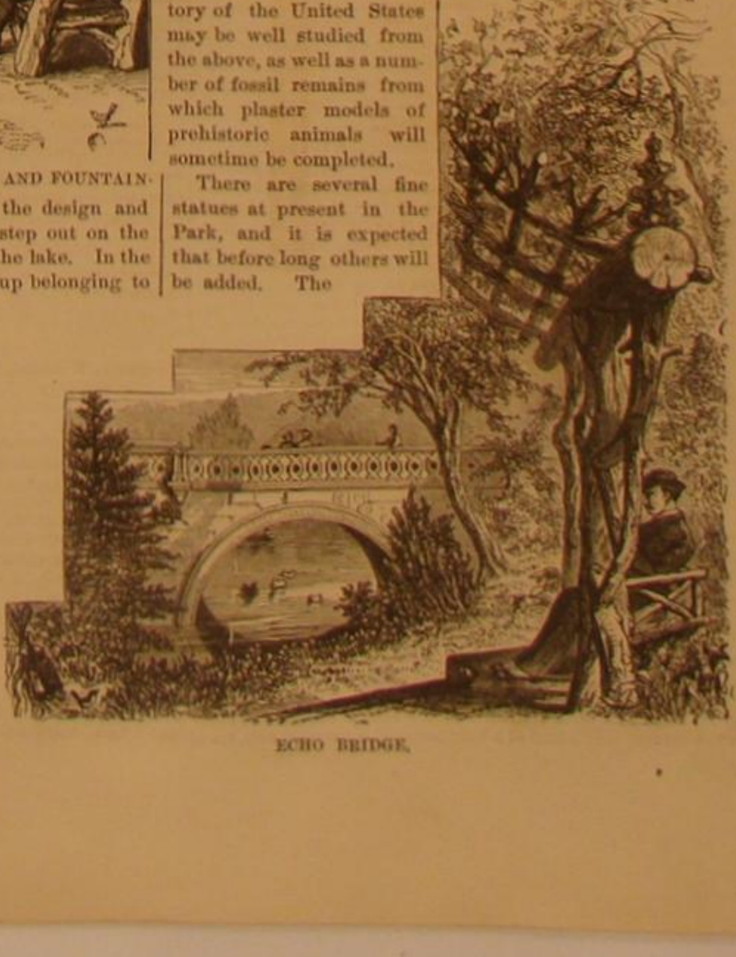
THE SPRING.



THE SUMMER HOUSE.

The tower on the hill is the Belvedere, now a granite and not a very prepossessing structure, which serves as an observatory. A splendid view can be gained, from its upper balcony, over the great Croton basins, the city and far across the Hudson and East Rivers to the shores of New Jersey and Long Island. Near the Fifth avenue entrance of the Park is the old Arsenal, but now the Museum. Here is a very fine zoological collection—which is at present in temporary quarters—comprising many valuable and rare living animals. Within the building proper are fine entomological collections, and a series of excellently prepared stuffed animals. The natural history of the United States may be well studied from the above, as well as a number of fossil remains from which plaster models of prehistoric animals will sometime be completed.

There are several fine statues at present in the Park, and it is expected that before long others will be added. The



ECHO BRIDGE.

Shakespeare monument is at the end of the wall, and close by it is a splendid group of an Indian hunter and his dog. There are also statues of Morse and busts of Schiller, Burns, and Humboldt.

Work is still in progress, and every year finds new beauties added to New York's great breathing place. That it is appreciated by the people, the crowds which throng every pathway on Sundays testify, suggesting indeed the thought that even this large expanse will ere long become too small, and another vast park will be needed to supply the want of our constantly increasing population.

NEW BOOKS AND PUBLICATIONS.

Castle's Universal Interest Tablets. New York: Root, Anthony & Co., 62 Liberty Street. Price $2.

This is a neat leather case, containing three cards with interest tables printed on them. By manipulating the cards according to the printed directions, the interest on any sum for any length of time can be easily ascertained. Our book keeper has tested the tables, and he pronounces the system the neatest and quickest he has ever seen.

Report of Progress of the Geological Survey of Canada for 1871-'72. Montreal: Dawson Brothers.

General Report of the Commissioner of Agriculture and Public Works of the Province of Quebec, for the Year 1871, and the Half Year ending June 30, 1872. Montreal: La Minerve.

The subjects of these two interesting and valuable reports are too large to be fully discussed in our columns; it must therefore suffice to say that the compilation of the books shows zealous and thorough research on the part of the officers of the Geological Survey and the Commissioner of Agriculture. Indications of thriving industries and a prosperous population are to be found throughout the agricultural report; and the cry is for more laborers, especially for farm hands.

Messrs. A. D. Mellick, Jr., & Brother, 6 Pine Street, New York city, have published an excellent book on the railway enterprises and real estate resources of New Jersey, which will be found valuable to all who think of locating near New York.

Flower Object Lessons, or First Lessons in Botany: A Familiar Description of a few Flowers. From the French of M. Emm. Le Maout. New York: William J. Read, 116 Fulton Street.

A little work likely to be useful to the teacher and interesting to the pupil. It is well suited for use in the well known *kindergarten* system, and will, we hope, help to popularize the knowledge of one of the most beautiful and accessible of scientific studies.

The Mystery of Metropolisville. By Edward Eggleston, author of the "Hoosier Schoolmaster," "The End of the World," etc. New York: Orange Judd & Co., 245 Broadway.

Here we have another pleasant, racy story of western life, from a writer who is thoroughly acquainted with the rough, hearty genuineness and the eccentricities of the border life in our States. Mr. Eggleston's fame as an original thinker and story teller was made by his first book; and the last work from his pen more than sustains his reputation. This story was written for *Hearth and Home*, wherein it first appeared.

Detail, Cottage, and Constructive Architecture, containing Seventy-five Plates of Perspectives, Elevations, and Plans for Houses, Villas, Cottages and Country Houses. Published under the direction of A. J. Bicknell. Price $10. New York: A. J. Bicknell & Co., 27 Warren Street.

This is a handsome and elaborate volume, containing some hundreds of designs for houses in all styles, with drawings of all the necessary details. The value of this book to persons intending to build, and to country builders in places where architectural talent is not readily available, will be well understood from its title; and the engraving and printing are such as to make it an ornamental volume, worthy of the admirable examples with which the book is filled.

Inventions Patented in England by Americans.

[Compiled from the Commissioners of Patents' Journal.]

From March 21 to March 27, 1873, inclusive.

Boot Pegging Machine.—J. H. Reed, Boston, Mass.
Bung and Bung Inserter.—L. Van Laak, J. Gillespie, San Francisco, Cal.
Cotton Press, etc.—B. G. Martin, New York city.
Making Hose.—E. P. Richardson, Laurence, Mass.
Middlings Separator.—E. L. Lacroix, Minneapolis, Minn.
Middlings Separator.—G. T. Smith, Minneapolis, Minn.
Needle Threading Device.—G. P. Farmer, Brooklyn, N. Y.
Pressure Gage.—J. W. Stiles, New York city.
Sawing Miters, etc.—J. H. Carpenter, Paterson, N. J.
Steam Boiler.—G. H. Babcock, Plainfield, N. J., S. Wilcox, Brooklyn, N. Y.
Treating Fiber.—W. Shedd, Boston, Mass.

Recent American and Foreign Patents.

Improved Shutter Fastener.

Ellen D. Anderson, Frederick, Md.—The invention consists in combining a telescopic lock bolt with two notched brackets, arranged one near the inside, rear, and bottom end of each shutter, whereby the shutters may not only be securely locked together against the weather strip, or back against the house, but may be "bowed" at various intermediate points, to afford a larger or smaller opening and a greater or less degree of light and air.

Improved Explosive Cartridge Pile Driver.

Henry Vogler, Baltimore, Md.—This invention consists in a novel mode of relatively constructing the hammer and anvil of that class of pile drivers in which a cartridge is employed and wherein powder is caused to explode and be converted into a highly expansible gas between the anvil and the hammer. The resistance of the latter enables it to drive the former with great force against the pile. By the present construction of hammer and anvil, much of the expansive power escapes and is lost unless the cartridge chamber is made very deep, while this increase in the depth causes the chamber to heat very rapidly, to often set fire to the cartridge, and thus to cause the hammer to stick in the anvil. The present invention entirely obviates both these evils, as the gases cannot expand except in the direction of and against the hammer and anvil, while the cartridge chamber can be made so shallow as not to heat the chamber sufficiently to set fire to the cartridge.

Improved Roll for Rolling Railway Rails.

John W. Cooper, Hubbard, Ohio.—The invention relates to modes of constructing rolls so as to shape a compound rail made of two sections and locked together by a groove on one, into which the upper edge of the other fits. The invention consists in the mode of constructing the roll grooves so that the larger section of rail is brought into preliminary shape and subsequently recessed on the under side of head to receive the upper edge of the lesser section.

Improved Pea Vine and Corn Stalk Gatherer.

Absolan B. Sharp, Labadieville, La.—This invention relates to a rake adapted especially for gathering pea vines, corn stalks, and other plants cultivated on ridges, and it consists in the provision of a revolving rake-head carrying a series of teeths of unequal lengths, which are so arranged in relation to each other that the teeth operate or rake both in the furrows and on the ridges, a hinged check plate being provided or combined with the rake for holding the teeth stationary until a load is collected by the same, when, through the medium of a hand lever and connecting rods, the plate is disengaged from the teeth, for allowing the same to revolve to discharge the load.

Improved Nut Lock.

Edward Turner, Greensburgh, Pa.—This invention relates to that class of devices used to prevent nuts from being turned on their screw bolts by jarring or jolting, and thus allowing the latter to be loosened. The invention consists in one or more disks cut away on a portion of their circumferences sufficiently to allow a nut to be applied to or removed from its bolt, and of such a diameter between two opposite points of the curved part of their circumferences that the said curved part and the corners of the nut will rotate in circles that cut each other.

Improved Lamp Shade.

Wm. Simons, Charleston, S. C.—This invention consists of a shade formed of two like parts, approximating an ellipse in shape, and united at the ends so as to have the usual conical truncated form, and also leave notches in top or upper edge which adapts it to the fan shaped flame of a lamp or gas burner. The two parts may be readily detached to adapt the shade for packing and transportation.

Improved Medicine Chest.

Wm. H. Cutler, Buffalo, N. Y.—The object of the invention is to provide an improved case for containing medicinal preparations (more especially that known as carbolate of iodine) and instruments for inhaling the same; and to this end an oblong rectangular wooden block is bored longitudinally with two parallel holes, one to contain the bottle, the other the inhaling instrument. The cover of the case is of sheet metal, provided with a thumb piece, and with flanges fitting in grooves formed in the longer sides of the block, at the open end thereof. The case is cheaper and more durable than paper boxes heretofore used for the same purpose, and is capable of resisting pressure or blows, and also dampness.

Improved Chair.

Jacob Baughman and Bennet B. Chalk, Mt. Washington, Md.—The invention consists in improving the ordinary mode of applying spring backs to sewing machine chairs so that any old and ordinary chair may readily receive a spring back, and so that the back may be rigidly held at any point of adjustment.

Improved Carpet Stretcher.

David White, Normal, Ill.—This invention consists in applying a swiveled button and sustaining yoke to the jointed strips so as to lock the stretcher in any desired position and thereby enable the same person to do the stretching and tacking down.

Improved Umbrella Holder.

Abraham Oberndorf, Jr., Baltimore City, Md.—The invention consists in providing the lower end of an umbrella handle with means whereby it may be easily and conveniently hung to the vest or other part of the clothing.

Improved Brush Socket.

Philipp Wagner, Morrisania, N. Y.—The invention relates to the construction of a bridge for sheet metal sockets of brushes (mainly paint brushes), so as to secure strength and cheapness in the manufacture. The invention consists in the employment of ribs or corrugations on the side edges whose subjacent concavities receive the side edges of the socket.

Buoying and Stopping Leaks.

John W. Cooper, Hubbard, Ohio.—The invention consists in a flat, flexible, and inflatable bag secured to the gunwale, passing down the side of the vessel, up through certain tubes, and connecting with the deck, whereby said bag may be adjusted to cover a breach at any point in the side of the vessel.

Improved Cotton Picker.

Enoch Taylor, Memphis, Tenn.—This invention consists in brushes fixed to vertical cylinders and revolving inwardly so that the balls of one side of each stalk with which the rotary brush comes in contact will be deprived of the ripe cotton. It also consists in the arrangement of mechanism for operating the cylinder from the wheels and in guides that reach cut from the side and in advance of the machine to catch, hold, and guide the cotton stalks up to the brushes.

Combined Adjustable Pinchers and Grappling Tool.

Simon B. Dexter, Mason city, Iowa.—This invention relates to a tool or instrument which may be used as a wrench, pinchers, or grapple for raising or carrying weights. The jaws, by means of a series of holes, are made adjustable to adapt them to articles of different size. A shank rod is connected by means of a fork on the end thereof, with the fulcrum pin of the pinchers. This rod extends back and passes into the handle, and on it is placed the wedge shaped slide consisting of two rods which pass through eyes at the ends of the pincher handles. At the back end of this slide is a screw which allows the handle or other appliance to be firmly attached to the slide. As this slide is moved back and forth on the rod, it will be seen that the handles of the pinchers and the jaws will be made to move nearer to or further from each other, the variations in this movement depending upon the angle of the slide rods with the shank rod. When any article is secured between the jaws, it is pinched or griped by pulling upon the slide or handle, and is loosened therefrom by a contrary movement. This feature adapts the tool for grappling for articles in wells or under water, as well as for carrying heavy articles or hot pieces of iron in founderies and similar places.

Improved Composition Sidewalk.

Charles H. Howard, Batavia, N. Y.—This invention has for its object to construct a sidewalk or pavement without having to haul loads of stones, bricks, gravel, or other matter to the locality of the proposed walk or pavement, which matter is usually embodied in the composition of walks, and used in place of the soil originally there contained. After the grade has been established, the earth to a depth of three or four inches and to the width of the proposed walk is thoroughly worked over and made very fine. A quantity of magnesia and carbonate of baryta, mixed together, varying in proportion with the nature of the soil found on the ground, is introduced and mixed with the earth. After the chemicals above mentioned have been properly incorporated in the soil, silicate of soda (soluble glass) is added, and the earth then replaced in its bed and properly smoothed on the surface. When the mass is almost dry, it should be covered over with a coat of chalk and magnesia mixed in water glass. This walk is cheaper than stone, will not rot like planks, and can be very rapidly made.

Improved Artificial Stone.

Phylander Daniels, Jackson City, Mich.—The object of this invention is to furnish an artificial stone or pavement which combines strength and durability, and offers, by its fireproof qualities, protection against the danger arising from the too rapid spread of fire. The invention consists in the use of a solution of glue, isinglass, soluble glass, and concentrated ley, which is applied to a mixture of sand, Portland cement, and pommeled glass. This mixture is well dampened with the solution till it forms a pasty mass of the consistency of mortar; and may be formed and well tamped into molds, where it will soon harden, to be taken out and exposed to the air to dry. It may also be laid in the form of a fireproof pavement, or any other suitable purpose.

Improved Harvester.

Thomas Y. Woolford, Romney, W. Va.—This invention belongs to the class of machines so constructed as to be adjusted for use as reapers or mowers, and as front cut or rear cut machines. To the outer end of the hub or central part of the drive wheel is attached a pulley to drive the reel when the machine is adjusted as a reaper. The main driving wheel revolves loosely upon the end of the axle and is made to receive the master wheel which is attached to the axle. The master wheel is made with an inwardly projecting rim, upon the outer surface of which are formed notches, upon which take hold spring pawls, attached to the inner side of the rim of the drive wheel. Upon the inner surface of the rim of the master wheel are formed teeth, into which mesh the teeth of the pinion wheel placed upon the end of the shaft. In the outer side of the gear wheel is formed a slot to receive a cross head formed upon the end of a shaft so that the said gear wheel may carry the said shaft with it in its revolution. By this construction, by moving the gear wheel inward sufficiently to remove it from the crosshead of the shaft, it will revolve loosely upon said shaft. The gear wheel is moved back and forth upon the shaft to throw it out of and into gear by a lever, which is pivoted to the frame and extends forward into such a position that it may be conveniently reached and operated by the driver with his foot. The shaft extends across the frame, revolves in bearings attached to the side bars of said frame, and to it is attached a gear wheel, the teeth of which mesh into the teeth of the small gear wheel attached to the driving shaft. Another shaft is placed a little below and in the rear of the axle, and to its end is attached a balance wheel which serves also as a crank wheel for the bar that drives the sickle bar. The shoe, to which the inner end of the finger bar is detachably bolted, and the various parts connected with it, can be readily adjusted to adapt the machine for a front or rear cut.

Improved Clasp Button.

Andrew Flatley, Brooklyn, N. Y.—This invention has for its object to furnish an improved detachable clasp button for connecting the ends of collars. The invention consists in a clasp button provided with spiral wire fasteners upon the inner side of its two parts to adapt it to be conveniently attached and detached.

Improved Car Coupling.

Aaron K. Kline, Readington, N. J.—This invention is an improvement on the patent granted, to the same inventor, March 5, 1872; and consists in a drawhead having a rear piece backwardly inclined on its top surface to receive and hold the coupling rod when not in use.

Improved Bag Tie.

John Bannihr, Hempstead, and Daniel H. Rhodes, Baldwinsville, N. Y.—This invention consists of two parallel plates connected together along one edge. A lever is pivoted to the connecting plate at one end and fastened to it at the other end by a hook. The string is fastened by passing it through a hole in each of the parallel plates above the connecting plate and under the lever. The latter is then pressed down upon the cord, drawing it down between the plates and wedging it fast, the lever being then fastened by the hook.

Improved Die for Forging Hoe Plates.

Lovell T. Richardson, Auburn, N. Y.—This invention relates to dies which are used in steam, water, or other power hammers for plating planters' hoes from the blanks before they are rolled out. Part of the face of the lower die is the arc of a circle transversely, and one fourth of its length is a flat or plane surface. The face of the upper die is beveled on its corners so as to leave a flat tapering surface.

Improved Waist Belt.

John H. Vogt and George Dietzel, New York city.—This invention consists of a waist belt for ladies' wear, which is woven of a fancy warp of silk cord for the front, a black or binding warp of gimp or strong thread for the body, fine silk warps for the borders, and a weft of gimp. The cord for the warp and the gimp for the weft are coarse and heavy, so as to produce a substantial article of a sufficient stiffness for a belt woven with open meshes.

Improved Fireproof Building Block.

William T. Van Zandt and Lucien A. Tartiere, New York city.—This invention consists in the use of asbestos and plaster of Pa. is in combination with saw dust, coke dust, cinders, sand, or other suitable material, to form fireproof blocks or bricks for walls, roofs, ceilings, floors, and partitions, the material being made plastic with water and shaped in molds.

Improved Sample Fastener.

Charles Mason, New York city.—The object of this invention is to supply to the trade a device by which goods may be quickly placed on show cards or boxes, and taken off again, avoiding thereby the inconvenience of the present mode of applying them, and saving time and labor. The invention consists of a wire bent in triangular shape, with ends overlapping each other, and acting like springs, one end being applied to show cards or boxes, the other to the article to be exhibited.

Improved Wood Fence.

Daniel G. Temple, Farmersville, La.—This invention has for its object to furnish an improved fastening for securing pickets and other upright boards or planks to the horizontal bars of the fence. In putting up the fence, bolts are passed through bars midway between the pickets. A wire is passed through a hole in the head of the bolts or around a groove or neck formed upon said bolts. A second wire is passed along a bar upon the side opposite the pickets, and the ends of the bolts or spikes are bent down or clinched around the said wire.

Improved Toy Puzzle.

Benjamin F. Ellis, Newton, Pa.—This invention consists of a puzzle comprising two or more U shaped bows of wire, with a ring formed in each end, a cross bar for each bow passing through the rings, and having a similar ring at each end, the two being connected together by the large bow passing through the rings of the cross bar of the small bow. With these bows and cross bars is a large ring made in two semicircular parts, which in working out the puzzle is to be worked on and off the small bow through the rings and over the ends of the bows and cross bars.

Improved Window Sash Ventilator.

John C. Bates, Cold Spring, N. Y.—The invention relates to the well known mode of ventilating houses through air inlets and outlets in the window sashes, and consists in employing two slides, relatively apertured with respect to each other and to the sash bar, so as to admit either a direct or indirect draft.

Improved Rotating Hook for Sewing Machines.

Andrew Aird and John Aird, Troy, N. Y.—The object of this invention is to substitute for the present brush loop check, applied to the rotating hook of Wheeler & Wilson sewing machines, a device which does the same work with great regularity, rapidity, and security, avoiding the insufficient working of the brush check and the annoyance resulting therefrom. This invention consists in a reciprocating hook placed inside of the rotating hook and in connection with and regulated by a cam in such a manner that the loop is straightened and held until the rotating hook is near the needle ready to take up a new loop.

Improved Hose Port Holes for Partition Walls.

Henry Woodman, Boston, Mass.—This invention has for its object to furnish an improved device to enable the firemen to introduce their hose nozzles into a closed room and flood it to extinguish a fire without its being necessary to break into the room, saving much time, and preventing the fire from making so much headway. The invention consists in the box flaring in both directions. The mouths of the box are closed with doors hinged at their lower edges, which are provided with spring catch locks which can be opened upon the outer side only with a key, but may be unlocked from the inside by drawing back the bolt of the lock with a stick. In the partition are formed two or more holes, each of which is provided with a door, which doors are placed upon the opposite sides of said partition and are hinged at their outer edges to the sides of the box, and are provided with springs to hold them closed. When it becomes necessary to use the device the door is opened; one of the spring doors is then opened, a stick or other article is inserted through the hole in the partition, and the other door is opened by drawing back the bolt of its lock by means of a projection upon the inner end of said bolt. The nozzle of the hose may then be inserted through one of the holes in the partition. One of the holes in the partition may be used to look through while the hose nozzle is inserted through the other, the flaring mouths of the box enabling all parts of the room to be seen, and the stream of water to be directed to any desired point. When the room has been flooded, or the fire extinguished, the hose nozzle may be withdrawn and the door closed, the spring door closing itself as soon as the hose nozzle is withdrawn.

Improved Furniture Castor.

Cevedra B. Sheldon, New York city.—The invention relates to castors for furniture and other purposes, and is an improvement upon the subject matter of a patent granted to the same inventor, April 1, 1873, the general idea being unchanged from the device therein described, but the particular means by which the same is carried out being made much more simple and less expensive to the manufacturer as well as to the public. Its movable balls will, equally with those of the former patent, prevent sliding friction, and insure a distribution of strain, requiring, however, much fewer balls, and but one set of them, while the whole structure can be manufactured at considerably less cost.

Slatted Flexible Support for Mattresses and Car Seats.

Collin Pullinger, Philadelphia, Pa.—The invention consists in two thicknesses of cloth, or other flexible material, placed one upon the other and united together at suitable intervals to form pockets into which are placed wooden or other slats.

Improved Cotton Press.

James P. Derden, Bastrop, La.—The object of this invention is to improve the means now in use for pressing cotton, hay, and similar commodities, and it consists, first, in a rectangular shaped base frame, upon which stands an upright frame of triangular form, consisting of two uprights, the lower ends of which are connected by a cross timber, upon which one end of the base frame rests. A screw is revolved in the end piece of the base frame. This screw has no longitudinal motion, but is simply revolved by means of a pulley on the end thereof, and a belt from the motive power. The screw presses through a truck frame as through a screw nut. As the screw is revolved, this truck frame travels back and forth. Truck wheels revolve on axle arms of this frame, and traverse on top of the base frame. There is a lever whose fulcrum is at a point near the top of the upright triangular frame; this lever is connected with the truck frame by a bar. The follower is suspended from the short end of the lever by a bar by means of a slot and pin, which allow it more or less play. The connecting bar is inclined to an angle and the follower is raised. If the screw is revolved so as to remove the truck frame outward and bring the bar to a right angle with the lever, it will be seen that the follower will be forced downward with inward power. The truck frame and the bar form a toggle or knee joint to operate upon the lever, while the toggle joint is actuated by the screw.

Improved Floor Clamp.

John J. Foster, Belmont, Texas.—The invention consists in improving the construction of flooring clamps. To the side edges of the rear part of a bar or plate, are secured two uprights by bolts, that pass through the said uprights and through the said plate. The upper parts of the uprights project above the plate, and are connected by bolts. The lower parts of the uprights project below the plate to straddle the timbers to which the flooring or ceiling is to be attached. The bolts are made longer than the width of the plate so that the uprights may be placed wider apart or closer together to adjust them to the width of the sleeper or other timber upon which the clamp is to be placed. Upon the upper side of the plate is placed a sliding plate which is made longer than, and is secured to, said plate by a hand screw which passes through a longitudinal slot. The hand screw is especially designed for locking the plate in place to hold the flooring or ceiling board in place until secured. In the upper side of the rear part of the sliding plate are formed teeth, into which mesh the teeth of the pinion wheel, the journals of which work in bearings in the upper parts of the uprights, said journals being made long so that they may not be drawn from their bearings when the uprights are spread apart. Upon the projecting end of one of the journals of the pinion wheel is formed a head to receive the lever for moving the sliding plate forward and back. To the forward end of the sliding plate is secured a plate to rest against the board or other timber to be moved, and which may be secured to said sliding plate by a set screw. Hooks are pivoted to the uprights to hook upon the opposite edge of the sleeper to prevent the device from slipping while being used.

Improved Street Sweeper.

Orson W. Kellogg, Fond Du Lac, Wis.—The invention consists in the improvement of street sweeping machines. The frame is pivoted at one end on the axle so as to swing or oscillate thereon, and its other support is the wheels which are directly under the brush shaft, and gage the brush to the ground. These wheels are mounted in the curved bars, which are fitted adjustably to the frame, so that the latter can be shifted as to hight to adjust the pressure of the brush on the ground. The dust pan is pivoted at one end of a rod just in advance of the brush, and the other end drags along the ground to receive all the dust lifted by the brush, and conduct it up to the endless elevator. This pan is divided vertically at the center in two parts, so as to conform to the uneven surface of the ground better than it would if made wholly in one piece. Near the lower end the pan is connected by cords with the frame, so as to be raised by the said frame when it is raised. The endless elevator runs from a roller up into the dust box, over another roller, and discharges the dust on the bottom. The roller has a hand crank for lowering and raising the bottom for unloading the dust; and mechanism for holding the bottom closed. Both the brush and the endless elevator are geared at each end with one of the truck wheels. The elevator, by belts and pulleys which turn independently of each other, and the pinions of the brush and pulleys of the elevators, are connected to their respective shafts by gearing which engages only when turning forward, so that in turning corners, when one truck wheel runs slower than the other, the shafts being turned by the outside one, having the greatest motion, will overrun the driver on the other side and be independent of it. A rake is provided for loosening up the matters caked on the pavement in advance of the brush.

Improved Distilling Apparatus.

Gaspar Hunziker, Summit, Miss.—The condensers consist of the vertical pipes in pairs, connected by return bends at the top, connecting with the large horizontal return pipe at the lower ends, the pairs of vertical pipes being connected together at about the middle by pipes, and arranged in sections of about three pairs. Pipe connections are made between each section, with the upper portions extending up into or through a cask to each section, the first section being connected to the kettle, and the last section with the final condensing coil in the tank by pipes. These tanks of the sectional condenser are connected together. The tank has a supply pipe extending to an elevation considerably above the kettle, and the condenser to receive the liquor to be distilled from an elevated cistern or tank high enough to force the liquor through the condensers and into the kettle. A rectifying flask is introduced in the connecting pipe between the last two sections of the condenser; and a flavoring flask is provided from which the distilled liquor passes from the last section of the sectional condenser to the coil in the tank. A small quantity of water is put in the kettle through a funnel, to protect it from the heat, and generate steam for heating the apparatus up to the working condition. The cock in the reservoir is then opened, and the liquor to be distilled is allowed to fill the tank, and, finally, flow into the kettle upon the sprinkler, by which it is divided into fine particles so as to be heated to the best advantage by the vapors which it comes in contact with. The vapors rise up into the condensing pipe within the tanks, the condensing begins in the first section, and whatever is condensed flows down into the return pipe to return to the kettle for being redistilled, while the vapors continue to be acted on in the other sections to which they flow by the cooling medium, by which the separation of the heavy vapors and watery substances is continued, increasing the strength of the alcoholic vapors, as required, using more or less of the sectional condensers, which will have such pipe connections and cocks as may be needed to pass the vapors through the number required. At the same time, after the heavy vapors and watery substances are mainly separated the volatile portions are passed through rectifying and flavoring substances, and thus the necessity for special apparatus to pass the distilled liquor through these substances is saved.

Improved Wrought Iron Blind Hinge.

William H. Goodrich, Utica, N. Y.—This invention relates to wrought metal hinges, which are not liable to fracture in use; and consists in the peculiar relative construction of parts by which the whole hinge is enabled to be constructed of wrought metal. The upper portions of the parts of the hinge are bent over at right angle to form flanges. In the forward part of the flange is formed a hole to receive the conical pintle of the other part. The rear part of the flange projects to serve as a stop to prevent the blind from swinging back against the wall, and also for the catch to lock the blind open. To the forward part of the flange of the other portion of the device is secured a conically enlarged pintle riveted to the leaf, and that fits into the hole before mentioned. Upon the rear part of the flange is formed a catch, the edges of which are made inclined or curved to catch upon the stop to lock the blind open. Upon the forward edge of the lower part of the second portion is formed a catch to serve as a stop by striking against the flange to prevent the blind from being raised from its hinges. In the edge of the flange is formed a notch, for the catch to pass through when raising the blind from its hinges.

Improved Cutter for Harvesters.

William McKeever, Staunton, Va.—The invention consists in a new mode of locking cutters to the cutter bar of a harvester so that each blade can be readily removed without taking off the others. It also consists in a novel mode of connecting the cutters with the cutter bar so that the latter can be reversed and the same cutter bar and blades be made to answer for a right or left handed machine. It also consists in a new mode of fastening the series of cutters together upon the cutter bar.

Improved Nail Plate Feeder.

Samuel K. Paden, Pulaski, Pa.—The invention relates to that class of nail plate feeders which vibrate laterally to bring the plate at the proper angle to the movable cutter. It consists in applying a pair of horizontally and intermittently rotated friction disks at the junction of the hopper and feed guide so as to advance the nail plate to the knives at the proper times and to the proper extent. It also consists in connecting the shafts of these friction disks, which are arranged in oblong bearings, with a spring peculiarly arranged to hold them to the plate yieldingly. It also consists in applying, at the front end of a vibrator, a hinged bearing arm, which is pressed down upon the nail plate by a spring whose tension may be adjusted. It also consists in a peculiar train mechanism for rotating the friction disks intermittently and to the proper distance. It also consists in a novel combination of instrumentalities to enable the nail plate to be turned at the proper angle to a movable knife and to be fed forward by a single movement of the vibrator. It also consists in the application to nail plate feeders of means whereby the vibration is allowed to move some distance before the friction disks begin to rotate so as to allow the movable cutter time to rise above the nail plate. It also consists in simple and convenient means of moving the front end of a nail plate a short distance out of the hopper as soon as its predecessor has passed from the hopper and grippers. It also consists in regulating the bevel or taper of the nail by means of the conveyance of two levers which determine the amount of oscillation of the plate.

Improved Magazine Fire Arm.

George D. Luce, New Orleans, La.—This invention relates to improvements in magazine fire arms; and consists in the construction and arrangement of loading, firing, and cartridge-ejecting mechanism. The hollow sheet metal stock constitutes the magazine chamber and contains a magazine of four tubes, arranged parallel with each other, connected together and mounted on a pivot at each end, so as to be turned to present the cartridges to the passage, through the base block, for being delivered into the carrier. The tubes of the magazine have a coiled spring in the lower end for pushing the cartridges into carrier. The magazine is provided with a thumb bit at the lower end for turning it by hand. A receiver or frame incloses the loading, firing, and cartridge-ejecting mechanism proper, and is formed of a continuation of the stock so shaped as to be cylindrical in its upper and rear portion, the barrel screwing into it, while its two sides are parallel below the barrel. The left side is, however, bent outward to form a tube through which the cartridge shells are ejected. The guard lever is pivoted to these plates and is allowed to move a certain distance before pushing the retractor forward. A stud pin with a friction roller on it is arranged on one side of the guard lever, to work under the hammer to throw it back, to be caught by the trigger when the guard lever is thrown forward for extracting the shell and introducing a new cartridge. The said guard lever also has mechanism to cause it to raise the breech plate to open the breech for the discharge of the shell and the introduction of a new cartridge; after which suitable means cause the breech plate to fall and close the barrel. The retractor has a notch into which the flange of the cartridge falls before being pushed into the barrel, in which it lies after being discharged, ready for being pushed back by the retractors into the hollow carrier, when the guard lever is pushed forward. The retractor also has a notch at the lower rear corner, which, as soon as the shell has been pushed back into the carrier, engages with devices so that the further movement of the guard lever pulls the rear end directly downward to swing the carrier down in front of the passage to receive another cartridge, as shown in broken lines. The cartridge is forced in by the spring of the magazine, and forces the shell out through the discharge tube, the flange of the shell being at this time released from the notch of the retractors by the swinging out of said cartridge with the carrier as the latter is swung down in front of passage. A rounded stud on the retractor is provided, so as to cause the retractor to spring down and escape past the flange of the cartridge when the guard lever is pulled back, in case a cartridge may fail of being discharged, and be forced back into the barrel with its flange in advance of the projection, which may occur when the last cartridge is fired, on account of there being none in the magazine to force it out of the carrier, and which might injure, or perhaps break the retractor; but this will not happen if the muzzle of the gun is held down so that the cartridge will fall out of the carrier by its own weight. It is only in case this may be forgotten or neglected that the shell can thus get back into the barrel, and even then the flange will not be in advance of the notch except in case the shell happens to move forward in the carrier before it is raised up to the barrel.

Improved Medical Compound.

Herman Themel, Esconawba, Mich.—The object of this compound is to purify the blood, and is composed of Indian rhubarb, gentian, galangal root, wormwood and saffron, macerated together in alcoholic liquor. A table spoonful is the quantity recommended as a dose by the patentee.

Improved Furnace for Heating Iron Bars, etc.

Joseph Pardoe, Worcester, Mass.—Two fires are arranged, one on each side of the furnace hearth, and are fed alternately with fuel, so that the gases from the fresh coal of one fire will be consumed by the heat from the incandescent coal of the opposite fire. The iron is placed lengthwise of the hearth, so that the flame and heat pass between the bars and lengthwise thereof, instead of first striking the sides of the bars, as in ordinary furnaces. The iron, besides being placed parallel with the draft, may by this arrangement be cut in longer pieces than where it is placed transversely of the course of the flame. By having two fires arranged in this furnace the iron may be introduced through the right and left hand doors alternately, and kept in two separate piles, one exposed to fire of the fresh fuel and in the process of gradually heating, and the other exposed to the heat of incandescent fuel, and ready to be withdrawn and rolled.

Improved Hot Air Register.

Edward A. Tuttle, Brooklyn, N. Y.—This invention consists of an extension of the hot air pipes of furnaces and the like a considerable distance above the floor, through large holes adapted to allow the air to circulate around the pipes as a protection against fire. The valves are placed on the top of the pipes so that the falling of the sweepings and other matters into the pipes is effectually prevented, and the whole is enclosed in an ornamental guard or screen of open metal work, which protects the pipes and hides them and the opening through the floor from view.

Improved Yarn and Cloth Beam and Whip Roller.

George Lawrence Garsed, Wilmington, Del.—The object of the invention is to remedy the tendency in the wooden yarn and cloth beams and whip rollers of looms to shrink and become warped at their junction with the pulleys, and thus to allow the pulleys to lean at an oblique angle thereto. This has the effect to cause the yarn to be wound unevenly on the yarn beam and to create, when unwound, an unevenness of tension which produces a want of uniformity in the cloth.

Improved Hand Car.

Daniel M. Hunt, Southampton Mills, Pa.—The invention consists in an improved mode of connecting the hand lever with the crank shaft. The frame or truck of the car supports a top frame work. The two wheels at one end are mounted upon the axle, which also carries a pinion. Into this pinion meshes a toothed wheel which is mounted upon a crank axle that hangs in the lower part of the frame. A rod connects the crank of the axle with a walking beam that is pivoted to the top of the frame. The beam is provided with handles at the ends, so that when it is, by the occupants of the car, oscillated on its pivot it will impart rotary motion in the desired direction to the wheel, and thence to the axle to propel the car. The crank shaft is hung in its bearings in such manner that it can slide thereon, and is by a joint connected at one end with an elbow lever which is pivoted to the under side of the frame. By swinging the lever in one direction the shaft will be moved in its bearings to carry the wheel out of gear, while, when the lever is swung in the other direction, the wheel will be thrown into gear with the pinions.

Improved Paper Feeding Machine.

Miguel Piedra, Jersey City, N. J.—The operation of feeding paper to a swift printing press, requiring considerable manual dexterity, is generally performed by hand labor. This invention of Mr. Piedra's, by substituting very ingenious and doubtless effective mechanism, is therefore destined not only to cause considerable economy in the wages of extra hands but to increase the capabilities of the presses in connection with which it may be used, and insure better register. The paper to be fed by this apparatus is in the form of superposed sheets placed upon a table at the back part of the machine. This table is made up and down adjustable, either by being hinged at its back end or secured by a vertical slide, and is especially made up and down adjustable at its forward end. A hollow cylinder is so arranged that, when it arrives at its backward position, a pipe pendent therefrom will arrive over the pile of papers resting on the table. At this moment a plunger is drawn out of the cylinder, and a vacuum, or at least a refraction of air created therein, and at the same time the paper is, by the elevation of the table, raised into contact with the cup shaped lower end of the pipe and a valve simultaneously opened. Therefore the vacuum in the cylinder will be applied against the upper sheet on the table, and will suck the same against the lower end of the pipe. The cylinder at this time makes its forward motion, and takes the upper sheet forward with it until after it has reached its most forward position. The plunger is, by suitable means, violently thrown into the cylinder to discharge the sheet from the end of its pendent pipe. The backward motion of the plunger causes a spring lever to shut the valve. The motion imparted to this lever is, of course, simultaneous with the entering of the plunger into the cylinder, and consequently the valve is shut at the same time that the plunger enters the cylinder; the paper being therefore discharged from the end of the tube by the shutting of the valve as much as or rather more than by the expulsion of air from the cylinder. The cylinder now resumes its backward motion, and the operation aforementioned is repeated until the paper on the table has been entirely removed, in successive sheets. The mechanism herein described is not intricate, and is stated to be easily kept in repair. The means of feeding the paper is certainly the most advantageous that can be devised, because it dispenses with all the griping devices by which the sheets are more or less injured.

Improved Wheel for Vehicle.

Hiram Pitcher, Fond Du Lac, Wis.—The invention consists in the peculiar mode of combining and arranging the hub with a sleeve and axle made fast together. The hub is made in two parts screwed together. The axle passes through a sleeve, the outer end being square, which fits the outer end of the sleeve, so that the latter forms the arm or wearing surface of the axle. The wearing surface of the sleeve is at each end thereof, between which is an oil chamber. The hub forms the box, the two parts of which have each a bearing for the sleeve, and a flange for supporting the spoke. There is a collar on the axle. An interior flange works against a collar on the axle and against the end of the sleeve. A screw nut on the end of the axle bears against the end of the sleeve. A cap screws on to the outer part of the hub, in which is a square orifice for introducing a plug wrench for turning it on or off. Through this cap oil is introduced to the oil chamber. A washer is made fast to the spokes. The ends of the spokes rest upon the inner part of the hub, but the flanges are equal in diameter, and support the spokes. The spokes entirely fill the space between the flanges so that the washer rests upon solid wood. The wheel is thus formed without mortises in the hub or tenons on the spokes. Each part of the hub has a polygonal section, by means of which they are readily separated with a wrench.

Improved Low Water Indicator and Alarm for Boilers.

Mark Ellwood, Girard, O.—This apparatus indicates the quantity of water in a steam boiler, and gives an alarm by blowing a whistle in case of low water. When the boiler has a sufficiency of water it cuts off the steam from the pumping engine, and stops thereby the supply of water. The frame, to which the actuating part of the apparatus is attached, is suspended by means of bolts from the shell of the boiler. The apparatus consists of two sections, one being inside and one outside of the boiler, the former being the actuating part and the latter the indicating and alarm part. A float is supported in position by the vertical guides which connect the upper plate with the lower plate of the frame inside the boiler. On one end of a lever is a sector wheel which engages with a vertical sliding rack. The other end of this lever is connected with the bottom of the float by a rod, and also has a counter weight, which is designed to balance the rack so that the float, as it rises and falls with the water in the boiler, will cause a corresponding motion in the rack, with but slight friction. A rod, the lower end of which is attached to an arm on the lower end of the rack, passes up through a tube into a dial chamber on top of the boiler, and has upon its upper end an index pointer. This pointer passes over the face of the graduated dial plate, and its position, being governed by the action of the float and consequently by the hight of the water in the boiler, will indicate, by means of the marks and figures on the plate, the quantity of water in the boiler. The entrance of the steam into the pipe connecting with the whistle is governed by the action of a valve which is on the lower end of a rod actuated by an arm on the upper end of the rack. The arm slides freely on the valve rod, and when it strikes the collar the valve is lifted from its seat, steam enters the pipe and the whistle is blown, thus giving the alarm for low water. A pipe connects the boiler with the pumping engine. When there is a sufficient supply of water this pipe is closed by a cone valve on top of the float. When the water in the boiler falls the valves fall with the float, and the pumping engine is again supplied with steam.

Improved Grain Measure and Register.

Royal B. Clark, Lyle, Minn.—This invention has for its object to furnish an improved machine for measuring grain and registering the amount as it comes from the separator. The hollow cylinder is supported by legs, of such a length that bags to receive the grain may be conveniently hung upon the discharging spout upon the lower side of said cylinder. With an opening in the upper side of the latter is connected a hopper to receive the grain, and which should have a glass plate inserted in its side to enable the attendant to conveniently see when the measure is full. An inner and smaller cylinder is pivoted to the cylinder by a shaft, by which it is revolved. The inner cylinder comes close up to the upper side of the outer cylinder, and consequently close to the hopper, leaving a space between the lower sides of the two cylinders to allow the grain to flow out freely through the spout. The inner cylinder is divided into two equal compartments, and upon the opposite sides of the partition are formed openings to receive the grain from the hopper. Each compartment contains exactly half a bushel. One end of the shaft projects and works in a small frame attached to the end of the outer cylinder, and to which the wheels of the register are pivoted. To the end of the shaft is attached mechanism to prevent the inner cylinder, and consequently the wheels of the register, from turning back, and also gearing which actuates a second shaft to which a lever is pivoted. To the side of the lever is pivoted a lever pawl, the inner end of which is bent inward, passes through a hole in the lever and enters a hole in a wheel. A number of holes is formed in this wheel to receive the end of the pawl, at such a distance apart that the movement of the wheel through the space between two of said holes will give a half revolution to the inner cylinder. The cylinder shaft connects with gearing which actuates the fingers on the dial plate of the register. Upon the dial plate are formed two circles of division marks, to the outer one of which one finger points, and to the inner one of which the other finger points. The teeth of the gear wheels are so arranged that the first finger may move one space upon its scale of division marks at each semi-revolution of the measuring cylinder. The second finger moves through one space upon its circle of division marks at each revolution of the first finger, so as to register the number of bushels counted. The machine is designed to be placed at the side of a grain thrasher or cleaner so as to receive the grain from an elevator connected with said thrasher or cleaner.

Improved Extension Attachment for Stove Pipes.

Samuel Johnson, James Creek, Pa.—This invention has for its object to furnish an improved attachment for stove pipes, by the use of which the stove pipe may be conveniently lengthened and shortened to adjust it to the place where the stove is to be set up. To the lower part of the length of pipe that slides into the other is attached the lower end of a bar that is slotted longitudinally. The end of the bar that is attached to the first pipe is made with an offset to raise the body of the bar away from the pipe. The other or free end of the bar has an inwardly projecting flange formed upon it to rest against the side of the pipe and steady it. To the lower part of the side of the other length of pipe is attached a screw, which projects through the slot of the bar to receive a hand nut, so that by tightening the said nut the bar will be clamped and the adjacent lengths of pipe will be held securely in place; and by loosening the said nut the lengths of pipe may be readily adjusted as required.

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Notes & Queries

E. B. H. asks how to galvanize sheet iron.

E. M. D. asks how old zinc can be made pure for use in a battery.

A. F. V. wants to know the best and quickest mode of kiln drying lumber.

E. J. C. asks: What is the preparation and process of burnishing gilding on china.

D. P. asks: How can I toughen horse hair so that it will not be brittle?

G. G. F. asks how to remove slight scratches off the face of a looking glass.

T. Y. S. asks how to bleach China grass. It can be made as white as snow.

R. R. asks: At what speed should a band saw run to cut saw logs best?

S. H. H. asks how to remove the rough back off the shell of the pearl oyster.

A. S. asks if it is possible to draw wire from a gold dollar to reach the length of a mile? If not, what length can it be drawn to?

W. W. C. asks: Is there anything that will make leather stick to iron and form a water tight joint for hydraulic rams?

C. H. R. asks for a recipe for an elastic polish or varnish that will give a patent leather finish, or one that will resemble it. It should bear bending and not break.

A. F. S. asks for the precise method by which gold fish are made to spawn. "I have a pond in which I have kept the same gold fish for over three years, and up to the present time they have not multiplied."

W. S. asks: 1. What will remove black ink from writing paper without injury? 2. What is the easiest way to make a hole in a watch spring, without taking the temper out?

J. R. C. asks: What is the best kind of material for a float for petroleum? "I want something that will float freely on the oil and that will not become affected by it."

C. M. D. asks for a rule for measuring painter's works on iron bridges; for instance, a bridge 800 feet long x 100 feet high x 20 feet wide on top. Are the sides, length, and hight measured as lattice work or once through?

R. R. asks: 1. What is the best time of the year as regards health to go to the Isthmus of Panama, and what sanitary course should be pursued?

C. J. F. says: I have a flat roof covered ten years ago with pitch and gravel. It now begins to leak a little. I have been thinking of scraping off the loose gravel and then applying a coat of Rosendale cement, say half cement and half sand. What do you think of it? Will it crack?

R. R. asks: If somebody buys a tract of land with a watercourse through it, and pays tax on the whole tract, water and all, has he a right to close up the creek with a dam, or must he let other people from below float their saw logs through his land? The logs could not float if the man had not dammed the creek some.

A. F. O. asks: What is bichromatized gelatin? How is it prepared, and what are its properties and uses? 2. How can I make a quickly drying cement that will resist the action of boiling alcohol, or with what varnish can I cover ordinary cements to accomplish the same object? 3. Is there any work in which are minutely described the manipulations of thermometer making, especially blowing the tubes and graduating the scales?

G. H. H. asks: Why is it that, in putting the finger on either the in or outside of the closed eye, a dark spot will appear on the opposite side of the ball in daylight, and a bright, luminous spot about the size of a gold dollar in the dark? It is an experiment which all can try; perhaps thousands have noticed it before; but what is it that appears so bright where all else is dark, because of a little manipulation of the closed eye and lid by the finger?

D. S. says: On page 52 of your current volume in answer to P. S. K. Maiers, you direct him to break stones into small pieces and then to mix sand (sharp grit), etc. I have no stones on or near my place, and I wish to know whether river gravel which I have in abundance (from the size of a goose egg to fine sand) would answer instead. Also, will it make a sufficiently strong cellar wall, and if so, would cement mixed with lime be better for a cellar wall than cement without the lime?

J. G. K. asks: 1. Where can I obtain the exact standard measure of the American foot or yard? Is there any place or office in the city of New York where such a standard or model measure is kept open for the public? 2. Could some correspondent give me some practical details concerning the system of irrigation as practiced by the Mormons in Utah, and also about irrigation generally for agricultural and gardening purposes? 2. Is there not a kind of oak with edible acorns which may be used as food, or are acorns actually used as food? If so, where and how? I wish to know the botanical or other name and some characteristic description of such oaks and where they grow.

M. E. P. says: Can there be any such thing as a steam boiler that is absolutely safe? I do not claim to be an engineer myself; but suppose a boiler should be made in the usual manner except that the safety valve should be set on the top of another larger safety valve. For instance, the whole top of the steam dome might form a valve, fitted and made steam tight and arranged with a sufficiently long lever and heavy weights to stand an internal pressure of say one hundred pounds to the square inch, while the small safety valve was set to blow off at eighty. Would that be practicable? Or would several smaller ones attached to one boiler be of any use?

E. A. S. says: Nearly two years ago I tore up an old coal chute, that had been built for eighteen years, and found the sleepers and cross trees as sound as when first laid. The timber was laid in our common sand, and some of it was round, just as cut in the woods, with the bark on, and this was as sound as the rest. There were pine, hemlock, spruce and oak. The slack coal had worked through the cracks, and water had leaked through and formed a crust about six inches through. We had to use a pick to break through the crust. The earth was saturated for about two feet down and looked like iron ore. Could slack coal and sand be used to lay Nicholson pavement, and be cheaper and better than the old process? And would it last till it wore out, without regard to the kind of timber used? I claim that this can be done, and, if so, the discovery of the same.

Answers to Correspondents

Owing to the illness of one of our editors, the replies to several of our correspondents relating to chemical subjects have been delayed, but will shortly be given.

F. A. S. will find particulars of cupro-ammonium on p. 177, vol. 28.—P. H. H. and J. C. C. will find directions for hardening taps and dies on p. 91, vol. 28.—G. T. S. can repair his leaky tin roof by following the directions on p. 139, vol. 28.—W. V. C. and M. C. M. will find the directions for polishing wood, given on p. 72, vol. 26, sufficient for the purpose.—W. H. G. will find the subject of preserving eggs practically discussed on p. 107, vol. 28. —C. R. asks how to brown gun barrels. Answer: Read the articles on pp. 154 & 266, vol. 26.—W. M. will find the process for bluing steel described on p. 10, vol. 25.—W. P. B. and J. P. C. will find ample directions for repairing rubber boots on p. 155, vol. 26.—J. A. E. asks how to join heavy gum belting. Answer: Read the two articles on p. 27, vol. 28.—G. R. and others will find the Gramme magneto-electrical apparatus described and illustrated on p. 410, vol. 26.—F. F. will find practical directions for making an Æolian harp on p. 230, vol. 26.—M. B. will find a recipe for a pickle for tempering mill picks on p. 106, vol. 25.—E. K., F. T. J., and W. H. W. will find the subject of whitewashing fully discussed on p. 122, vol. 24.—A. K. will find a recipe for transparent cement on p. 41, vol. 27. —M. C. M. will be able to mount chromos, etc., by following the directions on p. 154, vol. 27.—T. E. C. will find directions for porcelaining iron ware on p. 149, vol. 28.—M. T. B. will find the power of steam boilers fully discussed in the last few numbers of the SCIENTIFIC AMERICAN.—H. J. W. should read J. J. B.'s reply to W. D. O. on this page.—A. W. P. will find a recipe for marine glue on p. 202, vol. 28.—O. J. P. will find full directions for making and applying liquid bronze on p. 90, vol. 26.—R. S. W. asks for a covering for a flat roof. Answer: Consult our advertising columns.

E. C. M. is informed that the information on the regeneration of bone black is derived from the accounts published, by the inventors of the process, in Europe. It is not an extract from another publication.

J. L. L. asks what we mean by a saw of 16 gage. Answer: The blade of the saw is the thickness of No. 16 wire, according to the wire gage in ordinary use.

P. P. H. asks if any metal expands and contracts with various degrees of heat, as do mercury and alcohol. Answer: Yes; read S.'s letter on page 242 of our current volume.

P. P. H. asks if mercury can be kept in an iron vessel without affecting the latter. Answer: Yes: mercury is generally sold in cast iron flasks.

A. says: The following account of a boiler disaster appears in a Sacramento (Cal.) daily journal of March 25, 1873: "Last evening the residents were startled by a loud explosion, which was immediately followed by an alarm of fire. It became evident that some remarkable freak of steam had taken place, for an immense boiler, rent and torn by an explosion, lay across Second street, while an enormous hole in the third story of a brick house immediately opposite told of the terrific force with which it had been hurled. Investigation disclosed the fact that the boiler belonged to the Sacramento foundery of Wm. Guttenberger, 105 and 107 Front street, which had exploded with such force as to send it entirely through the end of the shop in which it was situated, across the alley, through a large yard, demolishing the fence on its road; then rising through the air, it passed entirely through three rooms and both front and back walls of a brick house before it had reached its lodging place in the middle of Second street. At first sight it seemed impossible that such an occurrence should have taken place without loss of life, and search was at once commenced amid the ruins for the injured, but none were found. It seems that the workmen had all left the foundery some time before, banking the fires and leaving everything apparently safe, and that all the occupants of the injured house were down stairs at the time. It is supposed that the explosion was of such a nature as to give a circular motion to the boiler in its flight, which, combined with the immense velocity, caused it to cut its way clean through all obstructions. The partition walls, furniture and brick walls were as completely and cleanly cut through as could have been done by the tools of a mechanic, while the boiler shop is a complete wreck of broken timbers. The most plausible theory of the cause of the explosion is that the fire got under way after the workmen had left, and thus generated steam sufficient to cause the accident. It was, however, impossible to arrive at any conclusions last night, and it will require removal and examination of the *debris* to-day to get at any accurate idea of how it occurred. A casual examination of the boiler shows that in some places it was very much worn and thin, some of the pieces left in its track being but little thicker than sheet iron." On going to the spot, immediately on reading the above, I found the boiler, as it lays on the street, to be about 10 feet long by 42 inches in diameter, 30 flues about 2 inches diameter. The front end is blown off and gone; one side of the boiler, from one end of the flues to the other, has been forced in by some cause, as if some great pressure had been applied to the outside. The flues are all forced close together at the center, while the ends of most of them remain in their proper places. Now what I wish to know is: How is it possible for the front end of a boiler to blow off and the balance of the boiler to follow with such force in the same direction? In this instance, the boiler was set facing the east; the front part is gone and the bottom we find about 300 feet east of where it was set, having struck the ground with the back end of the boiler first, showing that it must have made at least one half of a revolution endwise. I would as soon expect to see a cannon, when fired, go in the same direction as the ball, as to see a boiler follow up the end that is blown off. But perhaps you can give a satisfactory explanation of this mystery. Answer: We are quite as much at loss to account for this remarkable circumstance as is our correspondent, and hope that he will continue his investigation until he can give us more complete data upon which to base an opinion. Is there no mistake in the description given of the relative position of the boiler before and after the explosion, or some peculiarity of setting?

E. R. D. says: I have a $\frac{1}{2}$ horse power oscillating engine; how large a boiler shall I want and what thickness should the iron be? The boiler is to be heated by a stove; will a barrel setting over the boiler, with a pipe running down into it, do for a feeder? Answer: We should make a tubular boiler having about a square foot of grate surface and 20 feet of heating surface. It would probably be 20 inches in diameter of shell, and should be made of iron about an eighth of an inch thick to carry 100 pounds steam. A properly constructed plunger feed pump should be attached to the engine. We should not approve of the barrel arrangement.

J. H. C. asks what per cent of the water supplied to a hydraulic ram can be returned to the point from which it fell? Does a ram give as good results under a given head of water as a turbine wheel? Answer: See article on page 257 of this issue.

L. & D. W. C. ask: How can we ascertain the quantity of power transmitted by belts of different widths, and pulleys of various diameters and speed? Answer: See the editorial columns of this issue.

W. H. C. asks: Would a pressure of steam hold up a column of cold water under the following circumstances: Suppose I have a tank of cold water 3 feet high connected by a $\frac{3}{4}$ pipe to my boiler above the water line (the tank also sitting above the water line), what pressure of steam, if any, would hold the water back; or would the cold water condense the steam and the difference in temperatures create a current and allow the water to run in the boiler under any pressure, the steam taking its place? Would the same result take place (the tank being closed and able to sustain the pressure of the steam in the boiler) if the tank were full as if half full? Or would the same result take place if the water in the tank was at a temperature of 30° as at 200°? Answer: A pressure of one and a half pounds would equilibrate that of the column of water. In the case supposed, the water, if cold, and if the pipe conducting it to the boiler were large enough, might condense the steam. If that were to occur, the water in the tank would then flow into the boiler with the same rapidity that it would issue from the pipe were the pipe led into the open air and a hole made in the top of the tank. The steam could only take the place of the water when the pipe was made of sufficient size to allow the steam to bubble directly up into the tank. With heated feed water, condensation of the steam would not be likely to happen, and the arrangement has, in that shape, been used as an automatic feed, with some success.

D. G. says: We have a new kind of a pump lately introduced into this (mining) district; this pump was originally intended for a 14 inch pump, plunger and bucket combined, the object of which is to discharge one half the water on the down stroke and the other half on the up stroke, thus making what is claimed to be a balance pump, with a great saving in power in working in deep mines. The parties who use this pump discarded the bucket and changed the plunger to a 12 inch one, which makes the pump now a 12 inch plunger pump. The builder of this pump has discovered an advantage in discharging the water through the jack head over pump barrel, and a saving of ten feet travel of water, over the old fashioned plunger pump. This pump we call B and the former, A. We place the two pumps in a shaft, 200 feet deep; the foot valves are on a level with one another. Now the best talent in the county claims that the water in B will travel 10 feet further than it does in A, in other words that B raises a column of water 200 feet in hight, while A only raises a column 190 feet, and spills water 10 feet in advance of B. I claim that the water in B does not travel any further than it does in A, that they both pump against a column of water of the same hight, and that A does not discharge water 10 feet in advance of B. Will you give us your highly valued opinion? Answer: We are inclined to agree with our correspondent on this point. We think, with him, that if, by any contrivance, water is raised from one level and discharged into a reservoir at a level 200 feet above, no modification of the machine will be able to make the lift anything less than 200 feet. We differ from the said "best talent" (holding opposite views, and should prefer to accept the opinion of some of the intelligent apprentice boys who read the SCIENTIFIC AMERICAN, rather than subscribe to the views of said "best talent." Any two pumps, pumping against equal heads, will require the same power to do their work, provided frictional resistances are equal.

J. K. says: We have a steam mill for sawing logs, planing matching, etc.; our feed water is hard and causes a great deal of scale on the boiler. Now we have contracted for a new boiler of 30 horse power and wish to know what arrangement we can make to condense the exhaust steam to use for feed water. Answer: We presume that the most satisfactory arrangement will be found to be the usual condenser and air pump, which can be attached by any competent constructing engineer. There are one or two forms of "siphon condenser" in the market which are less expensive, however, and are said to perform well.

J. M. says: I have charge of a nest of three 42 inch boilers, 22 feet long, with 2 fourteen inch flues in each; the shells are made of ¼ inch iron and the flues are made of iron of the same gage. They have been in use for 12 years, and I inspected them this week; the scale that is deposited on them is no thicker than a sheet of writing paper and is black and glossy; there are no leaks and they appear to be in as good condition as though they were only two years in use. I am expected to press them to 65 lbs. per square inch. I have had charge of boilers for the last sixteen years and I have read the SCIENTIFIC all that time; but as this is the first time that I have had to deal with boilers with large flues, I wish you to give me information in regard to what you believe would be the highest safe strain that I could carry, and whether the shell or the flues will stand the most pressure before giving way. Will you tell me how to compute the strains on flues in plain arithmetic, as I have no knowledge of algebra? Answer: The shell of the boilers described, if perfectly sound and of good iron, is safe at the pressure of 65 lbs., and the steamboat law has generally allowed 110 lbs. on boilers of that size and of ¼ inch metal. The flues, if in equally good condition should collapse at about $806{,}000 \times \frac{1}{4} \times \frac{1}{4} \div 22 \times 14 = 163.5$ pounds. One quarter of this pressure, or 40 pounds, is generally named by engineers as the limit of pressure to be carried, and we, ourselves, should object to carrying more than one sixth, 28 pounds. The flues will, therefore, give way first, under the conditions assumed, and should not be subjected to more than 40 or 45 pounds, although they may stand four times that pressure. The weak spot in large numbers of boilers is the flues, and, as our correspondent probably knows quite as well as we do, many accidents occur from collapsing flues. To determine the strength of any flue, made of good iron, well put together, and perfectly cylindrical: Divide 806,000 times the square of the thickness in inches by the product of the diameter in inches and the length in feet.

D. says: Suppose a party owes me. I sue and get judgment entered up against him, and the sheriff reports "no property, except letters patent in the defendant's name for a valuable invention" (cannot say if it is his own or purchased). Can I have said letters patent attached and sold at sheriff's sale? Answer: A patent cannot be taken and sold under an execution in an ordinary action for debt in which judgment has been recovered.

P. L. asks: Would sleeping always with your head to the north tend to magnetize the metallic constituents of the fluids and solids of the human body? If so, would it increase nervousness? Answer: Persons having the "iron constitution" might be so affected.

P. L. asks: How can you construct a pump that will draw water from a well that is 45 or 50 feet deep? Answer: Use a common lift and force pump, the latter placed in the well, say, 25 feet above the water.

L. W. C. asks: Can you give me an explanation of how Chas. G. Page (or his heirs) could take out letters patent in 1868 on electrical instruments which, according to history, were discovered by Professors Henry, Wheatstone and Morse, as early as between 1836 and 1842? Also, could that patent be enforced and thereby close opposition telegraph companies? Answer: The Page patents were granted by special act of Congress. Their validity has not yet been determined by the Courts.

N. B. D. says: I wish you could tell me what is the matter with my magnet. The cores are made of soft iron, about ⅜ inches at one end and ⅜ inches at the other, and are 6 inches long; they are joined at the smaller end by being screwed into a small piece of iron and are wound with about 800 feet of fine covered wire. When I attach the wires of a local battery to them, they have scarcely any attractive power. My magnets are considerably larger than those on my sounder, but do not possess any attractive power. Can you tell me where the trouble lies? Answer: Your mistake may be in the connection of the terminal wires of the two spools forming the electro-magnet. If the two spools are wound in one direction and slipped on the cores, at the end furthest from the armature, connect either the two outside, or the two inside, terminal wires with each other. If we had your magnet here, we would correct your mistake, if not too great, without cost.

W. M. E. sends a mineral and asks what it is. Answer: The mineral sent is iron pyrites, or fool's gold. Of no value.

A. M. R. says: 1. What proportion of the weight of a car and load is the measure of adhesion of a 33 inch chilled cast iron wheel and an iron rail? 2. Of brakes with shoes of cast iron 4 x 13 inches, what proportion of car and load must be applied to the brakes to make the adhesion of wheel to brake equal to wheel on rail? 3. All things being equal, what is the measure of difference of adhesion between a rolling wheel and a sliding wheel on an iron rail? Answer: From fifteen to twenty per cent when dry, about ten per cent when greasy, and about five per cent for very light loads on a very greasy rail. 2. The friction is about the same as the preceding, and the same proportion of weight should be applied, rather less if it is desired that the wheels should not slide without turning. 3. Rolling friction of trains on a level being about one third of one per cent, the ratio of rolling to sliding will be 45 or 60 to 1 for dry, 30 to 1 for greasy, and 15 to 1 for very light weights and a very greasy rail. The *sliding* friction of a rolling and a sliding wheel are about the same.

W. H. C. asks: 1. How can zinc lining in bath tubs be kept bright, or brightened when tarnished? 2. Is there a durable paint or varnish for stoves, to be used in place of black lead? Answers: 1. Use elbow grease and whiting. 2. There is nothing equal to first quality finest ground black lead for stoves.

N. N. says: 1. I have a fire box boiler 18 feet by 42 inches, containing 5 seven inch flues, 3 near the center and 2 nearer the bottom. At about 2½ or 3 inches from the outside shell, a crack has occurred in one of the bottom flues, near the lower side where the flue joins the boiler head, on the under side of the flue and next to the adjoining flue. How can I instruct a blacksmith to repair the break? 2. The flues, from burning light wood, are incrusted with a thick coating on the fire surface of each, apparently deposited from the smoke; how can I remove it? It materially interferes with making steam, being a non conductor of heat. 3. What will precipitate cellulose from its cupro-ammonium solution? 4. What is celluloid? Answers: 1. Take a piece of boiler plate large enough to cover the crack completely, with width enough to allow room for flange through which to bolt. Fit very carefully, working it hot and finally bolt it in place with ⅜ inch head and nut bolts, making the joint tight with a cement of red and white lead and oil. 2. Make a scraping tool for the purpose and remove it with that, if it cannot be detached by a stream of water, or by a brush. 3. Precipitate by neutralizing with excess of hydrochloric acid. 4. From the Latin *cellula*, little cells, and *loid*, like.

W. A. P. says, in answer to S. P. S. who asked what are the diameters of English locomotive drivers: Their express locomotives have a single driving wheel on each side, the diameter of which differs on different railroads. I enquired concerning them while in London last summer, and was told that the largest on the London and Southeastern Railway were about 9 feet in diameter; those on the Midland railway from 8 to 8½ feet; and on the London and Northwestern railway and others, they varied from 6½ to 8½ feet. Those on the L. & N. W. railway are chiefly from 7 to 7¼ feet in diameter. Their freight locomotives have driving wheels of less diameter; but from what I saw, I should say that they were generally larger than those used on freight locomotives in this country.

J. J. B. says that W. D. O.'s question as to the commencement of the day is a perfectly legitimate one, and the answer is very simple: By the common consent of nations, the 180th degree of longitude from Greenwich is the starting point (or line) for each separate day in turn, and consequently this is the line sought for by W. D. O. When a ship going west crosses this line at noon on Friday, she crosses over to noon on Saturday, and *vice versa*; when a ship going east crosses this line at noon on Saturday, she finds, after she is across the line, that it is only Friday noon. This arrangement is, of course, purely artificial, but I believe is universally adhered to.

G. L. B. says, in answer to E. M. B.'s question on calculating speeds and diameters of pulleys: Multiply the diameter of the pulley (in inches) by the speed that it runs and divide by the diameter of the driven pulley. The answer will be the speed of the driven pulley. He says that machines come to him marked to run at so many revolutions per minute. Let him multiply the diameter of the pulley by the speed that it is marked to run and divide by the speed that his line of shafting runs, and the answer will be the diameter of the pulley required in inches.

J. C. H. says, in answer to T. G. who asks for directions to make a solid emery wheel: Take coarse emery, 2 lbs., Stourbridge loam, 1 lb.; mix to a thick paste and press into a metallic mold, then dry and bake or burn in a muffle to a white heat.

S. T. W. replies to S. L. D. who asked for a method of transferring pictures to glass: My method of transferring pictures is to use balsam of fir and alcohol; varnish the glass, place the picture face down upon it and then, instead of letting it dry for 24 hours, immediately commence rubbing off the back with water and forefinger; of course it requires a little more care, and it should be rubbed very lightly the closer you get to the picture. When allowed to dry for 24 hours, the paper absorbs a portion of the varnish, which prevents its being rubbed down thin, while the other way, with care, will secure a much finer and quicker job.

A. O. says, in reply to J. B. M., who asked what is the result produced by hardening cast steel in water strongly impregnated with salt, and what would be the difference if sal ammoniac were used in place of salt: All substances which increase the conductivity of heat of the water produce also a higher degree of hardness in the steel. This is the case with salt and sal ammoniac. The percentage of calcareous matter exerts no certain influence; so we can explain why the ancients considered certain rivulets and wells especially suitable for hardening steel. For this reason, according to Pliny, steel works were often erected in their vicinity, and at a distance from the mines. There are now used nitric acid, potash, nitre, prussiate of potash, crystals of tartar, etc. The English file cutters add 1 part of oil of vitriol to 30 or 40 parts of water. In some cases where no fresh cold water is at hand, such additions may be very useful, but they may in general be dispensed with.

A correspondent replies to T. E. B., who asked how to remove clinkers from the inside of a stove: Throw three or four oyster shells in the stove, while the fire is hot, and leave them there. They work like a charm.

A. H. M. says, in reply to J. C. C.'s query about cleansing feed water: If you will place your heater and filter above your pump a foot or two, so the hot water will flow to it, and then insert a small pipe in the suction close to the pump, of sufficient hight to extend above the head of hot water, leaving the upper end open for the steam to escape, I think you will be able to force your hot water without cooling it again, and thus you will not lose the advantage of heating and filtering.

MINERALS.—Specimens have been received from the following correspondents, and examined with the results stated:

S. H.—It is galena, the ore of lead.

J. W. T.—It is a siliceous rock, containing either carbonaceous matter or oxide of manganese; analysis would be necessary to determine.

A. H.—It is calcareous marl.

G. C. S.—They are pyrites and mica.

J. F. S.—The specimens contain neither cobalt nor nickel, but considerable iron.

J. A. C.—The metal is lead; but is J. A. C. sure that it came from the dark colored rock sent?

D. H. W.—It is not gold, but iron pyrites.

E.—It is yellow ocher, which is useful as a coarse paint and for polishing. If there is an abundance of it, it should not lie idle.

W. P. H.—The specimen is interesting as being a relic of the superstitious arts practised by the "medicine men" of Africa. We cannot think of any drug, certainly one with which the negroes are acquainted, which would produce the symptoms mentioned. If any other correspondents of the SCIENTIFIC AMERICAN know of the use of the "Hoodo," or anything similar, among the negroes in the Southern States, we wish they would communicate.

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges, with much pleasure, the receipt of original papers and contributions upon the following subjects:

On the Atlantic Disaster. By C. D. O.

On a Plan for an Underground Telegraph. By W. F.

On the Solarity of the Magnetic Needle. By H. S.

On a Railroad Accident near Memphis, Tenn. By A. C.

On a Hydraulic Ram. By J. P.

On Professor Haeckel's Opinion of the Embryo State of Man. By J. L.

On Trying Circles with a Square. By G. B. D.

On Moonites. By W. L. D.

On Double Action Friction Gear. By J. B. H.

On Clarifying the Water of Kansas City. By H. R.

Also enquiries from the following:

J. G.—G. W. S. & Co.—C. E. B.—J. J. E.—J. H. W.—W. J. S.—A. K.—R. D. B.—H. A.—G. G. S.—E. M.—J. D.—F. S. J.—E. F. O.—F. R.—W. G.—J. H. W.—J. S. M.—W. H. C.—T. C. J.—A. H.—J. B.—R. A. C.—A. C.—H. J. N.—R. W. S.—C. D. F.—G. M. E.—A. M.—J. S.

Correspondents who write to ask the address of certain manufacturers, or where specified articles are to be had, also those having goods for sale, or who want to find partners, should send with their communications an amount sufficient to cover the cost of publication under the head of "Business and Personal," which is specially devoted to such enquiries.

[OFFICIAL.]

Index of Inventions

FOR WHICH

Letters Patent of the United States

WERE GRANTED FOR THE WEEK ENDING

March 25, 1873,

AND EACH BEARING THAT DATE.

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Washing machine, F. Hulet	137,206
Washing machine, J. H. Kruse	137,218
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Washing machine, G. Seymour	137,151
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Water closet, J. G. Jennings	137,082
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Water wheel, J. E. Stevenson, (r)	5,341
Water cut off, rain, J. W. Wetmore	137,268
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Windmill, G. A. Swartz	137,111
Window shade clip, F. Muller, (r)	5,338
Wrench, etc., S. B. Dexter	137,129
Wrench heads, forming, L. Chapman	137,052
Wrench heads, forming, L. Chapman	137,053

APPLICATIONS FOR EXTENSIONS.

Applications have been duly filed, and are now pending, for the extension of the following Letters Patent. Hearings upon the respective applications are appointed for the days hereinafter mentioned:

24,598.—HARVESTING MACHINE.—Mc C. Young, Jr. June 11.
24,665.—PROTECTING IRON SURFACES.—T. Selleck. June 18.
24,695.—TILL ALARM.—E. B. White. June 18.
24,700.—HARVESTER.—L. and J. Miller. June 18.
24,772.—KEG.—J. Wilson, C. Green, W. Wilson, Jr. June 25.

EXTENSIONS GRANTED.

22,793.—CRACKER MACHINE.—J. Fox.
22,443.—PAPER FOLDING MACHINE.—C. Chambers, Jr.
23,596.—PYROTECHNIC NIGHT SIGNAL.—M. J. Coston.
23,436.—WRINGING MACHINE.—S. A. Bailey.
23,525.—BEDSTEAD FASTENING.—L. W. Buxton.
23,491.—ROPE LAYING MACHINE.—W. Pittman, W. C. Boone.
23,520.—BURNISHING MACHINE.—Le Roy S. White.

DESIGNS PATENTED.

6,512.—CARPET.—A. Cowell, Kidderminster, Eng.
6,513 to 6,517.—CARPETS.—O. Heinigke, New York city.
6,518 to 6,520.—CARPETS.—H. Horan, Newark, N. J.
6,521.—CARPET.—R. Hoskin, New York city.
6,522.—CARPET.—J. Humphries, Kidderminster, Eng.
6,523.—PENCIL.—E. S. Johnson, Jersey City, N. J.
6,524 & 6,525.—CARPETS.—L. G. Malkin, New York city.
6,526 & 6,527.—FLOOR CLOTHS, ETC.—C. T. and V. E. Meyer, Lyon's Farms, N. J.
6,528.—INKSTAND.—W. F. Muller, New York city.
6,529 to 6,532.—CARPETS.—E. J. Ney, New York city.
6,533.—CARPET.—H. Nordmann, New York city.
6,534.—CARPET.—J. H. Smith, Enfield, Conn.
6,535.—BOOT JACK.—E. J. Steele, New Haven, Conn.
6,536.—PICTURE FRAME.—L. Steinkilper and L. Welker, Williamsport, Pa.
6,537.—DOOR LATCHES, ETC.—A. Wunder, New Haven, Ct.

TRADE MARKS REGISTERED.

1,176.—PETROLEUM PRODUCT.—J. Chandler, Pioneer, Pa.
1,177.—WHISKY.—B. H. Engelke, St. Louis, Mo.
1,178.—MEDICAL PREPARATION.—R. Hoyt, New York city.
1,179.—CIGARS.—Kerbs & Spiess, New York city.
1,180.—CIGARS.—Kerbs & Spiess, New York city.
1,181.—WHISKY.—J. J. McClelland, Austin, Texas.
1,182.—COOK STOVE.—Bussey, McLeod & Co., Troy, N. Y.
1,183.—SUGAR LEMON COMPOUND.—Preston et al, Boston.
1,184.—GOLD FOIL.—S. S. White, Philadelphia, Pa.
1,185 & 1,186.—SOAPS.—J. B. Williams & Co., Glastenbury, Conn.

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And How to Obtain Them.

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How Can I Best Secure My Invention?

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Construct a neat model, not over a foot in any dimension—smaller if possible—and send by express, prepaid, addressed to MUNN & Co., 37 Park Row, together with a description of its operation and merits. On receipt thereof, they will examine the invention carefully, and advise you as to its patentability, free of charge. Or, if you have not time, or the means at hand, to construct a model, make as good a pen and ink sketch of the improvement as possible and send by mail. An answer as to the prospect of a patent will be received, usually, by return of mail. It is sometimes best to have a search made at the Patent Office; such a measure often saves the cost of an application for a patent.

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The applicant for a patent should furnish a model of his invention if susceptible of one, although sometimes it may be dispensed with; or, if the invention be a chemical production, he must furnish samples of the ingredients of which his composition consists. These should be securely packed, the inventor's name marked on them, and sent by express, prepaid. Small models, from a distance, can often be sent cheaper by mail. The safest way to remit money is by a draft, or postal order, on New York, payable to the order of MUNN & Co. Persons who live in remote parts of the country can usually purchase drafts from their merchants on their New York correspondents.

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