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THE MAXIM MACHINE GUN.

The mitrailleuse, or machine gun, as hitherto constructed, is a weapon in which all the functions of loading, cocking, firing, and extracting the empty shell from the gun are performed by turning a crank or by working a lever. The first successful gun of this kind was the invention of Dr. Gatling, an American. This gun was brought out during the war of the rebellion, and before metallic cartridges, which are so essential to the success of a machine gun, had reached their present degree of perfection.

Dr. Gatling did not succeed in getting his gun used to any extent in the war of 1860-64. The first machine gun which ever saw service in the field was the French mitrailleuse. This gun was large, absurd, and clumsy, and so heavy that it required to be drawn by horses; it would fire but 150 shots per minute. It did not comprise the necessary elements of success, and consequently failed.

The next machine guns to make their appearance were the Hotchkiss, the Lowell, the Nordenfelt, and the Gardner. All of these, except the Nordenfelt, were operated by a hand crank, the Nordenfelt alone being actuated by a reciprocating lever. All of these guns must necessarily be mounted upon a firm base, and be trained and elevated by screws and worm gears. If they were made to work freely upon a pivot or universal joint, they would not be firm enough to remain stationary while the crank or handle was being operated. The safe speed at which a machine gun can be fired depends in a great measure upon the kind and age of cartridges used. For instance, if cartridges have been made for some time, a trifling amount of moisture may have accumulated in the powder near the primer. When this dampness occurs, the cartridges are said to hang fire, that is, they do not explode at the instant of being struck. Suppose that one cartridge in a thousand should hang fire; it would be necessary to operate the gun sufficiently slowly on the entire series to give this slow cartridge time to explode, otherwise it might be drawn from the barrel before it exploded, or in the act of exploding, in either of which cases it would disable the gun. To this may be attributed a great deal of the trouble in operating machine guns, and their liability to get out of order when most needed. In the gun of which we publish illustrations herewith and which is the invention of Mr. Hiram S. Maxim, of Hatton Garden, London, slow cartridges do not offer an obstacle to the rapid firing of those which will explode quickly, from the fact that no cartridge can be drawn from the gun until it has exploded, as it requires the force of its own explosion to unlock the block from the barrel and extract the empty shell. In Mr. Maxim's new gun there is but one barrel, and all the functions of loading, cocking, firing, withdrawing the empty shell from the barrel, and ejecting it, are performed by the recoil resulting from the explosion. This gun may be likened to a small engine, the barrel under the influence of the recoil acting as the piston, the block as the crosshead, and the sear and trigger as the valve gear. The cartridges to the number of 333 are placed side by side in a canvas belt, secured together with brass eyelets and strips. One end of this belt is connected to the arm, and the gun is operated by hand until the first cartridge is driven into the barrel. Then the trigger is pulled, this cartridge explodes, the breech bolt is unlocked from the barrel, the empty case is extracted, moved to one side, a loaded cartridge is brought in front of the barrel, the arm is cocked, the cartridge pushed home, and the trigger pulled, when the explosion of the second cartridge operates the same as the first. Thus the firing may be kept up automatically without any action on the part of the attendant as long as there are any cartridges in the belt. Our engravings represent respectively a side view and a front view of the gun and its stand, a longitudinal section of the barrel and the mechanism, and a detail of the firing device. The weapon is mounted upon a tripod stand (Figs. 1 and 2), and between it and the top of the stand there is placed a magazine, which is protected from the enemy's fire by a pair of light shields. The gun can be rotated about the vertical axis by means of a handle (Fig. 1) which turns a tangent screw; or if the three-armed nut at the bottom of the axis be slackened, the barrel can be moved by hand to spread the fire over a considerable area. If a definite piece of ground is to be subject to the fire, such as a bridge, a pass, or a ford, the gun can be sighted in succession to each end of the space and its motion beyond those limits prevented by adjustable nuts on the screw spindle. The elevation of the barrel is altered by turning the hand wheel on the strut, stretching from the stand to the rear of the gun. By slackening a clip on this strut the screw is thrown free, and the weapon can be elevated and depressed.

We will now consider the mechanism by which the loading and firing is effected. The barrel, B, which is inclosed in a water jacket (Fig. 5), is capable of a longitudinal motion of about seven-sixteenths of an inch upon the explosion of a cartridge, and moves back, pushing before it the breech bolt, the sear, and the rest of the moving parts. Its motion is in the first instance opposed by two springs, which are forced outward by the toggle arms. As soon as the arms have passed the center, the springs begin to close again, and aid the motion of the barrel. At first, as we have already said, the barrel and the block or breech piece, A, travel back at the same speed, but for the spent shell to be extracted and the new cartridge to take its place, the block, A, must leave the barrel a considerable distance for the other mechanism to come into play.

The two are at first fixed together by the locking latch, C, which is held down by the stop, N. A slight

Continued on p. 398.

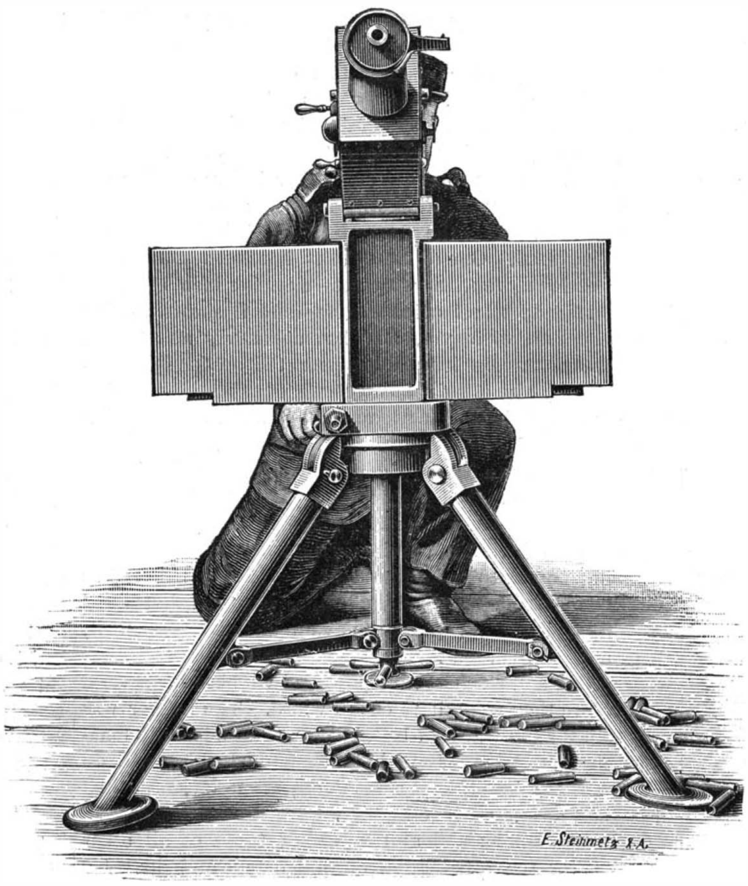

Fig. 2.

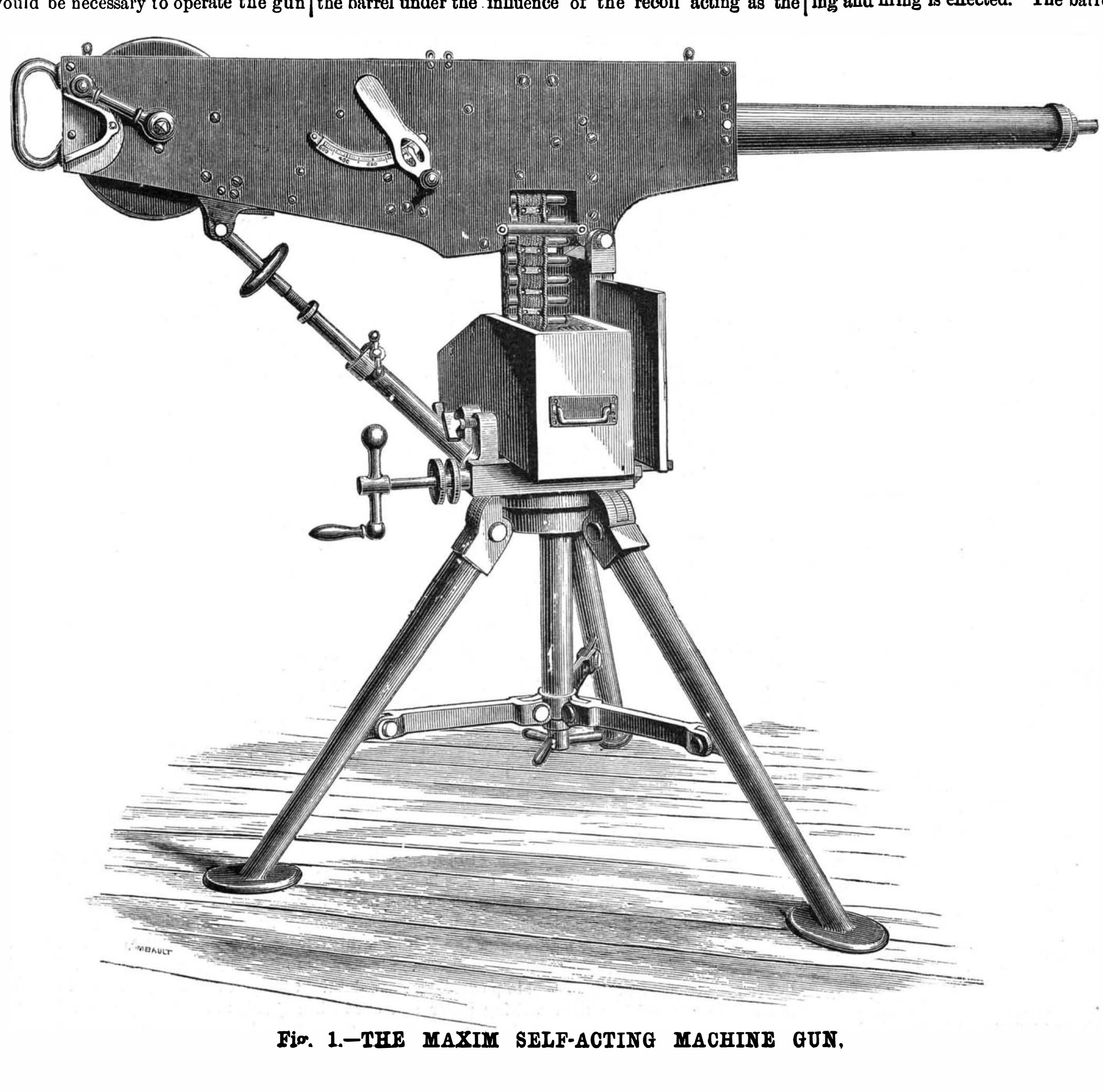

Fig. 1.—THE MAXIM SELF-ACTING MACHINE GUN.

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Contents.

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TABLE OF CONTENTS OF

THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 467,

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BELT MATERIAL.

The first idea of a belt for machine purposes is a leather band, but other materials have been used for many years; the writer remembers seeing a six inch or an eight inch belt that had run for more than a year in a wood working establishment, which was made of cotton cloth—sail duck. The belt connected two pulleys of three feet and two feet diameter respectively, the shafts of which were on the same level. To compensate for the shortening and lengthening of the belt by the changes in humidity of the atmosphere, a pivoted idler was used. This change of length appeared to be the only serious drawback to the employment of cotton as belt material; for the adhesion of the material to the face of the pulley was excellent.

Rubber belting is simply cloth and rubber united by being pressed between heavy rollers; its strength depends on the fibrous portion—the cloth. There has recently been another cloth belt put upon the market, that depends for its adhesiveness to the pulley face on cotton. This a woven belt, the woof or warp of which is of a series of continuous steel wires, the filling being coarse cotton yarn or twine. No preparation is given the cotton, either before or after the weaving, and the "shed" in weaving is so arranged that the steel wires, on which the strength of the belt depends, are entirely covered. One of these belts has been noticed by the writer for more than two years—a twelve inch belt leading from the fly wheel of an engine—and it shows no sign of destructive wear yet, and has absolutely no stretch. From these examples it would appear that under some circumstances (those of a dry atmosphere, equable temperature, and an unshipable belt), cotton might prove to be an excellent substitute for leather for belting purposes.

There appears to be only one sort of leather that is properly applicable to belt making—that from the skin of the ox or *Bos* tribe. During a residence of several years in one of the British American provinces, the writer was compelled by circumstances to make his own belts, of such material as could be obtained. Moose hide leather was tried, but it had a quality of indefinite stretch; to obtain a six inch wide belt, strips not less than ten inches wide were required, and these were wetted and stretched by powerful winches for several days before they were fit to cut to width. The leather was very thin for the width of belt, but it was wonderfully tenacious and adhesive. Raw hide (untanned skin) will do fairly well as a belt if kept soft by oil, but it lacks the hug of leather, and has little elasticity.

Ox leather belts stand at the head of those of all other materials for the satisfaction of all demands on belts. No other belts will stand the wear of the shipper; cotton belts are weakened when wet; rubber belts are rotted when oiled, but leather will stand wet and dryness, cold and heat, and lasts a long time even when oil saturated.

GOLD LEAF.

If a sheet of gold leaf is held up against the light, it appears to be of a vivid dark green color; this means that the light is transmitted through the leaf. When it is considered that this leaf is a piece of solid metal, a better idea of the extreme tenuity of thickness of the leaf can be comprehended than by any comparison by figures; nothing made by the hand of man equals it in thinness. This extreme thinness is produced by patient hammering, the hammers weighing from seven to twenty pounds, the lighter hammers being first used. When the true method of this beating is understood, the wonder expressed sometimes that gold leaf beating should not be relegated to machinery ceases; the art belongs to the highest department of human skill and judgment. Apprentices have served a term, and have been compelled to abandon the business, because they never could acquire the requisite skill and judgment combined necessary to become successful workmen.

The only pure gold leaf is that used by dentists for filling carious teeth, and it is called foil. It is left much thicker than the gold leaf for gilding—indeed, it could not be beaten so thin; for thin or leaf gold an alloy of silver and copper is required to impart the requisite tenacity. Dentist's foil weighs six grains, five, four, and three grains per sheet, or leaf, according to its thickness. The last operation on the leaf is annealing. This is done over a charcoal fire, the leaf being laid singly in a sort of corn popper—a square receptacle with wire bottom at the end of a handle—over which is held a similar cover to prevent the flame from carrying the leaf away. An instant's exposure to the flame induces a red heat, when the leaf is laid on a sheet of a book.

The material for gold leaf and dentist's foil is coin gold. The gold is precipitated by muriatic and nitric acids over a fire to separate the gold and silver, the copper of the alloy passing off in the heat. The silver from gold coin amounts to about seven pennyweights to $800 worth of coin—the amount usually treated at a time. This reduction and separation of the metals is the usual method, and does not require special description.

The pure gold is then melted in sand crucibles with the proper proportions of silver and copper to produce the color of leaf desired, very fine ornamental effects being produced in gilding with leaf of differing shades. The fluid metal is poured into iron moulds, making bars seven inches long, one and an eighth inches wide, and one-fourth of an inch thick. These bars are forged, like iron, between anvil and hammer, to even the edges, and then rolled in powerfully geared rolls to a ribbon not thicker than writing paper and one inch wide. Of course, in the rolling as in all the processes, there must be occasional annealings.

Now comes the first of the beating processes. These squares of gold (one inch square) are placed in a pile alternating with larger squares (four inches or more) of "kutch" paper, a material made from a pulp of animal membrane—raw hide, intestines, etc.—and the outside of the pile receives a square of parchment. The hammering then begins with a seven pound hammer on a block of marble that rests on a solid foundation. After one hour's beating the pile is warmed at a fire to anneal the gold, a process requiring care, so that the kutch paper be not burned. Four hours of beating suffices for this preliminary process, 180 squares of gold being treated in one pile. The final process requires great skill. The partially beaten squares are packed as before, but with alternates of gold beater's skin, until the pile contains 900 sheets. The beating is continued with increasingly heavier hammers until the final finish with the twenty pound hammer. The gold beater's skin comes from England, and the best of it—and the most of it—is made by one family—Frederick Perkins. The skin is so thin as to be almost transparent, and yet it is double, two thicknesses. It is prepared from the larger intestine of the ox. Each sheet of the skin is rubbed on each side, before the pack is made and whenever the pack is rearranged (placing the outer gold in the center and *vice versa*), with a powder made from calcined gypsum of a very pure sort, imported from Germany. This is to prevent the gold from sticking to the skin.

In beating, the work of spreading the gold is from the center of each square of gold out toward the edges, and the finished squares are thicker at the edges than in the center. A contrary spreading would split the edges and ruin the squares. In rearranging the squares in the process of beating they are sometimes torn, but another piece laid on as a patch, lapping over the torn place, will be firmly welded in the after beating.

The finished squares are cut to a size of three and three-eighths inches, and packed in a "book" holding twenty-five sheets, the paper leaves being rubbed with red ocher to prevent sticking. These books of twenty-five sheets are sold at from thirty to forty cents each. The cutting of the leaf is done by knives, which are simply slips of the outer shiny shell or skin of the Malacca cane such as is used for walking sticks. The outer rind contains silex or flint in minute, invisible particles, forming a peculiar edge. Steel will not answer the purpose.

CRIMINAL IGNORANCE.

The October number of *The Locomotive* has an editorial article on the foolish carelessness of engineers of stationary engines that ought to be generally read, because it tells the truth where subterfuge and pretense has sometimes blinded judgment. Engineers are not, as a class, pretenders and cheats; but there are many who pretend to know their business who are simply and only swindlers; who do not know the manual of their business even, and never thought of knowing its chemical and mechanical reality.

The Locomotive says:

The carelessness sometimes displayed by engineers (?) who have charge of boilers is simply criminal, and deserves the severest penalties. A recent occurrence will illustrate this. Visiting an establishment where we had boilers insured, our attention was attracted by the suspicious actions of the engineer. Watching for what he supposed was a favorable opportunity, he climbed up on top of the boilers and headed toward the safety valve, always keeping as nearly between it and us as he could, but not, however, succeeding in always keeping from view. Reaching the valve he busied himself a few moments about it, and then returned with a nonchalant air to where we were. The following conversation then occurred:

Inspector: "Tired of living, are you?"
Engineer: "No; what do you mean?"
Inspector: "I thought perhaps you were."
Engineer: "What makes you think so?"
Inspector: "Why, from the use you make of that wedge you now have in your overalls pocket. I see that you had the safety valve fastened down with it. Now, if you want to die, why don't you go out and jump into the river, and drown yourself; then nobody's life but your own would be endangered?"
Engineer: "Those boilers are all right. I don't believe a boiler can blow up so long as there is plenty of water in it. I have been running boilers twenty years." And so on to the end of the chapter.

This fellow had actually made an iron wedge, and driven it into the forked guide above the lever, so that it was impossible for the valve to lift, in order to "bottle up the steam," as he expressed it. And this in spite of the fact that the pressure was all that could be safely allowed; and he had also moved the weight out on the lever fifteen pounds beyond the limit allowed. This is an actual occurrence.

PULLEYS AND GEARS.

In American practice, pulleys have led gears for more than thirty years. There was a time when no large establishment driven by power could be arranged to run except by gearing; all the main shafting was geared to the prime mover, and if that was a steam engine a jack wheel instead of a belt imparted motion from the fly wheel or crank shaft. The writer remembers a set of cards in a cotton mill; the cylinders, licker-ins, doffers, and even the doffer combs, were all connected by gear wheels. Years after the grinding, wearing, noisy main gears were superseded here by the smoothly running pulleys and belts, the English adhered to the toothed wheel system. It had its value; it has its advantages, and the gear wheel is taking its place as a valuable adjunct to machinery of all kinds. One of these advantages is its absolute security; "give a tooth take a tooth" is an old adage in mechanics, and is an absolute law in gearing; there is no slipping and no failure of transmission of power.

But there were objections to the gear, and although some have been removed, others remain. One of the great objections to the gear, as it was formerly made, was its tendency to crowd apart—the two gears working against each other rather than with one another. But with the recent improvements in gear teeth cutting that objection is entirely removed; gears properly cut run together with no inclination whatever to come apart, except with a speed that develops centrifugal force. Some recent experiments seem to prove that the forcing apart tendency of well cut gears is reduced to *nil;* while on the other hand the connection of pulleys by belts necessitates a very strong pulling together, proportioned to the diameter of pulleys, width of belts, distances apart of the pulleys, and their relative positions.

Another objection to the use of gears is where the reach is considerable between the shafts; in which case the only connection feasible is by means of one or two intermediates, as the direction of revolution may demand. If the two connected shafts are to revolve in the same direction, a single intermediate may be used; but it is evident that the diameter of this wheel must be sufficient to reach between the peripheries of the two other wheels, else three intermediates must be employed. Sometimes these transmitters—or otherwise idlers—are unhandy, and then the advantage of pulleys and belts is apparent. The belt and pulley have a reach that is impossible without a train of gearing or a belt connection of links of machine chain. Except for this lack of reach it is evident that the gear connection is superior in itself to the pulleys and belt, which at its best must be considered a makeshift for an absolute transmitter.

A BASIC METAL.

The title of "the iron age," which has been applied by some writers to the present period, seems to demand some modification or addition; copper has become fashionable in our houses, in our public buildings, and in our monuments. It appears pure, or in alloys forming bronzes and brasses of a variety of color and a number of degrees of tenacity, obduracy, and durability. This is a revival of the fashions of several generations ago. It is a good one, however, for there is a limit to the tractability of iron and steel, and the eye tires of non-colored metal as it would of neutral tinted clothing.

The capacity of copper for combining with others forming different alloys is not possessed so fully by any other metal; with zinc the brasses that may be made vary from the deep red of the copper itself to the gray white of the zinc, and in tenacity from that of the toughest, purest copper to the hard brittleness of spelter. In combination with tin its products are still more varied in color and perfect in beauty.

Not one of the alloys of copper is subject to destructive oxidation when exposed to air, water, or steam; but by weather exposure the beauty of the bronzes is enhanced and their durability insured. There is more brass used in the machine shop than formerly; the work of the machinist of today is not limited to iron and steel; he must know the qualities of the "composition" he is working and how to work it well. Brass finishing can hardly be called a distinct trade nowadays. Recently there was noticed in a large machine manufacturing establishment one of its products that consisted of three-fourths by weight of copper and its compounds and only one-fourth of iron and steel. The work was of such a character as required the skill and tools of the machinist and the conveniences of the machine shop. Said the superintendent, a machinist of more than thirty years' experience:

"I can tackle any job now. Time was when I would have sent copper and brass work to the coppersmith and the brass finisher, but we must do these mixed jobs if we would do any work. So I compelled myself to learn the working of these metals, and then I taught my men. A machinist who can't work copper, bronze, and brass is not a competent workman."

The value of copper compositions in machinery is very great; a casting of bronze or of brass is wholly unlike one of iron in its tenacity, and it may combine this sometimes necessary quality with a hardness (durability under wear) that no iron casting can possess. These combined qualities cannot be imitated by any other metal. The writer once successfully proved this advantage. A small pinion made first of cast iron, then of cast steel, and lastly of forged Lowmoor iron, broke, or stretched beyond usefulness, when one of tough bronze was tested with satisfactory results.

To Foretell Weather.

Weather wise prognosticators seem to be on the increase. In last week's issue we quoted from a Cincinnati observer his method of foretelling the changes in the weather, from watching the habits of animals; and there now comes from the South a weather prophet who adds a long list of the signs which he has observed to precede changes in the weather.

Few intelligent persons, says the *Southern Planter,* can have any sympathy with the so-called prophets who oracularly announce phenomena, giving dates, occasionally making lucky hits, but as often firing their random shots altogether wide of the mark. That there is, however, something in weather philosophy, intelligent persons will be quite ready to concede, and they will be in accord with the view of the writer when he recommends the observation of natural phenomena, which has been long practiced. He says:

If one could read the signs, each day foretells the next; to-day is the progenitor of to-morrow. When the atmosphere is telescopic, and distant objects stand out unusually clear and distinct, a storm is near. We are on the crest of the wave, and the depression follows quick. It sometimes happens that clouds are not so indicative of a storm as their total absence. In this state of the atmosphere the stars are unusually numerous and bright at night, which is also a bad omen. It appears that the transparency of the air is prodigiously increased when a certain quantity of water is uniformly diffused through it. Mountaineers predict a change of weather when, the air being calm, the Alps covered with perpetual snow seem on a sudden to be near the observer, and their outlines are marked with great distinctness on the azure sky. This same condition of the atmosphere renders distant sounds more audible.

There is one redness of the east in the morning that means storm; another that indicates wind. The first is broad, deep, and angry; the clouds look like an immense bed of burning coals; the second is soft and more vapory. At the point where the sun is going to rise, and a few minutes in advance of his coming, there rises straight upward a rosy column, like a shaft of dyed vapor, blending with and yet partly separated from the clouds, and the base of which presently comes to glow like the sun himself. The day that follows is pretty sure to be windy.

It is uncertain to what extent birds and animals can foretell the weather. When swallows are seen hawking very high, it is a good indication, because the insects upon which they feed venture up there only in the most auspicious weather.

People live in the country all their lives without making one accurate observation about nature. The good observer of nature holds his eye long and firmly to the point, and finally gets the facts, not only because he has patience, but because his eye is sharp and his inference swift. There are many assertions, the result of hasty and incomplete observation, such as, for instance, that the way the Milky Way points at night indicates the direction of the wind the next day; also, that every new moon indicates either a dry or a wet month. There are many other stories about the moon too numerous to mention. Again, when a farmer kills his hogs in the fall, if the pork be very hard and solid he predicts a severe winter; if soft and loose, the opposite; overlooking the fact that the kind of food and the temperature of the fall make the pork hard or soft. Numerous other instances could be cited to prove that the would-be shrewd farmer does not interpret nature in the right way, and that his conclusions, being hasty and incomplete, are wrong; and until he studies nature understandingly, using a little common sense, so long will be be more or less under the ban of superstition and ignorance.

The Bell Telephone Patents Sustained.

The great telephone suit has been decided by Judge Wallace in favor of the Bell Telephone Company. The People's Company will, it is said, take an appeal to the United States Supreme Court, but they are in the mean time enjoined from putting up and operating any telephones under the Drawbaugh inventions. The suit of which the present opinion is the result was commenced in 1880, and the principal points relating thereto have already been referred to in these columns. Judge Wallace in his opinion says:

"The issues made by the pleadings are practically resolved into the single question—to which the proofs and arguments of counsel are mainly addressed—whether the patentee, Bell, or Daniel Drawbaugh, of Milltown, in Cumberland County, Pennsylvania, was the first inventor of the electric speaking telephone."

The theory of the defendants, according to the opinion of Judge Wallace, is that some of Drawbaugh's instruments were made in 1867, and others at various times before 1874.

"It is in proof that thirty-three patents were granted for improvements in telephones in 1878, sixty-four in 1879, more than one hundred in 1880, and ninety-four in the first six months of 1881. According to the theory of the defendants, therefore, as early as February, 1875, Drawbaugh had not only distanced Bell in the race of invention, but also Gray and Edison, and had accomplished practically all that has since been done by a host of other inventors."

The testimony on both sides is reviewed at length, and the Judge concludes:

"Succinctly stated most favorably for the defendants, the case is this: One hundred witnesses, more or less, testified that one or more occasions, which took place from five to ten years before, they think they saw this or that device used as a talking machine. They are ignorant of the principles and of the mechanical construction of the instruments. But they heard speech through them perfectly well, and through one set of instruments as well as the other. This case is met on the part of the complainants by proof that the instruments which most of the witnesses think they saw and heard through were incapable of being heard through in the manner described by them; and further, that the man who knew all about the capacity of his instruments never attempted to use them in a manner which would demonstrate their efficiency and commercial value, but on the contrary, for ten years after he could have patented them, and for five years after they were mechanically perfect, knowing all the time that a fortune awaited the patentee, and with no obstacles in his way, did not move, but calmly saw another obtain a patent and reap the fame and profit of the invention. Without regard to other features of the case, it is sufficient to say that the defense is not established so as to remove a fair doubt of its truth; and such doubt is fatal. . . . A decree is ordered for complainant."

Congress and the Patent Office.

The Hon. Benjamin Butterworth, Commissioner of Patents, labored earnestly during the last session of Congress to obtain from that body the relief which the Patent Office so sorely needs, in the way of increased appropriations for the employment of additional examining and clerical force, and urging the necessity for enlarged departments for the transaction of the steadily growing business of the office. Mr. Butterworth is now himself a member-elect of the next Congress. This body, however, does not meet, except it be called together in extra session, until December, 1885, and unless the present Congress takes some favorable action before its dissolution in March next, the Patent Office will continue to go on in its present crippled condition for a year, and perhaps a year and a half, to come. Mr. Butterworth succeeded last spring in getting a slight increase on the former appropriation, but his present position is such as to give added force to any effort he may now make in behalf of the inventors of the country to obtain from the Government what has only thus far been withheld by the grossest injustice.

In the mean time we trust that inventors themselves will not be entirely idle. There are enough of them in each Congressional district who have been greatly annoyed or injured by former delays in the Patent Office to exercise a potent influence on the action of their representatives. Let all such inventors, as well as those who are expecting in future to have business relations with the Patent Office, write direct to their representatives, urging prompt action on this hitherto greatly neglected matter. The present session is a short one, lasting only till March, but the appropriations now made must govern the business of the office for the year commencing next July. It is evident, therefore, that there is no time to lose, and interested parties should strongly urge that this appropriation should be one of the first considered, and not to be left to the hurry and accidents of the closing days of the session.

Madagascar.

Madagascar consists of a central plateau or highland rising from 4,000 feet to 5,000 feet above the lowlands of the coast, and from this plateau rise occasional volcanic cones, the highest, Ankaratra, being 8,950 feet above the sea. These volcanoes extend from the northern extremity of the island to the 20th parallel of south latitude. South of this appear granitic rocks, at least as far as 22° south latitude. At higher latitudes than this the rocks of the interior are practically unknown to Europeans. According to a recent paper by Mr. F. W. Rudler, F.G.S., several crater lakes and mineral springs abound; and to the north of the volcanic district of Ankaratra there is a tract of country containing silver, lead, zinc, and copper ores. As regards building stones, besides the granite which is so general, there are vast beds of sandstone and slate between the district of Ankaratra and the fossil regions in the southwest of the central plateau. These fossils, according to M. Grandidier, the recent French traveler in the interior, are referable to the Jurassic system, and comprise remains of hippopotami, gigantic tortoises, and an extinct bird of the ostrich species. The coasts of the country are rich in timber, and it would also appear that the interior is a good mineral field.

More Time for American Inventors.

For the purpose of allowing American inventors every possible facility for participating in the London "Inventions" Exhibition the time during which applications will be received has again been extended, the limit being now fixed at Jan. 31. As the exhibition opens in May next, it is hardly to be expected that there will be any further postponement, so intending applicants for space should take this as a last notice. The Hon. Pierrepont Edwards, British Consul in New York city, who will furnish the necessary printed forms for applicants, reports that the number of applications thus far from this country have been quite large, and the interest shown by our people in respect to the exhibition is quite encouraging.

Mr. Edwards is untiring in his efforts to interest American inventors in the exhibition, and he is encouraged to believe that the display of their works will be most creditable to the nation.

The Slaughtering of Cattle.

The process of killing and dressing beef at the stock yards, says a contemporary, is not as expeditious and wonderful in character as is that of killing and dressing hogs. The features most noticeable are the two methods used in killing the animal at the start. One of these methods is through the use of the rifle, and the other the lance. In both the animals are driven singly from the yard into a narrow box stall open at the top. A dozen of these stalls are in a row, and over their tops are laid some loose planks on which the slayer walks with rifle or lance in hand. In the case of the rifle the executioner puts a ball into the animal's brain at short range, which kills instantly. Not a groan is heard, not a muscle moves. The animal falls like a lump of lead, and is at once dragged from the stall into the slaughter-house, where the throat is cut and the process of dressing is completed.

EXPERIMENTS ON SUPERHEATING AS A CAUSE OF BOILER EXPLOSION.

On the 9th of April, 1883, Commandant Treve laid before the Academy of Sciences a note upon the different means proper to prevent the explosion of steam generators, and, in the course of his paper, attributed a large number of explosions to a peculiar state of the water called *superheating.*

The Minister of Public Works having invited the Central Committee on Steam Engines to examine the processes proposed by Commandant Treve, a number of experiments were made by that body, and a report was drawn up, from which we extract the following:

Not finding in the industrial facts that have been observed up to the present any decisive proof in favor of M. Treve's theory, the sub-committee endeavored to enlighten itself through experiments, as follows:

First Series of Experiments.—The object that these had in view was a study of ebullition in ordinary glass vessels. It was desired to ascertain what importance the long preparation which physicists cause their vessels to undergo may have from the standpoint of superheating.

Balloons of good, clear glass and small dimensions were selected, and pure water and dilute aqueous solutions of various materials were boiled therein. The heat was obtained from a Bunsen burner, the flame of which was spread out by means of wire cloth. The temperature was given by a thermometer which dipped into the liquid. The ebullition of the pure water and of the saline and alkaline solutions gave rise to but a few insignificant movements, even when it was prolonged for some time.

Slightly acidulated water gave rise to very marked superheating, which, however, did not exceed more than two or three degrees. The ebullition was accompanied with violent movements of, the vessel. When vaporization was excited by one of the means indicated for superheated water, there was at times a violent ebullition accompanied with projections.

Second Series of Experiments.—These experiments were performed at the shops of the Orleans Railway, in France, upon the saw mill boiler, and the object of them was as follows:

It results from the experiments of physicists that superheating is in all cases favored by a stagnation of water during a more or less prolonged stoppage, having for effect the expulsion of the imprisoned air. Let but a slightly energetic action occur on the superheated liquid, and evaporation will take place and a large quantity of steam will be

(*Continued on page* 397.)

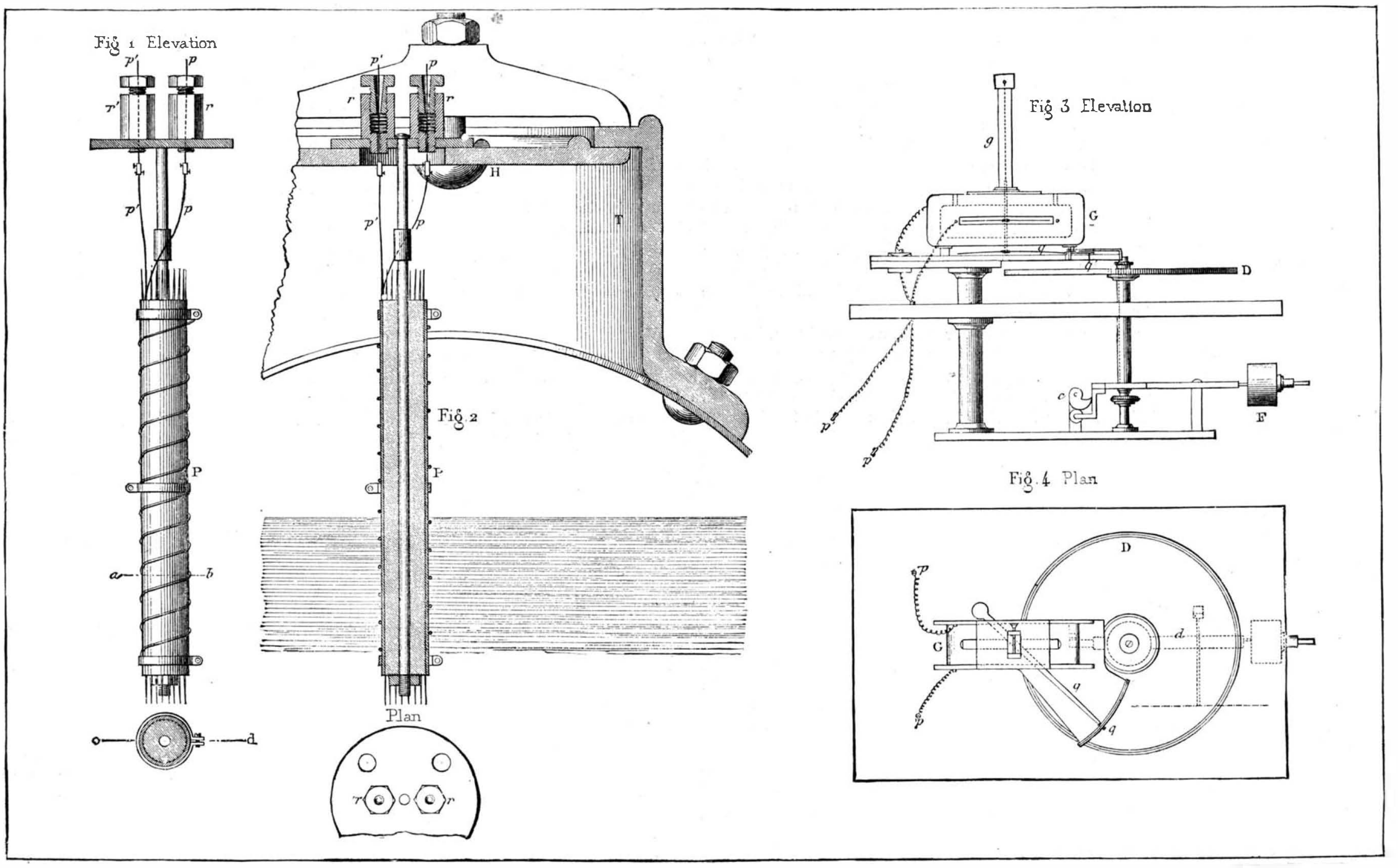


Fig 1.—Elevation. Fig. 2.—Section through *c d.* Fig. 3.—Elevation. Fig. 4.—Plan (Scale ¼).

Plate I.—EXPERIMENTS AT THE CONSERVATORY.

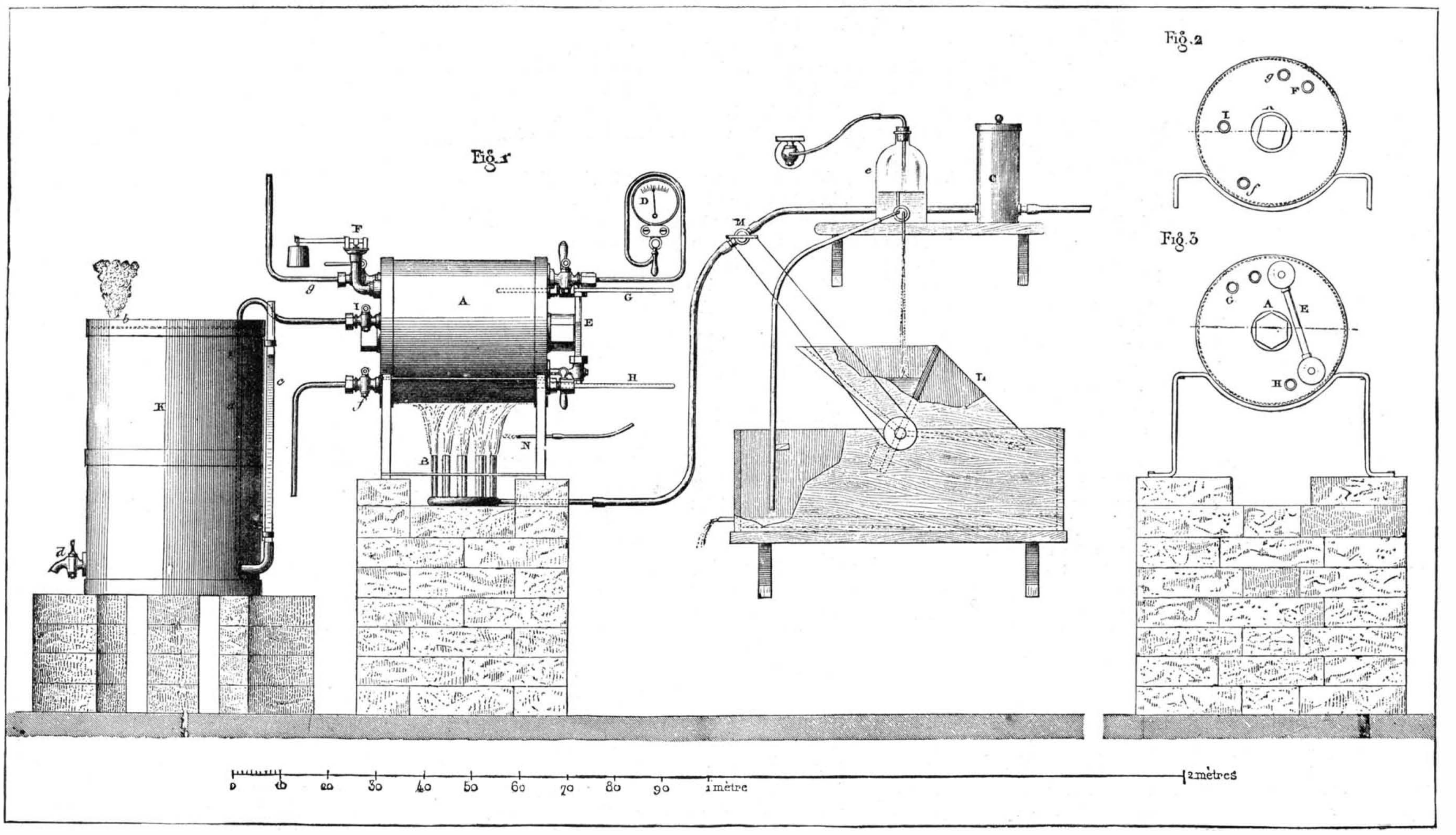


Fig. 1.—General Arrangement of Boiler and Accessories. Fig. 2.—Elevation of Boiler Front. Fig. 3.—Elevation of Rear End.

Plate II.—EXPERIMENTS AT THE TROCADERO.

THE PNEUMATIC TELEGRAPH LINE AT PARIS.

The line of pneumatic tubing, which was laid as far back as the year 1867, was, on the 1st of January, 1878, 20 5 miles in length, this representing from the beginning an average of 8,830 feet laid per year. Now the total length is 111 miles, to which must be added the 12·5 miles of tubing that secure communication with the centers of power. It includes a double main line, in which terminate 72 secondary ones, with various branches, plus a direct line between the central station and the Bourse.

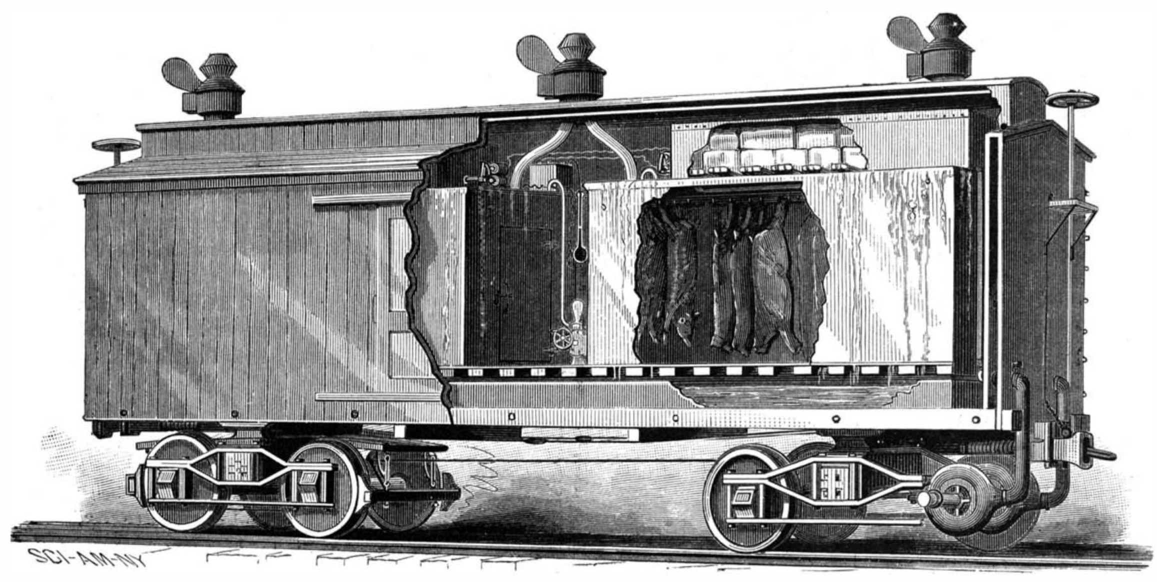
The number of offices that have been opened for the service of the tubes is 75, this including those of the Chamber of Deputies and Senate.

The 111 miles of lines are supplied by 8 stations, having steam engines of a total power of 315 horses, and 4 auxiliary water motors, which can eventually be used in addition. The trains run every three minutes upon the direct line from the central station to the Bourse, every five minutes upon the principal line, and every quarter of an hour only upon the few branches. The lines consists of tubes of 2½ inches internal diameter, that are bored perfectly true, so as to present no projection that might interfere with the running of the boxes. The boxes or travelers move through the tubes under the action of compressed (or rarefied) air produced by special pumps.

After the dispatches have been put into the box, the latter is closed by means of a rubber sheath which almost entirely covers it. The last box of each train carries at its back part a sort of collar formed of a flexible leather ring 3¼ inches in diameter, whose edges, being in contact with the inner surface of the tube, obstruct the latter completely without interfering with the movement of the box. The box thus arranged is called the piston box, and performs the part that a locomotive does on railways, while the simple boxes correspond to cars. There is, however, the difference that when the passengers (*i. e.*, the dispatches) are not numerous the locomotive itself carries them to their destination. Each box is capable of containing twenty dispatches.

The apparatus shown in the engraving serve as stations for the trains, and, as in all stations, there is a starting and an arriving side. The apparatus of the same line are thus grouped in pairs, and, moreover, are exactly alike, so that, if need be, the direction of the train may be reversed. They consist essentially of a vertical tube (in which the line terminates) ending in a square chamber whose anterior face is provided with a door that closes hermetically. It is through this latter that the boxes are introduced and taken out. The curved tubes that are seen here and there upon the central tube of each apparatus serve to connect the line with the vacuum or pressure apparatus by means of cocks that are maneuvered by a small hand wheel. The large collecting tubes placed horizontally communicate through tubing with the reservoirs, in which the play of the pumps is constantly renewing the stock of compressed or rarefied air.

Finally, in case a box that has reached one of the apparatus must start again through the contiguous one without getting a vacuum or pressure from the station itself (which is something that happens in all intermediate offices that are not connected directly with a center of power), it is necessary that the compressed or rarefied air shall be capable of traversing the station in order to drive the train toward the following stations. The two chambers that form the heads of the apparatus are then connected by opening a cock placed upon a connecting tube situated behind. In order to prevent a box that has reached the head of an apparatus from falling into the line, the tubist, as soon as a train arrives (which he knows through the noise of the shock), closes the line by means of a valve maneuvered by a lever that is within his reach. In the annexed figure the three apparatus to the left have their valves closed, that is to say, they are isolated from their lines. The fourth alone is in a position for receiving or sending.



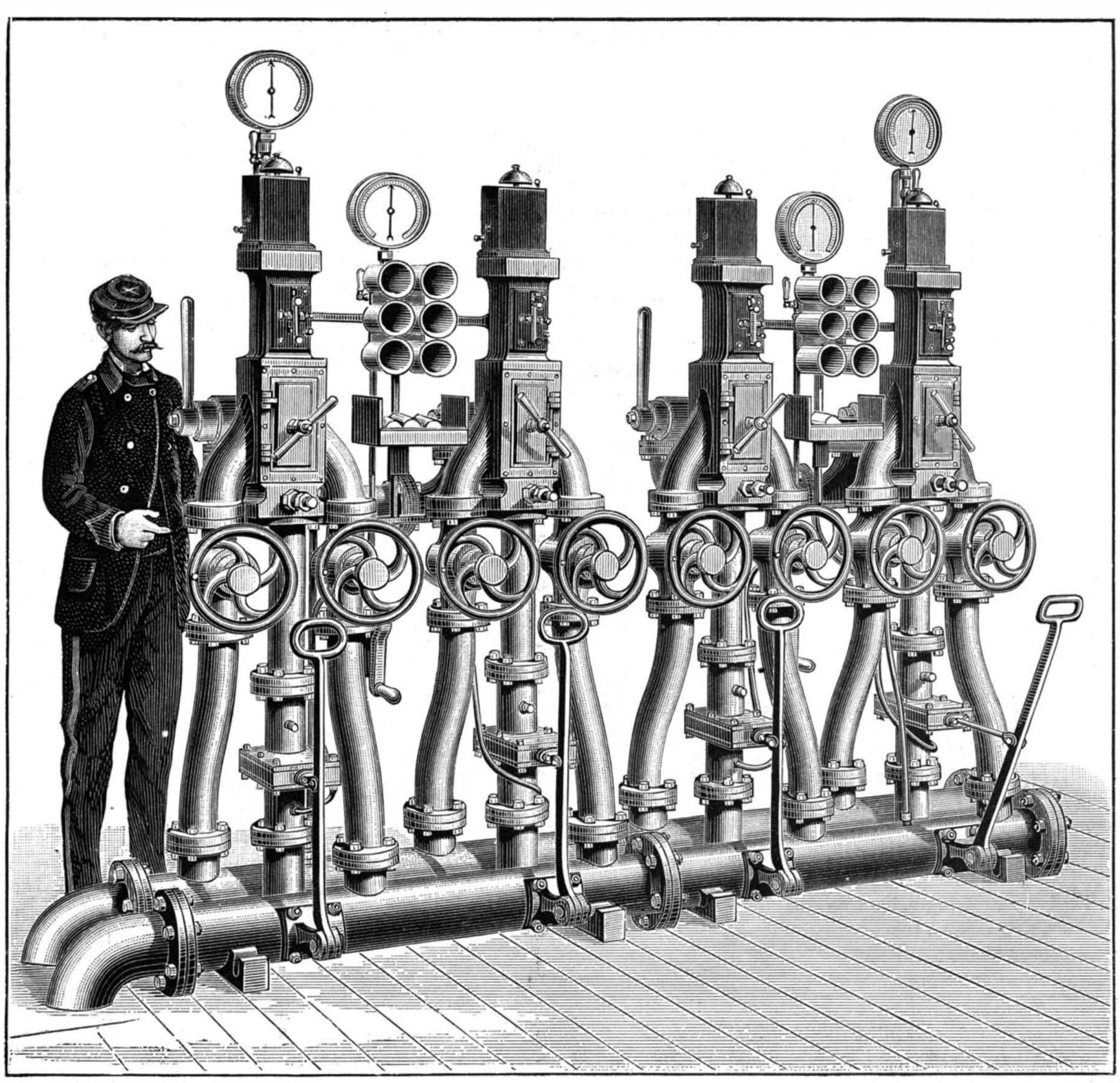
TALLICHET'S IMPROVED REFRIGERATING CAR.

The play of the valves is likewise utilized for preventing the compressed or rarefied air that fills the line at the moment of a train's arrival from being lost in the atmosphere when the door of the apparatus is opened.

The figure also shows several indispensable accessories. The pressure gauges indicate at every moment the degree of pressure or vacuum—an attentive examination of the movements of the needle upon the dial clearly showing to an experienced agent any irregularities that may occur in the running of the "piston." A manipulator placed over the door, and an electric bell surmounting the "cap" of the apparatus, serve for exchanging starting and arriving signals.

Finally, a series of iron plate sheaths serve for holding the exchange boxes. The velocity of the boxes varies with the length of the line and the amount of power that determines their motion. Under favorable circumstances, that is to say, upon very short lines, and with a difference of pressure of 40 centimeters of mercury, the velocity may reach six-tenths of a mile per minute.

The entire line will be finished this year, and telegram cards will soon be circulating in all the wards.—*La Nature*



NEW SYSTEM OF PNEUMATIC TUBES AT THE CENTRAL TELEGRAPH OFFICE, PARIS.

ACCORDING to the theory of F. Siemens, flame is the result of an infinite number of exceedingly minute electrical flashes, which are caused by the swift motion of gaseous particles.

IMPROVED REFRIGERATING CARS.

The object of an invention recently patented by Mr. Henry Tallichet, of Austin, Texas, is to provide an improved system of refrigeration and apparatus for applying the same to practical use. The body of the car has any approved double or packed walls serving as non-conductors of heat, and suitable side doors. The car is fitted with two chill rooms, one near each end, and of a size to afford free air spaces at the sides and ends, the center air space being wider for access to the rooms through their doors. These rooms are jacketed with a porous material, and rest upon a slat floor, beneath which are water tanks in which may be stored water or ice, with the drippings of which the porous jackets are kept saturated by a pump located in the center air space, and having suitable pipe connections for discharging the water on to the top of the rooms. The pump is operated from one of the car axles. The bottom of the tank descends each way to a well formed by a depression, and into which the suction pipe extends. Air is forced into the space between the top of the tank and floor on which the rooms rest by one or more blowers, driven from the car axle, for evaporating the water from the jackets to lower the temperature of the rooms. The water not evaporated flows back into the tank, and as but little escapes, a continuous supply is not needed. To increase the air draught the roof of the car is provided with ventilating fans, and although these may induce sufficiently strong air currents, the blowers are a valuable auxiliary. When the car is not moving the blowers are inoperative, and to guard against a rise in temperature, ice chambers opening near their tops for supply of ice are located over the the chill rooms. The devices described provide for cooling the rooms in every exigency of travel and without recourse to independent motors.

Near the bottom of the ice chamber is placed the central portion of a continuous pipe, having a zigzag construction, which serves as a rack to hold the ice and keep it above the drip water. This portion of the pipe is set in an inclined position, and at one end has a branch passing outward and downward and opening to the outer air, and at the other end has a branch passing down into the chill room. Air enters the pipe, and as it passes through the zigzag part in the ice chamber is deprived of its moisture by condensation, and appears in the chill room in a pure, cool, and dry condition, best suited for purposes of ventilation. The incline of the worm permits of a self-discharge of the condensed vapors. At a point as far removed as possible from the cold air outlet, there is passed into the chill room the open end of a pipe the other end of which opens into the case of one of the exhaust fans at the roof. This pipe acts constantly to exhaust and circulate the air of the chill room, thereby avoiding the deleterious effects of "dead air." An arrangement is provided for reducing the temperature of the chill room by saturating its top and side walls with the cold water drip of the ice chamber; this is accomplished automatically and at any premeditated temperature by an electrical contrivance acting on a valved outlet from the ice chamber. The water escaping from the ice chamber fills a shallow tray formed on the chill room roof by narrow ledges, and flows down the sides of the room, materially reducing the interior temperature.

This apparatus is automatic in action, and uses no chemicals as refrigerating agents. The quantity of ice used is reduced to a minimum, as its effects are required only, or principally, when the other means fail by stoppages of the car.

A Suggestion to Employers.

The Bridgeport (Conn.) *Daily Standard* hits the nail on the head when it recommends a year's subscription of the SCIENTIFIC AMERICAN as the best Christmas present an employer can make his workman, or a father his son. The editor further adds:

"And let any manufacturer try the experiment of asking each man in his employ as to the interest he would take in reading such a periodical if it was placed before him, and he will be surprised at the amount of pleasure and choice information that can be furnished at a small outlay. For every paper thus put in the hands of his employes he would receive four times its value by reason of the increased interest which would be taken in whatever work might be in hand, to say nothing of the benefit which would be directly derived from the enhanced skill of the workmen. The weekly visits of the periodical would constantly remind each man that his employer was concerned in his welfare, and that he had exerted himself to show that interest. We know from personal experience that information gained from the columns of the scientific journal above mentioned is invaluable to the person who is interested in science, art, or natural history, and it would be truly a pleasure to learn that we had induced even one employer to take a step which he would ever afterward be satisfied was a good one."

We await to see how many will follow the good suggestion of our valued contemporary before this month closes. —ED.

Putnam River, Alaska.

The Ounalaska (Lieut. G. M. Stoney, U.S.N., commanding) arrived in San Francisco, October 25, having completed the exploration of Putnam River so far as the time allotted would permit. The river was explored by a steam launch three hundred miles, when rapids were encountered; then a canoe was taken and towed by hand about eighty miles further; and from this point a short portage brought a portion of the party to the head waters of one of the northern tributaries, which was fed by two large lakes. A mountain near one of these lakes furnished a view far to the eastward, up the main valley of Putnam River, and showed it flowing in undiminished volume as far as the eye could reach. The natives reported that seven days' journey further up the river there was a great lake, looking like a sea; and it is thought that this is the source of the river. There is little doubt that the river has its origin as far east as the British possessions, and probably near to the Mackenzie.

Putnam River empties into Hotham Inlet just north of Selawik Lake and to the southeast of Kunatuk River. There is a large delta at its mouth stretching back about forty miles, which is pierced by over one hundred channels, one of which is about one mile in width. The river is navigable to boats drawing from five to six feet of water, up to the rapids. Here the water flows at about ten knots per hour. The river and most of its tributaries lie within the Arctic circle. Most of the tributaries are from the north, and they are generally shallow but rapid flowing, while the water is very cold; in some instances the observed temperature being 38°, while in one case it was 33°. Only one considerable branch was found flowing from the southward. This is called the Pah River by the natives, and it is used by them in journeying to the south; for a very short portage from its source enables them to reach one of the northern tributaries of the Yukon River, and they are thus brought in easy communication with the trading posts. It is believed that like easy portage can be made from the Putnam to the river discovered by Lieut. Ray near Point Barrow, and which empties into the Arctic Ocean.

The country about Putnam is mountainous. Long ranges extend along either side, but they are peculiar in existing in small detached groups, each of which possesses distinguishing characteristics, some being clearly defined, sharp, rocky peaks, while others are smoothly rounded. The higher ones are estimated at about three thousand feet. From the tops of those which were ascended the whole country to the north appeared to be a confused mass of mountain peaks, and the natives stated that the country was of the same character to the Arctic Ocean.

The country explored was found to possess a warm and agreeable summer climate, the thermometer having reached 115° in the sun, while the nights were cool. The valley of the Putnam is heavily timbered with spruce, birch, cottonwood, larch, and willow; while flowers were in abundance, roses being seen in large numbers. Cuttings of these latter, together with specimens of coal, gold, and copper, and a huge fossil trunk, form a part of the material collected for the Smithsonian Institution.

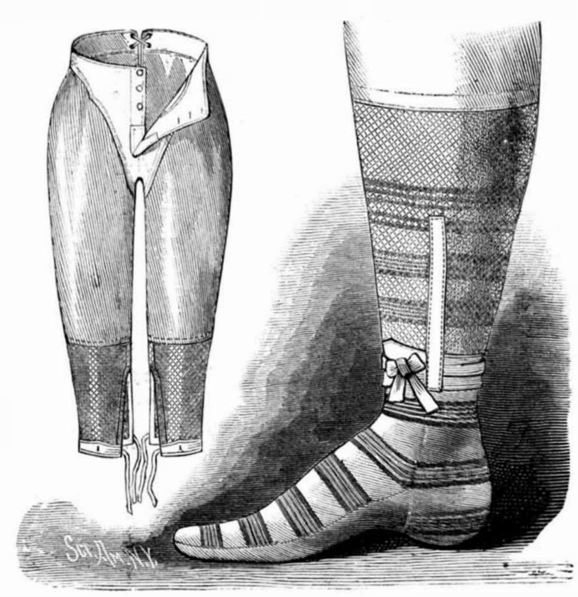
While Lieut. Stoney was absent, Ensign Purcell remained with two men in charge of the schooner, and made a survey of Hotham Inlet and the Selawik. He found that the Selawik River represented on the charts has no existence; but there is a channel, six miles in length, connecting Selawik Lake with a chain of three lakes to the eastward. He also found a five fathom channel over the Hotham Inlet bar.

The Ounalaska is a fifty-four ton schooner, and Lieut. Stoney was provided with two officers and a crew of eight men. There were no naturalists with the expedition.

While returning from his expedition, Lieut. Stoney encountered several severe gales. During one of the most severe he employed oil for stilling the waves, with marked success. The oil was rigged upon a spar to which a drag was attached, and the vessel was so maneuvered that the drag stood off the weather bow. The vessel holding the oil was so constructed that the oil was forced out in portions by each advancing wave. All the waves were affected by the oil, but the great foaming combers most markedly.

PATENT DRAWERS.

The top part of the drawers is made of woven or knit linen or cotton fabric, and the legs are made of the same material down to or a little behind the knees, and the lower part of the legs are of open work fabric. The perforated part of each leg is provided with an upright slit in the usual manner, and with bands or buttons at the lower end to hold the drawers leg securely, and at the same time prevent the socks from slipping off. The apertured parts permit of a free circulation of air, thereby keeping the legs cool and making the drawers comfortable and agreeable during hot weather. The front of the upper part of the drawers is



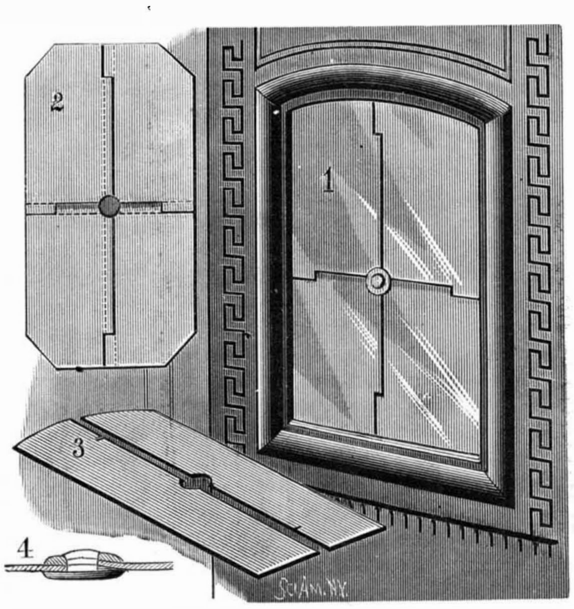
TOWLES' DRAWERS.

closed perfectly, one side overlapping and buttoning upon the other.

This invention has been patented by Mr. Wm. P. Towles, of 145 Baltimore Street, Baltimore, Md.

COMPOSITE MICA SHEET.

An invention recently patented by Mr. John L. Rorison, of Bakersville, N. C., is specially designed to meet the wants of retailers of stoves, who, with punch, rivet, and hammer, can join two or more small pieces of mica to form a sheet of any size and shape. Figs. 1 and 2 represent the completed sheet of mica, Fig. 3 shows the pieces separated, and Fig. 4 is a section through the rivet. In uniting four pieces the inner corner of each piece is slightly cut away, so that when they are put together a central opening will be formed for the passage of the rivet. The inner edges of each sheet are notched, so that when put together the edges lap past each other, forming good joints, and are at the same time locked in place. The contiguous edges being placed together, the rivet is inserted, when the washer is put upon the smaller end and the rivet headed down, thereby causing the head of the rivet and the edges of the washer to grasp and firmly hold the pieces. When only two pieces are used to form



RORISON'S COMPOSITE MICA SHEET.

the sheet, the edges are notched to form the lock joint, and the centers of the adjoining edges are cut away to make a passage for the rivet.

Civil Service Reform in Mines.

The recent mine explosion in the Connellsville region has led the mine inspectors to take steps to prevent a repetition of these horrors. This morning the inspectors met in this city. They will draw up a bill to present to the Legislature, in which miners ignorant of the business will be excluded from the mines. Pit bosses and men having charge of the ventilating of the mines will be required to pass a thorough examination before taking a position. It is also proposed that the inspectors move for establishing a school for the purpose of furnishing free instruction to men whose purpose is to engage in coal mining.

Magic Photographs.

What are called magic photographs are positives printed in a latent state upon white paper that it is only necessary to immerse in ordinary water to have the image appear.

The means employed for obtaining this curious and surprising effect are as follows: The positives are printed, from any negatives whatever, upon paper sensitized with chloride of silver, such as may be purchased of any dealer in photographic supplies. The printing is done with the aid of sunlight, either direct or diffused, in an ordinary printing frame, or, more simply, between two plates of glass held together by means of spring clips.

The image, when once printed, is fixed in a bath composed of 10 grammes of hyposulphite of soda dissolved in 100 grammes of ordinary water. It is not toned with gold, but is thoroughly washed with water after coming from the bath, so as to remove every trace of the hypo from the fibers of the paper.

This washing is absolutely necessary, in order that the paper may remain perfectly white after it has been treated with the following bath:

Bichloride of mercury	5 grammes.
Water	100 "

The image, when immersed in this bath, soon gradually begins to lose color, and finally disappears altogether. When the paper has become entirely white, it is washed in water and allowed to dry.

If it be desired to cause the latent image to reappear, it is only necessary to immerse the paper in a weak solution of hyposulphite of soda, or better of sulphite of soda.

To the back of these photographs there is attached a piece of bibulous paper impregnated with sulphite of soda. In this way, when the paper is immersed in water, the sulphite at once dissolves, and the image quickly appears.

The bichloride of mercury (corrosive sublimate) is a substance that should be used only with great precaution, as it is a violent poison. Care should therefore be taken to allow no delicate part of the body to come into contact with it, and to put the vessels containing it in a safe place out of reach.

The sensitive paper adapted for this curious recreation may be either albumenized or salted simply.

The sensitizing is performed by floating upon a 10 per cent nitrate of silver bath, for five minutes, either salted paper that may be purchased in this state or be easily prepared by immersing white paper in water containing 5 parts of table salt to 100.

After sensitizing, the paper is suspended by one corner, and allowed to dry in a dark place. For the balance of the operations one will proceed as above directed.

The *rationale* of the phenomenon is as follows: The image formed by the light is colored by the reduced silver. This image, when bleached by the bichloride, contains both calomel (chloride of mercury) and chloride of silver. Sulphite of soda possesses the property of dissolving chloride of silver, and of blackening chloride of mercury by forming a sulphide. —*Leon Vidal, in La Nature.*

How to Keep Cider Sweet.

Pure sweet cider that is arrested in the process of fermentation before it becomes acetic acid or even alcohol, and with carbonic acid gas worked out, is one of the most delightful beverages. The *Farm, Field, and Fireside* recommends the following scientific method of treating cider to preserve its sweetness. When the saccharine matters by fermentation are being converted to alcohol, if a bent tube be inserted air tight into the bung, with the other end into a pail of water, to allow the carbonic acid gas evolved to pass off without admitting any air into the barrel, a beverage will be obtained that is fit nectar for the gods.

A handy way is to fill your cask nearly up to the wooden faucet when the cask is rolled so the bung is down. Get a common rubber tube and slip it over the end of the plug in the faucet, with the other end in the pail. Then turn the plug so the cider can have communication with the pail. After the water ceases to bubble, bottle or store away.

Shameful Treatment of Inventors.

The fact that the revenues of the Patent Office are largely in excess of its expenditures is an unanswerable argument in favor of the very considerable increase of the clerical force in that office. American inventors do not ask to have reduced the fees which must be paid to get a patent. What they want is that their applications shall receive immediate attention, and that the money demanded of them shall be used to secure this for them. As the matter now stands, they are compelled to pay for that which they do not get. They are forced to submit to long and often ruinous delays because there are not enough clerks in the office to do the work, and meantime the money which they pay to have the work done is suffered to lie idle and accumulate until it now amounts to a fund of two or three million dollars. It would be difficult, we think, to conceive of anything more asinine than such an arrangement.—*The Textile Record.*

It is too bad, as our contemporary says, with such a large amount to the credit of the Patent fund, that the Patent Office should be crippled in its usefulness for the want of a sufficient clerical force to attend to the business, owing to a lack of a little Congressional wisdom. The inventors of the country are not small in numbers or weak in influence, and it is incumbent upon them to use their individual influence with the Congressmen from their respective districts in respect to the necessities of the Patent Office.

EXPERIMENTS ON SUPERHEATING AS A CAUSE OF BOILER EXPLOSION.

(*Continued from page* 394.)

quickly emitted. Such a thing occurs at the moment of starting a generator that has slowly cooled during an entire night, with register and ash box closed, and with a fire covered uniformly with cinders. It was of interest, then, to ascertain whether, under such circumstances, the opening of the steam port, by causing an ebullition, would not bring about a sudden forward motion of the pressure gauge.

The boiler experimented upon was a tubular one, having the shape of that of a locomotive, and the following dimensions: Heating surface, 65·4 square meters; capacity of the water reservoir, 3,130 liters; capacity of the steam reservoir, 1,089 liters.

During its normal operation this boiler vaporized about 425 liters of water per hour. It was heated by wood.

Observations were made on the 22d and 23d of June, 1883, and were resumed on the 11th of July, and continued every day till the 1st of August. In the morning, at the moment of setting the boiler in operation, and while the steam port was being opened, an observer had his eyes fixed upon the pressure gauge. But these observations showed absolutely nothing abnormal in the movements of the gauge. If the fire was quick at the moment of starting, the pressure continued to rise until the engine had acquired its normal speed; and, when the fire was covered, the pressure slowly lowered.

Third Series of Experiments.—In a boiler in normal operation the temperature of the steam is the same as that of the water. If, at a given moment, the water becomes superheated (to take that particular state in which it ceases to vaporize), the tension of the steam becomes independent of the temperature of the water, and there must, therefore, occur a difference between the temperature of the two. An endeavor was made to seize differences of such a nature, and, with this end in view, a series of experiments was planned in which the differences of the temperature of the steam and water of a boiler should register themselves for a long time.

The arrangement adopted for taking the temperature is shown in Plate I., Figs. 1 to 4.

The boiler experimented upon was that of the Conservatoire des Arts et Metiers. It was a cylindrical one, having four lateral feed-water heaters, a heating surface of 13 square meters, and a grate surface of 27·5 square decimeters.

A thermo-electric pile was constructed for suspension in the boiler in such a way that a series of solderings should dip into the water, while others of equal number should remain in the steam. This pile, which was 45 centimeters in length, consisted of 15 iron wires and 15 German silver ones, 1·5 millimeters in diameter, soldered successively by their extremities. These wires were arranged according to the generatrices of a boxwood cylinder, 40 millimeters in diameter, having an aperture running through it lengthwise for the passage of the copper wire by which the pile was suspended vertically from the self-closing cover of the manhole of the boiler.

The ends of contrary polarity, which remained free, were connected with a galvanometer needle, whose deflections were registered every quarter of an hour upon a sheet of paper by means of a puncture made by a vertical point fixed to the needle's extremity. This registering apparatus, with clockwork movement, was the same as had been successfully employed by Gen. Morin for measuring at the different points of a ventilating chimney, the excess of internal temperature over that of the surrounding air.

Each positive experiment included the registering, every twenty-four hours, of the position of the galvanometer needle, before firing up and until the boiler was under pressure, at the time the engine was set running, and while the latter was operating under nearly a constant pressure, and finally during the period of cooling, up to the next day or day after. Then the paper was changed in order to obtain a new diagram corresponding to the firing up again, before or after a new feed, until the pressure had risen to the normal one of five atmospheres, and had permitted the engine to run regularly.

No notable deviation was exhibited in the position of the galvanometer needle during all these alternations, or during the whole duration of the observations, which were greatly prolonged.

It resulted from an examination of the diagrams that the temperature of the steam pole was in general not quite so high; but the difference was always below 2°. This is explained by the proximity of the sides of the boiler, the temperature of which was naturally lower than that of the steam, and which radiated against the steam pole.

During the night of August 26–27, the galvanometer needle became strongly disturbed, as shown by the tracings. What was the cause of it? We do not know; but, at any event, the form of the tracing does not permit it to be attributed to superheating, seeing that the movements occurred between half-past one and six o'clock in the morning, that is to say, during the period of cooling. Further, the diagram shows that the deflections of the needle occurred suddenly and disappeared slowly, while the contrary would have taken place had superheating been the cause of the movements.

It is thus established by direct experiment that no appreciable difference is shown between the temperature of the water and that of the steam during any of the periods comprised in the observations, either during the running or during firing up or cooling.

Fourth Series of Experiments.—Finally, it was desired to ascertain whether, by depriving water entirely of the air in solution, by means of an extremely prolonged ebullition, the phenomenon of superheating could not be obtained in a metallic boiler.

The experiments were performed at the laboratory of the Ecole des Ponts et Chaussees, at the Trocadero.

The boiler, A, used (see Plate II., Figs. 1 to 3) consisted of an iron cylinder provided with strong cast iron heads. This was tested to a pressure of 15 kilogrammes per square centimeter. Its capacity was about 21 liters, and it was heated by a large Bunsen burner, B, having two crowns, one of them carrying 6, and the other 12 jets. The gas pipe was provided with a pressure regulator, C. By varying either the number of jets or the pressure of the gas, the conditions of heating could be modified within wide limits. The boiler was provided with the following accessories: A good Bourdon pressure gauge, D, divided into quarter kilogrammes; a water gauge, E; a safety valve, F; and various cocks. It was also provided with two horizontal mercurial thermometers that passed through stuffing boxes, G and H, and the bulbs of which entered, one of them, the water, and the other the steam. Their tubes were external to the boiler.

The arrangements made for obtaining a prolonged ebullition were as follows: From one of the cocks, I, which debouched a little over the center of the boiler, branched a tube that bent so as to run nearly to the bottom of a vertical cylindrical vessel of water, K, made of galvanized iron. The water in this reservoir had been previously boiled, and the same was the case with that which was to be added from time to time to replace the water which had evaporated. The capacity of this vessel was 50 liters.

The boiler being heated, the steam produced bubbled up through the water in the vessel, K, and kept it at a boiling point. As the cover of K had but two narrow apertures, one of them for the passage of the steam pipe, and the other for the exit of the excess of steam, it will be seen that there always existed at the surface of the ever hot water in K an atmosphere of steam, and that the water could not dissolve any air.

The operation was as follows: The boiler was heated for about an hour and a half, and then the gas was shut off. Through the condensation of the steam by cooling, the boiler became completely filled with water drawn from K. In half an hour, heat was again turned on, when there flowed through the feed pipe, first, water, and next steam. For alternately admitting and cutting off the gas, a small apparatus was used that consisted of a hydraulic working beam, L, which maneuvered the gas cock, M.

The boiler had been cleaned with caustic potash, and then washed with a large quantity of water. The apparatus was set running January 4, 1884, at 3 o'clock P. M. The experiments, properly so-called, began January 15. The water had therefore boiled, before the first experiment, for eleven days, night and day, with an interruption of half an hour every two hours, corresponding to about 200 hours of continuous ebullition. It may be admitted that on the 15th of January the boiler and water were absolutely devoid of air.

During this entire period the two thermometers were observed from time to time, and were always found to agree within about one or two degrees. Such difference we have already explained in our account of the Conservatoire experiments.

The experiments, properly so called, were performed on the 15th of January and the days succeeding, and were as follows:

All the cocks were closed, and the boiler being submitted to the action of heat, the temperature and pressure consequently rose. At intervals, simultaneous observations were made of the thermometer which dipped into the water, of the one which was in the steam, and of the pressure gauge.

Finally, the conditions of heating were varied, so as now to cause the temperature to rise 50° in half an hour, and then to rise only 28° in six hours and a half.

The last experiments were performed after the boiler had been kept closed, and slightly heated for nearly fifteen hours, and the result of them may be summed up as follows:

The two thermometers were constantly in accord; the difference, which was always less than 2°, as in the Conservatoire experiments, is very naturally explained by a few small variations in the construction of the instruments and the action of pressure upon their bulbs, and especially by the unequal effect of radiation from the sides of the boiler. It was remarked, in fact, that the thermometer in the steam gave lower indications than the other when the pressure rose, and, on the contrary, higher indications when it lowered. At the moment of opening the escapement no abnormal movement in the needle of the pressure gauge was ever seen.

Conclusions.—In conclusion, the committee believes that it has in no wise been demonstrated, up to the present, that the superheating of water has caused any boiler explosion, nor that superheating has ever occurred in generators used in the industries. If it does occur, it is only in extremely rare cases, and through the concurrence of exceptional circumstances that are up to the present neither defined nor known. There is, therefore, no need for the moment of examining the remedies that have been proposed for preventing the superheating of water in generators.

DESCRIPTION OF PLATE I.—P, thermo-electric pile; *pp'*, wires for connecting the poles of the pile and the galvanometer, G; Q, needle of the galvanometer, G, that moves around the axis of the suspension wire, *g*; *c*, cam of the registering apparatus, moved by clockwork and allowing the disk, D, to rise every 15 minutes under the action of the weight, F; T, man-hole, closed by the cover, H, which latter is provided with two stuffing boxes, *r*, *r'*.

PLATE II.—A, boiler; B, Bunsen burner; C, pressure regulator; D, Bourdon pressure gauge; E, water gauge; F, safety valve; G, thermometer in steam; H, thermometer in water; I, feed cock; K, freed water tank; *b*, steam eduction aperture; *c*, water gauge; *d*, blow-off cock; L, hydraulic working beam fed by the bottle, *e*; M, gas cock; N, lighter; *f*, blow-off cock of the boiler; *g*, escape pipe.—*Abstract from Annales des Ponts et Chaussees.*

Acetate of Soda Heaters.

For the last two years experiments have been making toward the warming of cars by means of a heat giving fluid, which continues for several hours to throw out heat with approximate regularity, for a time depending upon the original degree of heat imparted to the liquid. The cars of the De Kalb Avenue line in Brooklyn, seventy in number, have been heated by this system during the last winter to the satisfaction of the company, and presumably to that of the public.

A large iron pipe containing the compound passes under each seat of the car; through the center of the pipe runs a smaller pipe, through which steam is passed when it is desired to heat the compound. When heat is applied to the pipes from a steam boiler in the station, the crystals in the acetate of soda used are liquefied, and remain so until the temperature begins to fall perceptibly. Then the crystals begin to form, and the liquid throws out an increased heat. A thermometer taking the temperature of a pipe of the heated compound shows that during the first hour or two there is a slight fall in the temperature, then a sharp rise while crystallization takes place, and then a gradual fall.

A record of the temperature of one car kept during twenty days showed that after each run of sixteen miles, the temperature of the car was upon an average less than one degree lower when the car returned to the station than when it started out. The cost of heating cars by this system is said, by the company which controls the patents, to be not more than for stoves, while the heat is pleasanter and the atmosphere is free from gas and smoke. The compound in the pipes will last for an indefinite number of years, for all that is known to the contrary, being hermetically sealed.

This company now propose to introduce the same system as an improvement on heating by ordinary steam radiation. Steam coils often heat too violently in small rooms, and either give too little or too much heat. By using the steam to heat a reservoir of the compound liquid, the steam can be turned off when the room is sufficiently warm, and the reservoir will continue to throw out a constant amount of warmth for several hours. A small pipe full of the compound, 3 feet long and 4 inches in diameter, is made for heating private carriages.

Earth Worms.

An interesting paper on the habits of earth worms in New Zealand is contributed to the New Zealand Institute by Mr. A. T. Urquhart. The species are not named, but with such wonderful opportunities as Mr. Urquhart possesses for making a collection of these, may we hope that, in addition to his following out his painstaking observations as to their habits, he will also advance science by making a careful collection of the forms and placing them in the hands of some of the able naturalists of the Auckland Institute for description? It will be remembered that Darwin assumes that in old pastures there may be 26,886 worms per acre, and that Henson gives 53,767 worms per acre for garden ground and about half that number in corn fields. Mr. Urquhart gives, as the result of his investigations of an acre of pasture land near Auckland, the large number of 348,480 worms as found therein. It being suggested to him that in his selection of the spots for examination he may have unconsciously selected the richest, the experiment was again tried in a field seventeen years in grass. A piece was laid out into squares of 120 feet, and a square foot of soil was taken out of each corner; worms hanging to the side walls of the holes were not counted, and in one hole, where the return of worms was a blank, the walls were crowded with worms. As a result there was an average of 18 worms per square foot, or 784,080 per acre. Although this average is very striking when compared with that of Henson, it is worthy of note that the difference between the actual weight of the worms is not so marked. According to Henson, his average of 53,767 worms would weigh 356 pounds, while Mr. Urquhart finds that the average weight of the number found by him came to 612 pounds 9 ounces.

Indelible Stamping Ink.

E. Johanson, of St. Petersburg, gives the formula for a convenient ink for marking clothing by means of a stamp: 22 parts of carbonate of soda are dissolved in 85 parts of glycerine, and triturated with 20 parts of gum arabic. In a small flask are dissolved 11 parts of nitrate of silver in 20 parts of officinal water of ammonia. The two solutions are then mixed and heated to boiling. After the liquid has acquired a dark color, 10 parts Venetian turpentine are stirred into it. The quantity of glycerine may be varied to suit the size of the letters. After stamping, expose to the sun or apply a hot iron.—*Pharm. Rec.*

THE MAXIM MACHINE GUN.

(*Continued from first page.*)

motion carries the catch free of the stop, and a little more lifts the catch, by its tail coming in contact with the stop. The bolt and the barrel are then free of each other, and the former receives a rapidly accelerated motion from a lever pivoted on the barrel, and moves with it. As the barrel approaches the end of its stroke the point of the lever meets a stop, and commences to rotate about its pivot. In doing this it forces forward a piece connected to the block, first with a slow motion and then with a gradually augmenting one, as the leverage of one arm increases and that of the other diminishes while the lever rolls over the stop and the piece. By the action of the lever the barrel is arrested, while the block and the mechanism attached to it continue to move until the crank, I, gets on to the back center. As soon, however, as the block has commenced to leave the barrel, and before the latter has come to rest, the extractor, M, strikes the peg which stands in its path, and turning on its pivot on the barrel, draws the shell about ¼ inch out of the gun. This extractor has two arms, shown in dotted lines, which take hold of the empty cartridge at each side, and withdraw it with certainty. The extraction is completed by a hook shown (Fig. 5) attached to the crosshead.

This hook runs under a fixed spring, which is curved upward at each end to reduce the pressure when the shell is being started, and when it is about to be released. The empty cartridge case is deposited in one of the pockets of the cylinder, G, which is partially rotated just as the crank reaches the back center, and is carried round to be dropped out after the next shot. This cylinder is visible in Fig. 4, where a shell is seen in the act of falling out. The partial rotation of the cylinder brings the next pocket, which has already been charged, into a line with the barrel, and now the first series of operations is complete. The recoil has taken place, the breech block unlocked, the shell first started, and then completely extracted and removed, and the new cartridge brought into position for loading.

The next series, which is about to commence, consists in cocking the hammer or striker, pushing the cartridge home, locking the breech piece, and releasing the sear. As the crank approaches the back center the tail, D, of the cocking lever meets the stud, J, and the catch is caught and detained by the sear. The main spring, which is somewhat indistinctly shown coiled round the striker, is thus compressed, and held ready for action. When the crank has passed the center the breech block moves toward the barrel, pushing the cartridge before it until the latter is home and the block is locked by the catch, C.

The momentum of the crank and crosshead is sufficient to carry the barrel forward until the toggle arms, *d d*, pass the center, and the springs, *e e*, are in a position to urge it to the end of its travel. If the gun is set for very rapid firing they do this immediately, and the sear coming into contact with the cam, K, the striker is released, and the cartridge fired. After the shots have been fired the same cycle of operations is repeated, with this difference that the crank, instead of starting from the position shown in Fig. 5, occupies the dotted position, and commences to rotate in the opposite direction. It never makes a complete revolution. But if the gun be not set for a rapid rate of firing, there is a pause after the breech is locked, and the length of the time is determined by the adjustment of a hydraulic buffer, resembling in principle a cataract cylinder. This appliance (L, Fig. 5) consists of a piston working in a cylinder with a by-pass between its two ends. This by-pass is a plug, and is provided with a handle working over a quadrant on the outside of the case. This quadrant is marked for speeds between *nil* and the maximum, according to the opening which is afforded between the two ends of the cylinder at the various angles. The rate of fire can be reduced in practice to one shot in every twenty-five seconds, and by very careful adjustment to one in fifty seconds. The operation of the hydraulic buffer is as follows: Upon the upper side of the barrel is a stop which, just before the end of the forward stroke, meets the piston of the buffer, as clearly shown in Fig. 5. Under the influence of the springs, *e e*, it forces the liquid through the plug until the barrel has moved far enough to lift the sear, and then the explosion takes place. There is a valve in the piston of the buffer to allow it to be returned quickly by a spring during the recoil of the barrel.

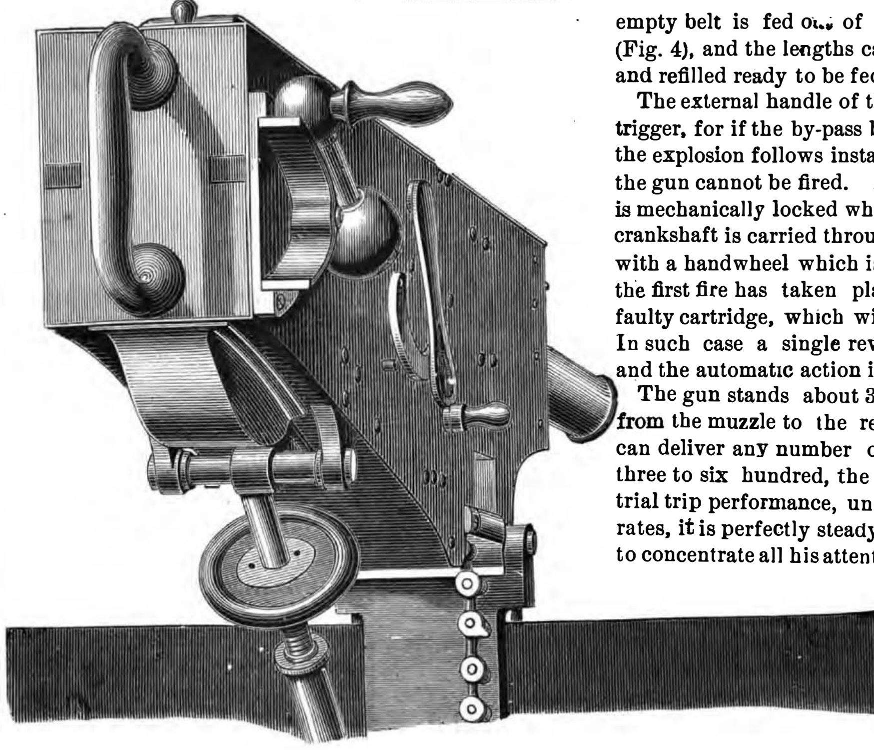


Fig. 3.

This completes the description of the introduction, firing, and extraction of a cartridge, but it remains to explain how the charges are withdrawn from the belts mentioned above, and introduced into the pockets of the cylinder, G. The full belt is drawn out of the magazine (Figs. 1 and 4), and passes over the wheel, F, which has recesses in each flange for the ends of the cartridges to rest in. This wheel is geared to the cylinder, G. In the firing position a hook or extractor, E, stands below the cartridge, and when the crosshead goes back this catches a cartridge and draws it into a pocket on the underside of the cylinder, where it leaves it to be carried upward to the barrel by the rotation of the cylinder. The empty belt is fed out of the opposite side of the machine (Fig. 4), and the lengths can be taken apart by unhooking and refilled ready to be fed in again.

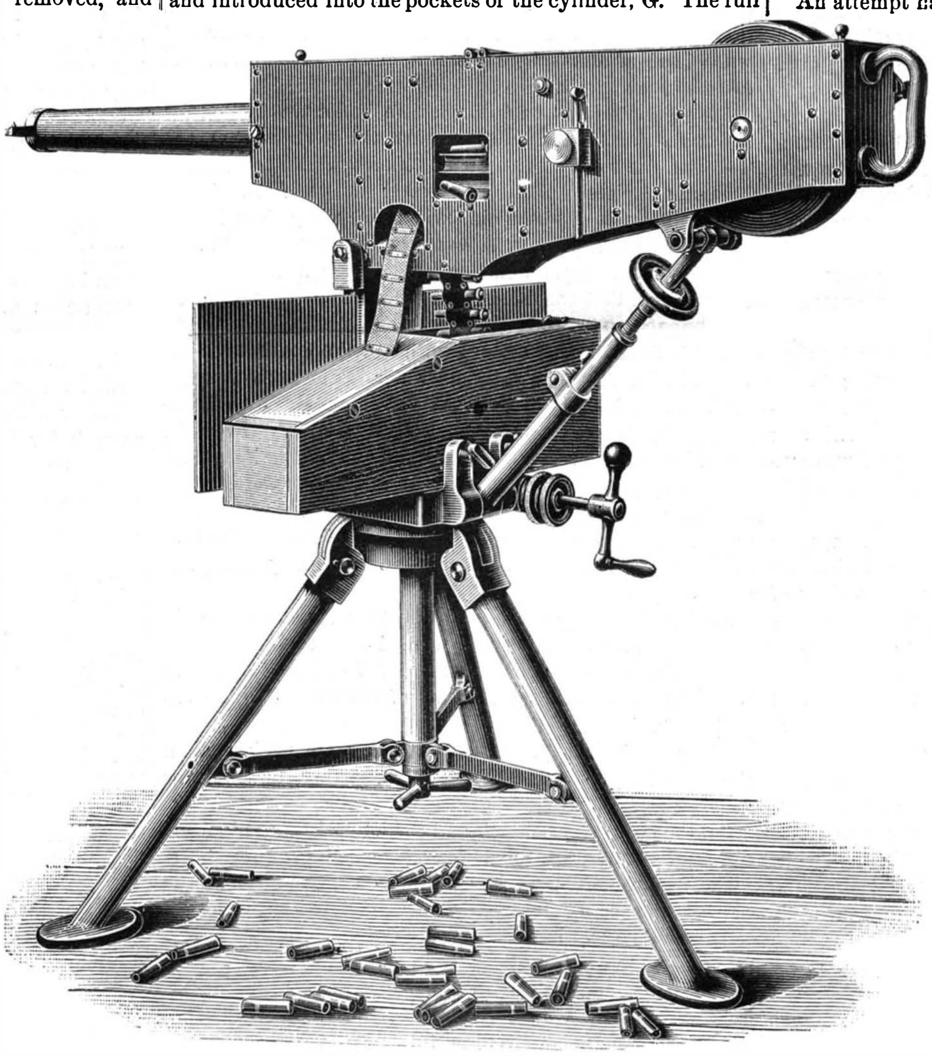


Fig. 4.

The external handle of the hydraulic buffer also acts as a trigger, for if the by-pass be opened when the gun is loaded the explosion follows instantly, while if it be entirely closed the gun cannot be fired. As a means of precaution the sear is mechanically locked when the by-pass is stopped. The crankshaft is carried through the casing, and is furnished with a handwheel which is worked in starting the gun until the first fire has taken place. It is also used whenever a faulty cartridge, which will not explode, stops the action. In such case a single revolution throws out the obstacle, and the automatic action is at once resumed.

The gun stands about 3 feet high, and is 4 feet 9 inches from the muzzle to the rear of the firing mechanism. It can deliver any number of shots per minute from two or three to six hundred, the latter being, of course, a kind of trial trip performance, under favorable conditions. At all rates, it is perfectly steady, and the gunner is perfectly free to concentrate all his attention upon the aim, without having his vision or his steadiness interfered with by turning a handle. No one can fail to be struck, says *Engineering*, to which we are indebted for these notes, with the wonderful ingenuity and great promise of this new weapon. Its automatic action, its power of regulation, and its rapidity of fire must recommend it to the military authorities, while its steadiness and the small demands it makes upon the attention of the man in charge must greatly enhance its value in action, where it is not the number of shots, but the number of hits, that count.

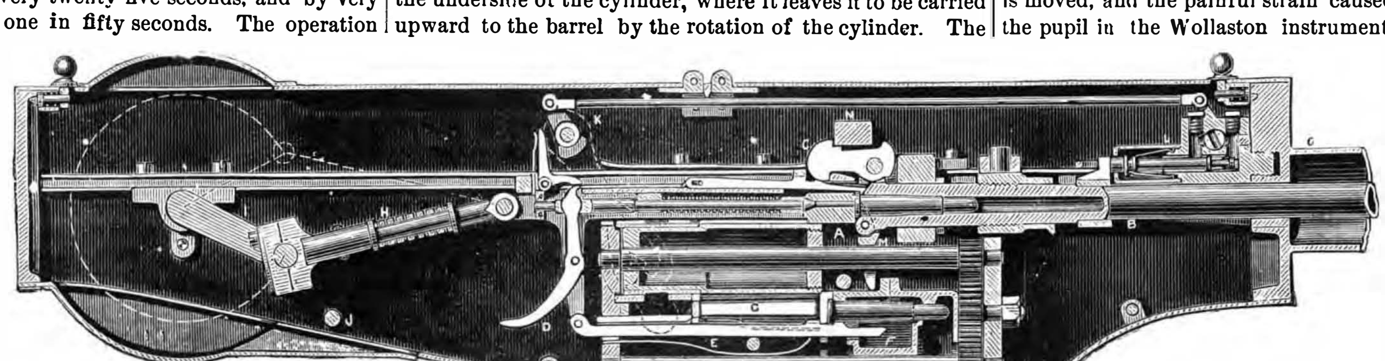


Fig. 5.—THE MAXIM SELF-ACTING MACHINE GUN.

A New Electrical Lantern.

An attempt has been made by Mr. A. P. Trotter to construct lanterns which shall diffuse powerful lights, such as that of the electric arc, without incurring the loss entailed by the use of opal glass. This was done with certain lamps fixed at the Health Exhibition, by a special modification of prismatic lenses (such as are used for lighthouses), adapted for ordinary lanterns. The general shape of the lanterns is the same as that of the more improved street lanterns for powerful gas flames—an inverted cone closed at the top by an opal glass cap in the form of a much flatter cone. The glazing of the lantern, however, instead of being with plane glass, is with specially moulded panes, bearing on them a number of prisms at one-fourth inch pitch. The prisms are formed on both sides of the glass, those on the front being horizontal, and those at the back running vertically. The effect is to break up the light source into a multitude of images of itself; care being taken that the angle of the prisms does not give a chromatic effect. Each pane so formed, for a 2 foot 6 inch lantern, is 14 inches long, tapering from 8 inches wide at the top to 2 inches at the bottom; and ten of these go to form the lantern. It is claimed that the absorption of light by such a lantern is only 10 or 15 per cent, as against 40 to 60 per cent with ground or opal glass.

A New Camera Lucida.

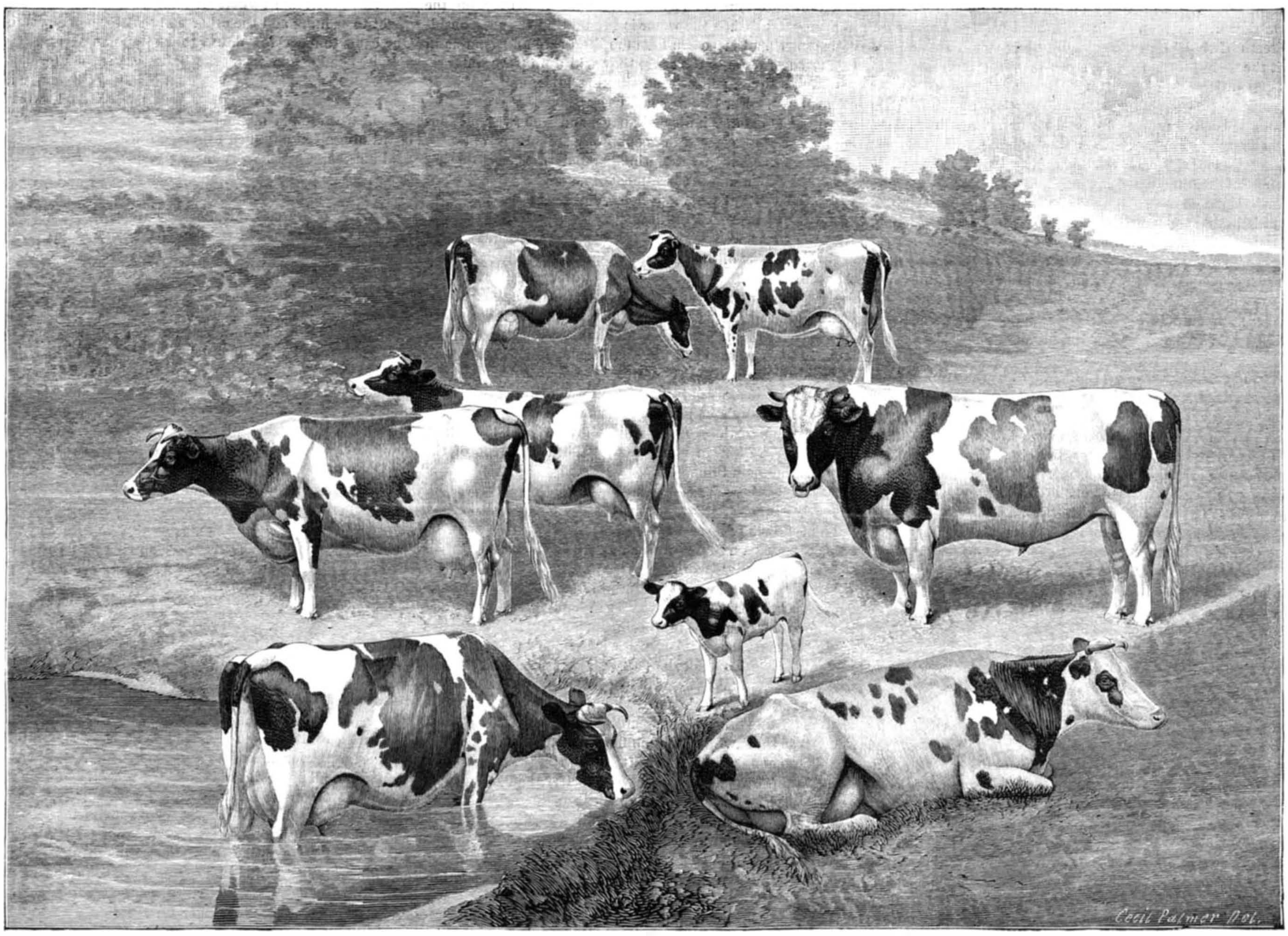
A new camera lucida has been invented by Dr. Schroder, possessing many advantages over the well known contrivance of Dr. Wollaston. The pencil emerging from the eye piece of the microscope is reflected twice, as in the old instrument, but the view of the paper and pencil is obtained by means of another prism placed under the first; the pencil from the microscope is totally reflected, and cannot pass through the film of air between the prisms, and the paper is seen directly between the two prisms, which offer no more obstruction to the view than a thick piece of plate glass.

The position of the image does not shift when the eye is moved, and the painful strain caused by the bisection of the pupil in the Wollaston instrument is entirely avoided. Drawings can be taken either with the body of the microscope at the usual inclination of 45°, or in a vertical position, both more comfortable in every respect than the old horizontal one, and preventing disturbance of the illuminating arrangement by having to shift everything when a drawing is required.

SOME SPECIMENS OF FINE CATTLE.

The accompanying representation of a select herd of cattle is from the pencil of Mr. Cecil Palmer, who has obtained considerable distinction in making pictures of this class; our engraving, for which we are indebted to the courtesy of the *Rural New-Yorker*, being a reduced copy of an original 28 by 36 in in size. The cattle represented all belong to the same family, the Aaggie, a breed imported from Holland, and now in possession of Messrs. Smiths & Powell, of Syracuse, N. Y.

At the right stands Neptune, the head of the family, and lying down in the foreground is Aaggie Kathleen; she has given this season, the first after her importation, 9,525 pounds of milk in seven months and five days to Nov. 1. Aaggie Beauty, standing in the water, has a milk record of 80 pounds 6 ounces in a day. As a three-year-old in Holland she gave 68½ pounds in a day; as a four year-old she gave, the first year after importation, 13,573 pounds, and made in one week 10 pounds of butter. Just above this one is Aaggie, having a milk record of 18,004 pounds 15 ounces in a year, and next behind her is Aaggie Beauty 2d, a daughter of Aaggie Beauty, who has given this season, as a three year-old, 7,793 pounds in seven months and six days to Nov. 1. At the left in the background is Aaggie Rosa, who as a five-year-old in Holland gave 91 pounds in a day, and last season gave 16,156 pounds in the year. The one in the right of the background is Aaggie May, the dam of the calf shown, and she has given this season, as a three-year-old, 57 pounds 13 ounces in one day, and 8,705 pounds in six months and sixteen days to Nov. 1.



SOME SPECIMENS OF FINE CATTLE.

Ardea Cœrulea.

Reader, I see before me a small lake or pond, lying in a vast tract of pine forest, unbroken, save here and there by the clearing of the settler who has cast his lot in this sunny clime of Florida; a pond that is decked here and there with beautiful water lilies, beneath which lies the alligator, ever ready to catch him who dares intrude on his domains; a pond wherein dwells the deadly moccasin, and whose shores are covered with a rank growth of wild oats and trees from which hangs the long Spanish moss—a landscape pleasing to the eye, but seen only by him who seeks Nature in all her glory. It is such a place as this that the little blue heron inhabits, and to which I shall take you for a glimpse of him as he is when freest from the fear of danger, and when pursuing his natural vocations. The little blue heron (*Ardea Cœrulea*), sometimes called the little white heron, is a constant resident of Florida, frequenting the small ponds, lakes, bayous, and lagoons, where its food is to be found, and where I have seen them assembled six or eight in number. The young are pure white in color (hence the name little white heron), from which they change to the dark blue color as they grow older, which, if I am not mistaken, they acquire in their third year.

Should there be a number of ponds near by, they seem to give preference to some certain one, at which they may almost always be found, unless previously frightened away, when they betake themselves to the next, where if they are not followed they remain for a time, and in the course of an hour or so wend their way back to the aforesaid pond. Now let me describe to you some of the habits of these birds, as I have observed them when lying in concealment on the shores of one of these ponds. Young and old feed together in perfect harmony, and a beautiful sight it is to see the snowy white plumage of the young birds intermingled with the dark blue of the old.

How proudly and yet how stealthily they step through the tall grass in search of their food! Suddenly one pauses, darts his beak at an insect, and again pursues his way. Yet in their chosen haunt they are constantly on the lookout for danger; pausing, they raise their long necks, and peer about them closely for some cause of alarm; assured that all is safe, they again betake themselves in search of whatever they may fancy as an article of diet.

Presently, one in his wanderings comes to a log lying partly on land, partly in water; mounting this, he proceeds to dress his plumage and to sun himself. With head drawn down between the shoulders, he stands motionless for an hour at a time, and it might seem as though he were asleep, but not so; let him hear but the snapping of a dry twig in the woods, and instantly every nerve is on the alert. Stretching out his neck, he gazes intently in the direction of the noise, and should he perceive sufficient cause for alarm, he immediately springs into the air together with the rest of his companions, who are not far off, when unless fired at they generally alight on the opposite shore, and seek refuge in the tall grass, or else alight in a tree. Should the one, however, who first heard the noise perceive no cause for alarm, he sometimes signals to his companions in some way, when they all arise, and fly a few times over the spot, and then alight again.

Let us now suppose that they have alighted in a tree where we can see them plainly. There they sit pluming themselves, but yet keeping a sharp lookout to see if they are followed. If everything remains quiet after a lapse of ten or fifteen minutes, they begin to fly down one at a time. Close at hand lies the upturned root of a fallen tree; on this they alight first, then from there they fly to the ground. The last one to leave his perch usually tarries a few moments as if to take a last look, then he also flies down and joins the rest, when they soon work their way to some favored spot.

When perched on a tree they carry their body in an oblique position, at an angle of about 45°; but when walking on the ground or when wading in the water in search of food, it is horizontal, or perhaps the breast is carried a trifle below the tail. The way in which they carry their necks when flying is different from their near relative, *Ardea Herodias* (great blue heron), being the shape of a broad, shallow U, with the head a little higher than the shoulders, whereas in *A. Herodias*, it is folded similar to a reef. Should they be suddenly approached, they fly away with a hoarse, harsh, croaking noise.

Occasionally they stroll for some distance into the woods, for the beetles, insects, etc., to be found there. I have seen them forty to fifty rods from the water. When there they sometimes rise and fly a few yards, and then alight again; in such cases they do not fly higher than four or five feet from the ground. I have never seen these birds in the rushes; they seem to prefer the grass from two to three feet high on the shores. Their manner of alighting is different from that of other herons. When about to alight, they throw themselves back into the air perpendicularly, with wings and tail widely expanded, and neck partially drawn in (representing as near as possible the screens that are made from them by taxidermists), then glide toward the spot selected, pause an instant, wheel, and alight. Sometimes these birds become so far accustomed to civilization that they will approach quite close to a building from which much noise proceeds. To illustrate: I saw one alight on the shore of a pond, in plain sight of and within a stone's throw of a large saw mill (which at the time was running at full speed), and remain there until frightened away by the mill hands. I have never heard this bird utter any note, except the note described when suddenly surprised, and then only when surprised.

Description: Length, 22⅝ in.; extent, 38 in.; iris light yellow in both stages of plumage. Bill dark blue at base, black at tip. Lores yellowish blue, tarsus pea green, toes pea green, claws blackish drab. In white plumage, mostly white, but generally showing some traces of blue, especially on the wing tips. In the full or blue plumage, slaty blue, or dark grayish blue, becoming purplish red or maroon colored on the neck and head. Bill on loral space, blue, shading to black toward the end. Legs and feet black.

E. M. HASBROUCK.

THE oldest person in the State of Wisconsin, John Jondro, aged 121 years, died on Saturday morning, Nov. 29, 1884, at Arkansaw. Mr. Jondro was born in the parish of Phillip, near Montreal, in 1763. He was in the employ of the Northwestern Fur Company forty years, and during the last forty years he has lived in this neighborhood. In his younger years he served some time in the Federal army, and often related interesting tales of army life. His age is taken from the statement of the parish prelate of Phillip.

Artificial Sea Water for Aquaria.

The following, by Prof. R. E. Hoffmann, of Berlin, is translated in the *Bulletin of the United States Fish Commission*:

In former years hardly any salt water aquaria were found in inland countries, because the expense and trouble of furnishing a constant supply of salt water were too great. Even the Berlin Aquarium, with its abundant funds, was so far from the nearest sea coast as to make the supply of natural sea water uncertain, and it suffered from this condition of affairs. The people of Berlin wittily called this chronic condition of their aquarium its "sea sickness." Although every new institution has to pass through a period of so-called "children's diseases," this peculiar "sickness" of the Berlin Aquarium proved very obstinate, and even threatened the life of the young and tender child whose birth had been hailed with so much joy. The Vienna Aquarium had to pass through similar experiences, and the stockholders were obliged to pay dearly for the experiment. As matters stood at the Berlin Aquarium, the use of artificial sea water seemed very desirable; but many a well planned experiment based on scientific principles proved a failure; for, although the component parts of sea water are well known, and any chemist can easily prepare it from a receipt, it seemed at first impossible, in a chemical way, to breathe the "breath of God" into our scientific sea water, and to impart to it the secret of true vitality. At last, however, long after the institution had been opened, Dr. Hermes succeeded in solving the problem in a scientific manner, and proved in the most incontrovertible way that the maintenance of inland salt water aquaria was no longer dependent on the nearness of the sea coast. Dr. Hermes succeeded in satisfying every demand, as regards sea water, within one week.

The very bold assertion of the director of the zoophyte aquaria in the zoological garden in Regent's Park, London, that artificial sea water, even if a chemical analysis cannot discover the least difference between it and natural sea water, is never beneficial to animals and plants, has been disproved by the success of the Berlin Aquarium. Since we have succeeded in manufacturing artificial sea water which possesses all the qualities necessary for the life of animals and plants, and which, by the use of suitable apparatus, can be kept fresh for years, nothing prevents inland towns from having sea water aquaria, which, in many respects, are peculiarly interesting.

As sea water aquaria have a great future in Germany, and will rapidly increase in number if proper directions for their maintenance are given, I will describe the manufacture of the water in such a manner that any one can easily prepare it himself. To 50 liters (about 13¼ gallons) of pure hard well water take 1,325 grammes (46⅜ ounces) of common salt, 100 grammes (about 3½ ounces) of sulphate of magnesium, 150 grammes (about 5¼ ounces) of chlorate of magnesium (chlormagnesium), and 60 grammes (about 2 ounces) of sulphate of potassium, all of which can be obtained at any drug-store, but generally not entirely pure; and foreign admixtures and impurities may easily cause the death of all the animals. Each of these chemicals is dissolved in water by itself; accordingly they may all be poured together and allowed to stand quietly for several hours, so that little stones and other impurities may settle to the bottom. All particles of dirt floating on the surface should be carefully removed by dipping. The mixture is then poured into another vessel, and diluted with fresh water until the hydrometer indicates the proper degree of saltness. The quantities given above will produce about 50 liters (about 13¼ gallons) of sea water.

This composition I have ascertained comes very near to that of natural sea water, for, besides the component parts given above, it also contains small quantities of soda, iron, and potash. I obtain the chemicals for preparing my sea water, which contains all the seven ingredients in their true proportions, from a friend of mine who is a chemist, and am prepared to supply others. Most of the sea water found in the market contains only the four first mentioned salts, and is likewise suitable for filling the basin. One should be careful, however, not to put animals in such freshly manufactured sea water, as this would almost beyond a doubt kill them. It is well known that sea water is 0·027 gramme heavier than fresh water; its weight is therefore 1·027. Everything lacking in this weight must be carefully added from time to time by pouring in fresh water as the water evaporates, while this is not the case with the salts. The solid ingredients of sea water constitute about 3½ per cent of its weight, or one-half ounce to a pound of water. A hydrometer is indispensable for ascertaining the degree of saltness.

Newly manufactured sea water should be placed in the open air in some cool place, and allowed to stand for some time. If one has any live salt water algæ adhering to stones they should be added, because they impregnate the water with oxygen. After some weeks the algæ will spread all round them clouds of diminutive seeds, which adhere to the walls, and quickly grow under the influence of light. By supplying oxygen they make the water, after it has been filtered several times, still more fitted to receive animals. Of sea plants, the green ulvæ and the confervæ are particularly suitable for recently manufactured salt water.

In the beginning only a few hardy animals should be placed in the water, which will flourish and thrive in it; and after a while an attempt may be made with more tender animals, which, if placed in the water in the beginning, would probably have died. If no algæ can be obtained, the water should be allowed to stand longer. Any one who can afford to wait until a green cover of algæ spreads over the panes, will do well to defer placing the animals in the water till that time, and a little patience is very commendable during the entire process. Like wine, salt water, if properly treated, improves with age, as special apparatus continually supply it with oxygen by night, and keep it agitated. The water in the Hamburg Aquarium has not been changed for fifteen years, and is still perfectly clear, transparent, and odorless, in short, of the very best quality; and all that has to be done is to make up for accidental losses or evaporation. The water of the salt water aquarium is changed or filtered only when it begins to get turbid, or if some change is to be made in the arrangement of the aquarium. It will always be advisable, however, to keep at least a double supply of sea water on hand, and place it in the cellar in well corked bottles, as any sudden emergency will then be fully met.

I have never been able to obtain natural sea water which was as clear as the artificial, through which one can see everything distinctly, even in the most remote corner of a large aquarium, which it would be very difficult to do in natural sea water. I have brought up sea water in a dipper which, when poured into a glass, was as clear as crystal and had a brilliant blue color; but this is possible only on the high seas, and when the water is brought up from a considerable depth. Fishermen take too little care and trouble in this respect: close to the shore they will dip up the water resembling a thick, yellow, and stinking juice, and ship it to other places. For this reason I use artificial sea water prepared in the manner indicated above, and even without adding any plants I succeed in keeping my animals alive.

It is self-evident that the principal point in constructing salt water aquaria is the treatment of the water, which, after all, is the element which decides the well-being and sickness, life and death, of the animals. Care should be taken to keep the water well supplied with oxygen, which is easily done by means of the aerating apparatus; and to see to it that the normal proportion between the salts and sea water is always maintained, and as soon as anything appears to be wanting in this respect, it should be supplied. As soon as the water begins to get turbid it should be filtered, and during an abnormal state of the weather it should be cooled. Only when these conditions are fulfilled will it be possible to keep up a successful salt water aquarium; only thus shall we be enabled to have in our rooms an exact representation of the bottom of the sea, with all its mysteries and wonders. I, therefore, repeat in conclusion, "The treatment of the water is the main thing."

A Florida Woman Who Runs a Sawmill.

The following letter, written to the *Northwestern Lumberman*, contains a number of homely truths that apply to all sorts of mechanical work:

Your letter of a late date requesting me to give my experience as a lumber manufacturer is at hand. I will state at the start that I am not in the business through choice; but having loaned money to parties with which to purchase a saw mill, I was compelled by their failure to make even the first payment to take the machinery from them. I then put my son-in-law, Ernest Wever, who promised great things, in charge. I told him I knew nothing of sawmilling, but I knew that the sawdust was too fine and the scratches on the boards too close together. I left him to run the mill, but in a short time I found he could do no better than other men, and I took him out of there so quick it made his head swim. I moved the mill a distance of 20 miles, fording the Hillsborough River, and placed it near my own house, at an actual expense of $9; and in a few days I had everything in good order. I have my own teams and carts, and take timber from my own lands.

Although accustomed to manage my own affairs, commencing by the time I was grown, I found difficulties enough in making lumber, and I have often said that a sawmill and Satan belong in the same family, and some people say that since I became the owner of one they are sure of it; but while they talk I am at work. This is the trouble with half the country sawmills: There is too much talking and not enough work. Why, Mr. Editor, the most of men talk over a log long enough to saw it into inch boards. Then when they get started they discover that the fireman has not steam enough; then they must all sit down and talk again. By the time steam is up and one or two boards sawed, a belt must be repaired, which might just as well have been attended to before working hours in the morning or at noon. Then one man sews the belt while all engage in talk again. When the belt is ready, the sawyer gets it into his mind that the machinery needs oiling; then he hunts up the oil can, for he never has a place for anything, and goes around squirting oil into every hole but the right one, while the other hands go on with their talking. The next day they are out of logs, and the mill hands do nothing except to allow "their time to go on." The day following some of the men are reported sick, and more time is lost. At the end of the month there is little lumber and no money, and they all wonder why sawmilling does not pay.

I knew well enough that machinery is made to run, and when running it should be at work, and all I had to do was to keep the saw cutting for ten hours a day and six days in the week. In order to do this the mill must be kept in good order, not by repairing broken parts, but by keeping it from getting broken. And I soon saw that the parts of machinery out of sight were neglected the most. I would suppose any man would know that it is the inside of things that needs attention—the inside of the boiler, the inside of the cylinder, the inside of the pump or inspirator is of far more importance than the outside. Nothing makes me more angry than to see a man rubbing up the outside of his boiler when I know the mud is six inches deep inside, baking, burning, and blistering the iron; yet I have seen but few saw mills except my own. But I saw how that was managed before I took possession of it, and I am told that others are managed no better.

Many a man in the sawmill business would do well if he could get skilled labor, but this State is cursed with a tribe of sawmill tramps who claim to know everything, and when tried can do nothing. They are always on foot and out of money, yet if we are to believe them they have been the superintendents of the largest mills in America. Every one of them has been Governor Drew's principal sawyer for at least ten years, receiving not less than $6 a day. They all know more of machinery than the men who make it, and are ready, not to commence sawing, but to commence cutting, changing, splicing, and rebuilding, with a promise that if I will give them $3.50 per day and board they will double the capacity of my mill and be ready for work in about three weeks. I have never been deceived by one of them, but they leave their mark wherever employed. One-half of them ought to be hung and the other half sent to the penitentiary. One came to me a few days ago who was an exception, for, notwithstanding he was "the best sawyer in Florida," he was willing to work for $10 a month and board, or $12 if he boarded "hisself"—hungry looking wretch! I wouldn't have boarded him even a day for $2, and I knew he couldn't board himself at any such price. Said I, "Do you see that road out there?" He very meekly said he did. "Then," said I, "you go out there, and when you get to it you take either end you like; the one that will put you out of my sight the quickest will suit me the best." He went. If he had not, I would have put the dogs after him in three minutes.

I employ none but the best hands—not paying too much or too little, for one fault is about as bad as the other.

I can't say just what my lumber costs me, but I know that when sold I have taken in more money than I have paid out. I am 53 years old, or about that, was born in Florida, and was raised at a time when bookkeeping was not thought of.

I now have my second husband, and I am the mother of nine children, seven of whom are now living. Several of the elder are doing business for themselves, yet they always come to "mother" for advice, and when they don't take it they wish they had. I have always managed my own business, and I expect to while I live. I awake in the morning and plan the day's work while the men are asleep, and at the breakfast table I give every one his orders, including my husband, who never objects to my doing the thinking for the family.

My first advice to men who contemplate going into the sawmill business is—don't do it, for not one in twenty of you has the ability to succeed. If, however, you are determined to try it, be careful that you get the best machinery, strong and heavy enough to stand the bad treatment of awkward hands. Buy the most durable belts, no matter what they cost, for half the failures in our backwoods mills are caused by constant breaking of belts. And when a complete outfit is secured, locate where you can get timber and sell lumber. Keep your machines in good order, taking special care of all parts out of sight. Pay your hands in cash, and not in promises, for they work for the money, and not for any love they have for you or your business. When you can't pay, shut down, stack your lumber, and discharge all hands. Your mill will neither eat, drink, nor wear anything while standing still. But when you do run, work everything to its full capacity. HARRIET SMITH.

Tuckertown, Fla., November 17, 1884.

A Bird Catching Tree.

Among the transactions of the New Zealand Institute Mr. R. H. Govett gives some startling facts as to the bird-killing powers of *Pisonia brunoniana* or *P. sinclairii*. A sticky gum is secreted by the carpels when they attain their full size, but is nearly as plentiful in their unripe as in their ripe condition. Possibly attracted by the flies which embalm themselves in these sticky seed vessels, birds alight on the branches, and on one occasion two silver-eyes (Zosteropos) and an English sparrow were found with their wings so glued that they were unable to flutter. Mr. Govett's sister, thinking to do a merciful act, collected all the fruit bearing branches that were within reach and threw them on a dust heap. Next day about a dozen silver-eyes were found glued to them, four or five of the pods to each bird. She writes: "Looking at the tree, one sees tufts of feathers and legs where the birds have died, and I don't think the birds could possibly get away without help. The black cat just lives under the tree, a good many of the birds falling to her share, but a good many pods get into her fur, and she has to come and get them dragged out."

In a note Mr. T. Kirk says that *Pisonia umbellifera*, Seeman = *P. sinclairii*, Hook. f., is found in several localities north of Whangerei, both on the east and west coasts, also on the Taranga Islands, Arid Island, Little Barrier Island, and on the East Cape, possibly in the last locality planted by the Maoris. The fruiting pericarp is remarkable for its viscidity, which is usually retained for a considerable period after the fruit is fully matured. It can be readily imagined that small birds tempted to feed on the seeds might easily become glued to a cluster of fruits.

On Steel Hardened by Pressure.

The new process invented by M. Clemandot for hardening steel was lately examined by M. Ad. Carnot, and made the subject of a report presented by him, as a chairman of a committee, to the French Societe d'Encouragement for National Industry. The method in question consists in heating the metal to the proper degree of softness, and submitting it while cooling to heavy pressure. The result is the formation of a hardened steel possessing properties similar to those developed by the operation of quenching.

The remarks and explanations contained in M. A. Carnot's paper are quite interesting and practical, but somewhat lengthy. We give below a condensation of the most important points.

The use of strong pressure in working steel, he says, was tried some years ago in England by Whitworth, but with a different object and under different circumstances. Then the idea was to prevent the flaws due to air bubbles forming during the solidification of cast steel. Similar trials were also made in France, but always in the same manner, that is, by operating on the steel while yet in the semi-liquid state. M. Clemandot, on the contrary, takes steel already worked, either cast, hammered, or rolled, which he only heats to cherry-red heat, and then submits, under a hydraulic press, to a pressure of from one thousand to three thousand kilogs. per square centimeter (about six and a half to twenty tons per square inch). The metal is allowed to cool in the press, and when withdrawn has acquired the new qualities, and needs no annealing or supplementary process whatever.

The metal thus produced sensibly differs from ordinary steel slowly cooled in the air without pressure. It is much finer grained, and considerably harder and tougher. To a certain extent it resembles steel hardened by quenching in water, yet the two are not identical.

On examining the process it will be seen that it consists of two physical effects, different although nearly simultaneous. One is continuous and powerful pressure; the other rapid cooling.

Strong pressure must cause, on one hand, a rise of temperature in the metal, and also a tightening of the steel molecules while they are yet soft enough to weld together. On the other hand, the cooling of the steel must be very rapid between the plates of the hydraulic press. It must be all the more so that a high pressure tends to render the contact very close between the objects and the heavy metallic plates of the press. Hence the final result of the operation is a double one: it combines to a certain extent the effects of hammering or rolling with those of hardening by quenching in water.

To better understand where the old processes and the new one differ and where they are similar, it is well to examine separately the various methods of working steel.

HAMMERING AND ROLLING.

When steel is heated to redness, and allowed to cool slowly, it is apt to acquire a granular structure, often at the same time allowing a part of the combined carbon to separate in the state of graphite. The operations of hammering and rolling the metal, while yet very hot, prevent to a certain extent the granular change, render the steel tougher and more homogeneous, and lessen the proportion of carbon which is lost in the shape of graphite. These operations, however, last but a short time, so that on being left to itself the metal soon crystallizes again, and in the end is not very different in texture from what it would have been if it had been left alone.

The effect of the hydraulic press must be quite dissimilar. The actual pressure, it is true, cannot equal that produced by the pounding of heavy hammers, but it is uninterrupted while the objects are cooling. Hence the molecules of the metal are possibly welded together permanently, thus forming a very tough and elastic steel.

TEMPERING.

The tempering of steel appears to have the effect of preventing the metal from crystallizing. Whether mercury, oil, pure water, or saline water be used for quenching, the principle is the same, and consists in a rapid cooling of the metal. The results are *chemical* and *physical*.

The *chemical* effects are still imperfectly known, yet it is generally admitted that steel contains, after quenching, a larger proportion of combined, or rather dissolved, carbon than before, while untempered steel contains more free carbon in a state resembling graphite. The chemical effects of tempering may therefore be said to closely unite the carbon and the iron, or to prevent the separation of the two substances already combined.

The *physical* effects are more complicated than is generally believed. At first the exterior strata contract on cooling, and strongly compress the internal portions, still soft and malleable, in such a way as to probably weld together the molecules of the metal. This first action may be compared to that produced by hammering the red hot steel.

But now a secondary action begins, which is quite different, and all the more noticeable that the piece is larger. At the moment of the sudden hardening of the surface the inside layers are yet hot and strongly dilated. Hence, when the latter, on cooling in their turn, tend to contract, the external strata having become hard and rigid cannot follow the motion, and this must create unequal tensions between the various sections of the steel.

There are no direct experiments proving the truth of this theory, but two facts indirectly show its correctness. One is the decrease observed in the specific gravity of steel when it is tempered. The other is the internal cracking so frequently noticed in large pieces of tempered steel, and which occurs sometimes at the moment of quenching, sometimes shortly afterward, and again after a longer delay, when the piece is struck or exposed to changes of temperature.

If it is considered that the internal inequality of tension above alluded to may become so considerable as to rise above the tenacity of the metal, the cause of these cracks becomes readily intelligible.

The remedies proposed for these fatal defects have all been either useless or impracticable. Among them the quenching in boiling water succeeds to a certain extent, but fails to afford the hardness obtained otherwise. The plan of cooling from the center instead of the exterior is excellent in theory, but almost impossible in practice.

HARDENING BY PRESSURE.

A mistaken idea must be, to begin with, brushed aside. It has been written by some that hardening by this process could only be obtained by pressure in a mould of the exact dimensions of the steel object.

Such is not the case. The pressure needs only be applied to two opposite surfaces of the object, previously heated to a cherry red heat. A square bar, for instance, straight or curved into horseshoe shape, has only to be laid flat on the plate of the hydraulic press. A cylinder or torus may have the pressure applied on two opposite edges, and so forth. As a rule, of course, it is advantageous to apply the pressure to the greatest surfaces. To work under the best conditions the steel object, previously heated as said above, should be compressed as speedily as possible. To this purpose the press is prepared so as to leave between the two plates space just sufficient to admit the object, and the pressure being applied at once, is carried as quickly as possible to the extent fixed beforehand. Care must be taken also that the metallic plates, which are in direct contact with the object, be clean and level, so as to be good heat conductors.

Thus the double result mentioned above, is obtained, namely, a tightening if not a welding of the steel molecules, owing to the powerful and uninterrupted action of the press, and at the same time, through contact with cold metallic masses, a rapid chilling similar to quenching in a liquid. And yet there is between the two processes this essential difference, that steel tempered by immersion increases in volume, thereby decreasing in specific gravity, while under the action of the hydraulic press steel retains its original volume, and escapes the state of internal distention already spoken of. Direct experiments have proved that *a priori* theories are confirmed by actual facts.

MAGNETIC EFFECTS OF COMPRESSION.

Between ordinary tempered steel and compressed steel there exists one more similarity, namely, the acquired power of forming magnets. A steel bar sufficiently rich in carbon becomes, after hardening by pressure, readily magnetized, just as if it had been hardened by immersion. Recently instituted trials have demonstrated that magnets made with compressed steel are slightly inferior in power to those composed of ordinary tempered steel, but the metal possesses the singular property of retaining its coercive force even after annealing and welding. Like ordinary steel it loses its magnetization on being heated to redness, but while common steel must be tempered again to make a magnet, compressed steel can be magnetized without further preparation.

The conclusions of the report are that M. Clemandot's invention deserves encouragement, as affording a new process for imparting to steel the hardness, homogeneousness, and capacity for magnetization hitherto obtained through tempering by immersion; certain disadvantages of this last process are at the same time obviated. It is the opening of a new way worthy of investigation.

Poisonous Cheese.

At the October meeting of the American Public Health Association at St. Louis, Professor V. C. Vaughan, M.D., of the State Board of Health of Michigan, read a paper on the "Study of Poisonous Cheese." It is well known that cases of severe illness follow the eating of some cheese, especially in North Germany and America, but in France no such cases are found. In Michigan, within the last six months, over three hundred cases of cheese poisoning have been reported. The symptoms produced are dryness of the throat, nausea, vomiting, diarrhœa, headache, and double vision—the same symptoms as gastro-intestinal poisoning. Cases of cheese poisoning are rarely fatal, six deaths in three hundred and forty-two cases occurring in Holland in 1874, a little over two per cent. Cheese that may be harmful to man may be eaten by lower animals without danger, and a cat once ate cheese that had poisoned thirty people, but the feline experienced no toxic effect. Coloring cheese with annatto may be looked upon, perhaps, as a justifiable adulteration. Samples of cheese that had poisoned many people indicated the presence of acids, litmus paper turning blue. The indications then were that the poison was caused by chemical acids and not by bacteria. Microscopic examination, however, revealed the presence of a spherical bacillus subtilis which did not affect a cat when injected beneath the skin. Only poisonous cheese violently reddens litmus paper, and this is a test easy of application. Every grocer should try the experiment when he cuts a new cheese. The following are the conclusions: 1. That toxic material in poisonous cheese is a compound soluble in acohol. 2. The production of this poisonous material is due to the rapid growth of the bacillus subtilis. 3. The difference between poisonous and non-poisonous new cheese is one of degree rather than of nature.

The Process by which Steel Pens are Made.

A representative of the New York *Sun* has been investigating the steel pen manufacturing business of this country, and reports as follows:

About a million gross of steel pens are worn out every year in the United States. What becomes of them? Twenty years ago most of the steel pens used in this country were imported. Now comparatively few are imported, and there are several factories in the country in which they are made in large quantities. One factory is in Connecticut, another is in Pennsylvania, and a large one is in Camden. The manufacturers say that the industry has been fostered by the protective tariff, and that if the tariff were to be taken off, the market would be flooded with cheap steel pens at lower prices than ours and of inferior quality. At present the importation of foreign pens is mainly confined to high priced articles.

It was at first doubted that steel pens could be made in this country, but it was soon learned that the requisite skilled labor could be obtained for high wages, and the success of the pioneers led one manufacturer after another into the business, until now the field is pretty well supplied. Most of the work on these little instruments is done with the aid of very nice machinery worked by women and girls. The steel used is imported, because it is believed that the quality is more uniform than American steel. This uniformity of quality is necessary because of the very delicate tempering required in the manufacture of the pens. That mysterious quality of steel which gives different grades of elasticity and brittleness to different colors of steel is a quality that requires expert manipulation on the part of the workman who does the tempering. He must know the nature of the material with which he works, and with that knowledge must exercise a celerity and skill that seizes upon the proper instant to fasten the steel at a heat which insures the requisite quality.

First the steel is rolled into big sheets. This is cut into strips about three inches wide. These strips are annealed, that is, they are heated to a red heat and permitted to cool very gradually, so that the brittleness is all removed and the steel is soft enough to be easily worked. Then the strips are again rolled to the required thickness, or, rather, thinness, for the average steel pen is not thicker than a sheet of thin letter paper. Next the blank pen is cut out of the flat strip. On this the name of the maker or of the brand is stamped. The last is a very important factor. There are numbers that have come to be a valuable property to manufacturers. Many clerks say they cannot work to advantage unless they have particular styles of pens. The result is that by passing the word from one writer to another a market is soon created for a favorite style. Each steel pen has therefore to be stamped with sufficient reading matter to identify it thoroughly. The stamping is done with very nicely cut sharp dies that cut deep and clean, so that the reading matter will not be obliterated by the finishing process. Next the pen is moulded in a form which combines gracefulness with strength. The rounding enables the pen to hold the requisite ink, and to distribute it more gradually than could be done with a flat blade.

The little hole which is cut at the end of the slit serves to regulate the elasticity, and also facilitates the running of the ink. Then comes the process of hardening and tempering. The steel is heated to a cherry-red, and then plunged suddenly into some cool substance. This at once changes the quality of the metal from that of a soft, lead-like substance to a brittle, springy one. Then the temper of the steel must be drawn, for without this process it would be too brittle. The drawing consists of heating the pen until it reaches a certain color. The quality of the temper varies according to the color to which the steel is permitted to run. It is the quick eye for color and the quick hand to fasten it that constitutes the skill of the temperer of steel. When the steel is heated for tempering, it is bright. The first color that appears is a straw color. This changes rapidly to a blue. The elasticity of the metal varies with the color, and is fastened at any point by instant plunging in cold water.

The processes of slitting, polishing, pointing, and finishing the pens are operations requiring dexterity, but by long practice the workmen and workwomen become very expert. There have been few changes of late years, and the process of manufacture is much the same that it was twenty years ago, and the prices are rather uniform, ranging from 75 cents to $4 a gross, according to the quality of the finish. The boxes sold almost universally contain a gross.

Fancies come and go in the styles of pens as in other fashions. One American maker alone turns out about 350 different patterns. Some are very odd, such as the stub pens, the draughtsman's pen, which makes two parallel lines at once; the mammoth pen, suited to use on rough paper; and the pen with the turned-up point, that writes a thick mark, yet runs smoothly over the paper. Then there are delicate pens for ladies, pens that make a fine hair line and yet can spring out to a heavy shading. Already the American steel pens have become famous abroad, and many are exported. Many pens are made of other metals besides steel. One kind is the German silver non-corrosive pen for red ink. Another is an imitation gold pen made of non-corrosive metal. There are pens of all colors and sizes for all trades and professions.

ENGINEERING INVENTIONS.

An electro-magnetic car uncoupler has been patented by Mr John D. Reed, of York, Neb. There is a pivot d shackle on the drawhead with an electro-magnet for operating it, conductors, contact strips on the ends of the cars for uniting them, with numerous parts and details of combinations, whereby cars may be uncoupled by electricity.

A vessel and apparatus for cutting channels in water ways has been patented by Mr. John Gates, of Portland, Oregon. The vessel has propelling apparatus and a movable rudder, with tanks or compartments for sinking the stern to any desired depth, a hoisting apparatus, and cables with anchors, to hold the stern in position to cut a channel by the backwash from the screw.

A pilot car has been patented by Mr. Jose Pesana y Pinol, of Madrid, Spain It has transverse partitions with buffer springs, with a water tank and bar or block of lead held transversely on the car, the side bars and braces having hinges, so the car can collapse, and the springs, water tank, and lead take up the force of concussion, the car being adapted to be coupled to the front of a locomotive to lessen danger or loss from collisions.

AGRICULTURAL INVENTIONS.

A potato planter has been patented by Mr. Joseph L. Ullathorne, of Memphis, Tenn It consists of a frame, rolling drum with wheels, and an open sided hopper arranged behind, and will also distribute a fertilizer in the furrows at the time of planting the potatoes.

A combined sod cutter, seeder, and harrow has been patented by Mr William F Hubbard, of Walla Walla, Washington Ter. This invention covers a special construction and combination of parts in a machine mounted on wheels, to be drawn over a field by a team, to pulverize hard soil, and at the same time drop and cover seed therein.

A cultivator has been patented by Mr. Thomas E. Gregg, of Mineral Spring, S. C. This invention covers a novel construction and combination to facilitate the cultivation of cotton and other plants planted in rows or drills, and also to promote convenience in adjusting the cultivator to work deeper or shallower in the soil.

A spade wheel plow has been patented by Hiram Skillings, of Minneapolis, Minn. This invention covers modifications and improvements in the construction of a spade wheel plow previously patented by the same inventor, the changes being principally with the view of reducing the expense of manufacture, and to promote convenience in putting in and removing the spades.

A stalk cutter has been patented by Messrs. Guernsey W. Davis and George A Davis, of Pine Bluff, Ark. A cutter roll bas end disks with radial grooves on their inner surfaces and hubs on their outer central faces, wings with bl[illegible] secured thereto being held in said grooves, and other novel features for breaking down two rows of corn, cotton, or other stalks, and cutting them into pieces.

A harrow has been patented by Mr William W Robinson, of Odebolt, Iowa. The teeth are carried by rocking beams under control of a [illegible] to change the angular position of the teeth relative to the ground, but the beams are of novel construction, with peculiar means for fastening the teeth as well as for carrying the beams and connecting them with the devices by which they are rocked

MISCELLANEOUS INVENTIONS

A nut lock has been patented by Mr Seth A. Lesan, of Mount Ayr, Iowa This invention consists in a special construction and combination of a screw bolt, a screw nut, washer, and key, for securing nuts upon screw bolts.

A gate has been patented by Mr Absalom King, of Wawpecong, Ind. This invention relates to gates adapted to close by their own weight, on farm and other roads, to prevent the straying of stock and to this end covers a special construction and combination of parts.

A weather board gauge has been patented by Messrs. William J. Dyerand Thomas W. Maxey of Nevada, Mo. This invention provides a means for carpenters to more accurately space weather boards, and hold them exactly in proper relation to previously placed boards, while nailing them in position

A log turner has been patented by Mr. William F. Fidler, of Rock Cave, West Va. This invention provides special means in combination with the hook and tackle, the carriage, and its knees or blocks for preventing the log from sliding laterally out of place while being turned.

A copy book has been patented by Mr. Edward P Conner, of Alameda, Cal It includes a book support, which may be shut up with the book or spread out and extended, a novel arrangement of covers and other special features, designed to afford a copy book which will facilitate giving instruction in penmanship

An ale faucet protector has been patented by Mr. George Hirschman, of Morristown, Pa. It has a flanged base, with an opening and recess in front, so it can be easily secured in place, and the faucet readily applied, detached, and operated, so the faucet will be protected.

A wire fence has been patented by Mr. Lafayette W. Lindley, of Danville, Ky. It is a fence which can be erected or taken down very rapidly, and folded compactly for storage or shipment, and is an improvement on a former patented invention of the same inventor.

A window bead fastener has been patented by Mr. Ezra W. Talbott, of Napoleon, Ohio. This is an improved device for holding the stop of a window in place on the frame in such a manner that it can be readily removed or secured in place, and need not be nailed or screwed.

A stencil holder has been patented by Mr. John W. Bennett, of Halifax, N. S., Canada. This invention covers a peculiar construction and arrangement of two clamp plates or frames for holding the stencil plates, and means for fastening the plates together and preventing them from moving laterally.

A piano forte attachment has been patented by Mr. Emil Hofinghoff, of Barmen, Germany. This invention covers a bar held to be movable across the strings, a series of tongues being fastened to the bar, and these tongues having rubber surfaces facing the strings, whereby the tones of the piano are changed.

An anchor support and tripper has been patented by Mr. Rufus P. Trefry, of Bridgewater, N. S., Canada. The anchor is so made as to hold by the fluke, while its stock comes against the hull of the vessel, and it is also so constructed as to facilitate its casting off without danger of fouling.

A game apparatus, or a new and improved game, has been patented by Mr. James A. Fitzgerald, of Salt Lake City, Utah Ter. It is formed of a vertically slotted board held between two side pieces or standards rubber face plates being secured on the surfaces of the bars between the slots, and the game being played with a series of disks or flat rollers.

A device for transmitting power by belts and pulleys has been patented by Mr. Nicholas Yagn, of St. Petersburg Russia. This invention covers a means of using pressure rollers upon both driving and driven pulleys to increase the power transmitted by belts, with the design of thus increasing their efficiency and economizing in amount of belting needed.

An improved universal joint has been patented by Mr. Rollin H Gleason, of Egan, Dakota Ter. The invention consists in providing one of two abutting ends of two shafts revolving in the same direction, but meeting at an angle with a socket, which has an inwardly projecting rib or flange upon its opposite interior sides, with other novel features.

A shield for brooms has been patented by Messrs. Neil W. Dew and Columbus F. Robertson, of Charleston, Ill. A safety shield of novel construction is made to cover that portion of the broom where the straws are joined to the handle, and thus largely dispense with the labor of winding and braiding, while giving a neat and durable finish.

An inkstand has been patented by Mr. Morris Herzberg, of West Point, Ga. It has a removable apertured tube, with a spring, and a vertically reciprocating dip cup resting on the spring within the tube, with other novel features, so there is no danger of covering the pen holder with ink, and if the ink stand is upset only the ink in the dip cup will be spilled.

A hoop fastener has been patented by Mr. William D Richardson of Springfield, Ill. This invention consists or a flat metal key, with converging rows of projecting barbs on one side and a flange or lip on the other side at the end, the key to be driven between the hoop and the barrel staves, with its barbs in contact with and burying in the wood, and the end flange turned outwardly and forming a shoulder.

An apparatus for painting wire fences has been patented by Messrs Alonzo L. Marsau and Henry C Hill of Milton, Iowa This invention relates to apparatus in which revolving brushes are supported in a paint reservoir moved along the wire, and provides for moving the apparatus continuously without stopping at the posts or removing the brushes off of contact in passing the posts

A roll for forming link blanks has been patented by Mr Jesse T Wright, of New Albany, Ind. The curved ends of blanks to be subsequently punched are made on the last pass when rolling the bar to prepare for the blanks in deep, narrow grooves of the rolls, for passing the bar edgewise, with dies corresponding to the length of the blanks, and for shaping the ends separating the blanks for car coupling links.

A measure for grain, shot, and other like articles has been patented by Mr. Hiram W. White, of Yankton, Dakota Ter. This invention covers a special construction and arrangement of parts, bins with hopper shaped bottoms, having lozenge shaped apertures, a measure, with novel means for operating the slides to convey the material from the bins to the discharge chamber, and other peculiar features.

An improvement in the manufacture of bichromate of soda has been patented by Mr. William Simon, of Baltimore, Md. It consists in evaporating the solution of neutral chromate of soda to dryness before adding the sulphuric or hydrochloric acid, and adding to the dry salt common sulphuric acid, whereby anhydrous sodium sulphate crystallizes out, whence the concentrated solution of bichromate of soda is mechanically separated.

NEW BOOKS AND PUBLICATIONS.

TRAITÉ PRATIQUE D'ELECTRICITÉ INDUSTRIELLE. Par E. Cadiat et L. Dubost.

This work, as its title indicates, is a practical treatise on the subject of electricity and it has been the purpose of the authors to present the subject in a form as free from technicalities and abstruse mathematical calculations as possible, and to render it at once interesting and instructive and a ready work of reference to the artisan, the engineer, and mechanic. The first part of the treatise is devoted to definitions and fundamental laws as well as the most important subject of units and measures. Then follows an examination of the different kinds of batteries, dynamos, and electric generators, secondary batteries, etc. The third section contains a review of the various systems of electric lighting, also a comparison between the cost of lighting by electricity and gas and the application of the former to the illumination of ships, theaters, studios, shops, and residences. Electricity as a motive force as applied to railways and aerial navigation is treated of in part four. There are two other sections, which are devoted to galvanoplastic and electro metallurgy and telephony. This work of 500 pages contains numerous illustrations. Price 15 francs. Publisher, J. Baudry, 15 Rue des Saints Pères, Paris, France.

Notes & Queries

HINTS TO CORRESPONDENTS.

Name and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.

Special Information requests on matters of personal rather than general interest, and requests for **Prompt Answers by Letter**, should be accompanied with remittance of $1 to $5, according to the subject, as we cannot be expected to perform such service without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Minerals sent for examination should be distinctly marked or labeled.

(1) J. T. W. writes: In the issue of October 25th, W. G. F. asks how calcium sulphide is used to remove hair, etc. Now, will calcium sulphide effectually and permanently remove superfluous hair, and if so, which of the sulphides of calcium? A. The calcium and barium sulphides are considered effectual depilatories. The particular one that is used is the CaH_2S_2 or CaS,H_2S, called by Watts the sulphydrate of calcium.

(2) C. J. D. asks: Is celluloid used to coat metals, as is nickel? Can you give me a good solution to coat tin with to prevent acids from eating same? A. Celluloid is not used in the manner suggested. Celluloid is soluble in chloroform, and by painting the surface with such a solution, as the chloroform evaporates a coating of celluloid will be deposited. A coat of good hard drying asphaltic varnish would, we think, be more suited to your wants.

(3) H. A. D. asks for the formula for making a fluid substitute for silver plating which will last for a few days. A. Prepare a solution of one part potassium cyanide in 6 parts water; add to it a concentrated aqueous solution of silver nitrate (free from acid) until the precipitate is redissolved. Mix this solution with fine chalk, and apply after previously clearing the objects.

(4) E. B. B. asks how to extract the oil from the skins of duck or other water fowl, to be used for trimmings. A. Dip the feathers for a few minutes in coal tar naphtha or benzine, and then dry by exposing to the sun.

(5) V. J. P. asks if there is any way to hold sulphur in solution in mineral oil (paraffine) to be used as a lubricator. A. Sulphur is frequent y a constituent of crude petroleum; it is soluble generally in the fatty oils, in naphtha especially, when the liquids are hot.

(6) E. S. B. writes: In a late number you say 1 ounce of salicylic acid will prevent fermentation in cider. Is this acid injurious to health? Would it not be a good ingredient in the composition of brine for the preservation of meat, making it unnecessary to use so much salt to make it keep? A. It is used as suggested by you for the preservation of meat. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 226, for exact quantities to be employed. By some its use is condemned, while others assert that it is not at all injurious to the health.

(7) P. S. M. asks the average amount of square plate or pipe surface used in practice for heating 1,000 cubic feet of room space in buildings by hot water or low pressure steam, say 5 pounds, and the same for high pressure steam. A. 10 to 12 square feet per 1,000 cubic feet for hot water, 7 to 9 square feet per 1,000 cubic feet for low pressure according to exposure, and 6 to 7 square feet per 1,000 cubic feet for high pressure.

(8) G. C. G. asks a good receipt for preparing raw meerschaum for smoking purposes. A. When freshly exhumed the mineral is covered with red, oily earth, and is so soft as to be easily cut by a knife. Its preparation is slow and troublesome. After removal of the earth, it is dried 5 or 6 days in the sun or 8 to 10 in a hot chamber, then it is cleaned again and polished with wax. Then the different kinds, of which there are ten, are sorted and carefully packed with wood in boxes. In Germany, where the bowls of the pipes are principally exported to, they are prepared for sale by soaking them first in tallow, then in wax, and finally by polishing them with a sharc glass.

(9) J. C. A. writes: Can you give me a formula for an ink which after being printed on paper the print can be transferred to cloth by a warm flat iron, the ink not to crack when the paper (printed on) is folded or rolled up? A. The process you desire has been described as follows: Dust over the stencil white lead (or any suitable coloring material) with a little resin, fixing the pattern by covering with a piece of paper and ironing with a hot iron. When the cloth can be turned (as by placing between boards or book covers) without scattering the powder, it may be preferable to apply the heat directly to the back of the fabric. It is also possible to prepare an ink by dissolving the coloring material and adding a thin solution of mucilage of gum acacia. The mixture should have the consistency of thin paste.

(10) B. F. A. asks: 1. I have a casting 8 inches in diameter, how much sulphuric acid is required to make it 2 pounds lighter, and how strong should the pickle be? A. Castings are generally turned smaller by cutting away a certain amount on the lathe. From the data furnished no estimate could be given. 2. What is the composition of inclosed mineral, and what acid will take the rock off without injuring the diamond? It is found in hard coal mines. A. The specimen is iron pyrites, or sulphide of iron. Mechanical treatment will remove the coal; possibly a gentle heat might be used to burn away the coal. Acids would decompose the mineral, and would be without influence upon the matrix.

(11) E. E. S. writes: I desire to construct a small electric engine, with power enough to run a sewing machine or such other machinery of about the same size. Can you tell me where I can get a description or directions for so doing? A. There is little difference between a small dynamo electric machine and an electric motor. By following the instructions given in SUPPLEMENT, No. 161, for the construction of a small dynamo, you will be able to make a machine that will answer as a motor, by altering the adjustment of the commutator.

(12) W. A. M. asks how to make yeast cakes known as dry hop yeast, and used for raising dough for bread. A. Marion Harland gives the following: 2 quarts water cold, 1 quart pared and sliced potatoes, double handful hops, tied in a coarse bag, flour to make stiff batter, and 1 cup Indian meal. Boil the potatoes and hop bag in two quarts of water for three-quarters of an hour. Remove the hops, and while boiling hot, strain the potatoes and water through a cullender into a bowl. Stir into the scalding liquor enough flour to make a stiff batter. Beat all up well, add two tablespoonfuls lively yeast, and set in a warm place to rise. When light, stir in a cup of Indian meal, roll into a sheet a quarter of an inch thick and cut into round cakes. Dry them in the hot sun or in a very moderate oven, taking care they do not heat to caking. When entirely dry and cold, hang them up in a bag in a cool dry place.

(13) W. F. S.—Perhaps the best method of preventing frost from forming on window glass is to cover the glass with a thin film of glycerine.

(14) A. De W. asks (1) if there is anything to bleach vaseline to a pure white or lard color. A. According to the U. S. Dispensatory, vaseline or petrolatum is decolorized by passing it through charcoal when in a liquid condition. 2. What is the best thing to remove paint and grease spots out of last year's overcoat without spoiling the goods? A. For the cleansing of various fabrics see table given in SCIENTIFIC AMERICAN SUPPLEMENT, No. 158.

(15) J. M. P.—Receipts for burnishing ink for shoes are numerous, but all the successful makers of this article have secrets, either as to the ingredients or the method of manufacture, which they guard as a valuable property right. As pertinent to this subject, we have knowledge of an attempt by a New York dealer to make an ink similar to that furnished by a leading Eastern manufacturer, in which the New York dealer failed after expending more than $10,000 in his experiment.

(16) J. S. O'B.—The American Bell Telephone Company claim to control all speaking telephones. If they are able to sustain their claim, you will, of course, not be entitled to make the telephone referred to for your own use or for any other purpose. The telephone described in SUPPLEMENT, No. 142, if well made, will talk for five or six miles. You should not use smaller than No. 14 iron wire; the No. 12 is the size commonly used. A magneto call bell is generally used with this kind of telephone. You can get a good ground connection by attaching your wires to the water pipes or to plates of copper, each having an area of about 8 or 10 feet, buried in earth that is constantly moist.

(17) F. U. S. writes: I have some fine colored engravings which have been badly soiled with printer's ink. Can you inform me what will remove the same without defacing the pictures? A. The process of cleaning soiled engravings is described in SCIENTIFIC AMERICAN SUPPLEMENT, No. 44. It would apply also to printer's ink, but the process is a delicate one, and great care must be taken not to injure the engraving. Hydrogen peroxide is another excellent bleaching agent.

(18) J. H. M.—As a young man desiring to become a thorough electrician, we think your better way would be to secure employment in some establishment manufacturing electrical apparatus, and while thus engaged to study the subject of electricity. You might begin with Sprague's new work on electricity, then study the works of Gordon and others on electric lighting and the general applications of electricity.

(19) D. W. asks how the polish is put on playing cards. A. All the successful manufacturers have some secrets in this department of their business, but the polish is made by a coating of size or varnish and then passing the sheets, with metal plates, through polishing rollers.

(20) D. E. C.—Lacquer for tin: Brass color: 3 ounces seed lac, 2 drachms dragon's blood, 1 ounce turmeric powder, 1 quart 95 per cent alcohol or methylic alcohol; put in a bottle well corked, and place in a warm place and shake up occasionally for a week or ten days, then strain through a fine cloth. Temper with methylic alcohol so as to spread freely with a brush. Heat the tin in an oven about as hot as boiling water; brush the lacquer on quickly. Vary the dragon's blood and turmeric to suit your taste as to depth of color.

(21) J. M F.—Lime cylinders for calcium lights are commonly made from selected pieces of unslaked lime of good quality. They are also made of lime obtained by calcining marble. We know of no method of utilizing slaked lime in a calciumlight.

(22) F. B.—Leclanche battery is good for certain kinds of experiments. It will not yield a constant current for a very long time; it certainly is cheap and clean, and if you require a current intermittently for a few moments at a time, it will probably answer your purpose. If you want a continuous current, the Daniell or the gravity battery would be better for your purpose.

(23) A. F. L. asks the cheapest and most practical way to finish cheap soft wood furniture, and what ingredients are used for such finishing. A. Fill the pores of the wood with a Wheeler wood filler, then apply one or two coats of white shellac varnish.

(24) J. C.—The process of separating fiber from vegetable growth depends something on the kind of fiber and the kind of vegetable from which it is to be separated. In general the vegetable may be reduced to a pulp by rolling or pounding, and then it may be washed away from the fiber. There are machines in use for this purpose, and a number of them have been patented. We know of no process of making the fiber stronger than it is, after being thoroughly freed from the vegetable pulp.

(25) J. F. D.—The great proportion of the carriage hardware used now is made of malleable iron, generally cast in one piece. Some of the better kinds of carriage hardware are made by the process of drop forging. The machinery used for producing such forges is a drop press and a steam or drip hammer.

(26) E. L. K. writes: I have an oscillating engine cylinder 1¼ diameter, 2 inches stroke. Have got to make a boiler. Have got a 3 burner oil stove, and am going to make boiler all of copper, and following dimensions to fit it: Drum 6 inches diameter, 6 inches long, shell one-sixteenth inch thick, heads a quarter of an inch thick, 40 drop tubes three-quarters of an inch diameter outside, 6 inches long, one-sixteenth thick, tube passing through drum as flue in center for stay. This will be well jacketed. Would like to know how much pressure is safe to carry, and if of sufficient capacity for above engine, understanding of course that boiler is to be well made. A. We doubt the propriety of putting 40 tubes ¾ inch in a 6 inch head. If the heads are slightly raised and the tubes made radial, you will add to its efficiency; one tube through center will not be sufficient vent. Such a boiler, if properly made with well brazed joints, ought to carry 80 pounds pressure and of capacity equal to your engine.

(27) H. M. F. asks (1) the size and kind of wire to make a spark coil for lighting gas. A. You will find instructions for making induction coils in SUPPLEMENT, No. 160. A simple magnetic coil of eight or ten layers of No. 18 or 20 wire will answer for gas lighting purposes. 2. How many cells of Faure's secondary battery would it take to light an incandescent light to read by, the secondary cells to be charged by one of Edison's large dynamos? How long would it take to charge them, and how long would they last? A. There is no economy in operating a single incandescent lamp by means of a secondary battery or in any other manner. A sixteen candle power incandescent lamp will probably require from 15 to 20 cells of secondary battery. To charge a secondary battery economically should take several hours, and the length of time during which the battery will yield a current depends altogether upon the resistance of the circuit through which it has to work. If the resistance is high, the battery will work for several hours; if the resistance is very low, the battery will run down in a few minutes.

(28) J. H. C. asks: 1. Is there an established rule for the speed of the circumference of the paddle wheels of a steamboat to give best results? A. No. 2. What length should the paddles be in proportion to width of boat? A. Usually about one-third, but depends much on model and draught of water. 3. Would a one horse engine run a boat capable of carrying a ton, the boat of fair proportion, and at about what speed? A. It would run a boat with speed, but little if any better than with two pairs of oars. 4. What length and width of boat—not to draw more than eight inches—would it require to carry 2,500 pounds? A. Depends much on model and weight of boat; if model is sharp, boat not less than 34 feet long and 6½ feet beam.

(29) E. L. S. asks: 1. What per cent of the power required to run a dynamo machine is utilized by the best motors in use, if they should receive the current from the dynamo? A. About sixty per cent. 2. Where can I buy a small dynamo of sufficient power to give electrical shocks? A. From any of the dealers in electric supplies who advertise in our columns. 3. About what is the electro-motive force of a small Grenet battery in good order in volts? A. About 1½ volts.

(30) C. G. S. writes: I have dipped my pencil into a goblet, and brought up a drop of water. 1. What force binds together the pencil and the drop? A. The attraction of adhesion. 2. What holds the drop to other drops? A. Cohesion. 3. Why is not this ice instead of water? A. Because it is fluid. 4. If I shake the pencil, in what direction does the drop fall? A. In a tangent to the line followed by the point of the pencil. 5. If the drop were larger than the world, which way would the world go? A. It might follow the drop of water. 6 What other force is there in it which, according to Faraday, is equal to that in a flash of lightning? Here are, then, five great forces in a drop of water. What I wish to know is the name of those forces, as cohesion, gravity, etc.? A. If furnished with the proper accessories, it might generate an electric current, which would equal in quantity the quantity of a very small flash of lightning.

(31) H. B. asks the size of boiler to give the best results in working a ten horse power engine (vertical), and says he will also require two horse power of live steam for other uses. A. If for anthracite coal, 32 or 34 inches diameter of shell and 11 feet in length; 20 or 22 return tubes 3 inches diameter. If bituminous coal be used, it would be best to make the boiler 18 inches or 2 feet longer. This boiler should supply the power with small grate, and economically.

(32) H. B. M.—We understand the engines referred to, to be the same which have so often broken down. You can rely upon it, that there is to be no gain of 30 per cent by the " patent quadrant."

(33) W. H. M. asks for the length and original cost of steamers Bristol and Providence, plying between Fall River and New York? A. Three hundred and sixty-two feet long; original cost understood to be about $900,000 each.

(34) F. W. writes: 1. Will you instruct me how to build a Holtz electric machine? A. Consult SUPPLEMENT, 278, 279, and 282. 2. Is hard rubber or glass preferable? A. Use common window glass. 3. What is the price of hard rubber in sheets? A. We believe it is about a dollar a pound. 4. Does the machine work equally as well in damp as in dry weather, or does moisture in the air affect it, as is the case with the old time electric machine with glass disk and rubbers? A. It will work better than the old fashioned disk and rubber, but it will sometimes fail in very warm damp days. 5. Will size of spark be increased by increasing size of plates? A. The size of a spark will be increased by increasing the size of the Leyden jars attached to the machine. The length of the spark will be increased by using plates of larger diameter. 6. Would it be possible to utilize the spark for illuminating purposes, and if not, why? A. No. The current generated by the Holtz machine has a very high intensity, whereas a quantity current is required for illumination.

(35) N. E. F. writes: If a man makes an improvement on the Bell telephone that does not infringe their patents, has he a right to attach it to an instrument he has rented of them, and use it for his own use? A. We know of nothing to prevent you from applying and using your improvement.

(36) C. M. writes: I have modeled flowers in clay, and would like to know how to bake them so that I can paint them. What else would answer the same purpose as clay? A. The method of baking the flowers you have modeled in clay depends in a measure upon the character of the clay, and we know of no way to determine the best method without experiment. A mixture of glue, resin, and whiting is used for the ornaments of gilt frames, and it might possibly answer your purpose. It is moulded warm, and, of course, needs no baking.

(37) W. B. R. asks of what agate buttons are made? A. Genuine agate buttons are, of course, made from natural agates; the artificial article is made of colored glass.

(38) W. M. B. writes: I desire to sustain a weight, say 2,500 pounds, on two floats, 24 feet apart; the weight must be 4 feet from one and 20 feet from the other float. I know the total displacement will be approximately 40⅓ cubic feet; how much displacement will there be in the large float, four feet from the weight, and how much in the small float, twenty feet from the weight? I think approximately 32 cubic feet in the large float and 8 feet in the small float. A. Your figures are correct for the centers of floats from supporting fulcrum. This is without consideration of the weight of the material of the floats and balance beam. The floats must be as much larger than your figures as is equivalent to the weight of the apparatus, in order to be equal to the support of 2,500 lb.

(39) J. T. writes: I use a good deal of walrus tusk for handles, and very often they have a yellow stain in them. I used to bleach them in the sun, but it is a very slow process. Is there any quicker way? A. Elephant tusks are bleached in three or four days by immersion in turpentine, keeping near the surface, and exposing to sunlight, and probably this is the best way now known for your purpos.

(40) G. W. B. asks: 1. What kind of cement used, and how to cement gum face on band saws? A. Ordinary rubber cement, such as you can purchase at any of the rubber stores, will answer your purpose. 2. Is there anything to be put in glue to prevent moisture from disturbing the joints in patterns? A. A little bichromate of potash put into your glue will render it insoluble, after exposure to light. 3. Is there anything to prevent shellac used for patterns from getting dark before using after it is mixed some time? A. We know of no way to prevent this.

(41) A. C. H. asks by what mode or process the rust stains in old Leclanche porous cups can be removed? A. Try dilute sulphuric acid.

(42) E. L. H. asks is there any way or process to reharden annealed brass rods? A. We know of none, except redrawing or burnishing, which will only harden the surface.

(43) S. E. F.—Waxed paper, such as used for wrapping soap, is prepared by placing cartridge or other paper on a hot iron and rubbing with beeswax or brushing on a solution of wax in turpentine. On a large scale, it is prepared by opening a quire of paper flat upon a table, and rapidly ironing it with a very hot iron against which is held a piece of wax, which, melting, runs down upon the paper and is absorbed by it. Any excess on the topmost layer readily penetrates to the lower ones.

(44) W. S. C.—In closed circuits for steam heating, the pressure of the steam along the flow pipes and in coils in well arranged systems is so nearly equalized with the pressure in the boiler, that it requires but small elevation of the water of condensation in the return pipe above the water level in the boiler to allow of its return by gravity. In this system all of the radiators should be not less than from 1 to 5 feet above the water level in the boiler, according to the complication and extent of the circuit. The air is discharged at the radiators, and no waste of water is necessary.

(45) W. B. R. writes: I have about a ton of tacks slightly rusted. How can I clean them? Sulphuric acid does it, but they rust again before I can dry them. Attrition in a rattler ruins the points. If dried in sawdust, how can I separate them from the same? If with lime, how remove that? They must be clean enough to carry in the mouth, as is the practice of most users of tacks? A. Put the tacks in a wire cloth basket, dip in the sulphuric acid bath and quickly plunge in boiling hot water, then in boiling hot lime water, then throw the tacks upon a wire cloth over a fire to dry quickly. The lime water should only contain as much lime as the water will hold in solution cold. It should not be milky.

(46) Dr. E. H.—Remove your carbon electrodes from the porous cells of your battery, and soak them for a day in warm water. Remove the granulated black oxide of manganese from the cells, and soak the cells in warm water for the same period; then replace the carbon electrodes in the cells, and fill with fresh granulated black oxide of manganese, and seal the cells with pitch, leaving a small aperture in the sealing for the escape of air, and we think you will find your batteries as good as new.

(47) G. D. writes: 1. Can you give formula for gelatine pads and the ink for use with them? A. consult article on " New Copying Process " in SUPPLEMENT 374. 2. I wish to light with bichromate batteries, using at different times 2, 5, and 10 Edison lamps. How many cells will I require in each case, and how should they be connected—for quantity or intensity? A. We cannot advise you to attempt to operate ten Edison lamps with bichromate batteries. You will find it exceedingly troublesome and expensive. You can light one or two for experimental purposes readily enough, but if you desire to run ten lamps for actual use, we advise you to purchase a dynamo and a steam engine to generate the current. If you conclude to try the experiment of lighting by means of incandescent lamps, operated by batteries, you might begin with about 150 cells of carbon bichromate battery of the Bunsen type. The lamps should be connected in multiple arc and the batteries in series of two to four, and these series connected for quantity.

(48) G. H. P. writes: I have a turbine water wheel which I am running with a full gate, using it to drive a paper machine. I am told, if I put on a larger driving pulley, that I will then drive the machinery faster with the same power. I contend that this cannot be so. A. Our opinion is that you cannot gain power by enlarging the pulley unless you can raise the head of water; much depends upon the present speed and size of wheel. The opinion of the maker of the wheel will be more reliable than that of those not knowing the peculiarities of its construction. If the wheel is now running at a very high speed, the reaction may not be perfect; in such case, increasing the size of the pulley might be of benefit. Our reference to the maker is therefore the best advice.

(49) W. A. M.—Good glue mixed with about one-quarter its bulk of fine wood ashes makes a strong cement impervious to oil. Gutta percha dissolved in bisulphide of carbon makes a strong cement not easily penetrated by oil. Make the cement as thick as treacle. Warm the parts to be cemented, and press together tightly.

(50) W. O. McK.—The Scotch water gauge glasses are made of silica and kelp or potash, and are slightly soluble, especially in acid waters, in which we understand, your State abounds, as we frequently hear of its action upon boiler tubes and pipes. Its action is more marked where there is rapid circulation. If you will measure accurately the inside of a new glass tube, and make comparison after a few months' use, you will probably find the hole larger by the dissolving or wearing away of the interior, as well as the exposed end.

(51) W. S. P. asks: What is a solar compass? On what principle it works? A. The solar attachment is a frame with arms and graduated limb, placed upon the telescope of a compass or field transit for the purpose of obtaining local meridians by observation of the sun's position. We cannot give a detailed description that you can comprehend without illustrations.

(52) M. R. S.—The crystallizing barometer or weather glass should not have a closed tube or be hermetically sealed, but should have an open top covered with gold beater's skin or fish bladder so loosely that the difference of pressure of the air may be transmitted to the liquid within the glass, otherwise it is of no value whatever. The alcohol holding camphor in a saturated solution crystallizes variably with the pressure, and does not always rise and fall, contrary to the motions of the mercury barometer, but often in the most fantastic combinations. It is a pretty and curious instrument for the study of the formation of crystalline combinations, but useless as an instrument of precision.

(53) W. M. J. M. asks: Would it be advisable in building a small steam yacht with a high pressure engine to put the exhaust under the fan tail and under water, to prevent the noise? A. The exhaust may be carried through the bottom and alongside of the keel, opening under the screw. It will partly condense in the pipes, and makes a little noise by concussion with the water. We do not think it of much advantage. Making the upper part of the exhaust pipe two or three times larger than at the engine, will modify its intensity.

(54) S. R. L. asks for receipts for dyeing cotton fabric red, blue, and ecru. A. Red: Muriate of tin, two-thirds cupful, add water to cover goods; raise to boiling heat; put in goods one hour; stir often; take out, empty kettle, put in clean water with Nicaragua wood one pound; steep one-half hour at hand heat, then put in goods and increase heat one hour, not boiling. Air goods, and dip one hour as before. Wash without soap. Blue: For three pounds goods blue vitriol 4 ounces, boil few minutes, then dip goods three hours; then pass them through strong lime water. Ecru: Continue the foregoing operation for blue by passing the goods through a solution of prussiate of potash. Also see the receipts given in SCIENTIFIC AMERICAN SUPPLEMENT, No. 167.

(55) E. H. S.—Coal tar alone with gravel and sand for side walks does not dry well. Asphaltum with equal parts of coal tar melted together and sprinkled upon the mixed sand and gravel that has been made hot upon an iron plate (the mixing to be done in a large pan of iron), putting no more asphalt and tar upon the sand and gravel than will just make it stick together; then dump into place while hot, spread quickly, and beat level with a ram or heavy roller. Dust over the surface with fine sand before rolling or beating, to prevent the material from sticking to the roller or beater. This operation requires a little care and experience as to just the amount of asphalt and tar for a given measure of sand and gravel, and also for the proportions of sand and gravel required to make the best pavement. Sometimes a thin bed of broken stone is laid as a foundation. Also a thin bed of coarse gravel is sometimes spread before dumping the hot mixture.

(56) J. F. S. writes: Can you inform us as to preparation or manufacture of "oil of apple" or "essence of apple," advertised by manufacturers and dealers in oils, extracts, essences, etc.? A. The essence of apple is composed of aldehyde 2 parts; chloroform, acetic ether, nitrous ether, and oxalic acid each 1 part; glycerin 4 parts; amyl valerianic ether 10 parts. 2. Please give a formula for the manufacture of artificial cider. A. Imitation cider consists of 25 gallons soft water, 25 pounds New Orleans sugar; 1 pint yeast; 2 pounds tartaric acid. Put all the ingredients into a clean cask, and stir them up well after standing twenty-four hours with the bung out. Then bung the cask up tight, add 3 gallons spirits, and let it stand 48 hours, after which time it will be ready for use. 3. And champagne cider. A. Champagne cider can be prepared by taking 10 gallons of cider, old and clear. Put this in a strong iron bound cask pitched inside (like beer casks); add 2¼ pints clarified white plain sirup; then dissolve in it 5 ounces tartaric acid; keep the bung ready in hand, then add 7½ ounces of potassium bicarbonate; bung it as quickly and as well as possible.

(57) A. H. says a manufacturer of ladders here contends that ladder rounds (for a common straight ladder) tapered off from the center gradually to the ends down to the size of the tenons are stronger and stiffer than to leave the rounds straight and taper them off at the ends just enough for the tenons; rounds the same size in the center. Is he right? A. No. He is wrong.

(58) S. Van D. asks: Why does a sulphurous smell always accompany a thunderbolt? A. The odor is supposed to be due to the formation of ozone.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Granted

November 25, 1884,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

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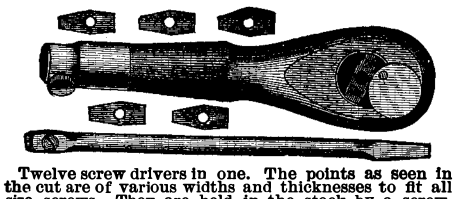

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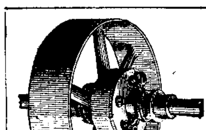

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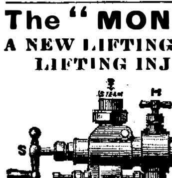

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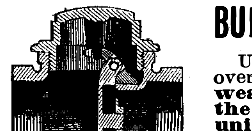

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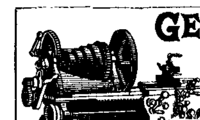

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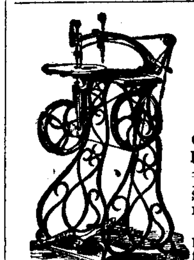

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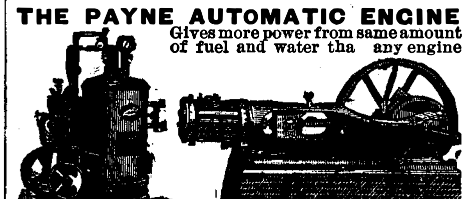

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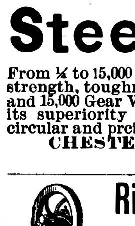

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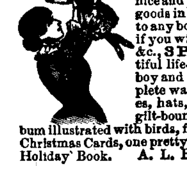

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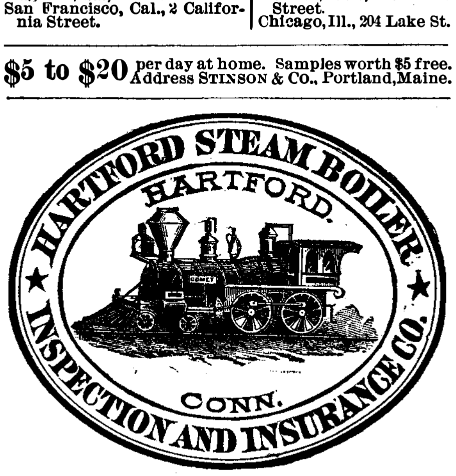

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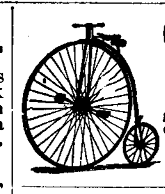

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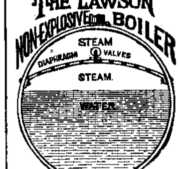

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