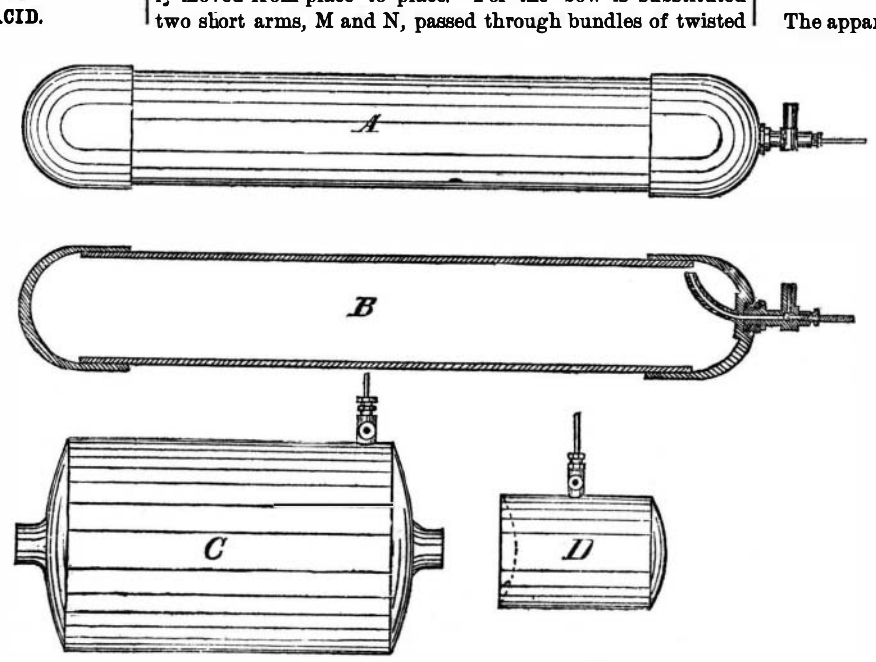
thing now apparent, either in point of efficiency or in cost to prevent the success of the inventor's experiment. His mode of stowing the meat is illustrated in the annexed engravings, the object sought being of course to give a free circulation of the icy draft about every piece. For loading and unloading, it is proposed to use a scow, as shown in Fig. 1, in which the meat is packed after being taken from the ship, and so transported by canal, inland or to the wharves. The scow is fitted with a refrigerating machine and arranged somewhat similarly to the ship, as will be seen by comparing the two sections given. The mode of stowing the quarters will be understood from Figs. 2 and 3, of which Fig. 2 is a thwartship, and Fig. 3 a fore-and-aft, view of the hold. The meat is laid in regular lines upon a light framework in such a manner as to be securely held, and at the same time to take up but little room. The pipes, C and *b*, in Fig. 2, are respectively the inlet and outlet pipes for the cold blast.

The Frigorific, we learn, will shortly sail from France; and as the inventor has invited several members of the French Academy of Sciences to make the voyage in her, carrying with them any articles the possibilities of the preservation of which it is especially desired to test, it is probable that the experiment will be conducted under very close scientific investigation, and that a valuable report will be made.

FLASKS FOR LIQUID CARBONIC ACID.

In our article on carbonic acid gas as a motor, published recently, we neglected to state specifically that the apparatus described was the invention of Mr. W. N. Hill, chemist of the U. S. Torpedo Station, at Newport, R. I., although the fact was clear from the context. We hasten to rectify this inadvertence, and at the same time take occasion to add an engraving of the flasks referred to in our article as those in which the liquid carbonic acid is stored, after it is produced by the machinery at the rate, as we are informed, of 55 pounds per hour (continuous working).



FLASK FOR LIQUID CARBONIC ACID.

The Highest Signal in the World.

A new surveying signal has lately been erected on the summit of Mount Shasta, Cal., by the Coast Survey Department. The signal is a hollow cylinder of galvanized iron, twelve feet high and two and a half feet in diameter, surrounded by a cone of nickel plated copper, with concave sides, three feet high and three feet in diameter at the base; and its altitude is, according to the observations taken by the members of the Coast Survey, 14,402 feet. The nickel plating of the signal is a brilliant reflector, and will, from 6 to 9 A. M., and from 3 to 7 P. M., reflect the sunlight in such a manner that the reflection can be seen from the valleys and the mountains from which the summit of the mountain is visible. It is believed that it can be used for observations at a distance of one hundred miles, and possibly further.

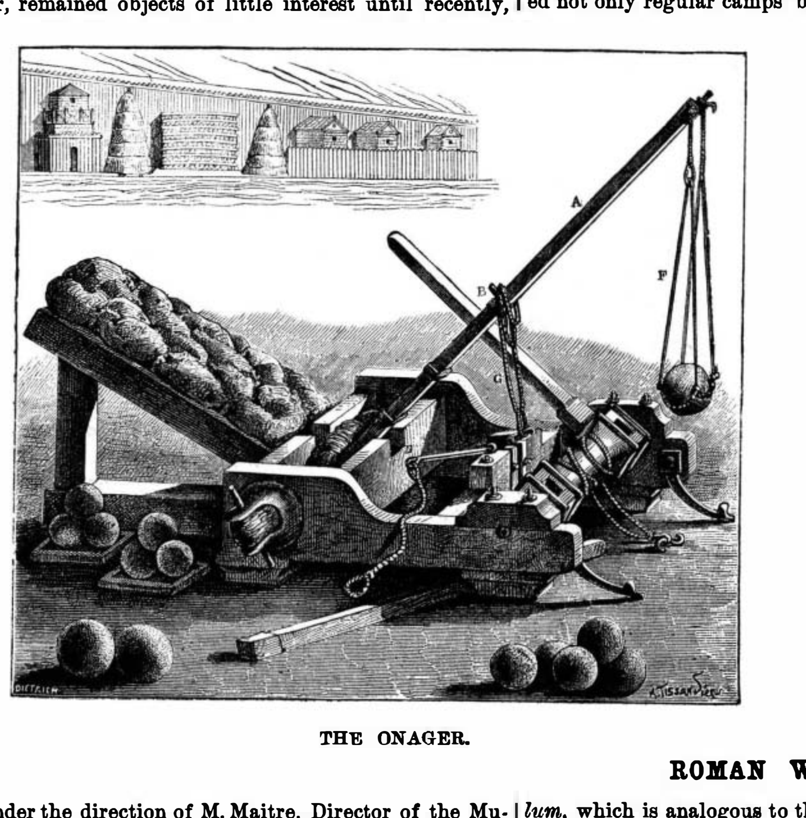
ANCIENT WAR ENGINES.

At the time when Napoleon III. was writing his life of Julius Cæsar, he caused to be constructed, at the Museum of St. Germain in Paris, a set of models of the weapons of war employed by the ancient Romans. These models (which were built, with the greatest care, according to the descriptions of Latin authors and after the representations in bas-relief on Trajan's Column), having served the purpose of the Emperor, remained objects of little interest until recently, when, under the direction of M. Maitre, Director of the Museum, a series of experiments were conducted upon them in order to determine their power. The results obtained are of historical importance, since they enable us to form a good idea of the means of attack on which the armies, which dominated Europe eighteen hundred years ago, relied.

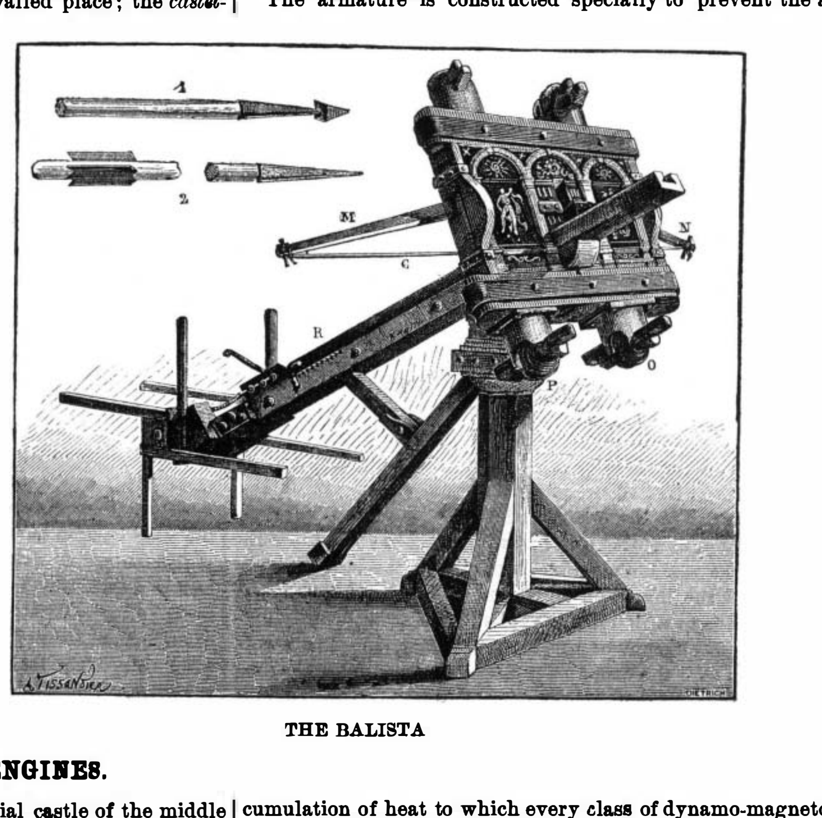
Two of the largest war engines are represented in the annexed engraving, for which we are indebted to *La Nature*. The onager, Fig. 1, consists of a wooden lever, A, which at its lowest end is inserted in a bundle of tightly twisted cords. These last are fixed on a massive frame, and there submitted to extreme torsion, so as to store up in them a powerful reacting force. By the aid of a windlass, the lever, A, is drawn back, thus still further twisting the cords, and the lever is secured in this position by the rope, C, passing over a hook, B. A sling, F, is suspended from the extremity of the lever, and carries the stone bullet. By means of a stop, the catch, B, is freed, when the lever flies forward with great force, bringing up against the cushion placed to receive its impact. The movement is so rapid that the eye cannot follow it, and the projectile is hurled to a distance, varying from 415 to 515 feet, according to weight. The velocity of the ball is low and its flight can easily be seen. The diameter varies from 3·1 to 5·8 inches. It is supposed that these missiles were thrown from the onager at very near range, and that they were also used to drop or roll down upon attacking parties from the summits of fortresses or palisades.

The balista, represented in Fig. 2, is a much more formidable weapon, since it is a huge crossbow mounted on a frame, which often was supported on wheels so as to be conveniently moved from place to place. For the bow is substituted two short arms, M and N, passed through bundles of twisted cords, O and P, similar to the arrangement in the onager. As the string of the balista cannot be pulled back by hand, this is done by catching it over the wooden piece, R, which last is then drawn back by the windlass. When a sufficient tension is obtained, the cord is fastened on a catch, and an arrow is placed in front of it in a suitable groove. By freeing the catch, the string flies forward, throwing out the projectile, which is of the form marked 1 and 2 in the engraving, and made of tough wood and iron The length of the missile is 4·1 feet and weight from 2½ ozs. to 1½ lbs. The range varied, with the weight, from 690 to 480 feet.

At the upper portion of Fig. 1 are sketched the various types of defensive fortification used during the period when the above described weapons were in vogue. These consisted in walls flanked by salient towers. The Romans knew of but three varieties of fortress: the *castrum*, which included not only regular camps but any walled place; the *castellum*, which is analogous to the baronial castle of the middle ages; and the *burgi*, which were similar to but less important than the *castella*.



THE ONAGER.



THE BALISTA

ROMAN WAR ENGINES.

TO FILL holes in burrstones, use melted alum mixed with burrstone pulverized to the size of grains of sand.

A New Reagent for Gold.

Sergius Kern says: "Studying the action of sulphocyanates on some double salts of gold, I have found a remarkably delicate test for gold; experiments prove that even less than $\frac{1}{15000}$ of a grain of gold may be easily detected by using my reagent.

The gold is first separated from foreign metals, and next converted by means of sodium chloride into sodio-gold chloride; the solution is then concentrated by evaporation. In order to detect gold, an aqueous solution of potassium sulphocyanide is used, containing for one part of the salts about 15 to 20 parts of water. About 92 grains of this solution are poured into a test tube, and some drops of the concentrated solution, obtained by treating the sample as described above, are added. If gold is present, a red orange turbidity is immediately obtained, which soon falls in the form of a precipitate; on gently heating the contents of the test tube, the precipitate dissolves and the solution turns colorless.

The reagent is so delicate that one drop of a solution of sodio-gold chloride (15 grains of the salt dissolved in 600 grains water) gives a very clear reaction.

This reaction showed the existence of very interesting double sulpho-cyanides of gold."—*Chemical News.*

A New Electric Machine.

The apparatus, by S. C. Tisley, consists essentially of an electro-magnet with shoes, forming a groove in which a Siemens armature is made to revolve: this is much the same as the original machines made by Siemens and Wheatstone, but the difference occurs in the break or commutator; here there are two springs or rubbers employed in taking the current off from the commutator. The commutator consists of three rings; one of these rings is complete for three quarters of the circle, the other quarter being cut away; another ring is cut away three quarters, leaving the one quarter; and in between these two rings is a third ring, insulated and connected with the insulated end of the wire wound round the armature; on this center ring are projecting pieces, one a quarter of a circle and the other three quarters, so arranged as to complete the two outer circles. The rubber spring which comes into contact with the quarter of the middle circle is connected with the electro-magnet of the machine, and the armature is so arranged that at the time of contact the best magnetizing current is displayed. The other spring rubber is in connection with the wire on the armature during the other three quarters of its revolution; and this is connected with any external piece of apparatus required to be worked

By this arrangement, the alternate currents being utilized, they are all in the same direction; and by the length of contact the whole of the current is obtained in the best condition for heating wires, decomposing water, giving an electric light, and other usual experiments.

At present a model machine has been constructed on this principle, the armature of which measures 5 inches long by 2 inches in diameter, on which is wound about 50 feet of cotton-covered copper wire, No. 16 B. W. G. The magnet has about 300 feet of covered copper wire, No. 14 B. W. G.: the whole instrument, without the driving gear, weighs 26 lbs.: with this apparatus 8 inches of platinum wire, of 0·005 inch diameter, can be made red hot, water is rapidly decomposed, etc.

The armature is constructed specially to prevent the accumulation of heat to which every class of dynamo-magneto-electric machine is liable. It is made in two halves, a groove of zigzag form being cast in each half; so that, when the two are screwed together, a continuous channel is maintained through the bearings for a current of cold water to pass during the whole time the machine is at work.

The Relation of Patents to the Various Industries.

We gave recently a *resumé* of a portion of Mr. J. A. Whitney's excellent address on the above topic. We continue our extracts below, commending them to the reader as of especial interest as showing the rise, progress, and profits of several of the most important American inventions:

"One of the most beneficent effects of the patent law is that, after it has caused a great invention to be made, it does not stop there, but leads to the production of many improvements upon it, the scope and value of the original invention being thus continually enlarged. It was so in a remarkable degree with the sewing machine; for this great invention owes nine tenths of its usefulness to scores of supplementary inventions that would never have been made if the patent laws had ceased with the fabrication of the first machines. Among these is the tuck creaser, a simple device patented fifteen years ago by Henry W. Fuller. The invention consisted in creasing or marking the cloth in lines parallel with the line of sewing, simultaneously with the operation of the needle, so that the making of one seam provided a guide, perfectly parallel with it, either for folding the fabric or for making the next seam. During the life of the patent fifty thousand of these creasers went into use in manufacturing establishments alone. The creasers were found on an average to last a year, or, to keep on the safe side, two hundred days of actual use. Each creaser would do three hundred yards of tucking per day, and this quantity was often doubled. A fair day's work without the creaser was one hundred yards; making the entire work done by one creaser in a year sixty thousand yards, worth three cents per yard, or a total of eighteen hundred dollars. The cost of the labor, including use of the sewing machine in which it was used, did not exceed four hundred dollars, leaving a net profit of fourteen hundred dollars. But as one third of this amount would be obtained by the same expense of labor, we must deduct this proportion, leaving a net profit from each creaser of $933.33, and showing that, in manufacturing establishments alone, in the short period of fourteen years, there was a saving of human labor—a saving in the work of tired fingers and weary eyes—of forty-six million, six hundred and fifty thousand dollars. But this was not all. One million, two hundred of the creasers were sold to families during the same time, and whatever economy resulted from this greater number must be added to the public benefit conferred by the invention. While the cost of materials, etc., remained the same, this invention reduced the price of the finished article from four cents a yard to two cents. And there was the ruffle, patented by George B. Arnold, and known in the market as the 'magic ruffle.' This was a new article, and the patentee devised a new way of producing it. His invention shortened the labor of making such articles twenty fold, and provided a ruffle more uniform and better in quality than had previously been made by hand. In its manufacture only three operators were required to do the work of fifty, so that, with twenty dollars' worth of material, ruffles could be made, ready for market, at a cost of twenty-three dollars that otherwise would cost seventy. These inventions were worth to the public two millions of dollars a year. The patents during fourteen years brought in to the owners $49,976.93, as proved from their accounts, to which must be added $15,000 received from their foreign patents.

"The gimlet-pointed screw invented by Thomas J. Sloan has made the old variety as obsolete as the hammers of the neolithic age. This inventor secured a number of patents for machinery for making the screws, and the value of these adjunctive patents is illustrated by one of them, granted in 1851. This particular apparatus was simply for taking off the slight burr left by the saw used in cutting the nick or groove in the head of the screw. The production of wood screws at that date was ten thousand gross per day. Two hundred and eighty-eight of these machines were in use in the works of the Eagle Screw Company in Providence, R. I., and in fourteen years—the term of patents at that time—the invention effected a saving of ninety-seven thousand dollars. The double hand stamps for canceling stamps and postmarking letters by the same stroke of one hand, patented sixteen years ago, saved the government in 1866 the salaries of two hundred and fifty-four clerks at from $700 to $900 each, or more than two hundred thousand dollars per annum. A slight modification in the manner of joining wrought and cast iron in the manufacture of railings, patented the same year, saved one fourth of the usual expense of repairs, and during the term of the patent saved seventy thousand dollars to the public by the comparative freedom from corrosion and breakage. The subject matter of Aiken and Felthousen's patent of twenty-four years ago was the first machine to sew tubular goods, such as shirt sleeves, boot legs, etc., and in 1865 it was estimated that fifty thousand sewing machines, embracing one or the other of the features of this improvement were in use. No other sewing machine would do the work. One of these machines would save the labor of eight hands, and the invention added ten dollars to the value of any machine to which it was applied. The curved rest which formed one element of the invention was stated by sworn experts to save the community fifty thousand dollars a year in the manufacture of boots alone. But let me turn again to patents, the results of which have reached all over the world.

"We can all recall the time, not many years ago, when metallic or fixed ammunition was used in fire arms to only a limited extent; whereas, not only for army but for all other fire arms, it is now universally used. It was impossible to manufacture such cartridges, either of good quality or cheap enough to permit their use, until Ethan Allen's patent of 1860 disclosed a method which produced a revolution in fire arms throughout the civilized world. And how much did Allen receive during the term of fourteen years? He made, in royalties and from the sale of a machine, thirteen thousand one hundred dollars. He also made a manufacturer's profit of forty cents a thousand on sixty seven millions of the cartridges sold, not to the Government, but to the general trade, which was little enough in all conscience when we consider the importance of the invention.

"Perhaps a greater benefit was conferred upon the country and upon mankind through the patents upon which the manufacture of American Brussels and pile carpeting has been founded. Erastus Bigelow secured his first patent in 1837, and subsequently obtained many others, that of 1847 embracing the features that made the machine an absolute success in weaving carpet by the power loom. Bigelow had made, up to the year 1861, $136,912.74 from these inventions. The history of Eli Whitney's cotton gin or Jethro Wood's iron plow show that it was the promise held out by the patent laws that led these men, through manifold trials, the one to open the way of this country to supremacy in the growth of the staple fiber of the world, the other to realize in sober fact the fairy tale of Scandinavian mythology, which told how a metal share added tenfold to the produce of the earth. Agriculture owes more than any other industry to the fostering spirit of the patent laws. And as the yield of the harvest begins with the turning of the furrow, perhaps the steel plow is the best illustration I can use in this connection. It was patented in 1864 by Francis F. Smith.

"Smith commenced business in Ohio, thirty-three years ago, as a blacksmith, and started his own shop in 1843. He sought to make improvements as early as 1850, and made two steel plows of sheet steel, by hand, in 1856. In 1859 he made numerous experiments in tempering sheet steel plows, but could not save more than one in three. In 1859 he was laid up by sickness, and learned by reading that steel could be cast to shape, but could get no satisfaction by enquiry until brought, by correspondence, into relations with the Collins Steel Company of Connecticut.

"The first cast steel plow was made and tried at Collinsville in July, 1860. Smith "gave all his time, energies, and thought to the development of this plow" up to the seventeenth day of April, 1874. The number made and sold by the Collins Company was eighty thousand five hundred and sixty-nine. Smith, up to January 1, 1874, over and above money expended, but without allowing anything for his labor during these years, received about $55,000. The Collins Company invested not less than two hundred and fifty thousand dollars in the manufacture and introduction of these plows; and the plows could not have been made at a price low enough to come within the reach of the farmer, neither could they have been introduced when made, without this large capital to pave the way. Cast iron plows are too soft to wear well in sand and grit; they will not scour in soft prairie or bottom lands. Plows made of sheet steel had been tried and been practically abandoned. Sheet steel plows are of flat plates; they do not have the greatest thickness at points of greatest wear; the plates tend to constantly renew their former flat form. The parts cannot be made uniform, cannot be readily duplicated or repaired, and will not admit of high temper and hardness; for tempering and hardening warp, and twist or crack, and spoil the sheet. All these defects are obviated in the cast steel plow. The worth to the farmer in increased durability, aside from scouring, estimated by sworn experts at five dollars per plow over and above common plows, after making allowance for difference in the prices at which they were sold—80,500 plows, with an increased value of five dollars each—is upwards of four hundred thousand dollars gained by the farmers of the West, while the inventor made less than one seventh of this amount.

"But a greater than the steel plow was McCormick's reaper; for his reel and divider made grain-harvesting a success. In the extension of these patents it was shown by sworn evidence that, in those districts of the West where reapers were introduced, the increase in the production of grain was one hundred per cent; for the labor of those regions could not harvest by the old methods more than one half of what the soil was capable of yielding. The work of sewing is one half easier than that of reaping; so that, if all was sown that could be, one half of the crop would have had to rot on the ground. On an average each machine cut, during each year of its lifetime of ten years, two hundred acres, or a total of two thousand acres. Hence it was that each machine saved to the user, in labor alone, at least five hundred dollars, besides paying its original cost; and in this way, up to 1859, the saving of labor to the public amounted to thirty-six millions six hundred thousand dollars. The gain to the public in the increase of the grain crop, due to the invention, to the same date, was one hundred millions of dollars. McCormick's patents were dated 1834, 1845, and 1847; but up to the year 1859 he had devoted twenty-seven years to his improvements. During this time he paid out one million, eight hundred and sixty-five thousand, two hundred and seventy-eight dollars. His receipts, exclusive of bad debts and costs of collection, were $2,527,698, leaving him a clear profit of $662,414. This included both manufacturer's profits and royalties. But the devices that would cut the upright hollow stalks of grain were unsatisfactory when applied to cutting the more slender and fibrous stems and the yielding leaves of grass; and the sickle bar, playing through slots in the guard fingers closed at both ends, clogged so that no successful machine for cutting grass was made before Eliakim R. Forbush, in 1849, patented his guard finger with the open slot. This enabled the knives to clean themselves, and effectually avoided clogging. This was applied to various machines that needed nothing more to fit them for cutting grass. The inventor was modest enough to estimate the value of this improvement at two dollars for each machine, although no machine that would successfully cut fine grass had ever been used before. Twelve years ago the number of mowing machines sold in one season was twenty-five thousand, or a gain to the farming community from this device of fifty thousand dollars annually. Forbush was unfortunate; and while the public was making this, he delivered, during the original term of his patent, just twenty-five dollars and ninety cents per annum.

"After machines had been made to reap, and other machines had been made to mow, it still remained to provide a machine that would do both. There were numerous attempts to do this before John H. Manny's patent of 1851, but none had succeeded. Before this two distinct machines were required for the two kinds of work, at a cost of from $235 to $270, or an average of $250 for the two. Manny sold a machine, equally efficient for both kinds of work, for $135, saving $115 to the purchaser of each of his machines. There were made and sold under this patent of 1851 sixty thousand machines, saving to the farmers in fourteen years, in this matter of first cost alone, six million nine hundred thousand dollars. But this is not all. Manny made the cutter bars of his machine so readily adjustable that they could be raised or lowered to cut lodged grain the lodged grain being picked up by the bar, cut, and saved. The loss from lodging has been frequently estimated at several bushels per acre; but at only half a bushel per acre, at eighty cents to the bushel, a machine cutting ten acres a day, the saving amounts to four dollars a day for every day a machine is used. Assuming each machine to be used only twelve days each year, the saving amounts to forty-eight dollars for each machine per annum. These machines, with usual wear and tear, were found to last eight years—a shorter time than McCormick's, because they mowed as well as reaped. Eight times forty-eight dollars is $384, and the sixty thousand machines saved in lodged grain alone $23,040,000. Add to this the saving in first cost of machines, and Manny's inventions saved to the agricultural community in fourteen years within a fraction of thirty millions of dollars. Manny secured no less than thirteen patents, from which he made altogether a trifle more than $283,000, including his profits as a manufacturer, or less than one per cent of what the farmers had gained from them during the same time. But Manny's profits, like those of every other inventor, ceased when his patents expired. But the public, with these, as with all other inventions, has their benefits for all time; and the same rule holds good for small inventions. In 1861 Nathan Brand patented a machine for making hoes by rolling instead of forging the plates. This reduced the cost from twelve to nine dollars a dozen; and there are one hundred thousand dozen hoes made and sold annually in the United States. Brand made from it, over and above the expense of his experiments, three thousand six hundred dollars.

A Silver Bath from Ditch Water.

"All our formulæ tell us to use pure water in making up our silver solutions. I was led into a discussion, a short time since, with a brother photographer on this one point of our manipulation, and it finally led to a small wager that I could not make a bath with such water as he might furnish, the first plate exposed in the bath to give a good negative.

"The water came; it was evidently such as he had dipped up from some hog puddle—muddy, greasy, and in every way filthy; and from this stuff I was to make a half gallon of silver bath which would work from the start. I commenced my labors, and had one week to finish the undertaking. First, I let the mud settle in the bucket in which I received the water, skimming off the green mass and the grease which floated on the surface. After leaving it a few hours to settle, I carefully decanted the liquid into a tall glass candy jar, and found I had about one gallon of stagnant water, anything but inviting for the purposes intended. I let it stand over night, and, for a result, had about half an inch of settlings in the bottom of the jar. I again decanted into another clean jar the liquid from the mud, and I had a little less than three quarts of water. I now added half an ounce of nitrate of silver, which turned the liquid brown before it was half dissolved. I placed the jar in the sun for one day, and in an hour it was black as ink; by next morning it showed signs of clearing up, and I again decanted the clear solution. I filtered it carefully, and made my bath by adding nitrate of silver sufficient to bring it up to forty grains strength, adding one and a half grains of iodide potassium for each ounce of silver used, shaking thoroughly. I put the bath in the sun, and left it for two days, when the solution was perfectly clear. I filtered through prepared cotton, and finally added chemically pure nitric acid until blue litmus paper turned slightly red. Placing the solution in my bath tub, I coated a plate with collodion, and left it in the bath over night. The result was that the first plate dipped in the bath and exposed in the camera gave a fine negative."—*F. J. K., in Western Photographic News.*

A Captive Gorilla.

The rather curious discovery has been made of a living gorilla amongst the apes in the Zoölogical Gardens of Dresden. The animal was purchased while quite young as a chimpanzee and an unhealthy one at that. As it became older, its development attracted general attention, and finally Dr. Schweinfurth, the African traveler, after examination, pronounced it a genuine gorilla. It is the first of the species that has been kept alive in captivity; and as it now appears to be doing well, there is a probability that it will reach maturity, and thus enable zoölogists to make important studies regarding its now little known habits and characteristics.

Useful Recipes for the Shop, the Household, and the Farm.

The grindstone is a self-sharpening tool; and after having been turned in one direction for some time (if a hard stone), the motion should be reversed. Sand of the right grit applied occasionally to a hard stone will improve it.

To remove rust from small hollow castings, dip in dilute sulphuric acid (1 part commercial acid to 10 of water). Wash in hot lime water and dry in a tumbler in dry sawdust.

To remove chuck cement from lathe work, warm the object over a spirit lamp and tap lightly with a stiff brush: the wax will adhere to the latter. If in a hurry, a few seconds' boiling in alcohol will remove the remainder of the wax.

Exhaust steam should never be discharged into a brick chimney. It is liable to disintegrate the mortar and thus to render the entire structure unstable.

A mortar celebrated for its durability is composed of well slaked lime mingled with finely sifted sand. To this is added one quarter as much fine unslaked lime as there has been sand used. While it is being mixed, the mass heats, and the mortar should then be immediately used. The substance is waterproof and becomes excessively hard.

Salmon skin makes a leather of about the thickness of dogskin and as tough as wash leather. The scale marks leave a neat pattern.

The finest glass enamels are generally prepared by fusing (at a high temperature) silica, oxide of tin, and oxide of lead, and spreading the mixture over a sheet of copper, of gold, or of platinum. A much more economical and as efficient a compound consists of arsenic 30 parts by weight; saltpeter 30 parts; silica 90 parts; litharge 250 parts. This is spread on plates of glass of the required shape and size, care being taken, however, that the kind of glass employed be not less fusible than the enamel. Enameled gears thus prepared may be drawn or written upon as readily as paper, and in less than one minute the writing may be rendered indelible by simply heating the plate in a small open furnace or muffle.

Hydraulic cement mixed with oil is recommended as a paint for concrete brick walls. The same is a good waterproof paint for roofs and walls of cisterns.

The French (St. Gobain) glass, used for lighthouses, is composed of silicic acid 72·1 parts: soda, 12·2 parts: lime, 15·7 parts; alumina and oxide of iron, traces. Birmingham glass is made of French sand 5 cwts.: carbonate of soda, 1 cwt., 3 quarters, 7 lbs.: lime 2 quarters, 7 lbs.: nitrate of soda, 1 quarter: arsenious acid, 3 lbs. The best qualities of this glass are at present produced in the Siemens furnace.

The following are good colored glazings for potter's use; White. Massicot 4 parts: tin ashes 2 parts: fragments of crystal glass 3 parts: sea salt ⅛ part. Melt in earthenware vessels, when the liquid flux may be used. Yellow: Equal parts of massicot, red lead, and sulphuret of antimony. Calcine the mixture and reduce it again to powder; add then pure sand 2 parts and salt ½ part. Melt the whole. Green: Sand, 2 parts: massicot, 3 parts: salt 1 part, and copper scales according to the shade to be produced. The mixture is melted as directed above. Violet: Massicot 1 part; sand, 3 parts: smalt 1 part: black oxide of manganese ⅛ part. Blue: white sand and massicot, equal parts: blue smalt ⅛ part. Black: Black oxide of manganese, 2 parts: smalt 1 part: burned quartz 1½ parts: massicot 2½ parts. Brown: Fragments of green bottle glass, 1 part: manganese 1 part: lead glass 2 parts.

It has been observed that old charcoal burns more energetically than recent, because the former has absorbed oxygen from the air, a circumstance which has been practically utilized with advantage in refining crude iron.

New linen may be embroidered more easily by rubbing it over with fine white soap. It prevents the threads from cracking.

The Southern States Agricultural and Industrial Exposition.

The attention of the reader is directed to the announcement of the Southern States Agricultural and Industrial Exposition, which appears on our advertising pages. This fair opens in New Orleans on February 26, 1876, and continues for ten days. Competition for very attractive premiums is asked from all parts of the United States, Mexico, and Central America, and special prizes are to be awarded for strictly southern products.

The industries of the south are now rapidly advancing, and that section of the country now offers a valuable field for the sale of improved machines and inventions of every description. To manufacturers of agricultural implements, cotton presses, machinery and apparatus for making cotton seed oil, and improved devices for tobacco and sugar culture and preparation, we have no doubt but that the above exposition will prove very profitable. The same may be said as regards builders of steam engines, and particularly small motors, portable and otherwise, for plantation and factory use. It will be observed that the display is to take place during a period when no similar exhibitions are in progress, and between the closing of the fall fairs and the opening of the Centennial, so that those who have contributed to the former, and who intend exhibiting at the latter, might easily send their articles to New Orleans during the intervening time.

Poisoning by Arsenical Wall Paper.

Cases of arsenical poisoning occasioned by living in rooms, the walls of which are covered with paper colored green by arsenite of copper, have frequently been recorded. Lately, a case of arsenical poisoning has come under my notice," writes Professor Cameron, "caused by inhaling the dust from paper not colored green. The family of a gentleman, Mr. Jones, residing at New Ross, suffered so severely from symptoms usually produced by arsenic that he was induced to get the wall paper of his house examined. Out of seven kinds of paper six were found to contain arsenic. No. 1, an olive green paper, with deep green flowers and gold-like lines, contained an immense amount of arsenic in the two green colors and the gold. No. 2, a faint lavender watered paper, contained arsenic in large amount. No. 3, a white paper with gray flowers, contained a very large amount of arsenic. No. 4, a paper with red and green flowers on a gray ground, was highly arsenical. No. 5, a dark olive-colored paper, with gilding, did not contain much arsenic. No. 6, a pale green and white paper, also contained only a small amount of arsenic, much less than was put on the lavender paper. Mr. Jones's family had not suffered from the symptoms of arsenical poisoning until shortly after the house was papered with the above, and the symptoms disappeared shortly after they left the house preparatory to the removal of the paper."—*Medical Press and Circular.*

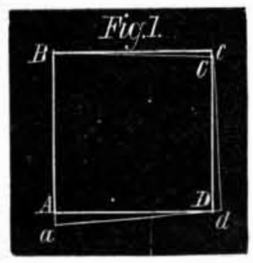
LAYING OFF A SQUARE.

In a letter recently received, a correspondent asks an explanation of the following difficulty:

He wants to get out a square board, 6 inches on a side. He first dresses one edge of the stuff true; and having proved his try square, he applies it to this edge, lays off one corner, and works it to the line; then he makes the new edge 6 inches long, applies his try square, and lays off a second right angle, and so proceeds. When he reaches the starting point, he finds that the last angle is not a right angle, and he wishes to be told the reason of this.

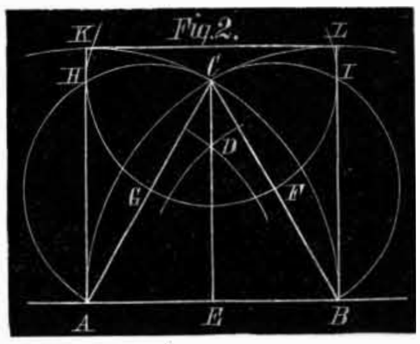
Many a young mechanic, on his promotion to the vise bench, is confronted with this difficulty, on trying to square up a nut with the aid of a try square; but not many, it is probable, know the reason, so perhaps a few remarks on the subject may not be out of place.

It must be evident to any one that, if the first three corners of a piece of stuff are square with absolute precision, the last corner must necessarily be square also, but it may not be so obvious that a slight error in each of the first three corners will be greatly magnified in the fourth. This can be made plain, however, by a little study of Fig. 1.



Suppose the workman starts on a straight edge, A B, and applies his square at B, laying off what he thinks to be a right angle; but partly from the error in the line, and partly from want of accuracy in working to the line, he actually makes the angle at the corner, B, A B *c*, which exceeds a right angle by the angle, *c* B C. Proceeding to the corner, *c*, he works out a second angle, B *c* which is as much in excess of a right angle as the first, but about twice as much in excess of the true angle of the corner, B C D. At the third corner, the angle, *c d a*, is worked out, only exceeding a right angle by the angle C *b c*, as in the first case, but having about three times this excess over the true angle of the third corner, C D A. This shows where the difficulty lies: the three corners, B, *c*, *d*, are each only a little out of square but the corner, *a*, has three times the error, and any error, however small, if multiplied considerably, becomes very noticeable. In the figure the error is purposely made quite large for the sake of clearly illustrating the point; but even in this aggravated case, the errors in the corners, B, *c*, *d*, seem trifling in comparison with that of the corner, *a*.

Having shown the error that is likely to arise from the use of the try square for cases of this kind, it is perhaps only fair to point out a more excellent way. Since the trouble is caused by the multiplication of errors from corner to corner, and since experience shows that work of absolute precision is rarely accomplished with ordinary tools, it will be better to divide the errors equally among all the corners, if possible, in laying out the square. One method of accomplishing this is shown in Fig 2. It needs for its execution



a straight edge, a pair of dividers with well sharpened points, and a fine scriber. Having worked one edge true or drawn a straight line, lay off on it a distance, A B, equal to one side of the proposed square. With A and B as centers, and with A B as a radius, describe two arcs, intersecting at the point, C. With the same points, A and B, as centers and with a radius less than A B, describe two arcs, intersecting at the point, D. Draw a straight line through the points, C and D, cutting the line, A B, at the point, E. E is the center point of the line, A B. Join the points, A and C, by the straight line, A C, and the points, B and C, by the straight line, B C. With C as a center, and with a radius equal to A E or E B, describe an arc, cutting the lines, A C and B C, in the points, G and F, respectively. With F as a center, and A E or E B as a radius, draw an arc, cutting the former circle in the point, I; and with G as a center, and the same radius, describe an arc, cutting this circle in the point, H. Draw a straight line through the points, B and I, cutting the arc drawn from B, in the point, L; draw also a straight line through the points, A and H, cutting the arc drawn from A, in the point K. Join the points, K and L, by a straight line, and the square will be complete; and any errors of construction will probably be evenly divided among the four corners, if care is used in drawing the lines. It is possible, also, to check the accuracy of the construction at different stages. Thus, the straight line drawn through the points, C and D, should bisect the line, A B, and this can readily be tested with the dividers. Also the circle drawn with C, as a center, and with a radius, A E or E B, should cut the lines, A C and B C, at their middle points.

Specific Heat.

Suppose we take two vessels, the one containing 1 lb. of water and the other 10 lbs. of water, and expose them to such a source of heat that equal amounts of heat will enter each vessel at equal intervals of time, we shall find that, when the temperature of the 1 lb. of water has risen to 10°, that of the 10 lb. will have risen only 1°. Now as ten units of heat have entered each vessel, it follows that it requires ten times as much heat to raise 10 lbs. of water 1°, as it does to raise 1 lb. of water the same amount; and as similar results are obtained with other substances, we may conclude that the amount of heat, required to raise different weights of the same substance 1°, must be proportional to these weights. Now suppose we take four vessels, containing respectively 1 lb. of water, 1 lb. of mercury, 1 lb. of silver, and 1 lb. of iron, and, as before, expose them to such a source of heat that each substance in the same intervals of time will receive the same amount of heat. Having placed a thermometer in each vessel, upon observation we shall find that, when the water has risen 1°, or, in other words, when it has received one unit of heat, the other substances will indicate a much higher temperature, as shown in the following table. We there find that one unit of heat will raise a pound of mercury 30°; consequently, it will only require $\frac{1}{30}$ or 0·033 of a unit to raise it 1°. In this manner, by taking water as unity, we can determine the fractional part of this unit required to raise equal weights of any other substances 1°. This fractional part, which is shown in the third column, is called the specific heat of the substance.

Name of Substance.	Temperature, with Application of one Unit of Heat.	Specific Heat.
Water............	1·0°	$1{\cdot}000=\frac{1}{1}$
Iron..............	8·8°	$0{\cdot}114=\frac{1}{8{\cdot}8}$
Silver............	17·5°	$0{\cdot}057=\frac{1}{17{\cdot}5}$
Mercury.........	30·0°	$0{\cdot}033=\frac{1}{30}$

From the above table we also learn that, at the same temperature, water contains 8·8 times as much heat as the same weight of iron; 17·5 times as much as the same weight of silver; or 30 times as much as the same weight of mercury. If we were to examine a more extended table of specific heats, we should find that water, at the same temperature and at equal weights, contains more heat than any other known substance; and for this reason, the specific heat of different substances is always expressed by the fraction obtained by comparing the amount of heat required to raise 1 lb. of the substance 1° to that required to raise 1 lb. of water 1°.—*Engineering.*

Long Rails.

During the recent celebration at Darlington of the fiftieth anniversary of the opening of the first passenger railway, the Britannia Iron Works Company, at their works at the neighboring town of Middlesborough, rolled for the inspection of visitors some rails of unprecedented length, and it is proposed to place one of them, 130 feet long, near the first locomotive engine, opposite the Darlington station, as a memorial of the jubilee. During the same week this company rolled in one mill, 1,350 tuns of rails 40 lbs. per yard, a quantity which it is believed has never been even approached in any other mill in the same space of time. The rails were for the New Zealand Government Railways.

Substitute for the Liquid Prism.

A new method of determining rapidly the index of refraction of liquids is given by MM. Terquem and Tannin in a recent number of the *Journal de Physique*. It is based on the fact that when a sheet of air, enclosed between two plates of glass, is placed in a liquid, parallel luminous rays striking this sheet obliquely are totally reflected at the limited angle of the liquid with reference to the air. It is sufficient then measure this angle, and one has all the necessary data for calculation of the index. The authors describe two different arrangements of the apparatus, and compare some of their results obtained by it with those of Fraunhofer and of Messrs. Dale and Gladstone, showing close correspondence. The method is quicker than that of the liquid prism; the cleaning of the small vessel is very easy; one has not to be preoccupied with the angle of a prism and the exact verticality of its surfaces; and lastly, the temperature of the liquid is more easily determined.

WE understand that Mr. Hughes, of Cincinnati, O., formerly of the firm of Hughes & Foster, is now making for use of the Defence Association a model of a planing machine with yielding pressure bars, such as were used in 1843, three years before the Woodbury Company date their claim to the invention.