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COMBINATION ICE AND FREEZING HOUSE.

We recently illustrated a novel plan for manufacturing ice (see page 54, Vol. XXXI.) during the winter season, which could be practised by any person owning a suitable house for the preservation of the ice. The main features of the process consisted in filling canvas tanks, supported in frames of wood or metal, with water, and allowing them to remain in a shed or freezing house until their contents were thoroughly frozen. A simple arrangement, whereby the tanks were afterwards submitted to warming by steam, allowed the ice to be readily removed in neatly shaped blocks, ready for storing.

The invention which we now present is a freezing house in which the above operation is carried on, placed above an ice house, so that the manufacture of the ice can be carried on in the upper story and the frozen blocks lowered at once into the receptacle beneath. Above the ice house, which may be of the form shown and of any suitable construction, are erected standards for the support of roof and side awnings. At A is a large water tank which is filled from a well or hydrant, and from which the water is elevated to a regulating cistern, B, by means of the pump, C. By slightly raising the gate of this cistern, the water is allowed to pass in a thin sheet to the inclined canvas cooling plane, D, where it is exposed to the action of the cold air which freely blows through the open sides of the shelter. When the water has flowed to the bottom of the first plane it is caught by a second plane, E, which conducts it to leaders, F, by which it is distributed to the freezing tanks, G, which consist of canvas receptacles placed in frames, as above described.

When these tanks are frozen solid, a fire is made under the boiler, H, the steam from which passes through a flexible tube to the box, I. It is merely necessary to place the box over each tank for a moment to insure the loosening of the ice, when the block may be at once removed and lowered into the ice house by means of the winch shown.

Combined ice and freezing houses may thus be constructed of various sizes and productive capacities, ranging from 10 tuns, suitable for private houses, to 200 tuns, suitable for butchers and confectioners, and 1,000 tuns and over for commercial purposes. By their use ice can be produced in any desired quantities in locations where none is to be obtained from ponds or rivers, and in latitudes where rivers never freeze over, the only care necessary being to store the ice, when made, before a change of weather can affect it. The plan, we are informed, can be used with advantage as far south as Northern Alabama. In a more southerly location, the number of cooling planes can be increased. Freezing will be accomplished most rapidly when the canvas roof and walls are removed and the uncovered tanks are free to radiate their heat.

The quantity of ice produced during a winter north of Baltimore is estimated at not less than two tuns for each freezing tank twenty eight inches square by ten inches deep, and the cost, we are assured, need not exceed fifty cents per tun. Two men are sufficient to fill a 1,000 tun ice house, and smaller houses of from one to two hundred tuns need not require the labor of more help than is ordinarily employed about the premises.

Patented July 14, 1874. For further particulars as to buildings, apparatus, and patent rights, address the inventors, Messrs. Newsham, Haines & Henson, 108 Pacific street, Newark, N. J.



NEWSHAM, HAINES AND HENSON'S COMBINATION ICE AND FREEZING HOUSE.

Protecting Cast Iron Pipes.

The water from mines frequently contains enough acid to attack cast iron pipes, destroying them in a short time. Oil colors and varnishes offer but a limited resistance, and the process of enameling employed in Oberschlesia, says M. Englehardt, of Ibbenburen, although permanent and effective, is expensive. Cement is cheaper, and is not acted upon by these waters, and the only question to be settled was whether it would adhere to the smooth iron with sufficient firmness.

Two similar pieces of rolled iron were taken, and one of them painted over five times with a very thin cement, so that the coating was 0·15 or 0·20 of an inch thick. Both pieces were suspended near together in that part of the shaft where the water had attacked the signal cable most violently, and were left there four months. On taking them out, the unprotected iron was found to be reduced to one third its original thickness; the other, in which a hole had been bored to suspend it, had suffered the same corrosion at the exposed portion; the cement covering was dark brown, but perfectly hard and unattacked by the acid. The cement was broken off, and the surface of the iron exhibited the dark blue color and luster that it had on leaving the rolls.

As this coating adhered so well to the smooth rolled iron, to which it cannot cling as tightly as to the rougher surface of cast iron, the experiment was continued on a larger scale. A 24 inch discharge pipe in the Oeyhausen shaft was protected on the inside with cement. The coating remained unchanged for two years, while the pump was in constant operation. At the beginning of last winter the pump was stopped; and the pipe being no longer under water, the cement was so much injured by the frost that it scaled off. Several other experiments were made with similar results.

The pipes should be new, or, if old, well cleaned from rust before applying the cement, which is mixed as thin as is possible without injury to its tenacity. The pipe is moistened before the cement is applied, a thin coating of cement is put on and allowed to dry; when hard, it is moistened and a second coating applied, and so on four or five times. The operation cannot be conducted so well in very hot weather, as the cement dries too quickly; nor must the pipes be exposed to frost during the operation or afterward. This unfortunate sensitiveness to cold may, perhaps, yet be overcome by intervening some semi-elastic material between the iron and cement.

Measuring Distances by Sound.

Major de Boulengé, of the Belgian army, has recently devised an instrument for the above purpose, which he calls a battle telemeter, and which appears to give remarkably accurate results. The apparatus consists of a glass tube having graduations along its length representing distances measured. The tube is closed at its extremities, and is filled with liquid in which is a metallic traveler, formed of two disks united by a central rod. The diameter of the disks is a little less than that of the tube, so that when the latter is vertical the traveler will descend with a slow and uniform motion. A brass covering protects the glass, and has a slit through which the scale and traveler can be seen. Knowing the velocity of sound and that of the traveler, it is easy to construct the distance scale.

In operation, the edge of one disk is brought to the 0 mark; and the instrument being held horizontally, the flash of the cannon, for example, is noted; at that instant the telemeter is turned to a vertical position, and so held, the traveler, of course, descending meanwhile, until the sound is heard, when it is again brought horizontal. The position of the traveler denotes the distance to be read on the scale.

It is stated that, during the course of official experiments at the Belgian Artillery School, the instrument, in estimating distances of 3,200 yards, did not make over 21 yards of error, a quantity certainly insignificant when other causes of irregularities in firing are taken into consideration.

The force of the wind is said to have but little effect in impairing its accuracy, and the error due to temperature may be corrected by using, as the fluid, a mixture of alcohol and water in proper proportions.

The Mammoth Cave of Mexico.

It is said that the cave of Cacahuamilpa is the largest cave in the world. Several persons, who have visited the Mammoth Cave of Kentucky and that of Cacahuamilpa in Mexico, pronounce the latter the larger. A volcanic mountain with an extinct crater covers this cave. It is not described in guide books or books of travel. It has, in fact, never been adequately described. Mr. Porter C. Bliss has twice examined and explored it, the last time in February of the present year. Six hundred persons constituted the last exploring party; they were provided with Bengal lights and scientific appliances. After reaching a level at perhaps 50 feet depth, they proceeded 3¾ miles into the interior. The roof was so high—a succession of halls—that rockets often exploded before striking it. Labyrinthine passages leave the main hall in every direction. Stalagmites and stalactites are abundant. Below this cave, at a great depth, are two other immense caves, from each of which issues a branch of a great river, uniting here. These two rivers enter some five miles distant at the other side of the mountain, flow parallel, and issue at last together. Vast quantities of bats are the most numerous inhabitants of these caverns.

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GAIN FROM THE APPLICATION OF CONDENSERS TO STEAM ENGINES.

In the early days of the steam engine, very low pressure was ordinarily employed for engines with condensers, while, on the contrary, what was considered a very high pressure was adopted for engines that exhausted into the atmosphere. Hence arose the terms high and low pressure engines, the former being engines with, and the latter without, condensers. At present, a high pressure of steam is ordinarily carried in both kinds of engines, so that the terms do not describe the two varieties as well as formerly. Many engineers prefer to class engines as condensing and non-condensing, rather than as high and low pressure; and we recommend this classification to our readers, as the more correct of the two. One who regards economy puts in a non-condensing engine, if he has plenty of water in the locality; and many old non-condensing engines are being fitted with condensers, under the more enlightened engineering practice of the present time. Many more steam users would doubtless make the change, if they realized the gain that would probably result; and though this cannot be predicted exactly, for any given case, it can generally be estimated with tolerable accuracy.

It may be fairly assumed that a non-condensing engine has, on an average, at least two pounds per square inch back pressure on the piston. Some have much more than this, and first class engines have less; but two pounds can be considered a fair example of ordinary practice. By the application of a condenser, it might be expected that there would be a negative pressure of ten pounds per square inch on the back of the piston, so that the piston pressure would be increased by twelve pounds. In this assumption, an allowance is made for the power required to work the air pump, and the engine is supposed to be at seventy-five horse power. For an engine smaller than this, it would be better to allow an increase in the positive pressure of not more than ten pounds per square inch. As the condenser, by decreasing the back pressure on the piston, adds just as much to the positive pressure, it is plain that a lower pressure of steam can be used, or what is better, the steam may be cut off at an earlier point of the stroke. The gain in either case can be approximately calculated. If the gain in positive pressure produced by the reduction in back pressure be multiplied by one hundred, and divided by the mean effective pressure on the piston, it will give the *per centage* of gain in pressure due to the condenser.

Thus, if the mean effective pressure on the piston is thirty pounds per square inch, the gain in pressure will be 100 times 12, or 1,200, divided by 30, which is 40 per cent. Now suppose that before the condenser was attached, the steam was cut off in the cylinder at half stroke; under the new conditions the required mean effective pressure can be obtained with a lower boiler pressure than before. Before the condenser was in use, it would be necessary to maintain a pressure in the boiler of about 58 pounds per square inch by gage, to give a mean effective pressure of 30 pounds on the piston; while with an increase of 12 pounds in the effective pressure, by the application of the condenser, a boiler pressure of about 39 pounds would suffice. As the weight of steam per cubic foot at 58 pounds pressure is 0·17481 pounds, and only 0·132 pounds at 39 pounds pressure, there would be a saving of about 24·5 per cent in the amount of steam required to run the engine. Instead of reducing the steam pressure after attaching a condenser to an engine, it would be better to maintain the same pressure in the boiler, and cut off the steam at an earlier part of the stroke. In the case under consideration, the increase in 12 pounds of the effective pressure would permit of closing the steam port a little before the completion of one third of the stroke; and supposing that the clearance space in the cylinder amounts to five per cent of the capacity of the cylinder, the quantities of steam required per stroke, before and after the use of the condenser, would be in the ratio of 550 to 363, so that there would be a saving of 34 per cent.

The example given represents a case in ordinary practice. By varying the data, of course a greater or less amount of saving would result; but with an engine in good condition, it is generally safe to estimate that a saving from 20 to 25 per cent of the amount *of* steam used, and, consequently, of the consumption of coal, will be realized by the application of a condenser. Indeed, it is not unusual for manufacturers to guarantee this amount of saving, in converting a non-condensing into a condensing engine. Those of our readers who think of having their engines changed in this manner can generally, by consulting a reliable engineer and giving him full details, obtain a pretty correct estimate of the advantage that will probably be derived. Matters of this kind are strictly professional, requiring so much experience and technical knowledge for their proper consideration, that nothing but general hints can be given in a popular article.

It occasionally happens that no saving, or one of very small amount, is effected by the use of a condenser. This almost invariably indicates that there are leaks about the engine, which are so much increased by the reduction of back pressure as to balance the increase in effective pressure due to this reduction. Of course, all calculations of probable gain are rendered useless by the introduction of this element. The question of leaks is purely a matter of fact, and is not subject to calculations until experimental data have been obtained. This should be remembered by users of steam power, and we repeat the statement, frequently given before, that it is true economy to have steam machinery examined sufficiently often to enable leaks and derangements to be discovered and remedied. This is especially important in cases where the vacuum in the condenser may magnify leaks that were trifling when the engine was non-condensing.

IMPRACTICABLE INVENTORS.

"It is one thing to construct a machine on paper, but a very different affair to make it go," remarked a friend to us recently, as he ruefully regarded a roll of elaborate drawings, which represented the fruitless labor of a year or so of his earlier life. "If friction and gravity were only out of the way, what a great inventor I should be!" and with this sententious observation, the plans were reconsigned to their dusty shelf.

It certainly does seem an extremely difficult matter to convince mankind in general that the same operation, when it is plainly impracticable by simple means, through its variance with some natural law, is just as impossible with the most elaborate combination of machinery. Moreover, as a corollary to the above proposition, and as a general rule, if we set about a piece of work wrongly and make errors (through negligence, through forgetfulness, or through ignorance) in its course, losing sight of the pitfalls in our road while regarding only the brightness of the goal, it is equally certain that the grand result we seek will not be reached. This neglect of detail, impracticability of design, in brief, appears to be one of the commonest difficulties in which inventors are prone to involve themselves; and the reason is that they become so completely imbued with the single grand idea that they fail to see anything of apparently minor importance, utterly oblivious of the fact that perfect parts alone constitute a perfect whole.

It is related that Brunel, the great English engineer, was constantly visited by inventors desirous of submitting their designs to his expert judgment. Although frequently wasting time of the utmost value, in the examination of impracticable schemes, he would patiently listen to the description, and then point out the fallacies in the chimerical projects. An enthusiastic individual came to him one day with a plan for sweeping chimneys; it would totally obviate the cruel employment of the small boys who were sent up the flues; it was simply a broom—a mere broom—which, worked from above, swept every minute crack perfectly.

"Excellent," gravely said Brunel, "but you have not told me how the rope is to be got to the top."

"Why, nothing is more simple," replied the sanguine inventor, "of course a boy will go up with it first."

At another time, the same celebrated engineer was interrupted in his labors by an Irish gentleman, who was burning to tell him all about a portable hood, which was to be stowed away under an open carriage in fine weather, ready for immediate use in case of a storm.

"But you cannot stow away such an enormous thing as that in so small a space," objected Brunel.

"Certainly not," ejaculated the unabashed inventor, "it's not that that I mean to do. It's at home the thing is to be left when the weather is fine; of course it won't be wanted, then, you know."

It is this looking only at results, more especially when coupled with ignorance, not merely of principles but of what others have already proved useless, that has led many an inventor to despair, oft-times to ruin.

A simple incident in point came to our notice recently in the course of our weekly stroll through the American Institute Fair: Among the entries for exhibition was that of a rotary engine, which in due time was brought to the building by its constructor; and the inventor, with the aid of the proper officials, proceeded to set it up. The inventor—an old man whose dress and general appearance betokened a hard struggle with the world in days past—grew quite garrulous over his pet, and told how he had worked upon it for years, how he had spent every cent to get it built, and how he had now brought it from the far West to show the Eastern people what it could do. Then the blood would crimson his cheeks and his eyes glisten, while he would stop and gaze fondly on the insensate metal. When the placing of the machine was completed, the throttle was opened. Two turns were made, then another slow one, and then everything stopped. A second trial did no better. It was the first practical test, and the machine had never before existed except on paper. Then the inventor, with trembling fingers, moved a wheel here, a nut there; for some time he worked, but in the end he threw down his tools, and sinking despairingly into a seat, buried his face in his hands, and great tears stole slowly down his wrinkled cheeks. He saw that his treacherous fondling could never be made to run, and yet for three days he returned again and again to its side, wistfully gazing at it as if he hoped to gain some inspiration which would, after all, set everything right. But none came; none could come, for the very principle of the machine had long ago been exploded. Finally, heart-broken with disappointment, the old man started alone for his far-off home—not altogether penniless, however, for before he left his worthless engine was purchased from him at a good price by one upon whose labors in the same path fortune had abundantly smiled. Then others contributed their mites, and a sufficient sum was collected to enable the man to pay his passage home, without touching the little capital derived from the sale of his machine. That was a genuine and a noble charity, and, while the names of the generous givers are known to but few, the deed is one which an all-wise Providence will not allow to pass unrewarded.

RAILROAD EMPLOYEES AND THEIR PAY.

It seems to us that the course taken by the managing powers of our public conveyances, relative to the payment of their employees, is far from the wisest that could be adopted. The plan appears to be not to encourage a feeling of common interest, or to impress upon the employee that so long as he studies the benefit of his employers his own will not be neglected, but rather to create a species of antagonism between the parties, in which any over reaching of one by the other is considered legitimate. Upon our city omnibus and car lines, it is perfectly well known that the pay of the employees is far below that to which their arduous labor would seem justly to entitle them. As a consequence, the positions are filled principally, not by a respectable and reliable class of men, but by persons either unfit for any business, or by those whose characters prevent their obtaining other employment, or by unfortunates whom reverses of fortune have driven to accept any means of support, however slender. It would be unreasonable to suppose that the majority of such individuals would or could refrain from peculation, and hence the "knocking down" system, as it is termed, has been carried on, year after year, until it has assumed such proportions that the street conveyance owners have at length become alarmed; and inventors of ingenious contrivances, which force stage drivers and conductors to be honest, are reaping a harvest. Natural honesty, then, is at a discount, and machine integrity rules the hour. As a mere matter of money, it would appear that it costs less to employ a scamp, *plus* a punch or a fare box, than to encourage upright service by the payment of a fair salary. The same policy is extended, on railroads and steamboats, to positions in which experience, judgment, forethought, and skill are all required. The traveling community, for its personal safety, is directly interested in the latter, and it seems to us a shortsighted policy on the part of the managers of our steam conveyances, whether carriers of passengers or freight, to pay only the lowest minimum of wages to their employees.

The average railroad car conductor is paid about as miserably, proportionately, as his brother of the street conveyance; and where the latter carries a bell punch to support his moral rectitude, the former is looked after by means of the duplex ticket system. And yet, with inexplicable inconsistency, a great corporation will commit to the fidelity of that individual, whom it tacitly admits it cannot trust with a few dollars, the care and management not only of valuable property, but the safety of human lives.

Not content with carrying out these peculiar notions as regards those on whom they depend for their money, several of the railroad companies are now manifesting a disposition to extend their demoralizing system, or a modification of it rather, into the ranks of the engineers. We do not mean

that any checks on the honesty of these men are proposed, for of course none such are necessary; but it seems to us that a perpetual tinkering with their hardly earned salaries, and a series of onslaughts thereon with a view of reducing their wages down to those of an ordinary day laborer, are about as well calculated to drive all good and reliable men out of the trade, and replace them with incompetent persons, as any plan which could be well devised. If the project has worked to this effect with one class of men, there is no reason why it will not act similarly as regards another; and we tell the railroad companies thus plainly that no investment is so poor a one as that in cheap skilled labor in any form.

No mechanic in any branch of trade has to face such responsibilities as the locomotive engineer. In none are such qualities of judgment, coolness, skill, and heroism, even, required. Few professions are more arduous or more physically exacting; none exist in which strong mental power is more certainly needed; and to suppose that men uniting in themselves all these conditions, and who, besides, have learned to discipline their faculties, with that unerring accuracy which every one on whose shoulders the weight of the existence of others falls must sooner or later attain, can be got to work for a pittance, or can be replaced by mechanics gathered at random from shops and founderies, is criminally foolish.

We notice that a meeting of engineers, from a large number of railroads, recently took place in this city, in order to protest against the proposed reduction of their wages, contemplated on many principal lines. The session was an orderly and decorous one, and the protest, embodied in the resolutions, earnest and emphatic. The men are clearly in the right, and, besides having their own excellent organization, they will find themselves amply supported by the traveling public; for when it comes to making us ride in trains managed by men whose ignorance or incapacity may put abrupt ends to our mortal careers at any moment, because of the niggardly arrangements of our railroad managers, it is time for the public to protest.

IMPROVISED APPARATUS FOR STEAM BOILER TRIALS.

In the course of his professional work, the engineer sometimes finds himself confronted with practical problems which only an exceptionally extended experience, or a remarkably ingenious mind, can satisfactorily solve. The marine engineer, who has charge of the machinery of a steam vessel on a long voyage, is often driven to adopt most singular expedients when a breakdown at sea makes important repairs necessary; and he sometimes succeeds, hundreds of miles from the shop, with but the few tools usually carried on shipboard, and with the ship rolling and pitching so violently that it is with difficulty that his men can keep their feet, in doing work which would be considered decidedly formidable even on land, where a stable footing and all needed appliances make the task a comparatively easy one. Such instances of difficulty seldom occur on shore; but in the course of his practice, every engineer occasionally finds exercise for his ingenuity, and for the application of such knowledge or experience as he may have acquired, in similar but usually less important matters; and he is always pleased to learn from the experience of others how to proceed, and what success to anticipate, in any specific case. The following will perhaps prove interesting and useful to others who may find themselves situated as was recently our occasional contributor, Professor Thurston, the Director of the new Mechanical Laboratory of the Stevens Institute of Technology.

It had become necessary to determine very carefully the evaporative power of a set of steam boilers. A large amount of money and important interests were involved, both directly and indirectly, in the case, and it was essential that the total amount of heat evolved from the fuel should be precisely ascertained. It was equally important that it should be learned how that heat was distributed. It was necessary to determine the temperature of the escaping gases in the chimney, and the percentage of water primed over with the steam. To determine the first point, it seemed necessary to use a pyrometer; but none had been provided, and there was not sufficient time to obtain one by sending to New York or Philadelphia, the nearest cities in which they were probably obtainable. The only reliable pieces of apparatus at hand which could be used in improvising a pyrometer were a very good platform scale and one of those excellent thermometers which were made some years ago by the Novelty Iron Works. A careful search in the scrap heap brought to light a conveniently shaped mass of iron, which, being weighed, was found to balance the scale at precisely sixty pounds. This was placed in the flue at the point where it was desired to measure the temperature of the products of combustion. A small tub was placed on the scale, and into it was carefully weighed fifty pounds of water. After a time, when the iron had remained in the flue long enough to have attained fully the temperature of the gases flowing past it, it was suddenly removed and immersed in the vessel of water, and the increase of temperature of the latter was very carefully observed. The estimation of the initial temperature of the heated iron, and that of the furnace gases, was then an easy matter. In one example, the water rose in temperature from 65° to 119° Fah., a range of 54°. Fifty pounds of water raised 50° in temperature had, consequently, received from the iron $50 \times 54 = 2{,}700$ units of heat. This having been communicated by 60 pounds of iron, each pound of metal had parted with $\frac{2700}{60} = 45$ units of heat. The specific heat of iron, as given in the SCIENTIFIC AMERICAN recently by Mr. R. H. Buel, is 0·113, or, very closely, one ninth. Each thermal unit abstracted from a pound of the iron, therefore, reduced its temperature nine degrees, and its total loss of temperature must have been $9 \times 45 = 405°$. The final temperature being 119°, the temperature before reduction was $119° + 405° = 524°$, and this was the temperature of the flue. In another instance, the water was heated by the pyrometer ball from 63° to 122° Fah. The temperature of the flue was in this case $\frac{(122-63) \times 50 \times 9}{60} + 122 = 564°$. With a good thermometer and accurate scales, the results thus obtained are probably more reliable, at high temperatures, than those usually obtained by the common pyrometer.

The determination of the proportion of water contained in the steam leaving a boiler is often, as in the case here considered, a matter of vital importance. It often happens that a pound of water takes from the fuel hardly a tenth as much heat as a pound of steam, and at least one instance has been given by our contributor in which more water left the boiler unevaporated than was actually made into steam. It is seen at a glance that, where the feed water only is measured, the most worthless of boilers may appear to compete successfully with the best; and the greater the amount of priming or foaming, the better is the apparent result. Makers of peculiar forms of boilers have actually guaranteed an evaporation (!) of *nineteen* pounds of steam, from cold water, per pound of coal, a performance to which the best boilers ever yet made do not approximate, and one half of which amount is never fairly obtained, except with heated feed water. The guaranty has *apparently* been fulfilled, because the guaranteed boilers carried over (by priming) a weight of water exceeding that of the steam by which it was transported. Every intelligent engineer would recognize in such a guaranty an evidence of inefficiency, rather than of economical steaming.

The first successful attempt to determine, with precision, the quality of steam made, and to obtain a trustworthy measure of the value of competing steam boilers, was probably that made by Professor Thurston at the exhibition of the American Institute in 1871, when conducting, for a committee of judges of which he was chairman, a trial of five competing steam boilers, which had been entered by as many different makers. In that instance, all of the steam made by each boiler was condensed in a surface condenser, and the total quantity of heat transferred carefully and accurately measured. At a subsequent trial, a neat form of apparatus, invented by Mr. Leicester Allen, was used for this purpose with quite satisfactory results. In the case about to be described, it was impossible to condense all of the steam. The Allen calorimeter was not to be had, as there was but one in the country, and that was the property of the American Institute, and could not be promptly obtained.

An ordinary oil barrel was obtained and mounted upon the platform of the scale. Precisely two hundred pounds of water was weighed into it. A three quarter inch gas pipe was tapped into the main steam pipe, and fitted with a stop valve. From a short piece of pipe projecting from the valve, a piece of rubber hose, some twenty feet long, led to the barrel, its extremity being lashed to a wooden pole for convenience of handling. The temperature of the water in the barrel was carefully determined, and an additional weight, indicating ten pounds, was placed on the pan of the scale. The valve was then opened, and steam was allowed to blow through the hose until it was warmed up, and condensation in the pipe was thus prevented. When the hose seemed as well cleared of water as it could be, the extremity was plunged into the barrel, and the issuing steam was condensed until the rising of the scale beam proved that ten pounds of steam had been added to the two hundred pounds of water originally placed in the barrel. The water was then thoroughly stirred with the thermometer, and the temperature noted. The following are the data obtained in one experiment:

Weight of water, 200 pounds; weight of steam, 10 pounds; original temperature of the water, 62°; final temperature of the water, 115° Fah; pressure of steam per square inch by gage, 75 pounds. Steam at 75 pounds pressure has a temperature of 320° Fah., and to raise it from 0° Fah. to 320°, and to evaporate it at the latter temperature and the given pressure, requires $1{,}178{\cdot}6° + [0{\cdot}305(320° - 212°)] = 1{,}211{\cdot}5$ units of heat. Each pound of steam, therefore, communicated to the water which condensed it, in this example, $1{,}211{\cdot}5 - 115 = 1{,}096{\cdot}5$ thermal units. Each pound of water suspended in the steam, and primed over into the condensing water, transferred only $320° - 115 = 205$ units of heat. The total heat transferred was $(115 - 62) \times 200 = 10{,}600$ thermal units. Then the product of the number of pounds of steam condensed multiplied into 1,096·5, *plus* the product of the number of pounds of water multiplied into 205, will be equal to the whole sum, 10,600. A simple algebraic equation will give the proportion of priming.

Let W = the total weight of steam condensed, together with the suspended water; then X may be taken to represent the weight of pure steam, and W—X will be the weight of water carried over with it. Let the total amount of heat transferred be called U, the heat transferred by a pound of steam, H, the heat transferred by a pound of water, h. Then

$$HX + (W - X)h = U; \text{ or, } X = \frac{\frac{U}{h} - W}{\frac{H}{h} - 1}$$

In the example above given, $X = \frac{\frac{10660}{205} - 10}{\frac{1096{\cdot}5}{205} - 1} = 9{\cdot}59$ pounds of steam, and $10 - 9{\cdot}59 = 0{\cdot}41$ pounds of water suspended in the steam. The priming, therefore, amounts to 4·1 per cent.

Now, suppose 100,000 pounds of water to have been apparently evaporated, under similar conditions, from feed water at 200° Fah., by 10,000 pounds of coal. Of this quantity, 95,900 pounds would have been steam, and 4,100 pounds would have been water. But each pound of steam requires for its evaporation under the assumed conditions $1{,}211{\cdot}5 - 200 = 1{,}011{\cdot}5$ thermal units, while each pound of water takes up but $320 - 200 = 120$ units of heat.

$$95{,}900 \times 1{,}211{\cdot}5 = 116{,}182{,}850$$
$$4{,}100 \times 120 = \quad 492{,}000$$

Total heat from fuel, 116,674,850
" " per pound coal, 11,667·5 thermal units.

Engineers are accustomed to reduce results obtained on such tests to evaporation from 212°, at atmospheric pressure. The amount of heat required to convert one pound of water into steam at atmospheric pressure, when already at the boiling point, is well known to be 966·6 thermal units. Hence, $\frac{11667{\cdot}5}{966{\cdot}6} = 12{\cdot}07$ pounds of water, per pound of coal, represents the performance of the apparatus tested.

In another example, with steam at 50 pounds, the water was raised from 70° to 118°, and he obtained $X = \frac{\frac{9500}{180} - 10}{\frac{1146{\cdot}6}{180} - 1} = 8{\cdot}07$ pounds steam, and the priming amounted to 19·3 per cent. In this case, had the steam been perfectly dry, and the evaporation equal to 12 pounds of water per pound of coal, the occurrence of priming to the extent just calculated, while causing an *apparent* increase of the evaporation to 14·31 pounds, would have really produced a very serious loss of efficiency, and even great pecuniary losses, by causing accidents which so commonly arise from serious priming.

It is evidently extremely important, therefore, in all trials of the economical performance of steam boilers, to determine carefully not only the quantity of water entering as feed, but also the quality of the steam leaving the boiler. This necessity, which was first exemplified in 1871, and which has become a usual feature of trials at the exhibitions of the American Institute, is becoming well understood. At the approaching exhibition of the Franklin Institute, at Philadelphia, competing boilers will be compared as to quality of steam, as well as to apparent, but fictitious, evaporative capacity.

Where expensive and elaborate apparatus cannot be afforded, the simple apparatus above described will often be found quite satisfactory.

SCIENTIFIC AND PRACTICAL INFORMATION.

ENGINEERING IN PERU.

The Pacasmayo railroad has just been finished from the Pacific to La Vina, a distance of 75 miles. The eastern termination is 3,469 feet above the ocean. Leaving Pacasmayo at 8 A. M., one can now reach Cajamarca—the famous city of the Incas—at 8 P. M. The most wonderful part of the road is the great iron mole, which is to extend 2,190 feet into the ocean. There will be 146 bays, each 15 feet; 101 are completed. There is to be a head over 90 feet wide by 300 long. The bottom of the Pacific here is mingled sandstone, conglomerate, and limestone, so hard that three tuns on the top of the iron pile, with steel-pointed drill, makes very little headway. The tide rises four feet; and the prevailing wind is S. W. Mr. Meiggs builds the road for $7,000,000.

KAURI GUM.

Professor M. M. P. Muir shows, as a result of his experiments on the Kauri gum of Australia, that it is a mixture of resins and true gum, classable among the gum-resins, as shown by distillation. One half of its weight consists of water and a heavy oil. The residue solidifies to a brittle, transparent, solid mass.

RANGE OF TORPEDOES.

From recent experiments conducted by an English Torpedo Committee against the iron hulk Oberon, with the view of ascertaining the maximum distance within which the engines of an enemy's vessel might be rendered useless, if not the ship herself destroyed, by the explosion of a submarine torpedo, it appears that the hull of an ironclad is practically safe from danger at a range of 100 feet from a 500 pound charge of gun cotton, exploded in 48 feet of water, but that her engines are liable to derangement at that distance.

IMPROVEMENT OF THE MISSISSIPPI.

The Commissioners, appointed by the President to report upon the best plan of improving the mouth of the Mississippi river, recently sailed from New York for Europe, where they purpose to examine the Deltas of the Danube, Rhine, and other rivers. The party consists of W. Milner Roberts, General Alexander, General Wright, General T. S Sickels (of the Union Pacific Railroad), Professor Mitchell, Mr. H. W. Whitcomb, and General Coombs. They return in November.

ACTION OF CHROMIC ACID ON TEXTILE MATERIALS.

In the presence of oxidizable substances, chromic acid loses a portion of its oxygen and passes to the state of green sesquioxide. With other substances, especially wool and silk, M. Jacquelin finds that it gives a bright yellow color, whence he concludes that the acid may be advantageously used to detect vegetable fibers from those of animal derivation in mixed stuffs, the former not yielding the yellow color. Chromic acid is also a good test to show the presence of cochineal in artificially colored wine.

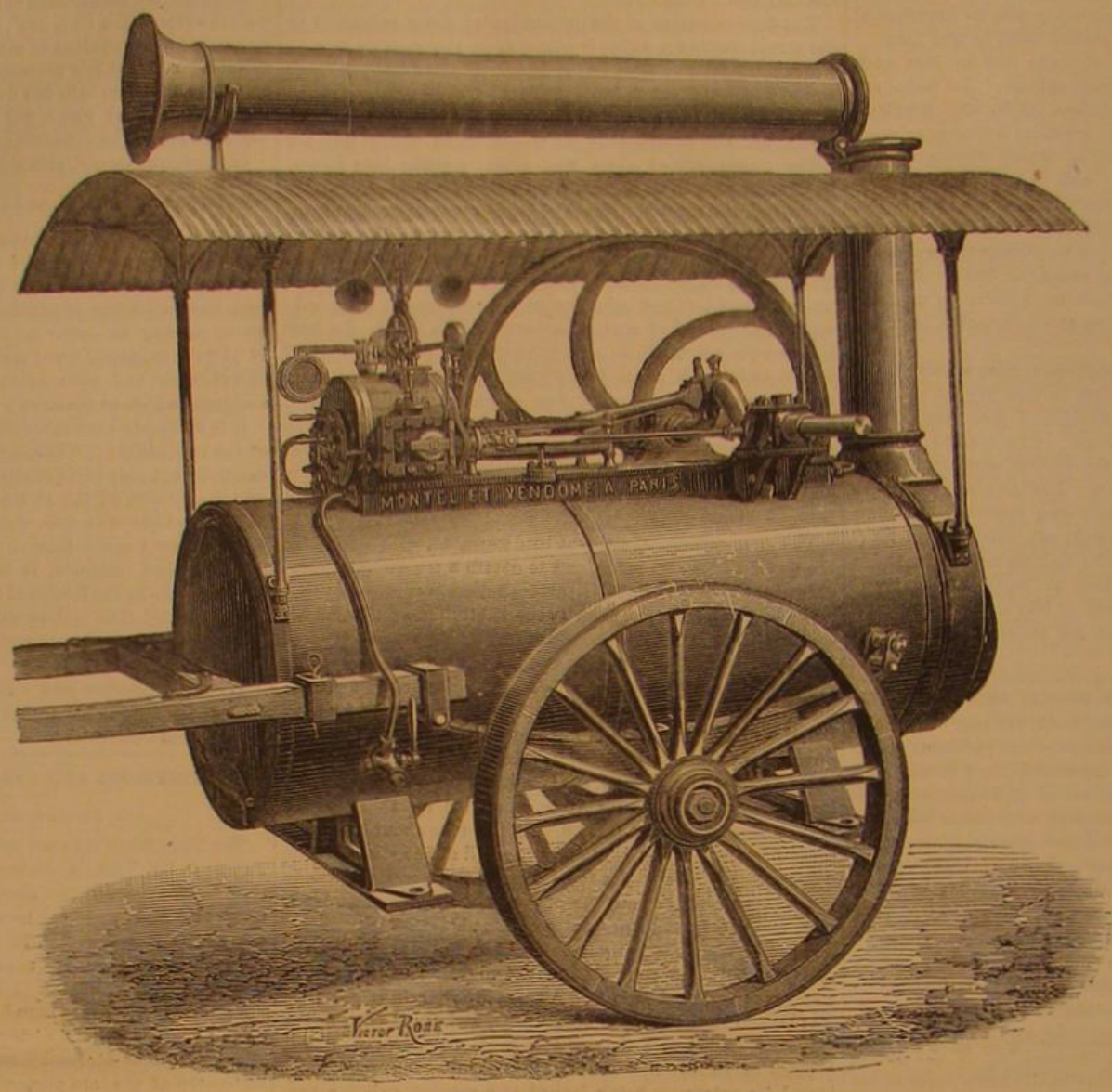
ENGRAVING ON COPPER.

M. de la Grye reports a new process in the above named art which consists in first covering the plate with a thin coating of adherent silver, which is in turn covered with colored varnish. The lines are then drawn with a sharp point, after the fashion of using a diamond for stone engraving, and subsequently sunk into the plate by means of the action of perchloride of iron.

NEW PORTABLE ENGINE.

We publish herewith an engraving of a portable engine (constructed by Messrs. Montel and Vendome, of Paris, France), which has several novel features. It is mounted on two wheels only, with springs, and can be readily drawn by horses, shafts being attached to the *springs*. When at the place where its services are required, the wheels are readily taken off, and the machine allowed to rest on its two bed plates, in which are holes for securing it to a foundation, if necessary.

The boiler is cylindrical in form and tubular. The fire box, which is wholly within the shell of the boiler, can be removed; the shafts are then attached to move the engine from place to place. An efficient superheater is placed at the upper part of the boiler, the cylinder of the engine is steam jacketed, and the cut-off is controlled by the governor. The feed water is heated by an appliance with the shell of the boiler.



MONTEL AND VENDOME'S PORTABLE ENGINE.

Non-Combustible Wood.

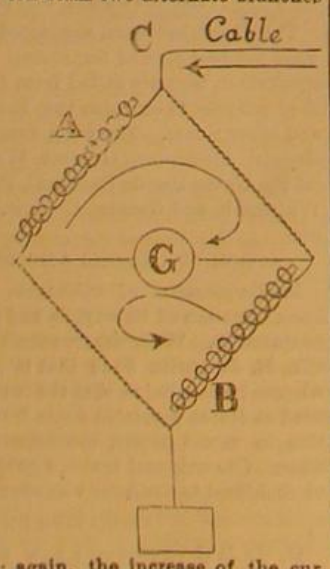
The English Admiralty have recently made some quite satisfactory experiments at Plymouth, upon a wood rendered uninflammable by treatment with a solution of sodium tungstate. The results prove that wood thus prepared is very much less inflammable than ordinary wood; chips and shavings made of it, though, of course, capable of being destroyed by fire, cannot be themselves inflamed, and cannot, of course, communicate fire to masses of wood thus prepared; so that framework made of this wood resists flame perfectly, at least when not exposed for a long time to a fierce fire. These advantages, however, are diminished by the considerable first cost of preparation, as well as by the increased weight of the wood after treatment.

IMPROVEMENT IN CABLE TELEGRAPHY.

My chief object in writing the present paper* is to make known an important improvement I have made in the use of the induction coil in cable signaling. The great disadvantage in the use of the induction coil is the so called magnetic retardation experienced by the cable current in passing through the primary wire. This magnetic retardation is caused by self-induction in the primary wire; any change in the current passing through the wire tends to produce a current in the opposite direction to such a change, and in this way rapid changes are, as it were, clogged, the effect being very similar to an increase in the length of the cable, so that magnetic retardation seems a very appropriate name for expressing the effect.

I have, however, been able not only to eliminate this magnetic retardation, but to cause the self induced currents, which are its cause, to aid in the formation of signals.

The method is briefly as follows: The primary and secondary wires of an induction coil form two alternate branches of a Wheatstone's bridge; say A and B, Fig. 2, are these branches. The other branches are simple resistance, which may be made to produce balance when a constant current is flowing. G is the galvanometer or other receiving instrument. The current entering at C divides between the resistance and the primary wire. The increase of the current through the primary wire, A, not only induces a current in B, the secondary wire, in the direction shown by the lower arrow, but also causes a self-induced current to flow in the direction of the upper arrow; again, the increase of the current through B not only causes an induced current in A, in the direction of the upper arrow, but also causes a self-induced current to flow in the direction of the lower arrow. During the decrease of the cable current, the direction of the induced currents is reversed. It is this reversal of the induced currents during the decrease of the cable current which gives value to the induction coil in cable signaling. Now the self-induced currents, which, in my plan, aid the formation of signals, are the very cause of magnetic retardation in the ordinary way of using the induction coil.



One great advantage in the use of the induction coil, over the condenser plan, is the much greater safety the cable is placed in during the prevalence of those intense earth currents which accompany magnetic storms. In the way in which cables are usually worked at present, the sending end of the cable is either connected directly or through a small battery to earth, while the other end is insulated by the condenser. In this way the cable is, at the receiving end, submitted to the greatest strain possible. On some lines, however, the cable is kept completely insulated between two condensers, one at each end. It is not difficult to show that at each end of an insulated conductor, the electric strain (if we may so call it) between the conductor and the earth, produced by earth currents, would be just half that which would be produced at an insulated end when the other end is joined to earth. When using the induction coil, or my modification of it, as a receiving apparatus instead of the condenser, the cable is joined to earth at each end through a moderate resistance, and is therefore nearly in its safest possible state.

* Paper read before the British Association, at Belfast, Ireland, by G. K. Winter.

Isaac Craig Buckhout.

Mr. Isaac Craig Buckhout, chief engineer of the New York and Harlem Railroad, and chief of the Board of Engineers of the Fourth Avenue Improvement, died at his residence in White Plains, N. A., September 27, in the forty-fourth year of his age. Among his principal engineering works were the Grand Central depot, and that portion of the Underground Railway system of this city extending along Fourth avenue from the Grand Central Depot, at 42nd street to Harlem river, 4½ miles, now nearly completed. To his arduous labors in connection with this great work is attributed the illness which has unfortunately resulted in his premature decease.

Two Wrinkles.

Very often a screw hole gets so worn that the screw will not stay in. Where glue is handy, the regular carpenter makes the hole larger and glues in a large plug, making a nest for an entirely new hole. But this is not always the case, and people without tools, and in an emergency, often have to fix the thing at once. Generally leather is used, but this is so hard that it does not hold well. The best of all things is to cut narrow strips of cork, and fill the hole completely. Then force the screw in. This will make as tight a job as if driven into an entirely new hole.

Another hint of a similar character may be useful. One often desires to put a staple into a block of stone. The hole is made, the staple inserted, and lead melted and run in. But unless the hole is made with the bottom larger than the top, the lead will in time work out, if there is much jar or side strain on the iron. Besides, the lead itself is liable to some compression, which admits of looseness, especially after being subjected to very hot fires. A much better article is sulphur. If this be melted and poured in around the staple instead of lead, it makes a much more durable job. Besides, it is often more easy to procure sulphur than lead, as every store keeps it that deals in general variety.—*American Builder.*

NEW INSTRUMENT FOR ESTIMATING UREA.

Dr. W. J. Russell, F.R.S., and Mr. S. H. West publish the following in the *Journal of the Chemical Society*:

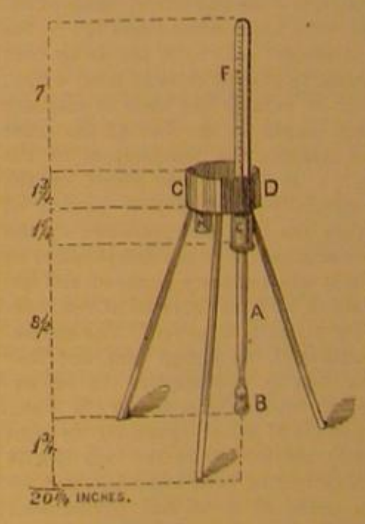
We find it most advantageous to use a solution of hypobromite, prepared by dissolving 3·5 ounces of common solid caustic soda in 15 cubic inches of water, and adding 1·5 cubic inches of bromine. This mixture gives a rapid and complete decomposition of the urea.

The form of the apparatus is shown in the accompanying engraving. A tube, A, about 9 inches long, is narrowed 2 inches from the closed end, and a bulb, B, holding about 0·75 cubic inch, blown on it. The upper part of the tube contains about 1·5 cubic inches. This is fitted, by means of an india rubber cork, into a small elliptic tin trough, C D, about 3 inches long, standing upon three legs. In using the apparatus a 0·3 cubic inch pipette is filled with the urine, and the liquid is allowed to flow into the bulb of this tube. Water is added, thus washing down the urine which adheres to the sides of the tube, and filling the bulb up to the top of the constriction. A glass rod, with a piece of india rubber tubing about half an inch long drawn over the end of it, is then introduced, so that the india rubber plugs up the constriction. The hypobromite solution is then poured into the upper part of the tube until it is full, and the trough is afterwards half filled with ordinary water.

A graduated tube, F, is filled with water, the thumb placed on the open end, and the tube then inverted in the trough. The glass rod is then pulled out, and the graduated tube slipped over the mouth of the bulb tube.

The reaction commences immediately, and a torrent of gas rises into the measuring tube. To prevent any of the gas being forced out by the reaction, the upper part of the bulb tube is slightly narrowed, so that the gas is directed to the center of the tube. With the strength of hypobromite solution which we suggest, the reaction is complete in the cold in about ten or fifteen minutes; but in order to expedite it, the bulb is slightly warmed. This causes the mixing to take place more rapidly, and the reaction is then complete in five minutes. The reaction will be rapid and complete only when there is considerable excess of the hypobromite present. After the reaction the liquid should still have the characteristic color of the hypobromite solution.

The measuring tube is graduated so that the amount of gas read off expresses at once what may be called the percentage amount of urea in the urine experimented upon, that is, the number of grains in 6 cubic inches, 0·3 cubic inch being the quantity of urine taken in each case.

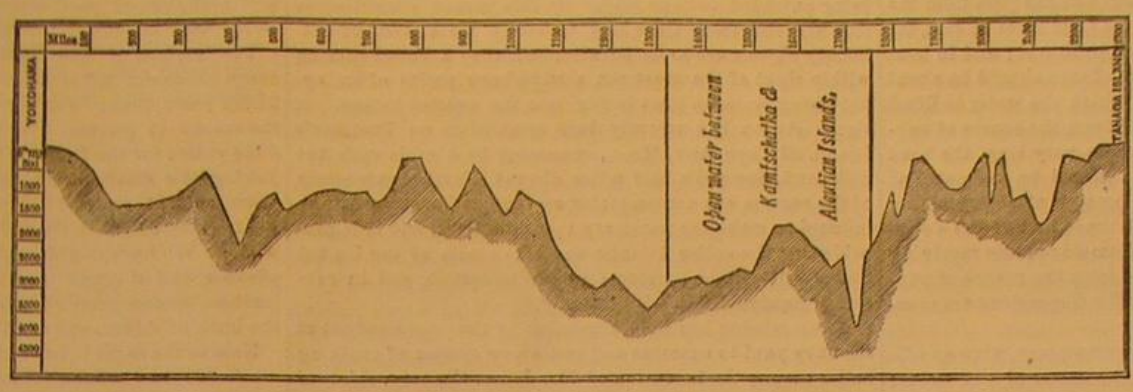


Three tenths of a cubic inch of a 2 per cent standard solution of urea gave, without correction: 2·25, 2·22, 2·22, 2·23, 2·215, 2·25, 2·22 2·215, 2·22, 2·226, 2·215, 2·225, 2·225, 2·22, showing a mean of 2·225 cubic inches.

If the urea had given off the whole of its nitrogen, we ought to have obtained 2·232 cubic inches. Even under these circumstances the difference between these two numbers represents only 0·001078 of a grain of urea. And even this error may be obviated by taking 2·225 cubic inches, as the basis for the graduation of the measuring tube, instead of 2·24. The presence of sugar in the urine does not affect the reaction.

THE PACIFIC OCEAN TELEGRAPH.

The latest advices from the Tuscarora and the party engaged in surveying the bed of the Pacific ocean, to find a suitable route for the cable, report progress from Yokohama, Japan, along the shores of the Kurile Islands and of some of the Aleutian group, and thence across the Kamchatka Sea. "For 1,000 miles from Yokohama," says a corrrespondent of the *Tribune*, from which journal we take the illustrative diagram, "the depths ranged from 300 to 2,270 fathoms. The greatest slope within the distance is from lat. 40° 01′ N., long. 142° 57′ E., to lat. 41° 09′ N., long. 144° 01′ E., being 161 feet to the mile. From lat. 47° 44′ N., long. 154° 15′ E., the depth gradually increased to 3,754 fathoms at position lat. 50 19′, long. 159° 39′, a distance of 260 miles, giving a slope of about 60 feet. Just before entering the Aleutian group, a most remarkable depression was ascertained. It was in lat. 52° 06′ N., long. 171° 15′ E., and its depth was 4,037 fathoms (24,222 feet), while the preceding and succeeding casts, each only 29 miles distant from this one, were in 2,460 fathoms (14,760 feet) of water, which gave a slope of 326 feet to a mile, the greatest as yet found by us since our departure from San Francisco. From the posit'on of this great depth to one about three miles from the island of Atchka, lat. 51° 58′ N., long. 174° 31′ E., a distance of 125 miles, the water shoaled to 332 fathoms, being at the rate of 187 feet to a mile, and from that position to Tanaga Island the depth ranged from 200 to 1,800 fathoms, with but one heavy slope of 250 feet between lat. 51° 08′ N., long. 178° 35′ W., and lat. 51° 28′ N., long. 177° 57′ W. This is nearly as much as the greatest slope found between Honolulu and Yokohama. This route thus far is not impracticable, so far as the plateau goes.



BED OF THE PACIFIC OCEAN ALONG THE TUSCARORA'S COURSE.

Ooze similar to that previously found, and grayish black sand, gravel, and lumps of lava, were found along the Kurile Islands, and grayish black sand, gravel, and sponge in the Aleutian group. After sighting the Agatton island, the line was run skirting along the shores to the island of Tanaga. From this point it will be run to the northward, to the island of Ounalaska. The deductions from aerial temperatures in connection with currents, corroborate previous observations upon the latter. In lat. 51° 39′ N., the counter current which sets to the southward and westward along the shores of Kamchatka and the Kurile Islands, extends to long. 164° E., with a surface temperature of 42° Fah., from which point to long. 174° E., in the same latitude, there is the Kamchatka current, which is a branch of the Japan stream, setting up through Behring's Straits. This stream has a surface temperature in this latitude of from 46° to 47° Fah."

As will be seen by the sectional view of the ocean bed, the course is along a range of submarine mountains, which (in the Kurile and Aleutian Islands) occasionally rise above the surface of the water. The ocean currents are very numerous, and their temperatures vary widely.

The Tuscarora completed this course, and put into Glory of Russia Bay, Tanaga, one of

THE ALEUTIAN CHAIN OF ISLANDS.

During the summer months, which are supposed by the natives to be a delightful season of the year, the islands are continually veiled in obscurity by fogs; and, in approaching them, cautiously feeling the way, there is a danger presented by strong, treacherous currents, as well as lack of confidence as to their positions. During the nine winter months, or from September to June, the winds are extremely violent. "After having waited patiently for nearly three days for a sufficiently clear day that would permit us, at even a ship's length, to see land, we, on the 19th, were fortunate in sighting the island of Tanaga in the morning, and at 6 P. M. anchoring safely in 10 fathoms of water in Glory of Russia Bay, which is proposed as an intermediate station for the cable. At an elevation of 2,650 feet, but a short distance back from the beach, upon the mountain side, is a glacier of considerable extent, which was visited by several of our officers. The short stay prevented any measurements of its rate of movement. The soil is spongy, owing to continued dampness, and of course destitute of trees or bushes, and inhabited solely by fowls of the air. There is here a

FINGAL CAVE,

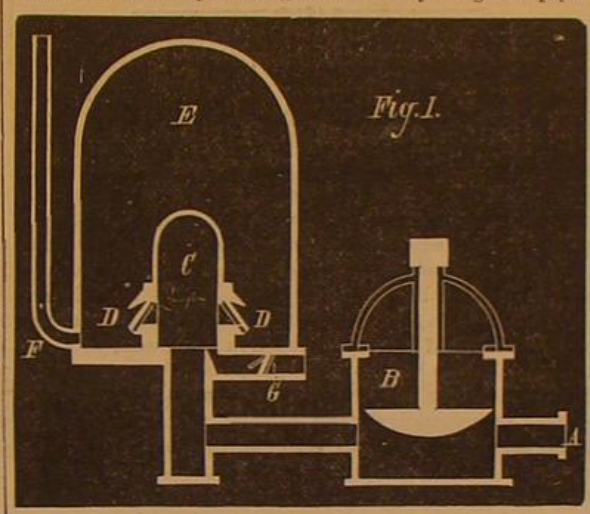
with its basaltic columns, which is scientifically interesting. But, taking everything into consideration, should this place be selected as an intermediate station, the operator whose headquarters it will be is not likely to regard it as a paradise. Although the practicability of the northern route is beyond dispute, the labor, uncertainty of success, and dangers involved, in even the passage of a steamer over the route just sounded by us, cause me to apprehend no small difficulty in an attempt to lay down a submarine cable.

Then consider the exertion of dredging for a broken cable in waters either clouded in a fog or beneath a gale, compared with those to be experienced on the southern route. Again, there is the submarine valley of over 4,000 fathoms depth just to the southward of the Aleutian Islands, through which the cable will have to pass. In laying the cable here, at least six and a half or seven miles of it will be suspended from the stern of the vessel, the weight of which the cable may be of insufficient strength to sustain, even if at the time the most favorable weather prevails. To sum it all up, the most obvious advantages in favor of the northern route are the smaller amount of cable required, and its being mostly within our own possessions.

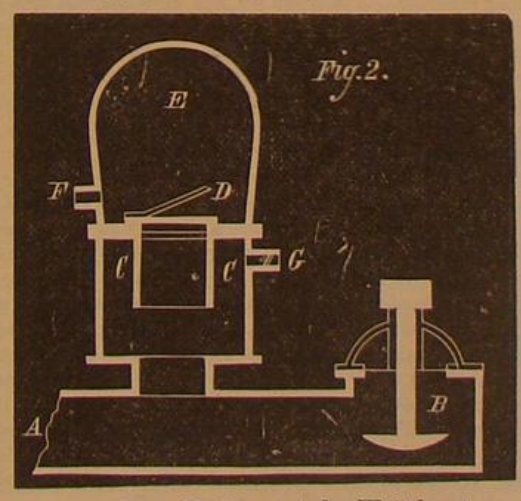
We arrived at Ounalaska on July 29; everything most satisfactory to date, as far as the accomplishment of our work is concerned. A line will next be run back to Tanaga island outside, or to the southward of the islands; then from here to where we left off last fall, and then to San Francisco, where the work will be completed."

THE HYDRAULIC RAM.

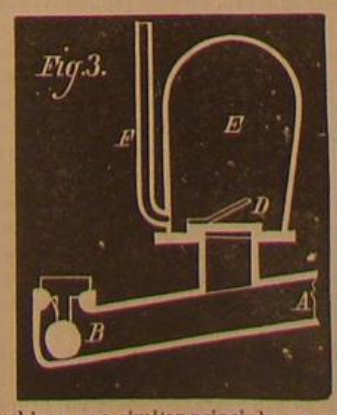
Many of our readers, on shutting the cock in a water pipe where there was considerable pressure, must have observed that the sudden arrest of the motion of the water caused a shock, sometimes producing sound and jarring the pipe.



Indeed, the water pipes in houses have often been burst by suddenly shutting off the water from a basin, and plumbers frequently provide against this accident by attaching an air vessel to the pipe, near each cock, so that the force of the

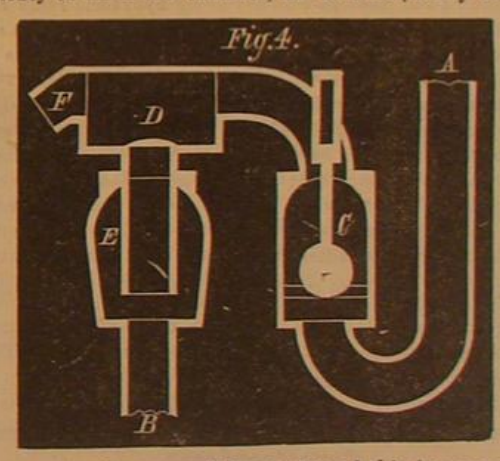


blow may not be suddenly arrested. Whitehurst, an Englishman, contrived a machine, in 1772, for raising water by utilizing its momentum when the discharge was suddenly



stopped. Machines on a similar principle are constructed today, for use in cities where the pressure in the mains is deficient. For instance, there are many buildings in the lower part of New York in which the pressure in the mains will not raise the water to the upper stories. Most of these buildings have tanks into which the water is forced by hand or steam power; and some of them have machines like those of Whitehurst, which are set in action every time water is drawn and shut off in the lower stories.

In 1796, Montgolfier, whose connection with the invention of balloons is well known, contrived an automatic machine for performing continually the work that Whitehurst's machine had done when controlled by hand. The Montgolfier ram, as at first constructed, is shown in Fig. 1; and Fig. 2 represents another form of the machine, embodying the same principles, and somewhat easier to build. The two figures are lettered alike, so that a description of the action of one will apply to the other. Water from a source higher than the ram flows through the pipe, A, and the discharge valve, B, being open, runs to waste. Some resistance being offered to its passage through the waste outlet, the water closes the valve, B; and its motion in this direction being suddenly arrested, it has sufficient force to open the valves, D D, and rise some distance in the delivery pipe, F. When the force is expended, the valve, B, again opens, and the former operation is repeated. It will be observed that, when the valve, B, closes, the air in C and E is compressed by the force of the water. When the force is expended, the air in C expands again, and presses back the water in the pipe, A, so that the valve, B, can more readily open, and the air in E also expands, forcing the water up the delivery pipe, F. Thus the air in C tends to make the valve, B, open more quickly than it otherwise would, after the water has exerted its force in the pipe, F, and the air in E makes the delivery more regular and continuous. The air in these vessels is liable to diminish in quantity, since water absorbs it under pressure. The entering water brings some air along with it, to make up the deficiency; but as this supply is frequently insufficient, a small air valve, G, opening inwards, is fitted, which admits air into the ram, whenever the pressure in the vessels falls below that of the atmosphere. A simpler and cheaper form of ram is shown in Fig. 4, which is the kind generally built by pump makers. It will be seen that it has no air vessel for aiding the opening of the waste valve, B, and no valve for supplying any deficiency of air in the chamber, E. It is frequently found



necessary, for the successful operation of this form of ram, to make a small hole in the pipe, A, so that air will be drawn in by the running water. It would be easy to render these rams more efficient by the addition of a casting that would change them into machines of the kind represented in Fig. 2, as will be rendered plain by an inspection of Figs. 2 and 3. The air valve, G, Figs. 1 and 2, is so low down that if the ram should become submerged it would admit water. An improved ram, patented a few years ago in France, has the air valve elevated to a considerable distance so as to overcome this difficulty.

The hydraulic ram, or, rather, a modification of it, is also employed to draw water from lower points. This form of the machine is sketched in Fig. 4. The pipe, A, leads to a source of supply higher than the ram, and connects with the place which is to be drained. The distance from the end of the pipe, A, to the valve, D, must not be greater than the hight to which water will rise in a vacuum—that is to say, 34 feet,—and for successful working, it should not exceed 26 feet. The action of the machine is as follows: The valve, C, being open, water flows through the pipe, A, and is discharged at F. When sufficient velocity is acquired, the valve, C, closes; and the water continuing to flow through F, a vacuum is formed behind it, so that water is drawn through the pipe, B, and valve, D, and discharged at F. Then the valve, C, again opens, and the same cycle of operations is repeated. E is an air chamber, aiding the continuity of discharge, as in the former cases.

The hydraulic ram finds various applications in industrial pursuits. It is largely employed for raising water into dwelling houses and farm yards. It was used at the Mont Cenis tunnel, working under a head of 85 feet, to compress air to five atmospheres for the purposes of ventilation and power. It will work under extremely low heads, and will raise water to almost any desired hight, and, when properly proportioned, is reasonably efficient. The efficiency is not, however, a matter of great importance in many cases. For instance, a man may have a spring on a hillside, at consider-

able distance from his house, which is at a much higher elevation. The expense of pumping this water by steam power might be very great. But with the hydraulic ram, whose first cost is very slight, the only considerable outlay will be for the delivery pipe; and if the connections are properly made, no farther expense need be incurred.

In setting a ram, if it is in a locality where the water in it would be frozen in winter if it were exposed, it should be carefully covered and protected; and the same precautions should be observed with the pipes.

To produce the best effect, the length of the pipe from the source of supply to the ram should be from 25 to 50 feet, for ordinary cases, with heads of from 8 to 15 feet; and in general, it may be stated that the length of pipe should be about 3 times the head. The hight to which the water is lifted should not exceed 15 times the head from the source of supply to the ram. If the delivery pipe is very long, the head required, to overcome the friction, should be estimated at so much additional head. The diameter of the receiving pipe is ordinarily made from 2 to 3 times that of the delivery pipe. For the best effect, the diameter of the receiving pipe should be about $\frac{1}{10}$ of the head from the source of supply to the tank; but very much smaller dimensions are commonly adopted.

Large rams, under favorable circumstances, give an efficiency of from 60 to 70 per cent of the power of the water; but small machines, under ordinary conditions, only utilize from 40 to 50 per cent. An example to illustrate these principles is appended. A hydraulic ram, working under a head of 10 feet, delivers 5 U. S. gallons of water per minute to a hight, including the friction of the pipe, of 100 feet, and 100 gallons run to waste in the same time. What is the efficiency of the ram? A gallon of water weighs 8·34 pounds, so that the useful work of the ram is the raising of 41·7 pounds 100 feet high in a minute, or it is 4,170 foot pounds. The total work that could be realized from the water (105 gallons falling 10 feet in a minute) would be the raising of 875·7 pounds 10 feet high in a minute, or 8,757 foot pounds. Hence the per centage of efficiency (which is found by multiplying the actual work by 100, and dividing the product by the total work of which the water is capable) is 47 6+.

A correspondent asks to what hight he can raise water with a ram, with a head of six feet, allowing $\frac{9}{10}$ of the water to run to waste? Assuming that the ram has an efficiency of 45 per cent, to find the hight of delivery: Multiply the head by the efficiency, and divide by the proportion of water raised. Thus: Head, 6, multiplied by efficiency, 0·45, gives a total of 2·7. Divide this by proportion of water raised, 0·1, and the hight in feet to which the water will be raised is 27.

Those of our readers who are using hydraulic rams may easily determine data by which they can calculate the efficiency. If any do so, we shall be pleased to receive the results of their calculations. As many prefer to work examples by algebra, the analytical expressions for the preceding rules are given below. Let h = hight above source of supply to which water is raised; H = hight of top of source of supply above waste outlet; L = length of pipe from source of supply of ram to waste outlet, in feet; D = diameter of pipe, in feet; W = pounds of water flowing per minute; w = pounds of water lifted per minute. Let E = per centage of efficiency, L = about 3 H, $D = \frac{H}{10}$, and h not more than 15 H; and for best effect, E = from 60 to 70, under most favorable circumstances, from 40 to 50, ordinarily. Then

$$E = \frac{100 \times w \times h}{W \times H}.$$

Correspondence.

Notes from Washington, D. C.

To the Editor of the Scientific American:

As foreshadowed in your last, Commissioner Leggett has resigned, and Mr. Thacher has been appointed in his place. This having made vacant the Assistant Commissionership, General Ellis Spear, of the Board of Examiner in Chief, has been appointed to this position, and his place is to be filled by the promotion of Major Hopkins, who now occupies the position of Examiner in Interference cases. It was rumored that Commissioner Leggett's son-in law, Mr. Seymour, was to be appointed Examiner of Interferences, but I believe it has finally been decided to have a competitive examination for this office.

The number of patents issued for the last three months has somewhat fallen off, the whole number, including reissues and designs, being 3,229, against 3,344 for the corresponding term of last year. If the designs and reissues are omitted, the numbers are, for the last three months 2,849, and for the same months last year 3,061. The number of patents issued during 1873 was 11,616, and for the nine months of the present year, 9,488, which shows a slight gain, on the whole, over the monthly average of the preceding year.

Congress at its last session, although reducing the army at large, did not reduce the signal service, but permitted it to retain its full complement of 450 men, and, to give steady employment to this force, provided for the construction of telegraph lines on our western frontiers under the direction of the Chief Signal Officer. One of these lines begins at Dennison, in Texas, and ends at Brownsville, in the same State, connecting a string of military posts with the civilized world. The total length of this line is 1,350 miles, and it crosses the famous "Staked Plain" for hundreds of miles. The plain is utterly destitute of timber and water, and passes through the heart of the country which is now the seat of Indian hostilities, from which it will be seen that the difficulties to be overcome by the builders are of no ordinary magnitude.

Another line, ordered to be built under the same auspices, starts at Prescott, Arizona Territory, and extends through Camp Verde to Camp Apache in the same territory, a distance of about two hundred miles, connecting with the line built by the War Department last year from Prescott to San Diego, which has been since transferred to the Signal Office.

Besides these lines, the Signal Officer has a line from the office in this city to Cape Hatteras, and another to Sandy Hook, Long Branch, and Barnegat, N. J.; and the latter is being extended to Cape May. By this means a continuous line will run from Cape May to Sandy Hook, and the cautionary signals are to be so arranged that a vessel passing within sight of the coast can always have notice of an approaching storm in time to run into the nearest harbor. A signal station has recently been established on Thatcher's Island, off Cape Ann, Mass., connected by a cable with the mainland, one and a half miles distant. Further extensions of the service are contemplated as soon as Congress can be induced to make the necessary appropriations, and it is probable that the entire Atlantic and lake coasts of the United States will soon be protected by the telegraph, and in constant communication with this city.

A commission has been appointed by the commandant of the navy yard to examine and test a new system of caulking boiler seams, the invention of Mr. James Connery, chief of the boiler department of the Baldwin Locomotive Works, to whom letters patent were granted therefor on May 12, last. The invention consists simply in using a caulking tool having a convex end, which produces a smooth concave indentation in the edge of the overlapping plate, and avoids the danger, almost inseparable from the old fashioned tool, of making a groove or cut in the under plate, whereby its strength is much weakened, and a starting point formed which will readily rend upon any unusual pressure being brought to bear.

Washington, D. C. OCCASIONAL.

Lunar Acceleration: Its Cause.

To the Editor of the Scientific American:

As has been the case with other theorists and their theories, so with me and mine. Few scientists have hitherto admitted the retrograde motion of the sun in space, and one or two have even had courage enough to say: "It is not true," and so also with other of my theories. I make all objectors and objections welcome of course. Candid, honest exchange and interchange of opinion is what this world needs; and it seems to me that this is as powerful and potent a way as any to reach the truth. My object in writing this article is not only to show your readers the fact that lunar acceleration is not of increased motion in the moon, as some eminent scientists have supposed, and that it is owing to increased velocity in the sun; but also to present a fresh, undeniably demonstrative proof of solar retrograde motion. And as the subject, even to scientific men and great thinkers, is not so easily grasped and comprehended as many are apt to suppose, I will, with your permission and indulgence, thus simplify and explain it in as short and concise a manner as I can.

Seated in imagination at the zenith, and looking down upon our solar system, we see it all in action as we see a working machine. And when we look upon the vast area of the solar orbit, and behold the sun, as it were, slowly tracing his retrograde way all round the ecliptic, on the border or periphery of his orbit, and liken it to a vast and by far the largest wheel in the celestial machine: and when we look upon the orbit of each planet, being likewise respectively a wheel, a wheel having its center in the sun, and the planet sitting on its (the wheel's) periphery: and when we remember that the motion of the great wheel is retrograde, and that of all the smaller wheels direct, and that every smaller wheel is carried gradually retrogressively by virtue of the motion of the largest one: I say, when we see and remember all this of our great solar planet-wheeled system, we cannot but see that every second, minute, or degree of space retrograded by the sun must yield correspondent phenomena to or upon every other wheel or planet. And so also the motion of one planet or satellite around another must yield its phenomenon. Thus premised, I now proceed to show, from real astronomical data and discovery, that increased and increasing velocity of the sun is certainly the origin and all of so-called lunar acceleration.

To begin: The data which astronomical writers give regarding the motion of precession is substantially as follows: The stars appear to move directly (annually) about 50¼", or about 1° in 71⅔ years; and the equinoctial points, of course, recede that much in the same time. This recession of the equinoxes, *versus* precession of the stars, is owing to the retrograde motion of the sun; and from the said motion comes, likewise, recession of eclipses; for eclipses, when we take them in cycles, do recede round the ecliptic as the equinoxes do, and at the same exact rate too. At such a rate of motion, the sun would require some 25,800 years to move round the ecliptic or to complete his orbit; and if his rate of motion was ever the same, there would be no acceleration, so-called in lunar motion. It is because this motion of the sun is ever on the increase that the phenomenon alluded to arises.

As proof of the increase of solar motion, the writers alluded to tell us that precession is constantly increasing at such rate as amounts to 218 years less every 90° or quarter revolution, and say that, owing to the said increase, precession will complete a revolution in about 24 992 years, instead of the number of years above given. This increase, I claim, is the increase exactly of solar motion. And now I am going to show, not only that it produces lunar acceleration, but also that its result is in absolute accordance with the discovery and deduction of some of the most profound astronomers who ever lived.

Halley and some other eminent astronomers found, when comparing the present time of eclipses with that given by the most celebrated of ancient Egyptian and Chaldean astronomers, that, to make both agree, it is necessary to allow a lunar acceleration per century of about 11 seconds. Thus, then, we have the amount of lunar acceleration per century, as set forth, and no doubt perfectly correctly, by the wisest and most able of past astronomers. See how our theory works hand to hand in the matter, and proves them correct.

The increase of solar motion is equal to 218 years less every quarter or 90° of the orbit. The whole will be run in 24 992 years, thus: For the first quarter, 6,575 years; for the second or present quarter, 6,357 years; for the third, 6,139 years; for the fourth, 5,921 years; in all, 24,992 years. Taking the mathematical amount of increase, or the 218 years, out of the past 6 575 years, we find that it is almost 1° for every 30', 2° in 60, and 3° in 90', or about $\frac{1}{30}$ of the whole. We have therefore three degrees of solar retrograde advance, and of course three degrees of so-called lunar acceleration, since a point of time seven hundred years beyond the birth of Adam, and of 51' 26" since the birth of Christ.

Now as the earth in her diurnal motion moves through the whole 360° in 24 hours, through 90° in six hours, 3° in twelve hours, and through 51' 26" in 3 minutes and 26 seconds; it follows that since the year 1 (Christian era) the moon has accelerated the earth about three minutes and twenty six seconds, *versus* the earth's retardation, which is equal to 51' 26" since the birth of Christ. Need I tell your readers that three minutes and twenty-six seconds, of lunar acceleration since the birth of Christ, is equal to 11 seconds per century? That is just what it is. Consequently the phenomenon of lunar acceleration is not of the moon, nor in the moon, but of the sun. It is not an acceleration of the lunar motion, but clearly and positively acceleration in the sun.

Thus wise, accurate, and profound astronomy and despised rejected theory meet, kiss, and fall into one. Yet, strange to say, the present learned astronomic world cannot see it. It must, though, no doubt, soon. JOHN HEPBURN.

Gloucester, N. J.

The Sezaroch.

To the Editor of the Scientific American:

The idea of making a projectile contain a part of the powder charge, and thus causing two explosions of the charge instead of one, originated with Mr. James Rose, of the Ashford Railway Works, in England, in the year 1854. Drawings were made and submitted by him to several prominent English engineers, and to at least one government, in that year. There are several engineers in this city to whom I have, during the last five or six years, shown sketches of such projectiles. JOSHUA ROSE.

279 West 12th street, New York city.

Stevens Institute of Technology.

The Stevens Institute of Technology has commenced its third college year with a new class of over fifty in number —double the number that it was originally proposed to admit as a maximum. The large space necessarily devoted to its laboratories, workshops, and drawing rooms compels this restriction of numbers. The aim must consequently be to educate a limited number of young men of more than average ability, keeping the standard so high that the quality of educated material given to the engineering profession by that college may compensate for the comparatively small number of its graduates.

The indications are that the authorities will soon be compelled to raise both the requirements prescribed for candidates for admission and the charges for tuition.

No student of good habits, of intelligence and high general character, and capable of taking a high position in this class has ever yet been denied instruction because of poverty, and it is not probable that this generous policy of the trustees of Mr. Stevens' noble bequest will be changed.

The museum, the mechanical laboratory, the collections in the department of engineering and other cabinets, are continually receiving important additions, principally from our most successful and most intelligent manufacturers. Such contributions are of most practical value, and must aid the Faculty in their work in a very important degree.

The Saw Premium at the Cincinnati Exhibition.

The prize offered for the best circular saw at the Cincinnati fair, $100 in gold, was awarded to Messrs. Emerson, Ford, & Co., of Beaver Falls, Pa. There were nine contestants, and the work done by each saw was remarkable for excellence and rapidity. A Cincinnati contemporary says that Messrs. Emerson & Co.'s solid tooth saw, "when it struck the test log, showed its real metal. It took in the situation most beautifully, making the sparks fly gaily at every entrance into the tough poplar, but was steady and kept right down to actual work all the time, making sixteen good boards, 10x20, in two minutes and forty-four seconds, on 3½ inches feed, and coming out cool as a cucumber. The oak log was then placed upon the carriage, and the saw proved that its appetite had merely been sharpened by the poplar. It cut twelve oak boards, 12x15, in one minute and forty-three seconds, all No 1. lumber. This is the crowning feat of the test so far."

Messrs. Emerson, Ford, & Co. were also awarded the silver medal for the best saw exhibited.

GERMAN SILVER FOR CASTING.—Copper, 50 lbs.; zinc, 20 lbs.; nickel, best pulverized, 25 lbs.

PRACTICAL MECHANISM.

NUMBER XI.

BY JOSHUA ROSE.

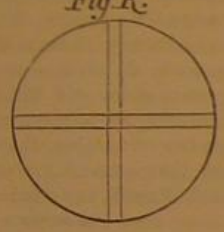
LATHE WORK.

The centers of a lathe should be turned both to an equal taper, a gage being used for the purpose. The running center should be tempered to a blue and the standing center to a brown color. If the holes in the headstock or tailstock of the lathe into which the centers fit are out of true, as is sometimes the case, a center punch mark should be made upon the diameter of the exposed part of the center, and another upon the end face of the spindle, and the center always placed so that the two "center pops" are opposite to each other; thus the centers will run true whether the taper holes into which they fit are true or not.

After the centers are hardened, care should be taken to properly clean their taper parts so that there may be no dirt or grit upon them to cause them to run out of true. If the running center is removed from the headstock, as is sometimes necessary in boring and for other purposes, the hole into which the center fits should be plugged with a piece of waste or rag to prevent it from becoming filled, or partly so, with shavings.

Plain work that is not easy to handle may be marked off for the center punch by a pair of compass callipers, and light work as follows: Place upon a planed surface a pair of parallel strips or pieces, one being under one end, the other under the other end, of the work; then set the point of the scribing block scriber as near the center of the work as the eye can determine, and draw a line across the end of the work; then turn the latter upside down and mark another line across its end; the work must then be turned a quarter revolution, so that the next line marked by the scriber will be at about right angles to the two lines already drawn, which being done and the line drawn, the work must again be turned upside down and the final line drawn, when the end of the work will be marked as shown in Fig. R, an illustration

Fig. R.



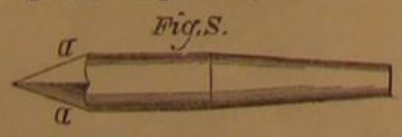
of an end view of a piece of round iron so scribed, in which case the center of the small square formed by the lines around the center of the work will be the center of the latter. It is obvious, however, that, if the scriber be placed at the center of the iron, only two such lines will be visible, the point of their intersection being, in that case, the center of the work.

The centers of all lathe work should be cleared at the extreme central part, so that such part will not revolve against the points of the lathe centers, which would cause the work to run out of true after running a short time in the lathe.

Such clearance is best accomplished by drilling a small hole in the central part of the work centers; it may, however, be done by using a center punch of a more acute taper than is the lathe center, or by cutting out the centers by means of a square center, as will be hereafter described. The drilling is, however, the preferable plan, being the least liable to cause the centers of the work to wear out of true.

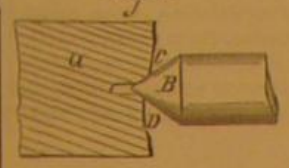
If, however, the work requires to run very true, as in the case of recentering work which has once been turned, the square center must be employed to cut the center of the work true to its circumference. A square center is a center fitted to the lathe in the same manner as the common center, but having four flat sides ground upon its conical point, all four sides meeting at the point, and having sharp edges as shown in Fig. S, *a a* being two of the flat sides referred to:

Fig. S.



the taper of these sides should be more acute than is the taper of the lathe center, so that the center cut in the work by the square center shall not bear upon the point of the lathe center, and cause it to run, in time, out of true. The square center should be hardened to a straw color, and may then be used to simply countersink centers which have been center-drilled, in which case it is put into the center hole of the head of the lathe and revolved at a high speed (by the lathe) while the work is forced up to it by winding out the back center, the work being between the two centers. To center work very truly, it is employed as follows: The square center is put in the tailstock spindle of the lathe, in the same way as the ordinary center is placed, the work having a dog or driver placed on it, as if the intention were to turn the work; it must then be placed in the lathe between the centers. A piece of iron or steel, having a hollow or flat end (as, for instance, the butt end of a tool) must then be fastened in the tool post of the lathe; then the lathe may be started and the tool end wound against the end of the work (close to the square center) until it touches it and forces it to run truly, in which position the tool end is left, while the square center is fed up and into the work until the latter is true, when the operation will be completed. Before any turning is done to the diameter of any lathe work which runs between the centers, the ends of such work should be made true; because if there be a projecting part on the end, or if the latter is not quite true, the center gradually moves over to the lowest side, as explained by Fig. 41, *a* being a section of the work,

Fig. 41.



B the dead or standing center of the lathe, C, the high, and D, the low, part of the end of the work; to the latter the center gradually moves. All work which requires to be turned at both ends (and hence must be turned or placed end for end in the lathe) should be roughed out (that is, cut down to nearly the required size) all over before any part of it is finished, or, when turned end for end in the lathe, the part first turned up will run out of true with the part last turned up, though the lathe centers may be correctly placed. This may be caused by the centers of the work moving a little as they come to their bearings on the lathe centers, or in consequence of breaking the skin of the work; for nearly all work alters in form as its outside skin is removed, especially work in cast iron.

Lathe work requiring to be very finely finished and highly polished should be cut as smoothly as it can be by the tool, so as to leave as little as possible for the file to do, because a file used on lathe work cuts the softer parts of the metal more rapidly than it does the harder parts, and hence makes the work out of true. The file should therefore only be required to take off the fine marks left by the tool, and should be a dead smooth, used with chalk, applied in the same manner as already described for vise work. The emery cloth or paper should be moved rapidly back and forth so that the emery marks cross each other, which will remove the file marks quickly. Use finer emery paper as the finishing progresses, and conclude with the most worn of the finest emery used, moving it along the work very slowly and pressing it very lightly. The grades of emery paper should be the same as those given for vise work; and a finish and polish so fine may be given that it cannot be discerned whether the work was finished endwise or in the direction of its circumference. For finishing the faces of lathe work (in which case a file cannot be employed), the tool marks may be taken out by using grain emery applied with oil to the end of a wooden lever, fastening a tool or piece of iron in the tool post as a fulcrum for the lever. In this case, however, the lever must be kept continually moving, from the center of the work towards the periphery and *vice versa*, so that the emery marks cross each other; then when the tool marks are erased, emery paper (of finer and finer grade, as the finishing progresses) may be used, concluding as before with the most worn of the finest emery paper used and moving it slowly. The reason of the necessity of keeping the lever moving and the emery marks crossed is that, if the lever or emery cloth is kept in one position or nearly so, it will cut rings in the work; and wherever there may be a hollow spot or sand hole in the metal, the emery will accumulate and cut a groove in the work; especially is this the case in work of cast iron or brass. It is not possible, however, under any circumstances, to finish work so finely in the lathe as may be done by hand in the vise.

TURNING ECCENTRICS.

If an eccentric has a hub or boss on one side only of its bore (as in the case of those for engines having link motions, where it is desirable to keep the eccentries as close together as possible in order to avoid offset either in the bodies or double eyes of the eccentric rods), the first operation to be performed in turning it up is to chuck it with the hub side towards the face plate of the lathe, setting it true with its outside diameter (irrespective of the hole and hub running out of true), and to then face up the outside face. It must next be chucked so that the face already turned will be clamped against the face plate, setting the eccentric true to bore the hole out, and clamping balance weights on the face plate, opposite to the overhanging part of the eccentric. The hole, the face of the hub, the hub itself (if it is circular), and the face of the eccentric must be roughed out before any of them are finished, when, the whole of them may be finished, to the requisite sizes and thicknesses. The eccentric must then be turned about and held to the chuckplate by a plate or plates clamping the hub or boss only, the diameter of the eccentric being set true to the lines marked to set it by; then the diameter of the eccentric may be turned to fit the strap, the latter having been taken apart for that purpose. The reason for turning the strap before the eccentric is turned is (as may be inferred by the above) that the strap can be fitted to the eccentric while the latter is in the lathe, whereas the eccentric cannot be got into the strap while the strap is in the lathe. The strap should have a piece of thin sheet tin placed between the joint of the two halves before it is turned out, which tin should be taken out when the turning is completed, and the strap bolted together again. The size for the eccentric will then be from crown to crown of each half of the strap.

The object of inserting the tin is to make each half of the eccentric bed well upon the crown, and to prevent it from bearing too hard upon the points, as all straps do if the joint is not kept a little apart during the boring process. If the eccentric is already turned, an allowance may be made for the thickness of the sheet tin between the strap joint by placing a piece of the same tin beneath one of the calliper points when gaging the eccentric to take the size for the strap.

Eccentrics having a proportionally large amount of throw upon them are sometimes difficult to hold firmly, while their outside diameters are being turned to fit the strap, because the hub which is bolted against the face plate is so far from the center of the work that, when the tool is cutting on the side of the eccentric opposite to the hub, the force of the cut is at a considerable leverage to the plates clamping the eccentrics; and the latter are, in consequence, very apt to move if a heavy cut is taken by the tool. Such an eccentric however, usually has open spaces in its throw, which spaces are placed there to lighten it; the method of chucking may, under such circumstances, be varied as follows: The outside diameter of the eccentric may be gripped by the dog chuck, if the dogs of the chuck project far enough out to reach it (otherwise the dogs may grip the hub of the eccentric), while the hole is bored and the plain face of the eccentric turned. The eccentric must then be reversed in the lathe, and the hub and the face on that side must be turned. Then the plain face of the eccentric must be bolted to the face plate by plates placed across the spaces which are made to lighten the eccentric, and by a plate across the face of the hub. The eccentric being set true to the lines may then be turned on its outside diameter to fit the strap; to facilitate which fitting, thin parallel strips may be placed between the face plate and the plain face of the eccentric at this last chucking. It will be observed that, in either method of chucking, the outside diameter of the eccentric (that is to say, the part on which the strap fits) is turned with the face which was turned at the same chucking at which the hole was bored, clamped to the face plate. In cases where a number of eccentrics having the same size of bore and the same amount of throw are turned, there may be fitted to the face plate of the lathe a disk of sufficient diameter to fit the hole of the eccentric, said disk being fastened to the face plate at the required distance from the center of the lathe to give the necessary amount of throw to the eccentric. The best method of fastening such a disk to the face plate is to provide it with a plain pin turned true with the disk, and let it fit a hole (bored in the face plate to receive it) sufficiently tightly to be just able to be taken in and out by the hand, the pin being provided with a screw at the end so that it can be screwed tight, by a nut, to the face plate. The last chucking of the eccentric is then performed by placing the hole of the eccentric on the disk, which will ensure the correctness of the throw without the aid of any lines on the eccentric which may be set as true as the diameter of the casting will permit, and then turned to fit the strap. A similar disk, used in the same manner, may be employed on cranks, to ensure exactness in their throw.

New Spectroscope.

The instrument is the invention of Professor A. K. Eaton, of Brooklyn, N. Y., and is by himself named "a direct-vision spectroscope." It consists of a thick plate of glass with parallel sides, united to one of the faces of an ordinary bisulphide of carbon prism, or a prism of dense flint glass. According to the amount of dispersion desired, the light is made to enter either on the end of the glass plate, or on the opposite face of the bisulphide prism. The results obtained from this instrument are as follows: The dispersion of this compound prism is nearly four times greater than that of the ordinary 60° prism. The mean emergent ray is practically parallel to the incident ray. It does not deflect the ray from its original path. Many Fraunhofer lines are visible by this prism with the naked eye, while with the observing telescope all the prominent lines are clearly reversed, without the use of the slit or collimeter, by merely throwing a strong beam of light by means of a mirror.

When the usual appliances of slit-collimeter and telescope are employed, it widely resolves the D line, and shows the nickel line between these two lines—a result claimed as the best obtained by a four prism instrument of Browning.

It is stated that a simple bisulphide prism in this instrument gives a dispersion of 40° between the B and G lines; when it is used for projection, it gives a spectrum 8 feet long at a distance of 10 feet from the screen, enabling 100 dark lines to be counted.

It is evident, therefore, that this prism promises to become a most valuable instrument for projection in the lecture room, while either solar, electric, or oxyhydrogen illumination may be employed, having the great advantage of simplicity of adjustment, since it avoids the necessity of turning the lantern after the slit has been focussed on the screen.

The Louse a Substitute for the Compass.

The Great Dismal Swamp is partly in North Carolina and partly in Virginia. It is 40 miles long and 15 to 20 miles wide. Professor Webster, at the late meeting of the American Association, told the story of a party that divided in the swamp, one portion of the party having no compass. The latter portion of the party was lost, and after long wandering found their way out by a singular expedient. They made use of the insect for which fine tooth combs were invented. Putting the insect on a flat piece of wood, and leaving it to its own devices, it invariably began to move in a certain direction. This direction was followed out by the party, and they were thus led out to the northward. It is supposed that this instinctive movement of the insect is due to its seeking the way toward the greatest light.

EXTENSION OF UNDERGROUND RAILWAYS IN LONDON.—At the enormous cost of $12,500,000, the Metropolitan Inner Circle Railway Company is busily engaged in carrying out its plans. In addition to the construction of lines, stations, etc., this company is compelled to make an entirely new street, from Fenchurch street to King William street, and also to widen the streets right and left which branch therefrom. The importance attached to this enterprize may be gathered from the fact that the Metropolitan Board of Works and the corporation of the City of London have subscribed the sum of $2,500,000.

IMPROVED AIR SPRING FORGE HAMMER.

The annexed engravings represent the spring forge hammer of Mr. Hotchkiss, in which air is used as the elastic medium, and the principle of which has already been applied, during the past fifteen years, to a wide range of purposes; and it is capable of still further extension. Such hammers can be made of nearly any weight, the heaviest being suited for use on heavy forgings, for ore crushing, and similar duty; and small ones are employed for planishing metal surfaces and forging spectacle bows, corkscrews, and other fine work. Another and a curious use for the invention is its application in a water engine for blowing organ bellows; the escape holes in the cylinder being useful in overcoming the dead center, on which the piston would ordinarily remain, causing a tremulous effect on the sounds issuing from the pipes. Five hundred of these hammers, of various sizes, are now doing good work in all parts of the country. The inventor states that a 40 lbs. hammer will draw a three inch bar three feet at one beat.

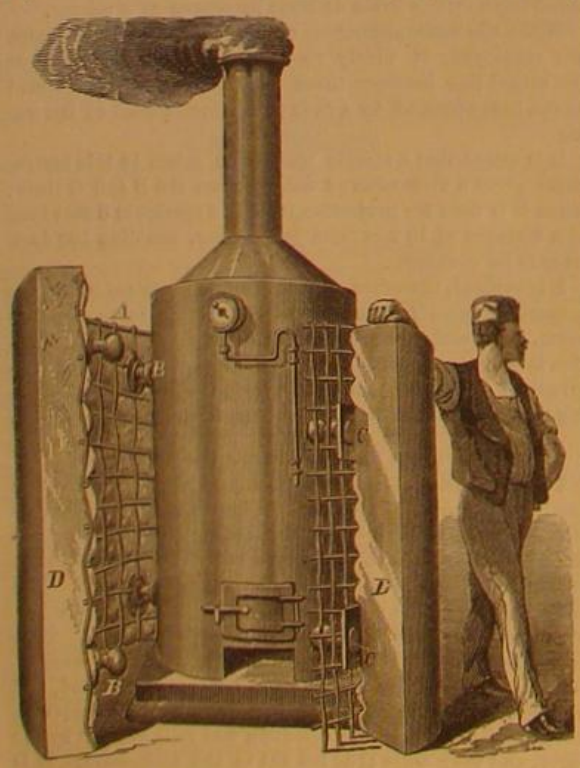
By the construction, as shown in the engravings, the cylinder and hammer move in vertical slides; each blow is square, and die work can be forged with the greatest nicety as well as rapidity; the number and force of the blows can be varied at will by the operator, and the machine, it is claimed, requires less power than any other hammer giving the same blow. The air is compressed by the piston, B, in the cylinder, A, the fit being airtight, as shown in Fig. 2. The slides, C, keep the cylinder and piston vertical, and the motion of the latter is effected by the rotation of the crank disk, E, driven by belting, and operating the connecting rod, D. The holes, F, in the cylinder, A, allow free ingress of air, thus insuring a perfect cushion at each stroke. G is the anvil, which, being movable, can be readily changed to suit any work for which the machine is used. A guide pulley, operated by the treadle, I, for tightening the belt into action is also provided.

The claims cover the use of an interposed spring cushion of air, rubber, or metal, and an actuating mechanism having a definite reciprocating motion. A considerable reduction in the expense of these machines has lately been effected by casting the whole frame in one piece, as shown in Fig. 1.

For further particulars, address Messrs. D. Frisbie & Co., manufacturers of the machine, 26 and 28 Grand street, New Haven, Conn.

A NEW BOILER COVERING.

A new boiler covering, the construction and mode of application of which is represented in the accompanying engraving, was patented July 21, 1874, through the Scientific American Patent Agency, by Messrs. Alonzo Irons and Lewis Clayton, of N. W. corner of 13th street and Washington avenue, Philadelphia, Pa. A web of coarse wire cloth, A, is provided with a number of short studs, B, secured to it by



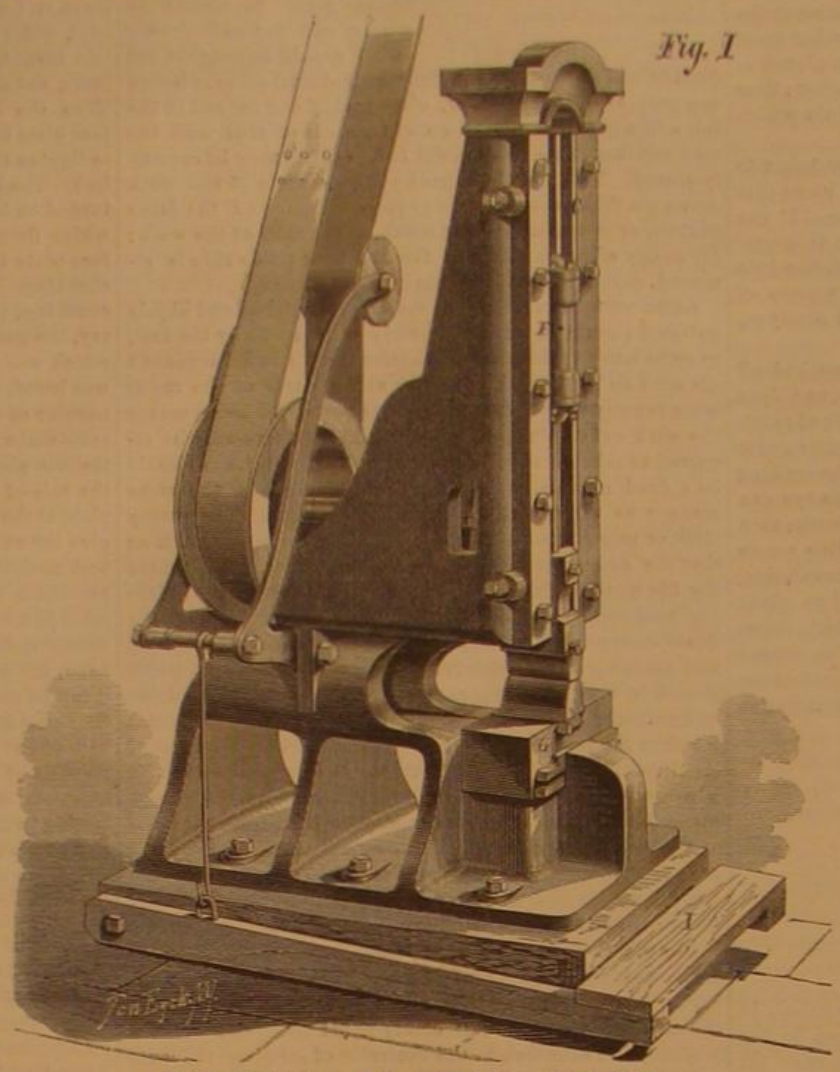
washers, C, to form an inside fastening and to prevent the sweating of the boiler, when cold, from loosening the cement. To this fabric is applied a non-conducting compound, D, and the whole is supported at a short distance from the boiler. This affords an air space between the casing and boiler, which not only largely aids in retaining the heat in the latter, but also prevents cracking or breaking, as might be the case were the covering placed directly in contact with the generator, and so subject to the contraction and expansion of the boiler shell. In practice the wire cloth is first fitted to the boiler, and the non-conducting compound subsequently applied in a plastic state.

For further particulars address the inventors as above.

Soda Hailstones.

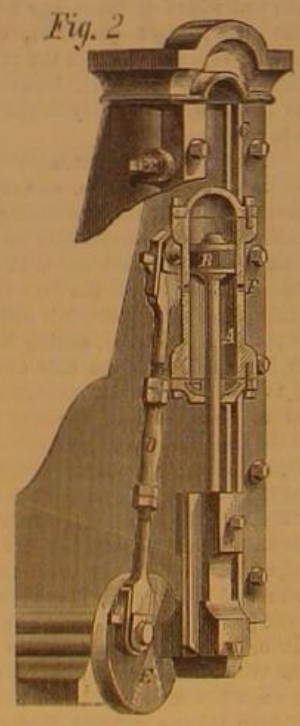
On the 9th of June of this year, a great hailstorm was experienced at Elizabeth, N. J.; and of the many hailstones which fell on the occasion, two have so peculiar a history as to deserve especial mention. One of them, when found, "appeared to be a mass of ice, but as the ice melted away, there remained a clear crystal of this salt"—meaning the salt referred to in the analysis stated below—"which, in drying, became pulverulent on the surface, and finally broke

Fig. 1



HOTCHKISS' AIR SPRING HAMMER.

Fig. 2



up. It was taken from the ground by a neighbor, Mr. James H. Hooley, and the facts are attested by a score of witnesses."

The above extract is contained in a letter from Mr. Jacob M. Clark to Professor Thurston. The letter, together with the solid residue said to have been left by the hailstone on evaporation, was placed in the hands of Professor Leeds, of the STEVENS INSTITUTE OF TECHNOLOGY, who found that it consisted of water 14·50, soda 49·41, carbonic acid 35·07, loss, 1·02, in 100 parts, which is carbonate of soda.

A subsequent letter alludes to the experience of another observer, who "picked up a singularly large, clean hailstone and placed it in the mouth; but it proved so intensely bitter that it was thrown away at once."

It is easy to discredit these curious observations by the supposition that the hailstones fell upon, or were preserved in, vessels containing carbonate of soda; but if the observations and statements of credible witnesses are to be accepted, it must be put on record that hailstones containing carbonate of soda actually fell at the time and place indicated.

J. C. B., JR., writes from Berlin, Germany: "The good the SCIENTIFIC AMERICAN has done the world is not to be estimated in dollars and cents. One must go early to the library here to find the SCIENTIFIC AMERICAN."

The German Navy.

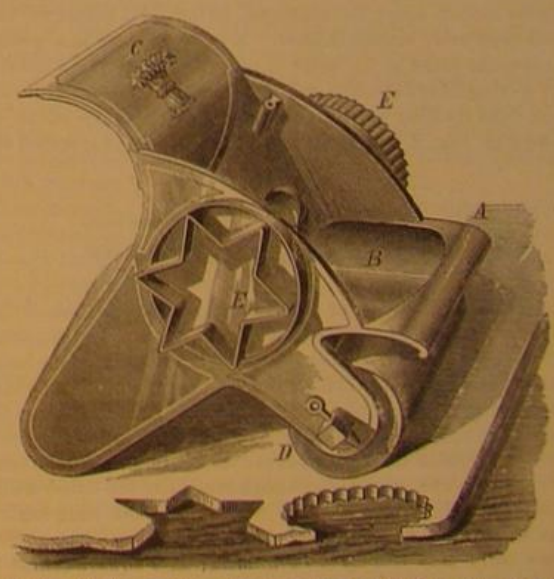
The Friedrich der Grosse, which has just been launched is the seventh iron-cased frigate of the German navy, and the eighth being expected to leave the stocks early next summer, the autumn of 1875, or, at the very latest, the spring of 1876, will see a rather formidable squadron assembled off the Oldenburg coast. By that time Germany will be mistress of eight iron-cased frigates, carrying 92 guns of the very heaviest caliber (mostly 400 and 500 pounders), and set in motion by engines with a total of 48,500 horse power. In addition to these first-class ships there are three more ironclads of minor proportions, making up together 15 heavy guns and 5,400 horse power. Twelve corvettes (the twelfth will be ready next year), with 168 heavy guns and 18,600 horse power, attended by 24 gunboats, mustering 59 guns and 8,850 horse power, complete the fighting array of the youthful but aspiring fleet. Of the corvettes some have 20, others 10 or 15 guns, 3 of the number carrying only 5, with engines of above 2,000 horse power, being intended to act on the Alabama plan in far-off seas. The names of these peculiar vessels, which will probably be heard of in the next war, whenever that may be, are Ariadne, Louisa, and Freya, the last being yet on the stocks. The whole German navy, including, beside the above, 3 sailing frigates and 3 sailing brigs, already numbers 55 ships, 425 guns, 73,768 tuns, and 84,770 horse power. About 4,000 sailors, with 1,000 marines, 500 artillerymen, and officers in proportion, were this year reported in the Blue Books. Next year will witness an increase of about 2,000, in consequence of the new ironclads being equipped for active service.

Europe at this moment has 142 ironclads fit to be placed in line of battle. Of these England owns 38; France, 28; Austria, Russia, Italy, and Turkey, 15 each; Germany, 8; Spain, 7; Denmark, 3; Greece, 2. The tunnage of the German ships and the size of their guns are, however, so uncommonly great that, although few in number, they are supposed to be more than a match for any navy, those of England, Russia, and France excepted.

DOUGH KNEADER AND CUTTER.

Another ingenious device for lightening "woman's labor,"—this time in the kitchen. Our engraving represents an invention which is a dough kneader, a cutter, a scraper, and a rolling pin, all in one,—which abolishes the use, first of the bare fists; second, of an inverted spice box, or whatever else may be the favorite implement for molding cookies, cakes, or crackers; third, of the table knife blade; and, fourth, of the time-honored and cumbrous wooden roller. Besides it saves steps, in having the three last mentioned implements always conveniently at hand, and economizes one's stock of patience in that rather tedious though not to be neglected operation of kneading the dough.

The device is made of tin, suitably strengthened inside. The forward U shaped portion constitutes the kneader. When this is in use, the palm of one hand is rested on the part, A, the fingers being placed in the curved handle, B, so that a secure hold is thus obtained. To gain greater power, the other hand is applied to the curved upper end, C, the



edge of which portion, sharpened, forms the scraper for gathering the dough or dividing the same, as required. At D is the roller, the shaft of which enters apertures in the body, and is secured by pins so as to allow of ready detaching. Lastly, the dough cutters, E, of different shapes, are applied by central tubes to sockets at both sides of the body, and may be used with the latter as a handle, or be removed and used separately.

Patented through the Scientific American Patent Agency, April 21, 1874, by Mr. Frank Möckli. For particulars relative to sale of the patent, address the present owner of the same, Mr. Valentine Lorra, Galveston, Texas.

A GOOD BRITANNIA METAL.—Tin, 150 lbs.; copper, 3 lbs. antimony, 10 lbs.

THE CULTIVATION OF THE VICTORIA REGIA.

The English *Garden* gives the following description of the cultivation of the water lily of the Amazons, known as the Victoria Regia: The indoor culture of this plant is very simple. Although not naturally an annual, it flowers much better when treated as one, seedlings being raised every winter. These are simply planted out, in the spring, on a mound of richly manured compost, the temperature of the surrounding water being kept as near 80° Fah. as possible, by means of hot water pipes which are conducted round the bottom of the tank. In order to keep the water fresh and sweet, some system must be adopted to secure circulation, and this may be obtained by having water constantly flowing into the tank on one side with an outlet at the other. Some cultivators employ a small overshot wheel, which is turned by the inflowing water, and at the same time keeps the whole body of the water in constant motion. This appliance is, however, not absolutely necessary, as the inlet and outlet pipes, with a constant supply of fresh water, are all that are requisite to insure success. There are, however, many situations out of doors in which this plant will not only make a luxuriant growth, but produce flowers during the summer months. It has already flowered at several places in England, where tanks have been formed to receive the condensed steam from the engines of water works or manufactories, and in favorable situations like these it deserves a fair trial. The main elements of success consist in having a strong, healthy, well established plant ready for planting out in the latter end of May or beginning of June; and in order to prevent the growth being checked, it would be advisable to have the young specimen planted in a coarse basket of wickerwork, using a rich compost of sandy loam and well rotted hotbed manure. This basket and its contents would not take up much room in a shallow tub or tank in the plant stove, and when the mild weather arrives the plant could be gradually hardened off; and the basket and its contents might then be placed in a suitable position in the open air tank. The plant is readily propagated from seed sown during the winter months, or nearly as soon as it is ripe.



THE VICTORIA REGIA WATER LILY.

The plant is a native of Guiana, where it occurs in the Parana river, and in South America, being found abundantly in some of the sheltered tributaries of the Orinoco, and also in those of the Amazon. In its native habitat, the flowers acquire a richer rosy tint than in hothouses, where it is a rarity to see more than one of its delicately perfumed flowers open at the same time. The leaves of this species are frequently 6 feet, or even more, in diameter, and float on the surface of the water, being supported by a beautiful network of hollow veins. The under surface of the great table-like expansion is of a rich purple color, the upper surface being deep green. The plant is frequently to be seen in bloom at Kew, Chatsworth, and many other celebrated gardens in England. We select the excellent engraving of this beautiful exotic from the pages of our cotemporary above mentioned.

The Society for the Promotion of Scientific Industry.

We have received, by the courtesy of Mr. Frank Spence, from Manchester, England, the report of this recently instituted body, which has already done good service to the scientific industries by carrying to a successful issue the recent exhibition of devices for the economical consumption of fuel. Some excellent inventions, called forth by this competition, have been illustrated and described in our journal. The society also sent thirty-four skilled workmen to Vienna as reporters, and their accounts of the Exposition and their criticism of the exhibits are interesting and valuable. The institution also publishes a journal, intended to keep its members posted as to contemporary events. It numbers many important leaders of the scientific and industrial specialties among its members, and seems to be doing much useful work.

Importance of Salts in Food.

Mr. Foster has made some interesting experiments on dogs and pigeons, which show that animals suffer and die when inorganic salts are altogether absent from their food, although the other nutritive constituents may be abundant. In all the animals tried, there was a condition of muscular weakness, tremor, and general exhaustion. In the dog, the muscles of the posterior extremities, from the second week of the experiment onward, gradually assumed a paralytic character, as when the function of the spinal cord is weakened. The activity of the cerebrum was also impaired, as was evident from the bluntness of the senses and apathy of the animal. Later on, increased excitability often appeared; the dogs were terrified at any quick motion; one had a brief attack of madness, but soon crouched down trembling and growling. On being taken out, it ran forward and knocked its head violently against a wall. After the animals had been deprived of salts for some time, the juices of the intestinal canal either lost their digestive power or were not secreted in proper quantity, and nutrition was thus interfered with. Death took place, however, from the alterations in the nervous system, before there had been time for it to occur from inanition. The quantity of salts necessary to life is smaller than is generally supposed, but the exact amount required is still to be determined.

These experiments amount practically to a scientific exposure of the unnaturalness and consequent abnormality of the use of sifted wheat flour the principal food of women and children, and of too many men. The inorganic salts are almost absent from this artificial food, the chief material weakness of modern pseudo-civilization. Mr. Foster's experiments are contributed to the *London Medical Record*.

LONG MOSS.

There is a singular and beautiful parasite, known by the name of long moss, to be found pendent from forest trees in nearly all the Southern States. It is especially abundant upon those which grow in damp situations. It is sometimes found only here and there in small tufts, but frequently it is in such quantities upon a tree as to appear to fill all the spaces between its branches, and from the lower limbs it hangs in pendent tufts several feet in length, which, as they are swayed by the wind, wave with a certain amount of grace. In localities where it is abundant, its dull gray color and general drooping habit produce a very somber effect. As it grows most luxuriantly in situations which, from being constantly moist, are unhealthy, it is easy to associate it with disease and death, and in some localities it bears the not very cheerful name of coffin fringe. Though popularly called moss, it does not belong to mosses, properly so called, at all, but, strange as it may seem, to the pineapple family, the *bromeliaceæ*. Its botanical name is *Tillandsia usneoides*, and was named in honor of a Russian professor, Tillands. Its specific name means "resembling usnea," a long drooping lichen which hangs from northern trees in a similar manner.



Aside from forming a striking feature in the landscape, says *The American Agriculturist*, the long moss is of no little economical importance. The central portion, exceedingly tenacious and elastic, has long been employed as a substitute for hair. The plant is found in Central and South America and the West Indies, and has been put to so many uses by the Spanish Americans that in some localities it is known as Spanish moss. The primitive method of procuring the fiber is to place the moss in shallow ponds, exposed to the sun, to rot the somewhat fleshy outer covering; it is then taken out and allowed to dry, after which a moderate beating removes the outer portion, and the fiber is left in a black tangled mass, which, but for its branching character, it would be difficult to distinguish from hair. Northern people, traveling in the South, frequently send home specimens of this moss, and we have seen it suspended from trees growing on lawns in several places during the past summer.

Population of the United States.

The first census of the country was taken in 1790, and decennial censuses have been taken ever since. An estimate has been made for the ten years previous to 1790, from the data of years 1790, 1800, 1810, and 1820. An examination of these years exhibited successively by subtraction two second differences that were nearly equal, so much so as to indicate in general, as the law of their progression, approximately, constant second differences. From the average of these second differences, treated as a second difference for completing the series, the population for the year 1780 was estimated at 3,070,000.

The present and prospective population of the United States is as follows:

1870	38,558,371	1876	45,316,000
1871	39,555,000	1877	46,624,000
1872	40,604,000	1878	47,983,000
1873	41,704,000	1879	49,395,000
1874	42,856,000	1880	50,858,000
1875	44,060,000		

No Coal in California.

Dr. J. C. Cooper, who has made the most careful surveys of the State, says that the geological facts are all against the probability of the existence of any true coal measures in California. In ninety-nine cases out of a hundred, the alleged coal discoveries are of no value whatever. In other countries, the true coal of the carboniferous rock is formed of tree ferns, algæ, and other plants of low organization. None of these remains are found in California, but in their stead are found the remains of coniferous and dicotyledonous trees, or those having double-lobed leaves, the beds in which they are found being classed by geologists as lignites. In some parts of the State, this lignite is found in useful quantities, and may be employed, like peat, for local consumption.

A New Material for Aniline Lake.

Professor R. Böttger finds that when an alcoholic solution of any aniline color is mixed with a sufficient quantity of infusorial earth (sometimes called mountain flour, a minutely divided silica), water added, and the mixture placed on filtering paper, the liquid will run off clear, while the earth retains all the pigment. Hitherto compounds of alumina only have been used for such purposes, to make the so-called lakes (carmine lake, madder lake, etc.) The behavior of the excessively cheap infusorial earth to the aniline colors here described will undoubtedly lead to some practical application.

A RECENT test of the relative strength of oak and Oregon pine, made at San Francisco, with bars each 1 inch square and 3 feet long, showed that the pine was equal to the oak. Both broke under the same weight placed in the middle of each bar, namely 260 lbs.

THE EARLY HISTORY OF WHEELED VEHICLES AND RAILWAYS.

NUMBER I.

"Men of genius have a hard time, I perceive; and must expect contradictions next to unendurable....the plurality of blockheads being so extreme!"—CARLYLE.

Nothing, perhaps in the history of human achievement is more interesting and instructing than the opposition offered by cupidity and prejudice to those great mechanical improvements and inventions which are the just pride and boast of the nineteenth century. We boast that our age is distinguished from all other ages, and endowed with a special wonder and glory by its material triumphs; that we have compressed the huge globe into a neighborhood and brought all its interests within the system of a daily newspaper; that we have caught and harnessed the wild forces of Nature that tear the arteries of the earth and heave volcanoes; that even magnificent Nature herself has been humbled to toil all day at our looms and in our factories, without food, without sweat, and without weariness; and made to run on our meanest messages. Yet all this was accomplished in the face of violent opposition.

It may at first sight seem unreasonable and ungrateful that men, while constantly striving to better their condition, should be constantly opposing those who are contributing most to their success. But in truth, it is an hostility which has its origin in the diversities of temper, of understanding, and of interest which are found in all societies, and which will be found so long as the human mind continues to be drawn in opposite directions by the charm of novelty and the charm of habit. It has been the fate of every man who has ever attempted to enlarge the knowledge, or lessen the sufferings, or increase the comforts of his race, to be withstood by the most unreasonable opposition and well nigh overcome by the most bitter ridicule; and it always must be so. No man, not utterly destitute of all candor and judgment, will deny but that, in some age anterior to the dawn of history, there were fools who opposed the introduction of the alphabet and the plow with as loud complaints and as bitter invectives as our ancestors did that of the stage coach and the penny post; as we in our time have opposed railroads and telegraphs, and as fools, in some age yet far in the future, will resist some new invention or some new innovation of which the world has not now the faintest conception.

The workings of this strange species of human obstinacy, an obstinacy which the accumulated experience of nineteen centuries of progress has not been able to cure, is surely deserving of the greatest consideration, as the proper result of a cause lying deep in the innermost recesses of human nature, and which, while tending to degenerate us into bigoted dotards, has saved us from becoming shallow and reckless empirics. It will be our endeavor, therefore, to relate the history of that cruel opposition, meted out so unsparingly to those wonderful inventions now never mentioned without respect and gratitude in any part of the globe.

Of all inventions, the alphabet and printing press alone excepted, those inventions which abridge distance have undoubtedly done the most for the civilization of our species; and with these we propose to begin. To improve the means of locomotion afforded to man by Nature has been the intricate problem which all nations from the earliest down have attempted to solve; but in truth, it is only within the lifetime of the past six generations that anything approaching to a solution has been arrived at. Two hundred years ago there did not exist in all England a single navigable canal, not an inch of railway (as we understand the term), not a public conveyance that would bear comparison with the most lumbering farm wagon that can now be found on the prairies beyond the Mississippi, and not a mile of road which the traveler of today would not consider as impassable. The accounts that have come down to us of the state of travel in England under the reign of "Old Rowley, the King," are indeed surprising in the extreme. It was by the highways that both travelers and goods passed from place to place, and those highways appear to have been far worse than the most ruinous roads that can now be found outside of the sheepwalks of Australia or the jungles of South Africa. Thorsby has left us accounts of journeys made with a guide along roads that lead "over most prodigious high hills," "steeper than the roofs of many houses," of rides "along the edge of precipices that grew to that hight and steepness, and withall so exceeding narrow, that we had not an inch of ground to set foot upon to alight from our horses;" and of tramps over highways "full of ice and snow, rougher than a ploughed field, yet hard as iron." Hagbush lane, the principal bridle path from London to the north of England, was worn so deep that the rider's head was beneath the level of the ground on either side, and so narrow as barely to afford passage for a single horseman. Indeed, in many parts, being once in it, to turn back became utterly impossible, such was its extreme narrowness! Nor does this seem to be the exception rather than the rule. John Marriott has left us a humorous ballad on the "Devonshire Lane," which certainly justifies the belief that that "bit of the road" was in a condition quite as ruinous. Even on roads which the Englishmen of that day were accustomed to regard as the best, the ruts were deep, the descents precipitous, and the mud often lay so thick that all communication was cut off for months at a time, between towns separated by scarcely a score of miles.

Over such roads as these, as may well be supposed, the only practicable method of traveling was on foot or on horse. The rich rode: the poor walked. What the latter lost in comfort and speed they more than made up in safety, for the dangers of the road were by no means confined to its ruggedness. The mounted highwayman, a marauder known to this generation only from books, was to be found on every main road. The members of Parliament, the country gentlemen, and the rural merchants traveled in bands from the remote counties to the capital, armed with swords and pistols, and in hourly fear of being stopped and plundered by Turpin or Bradshaw, Duval or Macheath, or the hundred other celebrated banditti who infested the great North Road, Hounslow Heath or Shooter's Hill. Justices rode the circuits in jack boots, the bar following on foot, surrounded by a numerous escort armed to the teeth. Indeed a sum of money, called "dagger money", was annually contributed by the sheriff for the purpose of providing such escort with weapons.

Such a state of affairs in our day would be made the subject of "indignation meetings", "reform associations", and loud public demands for improvement. But with the men of Charles II's time, the case was quite the reverse; they vigorously resisted improvement; and it was not till many toll bars had been violently pulled down, and some blood shed, that a good system of road repairs was established; and not till the stage coach had been made the subject of much heated discussion, and numberless grave pamphlets and petitions to Parliament for its suppression had appeared that it ceased to be looked upon as a crying evil. This latter mode of conveyance was first introduced into England in the closing days of the Protectorate, but did not excite much public interest till the spring time of 1669, when a daring innovation was attempted. It was announced that a vehicle described as the "Flying Coach" would make the journey, "Providence permitting", from Oxford to London between sunrise and sunset. This spirited undertaking was solemnly considered and sanctioned by the heads of the University, and appears to have excited the same kind of interest which is excited in our day by the opening of a new railway. The success was complete; but with the boasts of its supporters were mingled the complaints and invectives of its enemies. Large interests had been unfavorably affected, and as usual many were disposed, from stupidity and obstinacy, to clamor against the innovation simply because it was an innovation. In John Crasset's "Reasons for Suppressing the Stage Coaches", published in 1672, they are denounced as one of the greatest evils that had happened of late years to the kingdom; mischievous to the public, destructive to trade, and prejudicial to lands. The breed of horses would be destroyed, and men would grow careless of good horsemanship; the Thames, that had so long been the important nursery of seamen, would cease to be the chief thoroughfare from London up to Windsor and down to Gravesend; and saddlers and spurriers would be ruined by hundreds. It was vehemently argued that those who traveled in coaches became weary and listless when they rode a few miles and were unwilling to get on horseback, "not able to endure frost, snow, and rain, or to lodge in the fields"; that to save their clothes and keep themselves clean and neat, people rode in coaches; that this was ruinous to trade, "for that most gentlemen, before they rode in coaches, used to ride with swords, belts, pistols, portmanteaus, and hat cases, which in these coaches they have little or no occasion for"; and that after traveling two or three journeys on horseback their "clothes were wont to be spoiled; which done, they were forced to have new very often, and that increased the consumption of the manufactures and the employment of the manufacturers, which traveling in coaches doth no way do." Such were the cogent reasons for which our worthy forefathers demanded that the stage coach should be "put down." How it ultimately triumphed over all opposition, and became, with its rosy gilled coachman and facetious guard, its upsets and break downs, its "outsides" and "insides," a peculiarly English institution, is familiar to all readers of English novels for three generations back.

The Scient.

Mr. Proctor recently asked for a single word, which, without being objectionable, should convey the meaning of "man of science." Mr. Gosse has recently suggested the name "scient"—a word which receives the support of Mr. A. J. Ellis, who, in the *Academy* for September 19, says: "I beg leave formally to introduce a scient into this heterogeneous company (from 'an incumbent', through 'a president', to 'an insolvent'), and to propose that this strictly formed disyllable should take the place of the American barbaric trisyllable 'scientist'. A 'scient' would not mean one who 'possesses knowledge in general' so much as one who rejects all but knowledge for the foundation of hypotheses, and therefore constructs only with such materials as he already 'knows'. A 'scientist' would then be an 'adherent to scients.'" It will be seen, however, from the letter of a correspondent that the word is not entirely unobjectionable, as it may be confounded with Science when it is spoken in the plural.—*English Mechanic.*

We suggest that our cousins call him the "sci-ist," which will be O. K., used in the singular or plural.

Cause of Some Blasting Accidents.

One cause of accident in blasting, but little understood, and which applies to powder as well as nitro-glycerin, is thus stated: "The blaster, not aware that he is a walking charge of electricity, proceeds to his work, inserting cartridge after cartridge of nitro-glycerin, until he comes to the last, which is armed with the elertric fuse. The moment his hand touches one of the naked wires, the current passes through the priming, and explosion follows. Let a blaster, before he handles these wires, invariably grasp some metal in moistened contact with the earth, or place both hands against the moist walls of the tunnel."

Buying a Horse.

The following hints on examining a horse appear in *The Maryland Farmer*. They contain much good advice to the non-professional dealer, but fail to cover all the defects a horse may possess. But the chances are that the purchaser who gets a horse free from every defect herein enumerated will have a pretty sound animal.

Examine the eyes in the stable, then in the light; if they are in any degree defective, reject.

Examine the teeth to determine the age.

Examine the poll or crown of the head, and the withers, or top of the shoulders, as the former is the seat of poll evil, and the latter that of fistula.

Examine the front feet; and if the frog has fallen, or settled down between the heels of the shoes, and the heels are contracted, reject him; as he, if not already lame, is liable to become so at any moment.

Next observe the knees and ankles of the horse you desire to purchase, and, if cocked, you may be sure that it is the result of the displacement of the internal organs of the foot, a consequence of neglect of the form of the foot, and injudicious shoeing.

Examine for interfering, from the ankle to the knees, and if it proves that he cuts the knee, or the leg between the knee and the ankle, or the latter badly, reject.

"Speedy cuts" of the knee and leg are most serious in their effects. Many trotting horses, which would be of great value were it not for this single defect, are by it rendered valueless.

Carefully examine the hoofs for cracks, as jockeys have acquired great skill in concealing cracks in the hoofs. If cracks are observable in any degree, reject. Also both look and feel for ringbones, which are callosities on the bones of the pastern near the foot; if apparent, reject.

Examine the hind feet for the same defects of the foot and ankle that we have named in connection with the front foot. Then proceed to the hock, which is the seat of curb, and both bones and blood spavins.

The former is a bony enlargement of the posterior and lower portion of the hock joint; the second a bony excrescence on the lower, inner, and rather anterior portion of the hock; and the last is a soft enlargement of the synovial membrane on the inner and upper portion of the back. They are either of them sufficient reason for rejecting.

See that the horse stands with the front feet well under him, and observe both the heels of the feet and shoes to see if he "forges" or overreaches; and in case he does, and the toes of the front feet are low, the heels high, and the heels of the front shoes a good thickness, and the toes of the hind feet are of no proper length, reject him; for if he still overreaches with his feet in the condition described, he is incurable. If he props out both front feet, or points them alternately, reject.

In testing the driving qualities, take the reins while on the ground, invite the owner to get in the vehicle first, then drive yourself. Avoid the display or the use of the whip; and if he has not sufficient spirit to exhibit his best speed without it, reject. Should he drive satisfactorily without, it will then be proper to test his amiability and the extent of his training in the use of the whip.

Thoroughly test his walking qualities first, as that gait is more important in the horse of all work than great trotting speed. The value of a horse, safe for all purposes without blinds, is greatly enhanced thereby.

Purchase of the breeder of the horse if practicable; the reasons are obvious.

MR. LE NEVE FOSTER, an English Government Inspector of Mines, has given notice to the managers of Cornish mines to comply with the act, and remove their vertical ladders and put them "on the lay." This is an alteration which will prove a great boon to the working miners. It is a terrible task for a man to climb up vertical ladders, sometimes from 180 to 260 fathoms deep, after working, perhaps in bad air, for eight hours. The climbing of these ladders has given the miners a peculiar complaint in the lungs, unknown to miners who ascend and descend in any other way.

Recent American and Foreign Patents.

Improved Grain Cleaner.

Samuel B. Johnson, Oswego, N. Y.—This invention contemplates the improvements of grain cleaners by a novel organization of elements that relieves the grain of all dust or chaff in a speedy and efficient manner, the machine itself being cheaper in construction and doing its work more economically than those now known to the public.

Improved Steam Trap.

William H. Jenkins, Philadelphia.—The object of this invention is to reduce the cost and increase the reliability and general efficiency of steam traps of the class in which a rising and falling float is employed to operate the valve or valves that control the discharge of the water of condensation accumulated in or received from the connected steam heating coil pipe or vessel. The invention consists in providing a hollow float with a tube through which steam is admitted, and by which the water condensed therefrom escapes into the chamber of the trap. The float has no other outlet save the tube. The invention further consists in a weighted valve for discharging the water which fills the lower portion of the trap below the line of buoyancy of the float. The invention also consists in the construction of the filter through which the water, condensed in the steam-heating coil, pipe, or vessel, flows into the trap.

Improved Fence.

William C. Banks, Como, Miss.—This invention consists in forming a fence of rails, stakes, posts, and blocks, so that it is entirely protected against winds, floods, or storms, and, being without tenon or mortise, may be constructed at a very small expense.

Improved Water and Gas Meter.

Thomas M. Snank, St. Albans, W. Va.—This invention consists in novel and greatly improved means for rocking the valve which admits and allows the discharge of the fluid. The invention not only simplifies the instrumentalities by which the oscillation is produced, and thereby greatly lessens the liability to get out of order, but insures perfect accuracy and uniformity of action in the measurement.

Improved Wheat Cleaner.

Herman Kurth, Milwaukee City, Wis.—This invention relates to improved means for freeing wheat of light or defective grains, cockle, or other impurities. It consists in the mode of suspending and rotating the cylinder; the application of a wiper wheel for vibrating a sieve or cleaner within the cylinder; the arrangement of an inclined plate or board to convey defective wheat grains, cockle, and other foreign seed from the inner periphery of the cylinder to a trough located above the sieve by which they are discharged; and in attaching elastic blocks to the wiper wheel to break the fall or concussion of the yoke, whose movement imparts vibratory movement to the sieve.

Improved Mail Bag Holder.

Blanchard Chamberlain and Augustus G. Wright, Bellefontaine, Ohio.—This invention consists in making the standards which support a mail bag in two parts, one of which may be adjusted on the other to raise or lower it. Also in angle plates to support the rear weighted lever horizontally on the top of the post when the mail bag is upon it. Also in a pivoted cover to work with the lever and always exclude dirt from the space between the angle irons.

Improved Machine for Cleaning and Separating Grain.

Herman Kurth, Milwaukee City, Wis.—The object of this invention is to provide a machine for cleaning and separating grain from cockle and other impurities. It consists in a tapering metallic cylinder suspended upon double acting friction wheels, and provided upon its inner periphery with flat-bottomed cavities. Said cylinder is rotated by the friction wheels, and has two guide rollers to keep it steady. At one end of the cylinder is a grain receiver, consisting of a series of sieves, which said receiver is extended through the cylinder in the form of two chutes, one for the impurities, and the other for the grain. The grain receiver and chutes are supported upon springs, and agitated by means of eccentric barrels. Inclined toward the top chute, inside the cylinder, are two adjustable slide boards which convey the impurities which drop from the cavities in the cylinder into the top chute; and just above said slides is a reciprocating brush, which engages the inner periphery of the cylinder and insures the removal of all particles of dirt, chaff, etc.

Improved Slate Roof.

William Ellis Elliott, St. Denis, Md.—This invention relates to new and improved methods of roofing, and consists in the use of slabs of slate, instead of ordinary tiles, having chamfered edges and joined together in seams at right angles to the ridge pole, by means of a cement, and supporting each other by means of grooves in their upper ends running parallel to said ridge pole. Said slabs are screwed to up and down pieces, resting upon a felt or other waterproof sheathing, which pieces divide the space between the slabs and said sheathing into two compartments, one passing up the middle of the slabs, extending up and down the incline of the roof and forming a ventilating passage, and the other fashioned into a trough and passing up and down the roof just beneath the seams where the slabs join, to receive and conduct away any leakage which may result from the breaking of the cement.

Improved Spring Board for Vehicles.

George E. Norris, Glen's Falls, N. Y.—The object of this invention is to provide spring board wagons with a support by which the board may be readily kept level or crowned, as required, and thereby a lighter and better looking vehicle obtained. A spring board has central springs and longitudinally connecting brace rods, which are adjustable thereon for setting the board.

Improved Music Leaf Turner.

George W. Rogers, South Brooklyn, N. Y., assignor to Ida Rautenberg, New York city.—This invention consists of a slide for moving the swinging wires for turning over the leaves, the said slide being arranged to run in a race a little below, and partly in front of, the lower arms of the leaf-turning wires. It has a little tongue rising a little higher than the arms, that springs behind each arm when it passes the outer end, swings the arm around as it moves back, and passes the axis of the arm. The slide is worked in one direction by a foot treadle and cord, and in the other by a spring. The leaf-turning wires are pivoted side by side in a row parallel with the slide face, so that whichever way they may be turned the front wire will swing a little short of the next at the outer end. When the tongue passes off the front wire, to spring behind to swing the wire forward, it will strike against the next wire, and thus be prevented from engaging it. A notched bar is arranged alongside of the foot treadle, to engage and hold it against the spring at any point.

Improved Watch Regulator.

Foster Keeping, New York city.—This is an attachment for regulating the balance spring in connection with the hands, in exact proportion to the distance to which they are moved forward or backward on the dial, so as to admit thereby the mechanical regulating of the watches without opening the inner cap and interfering with the interior part of the watch mechanism. A pinion is keyed to the set hand square, for gearing with an intermediate spur wheel at the end of a spring slide piece when the same is carried forward, which wheel gears also with a sector shaped wheel of the balance spring, for regulating the same by turning the hand square. When, therefore, the slide piece is carried forward and the hands turned by the key, the pinion causes the turning of the gear wheel and of the sector wheel. The regulation of the balance spring, and thereby that of the watch, is effected by simply pressing on the slide end and setting the hands in forward or backward direction.

Improved Joint for Check Row Cords.

Lysander L. Haworth, London, Ohio.—The object of this invention is to provide a joint for check row cords, used for dropping devices in corn planters, so that the cord can be readily unhooked and passed around trees, and be hooked again without requiring the changing of the corn-planting implement, or the position of the cord across the field. There is a metallic bell-shaped sleeve with projecting hook, which is jointed to the connecting hook, while the sleeve is firmly closed or clinched on the loop-shaped cord end after passing the same around the hook. The joint is thus adapted to serve as stop, and as connecting and detaching device for any part of the check cord.

Improved Valve.

Hamilton D. Lockwood, Charlestown, Mass.—This valve is mainly for use with rubber piping, it being located in a short section of tube, over flanged ends of which the rubber pipe fits. One portion of the short tube extends into the valve box and opens upward with a flanged aperture. By pressing the upper arm of a spring toward the cap, a pin is forced inward, which presses the middle part of a rubber disk down upon the flange of the hole, and closes the valve securely. At the same time, the end of the upper arm of the spring is caught by the spring catch, which holds the valve closed until released by pressing back the catch, when the elasticity of the rubber disk raises the pin, and the valve is again open.

Improved Pen and Pencil Case.

Richard M. Collard, New York city.—The works of this pen and pencil case are so contrived that the extension tube may be forced down by the pen slide to force the pencil back into the case when the pen is shoved out, and yet the extension tube may be drawn back for use all the same. There is also an improved way of fastening the revolving tube in the stationary tube, so that it can be readily unfastened when it may be required to do so.

Improved Pulp Regulator for Paper Machines.

Robert Hutton, Holyoke, Mass.—A box, of nearly square form, has two vertical partitions, between which is a space, which is covered over with a flexible waterproof diaphragm. The pulp flows up in one compartment to the flexible diaphragm, and thence over a partition in to two small compartments. When the pulp is thick, it will not pass over the partition so readily, and will gather on the diaphragm and will depress it, and also a plate beneath on the inner end of a scale beam, which raises the outer end and an adjustable weight, thus operating a simple mechanism, which has the effect of raising a valve, which allows water to flow into and mingle with the pulp which is flowing down to the pulp reservoir. The flow of pulp is increased to one compartment and diminished to the other, according to the direction in which a gage moves.

Improved Turbine Water Wheel.

Joseph E. Safford, Hartford, Vt.—There is a prolongation of the inner ends of the buckets below the lower rim of the wheel. These extensions are inclined backward and outward relatively to the direction in which the wheel turns. The gates are pivoted at the middle, so that the pressure of the water will balance on them, and at their outer ends the chutes have an offset formed on the circle described by them, so as to cut off the water from behind, and at the same time allow the gates to swing far enough to shut tight at the inner ends.

Improved Grain Binder.

James L. Skelly and William Skelly, Sparta, Ill.—In this invention there is a needle for passing the twine through the gavel, a clamp or loop catcher for receiving and holding the twine while the needle goes back, and an arm for carrying the twine around the bundle. Apparatus is provided for operating this mechanism, and there are clamps for compressing and holding the bundle while being bound.

Improved Boiler Feeder.

Philip T. Brownell, Elmira, N. Y.—This invention consists of a double chambered hollow cylinder, having a slow oscillatory movement imparted to it by any suitable connection with the operating gear of the engine. Ports in the chambers are thus alternately caused to register with ports in the heater, a feed pipe to the boiler, and with a steam pipe connecting with the boiler at the water level, in such manner that one of the chambers will be receiving water from the heater while the other is being emptied into the boiler. This last is caused by the action of steam admitted through the steam pipe to the surface of the water.

Improved Book Holder.

Andrew J. Furr and Walter C. Knaus, Boonsborough, Mo.—The side edges of the book cover are clamped against hooks by set screws, which pass in through sliding blocks. The leaves are held by fingers pivoted to pins attached to the blocks, upon which are placed coiled springs by which said fingers are held down upon the book leaves. By this construction, by moving the fingers to one side, the leaves can be conveniently turned. In using the holder, bars are placed upon the bed just beneath the shoulders of the invalid. The book is then, by means of the mechanism, adjusted to the proper hight, and also farther from or nearer to the reader's eyes.

Improved Surface Blow-off.

Robert Waugh, New Orleans, La.—This invention consists of a kind of hollow flat skimmer, with wide openings to receive the surface water from all directions, suspended in the boiler from an outside support, in which it is vertically adjustable. It is provided with a test cock at the top, by which to determine the position of the skimmer relatively to the water to receive the scum from the surface, and also with a blow-off cock, through which the scum will be expelled. The arrangement is such that the escape passage will not be affected by the rising and falling of the pipe.

Improved Pulley Block Hanger.

Ray Howland, Brooklyn, N. Y.—This is an improvement upon the device for which letters patent were granted to G. B. and C. Lewis, January 1, 1867, and it consists of a U or equivalent shaped bar, to the bottom of which the pulley block is attached. Upon the insides of the upper ends of the branches are jointed catches, with which adjusting screws are combined in such manner that the hanger can be readily and firmly attached to any overhead beam by placing the catches one on each side of the beam, and pressing them against the sides by the screws. The object is to provide a simple and efficient hanger for use in warehouses, by which to suspend the pulley blocks or hoisting tackle temporarily over any part of the floor, which is often required for handling and piling packages, etc.

Machine for Applying Paris Green Compounds to Cotton Plants.

Charles H. Levy, Natchitoches, La.—Two cylinders are made of fine wire gauze. To the inner surfaces are attached longitudinal strips, to one side of each of which is attached a strip of tin, which thus form flanges, which, as the cylinders revolve, raise the compound and allow it to fall back, so as to keep it stirred up. These cylinders are mounted on the ends of a crank shaft which is supported in a frame and rotated by suitable mechanism.

Improved Lathe Dog.

William Grout, New York city, assignor to Levi A. Fuller.—This is a carrier to take the place of the numerous iron dogs which are used on the face plate of iron lathes. It is composed of two jaws connected together by the pivot bolt which passes through the face plate of the lathe. The carrier is fastened to the face plate by means of screw nuts, so that it will stand out an inch from the surface of the face plate. Notches are cut on the inner sides of these jaws to more effectually hold a square or round piece of iron. The clamp is made to hold by means of a curved ratchet bar and thumb nut. By means of a ratchet and screw the jaws can be adjusted so as to hold any article from the size of a quarter of an inch up.

Improved Pruning Shears.

Orson P. Smith, Buford, and Andrew W. Miller, Morrisonville, Ill.—A book-shaped cutting blade slide on a main bar, to the uppermost end of which is pivoted a lever. The opposite end of the latter is again pivoted to a brace bar connected with an extension lug near the lower end of the hook blade. A cutting blade or knife is pivoted to an intermediate point of the lever and to the hook blade at suitable distance from the cutting part of the same. A spring serves to secure the sliding part of the hook blade, for the purpose of keeping the shears in open position ready for cutting. The hook blade is placed on the branch to be cut, and the main bar pulled down, which produces the upward motion of the knife blade and the closing of the same on the hook for cutting off the branch or limb.

Improved Bilge Water Gage.

William G. Conklin, Seattle, Wash. Ter.—This invention consists of a tube formed partly or wholly of glass with a valve in the bottom to allow the tube to fill, and a scale on the side to show the measure of the hight of water in the tube, which will be the measure of the depth of water in the hold. The valve is arranged so as to be forced open to admit the water by the stem striking the bottom, and closed by a spring.

Improved Grain Binder.

Pascal Whitney and Newell Whitney, Osage, Iowa.—This invention relates to certain improvements in grain binders. It consists in a curved passage for the grain, formed by a slotted plane surface on one side, and spring guide bars on the other. Down this passage moves a rake, attached to chains passing over rag wheels, which gathers up a gavel of grain and presses it forward to a feed which carries it under a presser foot, where it is sewn through and through by a sewing machine device, and the sheaves afterward separated from each other by a knife.

Improved Pump for Hydraulic Press.

Herman Thalheim and Joseph Gordon, Atlanta, Ga.—This invention relates to that class of double-acting pumps which are used in connection with hydraulic presses, and consists in placing upon the piston rod of a steam cylinder a much smaller pump piston, constructed to operate in a water cylinder with an alternating high pressure and low pressure stroke; by reason of the smaller volumes of water on one side of the said smal, piston occasioned by the displacement of the same by the rod.

Improved Rein Holder.

Albert K. Smith, Nebraska, O.—This device is designed to take the place of the ordinary rein ring now in use on harness hames. It consists of a frame containing two metal rollers held against each other by spring pressure. The objects of the invention are to prevent the twisting of the reins and their falling underneath the animal's feet—inconveniences which commonly attend the use of the ordinary ring.

Improved Neck Yoke.

William A. Lloyd, Cheshire, Mass.—The object of this invention is to relieve the horses from the sudden strain caused by the pole and collar connecting chains, when the vehicle pole is thrown, by rough roads or obstructions, in an upward or downward inclined position. Spreading rods are adjustably applied to the pole end of a vehicle. Connecting chains extend from the ends of the rod to the extremity of the pole. The triangles formed by spreader rods and chains swing readily at both sides above and below the pole, according to the higher or lower position of the same, and neutralize thereby the injurious and annoying jerks.

Improved Apparatus for Spreading Plasters.

William G. Neubauer, Long Island City, N. Y.—This is a device for spreading plasters, consisting of a bed having adjustable hinged straps and hinged plates, which hook over a straining rod so as to tightly clamp the cloth to the bed by means of a straining screw. There are plates for round plasters and another plate having apertures for ear plasters. These are secured to the bed by thumb screws and may be clamped down by straps. The spreader is a metallic bar of any desired length. When the material for the plaster is laid upon the cloth, this spreader, heated to the proper temperature, is moved over, and melts and spreads the gum evenly, leaving the margin of the cloth, which is covered by the straps and plates, clean and free.

Improved Spark Arrester and Consumer.

Thomas E. Roberts, Ionia, Mich.—By suitable construction, as the sparks rise through the smoke stack, they are divided and guided into the space between a ring and the enlarged top of the smoke stack, and are guided by V partitions into spouts, through which they pass into the space between the walls of the smoke box and a jacket, and thence through the outer row of flues into the firebox, where they are consumed.

Improved Folding and Extension Trestle.

Hiram K. Stevens, Providence, R. I.—This invention consists of a pair of vertical posts with braces jointed to them at the top to fold against the posts for packing away, and having other braces to hold them in the extended position for use. The posts are made in two parts, placed a little apart and connected by cross pieces to form guides. In the latter extension posts connected by a cross beam at the top work up and down to vary the hight of the bench. The whole forms a simple and cheap bench for plasterers and others to use for holding stagings inside of rooms of different hights. The extension posts are fastened at any required hight by pins put in holes in them above the cross bars of the main posts.

Improved Oar Lock.

George L. Stuck, Selma, Ala.—This invention consists in the employment of a bridle chain, the ends of which are attached to the oar, while its middle portion is connected with the oar lock through the medium of a projection on the latter, which fits in one of the links of the chain. By the provision of the bridle chain, the oar is secured to the oar lock, so as to prevent it from slipping through the same; and furthermore means are also furnished for adjusting the oar in a longitudinal direction, so as to increase or diminish the leverage, the swiveled oar lock enabling the vertical and horizontal movement of the car to take place.

Improved Cutter Head.

George Montgomery, Galena, Ill.—This is a double cutter head in combination with the eccentric journal of a revolving shaft having a radial stop. A stop is arranged symmetrically to the point of greatest eccentricity of the spindle, producing thereby the throwing out of the cutting edge to a greater distance from the axis of the shaft, whose shoulder is carried against the stop. The other cutting edge is thereby thrown within the circle formed by the revolving outer edge, so as to clear the work completely. By reversing the motion of the shaft, the cutter head is carried with its opposite shoulder against the stop, producing thereby the eccentricity of the other cutting edge, and the clearing of the former. The cutter head is secured by washer and lock nut on the spindle, and automatically reversed by the reversing of the shaft motion, forming thereby a strong cutting device for molding purposes.

Improved Means for Propelling Boats.

William H. Holdam, Crab Orchard, Ky.—The longitudinal guide ropes are arranged near both banks in such a manner that boats may be run in both directions on the canal without interfering with each other. By turning a lever pawl to one side, friction pulleys are instantly applied to a guide rope, and the boat is propelled thereby, being detached by turning the pawl in opposite direction, so as to rotate without imparting motion to the boat. A reversing gear of the engine admits of the ready propulsion of the boat on the same rope for the purpose of backing up in landing, etc. Lateral guide rollers are applied in front and rear of the friction rollers for taking up the sagging rope and guiding it in horizontal position to and from the friction rollers.

Improved Machine for Dressing Millstones.

Samuel G. Johnson, William S. Terry, Robert Y. H. Terry, and Alonzo W. Terry, Hamburg, Ark.—The standards are laterally connected by strong bars carrying at the front a top bar, with hollow screw, which guides the shaft of the pick bar, and controls also a coiled spring, by which the force is imparted to the blows of the pick bar. A curved lever is inserted loosely with its free end into a hole at the top of the pick bar below the spring. Its shorter rear end is provided with a small roller, on which a ratchet wheel acts, operating the front end of the lever, raising the pick bar, and producing short, rapid blows of the same by the force of the coiled spring.

Improved Screw Propeller.

Philo M. Blatchley, Guilford, Conn.—This invention consists of detachable blades for propeller wheels, secured to the hub by the inner end fitted in a dovetail spiral groove, and keyed in the groove by a key, which is itself secured by collars screwed against the hub by a nut screwing on the outer end of a shaft. By this means the blades are fastened more securely than when bolted through a flange. The hub is as smooth and free from projections as a solid hub, and the blades may, on account of not requiring a flange by which to fasten them, be made of steel plates, of which they may be shaped by stamping or pressing in dies.

Improved Scaffold.

Charles M. French and John J. McFadden, Akron, O.—This is a scaffold which comprises four slotted corner posts, connected in pairs by horizontal platform beams, which are capable of being adjusted in a vertical direction through the medium of long screw shafts passing directly through the top ends of the vertical slotted parts, through the tenoned ends of the vertically adjustable platform beams, and bearing at their lower ends against metallic plates at the bottom of the slots in the posts. The devices above referred to constitute the means for adjusting the scaffold beams in a vertical direction, while the longitudinal expansion or contraction of the entire scaffold is effected by means of slotted braces or connecting bars, which extend either in a diagonal or horizontal direction, and are attached in an adjustable manner to the corner posts.

Improved Horse Protector.

Reuben P. Lawton, Oramel, N. Y.—In this device the headpiece may be used in place of the check rein, and be thrown out of the way on detaching it, while the body of the protector is so applied to the thills that the horse may be readily unhitched without being hindered thereby. The reins are furthermore guided and supported in such a manner that no entangling of the tail with the same is possible.

Treating Animal Fats and Manufacturing Artificial Butter.

William L. Churchill, Rahway, N. J., and Jacob L. Englehart, New York city, assignors to Churchill Dairy Company, New York city.—This process consists in softening, washing, and disintegrating the fat of animals for the purpose of rendering the oleomargarin and stearin separable from the membranous tissues. The hashed fat is then heated by steam for the purpose of melting the same and rendering its elements mobile. Hot air is forced through the same while in the heating caldron for the purpose of effecting the thorough separation of said oleomargarin and stearin from the useless tissues, by means of which the oleomargarin and stearin are eliminated from the tissues, and left in such relative positions in the caldron as to be readily separated. The eliminated pure fat is maintained at a temperature of 110° Fahrenheit for twelve hours, after which the partial separation of the oleomargarin and stearin is accomplished by decantation, and the complete separation of the oleomargarin from the stearin is effected by compression in cotton bags at a temperature of about 80° Fahrenheit. For these purposes a suitable agitating and purifying apparatus is employed.

Improved Seed Planter.

Lawrence S. Connor, Orangeburg, S. C.—This invention relates to certain improvements in seed planters, and consists in the peculiar construction and arrangement of an opener with reference to the furrow wheel, the combination with the after portion of the frame of an adjustable coverer, and the construction and combination of devices for operating and adjusting the feed in the bottom of the grain box.

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ANSWERS TO CORRESPONDENTS

E. C. will find directions for dyeing silk silk black on p. 107, vol. 30. We do not understand his other question.—H. B. H. will find directions for dyeing several materials black on p. 107, vol. 30.—C. R. will find Professor Bottger's recipe for removing superfluous hair on p. 20 of *Science Record* for 1874.—C. W. K. will find a good recipe for black ink on p. 203, vol. 26.—J. L. H. can make a colorless varnish by the directions on p. 150, vol. 29. Marking ink is described on p. 251, vol 29.—E. R. W. will find full directions for making waterproof paper on p. 346, vol. 30.—J. M. will find a description of the field camera on p. 58, vol. 31.—C. will find directions for treating cider on p. 10, vol. 29.

(1) W. T. H. says: I read that oleate of soda, mixed with glycerin, would make tough soap bubbles. What is this? A. Oleic acid combines with soda to form oleate of soda, which is a hard soap, and enters largely into the composition of what is known as Marseilles soap. The corresponding salt of potash is a soft soap, and is the chief ingredient in the so-called Naples soap.

(2) T. I. H. asks: I am about to build a levee, and would like to know if the angle towards the water should be equal to or greater or less than the angle towards the land. It will be a trapezium in cross section, 15 feet at base, with a 4 foot brow parallel to the base. What are the best inclinations for the other two sides? A. The dimensions given by you are the horizontal and not the surface dimensions. It cannot, therefore, be deduced from them what is to be the hight of the levee, and yet upon this depends the grade of the slopes. The shape and size of a dam or levee is not usually determined by the dimensions and form necessary to resist the pressure of the water, so much as by those necessary to contend against the filtration of the water through the levee, and the effects of that filtration on the work itself. The pressure, however, is greatest at the base of the levee, and therefore, for this alone, requires the greatest resistance there; if the water rises 6 feet above the base of the levee, the pressure on the first foot will be 6 times that on the highest foot—and this latter will be only 62½ lbs. per square foot of the surface. But an embankment erected of earth, simply to resist this pressure, would soon be worked away by the filtration of the water through it; it becomes, necessary, therefore, to construct it of much greater dimensions, and this in accordance with the character of the earth of which it is constructed. It should be of a good binding earth, the surface soil removed under it, and the deposit rammed in layers not over a foot thick. If possible, a stratum of puddling clay should be built up in the center of the levee, from bottom to top. To prevent the washing of the current, the slope towards the water should be the greatest, and may be from three to six base to one perpendicular; the reverse slope need only be a little more than the natural slope of the earth. The roots of plants have a tendency to hold the earth in place, and their growth upon the sides of the embankment is therefore favorable to its stability.

(3) T. A. W. asks: What is concrete? Can particles of brick, too small to be laid in mortar, be utilized in building? If so, with what should they be mixed, and in what proportion? A. If you mix one measure of a good quality of cement with three or four measures of sand, gravel, small stones, stone chips, or pieces of brick, and add enough water to combine the whole and saturate the ingredients, so that the cement and sand may assume the form of a paste, the cement will soon set, and the whole composition become as hard as some kinds of stone. This is called concrete, and is extensively used in building.

(4) J. S. says: I am a mechanic and have been reading the SCIENTIFIC AMERICAN for the past 10 years, and it affords me great pleasure to say that it has been the means of saving me hundreds of hours of labor. I would not be without it for ten times its subscription price. No other paper I have ever read gives me such useful knowledge. A. All readers will agree to the testimony of our correspondent concerning the useful character of the SCIENTIFIC AMERICAN.

Is it practicable to use a common plunger pump to take water from a well 140 feet from pump and 28 feet deep, using a check valve in the well 6 feet from the bottom? I have a well 22 feet deep, of 4½ inches bore, in which the supply of water used to be good. But now it is pumped dry in a few minutes, all other things being the same as when the supply is ample. Can you give me a remedy? A. The plunger pump, if well made and placed within say 20 feet of the water, will operate. To the delivery nozzle of the pump, a pipe containing a check valve conducts the water up to any desired hight. The pump piston is worked by a lever above the mouth of the well, a rod extending from the lever down to the piston. We advise the use of a first class force pump instead of a common pump. Perhaps some of our readers can give information about the drying up here spoken of.

(5) A. L. C. asks: 1. How many asteroids have been discovered up to the present time, and what is their average diameter? A. One hundred and thirty-seven. The largest are: Pallas 600 miles, Juno 360, Vesta 300, Ceres 220: the rest probably number 100,000, and are too small to measure. 2. Allowing the earth to be 7,912 miles in diameter, and the moon to be 2,160 miles in diameter, how much depth of the earth would it take to make a body as large as the moon? A. About 40 miles. 3. Allowing the sun to be 886,000 miles in diameter, how much depth of sun would it take to make a body as large as the earth? A. The sun's mass is 355,000, and his volume 1,400,000, times that of the earth.

(6) W. B. asks: When is the date of the nearest approximation of the earth to the planet Jupiter? A. Jupiter will be in aphelion, or furthest from the sun, at 0h. on October 24, 1874.

(7) E. A. D. asks: 1. In the conjunction of the planets Jupiter and Venus, is there a point on the earth at which Venus will appear to pass over the face of Jupiter, in other words, where the conjunction will become an occultation? A. No. At the conjunction of August 12, Venus was 58 minutes south of Jupiter. 2. Is there a rule by which the distance of the planets from each other at the time of their conjunctions may be calculated arithmetically? A. See Loomis' "Astronomy," p. 219.

(8) J. P. asks: Will you put your method of calculating the power of an engine so that a man without education can understand it? Your answer No. 51, on p. 219, current volume, seems to be simple, but I do not understand it. A. It is impossible for a man without any education to make calculations. We do not understand your difficulty? Do you not know what is meant by multiplying and dividing? We would be glad to hear from you again, and perhaps we can simplify the rule.

Is galvanized sheet iron as good for a small boiler as plain charcoal iron? A. Yes, if it is of the same quality.

In your answer No. 57, p. 219, current volume, what do the figures 11·5, 13·2, 50·1, 54·8, etc., mean? A. They represent the number of pounds of the various constituents in 100 lbs. of corn meal.

(9) A. C. asks: How much steam can I safely carry in a boiler 2 feet long by 14 inches in diameter, with five 1½ inch flues, and a stay bolt? The shell is of ¼ inch iron and doubly riveted. A. About 175 lbs.

(10) C. McC. asks: How far can steam be carried through one inch pipe from a ten horse boiler, to drive a small one horse engine? A. Several thousand feet, with proper precautions.

(11) W. C. F. asks: What is the centrifugal force of a 1 lb. weight swung round in a 12 inch circle at 1,000 revolutions per minute? A. About 170 lbs.

(12) M. S. T. asks: 1. Has nitrate of ammonia ever been employed for making gunpowder? If so, by whom? A. Yes, by Messrs. Noirbin and Ohlson, of Stockholm; but it requires too high a temperature for its decomposition. 2. Who was the first discoverer of gunpowder, and when was it discovered? A. The date of its invention is involved in obscurity. It has been said that it was used in China as early as A.D. 85, and that the knowledge of it was conveyed to England from the Arabs on the return of the crusaders to Europe; that the Arabs made use of it in the siege of Mecca in 690; and that they derived it from the Indians. 3. Are there any gunpowder mills in the vicinity of New York city? A. We believe not.

Is ozone soluble in any kind of oil? A. Some oils are rapidly oxydized in its presence.

(13) G. F. L. says: How are perishable flowers made lasting? A. *The American Agriculturist* gives the following directions: The flowers must be carefully surrounded by perfectly dry, fine sand, in such a manner that they will hold their form, the pressure of the sand upon all surfaces being alike. Any fine clean sand will answer; it should be sifted to remove all coarse particles, and then washed in successive waters until dust and all earthy and clayey matters are washed away, and the last waters when poured off are perfectly clear. The sand is then to be dried and then placed over a fire in a proper vessel, until quite hot, hotter than the hand can bear, and when cool it will be fit to use. After heating, it should be used at once, before it can absorb moisture from the air. We have had good success by taking a clean, thoroughly dry flower pot, the hole in the bottom of which was stopped by a cork. This was filled a third full of the dry sand; the flowers set carefully in the sand, and then more sand slowly added, so as to surround and cover the flowers inside and out, and set in a warm place. At the end of 24 hours, the cork was removed from the hole in the flower pot, and the sand allowed to run out in a small and gentle stream. The flowers were left in the pot, perfectly dry.

(14) A. V. D. V. asks: Can nitrogen be compressed like atmospheric air? A. Yes.

Of what is illuminating gas composed? A. It consists chiefly of hydrogen and carbon.

Can I cast brass in plaster of Paris molds, and how should the molds be prepared? A. Mix the plaster with water, form the molds, and thoroughly dry them.

Where can I get the back numbers of the SCIENTIFIC AMERICAN, and covers for binding them? A. At this office.

I am 19 years of age; am I too old to go to college and take a degree? A. No.

(15) I. G. H.—Several kinds of cigar making machines are in use.

(16) J. C. asks: Does the zodiacal light appear at regular intervals during the spring and summer equinoxes? When and how may it be observed? I have seen it somewhere stated that, on watching the reflection of the western skies after sunset on a smooth sheet of water, the line of the light could be distinctly traced in the reflection; but I have failed to find it. A. The zodiacal light, as its name imports, invariably appears in the zodiac, or, to speak more precisely, in the plane of the sun's equator, which is 7° inclined to the zodiac, and which plane, seen from the sun, intersects the ecliptic in longitude 75° and 255°, or so much in advance of the equinoctial points. In consequence it is seen to the best advantage at or a little after the equinoxes, after sunset at the spring, and before sunrise at the autumn, equinox. At the vernal equinox the appearance of the zodiacal light is that of a pretty broad pyramidal, or rather lenticular, body of light, which begins to be visible as soon as the twilight decays. It is very bright at its broader or lower part near the horizon, and (if there be broken clouds about) often appears like the glow of a distant conflagration, or of the rising moon, only less red. We do not see the advantage of viewing it by reflection.

Some months since you published a prescription for catarrh, consisting of ammonia, alcohol, carbolic acid, and distilled water, saying: "Mix and inhale the vapors." In your last issue you remark that the vapor of ammonia is hurtful if inhaled. How do you reconcile these two items? A. We were speaking in a general way of the effects of inhaling the vapors of ammonia. It is only dangerous when a strong solution is used, such as "*aqua ammoniæ fortioris*, the stronger water of ammonia. This applied to the skin, causes pain, redness, vesication, and destruction of the part; thus acting first as a rubefacient, then as a vesicant, and lastly as a caustic or corrosive. Its emanations are also irritant; when they come in contact with the conjunctival membrane, a flow of tears is the result; when inhaled, their powerful action on the air passages is well known. Persons in syncope are observed to be almost immediately raised from a deathlike state by merely inhaling the vapor of this solution. In cases of insensibility, it must be employed with great caution, for if used injudiciously serious or even fatal consequences may be the result. When swallowed it acts as a powerfully corrosive poison. In small or therapeutic doses, such as we are accustomed to employ in the treatment of diseases, ammonia acts as a diffusible stimulant, excitant, or calefacient. It produces a feeling of warmth in the mouth, throat, and epigastrium. The heat of the skin is sometimes increased, and there is a tendency to sweating, which, if promoted by the use of warm diluents and clothing, frequently terminates in copious perspiration. If we compare the effects of ammonia with those of other stimulants, as camphor, wine, and opium, we observe, in the first place, that the influence of ammonia is principally manifested in the ganglionic and true spinal systems, while the other stimulants above mentioned affect the cerebral system. Thus the effects of ammonia are usually exhibited on the circulation, respiration, secretion, and the spasmodic actions; but camphor, wine, and opium, though they also affect these functions, yet principally affect the intellectual functions. Secondly, the effects of ammonia are more transient than those of the other agents just referred to. Thirdly, the vascular excitement caused by wine and opium is attended by diminished mucous secretion, and is allied more to an ordinary febrile attack. —*Pereira.*

(17) C. F. S. asks: 1. How high a degree of heat can be obtained from gas flame, by the use of the Bunsen burner, upon a sheet iron surface? A. This depends upon the quantity of gas consumed in a given time, as also its quality and the construction of the burner, which is variable. 2. Is there anything better than the Bunsen burner for procuring a high heat from gas flame? A. There is nothing that will compare with it in point of economy.

What is the boiling point of crude petroleum? A. Petroleum cannot be said to be a homogeneous substance, but must be looked upon rather as a mixture of an indefinite, and apparently unlimited, variety of similarly constituted compounds. So interminable is the number of these compounds, and so infinitesimal are the shades of difference between each member of the series and the next in order of succession, that the only practical method of classifying them has been to group the products of distillation into classes, according to their specific gravities, designating the number of the series belonging to each class with one generic name. When petroleum is subjected to distillation, the lightest and most volatile of the substances which compose it distils over at first, the products growing heavier and less volatile as the distillation proceeds and the heat is increased; and it is by taking advantage of this circumstance that the distiller is enabled to separate the several oils of which it is composed, according to any desired classification, the lines of demarcation being determined by the specific gravity of the liquid which distils over. This is what is known as fractional distillation. The classification usually adopted by distillers is as follows: All above 88° of Baumé's hydrometer is called chymogene, from 88° to 70° gasoline, from 70° to 50° naphtha, from 60° to 50° benzine, from 50° to 35° kerosene, from 35° to 28° lubricating oil.

(18) J. T. and others ask: How is rosin oil made? A. It is a product of the dry distillation of rosin. The apparatus used consists of an iron pot, a head piece, a condensing arrangement, and a receiver. In the distillation, a light oil comes over first, together with water. As soon as a cessation in the flow of the distilate occurs, the receiver is changed, and the heat is further raised, when a red colored and heavy rosin oil comes over. The black residue remaining in the pot is used as pitch. The light oil, called pinoline, is rectified, and the acetic acid water, passing over with it, is saturated with calcium hydrate, filtered, and evaporated to dryness, and the calcium acetate obtained is employed in the manufacture of acetic acid. The rosin oil, obtained after the light oil has passed over, has a dark violet blue color, and is called "blue rosin oil." The red oil is boiled for a day, the evaporated water being returned to the vessel; next day the water is drawn off and the remaining rosin oil is saponified with caustic soda lye of 36° Baumé, and the resulting almost solid mass is distilled so long as oil passes over. The product obtained is rectified rosin oil, which is allowed to stand in iron vessels, protected by a thin layer of gypsum, whereby after a few weeks a perfectly clear oil is obtained, free from water. The oil of first quality is obtained by a repetition of the foregoing operation upon the once rectified oil. The residues of both operations are melted up with the pitch.

(19) J. S. J. asks: What is the bursting pressure of a cylindrical boiler of 50 inches diameter of ¼ inch plates, with a single row of rivets? What is a safe working pressure? A. Bursting pressure is about 250 lbs. per square inch; working pressure 30 lbs.

(20) P. S. asks: What do traveling glass blowers burn in their lamps to make such a great heat as they produce? I have seen them blow up a ball in the middle of a glass rod, and then, by suction with the mouth, bring some kind of a melted liquid into said ball, and silver it over on the inside. A. They generally use alcohol. 2. What do they use for the silvering? A. The following alloy is frequently used: 3 parts lead, 2 tin, 5 bismuth.

(21) H. L. C. says: 1. What appearance has porcelain clay in its natural or crude state? A. Clays are naturally white, yellow, blue, or green. Pure clay is white; colored clays are the result of several admixtures. White clay contains but small quantities of protoxide of iron, and becomes after burning yellow or red; these colors, originating from the numerous organic substances, disappear after being volatilized by many firings. The colored clays change their color during firing, becoming red or red yellow. Fine clays are prepared only from those becoming white by continued burning. 2. Would a good mine of porcelain clay be of great value? A. You had better have a sample analyzed, and so determine its exact value. 3. What is the proper name for porcelain clay? A. The technical name is kaolin.

(22) H. A. M. asks: What will harden coal tar, so that the heat of the sun will not cause it to run or melt? A. The only process that we know of in this connection is the distillation of the tar, to obtain pitch or asphalt.

What would be the results attaching a force air pump to the steam tube leading to the cylinder and forcing air in with the steam? Our engineer thinks the expansion of the air would add to the power, and prove a saving. A. Sufficient data are not sent. In general, this plan would be anything but economical.

(23) W. E. L. asks: Could not photographers place a looking glass in such a position that any one sitting for a picture could look at themselves, and be sure to get the desired expression of countenance? A. They could. It is an old idea.

(24) F. M. H. asks: How can I ascertain how many feet a belt runs at any given speed of rotation of pulley? A. Find the circumference of a circle whose diameter is equal to that of the pulley on which the belt runs increased by the thickness of the belt. Multiply this circumference by the number of revolutions that the pulley makes per minute.

What are the principal questions that are asked of a person in order to get an engineer's license? A. You should apply to the local supervising inspector.

(25) J. D. W. asks: How are glass globes, reflectors, etc., silvered? How can I silver a bent glass without having to use a hot solution or the ordinary method of tinfoil and quicksilver? A nitrate of silver solution would be too costly, as it would take too much and the waste would be of no use. A. We can give you no recipe that will answer all your requirements.

(26) C. B. W. says: 1. I have tried to construct a cheap telescope as described by you, but it will not work. The lenses are a meniscus of 1¼ inches diameter and 48 inches focus, and a plano-convex ½ inch in diameter, 1 inch focus. Which way should the lenses be set, convex side toward the eye or otherwise? A. Otherwise. 2. Will not a straight tube do as well as a tapering one? A. Yes. 3. How far should the above lenses be from each other? A. 49 inches.

(27) C. J. W. says: I intend to make a telescope with a two inch achromatic object glass of 30 inches focus. 1. How can I make a terrestrial eyepiece for it, having a power of 80, and another having a power of 20? A. The equivalent focus of a terrestrial eyepiece is about equal to the mean of that of the first and last lenses. Thus if the object lens (A) is 1·5″ focus, amplifying lens (B) 2″, field lens (C) 1·6″, eye lens (D) 1·2 focus; the equivalent focus will be 1·35″ and the power 22. If you wish a pancratic or variable power eyepiece, make the foci (in sixteenths of an inch): A 19, B 24, C 24, D 11; the apertures respectively 9,7,9,7. From A to B = 27, C to D = 20. From A to D = 74, when the draw tube is shut; A to D = 124 when it is open. Power 16 shut, 30 open. Diaphragm aperture 2, distant 18 from A toward B. Ditto aperture 5, distant 8 from C toward D. 2. Has the Huyghenian eyepiece any advantage over a single equivalent lens? If so, what is it? A. There is less aberration. 3. How do you tell the focal length of the Huyghenian eyepiece, when given the focal length of the two lenses? A. Divide focus of objective by ⅓ focus of field lens. 4. Will you please give me a formula for making a terrestrial eyepiece of any power for any focal length of object glass? A. Sir D. Brewster's formula is: Foci, 14, 21, 27, 32. Distances, 23, 41, 40. Apertures 5·6, 3·4, 13 5, 2·6; diaphragm at inside focus of eyelens, 7.

(28) Z. says: I have an object glass 2 inches in diameter and of 24 inches focus. I wish to increase the length of the focus by means of a concave lens placed between the object glass and the eyepiece, so that my telescope shall be equal in power to an ordinary telescope of 48 inches in length with an object glass two inches in diameter. What must be the size and focus of the concave lens, and at what distance must it be placed from the object glass? How is the calculation made? A. Place, 12 inches from your objective, a concave achromatic lens of 1 inch aperture, and 24 inches virtual focus. For optical formulæ, see any work on physics.

(29) W. B. asks: What is the cause and what is the remedy in case of a person's hair getting prematurely gray? Is it poverty of the particular constituents of the blood, which furnished sustenance for the hair? If so, what should be added to enrich it in that respect? A. It may be congenital or accidental, depending upon some constitutional peculiarity in the organization of the individual; causes which have been observed to cause it are mental emotion, disease, and injuries. Grief and terror have been known to cause it, varying in time from a few hours to years. Bichat says: "The different passions of the mind have a remarkable influence over the internal structure of the hair; often, in a short period, grief effects change in its color, blanching the hair, probably by means of absorption of the fluids contained in its tissue." The treatment is to remove the causes of debility existing in the constitution by tonics, especially chalybeates and phosphoric acid, and (where defective nutritive power prevails) by means of preparations of iron and arsenic, and to stimulate the skin locally by abundant brushing and some gentle stimulant, such as cologne and aqua ammonia used at the same time.

(30) R. H. says: If you sprinkle salt on a fly which is dead from drowning, it will come to life again and fly away. What is the cause? A. The fly is not dead, although he may be apparently lifeless. The salt absorbs the water from the breathing apparatus of the insect, and so restores animation.

(31) W. P. H. asks: 1. How is the concave surface of a glass reflector for a reflecting telescope silvered on the inside? A. Draper's method of silvering glass: Dissolve 560 grains Rochelle salt in 3 ozs. of water. Dissolve 800 grains nitrate of silver in 4 ozs. of water. Add silver solution to an ounce strong ammonia until brown oxids of silver remains undissolved. Then add alternately ammonia and silver solution carefully until the nitrate of silver is exhausted, when a little of the brown precipitate should remain. Filter. Just before using mix with the Rochelle salt solution and dilute to 22 ozs. Clean the mirror with nitric acid or plain collodion and tissue paper. Coat a tin pan with beeswax and rosin equal parts. Fasten a stick ½ inch thick across the bottom. Pour in the silvering solution. Put in quickly the glass mirror, face downwards, one edge first. Carry the pan to a window and rock the glass slowly for half an hour. Bright objects should now be scarcely visible through the film. Take out the mirror; set it on edge on blotting paper to dry. When thoroughly dry, lay it face up on a dusted table. Stuff a piece of softest thin buckskin loosely with cotton. Go gently over the whole silver surface with this rubber in circular strokes. Put some very fine rouge on a piece of buckskin laid flat on the table, and impregnate the rubber with it. The best stroke for polishing is a motion in small circles, at times going gradually round on the mirror, at times across, on the various chords. At the end of an hour of continuous gentle rubbing, with occasional touches on the flat, rouged skin, the surface will be polished so as to be perfectly black in oblique positions, and, with moderate care, scratchless. It is best, before silvering, to warm the bottle of silver solution and the mirror in water heated to 100° Fah. 2. What is the best composition for a metallic speculum for a reflecting telescope, and what proportion should the metals have? A. Copper 126·4, tin 58·9 parts. 3. How can I grind and polish a concave metallic speculum for a reflecting telescope? A. Coarse, fine, and elutriated emeries, then rouge, must be applied to the surface in curves, at first circular, then in adjustable hypocycloid curves, by appropriate machinery or by hand. The hollow is ground by lead and by iron surfaces, and is polished by pitch tempered with rosin.

(32) T. S. K. asks: How can I cement a broken crucible? A. We know of no authentic recipe that answers your purpose.

(33) G. B. asks: How can the black scale on sheet steel be removed most efficiently? Cold acid will not touch it; and for a small quantity, the expense of a lead bath and apparatus is too great. A. We know of no method other than those you mention.

(34) R. A. says: I have a Rhumkorff induction coil. The connections are perfect as far as I can see, and I have a Smee's battery of two elements. Is the battery strong enough? It will work at times, but will give no perceptible shocks. Occasionally the keeper will tap for a few moments, then stop. If I touch it it will start again, only to stop as before. Can you inform me as to the probable cause? A. It is necessary for the proper working of the machine that the keeper and all connections should be perfectly free from dust, corrosion, etc. Your battery is amply sufficient for the purpose.

(35) W. L. L. says: In Humboldt's "Cosmos," I read that "the early races of mankind beheld in the far north the glorious constellation of our southern hemisphere rise before them, which, after remaining long invisible, will again appear in those latitudes after the lapse of thousands of years." Again: "The places of the north pole will successively be indicated by the stars *Beta* and *Alpha Cephei* and *Delta Cygni* until, after a period of 14,000 years, Vega in *Lyra* will shine forth as the brightest of all possible pole stars." If this be so, are not the zones and climates moving around the earth, slowly but surely, so that what now is the frigid zone was once the torrid zone, and *vice versa*? Again: If, as Herschel says, the sun is leading this system through space, is another glacial period possible? What caused the glacial period? Was it the physical condition of the sun, and was the ice destroyed by the growing heat of the sun? Is the sun's heat increasing or decreasing? Are not all the living beings on this earth doomed to certain extinction through and by the course of the natural laws of the Universe in the distant future? Will not the earth become as the moon is now, dead and nonproductive? A. Glacial periods have occurred in both hemispheres, and may have been caused: 1. By elevation of land 5,000 feet. 2. By changes in the obliquity of the ecliptic, causing an alternate accumulation of ice at either pole. This occurred here from 80,000 to 200,000 years ago. 3. The sun, being now a variable star, period 11 years, may have emitted less heat. 4. The solar system may have travelled in cold spaces comparatively destitute of stars. The life history of a planet is supposed to be entirely comprised in the short period requisite to cool its surface from the boiling to the freezing point of water, being inhabited only for an infinitesimal part of its existence.

(36) F. O. C. asks: Can you give me a sample test by which I can tell pure oxide of zinc from adulterated, before it is ground in oil? A. Oxide of zinc and its hydrates are white powders, which are insoluble in water, but dissolve readily in hydrochloric, nitric, and sulphuric acids. The oxide of zinc acquires a lemon yellow tint when heated, but it reassumes its original white color upon cooling. When ignited before the blowpipe, it shines with considerable brilliancy. You do not state with what you consider the zinc to be adulterated. The substance most commonly used is sulphate of baryta; this substance is insoluble in the acids (except in an almost imperceptible amount) and can be separated from zinc in that manner, the insoluble residue left from a strong acid solution in this instance being baric sulphate.

What is a good test to detect impurities in hydrochloric acid? A. Pure hydrochloric acid must be colorless, and leave no residue upon evaporation. Hydrosulphuric must leave it unaltered, and sulphocyanide of potassium must not impart the least red tint to greatly diluted acid.

I have been told that, in one of Sorel's formulæ for the oxide and chloride of zinc cement, he used a portion of carbonate of baryta. Is this so? A. One of Sorel's cements contains 3 per cent of borax or the same proportion of sal ammoniac, but we have no record of any baryta salt being used.

(37) F. H. B. asks: What vessels have made the fastest time across the ocean, on record? A. We believe that the run of the steamer Adriatic of the White Star line, from Queenstown to the lightship off Sandy Hook in 8 days less 5 minutes, is the quickest western trip on record. The Adriatic is 450 feet long, and has a beam of 41 feet.

(38) E. L. H. asks: How can I set the lenses of an eyepiece to a telescope? It is composed of two plano-convex lenses. A. The Huyghenian eyelens is one third the focus of the field lens, and is placed its own focal length within the focus of the latter.

(39) J. C. B. of Berlin, Germany, asks: 1. What is expected of a mechanical draftsman in America when he takes a position in the drafting room of machine works? A. If he is the head draftsman, he is expected to design and superintend the construction of all work. 2. What percentage on the estimate of an engine does a mechanical draftsman charge for the drawings, etc.? A. No general answer can be given to this question. The compensation received depends upon the ability and reputation of the designer. 3. How do the proprietors of machine works charge for work done in their shops, and also for a man going out to do work? A. From 10 to 25 per cent profit may be considered an average amount.

How many editions of "Uncle Tom's Cabin" have been published altogether? A. It is stated on good authority that the number of copies sold amounts to millions. We do not think that the number of editions is known. The work has been translated into 17 languages.

(40) J. H. F. asks: 1. Will turpentine do to preserve animals in place of arsenic? A. No, because of evaporation. 2. Is there any book on the animals of New York? A. The "Natural History of New York" contains all the information you require.

What is a standard work on civil engineering? A. Mahan's "Civil Engineering."

Is gasoline dangerous to use? A. Yes, very.

(41) W. C. B. asks: What is a foot pound? Weil's in his "Chemistry" says that is a force sufficient to raise 772 lbs. weight to the hight of one foot; but he does not say how long a time may be occupied in raising it. A. A foot pound is the amount of work required to raise a weight of one pound one foot high. We think you are mistaken in the definition you attribute to Mr. Wells.

(42) H. B. says: Your correspondent J. A. asks where the fallacy is in the following demonstration: $x=1$, $y=1$; then $x=y$. $x^2=xy$. $x^2-y^2=xy-y^2=(x+y)(x-y)=y(x-y)$. $x+y=y$. $2=1$. He might have obtained the same result by a shorter course of algebra: $2\times0=1\times0$; or both sides divided by 0, $2=1$. The fallacy consists in dividing the two sides of an equation by a divisor equal to 0, in which case the resulting equation is not necessarily right, though it may be so in most cases.

(43) B. F. C. says, in answer to J. L. L., who asked as to fire clay for a boiler furnace: Take common earth, well mixed with water, to which is added a small quantity of rock salt; let the water stand until the salt dissolves, which will take about 2 or 3 hours. It is then ready for use. Apply it as fire clay is used, and your furnace will stand much longer.

(44) B. F. C. says: I see that a mechanic of Cleveland, O., secured a good draft and succeeded in consuming the smoke from his furnace by the application of steam in small jets, which you seem to doubt. I have a similar apparatus; but instead of two jets there are five, and it not only creates a bright light, but, with careful firing, it consumes at least two thirds of the smoke. Where you have a good draft, I would not advise any one to use it, as it creates rapid combustion, and would cause a waste of fuel.

(45) D. M. says, in answer to I. A., who asks: Where is the fallacy in the demonstration given that 2=1? It should be remembered that multiplying an equation by a factor of the first degree raises the equation one degree and introduces a new solution which is found by making that factor equal to zero. Inversely, if we divide an equation by a factor of the first degree, the quotient is an equation one degree less, and has one solution less, which solution is that expressed by making the diviser = 0. Thus, in the present instance, $x=y$ or $x-y=0$ has but one solution. Multiplying by x, we have $x^2=xy$, or $x(x-y)=0$, which, being of the second degree in regard to x, has the two solutions $x-y=0$ and $x=0$. If we divide by $x-y$, the supposition that $x=y$ disappears, and there remains only $x=0$. From which it appears that in $x\div y=y$, the quotient obtained by I. A., x should be made equal to zero. The quantity y^2, subtracted from each member of the equation $x^2=xy$, since it does not alter the equation, has nothing to do with the result obtained.

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

W. F. S. and G. S. A.—Your insects have been put in the hands of a distinguished entomologist for examination, and will be reported upon as soon as an answer is received.—W. E. D.—It is plumbago.—J. E. B.—They are both specimens of trap rock, and would possibly make such a paint as you desire.—J. B.—No. 1 is bituminous shale. No. 2 is brown hematite, with considerable amount of clay. No. 3 is jaspery hematite. No. 4 is laminated argillaceous brown hematite. No. 5 is clay and sand, cemented with hydrated sesquioxide of iron. No. 6 is fossiliferous yellow and red hematite. No. 7 is compact clay. No. 8 is bituminous clay. No. 9 is argillyte. No. 10 is galena.—F. J. R.—It is hornblende and quartz.—C. O. R.—No. 1 is chalcopyrite. No. 2, the gray part is fibrous zeolite; the green is in too minute particles for satisfactory examination. No. 3 is fibrous amphibole. No. 4 is leucopyrite or arsenide of iron. No. 5 is azurite. There was no No. 6 in the box. No. 7 is flesh-colored calcite.

COMMUNICATIONS RECEIVED.

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

On Cribbing in Horses. By D. C.

On the Decomposition of Eggs. By Z. M. P. K.

On Mosquitoes. By W. C.

On the Treatment of Criminals. By H. H.

On Floating Magnets. By H. P. H.

On a Carpenter's Bench. By J. C. P.

On a Boiler Explosion. By M. A. K.

On the Potato Bug. By E. S. W.

On the Phylloxera. By R. J., and by R. B. S.

On Tides. By P. G. McE.

On an Amalgamator for Gold and Silver Ores. By W. T. B.

On Crucibles. By J. D.

Also enquiries and answers from the following:

G. S.—R. H. P.—J. N. B.—E. F. C.—E. L. W.—O. P. S.

HINTS TO CORRESPONDENTS.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Enquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasure in answering briefly by mail, if the writer's address is given.

We have some queer correspondents: One writes to know if we will not be so good as to send a messenger to an address which he gives—distance two and a half miles from our office—to make certain inquiries for him. It would require one and a half hours' time to do the errand, and not a stamp inclosed. Another wants us to write a letter and tell him where to get a combined thermometer and barometer. Another: "Will you be good enough to give me the names and addresses of several of the makers of the best brick machines"; another wants water wheels; another threshing machines; each writer desires our written opinion as to which is the best device, with our reasons, and not one is thoughtful enough to inclose a fee, or to reflect that to answer his request will consume considerable of our time. Another party wishes us to write to him the recipe for making ornaments out of coal tar, where he can buy the mixture ready for use, and how much checkermen will sell for in the New York market. For this information he sends us the generous sum of three cents in postage stamp. Mr. C. wants us to tell him of some valuable invention, of which he can buy the patent cheap, that would be suitable for him to take to sell, on his travels out West, by towns, counties, etc., three cents inclosed. Others want us to put them in communication with some person who will purchase an interest in their inventions, or manufacture for them, or furnish this or that personal information, our reply to be printed in the SCIENTIFIC AMERICAN. We are at all times happy to serve our correspondents, and when they present enquiries which we consider of general interest to our readers, we give space for them in the above columns; but if replies to purely personal errands are expected, a small fee, say from one to five dollars, should be sent.

[OFFICIAL.]

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September 22, 1874,

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Horse detacher, I. L. Landis	155,317
Horse detacher, Pilep & Mayer	153,336
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Water closet, etc, guard, J. F. Larrabee	155,319
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Wood, preserving, T. Jones	155,191
Wrench, B. C. Bradley	155,139
Yarn, machine for drying, W. F. Brook	155,285
Yarn, machine for winding, J. Liebing	155,161

APPLICATIONS FOR EXTENSION.

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

31,082.—DOUGH MIXING MACHINE.—W. Hotine. Dec. 23.

31,330.—CARRIAGE WORK COLLARS.—M. Seward. Jan. 20.

EXTENSIONS GRANTED

30,153.—ATTACHING SAW HANDLES.—I. Pelham.

30,138.—SADDLE TREE —S. E. Tomkins.

30,175.—EARTH BORER.—A. S. Ballard.

DESIGNS PATENTED.

7,763 & 7,764.—CARPETS.—H. F. Goetze, Boston, Mass.

7,765.—OIL CLOTH.—H. Kagy, Philadelphia, Pa.

7,766 to 7,770.—CLOCK CASES.—F. Kroeber, Hoboken, N. J.

7,771.—SODA WATER APPARATUS.—G. F. Meacham, Jas. W. Tufts, Bedford, Mass.

7,772 to 7,774.—WATCH CASES.—S. Strasburger, Boston, Ms.

7,775.—BASE BURNING STOVE.—N. S. Vedder *et al.*, Troy, N. Y.

7,776 —SPOON HANDLES.—W. K. Vandersilce *et al.*, San Francisco, Cal.

TRADE MARKS REGISTERED.

1,990.—ELECTRIC CHAIN BELT.—J. Bryan, New York city

1,991.—CAKES, ETC.—W. E. & N. H. Camp, Phila., Pa.

1,992.—WASHING MACHINE.—J. Campbell *et al.*, West Alexandria, Ohio.

1,993.—OIL.—J. B. Hay, Philadelphia, Pa.

1 994.—DENTIFRICE.—M. F. Keeshan & Brother, Cincinnati, Ohio.

1,995.—STOVES.—C. Noble & Co., Philadelphia, Pa.

1,996.—CORN SALVE.—J. H. Richelderfer, Philadelphia, Pa.

1,997.—SOAP.—Schultz & Co., Zanesville, Ohio.

1,998.—BREAD.—H. C. Stewart & Co., Cincinnati, Ohio.

1,999.—FINISHED LEATHER, ETC.—G. H. Thomas & Co. Middleville, N. Y.

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CANADIAN PATENTS.

LIST OF PATENTS GRANTED IN CANADA SEPTEMBER 25 to 30, 1874.

3,868.—W. C. Stone, Picton, Prince Edward county, Ont. "Stone's Instantaneous Process for Dressing and Dyeing Furs, Wools, Hairs, Skins, Pelts, and Hides." (Extension of provincial patent No. 3,260.) Sept. 25, 1874.

3,869.—P. Gamboni, Valparaiso, Chili. Improvements in the means of and apparatus for producing and maintaining motive power or assisting to produce and maintain such power, called "Gamboni's Mechanical Movement." Sept. 25, 1874.

3,870.—D. Whittemore, Boston, Suffolk county, Mass., U. S.; assignee, W. H. Rounds, Brockton, Plymouth county, Mass., U. S. Improvements on heel trimming machines, called "Round's Improved Heel Trimming Machine." Sept. 25, 1874.

3,871.—D. H. Dotterer, Philadelphia, Philadelphia county, Pa., U. S., and H. Wood, same place. Improvements on locks for sliding doors, called "Dotterer's Railway Freight Car Door Lock." Sept. 25, 1874.

3,872.—J. Behel, Rockford, Winnebago county, Ill., U. S. Improvements on whiffletree hooks, called "Behel's Whiffletree Hook." Sept. 30, 1874.

3,873.—William Fost, Glenwilliams, Halton county, Ont. Improvements in a machine for tilling land, called "Fost's Combination Beam." Sept. 30, 1874.

3,874.—O. T. Springer, Wellington Square, Holton county, Ont. Improvements in windmills, called "The Ontario Farmer's Windmill." Sept. 30, 1874.

3,875.—G. d'Infreville, New York city, U. S. Improvement in sending messages by a current of electricity in opposite directions by the same wire and simultaneously, called "Improvement in Duplex Telegraphy." Sept. 30, 1874.

3,876.—T. Groom, Guelph, Wellington county, Ont. Improvements in cooking ranges, called "Guelph Economical Cooking Range." Sept. 30, 1874.

3,877.—G. B. Durkee, Alden, Erie county, N. Y., U. S. Improvements in axle boxes, called "Durkee's Improved Axle Box for Wagons." Sept. 30, 1874.

3,878.—C. L. Page, Cambridge, Middlesex county, Mass., U. S. Improvements in elevators, called "The Page Safety Elevator." Sept. 30, 1874.

3,879.—M. G. Crane, Newton, Middlesex county, Mass., U. S. Improvements in automatic signal boxes for electro-magnetic fire alarm telegraphs, called "Crane's Automatic Signal Boxes for Electro-magnetic Fire Alarm Telegraph." Sept. 30 1874.

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PUBLIC NOTICE IS HEREBY GIVEN, that the undersigned, Assignee of the estate of Margaret E. Hanson and Silas F. Connor, Bankrupts, will on the

THIRTIETH DAY OF OCTOBER, A. D. 1874,

at 10 o'clock A. M., at the shops known as the Alton Agricultural Works, Alton, Illinois, sell at public auction, for cash, the following described personal property, belonging to said estate:

IRON WORKING MACHINERY:

1 sixteen foot Engine Lathe, 1 eight and one-half foot Engine Lathe, 1 ten foot Engine Lathe, 1 seven foot Engine Lathe, 3 Boring Lathes, 2 Drill Lathes, 3 Press Drills, 1 Bolt Cutter, 1 Screw Cutter and Dies 1 Power Punch and Shears, 1 Power Punch with Punches and Dies, and self acting gauge for cider mill hoop, 1 three and one-half foot Planer with milling attachment and key seat cutter, 1 Balancing Frame, Pulley and Counter Shaft, 2 Horton Chucks, 3 cast Gear Chucks, 1 Patent Chuck, 1 Key Seat Cutter, 1 Nut Machine, ninety feet Line Shafting and Pulleys, 5 Grind Stones, shafts and frames, machinist's tools, taps, dies, die plates, etc, etc.

1 Blacksmith's Fan with counter shaft and pipe, Bolt Machines, Tyre Bender, Eye Bolt Machine, 1 Trip Hammer with counter shaft, Anvils, Sledges, Hammers, Tongs and other Blacksmith's Tools, 1 Foundry Fan and Pipe, lot of iron Flasks, lot of wooden Flasks, Patterns, Ladles, Rattle Box, Coal Mill, Stoves, 3 Platform Scales, Oil Cans.

WOOD WORKING MACHINERY:

1 Cross Cut or Railway Saw and Rip Saw and Table, 1 Band Saw and Table, 2 Rip Saws and Tables, 1 Gaining Machine and Saw, 1 Gang Saw and Table, 1 Head Saw and Gang Boring Machine, 1 Gang Boring Machine, 1 Boring Machine, 1 Power Mortiser and Boring Machine with Tools, 1 Foot Mortiser, 1 Turning Lathe with Tools, 2 Pin Machines, 1 Fan Side Machine, 2 Sand Papering Machines, 1 Emery Wheel Saw Gummer, 1 Saw Gummer and Dies, 1 Rogers' Planer, 1 Upright Shaping Machine, 1 Tenoning Machine, 1 Matching Machine, 1 Chamfering Machine, 1 Daniel's Planer, 1 Fay & Co.'s Iron Frame Molding Machine (largest size), 1 Sixteen foot Lathe with Scotch Rest, 1 Paint Mill, 1 Power Shears, 3 pair Shears, Circular Saws, Augers, Sleeges, Patterns, Hand Trucks, Wheelbarrows, Hydraulic Elevators, Line Shafting, and all other tools about said Machine Shops, together with 2 Champion Threshing Machines, complete, 2 Second-hand Champion Threshing Machines, 120 Cider Mills, 1 large Portable Press, Lumber, Iron, Machine extras, Safes, Desk, Letter Press and other office furniture.

Also, the life estate of Margaret E. Hanson in the following described real estate, viz: Lots 1, 2 and 3, in block 5, including the buildings thereon, known as the Alton Agricultural Works of Hanson and Connor; the Machine Shop is 3 story brick, with slate roof 50 by 100 feet, brick foundry 60 by 60 feet, brick blacksmith shop 20 by 65 feet.

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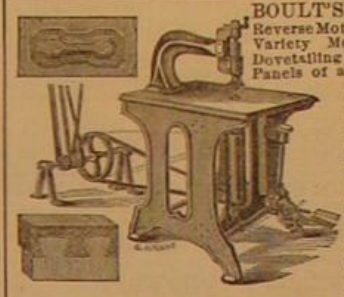
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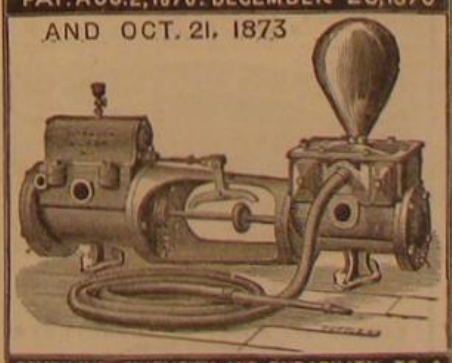
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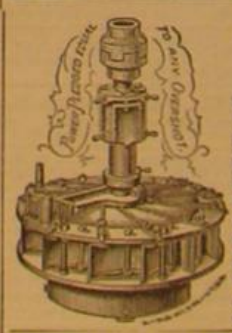
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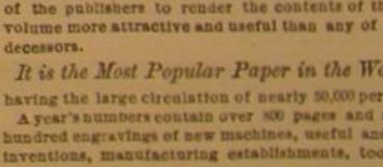
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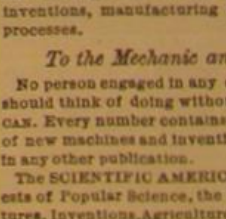
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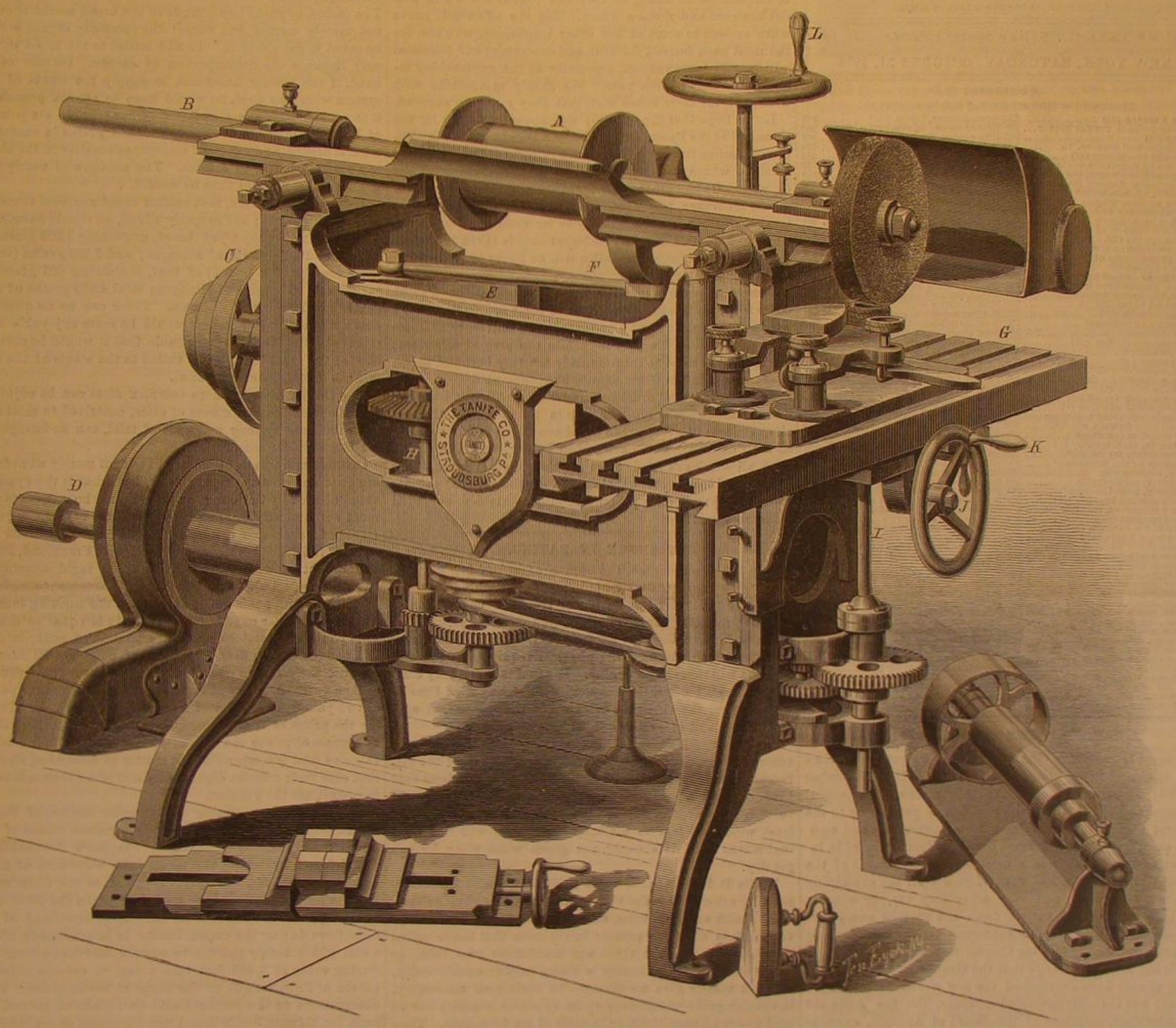
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THE TANITE COMPANY'S NEW MILLING MACHINE.

THE TANITE COMPANY'S NEW MILLING MACHINE.

The Tanite Company, of Stroudsburg, Pa., have now on exhibition at the Fair of the American Institute in this city, and at the Franklin Institute, Philadelphia, a new machine, in which an emery wheel is used, for the first time, for surfacing files and sad irons, finishing anvils, nuts, gibs, keys, slide valves, straps, slides, crossheads, and in short, for accomplishing the majority of work now surfaced on the ordinary planer, milling machine, or shaper. It will be remembered that the emery wheel made by the above-named corporation is of the solid type, and a brief review of the advantages claimed for it may appropriately precede the mechanical description of the large and fine engraving, herewith presented, of the machine above referred to.

The solid emery wheel performs the office of a rotary file, the cutting edges of which never grow dull: in other words, it retains its efficiency as a cutting tool until literally worn out. It is hard, and cannot be broken by a fall or blow; it travels uniformly and steadily at a high speed, the latter exceeding, with safety, that of the grindstone, while the emery cuts faster and lasts longer than the sand. Being composed of an artificial mixture, its grit is more even than that of the natural substance; and the waste of material and time lost in making changes is said to be less than is the case with the wooden wheel. Finally, the solid wheels are successfully used for putting the cutting edges on tools of all descriptions, and they may be produced of any shape, fitted for any special work.

The size and clearness of our illustration will enable the forming of an excellent idea of the details of the machine. The driving belt acts upon the pulley, A, secured to shaft, B. The latter at its left hand extremity carries another belt, leading to a counter shaft attached to the floor (represented detached, and lying on the right of the machine), whence a third belt returns to the pulleys, C, and a fourth to the blower shaft, D. Through suitable mechanism, the pulleys, C, actuate the slotted crosshead, E, the revolution of which communicates, by the rod, F, reciprocating motion to the main shaft, B, and thus imparts to the emery wheel, represented on the right hand extremity of said shaft, a transverse movement across the sad iron, which is shown secured in the chuck on the table, G. In addition to performing this labor, the gearing, immediately driven by pulleys, C, also rotates the vertical shaft, H, which in turn transmits power to the cones on its right. These again (through the medium of a belt, other cones, and further suitable interposing mechanism) revolve a vertical rod, I, the lower end of which is fitted with a globe joint. Its upper extremity carries a pinion, which, by means of the handle, at J, may be thrown into action with one or the other of two racks under the table, G, so that the latter, by manipulating the handle as required, may be caused to travel automatically to and fro under the emery wheel, and over such distances as may be necessitated by the dimensions of the work. The hand wheel, at K, allows of similar movement to be imparted to the table by hand, in circumstances where the automatic motion is not desired.

The mode of operation consists in adjusting the work in the chuck to the proper elevation and starting the machine. The surface of the sad iron, for example, is thus carried under the wheel, and at the same time the latter is drawn across it; and this continues until the motion of the table transports the object out of the action of the grinder. The workman then gives the handwheel, shown at L, a part of a turn, thereby moving a fine screw which passes through an arm on the table, thus slightly elevating the latter, so as to give new surface for the tool to take upon. The handle, J, being shifted, the work travels back under the wheel, and so the operation is repeated as often as is desired, or else a new article is substituted after one passage under the emery. To avoid injury to tools and workmen, a small suction blower, with the necessary pipes and an enlarged receptacle in rear of the wheel, is provided, and so arranged as to draw away all dust, while at the same time to be easily removed for setting the work. For keys and similar small articles, a different chuck (see sample in the foreground of the engraving) is needed.

The machine, it is claimed, allows of using the wheel to its full capacity, while protecting the same against uneven wearing, thus rendering the employment of the diamond tool unnecessary. The cut made is much deeper than has hitherto been considered possible to accomplish by the emery grinder. The manufacturers also claim that in those articles in which first quality iron is used, on account of its being more easily worked, the use of their wheel will soon save enough valuable metal to pay for a machine. From a careful examination of the apparatus, these advantages appear to us to be well substantiated.

These machines are manufactured only by the Tanite Company, who may be addressed as above.

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A PANIC AT THE PATENT OFFICE.

General Leggett, the Commissioner of Patents, some time ago announced his resignation, to take effect November 1, 1874; whereupon some of the lady clerks, with natural feminine impulse, made it the occasion of presenting to the General a testimonial of esteem from themselves and associate employees. The General has been instrumental in introducing female labor in almost every department of the Patent Office; the clerical work of nearly all the examining officers is now done, and very acceptably too, by women. The ladies procured donations from the various examiners and assistants, with which a handsome tea set was obtained and presented to the retiring Commissioner.

It is not perhaps strange that the General and his corps of ladies should have overlooked the law which forbids such doings; but that disinterested persons, like the Assistant Commissioner, members of the Board of Appeals, examiners-in chief, and other legal minds connected with the office, should have been so unobservant seems remarkable. The provision of the statute is very stringent, and is as follows:

"Be it enacted, etc.: That no officer or clerk in the United States Government employ shall at any time solicit contributions of other officials or employees in the Government service for a gift or present to those in a superior official position, nor shall any such officials or clerical superiors receive any gift or present offered or presented to them as the contribution of those in the Government employ receiving a less salary than themselves; nor shall any officer or clerk make any donation as a gift or present to any official superior. Any officer or clerk violating any of the provisions of this bill shall be summarily discharged from the Government employ."

We believe it is not pretended that this statute is unconstitutional, or that for any reason it is to be treated as a dead letter. In refusing, summarily, to discharge the Commissioner of Patents and all the subscribers to this tea party, both the Secretary of the Interior and, through him, the President of the United States, are open to the charge of neglecting their plain duty.

A considerable time has elapsed since the knowledge of the above transgression of the law was made known, but the officers of the government have not as yet dismissed one of the offenders.

It is rumored that they are all to be discharged, and then all immediately reappointed. But this would amount practically to a nullification of the statute. The evident intention of the law was to place the seal of public condemnation upon all such transactions, and wholly to remove from the public service those who should be guilty of them.

In no other way can the observance of law be promoted. To dismiss and then reappoint would be to trifle openly with the law, a course which would assuredly meet with public condemnation.

There is but one way for the President to deal with this matter, and that is promptly to discharge all the parties involved from the public service, as the law specifies. To dismiss them in a body would be disadvantageous to the public service, and therefore unwise; but it should be done as rapidly as possible. He should begin with the most prominent offenders first. General Leggett, the Commissioner, should be at once dismissed, and a new commissioner appointed. Mr. Thacher's removal should follow, and so on, down, until the law has been entirely vindicated.

The removal of the Commissioner, the Assistant Commissioner, and some of the examiners would be of little personal inconvenience to them, as they can readily set up in patent business and make a living. But the affair will prove more serious to some of the other employees, who are, for the most part, honest, faithful, and deserving; and dismissal will be very inconvenient, especially at the approaching inclement season of the year. We deeply sympathize with them, and for their sakes wish that they could be excused.

Let us hope that the effect of this general change in the *personnel* of the Patent Office will be a benefit to that institution. Among its officers are many intelligent and valuable persons, whose departure will be a disadvantage to the country. On the other hand there are a number of officials whose ignorance, tardiness, and illiberality towards inventors make their removal greatly to be desired. By an entirely new organization, if intelligent care is taken in the selection of individuals, the Office will be likely to be benefited rather than damaged.

Competent persons who desire employment at the Patent Office may, we think, properly file in their applications. We assume that nothing but a special act of Congress can relieve from dismissal or properly re-instate the present offenders; and if any are to be re-instated, only the very best and ablest of those now in the Office should be reappointed.

The poor material must be eliminated. All who have exhibited indolence or sluggishness in the discharge of duty, all examiners of every grade who have failed to act promptly on their cases, all who have suffered their work to get behind, all who have tried to set up their dictum against the most liberal interpretation of the laws in the grant of patents to inventors: all such persons should be rigidly excluded from the service.

ECONOMY IN EATING.

Like the steam engine, the human organism is a machine for the development and application of power. Like the steam engine, it derives its power from the combustion of organic products. But, unlike the iron mechanism, man has other ends than the performance of work, and there is no one food which will meet his physical requirements, as coal or wood will those of an engine. His fuel is necessarily complex, and, still more, its complexity must be varied time to time to meet the changing demands of the seasons, of age, occupation, and other life conditions.

In choosing his source of mechanical power, the engineer takes into account the relative cost and efficiency of the different sorts of fuel to be had in his locality, and selects that kind, or such a combination of two or more kinds, as will furnish the power he needs at the smallest cost, and with the least wear and tear to his machinery. He will not burn coal where wood is cheaper, nor green wood when he can get dry.

While it is immensely more difficult to make the corresponding selection for the human machine, it is obvious that, since health and happiness, as well as working force, are involved, it is of vastly greater importance that the selection be wisely made. Yet there are multitudes who take, or would take, pride in running a steam engine economically, who not merely give no thought to their own machinery, but rather pride themselves on its apparent capacity to run well under all conditions, or in spite of maltreatment. They "can eat anything"; and so long as their food is savory and they can get their fill, they do not care what its elementary composition may be, or how much unnecessary labor it puts upon their digestive and alimentary organs to dispose of it. Mention economy in eating to them, and they straightway call to mind the pint of beans or pound of oatmeal that ignorant theorists have proclaimed as sufficient for their daily needs, and more or less politely decline to eat by rule. Others, to whom the cost of supplying food for a numerous family is a matter of serious moment, are ignorantly proud of setting as good a table as their neighbors, unconscious that their neighbors have as vague an appreciation of what is "good", under the circumstances, as they themselves have, and that the money they misspend would more than suffice to provide an abundance of food, at once better suited to their needs, more enjoyable, and, in many cases, much more wholesome.

The fact is that the much misused word "economy" is never more severely warped from its true meaning—judicious management—than in its application to domestic matters. To be economical in one's diet is commonly thought to imply the use of cheap food in preference to the costly, to restrict one's self to one dish when appetite would suggest a dozen, to eat vegetables rather than meat: in short, the reduction of the amount, the quality, and the cost of food to the minimum. On the contrary, true economy in eating requires us to select and combine the greatest variety of food so as to furnish the maximum growth or power most enjoyably, with the least waste of substance and the least tax upon the system, in assimilating what is useful and rejecting what is useless. To do this wisely, we need to know not only what the system requires under the varying conditions of life, but also the chemical constitution of different foods, their dynamic power, and how to combine them so as to develop their highest utility with the smallest functional expenditure. For example, a laboring man requires daily, to sustain his bodily temperature under ordinary conditions, to enable the vital processes of respiration, digestion, and the rest to go on well, and to meet the demands of muscular effort, an amount of power equivalent to about 4,000 foot tuns, or enough to raise a man of average weight about eleven miles, vertically. To maintain these conditions, it is found by experiment that a daily diet furnishing about 300 grains of nitrogen and 4,800 grains of carbon is required.

To obtain these 300 grains of nitrogen from bread, the laborer would have to eat rather more than four pounds, containing nearly twice as much carbon as would be needed. The carbon of about two pounds of the bread would thus be not merely wasted, but worse: the excretory organs would be taxed to get rid of it. To add butter to the bread would only increase the disproportion of carbon. On the other hand, if the laborer undertook to supply the wants of his system with lean beef, he would have to eat six pounds of it to get the requisite amount of carbon; but in six pounds of beef the nitrogen is over a thousand grains in excess of what is needed, and excess of nitrogenous matter in the blood is a fruitful source of disease. The nitrogen of nearly five pounds of beef would thus be wasted.

It appears, therefore, that neither bread nor beef is economical eating alone; but properly mixed, we should have, say: 14,000 grains (2 pounds) of bread, containing 4,200 grains of carbon and 140 grains of nitrogen; and 5,500 grains (about three fourths of a pound) of beef, containing 605 grains of carbon and 165 grains of nitrogen; total 4,805 grains of carbon and 305 grains of nitrogen. There can be no question that a diet of bread and beef would be more enjoyable than either singly. It is demonstrable that it would be cheaper and, at the same time, better suited to the wants of the system: in short, more economical.

In a similar manner, more complex diets can be adjusted, and the scientific correctness of diets, contrived to meet special conditions by long processes of trial, can be brought to mathematical demonstration.

In time our works on dietetics will tell not merely what foods are good and how to prepare them, but what is the dynamic value of each by the ounce or pound, and how they may be most economically combined to meet the varying requirements of youth and age, and the different conditions and callings in life. The researches of Payen, Frankland, Pavy, and a host of others have lately made rapid approaches toward this desirable state of things. For instance, a glance at one of Frankland's tables shows that the working force of a pound of butter oxydized in the body is equal to that of nine pounds of potatoes, or twelve pounds of milk, or over five pounds of lean beef. A pound of oatmeal will furnish as much force as two pounds of bread, or over three pounds of lean veal. A pound of lump sugar has the dynamic power of two pounds of ham or eight pounds of cabbage. Knowing the prices of these substances, their comparative values as sources of power can be easily calculated. Their relative value as food is a more difficult matter to determine, since in that case their relative digestibility and other elements enter to complicate the problem.

An extremely interesting and valuable feature of Pavy's recent work is the calculation of the dynamic values of different dietaries. For instance, Playfair's "subsistence diet," found by taking the mean daily allowance of nitrogenous matter, fat, and carbo-hydrates in the dietaries of London needlewomen, of the convalescents in the Edinburgh Infirmary, of the inmates of several prisons, and of the operatives during the cotton famine in Lancashire in 1862—a diet which barely suffices to sustain life—has a force producing value of 2,453 foot tuns a day, or enough to raise a person of light weight to the hight of seven miles. From observations on the carbonic acid excretions of several persons, Dr. Edward Smith found that the power expended daily in maintaining the body's heat is, on the average, enough to raise the body six miles. Professor Haughton calculated the power required to perform the necessary vital functions of respiration, digestion, and the rest, to be, speaking generally, enough to raise the body to the hight of one mile. The seven mile power of the "subsistence diet" would therefore be used up without work or active exercise.

The average diet of adults in full health and with moderate exercise was calculated from the dietaries of the English, French, Prussian, and Austrian soldiery during times of peace. Its dynamic value is 4,021 foot tuns. The average of the dietaries of European and American soldiers during the great wars of recent years gave the diet assigned to active laborers. Its force value is 4,458 foot tuns. The diet of hardworking laborers, determined from the actual amounts of food consumed by railway navvies, hardworked weavers, blacksmiths, and others, is equivalent to 4,849 foot tuns. A similar calculation for the diet of a body of Royal Engineers, actively engaged, gives the high dynamic value of 5,532 foot tuns, or enough each day to lift the eaters over fourteen miles vertically. In food value, this full diet compares with the subsistence diet above mentioned (salts omitted) as follows:

	Subsistance Diet	Royal Engineers' Diet
Nitrogenous matter (dry)	2·33 ozs.	5·08 ozs.
Fat	0·84 "	2·91 "
Carbo-hydrates	11·69 "	22·32 "
Total	14·86 ozs.	Total 30·21 ozs.

With these it may be well to contrast the standard diet of Moleschott, which is generally accepted as a fair representation of a model diet, that is, one containing the requisite

combination of alimentary principles for the daily support of an ordinary working man of average hight and weight. It is as follows:

Albuminous matter	4·587 ozs.
Fatty matter	2·964 "
Carbo-hydrate	14·250 "
Salts	1·058 "
Total	22·859 ozs.

Thus about 23 ounces of dry solid matter, one fifth nitrogenous, may be taken as sufficient for the daily needs of an average adult workman. Ordinary food contains about 50 per cent of water, which would swell this amount of dry matter to 46 ounces of solid food. To complete the diet, we must allow from fifty to eighty ounces of water in addition, daily.

Of course, the varying requirements of youth and age, hot weather and cold, indoor and outdoor occupation, individual idiosyncracy, taste, and a thousand other conditions combine to vary the proportion of the several elements needed in any case; nevertheless, all such average determinations are helps toward the developed science of dietetics, which the coming years will see.

DEMONIACAL POSSESSIONS.

The devil dies hard, and the fifteenth century lingers in other quarters than Italy and Spain.

In the middle ages the unfortunate victim of morbid or insane impulses was looked upon as the sport of demons. The history of medicine records the successive steps of progress in knowledge by which this delusion was dispelled, and the true cause of these maladies was found to be organic derangement or vicious education.

A man of kindly disposition suddenly manifests an irresistible desire to kill somebody. He may say that his grandmother's ghost or the spirit of George Washington has ordered him to shed blood; but intelligent people know better. They do not assume, as of old, that some evil spirit has caught his soul abroad and has slipped in and taken possession of the vacant body for diabolical purposes. They say that something is wrong in his physical organization, a tumor on the brain, may be, and treat him accordingly. When he dies, the surgeon's knife will lay bare the cause of the difficulty, which had been slowly developing, perhaps for years before the crisis came. Does any one wonder why, at this late day, we soberly set down what every civilized child is supposed to know? or soberly discuss a theory that died with witchcraft? Simply to spring upon the intelligent reader the surprising fact that belief in witchcraft and the theory of demoniacal possessions is not dead, here, in this land of common schools and newspapers: not among the illiterate, but among newspaper readers: worse, among the editors of newspapers which profess to lead the advance of civilization.

How does this sound for the nineteenth century? We quote from a family paper bearing date October 8, 1874:

"A favorite scoff against religion has been founded on the instances, recorded in the gospels, of persons who were possessed with demons. Perhaps two items of news published recently may throw some light on the demoniacal possessions on which infidels have long exercised their wits." The paper goes on to describe the case of the Pomeroy boy of Boston, and that of a girl in this city who felt a strong desire to burn an infant she was nursing, but fortunately confessed the desire before attempting its execution; then it continues: "These are two of the latest startling items of news. Do they not look as if the devil had more power over human nature than he is ordinarily credited with? In view of them, can we say that demoniacal possessions are impossible?" This is from the *Christian Observer*, and is quoted approvingly by another *Observer*, which puts *New York* as part of its title, but is presumed to be Christian all the same.

We do not know the circumstances of the last mentioned case, nor the history of the girl whose homicidal desire was kept from being carried out. Cases of the kind, however, are not uncommon, and not unaccountable, without the devil's assistance. As regards the Pomeroy boy, there was never a clearer case of moral warping by vicious influences, systematically brought to bear on the child *in utero* as well as in infancy. Had the mother's desire been to breed a monster of bloodthirstiness, her course could not have been more surely adapted to accomplish that end. And the mother's morbid pleasure at the sight of blood was not only inherited but cultivated by the child, who was a butcher by instinct, taking up his father's trade almost as soon as he could walk. Yet we are gravely told that this boy's horrid desire to see how a child would die was due to his momentary possession by the devil!

This is worse than the experience of a medical friend, who, calling the other day to learn the effect of a prescription for a sick child, was greeted by the mother with the triumphant exclamation. "I don't think baby will have convulsions any more!" "Ah!" said the doctor; "why not?" "*I've burned his shirt!*" The lady is the wife of a wealthy merchant and a member of polite society. Very likely she reads the *Observer*: possibly both of the papers of that name.

REPORTS ON SMALL ENGINES.

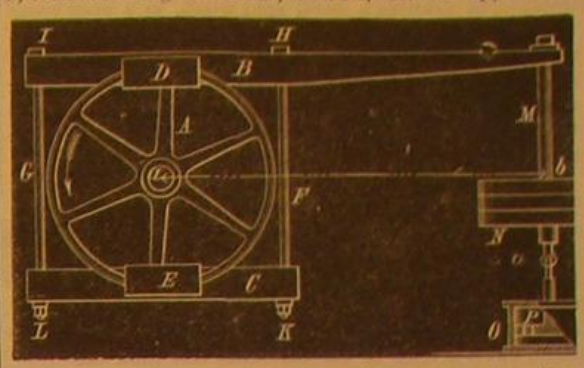
We have been much gratified, of late, by the receipt of letters giving particulars of small engines and boilers. Data of this kind are extremely valuable, showing the results of actual practice, and we hope to receive many more letters of the same kind. These accounts would be more interesting and useful, however, if they contained fuller details of the performance; and we propose to give some account of the manner of making a test. The apparatus needed is quite simple, and can be readily constructed by the young mechanic. The following embrace the principal points that are generally of interest in regard to engines and boilers: Diameter of cylinder, length of stroke, diameters of piston rod, connecting rod, crank pin, valve stem, fly wheel, and shaft; lengths of connecting rod and crank pin, weights of whole engine and of fly wheel, size of ports, stroke of valve, point at which steam is cut off, number of revolutions per minute, clearance at each end of cylinder, pressure of steam in boiler, dimensions and weight of boiler, diameters of steam pipe and safety valve, number of pounds of water evaporated, fuel burned per hour, and power of the engine. Many of these data are obtained at once, by direct measurement or weight. The diameter of the cylinder should be measured when it is at the temperature at which it is ordinarily maintained while running. The point of cut off can generally be ascertained by removing the cover of the valve chest, and observing the point at which the steam valve closes when the engine is moved by hand. This should be done when the parts are heated. The clearance at each end of the cylinder includes not only the space between the piston and cylinder head at the end of the stroke, but also the volume of the ports. A simple and accurate manner of measuring the clearance is to fill the cylinder with water, when the piston is at one end of the stroke, and then measure the water carefully in a cylindrical or rectangular vessel. The difference between the volume of the water and the volume of piston displacement (area of piston multiplied by length of stroke) will be the clearance. In measuring the piston displacement at the front end of the cylinder, the volume of the piston rod (area of section of rod multiplied by length of stroke) must, of course, be deducted.

The number of revolutions of the engine per minute can be determined approximately by observation; but errors are apt to result, especially in the case of small engines moving at a high rate of speed. Small shaft counters can be obtained at a very reasonable price, and measurements made with them are far more likely to be accurate.

Many small boilers are not provided with steam gages, so that the pressure of the steam cannot be observed directly; but all such boilers have, or should have, safety valves, and the pressure of the steam can be determined from them. Secure the valve stem of the safety valve to the lever, with wire or string, and attach a loop to the lever, into which pass the hook of an accurate spring balance, arranging the loop so that it is directly over the center of the valve stem. Then take hold of the upper part of the spring balance, and lift the valve slightly, noting the reading of the balance. Measure the lower diameter of the safety valve, and find its area; divide the reading of the spring balance by the area of the valve, and the result will be the pressure, in pounds per square inch, at which the steam will raise the safety valve. Suppose, for instance, that the diameter of the safety valve is 1 inch; its area will be about $\frac{7854}{10000}$ of an inch. Now, if the tension of the spring balance in raising the valve is 120 pounds, the pressure at which the valve will rise is the quotient arising from dividing 120 by $\frac{7854}{10000}$, or 153 pounds per square inch. It will be easy to make a table for any particular case, giving the pressure corresponding to each pound or fraction of a pound of tension in the balance; and by calculating in advance the reading of the balance for any given pressure, the weight can be adjusted on the lever until that tension is obtained, and the valve can thus be graduated to lift at any required pressure. It may be added that this simple method is applicable to any safety valve, and affords a ready means of testing the accuracy of the graduation; but at present we are treating of this method only with a view to explain how the steam pressure in the boiler may be ascertained at any time. Having determined the pressure at which the safety valve will rise when the boiler is cold, raise the valve by means of the balance, from time to time, when the engine is working, and observe the tension. Find the pressure corresponding to this tension, and subtract it from the pressure at which the valve will be raised by the steam. The difference is the pressure in the boiler at the time. For example, suppose that in the last case the tension of the balance, on raising the valve when the engine was working, was 50 pounds. The pressure corresponding to this will be 50 divided by $\frac{7854}{10000}$, or about 64 pounds, so that the pressure in the boiler at the time would be the difference between 153 and 64, or 89 pounds per square inch. By preparing a table showing the pressure in the boiler due to each pound of tension in the spring balance, the pressure at any time can be read off as soon as the indication of the balance is observed.

The amount of water evaporated per hour and the fuel burned can, of course, be readily determined by measurement, drawing the water from a tank of known dimensions, and observing its state at the commencement and close of a trial, being careful to leave the water in the boiler at the same hight at which it was at the commencement, and maintaining this hight as constant as possible during the experiment. In measuring the fuel consumed, it is best to draw out the fire at the commencement of the trial, rekindling it as soon as possible, and charging all the fuel used from that time, hauling and quenching the fire immediately at the close of the trial, and weighing back all fuel that is unconsumed. In the case of small boilers heated by lamps, a measurement of the oil used between the beginning and end of the trial will generally be sufficient; and if gas is employed as fuel, it will be necessary to attach a meter to the pipe, to determine the quantity consumed in any given time.

To ascertain the power of the engine, the most convenient method is, generally, to attach a friction brake, shown in the accompanying engraving, to the band wheel. Hollow out two pieces of wood, B and C, so that they will fit the circumference of the band wheel, A, and attach light plates of metal, D and E, to the sides, so that the pieces of wood cannot slip off when secured in position. Provide two belts, F, G, countersinking the heads, H and I, into the upper piece



of wood, so that they cannot turn, and put nuts and washers, K and L, on the other ends, so that the two pieces of wood can be clamped on the band wheel as tightly as is necessary. Make the upper piece of wood somewhat longer than the other, and pass a rod, M, through the end. On this rod weights, N, are to be placed, and the lower end of the rod is hooked to the piston rod of a small cylinder, O. The piston, P, fits loosely in this cylinder, which is filled with oil or water; and the piston has small holes in it, so that it can move up and down without much resistance, if moved slowly, but offers considerable resistance to sudden motion. The action of the apparatus will doubtless be apparent to our readers. By tightening the nuts on the bolts, F, G, there will be considerable friction between the band wheel and the pieces of wood. The rod, M, must then be loaded with sufficient weight, so that the engine can just move at its regular rate of speed, and keep the upper piece of wood in a horizontal position. The friction on the band wheel will cause it to become heated, unless some arrangements are made for cooling, either by keeping a stream of water running upon it, or immersing the lower part in a trough in which the water is constantly changed. The small cylinder, O, and piston, P, serve to counteract the effect of sudden shocks, which would otherwise throw the arm of the piece, B, from a horizontal position. Now it will be plain that, as the band wheel revolves (constantly maintaining the arm, with the weight attached, in a horizontal position), the effect is the same as if it were lifting this weight by means of a rope running over a windlass, and the distance through which it would lift the weight in a given time is the same as the weight would move if the whole apparatus were free to revolve. If, for example, the wheel makes 300 revolutions in a minute, the distance from the center of the wheel to the center of the weight is 1 foot, and the weight is 10 pounds; this weight, if free to revolve, would move in each revolution through the circumference of a circle whose radius is 1 foot, and in a minute would move 300 times as far, or about 1,885 feet. The work of the engine in a minute, then, will be that required to lift 10 pounds through a hight of 1,885 feet, or 18,850 foot pounds; and as one horse power is the work represented by 33,000 foot pounds per minute, the engine would be developing a little more than half a horse power.

In making experiments with the friction brake, the apparatus should be placed loosely on the band wheel; and before the weights are attached, a spring balance should be secured to the arm, at the center of the hole for the rod, M, and the reading noted when the arm is in a horizontal position. This reading must be added to the weights that are afterwards attached. The horizontal distance from the center of the wheel to the center of the rod, M, should be carefully measured. Then start the engine, with the throttle valve wide open, and screw up the nuts, K, L, gradually, adding weights at N. It will then only be necessary, when sufficient weights are added, to keep the wheel cool, and occasionally adjust the nuts, K, L, should the brake bind or become too loose from any cause. Should it be difficult or inconvenient to maintain the arm in a horizontal position, note carefully the position it assumes during the test; and for the radius to be used in the calculation, measure the distance, *a b*, from the center of the wheel to the center of the rod, M, in a direction perpendicular to the direction of the rod.

Instead of the weights, N, and cylinder, O, a spring balance may be attached to the end of the rod, M, and secured to some fixed support, its readings during the trial being used in place of the attached weights. In this case, also, the weight of the apparatus must be first determined, and added to the readings of the spring balance. The plan represented in the engraving is, however, the best.

We have thus described, in detail, the methods to be pursued in preparing a report of the performance of small engines and boilers. Although they are far from fulfilling all the requirements of a scientific test, they will give very accurate results if carefully conducted. Should any of our readers make the experiments referred to in this paper, we shall be glad to receive the results, with full particulars.

THE PHYLLOXERA.—R. J. writes to assure us that 1 pint slaked lime, mixed with half a peck horse manure, put round the roots of each vine, will ensure a speedy cure for the disease, protect the plant from frost, and give it a vigorous growth. This remedy, which has been tried and found successful, should be applied in the fall of the year. He offers us half the reward.

IMPROVED DRAFTSMAN'S RULE.

Professor C. W. Maccord, of the Stevens Institute of Technology, has recently published the following in the *American Artisan*:

In making mechanical drawings, it is often required to lay down a series of lines radiating from a single point, as, for instance, in drawing a bevel spur wheel, or a spur wheel whose teeth have radial flanks. This looks like a very simple thing to do with a common straight edge; but the necessity of adjusting the ruler with reference to two points, for every line, renders the task very irksome; and the same is true of drawing a series of lines tangent to a circle, as in the case of the teeth of a ratchet wheel.

These operations are facilitated by the use of the centrolinead, the common form of which consists merely of an arm carrying a needle point, to which the ruler may be clamped at any desired angle, so that the prolongation of its edge shall either pass through the needle point or be tangent to a circle of which the needle is the center. This is very simple and convenient, but it is open to the objections that lines cannot, by its aid, be drawn *through* the center, and that there is danger of defacing the drawing by wearing a hole in the paper; and it evidently gives no assistance in the division of the circle, which must be effected previously by independent means.

The instrument here shown, which may be called a protracting centrolinead, is designed to obviate the objections above named, and to add to the utility of the apparatus by enabling the user to divide the circle and draw diameters at the same time. This is effected by jointing the ruler, by transverse pieces, to two parallel bars, which, rotating about fixed centers, compel the ruler to move in a similar manner.

Fig. 1 shows the instrument complete, adjusted for drawing radial lines; Fig. 2 shows it as set for drawing tangents, and with the graduated disk removed. From the latter figure it will be seen that since E and F are the extremities of two similar and parallel transverse bars, the line E F will be always parallel to the center lines, A B, C D, of the parallel bars to which ACE, BDF are jointed; also that as these center lines can only turn about the centers, G, H, which are similarly situated with respect to them, the line EF, and consequently any rigid body pivoted to E and F, must rotate about a corresponding center, I. The ruler is pivoted directly to F; and if it be placed, as in Fig. 1, with its edge passing through I, the action as a centrolinead requires no further explanation.

In order to render the instrument capable of adjustment, E is pivoted to the triangle, ELM; this triangle is composed of the two bars, EL, LM, and a radius rod, E M, the latter sliding through a socket pivoted to E; M is pivoted to the ruler; and by means of binding screws at E and L, the triangle may be made rigid at pleasure. This, with the ruler, constitutes a rigid triangle, MEF, every part of which must, therefore, like EF, rotate round the center, I. Consequently, the edge of the ruler may be inclined to EF, or its parallel, I K, at any desired angle within limits; and when this is done, it must, in all positions, be tangent to a circle of which I is the center, as shown in Fig. 2.

The centers, G and H, are fixed in a three armed plate, seen below A B and CD; the under side of this plate is provided with elastic pads, by which adhesion is secured without defacing the paper with holes.

Above the bars, A B, C D, is a disk, held in place by the screws, G and H, which pass through short ferules supporting the disk; the screw, G, is in the center of this disk (which is indicated by the dotted circle in Fig. 2), and the bar, AB, has its upper edge passing through G, thus enabling the user to read with ease the angles measured by the divisions on the chamfered edge of the disk shown in Fig. 1. These divisions extend through only one third of the circumference, since the range of motion in the instrument, shown in Figs. 1 and 2, is limited to 60° in each direction from the position here given. This, however, is sufficient to make it a most convenient addition to the labor-saving devices at the draftsman's command, which, at best, are but few enough; since, besides enabling him to draw tangents at any required intervals, it is at once a centrolinead and a protractor, with the center of the circle always accessible—an important feature not possessed even by the separate instruments heretofore used for the purposes accomplished by the one which we here present for his consideration.

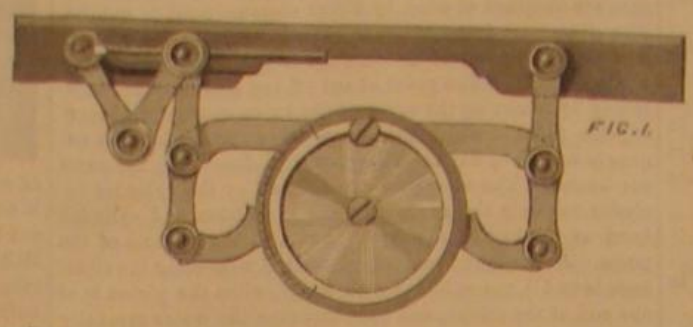


FIG. 1.

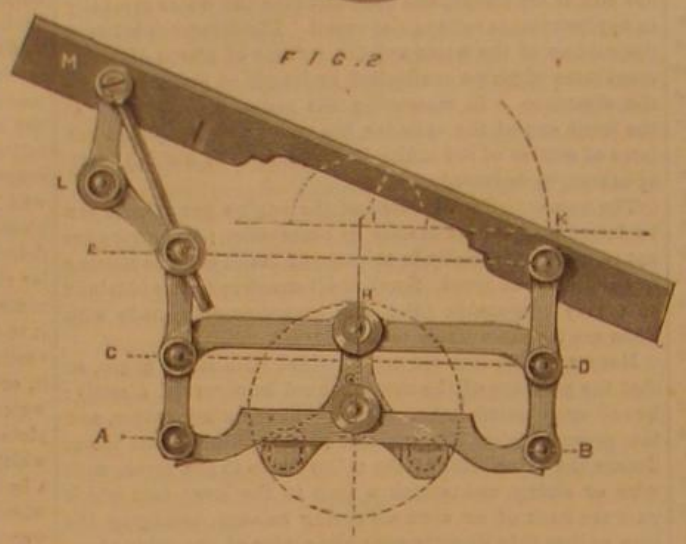


FIG. 2

MACCORD'S PROTRACTING CENTROLINEAD.

Pre-Glacial Man in England.

The human remains found in Kent's Hole, in deposits attributed to pre-glacial times, have a rival in antiquity in the human bone discovered in Victoria Cave. The Committee of the British Association for assisting in the exploration of this cave describe minutely the condition under which the bone was found, and express the "inevitable conclusion" that man lived in Yorkshire with *elephas antiquus*, *rhinoceros tichorrus*, *ursus priscus* and *spelæus*, hyæna, bison, and red deer long before the existence of the great ice sheet in Northern Britain and Ireland.

Local Remedy in Diphtheria.

Dr. James A. Hopkins, of Milton, Del., in *The Physician and Pharmacist*, says: Many have been the remedies used in the local treatment of diphtheria. Some have vaunted *argenti nitras*, in solid form. Others advise the preparations of potassa and its combinations. Carbolic acid has its votaries, as well as muriatic acid and the muriated tincture of iron; externally the oakum poultice has some reputation, and no doubt is of more importance than we are ready to admit. Terebinthine liniment, as well as kerosene oil, stands prominent in the list of external remedies.

But above and before all is the acid tannate of iron. This is a remedy not known to the pharmacopœia, yet it stands second to none among local remedies, and I believe is the only one that bears a shade of semblance to a remedy in this fearful disease, and thus far exceeds any that has become known to the professional world. It may be prepared by the addition of one ounce of the muriated tincture of iron to one of a strong solution of tannin, and applied by means of a brush to the diseased throat, or elsewhere, as the case may be; or, what I believe to be a better way, apply the muriated tincture of iron in full strength to the diseased part with a brush, wait a few moments, then apply the solution of tannin in the same way, thereby forming a union of the two at the point of disease, having at the same time the advantage of chemical action, if there be any. On examination a few hours after, you will see the line of demarcation distinctly drawn by the discoloration of the diseased tissue, showing exactly the extent of the disease, the very thing desired, with a tendency to reparation, which will go on rapidly if the system be properly treated with a nourishing diet and tonic and stimulating remedies.

A SIPHON FOR POISONOUS LIQUIDS AND ACIDS.

In starting the ordinary siphon, by sucking on the longer leg or on a tube attached thereto, it is almost impossible to avoid inhaling the vapors of the liquid, even if the liquid itself does not enter the mouth. A new form of siphon, invented by Professor Weinhold, avoids this difficulty, inasmuch as the suction is produced by blowing, somewhat on the principle of the Sprengel air pump.

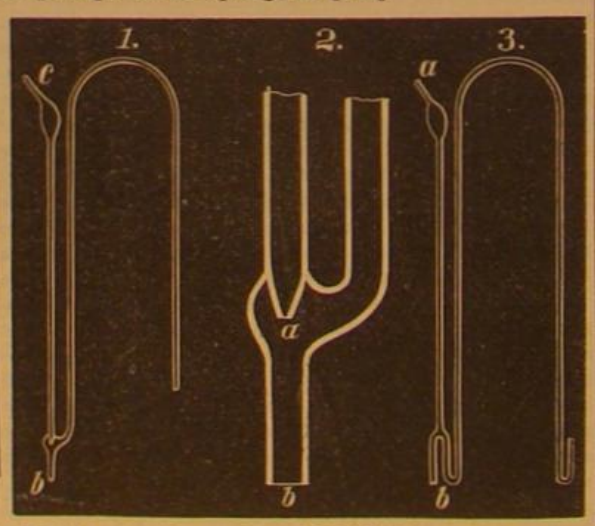


Fig. 1 represents a section of Weinhold's siphon on a reduced scale; Fig. 2 is a full sized drawing of the essential portion of the apparatus. By blowing strongly into *c*, the liquid will flow out of *b*, provided the pressure to be overcome is not more than 12 inches of water, and that the diameter of the siphon is not too great. It is very important that the dimensions be exactly right; the opening at *a* should be 1·5 millimeters (one sixteenth of an inch); the opening at *b*, as well as the diameter of all the tubes, should be 5 millimeters (one fifth of an inch), and the distance from *a* to *b* should be 25 millimeters (one inch).

The so-called French siphon has legs of equal length, turned up at the bottom to prevent its emptying itself when taken out of the liquid. This would probably be more used than it is, were it not so difficult to fill; besides, it gives a spirting or oblique stream. Both disadvantages may be avoided by giving it the form shown in Fig. 3. This siphon is started by closing the opening, *b*, and sucking on *a*, as in the old-fashioned poison siphon. The stream is, of course, delivered downward from *b*. The three pieces of tube at the lower end of the left leg are not arranged in one plane, as shown in the engraving, but in the form of a triangle, so as to be as close together as possible. A French siphon must be lifted out of the liquid slowly and carefully, to prevent the liquid running out.

English Enamel for Cast Iron.

A brilliant white and very adhesive enamel is formed on cast iron articles in the following way: After heating them to a red heat in sand, and keeping them thus for half an hour, they are allowed to cool slowly, and are then carefully cleaned with hot dilute sulphuric or hydrochloric acid, rinsed with water and dried. A ground is then laid on by coating them with the following mixture, afterward drying them at a high temperature, and then heating them in separate muffles to vitrification of the coating: 6 parts of flint glass, 3 of borax, 1 of minium, 1 of oxide of zinc, mixed and finely pulverized, and heated for four hours up to a red heat, and finally rendered semi-fluid by increase of temperature; the mass is then quickly quenched in cold water, and one part of it is mixed with two parts of bone meal, and formed into a pap by triturating finely with sufficient water. Upon this ground the two following mixtures, prepared like the first, are then laid in succession, the first of 32 parts of calcined bones, 16 of kaolin, 14 of felspar, 4 of potash stirred up with water, dried, calcined, and suddenly cooled in water, and the powdered mass triturated with water to a fine paste with 16 parts of flint glass, 5½ of calcined bones, and 3 of calcined quartz; after this has been laid on and well dried, a second coating is laid on of 4 parts of felspar, 4 of pure sand, 4 of potash, 6 of borax, 1 of oxide of zinc, 1 of saltpeter, 1 of white arsenic, 1 of the best chalk; these ingredients are mixed, calcined, suddenly cooled in water, and triturated with 5½ parts of calcined bones, and 3 of quartz. The dried article is finally heated in a muffle, in a furnace similar to a porcelain furnace, when both coatings fuse and mix, thus forming the enamel.

More Fulgurites.

We recently published in the SCIENTIFIC AMERICAN the results of certain analyses, by Professor Albert R. Leeds, of a curious mineral which was forwarded to us from Fayetteville, N. C., and proved to be a "lightning tube," or "fulgurite."

A correspondent from Orange, Texas, Mr. W. D. Street, sends us fragments of two more fulgurites. While closely resembling the Fayetteville fulgurites, Professor Leeds states that they have some interesting points of difference. Like the former, one side is highly vitreous, curved into innumerable small, semi-globular forms, stained with bluish black streaks, and presenting, in its glassy and vesicular character, the appearance of complete fusion. The Orange fulgurite differs in being almost white, and very slightly stained with oxide of iron. The rugosities on their exterior or convex sides, where the sand was remote from the source of heat, are somewhat hidden by the greater mass of partly cemented, adherent white sand. The fragments are of two sizes, the thicker pieces, whose interior surfaces are stained black, coming from one lightning tube, and the thinner, unstained pieces coming from a second, located in the sand at a distance of six feet from the former. The tube-like character of these fulgurites has so strongly impressed our correspondent that he is surprised to find nothing visible coming through them. If other correspondents will forward specimens or information concerning these remarkable phenomena, we shall shortly be in a position to know more about them than has been known hitherto.

A New Theory of Electricity.

Professor Edlund, a Swedish physicist, expounds in a recent work a new theory of electricity, the substance of which is as follows: He supposes the existence of a highly subtle and elastic ether, everywhere present both *in vacuo* and in ponderable matter. Two molecules of this ether are mutually repelled along the line of their connection and in inverse ratio to the squares of the distances. In good conductors, the molecules are displaced easily from point to point, it being presumed that they can be moved with little force. If the body be a non-conductor, this mobility is arrested and depends on the molecules of the material body. A molecule is at rest from the moment when it is equally repelled on all sides. If the repulsion be less at one side than at the other, the body will move if it be free in the direction of the resulting forces.

An Ancient Chip.

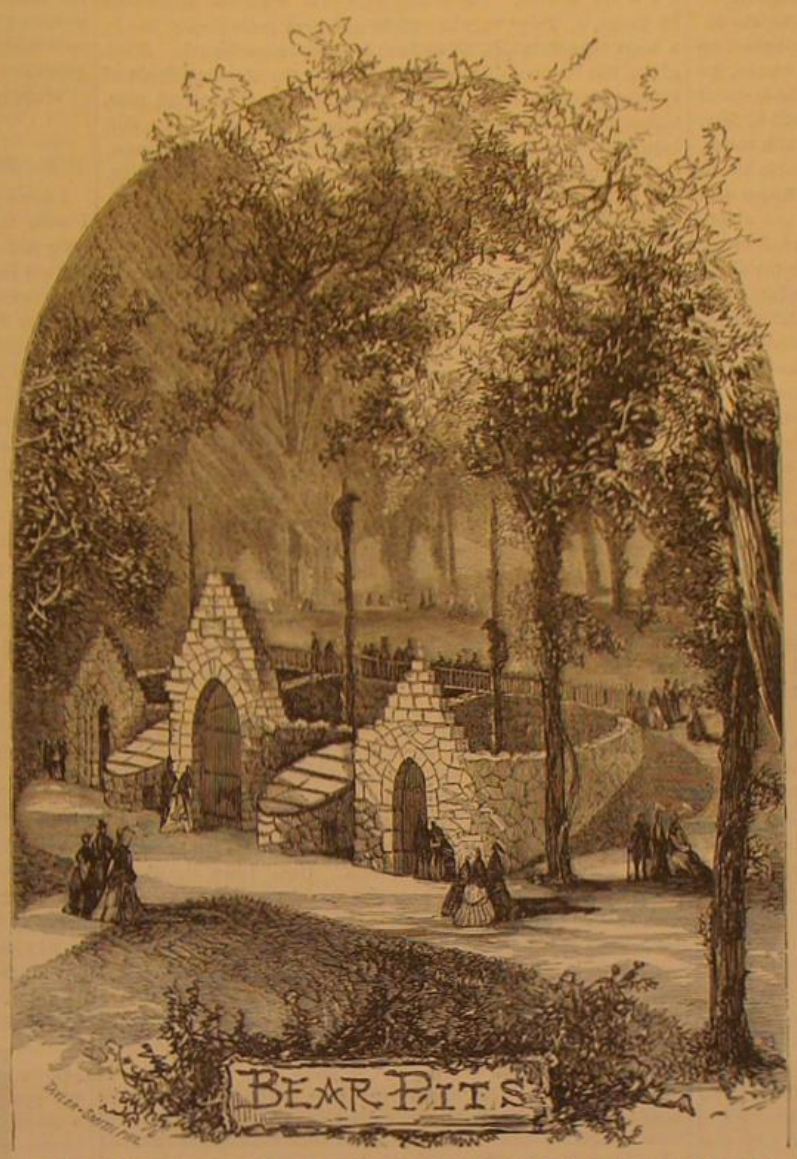
At the recent meeting of the British Association, Professor H. A. Nicholson exhibited and described a silicified chip of wood from the Rocky Mountains. At the Brighton meeting, the same specimen was shown, the opinion then being that its woodlike appearance was due to mineral structure, that it was in fact merely a specimen of the hornblendic mineral known as rockwood. Subsequent examination has shown conclusively that it is a genuine chip of wood, silicified. The age of the chip and the circumstances of its production were thought to present many points of interest, the accepted conclusion being that it is a prehistoric relic, produced by the stroke of a copper ax, such as the mound builders used to hammer out of native copper.

THE FAIRMOUNT PARK BEAR PITS.

The bears cooped up in the dirty and narrow cages, in the temporary quarters provided for the animals in our Central Park, have good cause to envy their brothers of the Philadelphia Zöological Society's collection. The unfortunate brutes in the first mentioned menagerie, are dependent upon public enterprize, and doubtless will die as they have lived, in their confined boxes, unless some unwonted celerity in our city officials results in the establishment of the proposed zöological grounds, at a much earlier date than now seems probable. The Philadelphia bears are, however, the happy property of a society of private individuals, who rapidly pushed forward their undertaking from its beginning, until, in July last, it assumed a nearly completed shape, and the public were admitted to examine a collection of animals, which, in course of time, it is hoped will rival that of the renowned Zöological Gardens of London.

Our illustration, extracted from the pages of the *Fancier's Journal*, published in Philadelphia, represents the bear pits in the grounds of the Philadelphia society; and between such commodious quarters as are here depicted and the ordinary menagerie cage, the difference need hardly be pointed out. The structure is strongly built of pointed stone work, iron, and cement floors; and in the center of each pit is erected a very strong cedar pole, on the summit of which the bears perch as if enjoying the view of the surrounding scenery.

The pit nearest the foreground of our engraving contains a fine grizzly, purchased in Omaha. Pit No. 2 serves as a dwelling for three brown, one black, and one cinnamon bears, all young and not yet full grown. A pair of black bears, male and female, inhabit the third pit. The entire building was planned with much skill by Mr. C. P. Chandler, and serves greatly to add to the comfort of the animals, as well as to maintain them in healthy condition. The beauty of the surroundings, as well as the artistic appearance of the structure itself, is well represented in the picture.



BEAR PITS IN THE PHILADELPHIA ZOOLOGICAL GARDENS.

Quick Telegraphing.

Several instances of quick telegraphing have been brought under our notice of late, but the following shows the perfection to which the cable telegraph service has been brought. A message was sent from New York to London, and in thirty minutes, actual time, the answer was received in New York. Another dispatch was sent to London, to which a reply was received in thirty-five minutes, actual time. In neither of these instances was any special effort made to hurry the answers, but the party addressed sent the reply to the London office by the messenger delivering the original message.

To fully appreciate this wonderful achievement, we must consider that the distance from New York to the cable station at Heart's Content, N.F., is about 1,300 miles, that of the cable about 2,000 miles, and of the land lines and cable from Valentia to London about 300 more. Each message, therefore, was transmitted about 3,600 miles, and passed through the hands of eighteen persons, all told; consequently, the message and reply, in each case, passed through the hands of thirty-six persons and traveled over 7,000 miles in thirty to thirty-five minutes.—*The Telegraphic Journal.*

MILK COOLING CAN.

This is an ingenious device for cooling milk during transportation. The car is provided with an ice chamber, which



is suitably covered with non-conducting material, and the bottom of which is slightly inclined so as to keep the ice which is placed therein in contact with the main vessel. Recesses in this bottom conduct the water through a perforation to an annular receptacle, A, formed by soldering a sheet metal strip of suitable shape around the can. One end of this channel is closed so that the water is obliged to pass around the entire circumference to be drawn off by a faucet at a point opposite that of its entrance. In this manner the full cooling capacity of the ice water is utilized without increasing to any large degree the bulk or cost of the cans.

Patented through the Scientific American Patent Agency, June 23, 1874, by Mr. George W. Fluke, of Mount Pleasant, Henry county, Iowa.

Stuttering.

Stuttering frequently disappears for the time in whispering, and in speaking in an unnatural pitch of tone. These facts have been taken advantage of in the treatment of the affection, to inspire confidence in the patient that it is not impossible to conquer his defect; and the inspiration of this confidence is not without its effect in the success of a rational method of treatment.

In most instances the defect will be found, says Dr. J. S. Cohen, in the *Medical and Surgical Reporter*, to be in great part mental, and to consist chiefly in a want of consentaneous action of the involuntary muscles of respiration and the voluntary muscles of vocalization and of articulation. Here lies one of the chief indications of treatment: to secure a voluntary harmony of action between lungs, larynx, and mouth (including palate, tongue, jaw, and lips).

When a stutterer is carefully examined in the utterances of those sounds in the enunciation of which his deficiency exists, it will often be found that some portions of the organs concerned in speech are too active or too inactive proportionnately to the activity of the remaining organs; and this may exist in the chest, the larynx, the palate, the tongue, the jaw, or the lips. One or several of these organs may be in defective action simultaneously.

Irregular respiration is to be overcome by voluntary efforts at rhythmical respiration at the will of the teacher, being regulated by some movement which the patient may see and follow, or some sound which falls upon his ear at stated regular intervals. In similar manner, gymnastic exercises of the tongue, lips, jaw, and larynx are instituted, either with or without the enunciation of sounds, as the case may seem to require, or as may best suit the condition of the patient for the time being. Finally, exercises in reading and in speaking are made to suit the special defect which is being combated. Thus, words and sentences are arranged in which the defective sounds recur with more or less frequency, and at more or less regular intervals; and these are repeated more or less slowly at first, and afterwards with more or less rapidity and in varying rhythm. In this manner the patient is gradually educated to bring the defective movements under voluntary control; and as he progresses in the cure his voluntary movements gradually become individually unconscious, like the fingering of the instrumental musician; and in this way he becomes rid of his defect.

AN interesting discovery of a life-sized female bust in pure silver has lately been made at Herculaneum. A discussion has arisen whether the work was originally cast or chiseled, but there is little doubt that the former hypothesis is correct. The head is that of a beautiful young woman; but the features have not been identified with that of any other extant head.

Engineering Two Thousand Years Ago.

Perhaps some of the most remarkable remains of ancient engineering are those which were discovered by excavations made some ten or twelve years since, a short distance from Rome, and near the ruins of the ancient city of Alatri. This city was surrounded by massive walls, and located on a mountain, or elevated point, and ill provided with water. About 150 years before Christ, as we learn from a Roman inscription, an immense aqueduct was built to bring water from a neighboring mountain better supplied with that element. We are furthermore told that this aqueduct was 340 feet high, supported upon arches and provided with strong pipes. The topography of the country, moreover, assures us that the water supply could not have been conducted into the city, even over such high supports, except by pipes—an inverted siphon—the lowest point of which must have been some 340 feet below the point of delivery, or under a pressure of at least ten atmospheres, 150 lbs. per square inch.

The excavations already alluded to show that the aqueduct must have been of large size, as the piers of the arches are not less than 5 feet 9 inches in breadth, while the total length of the siphon must have been between four and five miles. The question naturally arises: How, and of what material, was this syphon built? As iron pipes of large dimensions, if of any dimensions at all, were not known at that era, we can look only to masonry or woodwork for the material of such construction. Possibly a clue has been found to the mode of their construction by a subsequent discovery, near the same locality, of a field, supposed to have been the site of an ancient parade ground near this once walled city of Alatri. A complete system of underground drainage has been revealed at a depth of about 7 feet below the surface of the field, effected by a well constructed system of pipes made of fire clay, each about 18 inches in diameter. It is possible that such a pipe, of larger dimensions, and strengthened on its exterior by a strong and massive bulwark of masonry, may have been the means of conveying the water into the city. But however that end might have been attained, the work was certainly a most wonderful feat of engineering, considering the condition of the mechanic arts of that early day. The excavations and discoveries thus brought to light, and so fully confirming the truth of the ancient inscription, were conducted by order of the present Pope, and under the immediate supervision of the well known Italian scientist, Father Secchi.—*Iron.*

LIGHTS FOR GREENHOUSES.

J. L. N. publishes, in the *English Mechanic*, an account of a novel mode of fitting lights in greenhouses and forcing frames, which facilitates the transmission, removal, and putting together of horticultural buildings. It consists in making the lights in two or more rows for the roof of a greenhouse, each light being capable of being raised, and, if necessary, turned over or removed, by means of a hinge joint, one part of which is fixed to the framing of the roof or the garden frame, and the other to the light, the connection being made by a removable pin. Iron "set-opens" are attached to each light, to keep it open to any required degree, and these being connected by suitable gearing, all the lights in a house can be opened simultaneously.

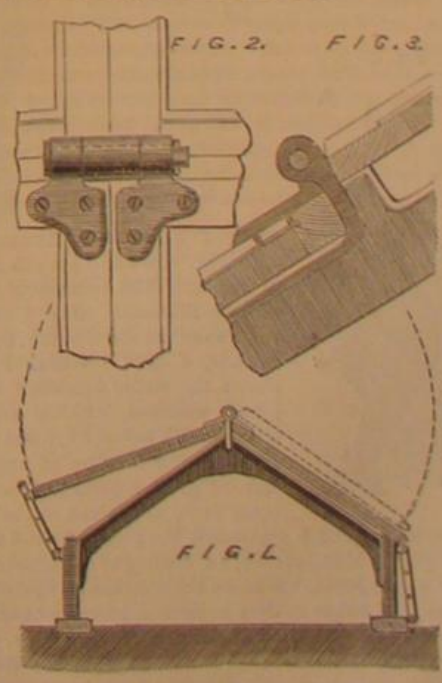


Fig. 1 is a section of a well known and very useful horticultural appliance, showing the light partly open, and also, by the dotted lines, how it may be thrown completely over when required. Figs. 2 and 3 represent top and side views of the hinge, as applied to greenhouse roofs, by which it will be seen that the lights may be thrown over completely, removed altogether, or partially opened, with the minimum

expenditure of labor. The lights being interchangeable facilitates the removal of the structures when necessary, and also renders them more easy to repair. The invention, it will be seen, is a very simple thing, but it will, says the author, be found an improvement in the construction of garden frames and other horticultural appliances.

SPIDERS' WEBS AND SPINNERETS.

The exterior parts of the silk-producing organs of spiders are called spinnerets. They are four, six, or eight papillæ, or sometimes, instead of papillæ, flat plates, situate on the under side of the end of the abdomen, in a little depression adapted to their size and shape. As far as I am aware, no British spider has a less number than six. On the ends of each spinneret are little funnel-shaped tubes, *a* and *b*, Fig. 1, from which the silk is emitted, and which I call silk tubes, being ignorant of their proper name. The spinnerets lie in pairs, and are naturally divisible into two sets, an upper and a lower. There are two pairs in the upper set, one above the other, which I therefore name the first and second pairs, the one pair in the lower set being distinguished as the third pair. The spinnerets of the first pair have two joints, and their silk tubes are situated sometimes on the end of the second joint, and sometimes irregularly down its inner side. The second spinnerets have but one joint. They are smaller than the first, and have the silk tubes on and around the ends. The construction of the third pair differs a little from that of the other two. Like the first they have two joints, but the basal joint is always much larger than the terminal, which is very short. Their silk tubes are on a retractile plate at the end of the second or terminal joint, which, when not in use, is drawn inwards until the tips of the silk tubes are nearly level with the end of the spinneret. This plate has a thickened rim, and on the interior margin, where the rim is broadened for the purpose, are a few holes and two silk tubes of unusual size. The exact use of these I have been unable as yet to determine. The spinnerets of a spider are mobile, and their movements are effected by longitudinal muscles.

The first and second spinnerets always produce plain or non-adhesive threads; if the spider be of a species that spins viscid threads, these are always emitted by the third pair. There is one family of British spiders which has an extra and very remarkable pair of spinnerets in the lower set, which produce threads of a peculiar character; they are described further on.

Fig. 1. Fig. 3. Fig. 4.

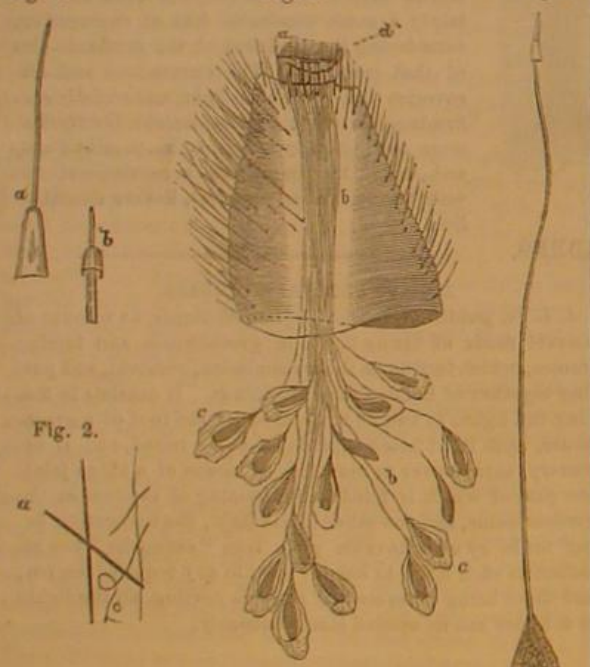


Fig. 2.

Fig. 5.



SPIDERS' WEBS AND SPINNERETS.

In Fig. 1, *a* and *b* are silk tubes of first and third spinnerets of *tegenaria domestica*. Fig. 2 shows the web of the same ×150; *a*, first threads, *c*, third threads. Fig. 3 shows the under spinneret, with glands attached, ×38. *a* are the common silk tubes; *b b*, ducts; *c c*, glands; *d*, silk tube of unusual size. Fig. 4 represents the silk tube, duct, and gland of the first spinnerets, ×38. Fig. 5 represents the gland of third spinnerets; *a*, gland; *b*, bag or case; *c c*, coating of epithelial cells.

As may be supposed, I selected the commonest spiders for observation, and house spiders happened to come handiest. The web of a tegenaria, and I believe of every spider, contains three sorts of threads, not two only, as usually stated. Two of these are plain, and stretched taut from point to point (*a*, Fig. 2), and they differ in nothing but size, being spun by the first and second spinnerets, of which in all spiders the first is larger than the second, although in some instances it has a fewer number of silk tubes. The third thread (also shown on Fig. 2) is exceedingly elastic, and studded with viscid globules, or, if these be absent (as in the web selected for illustration), it is slack, irregular, and sometimes much curled.

The apparatus by means of which a spider forms its silk is a series of glands within the abdomen, near and attached to the spinnerets, and immediately beneath the liver and intestinal canal. The glands of the upper and lower sets of spinnerets differ somewhat in character and shape, as is noted below. Fig. 3 is a drawing of one of the third spinnerets of *tegenaria domestica*, with its glands, of which only a few are shown. These communicate with the silk tubes by ducts, *b*. They vary in size in different individuals, but in a large tegenaria $\frac{1}{100}$ of an inch is an average length. Each gland has its own duct and silk tube. On the first pair of spinnerets there are about 60 silk tubes; on the second pair, although the spinnerets are smaller, about 80. The silk tubes on these two pairs are alike; but they differ in shape from those of the third pair and are much larger (see Fig. 3, *a* and *b*). There are nearly 220 tubes on the third pair, thus making altogether about 360 on the six spinnerets.

The glands, likewise, which are proper to the first and second pairs of spinnerets differ from those belonging to the third. Fig. 4 represents one of them with its duct and silk tube, drawn to the same scale as Fig. 3, for the sake of comparison. It is a simple sac, closed at one end, and terminating at the other in the duct, which carries the secretion to the silk tube. On the surface of the gland is a coating of cells, probably epithelial, which are surrounded by a very delicate membrane. The points of difference in the silk glands of the third spinnerets are these: They are smaller (about one quarter the length), of a different shape, and chiefly, they are enveloped by a bag or case interposing between the actual gland and the epithelium (see A, Fig. 5, *b* and *c*), which bag is wanting in the other glands; while the epithelium is apparently without the membranous covering by which, in them, it is always surrounded. This case, continued as a tube, surrounds the duct for some distance, in all probability as far as the silk tubes, but I have not been able to trace it so far.

It has been argued that the drops of liquid silk coalesce as they emerge from the spinnerets, and so form a simple, homogeneous thread, but various observations have convinced me that such is not the case. The following also tends to contradict this theory, namely: When a garden spider has caught a fly, as every one knows, she very expeditiously binds it in a covering of silk. Until I saw the exact process, I often wondered how she could manage to accomplish this so quickly. She places the tips of her six spinnerets almost in a line, at the same time seeming to erect each separate silk tube, and thus puts forth, not a single thread, but a broad band of many detached threads, which is rapidly wound round the unfortunate fly. The examination of the web of a house spider, under a high magnifying power, will show that many of its main threads are frayed, like a rope worn by use; this could not occur if they were homogeneous.—*H. M. J. Underhill, in Science Gossip.*

Correspondence.

The Scientific Treatment of Criminals.

To the Editor of the Scientific American:

Your remarks on the "Scientific Treatment of Criminals," on page 224 of your current volume, strike me as being, in the main, profound and sensible. You omit, however, to take account of one grave fact, which is a weighty factor in determining society's method of the treatment of criminals.

It is this: Each one of these "ill-regulated machines" is a generator of other and worse regulable machines, and generally the prolificness is in inverse ratio to the regulability. This is a state of facts which the modern theory of dealing with the criminal class takes no account of. We send a badly constructed locomotive to the repair shop, and if it can be tinkered up at all it may have some degree of utility. The case, I imagine, would be very different if each locomotive were the spawner and perpetuator of its own defects to all futurity. The mode of dealing would then be the summary breaking up in the shop for the sake of the old material. This is just what human society has done in all past time with its own failures, and to this process of "moral selection" we unquestionably mainly owe the advance which the race has made in moral evolution. It is only in the most recent times that the retrograde course has been adopted, chiefly for sentimental reasons under false theories. Having reached a plateau of comparative security, society kicks down the ladder by which its moral eminence has been in part attained, and ignores the horrid depths from whence it commenced its ascent toward the light.

It is highly questionable whether, sentiment aside, the profit to society from the maintenance of costly prisons and reformatories is greater than the old, simple, and inexpensive methods. For cases other than the most incurable and hopeless failures, however, there seems to be no reason for abandoning the reformatory and punitive modes of treatment, simply on account of a better philosophical hypothesis. The presentation, by society, of powerful motives of action has been, next to selection, a most efficient agent in moral evolution. Now, on the mechanical theory, or any other, it is certain that these motives act, namely, fear of punishment, hope of reward, love of approbation. This is a mere matter of observation. Where, then, does human responsibility to society cease? To be alarmed on this score is to imitate the consternation of the old lady, who, when told that red flames 10,000 miles high had been discovered in the sun, exclaimed: "Now we shall all be burned up alive!" The truth is that the machine is just what it always has been, complex beyond calculation, full of numberless antagonistic springs and coördinating devices, adapted to be played upon by the minutest objective and even subjective phenomena, and capable, to a certain small extent, of a choice of motives. In this lies its responsibility. It is clear that some of the motives by which the components of society have in the past been powerfully influenced and molded may become less potent or disappear. Such transformations are continually going on as society progresses; but there can be no fear that, while the machinery remains constituted as it is, that portion of it which is so wonderfully susceptible to the influence of motives, namely, the imagination and the passions, will, as in the past, be also the prolific generator of new motives sufficient to control the action of all for the general good.

H. H.

Washington, D. C.

Small Boat Engine.

To the Editor of the Scientific American:

I have taken an interest in the small engine question, and I wish to say that I have a small engine in a boat 17 feet long and 5 feet wide. It is an upright engine; the cylinder is 2 x 3 inches, and drives a propeller 18 inches in diameter. The boiler is a common upright one with 22 tubes. I can run for four hours with one fire; in a whole day's run, it consumes about 4 buckets of coal. The boat's general rate of speed in still water is about 6½ miles per hour.

Barrytown, N. Y. J. ASPINWALL.

[In descriptions of engines, further particulars would be useful—such as dimensions of boiler, pressure of steam, pitch of screw, and revolutions of engine per minute.—EDS.]

Ice Lenses of Unlimited Size.

To the Editor of the Scientific American:

If you had lived in Minnesota and seen our ice, you would not think me foolish in suggesting the possibility of freezing filtered water so as to make a perfectly achromatic lens of unlimited size, to be used in a telescope during the winter months; but as you are used to New York ice, I shall only expect you to think that I am somewhat visionary in this last thought.

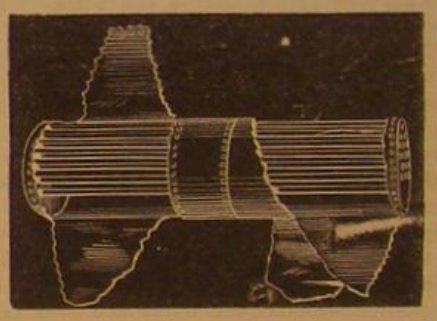
C. RIDGWAY SNYDER.

Minneapolis, Minn.

Remarkable Boiler Explosion.

To the Editor of the Scientific American:

A fatal boiler explosion occurred in this city at 9 A. M., on October 2, in the factory of the Dubuque Cabinet maker's Association. The engineer and another man were instantly killed, and a third severely scalded. The cause of the explosion cannot be ascertained. The boiler was new (not much over a year in use); it was 15 feet long by 4 feet diameter, with 38 four inch flues. It burst in a queer way, both heads remained on the flues, but the shell of the boiler



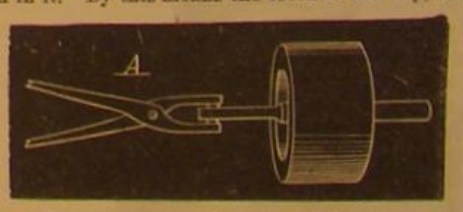
burst along the rivet holes nearly all around both heads, leaving a wreck as shown in the engraving.

Dubuque, Iowa. M. A. KELLER.

Hardening and Tempering Tools.

To the Editor of the Scientific American:

Upon the above subject permit me, in conclusion, to say that, since I withdraw the tube from the fire before inserting the tap, the products of combustion do not interfere with my operation of tempering; and since the tube is shorter than the tap, some part of the latter is at all times exposed to the air, as here illustrated, at A, it being obvious that the tap must be moved endwise through the tube as well as revolved in it. By this means the teeth of the tap, which become heated more quickly than its middle, impart the heat to the body of the tap, making its temperature, and hence its temper, even all through, the color of the temper being plainly, at all times, discernible; and perfect access of the air is permitted. The sand bath process I have objected to from the first, for reasons then stated, to which Mr. Hawkins has given his endorsement.



In tempering dies, I do not permit them to lie more than a few seconds on either face, excepting at the end of the operation, when I lay the back edge (the one furthest from the teeth) for several seconds on the hot iron, making the back a little softer than the teeth, and thus strengthening the die.

JOSHUA ROSE.

New York city.

To the Editor of the Scientific American:

Enclosed find a tap, or rather the pieces of a broken tap, a quarter inch in diameter, with twenty threads to the inch, with a very deep wire thread (round top and round bottom This tap has tapped over two hundred thousand hot forged

nuts. It broke in tapping a nut which was too small in the hole, otherwise it was good for several thousands more. It ran constantly at 480 revolutions per minute for 48 days. This tap I believe to have been well made and properly tempered; and if any of your readers can improve on it, I should be glad to hear from them. It was made from W. Jessop & Sons' best English steel, swaged at as low a heat as possible, the screw end being a sixteenth of an inch larger than the size, in order to true up to size; the shank was forged and swaged as near the finished size as possible, and it was then heated slowly to a cherry red and imbedded in lime until cold; it was then centered and straightened. The shank was filed bright in the lathe, then reversed and the screw end turned straight and parallel for about two diameters, or half an inch from the end of the thread; and from that to the point, the tap is given the amount of taper that will allow a nut of the proper size to go on the tap flush with the end. The lathe is then set to chase a straight parallel thread; the tap, when chased, is passed through a hardened steel gage, and is then ready for the milling machine. It is milled with three deep half round grooves; it is afterwards filed with a little clearance on the top of the thread, then passed through the same steel gage as before (but this time in the reverse way, namely, shank end first), and unwound through the gage. This is done to remove the fine burr made by the milling and filing, which is very necessary; though sometimes the burr is scarcely perceptible, yet it would make a material difference in the size of the nut. The tempering is done thus: Heat the tap slowly to a cherry red, and dip endways and straight into clean cold water; and when perfectly cold, clean off the oxide or thin scale, with soft brick or an emery stick, until bright. The cleaner you make your tap, the higher and brighter will be your color. Then draw the temper to a purple bordering on a blue, by placing the tap shank on a piece of heated iron, and drawing the shank as soft as possible, drawing the temper towards the point. When the shank is soft, roll the tap backwards and forwards over the hot iron, until you have an even temper and color all over the body of the tap; then drop it into oil to cool. The taps are kept sharp by grinding the top of the thread where the nut starts; for the scale in the nuts soon wears a step on the tap and the starting point must be kept sharp or the tap would have to be forced into the nut. This is all the grinding or sharpening given these taps, and, in my judgment, is all they require. I am using taps all of which run at a high rate of speed, and the average amount of work got out of quarter inch taps is ninety thousand nuts. I have sent a quarter inch tap, as a small tap is a more delicate test of quality. Large taps never break if properly made and used, and they last a long time before they wear out; whereas a small tap, if not carefully and properly made, would either snap off or burr up, perhaps with the first nut. I also mentioned machine taps because you can never judge the results or gage the work done by hand taps. One particular point in making a taper tap is to be sure and have the thread parallel, giving the taper only to the outside or top of thread. By so doing each tooth does its share of the work, and the cut is regular.

Pittsburgh, Pa. T. J. B.

The Engines at the American Institute Fair.

To the Editor of the Scientific American:

In your issue of October 17, a correspondent who signs his name "Esor," makes some remarks upon the engines at the Fair which seem to display a hypercritical spirit, and have the further disadvantage of being in one or two instances incorrect in point of fact. For example: He says that "the Wright engine has its eccentric straps a quarter of an inch apart, and are not locked together by the bolts at all, but merely hang on the shaft; they are the only ones in the Fair possessing this defect." When I saw the bolts this morning, there was a head on one end and a nut on the other, and the eccentric straps were held together by them. "Esor" must intend to convey some other impression than that naturally attaching to his expressions. As to the straps being open a quarter of an inch, he is correct; but it is not a defect to have them so, but standard engineering practice, not necessarily faulty because disapproved of by your correspondent. He further says that a small rod on this engine (meaning probably the Wright engine though he has just referred to one or two others previously) "is about ten inches long and connects one end of the rocker arm to the arm of the shaft working the cut off, the movement of each end of the rod being part of the circumference of a circle, the plane of one circle being at right angles to the plane of the other, and said rod having the bore of its brasses at each end trumpet-shaped from the center to each face of the brass, so that the rod has a right-about-face and 'slantindicular' movement, in all directions, merely hanging on its journals, since its faces will be free, and unconfined by flanges, collars, or other guides common to a respectable connecting rod."

In point of fact, and in few words, this rod has a ball and socket joint; how it can be "trumpet-shaped" under such circumstances is more than I, or any one whom I have asked, can discover. It is an old device, not new or claimed to be, by the makers of the engine. As regards the "thump" of the engine, your correspondent, before pointing out such a thing, might have reflected that it is not possible or desirable to go to the expense of putting down as heavy foundations for an engine at a Fair as they would be if intended to be permanent. The slight pound is caused by the springing and settling of the supports, and is in no way attributable to the connecting rod brasses.

Intelligent criticism is always in order and desirable, especially in mechanical matters; but the crudity of your correspondent's remarks can only be accounted for by a want of familiarity with the subject he discusses.

42 Cliff Street, N. Y. EGBERT P. WATSON.

[We were glad to observe, on our last visit to the Fair, that the exhibitors of the engine, acting on the hints of "Esor," had re-adjusted the machine and stopped the pounding. This is practical. But the charges of "hypercritical spirit", "crudity", "ignorance of the subject", etc., raised by the above correspondent, appear to be a waste of adjectives.—EDS.]

The South American Boxer.

To the Editor of the Scientific American:

The boxer of South America is so called by English and American settlers on account of its pugilistic propensities. It is of the grasshopper family, light-made, long limbed, and of a beautiful green color, and is an inhabitant of the south temperate zone. Those which I saw were brought in by *gauchers* (herdsmen) from the camp (country) and given to the *major domo* (foreman) of the *salerado* (salting establishment) at Port Roman, situated on the east side of the Uruguay river, about forty miles above Independencia and in about latitude 34° S. They were brought in to show as curiosities. The major domo, with whom I was well acquainted, placed one of these little fighters on a table and said to me: Tease him, and see what he will do. So I put my forefinger against him and pushed him lightly back; he was then in his natural position, on all fours. He faced around toward me and moved back about an inch. I then touched him lightly again, and he retreated again, as before; and we observed a sort of nervous movement in the hands, or rather the lower extremities of the fore legs, which we will call hands. I followed him up again; but this time, instead of retreating, he raised himself up, his body being nearly perpendicular, and drew his feet up, placing himself like a Turk in sitting posture, at the same time clinching his fists and putting himself on guard as a boxer would do.

I then made a pass at him with my finger, which he turned off as well as Yankee Sullivan could have done; and as long as I continued teasing him in this way, he warded off and gave blows as regularly as any pugilist could do. Soon after I ceased teasing him, he came down on all fours again and walked off leisurely across the table. The major domo told me that he had seen plenty of them, and that they all showed fight when teased, the same as this one had done.

Stratford, Conn. TRUMAN HOTCHKISS.

Vesicatory Potato Bugs.

To the Editor of the Scientific American:

Your correspondent, Mr. I. B. Hodgkin, is correct as to blistering with potato bugs.

In childhood, in the country, I frequently ran bare-legged among potato vines, and nearly always was blistered on my ankles by contact with these same bugs. I am not sure that crushing the insect was necessary; contact sometimes seemed to raise a blister. Generally a sac larger than a buckshot occurred, which (unless attended to) caused an irritating sore.

It was a well known fact; but the bug was rarely used in blistering, in consequence of the acridity of the poison, and consequent difficulty in healing. The Colorado bug, common this season, should rather be called a grub; it will be recognized by most persons who have seen it as similar in form and movement to the blood sucker of the brooks (leech), but different in color and not active. The common impression is that it is in some way poisonous. It is as tough as rubber; a sharp knife will scarcely cut it. Most people hereabout know what it is like to their cost. R. H. A.

Baltimore, Md.

[For the Scientific American.]

SOME NEW GALVANIC BATTERIES.

Several new forms of the galvanic battery have lately been brought to our notice, a short description of which will interest our readers.

I. A copper pot is filled with dilute sulphuric acid, inside of which is placed the ordinary porous cup, filled with a strong solution of sal ammoniac in water, in which is placed the amalgamated zinc. The action of this battery seems to be as follows: The sulphuric acid, entering through the porous vessel, decomposes the chloride of ammonium, setting free the hydrochloric acid, which, in turn, attacks the already oxydized zinc, forming water and chloride of zinc.

II. In a jar, of about six inches diameter by ten inches hight, is placed a carbon plate, within a bag of unoiled leather; the bag is surrounded by peroxide of manganese, closely packed; the jar is then filled with a strong solution of sal ammoniac to which a few drops of hydrochloric acid are added; a plate of amalgamated zinc, of the same dimensions as the carbon plate, is placed in juxtaposition with the carbon. The action in this closely resembles that of the well known Leclanché cell. Constancy of action and large electromotive force are claimed for it.

III. A copper pot or cylinder is taken, inside of which is placed a porous cup filled with a strong solution of sal ammoniac in water and a plate of zinc (amalgamated). The outer vessel is filled with rain water, in which is placed a quantity of lucifer matches surrounding the porous cup. This form of battery is simple yet powerful. The matches seem to furnish a supply of ozone which is really its motive power. L. B.

LABOR is the duty man owes to society; rest is the duty he owes to his person; recreation is the duty he owes to his mind.

Charles M. Keller.

It is with the deepest regret that we announce the death of Charles M. Keller, the eminent patent lawyer, which occurred at his country seat at Milburn, N. J., on Thursday morning, October 14. For a year past Mr. Keller was in delicate health, and it was very evident to his friends that he needed rest from the arduous labors of his profession. Early last spring he was directed by his physician, and implored by his friends, to withdraw for a time from active work, and to devote himself to the restoration of his health. To these entreaties he gave no heed, insisting that his duties to his clients and to his cases were paramount to all others. At last, the feared result came; and about ten days before his death he was assailed by the complication of diseases which ended his life. He died in harness, working and consulting, on the last day before his attack, upon a difficult argument. And almost his last words were an expression of pleasure at the decision of an important case in his favor.

Mr. Keller was born in France, but came to this country with his parents at an early age. His father was employed in the old Patent Office; and at the early age of twelve years, young Keller began his career in the Office. He had a remarkable talent for mechanics, which he developed by assiduous and extensive study. His value was appreciated, and for many years he was an examiner under the organization of the Office prior to the act of 1836. In 1834, he conceived the idea of reconstructing the system of patents, and drew the act which was passed in 1836, and which is the foundation of the Patent Law of today.

A few years afterwards, Mr. Keller determined to leave the Office and to commence the practice of the law. For two years he studied, after office hours, until he deemed himself equipped for his new profession. So wide was his reputation that, before he opened his office, he was besieged with retainers, and with his first case he stepped to a foremost place at the patent bar. Since that day he has been engaged, on one side or the other, of most of the important patentl itigations which have occupied the courts; and his practice was attended with singular success.

Mr. Keller's life was that of a purely professional man. He was fond of social pleasures, and was a charming and genial companion; but his thoughts day and night were on his cases, at which he labored with wonderful assiduity. No one has ever equaled him in his skill and perspicuity in explaining machinery in court, or in describing and claiming it in patents. To this talent he added excellent attainments in the law. His knowledge of equity, of pleading, and of the theory of the law of contracts was thorough and complete; and his method of preparing his cases for argument was so good that some twenty years since, the Supreme Court of South Carolina, in adopting a rule to regulate the form of briefs to be used before that court, printed with their rule a brief of Mr. Keller's as a model.

All friends of the mechanic arts will deplore the great loss they have sustained by his death. He was wise and prudent, learned and modest in consultation, earnest in argument, and always truthful, sincere, and just. His memory will long be cherished as that of one of the Fathers of the Patent Law.

Transformation of Sandstone to Marble.

J. Corvin, an engineer residing at Dresden, Germany, has invented a method of giving the ordinary sandstone, found in abundance in many localities, the exterior appearance of marble. He accomplishes this by impregnating the well dried stone with solable silica and alumina. The thus prepared sandstone becomes much lighter in color, some kinds being intensely white and translucent, while it is capable of the highest polish, equal to that on the purest marble. He has even succeeded in imitating marbles of every color by adding mineral colors to the liquid used for impregnation. The famous quarries near Pirna, in Saxony, produce a sandstone especially adapted to this process, and Mr. Corvin now makes colored stones from this sandstone, adapted to the most elegant architectural structures. The price is considerably below that of marble; and the new material has the important advantage that it is much more fireproof than marble, which, when exposed to the fire, rapidly burns into quicklime and crumbles to dust.

Distilling Sea Water.

The author of a book lately published in England, entitled "Two Years in Peru," thus describes a simple contrivance recently devised by an English resident of that country for procuring fresh water from sea water through the direct action of the sun's rays:

"The apparatus consists of a box of pine wood, 1 inch thick, and which is about 14 feet long, 2 feet wide, and an average depth of 6 inches. The upper part of this box is closed with ordinary glass, which has an inclination of 1½ inches.

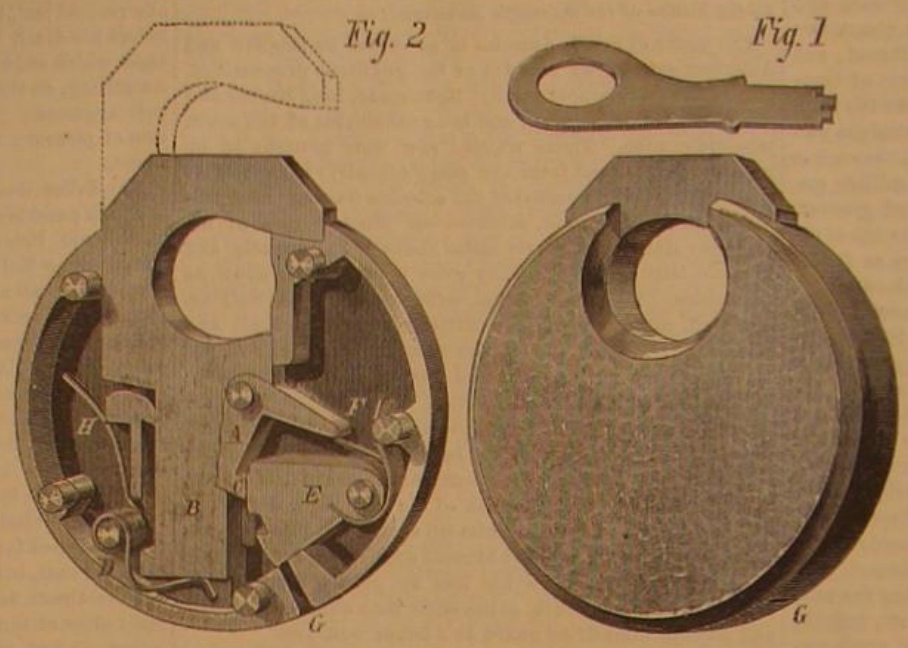
"At the lower edge of the glass, there is a semi-circular channel, destined to receive the fresh water which is condensed on the interior surface of the glass. The salt water is let into the box to about 1 inch in depth. It is then exposed to the rays of the sun, the heat of which is sufficient to raise it to 160° or 180° Fah. A very active evaporation then begins, and it is proved that 10½ square feet of glass will condense daily two gallons of pure water."

The author says he saw the apparatus in successful operation at Callao. There are many places on the coast of Peru, as in various other parts of the world, where fresh water is only to be got by distillation, and in such localities the device cannot fail to be exceedingly useful.

IMPROVED SELF-LOCKING PADLOCK.

The novel form of self-locking padlock represented in the engraving is the invention of Mr. D. K. Miller, of Philadelphia, a well-known safe and bank clock manufacturer and a lock expert of some celebrity. In points of workmanship and construction the device possesses the merits of simplicity and convenience; while its durability is enhanced by its being made entirely of brass. The pins at all movable joints are wrought of that metal, so that deterioration from the effects of weather is amply provided against.

Fig. 1 shows the exterior of the lock and its key. In Fig. 2 the outer plate is removed in order to exhibit the mechanism. A is the dog, which is so pivoted as to fit into a recess of the latch, B, when the latter is pushed down. The end of the lower arm of the dog is formed with an angular projection, C, which, engaging against a properly shaped shoulder at the bottom of the recess, holds the latch in the position mentioned, in opposition to the upward tending force of one arm of the spring, D. At E are the tumblers, either six or seven in number, according to the size of lock, all of which are pivoted on a single pin, and each provided with a bent wire spring, as shown. The upper portion, F, of one of these springs, instead of taking, as do the others, against the projecting part in the shell, is brought forward and under the straight arm of the dog, so that its tendency is to force the lower arm of the latter against the tumblers, causing the projection, C, to enter notches in the tumblers when the same are brought into proper position.



MILLER'S IMPROVED SELF-LOCKING PADLOCK.

It will be readily understood that, owing to the angle of the notches in the tumblers, and to the dog being in a solid piece, it is only when all the notches coincide that the projection can enter them; and hence, if each notch were placed in exactly the same position on the edge of the tumblers, then any square bit of metal pushed in through the key aperture, at G, would lift all the tumblers together until the coincident notches met the projection. But this evidently would at once defeat the purpose of the invention, for one of its main features is that no two locks are alike: the key that fits one must be, and is, entirely useless to open another. The important advantage, however, is easily secured by varying the positions of the notches on the tumblers; so that in order to render all the notches coincident, a key having peculiarly formed projections and recesses at its extremity must be employed, which, acting on all the tumblers simultaneously, lifts each the exact distance required.

The key is merely pushed into the proper aperture, freeing the dog as above described, and allowing the latch to be acted upon by the spring, D, and so lifted upward into the position indicated by the dotted lines in Fig. 2. Motion in this direction is then limited by the catch, H, which is held against the side of the latch by the upper arm of the spring, D. The angular projection shown on the left hand lower corner of the latch engages in a corresponding projection in the catch, the lower part of the latch being guided in its ascent by the dog on one side and the straight part of the catch on the other.

We learn that this invention has, after thorough testing, and against a number of competitors, been adopted by the United States Government. The present device was patented in this country July 26, 1870, and October 21, 1873. Similar protection has been obtained in England, France, and Belgium.

For particulars regarding sale of foreign patents and other information, address the manufacturers, the D. K. Miller Lock Company, 712 Cherry street, Philadelphia. The locks are for sale by the hardware trade generally.

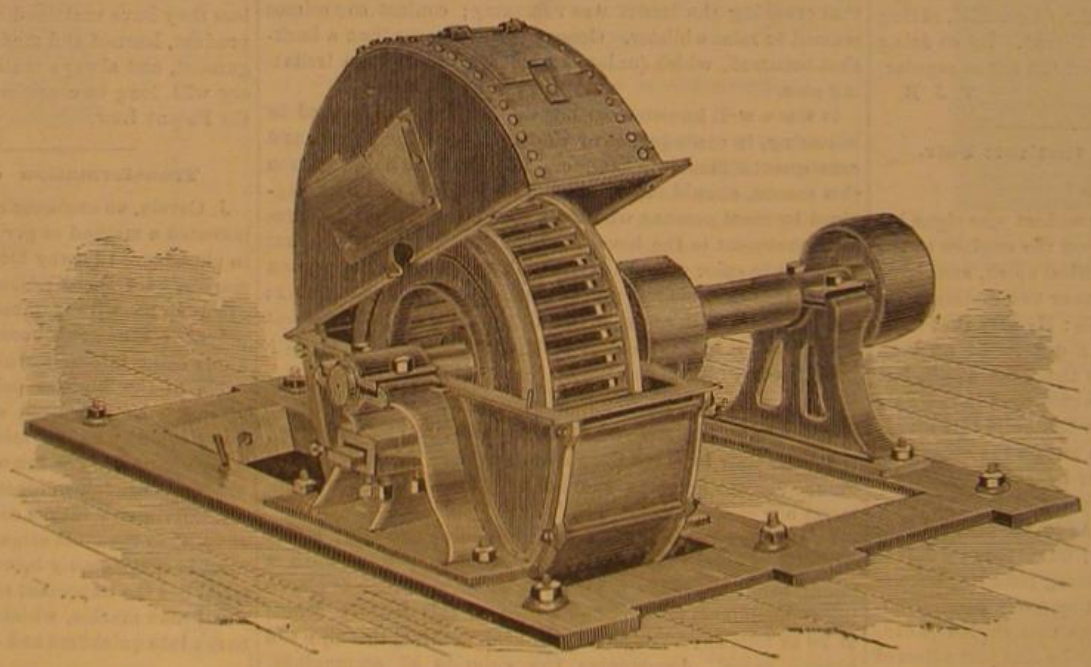
IMPROVED DISINTEGRATOR.

Among the industries based upon the utilization of waste products, that of grinding bones, in order to prepare them for use as fertilizers, is believed to be one of the most profitable. Immense quantities of material are obtainable in the neighborhood of cities, and especially in the cattle raising districts of the Southern and Western States, and this, we are informed, at a cost which, including the expense of transportation to almost any locality in the country, renders the erection of mills and machinery, for its preparation, no small inducement to investors.

The disintegrating mill, which we illustrate in the annexed engraving, is especially adapted to the treatment of bones as above mentioned, and also to the pulverization of a large variety of other substances. Among these may be noted Peruvian guano, alone and mixed with other materials; South Carolina phosphates, also either alone or mixed; and slaughterhouse tankage, bone ash, salt cake, carbonated soda, cracklings, coal, corn and cob, sugar, oyster shells, clay for fire and building brick, animal matter in almost all conditions, mortar, cement, and numerous others. The machine consists of several cylindrical cages, formed of round bars secured to disks and annular rings, one inside the other, and made to revolve in opposite directions, presenting, however, no scrubbing or grinding action. The materials to be disintegrated are received into the inner cage, and, by the rapid revolving of the cages, are projected through the latter by the creation of a powerful centrifugal force. The effect is to disintegrate the substances by a system of free blows from which no friction ensues.

The strength, durability, and capacity of this mill are very great. No skilled labor is required for its running, and the operations of sharpening or dressing are, of course, done away with. As ordinarily constructed the machine, it is claimed, will pulverize the hardest known ores. In bone grinding, where large pieces of wrought iron (that is, larger than ½ or ⅝ metal, pieces of which do no harm) are found in nearly every lot of bones, the disks of the mills to be used for the purpose are so reinforced that the entrance of a large fragment of iron can do no more damage than to break a few pins, and these last, owing to peculiar construction, may be quickly and readily replaced.

For grinding coal and pitch for coke and patent fuel making, the apparatus is also well suited. Many of the machines of three feet in diameter, and a few of four feet in similar dimensions, are, we understand, in successful use by brick makers in disintegrating wet, dry, or frozen clay. The stones found in the material are pulverized as thoroughly as the clay itself. Sand may also be mixed with the latter during the operation, or a small stream of water may be run into the mill for dampening the clay. We are informed by the manufacturers that the mill, three feet in diameter, will disintegrate clay sufficient for 3,500 bricks per day, and they report a very large sale of their machines, during the three years which have elapsed since their introduction. Parties ordering mills will be supplied with complete drawings for foundation and for the erection of mill and machinery. If speed of shaft, from which the machine is to be driven, is given, the size of pulleys and other useful particulars will be furnished. Manufactured under the patent of Mr. G. B. Davids, by Messrs. Denmead & Son, North and Monument streets, Baltimore, Md.



DAVIS' DISINTEGRATOR.

ONE of the latest discoveries in the excavations at Rome is a magnificent bust, in perfect condition, of the Empress Plotina, wife of Trajan.

Compressed Air as a Street Car Motor.

Some time ago, in discussing the question of a cheap and effective motive power, for street cars and for use under similar circumstances, where opportunities exist for replacing the stored-up force after its employment for a given time, we intimated the possibility of some mechanism being devised whereby, for the purpose, the power of a strong spring might be advantageously employed. The suggestion, like many others which have appeared in these columns, set one person, at least, thinking; the train of thought led to experimenting, and this, in the end, has culminated in the invention of a novel plan for the adaptation of the natural spring of compressed air to the impulsion of street railway cars.

We have recently inspected a working model of a vehicle provided with the new machinery, and have obtained from the inventor, Mr. Henry Bushnell, of New Haven, Conn., an outline of the proposed plan. The project will, in a measure, call to mind the fireless locomotive, inasmuch as it requires the use of relay stations at which the power expended, in making the intervening journeys, is restored by filling the reservoirs with new supplies of the motor. At these stations the air is compressed into strong receptacles (by means of machinery devised by the above named inventor, through which he is enabled to secure a pressure of over 2,000 pounds per square inch), and is drawn off as required into metal tubes 18 feet long by 8 inches in diameter, four of which are located under the flooring of every car. We are informed that a force, equal to two mechanical horse power, capable of driving the vehicle for three hours, is thus stored. From the tubes the air passes through a regulating device located at one end of the car, by which the pressure, transmitted to drive the engine located at the opposite extremity, may be adjusted as desired. In order to avoid the effects of the extreme cold due to the expansion of the air, the valves and cylinders of the engine are completely jacketed, and a pump is employed to compress air within the jacket to a pressure of some 75 pounds. The model exhibited ran quite rapidly over about 80 feet of track, and we were informed that it would readily ascend a grade of one foot in six. The invention has not yet been tested under actual practical conditions, so that its economical value remains, as yet, undetermined.

The Telegraph between Great Britain and Ireland.

Telegraphic communication with Ireland is maintained by means of four submarine cables, submerged between different points in Great Britain and the Irish coast. These cables contain in all twenty-two separate wires.

One of the largest cables—that between Holyhead and Dublin—has been laid since the post office acquired the control of the telegraphs, and all of them have been under repair during the same period. The rocky nature of the bottom along the Anglesea coast has, it appears, seriously affected the condition of the Holyhead and Dublin line, the newest of all the Irish cables; in many places the outer iron wires which form the chief protection of the core have been completely chafed through from constant friction. Quite a new feature has also developed itself in connection with this fault, namely, the eating away, by a kind of worm, of the gutta percha covering of the core, in much the same way as wood is bored and eaten away by these destructive insects. The post office can hardly be congratulated on the possession of these lines to Ireland, as they have been a constant source of trouble and expense ever since the transfer of the telegraphic system to the government.—*London Times.*

The Passivity of Iron.

M. de Régnon, in order to produce in a certain manner the somewhat capricious phenomena of passivity, uses rods of fencing foil or iron wire, the surface of which is protected for a certain length by a glass tube or a layer of mastic. The free extremity, to a length of 0·9 inch, is plunged entirely in the acid. The conclusions recently reached by the above means show that most of the causes which produce passivity in iron may be reduced to a voltaic force carrying the oxygen to the iron and polarizing it on the surface of the metal. Most of the causes which destroy the passivity of iron may be reduced either to a voltaic force of the contrary direction, or to a current, due to the polarization of the oxygen and by which it is exhausted: or, lastly, to an absorption of the polarized gas by a body that has avidity for oxygen.

These phenomena of passivity are believed to be more general than is now supposed. The acid employed in the experiments was nitric, marking 35° B.

THE ENGLISH CHANNEL STEAMERS.

We have already alluded to the oscillating saloon steamer, and some time ago we gave an illustration of her peculiar saloon, designed by Mr. Henry Bessemer to overcome the seasickness so prevalent in crossing the English Channel. She is now nearly ready for service, and is 350 feet long by 610 broad. She is fitted with two sets of paddle wheels, 106 feet apart, and is double ended. The saloon, suspended on pivots and controlled by hydraulic gear, is 70 feet long by 35 feet wide. Twenty miles an hour is expected of her but it is doubtful if she attains it. We hope to publish a view of the entire ship in a few weeks.

Mr. Bessemer's experimental vessel will, however, be tested by competition with a formidable rival, the Castalia, built on the largest scale and at great expense for the same traffic. This is a twin ship, propelled by paddle wheels placed between the connecting girders; and she is especially designed to sail without pitching or rolling in any sea, however rough. The engraving, reproduced from the London *Graphic*, gives the reader a clear idea of her appearance on the water and the extent of her accommodations. She is 296 feer long and 60 feet wide over all, each hull having a width of 17 feet; she is also double-ended, to avoid the necessity of turning in entering or leaving a harbor. Her cabins and saloons are handsomely appointed; and she was much commended as a successful sea boat in her preliminary voyage from the Thames, where she was built, to Dover, her intended point of departure for the continent. Thirteen knots an hour is to be her speed, according to the expectation of her designer (Captain Dicey) and the builders and engineers. By the latest advices she was waiting at Dover for a heavy sea to thoroughly test her capabilities. We shall shortly know the result of her further trial, and hear, we hope, of her success.

Launch of the Bessemer.

The Bessemer saloon steamer was recently launched from the yard of Earle's Shipbuilding and Engineering Company, Hull. According to the London *Times*, she has very much the appearance of a breastwork turret ship. She is shaped alike at bow and stern, and for 48 feet from each end she has a freeboard of about 3 feet only. Her total length at the water line is 350 feet, and the raised central portion, rising 8 feet above the low bow and stern, is 254 feet long, and extends the whole width of the vessel, 60 feet over all. The swinging saloon, 70 feet long, is in the center, and the engines and boilers which drive the two pair of paddlewheels are stowed in the hold at either end of the raised portion of the vessel.

The whole of the machinery is on board, and the after pair of engines is completely fitted. The nominal horse power is 750, working up to 4,600, sufficient, it is estimated, to drive the vessel 18 or 20 miles an hour. The two pairs of paddlewheels are placed 106 feet apart, and each wheel is 27 feet, 10 inches in diameter, and fitted with 12 feathering floats. The saloon is entered from two staircases leading to a landing, connected with the saloon by a flexible flooring. The saloon itself is upheld on its axis by four steel supports, one at each end, and two close together in the middle. The aftermost of the two central supports is hollow, and serves as a part of the powerful hydraulic machinery which will regulate the motions of the saloon. Without entering into a long technical explanation, it is enough to say that Mr. Bessemer has constructed some machinery which will cause the valves, the opening and shutting of which will adjust the saloon, to work automatically. The interior of the swinging saloon measures 70 feet long, 35 feet wide, and 20 feet high.

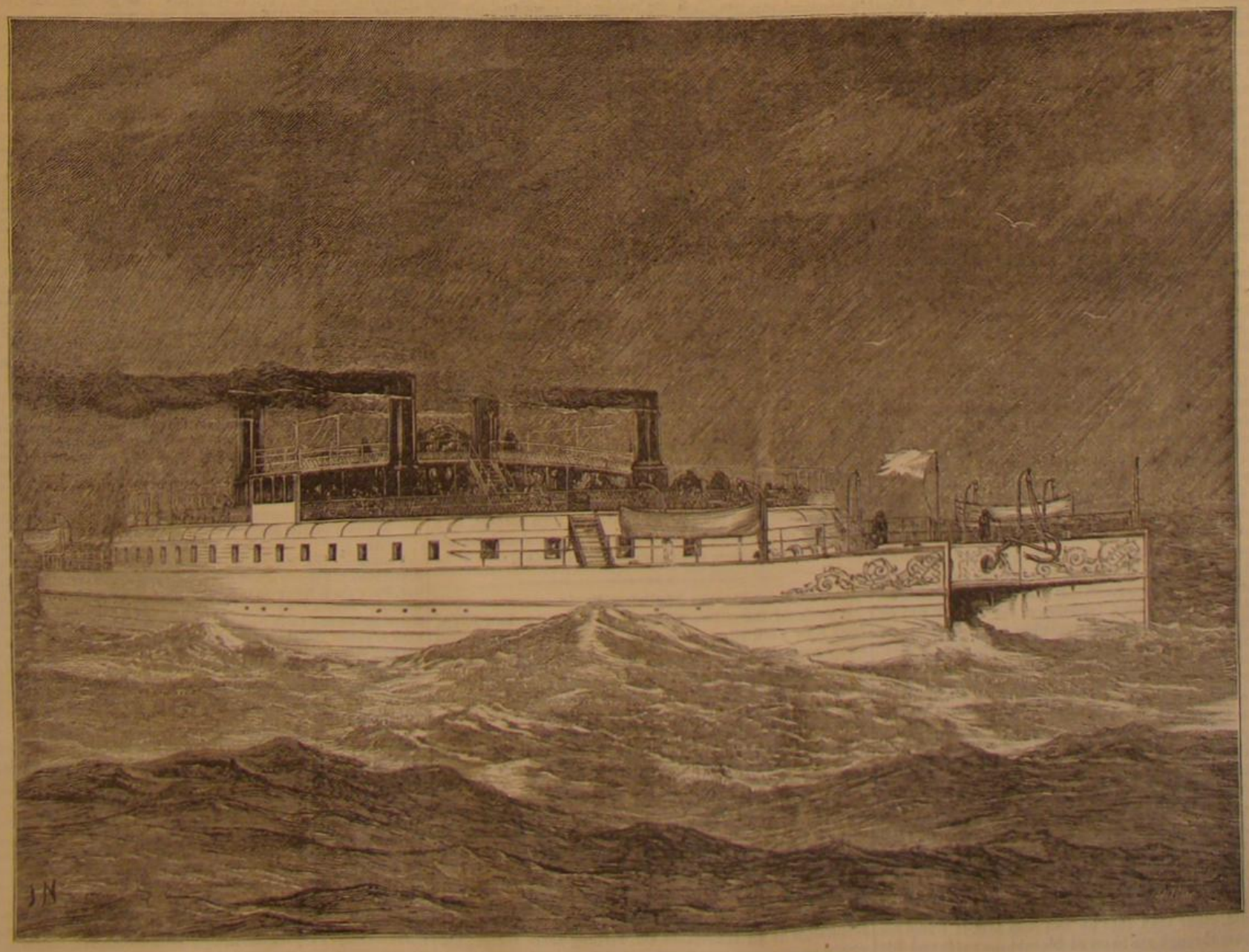
As to the question of the double set of paddlewheels and their effect upon the speed as compared with a single pair of wheels, Mr. Reed's view is as follows: When a ship is being propelled at a uniform speed by the exertion of a given constant power of engine, all that the engine does is to prevent the speed from decreasing, as it would do if the propelling power were removed. Were that power removed, the ship would not suddenly stop, but be gradually and slowly brought to rest by the resistances opposed by the water to her progress through it. In point of fact, therefore, in the case of a paddlewheel steamer at full speed, the ship herself carries the wheels rapidly past the surrounding water; and before the wheels can begin to propel at all, the engine must cause them to revolve with a corresponding velocity. If, for example, we take the case of a steamer going at a uniform speed of 14 knots an hour, with 36 revolutions of her engines, we may assume that 30 of those revolutions were required for enabling the wheels to overtake the ship, and that the remaining six only are useful for propulsion. These six revolutions no doubt impart a sternward velocity or race to the water of corresponding amount; and if another wheel has now to be brought into action in order to apply increased power, and has to be set to work in this race, it is obvious that it will require to be turned 36 times before it will begin to propel, and the few revolutions necessary for propulsion must be added to this number. The difference between the two wheels will therefore simply be that the sternward wheel will require to revolve a few revolutions more than the other before it begins to propel, but after that the two will be upon equal terms, excepting as regards any losses from friction, etc., due to the extra speed of revolution. This is Mr. Reed's view, and, if he be correct, the speed realized by the Bessemer will probably prove at least equal to that of the fastest paddle steamers in the world; although, at the same time, the designer considers the very light draft and great beam of the ship, and the extra weights which have been found necessary in connection with the saloon and its machine beyond what he was called upon to design for, will in some degree detract from the speed which has been predicted by the admirers of the vessel.

THE EARLY HISTORY OF WHEELED VEHICLES AND RAILWAYS.

NUMBER 2.

"Men of genius have a hard time, I perceive; and must expect contradictions next to unendurable—the plurality of blockheads being so extreme!"—CARLYLE

The struggle, however, between the friends and enemies of improvement was by no means over. One hundred and fifty years after John Crasset wrote his "reasons," a new motive power, which was to produce an unprecedented revolution in human affairs, to enable immense navies to advance in the face of wind and tide, and vast armies to traverse under lofty mountains and across deep rivers at a pace which far outstrips the fleetest race horse, made its appearance, and the conflict was again renewed with increased vigor. In truth, the opposition made to the railroad in its early years stands peculiarly alone. On the one side was a little band of merchants and manufacturers headed by George Stephenson the self-educated "Killingworth brakesman." On the other hand were the rich monopolies whose interests were about to be affected by the railway: the coach companies now about to be ruined, the canal companies about to avenge on the railroad the opposition they had experienced in time past; the nobility, the preservers of game, the celebrated engineers and famous doctors, the landed gentry, the small farmers, the public press "backed by the opinion of the nation," every profession from the clergy to the engineer, every trade, every rank of society from the peer to the Northumbrian miner, was bitterly hostile to the steam railway. Against this array of public-spirited obstructives ready to choke the new invention at its birth on the ground of the public good, it struggled hard to gain a footing, scarcely daring to lift itself into notice for fear of ridicule. The civil engineers to a man rejected the idea of a "locomotive railway." The idea of traveling at a rate of speed double that of a stage coach was too preposterous for any engineer to risk his reputation by supporting it. Such a thing, they said, "did not fall within their general experience." Mr. Nicholas Wood, C. E., of London, in 1825, speaking of the powers of the locomotive, remarks: "It is not my wish to promulgate to the world that the ridiculous expectations, or rather professions, of the enthusiastic speculator will be realized, and that we shall see engines traveling at the rate of twelve, sixteen, eighteen, or twenty miles an hour. Nothing could do more harm towards their general adoption and improvement than the promulgation of such nonsense." "What," says a writer in the *Quarterly Review* for March 1825, "can be more palpably absurd and ridi-



CAPTAIN DICEY'S TWIN STEAMER CASTALIA.

culous than the prospect held out, of locomotives traveling twice as fast as stage coaches! We will back old Father Thames against the Woolwich railway for any sum." No engine, it was claimed, could be made to move when attached to a heavy load. "The wheels will but slip round on the rails"; besides, even admitting that the engine would move, "no railroad could be so constructed as to bear the weight of forty tuns running at the rate of twelve miles an hour; because the more rapidly a body moves the greater the momentum generated, and no railroad could stand this increase of momentum." Moreover, it was vehemently asserted that the engine running at twelve miles an hour could never be made to "run round curves"; either the curved rail would bend straight, or the machine leap the track.

When engineers, high in their profession, whose experience had been large and whose opinions on such matters was held to be of great moment, advanced such ruinous views, with nothing to refute them but the evidence of a self-educated mechanic of Northumberland, it is not surprising that men of other professions began to find objections based on their own professional learning. Sanitary objections were now urged against railways; and many wise doctors (never to be outdone at such a time) strongly inveighed against tunnels. Sir Anthony Carlisle insisted that "tunnels would expose healthy people to colds, catarrhs, and consumption", and others believed the noise would be injurious to hearing. But worst of all was the "destruction of atmospheric air", as Dr. Lardner termed it. This learned gentleman made elaborate calculations to prove that the provision of ventilating shafts would be altogether insufficient to prevent the dangers arising from the combustion of coke, producing carbonic acid gas, which was fatal to life. There was not, however, the same unanimity among the doctors as among the engineers. Indeed, the proverbial disagreement of the doctors was, in this case, productive of much good. Solemn documents in the form of certificates, signed by many of the most distinguished physicians of the day, attesting the perfect wholesomeness of tunnels, were prepared and published. There were not wanting some, however, who, in default of reasons of their own, carried the statements made by others to the last extreme, and asserted that the air along the routes of the railroads would become unhealthy, that birds would drop dead as they flew over the locomotive in consequence of the CO_2 discharged; and that the noise would cause cows to cease giving milk and women to miscarry!

Nor did the clergy and country gentlemen fail in this extreme. So violent was the antagonism of many patient and long-suffering men "of the cloth" to even a survey being made on their grounds, that the expedient was resorted to of performing this piece of work while the clerical gentlemen were in their pulpits.

By far the most persistent opposition, however, was undoubtedly that met with among those classes whose pleasures or interests were directly interfered with, or whose prejudices had been aroused through ignorance and false representations. For the opposition resulting from this latter cause, the press must to a great extent be held responsible. Thus in 1825, when the Liverpool and Manchester Company were preparing to introduce their bill to Parliament, the Leeds, Liverpool, and Birmingham canal companies appealed to the public to oppose the measure, and a Birmingham paper invited all to resist it to the last; and subscriptions were taken up to render this opposition more effectual. The farmer was told that his cows would be prevented from grazing and his hens from laying; that his sheep would no longer fatten, his horses would start and shy when at the plough, his houses and barns would be burned to ashes by the fire thrown from the engine chimney, and the air polluted by dense clouds of smoke; his hay and oats, usually so saleable, would rot in his fields and granary, his agricultural communications be destroyed, his lands thrown out of cultivation, and himself reduced to beggary. There would no longer be any use for his horses, and the breed, nay the very species, would soon become extinct! The poor rates would be largely increased in consequence of the number of laborers thrown out of employment. Every calling was to be utterly ruined. Hundreds of excellent inns would fall into decay; and in a short time, not a solitary house of this description would be found within the four kingdoms; posting towns would become depopulated, turnpike roads deserted, and the institution of the English stage coach destroyed for ever. The noble sport of the chase, the love of which was born in every true Englishman, must be ended for all time in order that a few merchants and cotton spinners might build railroads, and send their engines screaming through the heart of the fox covers and game preserves. It was another deplorable illustration of the leveling tendency of the age. It put an end to that gradation of rank in traveling which was one of the few things left to distinguish a nobleman from a Manchester bagman. There was, however, one consolation left; none but fools would trust their persons to the conduct of explosive machines like the locomotive, and the canals would beat them after all.

It may well be believed that such a doleful picture of evils as this was not without its effect on those most interested. In the large towns, meetings were held denouncing the railway system as a delusion, similar to the many other absurd projects of that madly speculative period, when balloon companies proposed to work passenger traffic through the air at forty miles an hour, and road companies projected carriages to run on turnpikes at twelve miles an hour, with relays of bottled gas for horses. In the country, however, where not one man in five hundred knew anything about the railroad, other than that he had been told it would assuredly pass through the heart of his cabbage patch and his bean field, the fury of the opposition lead to blows. When Mr. Stephenson was making the preliminary surveys for the projected Liverpool and Manchester railroad, many of the nobility stoutly refused him permission to enter their lands. At Knowsley, Mr. Stephenson was driven back by the keeper and threatened with rough handling if found there again; Lord Derby's farmers turned out all their men to watch the surveyors; guns were discharged over the property of then Duke of Bridgwater, and men armed with pitchforks, were stationed at the gates; while at St. Helen's, as a chainman was clambering over a gate, a laborer ran at him with a pitchfork and thrust the prongs through his clothes into his back; others of his party coming to his assistance, the laborers, who had now gathered in force, poured in a volley of stones and finally completely demolished the harmless theodolite. Finally, in order to protect both his surveyors and his instrument, Mr. Stephenson was forced to make his surveys at night with the aid of dark lanterns, and to employ a "noted bruiser" to carry the theodolite.

Forty-nine years have passed since George Stephenson finished his first railroad, and all doubts of the merits of this great invention were set at rest forever. Fifty years ago it was the dream of a mechanic; today it is a great, almost the greatest, achievement of human ingenuity and human skill, the great civilizing agent of the nineteenth century, increasing the means of public intercourse, removing national and provincial antipathies and binding together all the branches of the world family.

Never did so marvelous an invention pass through more vicissitudes, or struggle up through more bitter opposition to a more glorious triumph never was courage tried by more reverses and disappointments that was George Stephenson's; yet that background of disaster only sets in brighter relief the spirit that bore up under all, the faith that never gave way, and the patience that never was weary.

Premium for Fireproof Construction.

The Merchants', Farmers', and Mechanics' Savings Bank, of Chicago, Ill., offers a premium of $1,000 for the best plan for two fireproof buildings, subject to conditions, among which are the following:

"One building shall be a dwelling house of not less than 18 feet front, with 5 rooms, and shall contain not less than 5,500 cubic feet; of which a complete building as per plans must be erected, at expense of the bank, by the successful competitor; also a building of not less than four rooms for dwelling, with store on ground floor, of a cubic capacity of not less than 30,000 cubic feet, subject to the same requirements as the foregoing. The successful competitor will be required to erect, at prices specified in his plans, one or fifty buildings, at the option of the bank, anywhere within the corporate limits of Chicago. The model erected by the successful competitor shall undergo a thorough test as to its fireproof qualities, and also as to the action of water upon the material when heated. All damages resulting from such test will be at the expense of the successful competitor.

The main purpose of this offer is to secure an approximately fireproof cottage; but other things being equal, preference will be given to the best arranged building in the matter of symmetry, convenience, ventilation, heating, and drainage, and which, as the purpose is mainly for the benefit of employees, falls in price not above $1,000 when ready for occupancy."

The competition will be open till January 1, 1875. We are curious to know if the bank really expects to have all the specified conditions filled, for one thousand dollars. Guess not, gentlemen.

A Question for American Steel Manufacturers.

The ordnance bureaux of both the war and navy departments have just ordered from Mr. B. B. Hotchkiss, the inventor of the well known rifle projectiles and of the revolving cannon not long since illustrated in these columns, two of his new breech-loading metallic cartridge steel field guns, with equipments complete, the same to be exported from Europe. The trials of these weapons, we understand, are to be held in April next. Mr. Hotchkiss informs us that he cannot obtain steel blocks, large enough for the manufacture of his guns, from any foundery in this country, and that therefore he is compelled to have resort to foreign productions. It strikes us that the necessity existing, of making arms for service of the nation outside our own borders, is a condition of affairs to which American steel manufacturers may profitably devote their serious consideration.

Recent Walking Feats.

A walk of thirty-two miles, in seven and a half hours, from New York city to Bronxville, N. Y., and return, was lately performed by James A. Crozier. The wager was $250, and eight hours time was allowed.

E. P. Weston lately completed in this city his third attempt to walk 500 miles in six days. On the second day, after about 200 miles had been walked, one foot was attacked with erysipelas, and he had to rest for a day for treatment. At the end of the six days he had walked 346 miles.

THE New York *Christian Intelligencer* says: Among all our exchanges, none is valued more highly than the SCIENTIFIC AMERICAN. We never open its pages without finding something useful, instructive, or entertaining to reward us for so doing. It is a most valuable educator to youth; while to those who have a practical advanced knowledge of matters relating to art, science, mechanics, chemistry, and manufactures, it is an invaluable aid, keeping them thoroughly posted on whatsoever is doing, or has been accomplished, in those important branches.

Invisible Ink.

If we write with a very dilute solution of chloride of copper, which has scarcely more color than pure water, the characters are invisible; but if gently heated, they become distinctly yellow, and are easily read. Let the paper cool, and they vanish; and they may be made to appear and disappear an indefinite number of times. If heated too strongly, the compound is decomposed, and the writing becomes permanently brown from the deposition of the copper. The chloride of copper may be conveniently made by mixing solutions of ammonic chloride (sal ammoniac) and of cupric sulphate (blue vitriol).

The change of color in this and kindred cases is due to the removal of the water of crystalization by the heat. In chemical combination with the water, the salt is transparent; without the water, it is opaque. The salt, being very deliquescent, rapidly absorbs moisture from the air when cool.—*Boston Journal of Chemistry.*

DECISIONS OF THE COURTS.

Supreme Court of the United States.

THE GREAT CORN PLANTER PATENTS.—GEORGE W. BROWN, APPELLANT, *vs.* RUFUS R. GUILD, EXECUTORS, ETC.; AND GEORGE W. BROWN, APPELLANT, *vs.* JAMES SELBY *et al.*

[Appeal from the Circuit Court of the United States for the Northern District of Illinois.—October Term, 1873.]

Bradley, Judge:

These cases arise upon separate bills in equity filed in the court below by the appellant against George J. Bergen and Frederick P. Sisson, in the one case, and James Selby and others in the other case, charging them, respectively, with infringement of certain letters patent granted to the complainant for improvements in corn-planting machines, being reissues of previous patents, and praying for an account of profits, for injunctions, and for general relief. The defendant in the first named case filed an answer, and two amended answers, setting up, in general, that the complainant was not the original and first inventor of the improvements patented to him, but that the same were previously known and used by various other persons named in the answers; and that the reissued patents of complainant were fraudulently obtained; and they denied that they infringed the complainant's patents. The pleadings in the other case were substantially the same. Much testimony having been taken, the causes were heard together before the Circuit Court, and the complainant's bills were severally dismissed. These appeals are from those decrees. * The principal question in these causes is, whether the appellant was the original and first inventor of the improvements claimed by and patented to him, or whether he was anticipated therein by other persons named in the answers of the defendants.

As set forth in the bill, the first patent obtained by the complainant for one portion of his alleged invention and improvement was granted to him on the 2d day of August, but antedated the 2d day of February, 1853. This patent was surrendered on the 16th day of February, 1858, and a new patent was issued in lieu thereof, upon a corrected specification. This reissued patent was also surrendered on the 11th day of September, 1860, and in lieu thereof five new patents were issued upon five several corrected specifications, which new patents were numbered, respectively, reissues 1,036, 1,037, 1,038, 1,039, 1,040, each one being for a distinct and separate part of the original invention alleged to have been made by the complainant.

On the 8th day of May, 1855, a patent was granted to the complainant for certain improvements on his corn planter, which patent was, on the 10th day of November, 1857, surrendered, and a new patent was issued in lieu thereof on a corrected specification. This last patent was also surrendered on the 11th day of December, 1860, and five new patents were issued in lieu thereof on five amended specifications, each being for a distinct and separate part of the improvements intended to be secured by the patent of 1855. The last-mentioned patents were respectively numbered reissues 1,091, 1,092, 1,093, 1,094, and 1,095. Copies of all the reissued patents of both series were annexed to the bill. Upon the taking of proofs in the cause copies of the two original patents, and of the first reissues thereof, as well as the reissued patents on which the bill was founded, were put in evidence, together with full detailed drawings and models of the complainant's original and improved machines.

The defendants, in their answer, and the several amendments thereof, referred to many machines, patents, and applications for patents which, as they alleged, embodied all the improvements of the complainant's machine, and antedated the same.

The Supreme Court reverses the decrees of the Circuit Court and declares that the Brown patents are valid and the defendants infringers. The following points were held by the Court:

If an alleged prior invention was only an experiment, never perfected, but abandoned, it cannot prejudice a patent for a similar improvement obtained by a subsequent inventor.

An application for a patent which stands rejected will not, in such a case, avoid the subsequent patent.

The question of fraud in obtaining a reissue must be regarded as settled by the Commissioner of Patents in granting it.

An inventor cannot claim such parts of a machine as another had previously devised, and which worked well after the machine was perfected, although this was not until after the other had perfected his.

But he may claim them in a new combination of them with devices of his own which result in a useful machine.

If a patent describes the invention as embodied in a cheap and rude form, this will not relieve those who construct the machine with more expensive fixtures from the charge of infringement, however useful they may be.

The summary of the patentee's claim, usually annexed to the specification, admits that all that is not included is old, and it is a sufficient compliance with the law requiring the new to be distinguished from the old.

A claim for "mounting the attendant upon a seed-planting machine in in such a position that he can see the marks made on the ground and operate the dropping of the seed accordingly" is void as a claim for a result irrespective of the means of accomplishing it. But if qualified by the words "substantially as herein set forth," and the means are described in the specification, it is no longer open to the objection.

A patent is void which claims substantially the same thing which is claimed by the same party in a prior patent.

A peg or stop, to prevent the rear part of a machine from tipping so far as to bump the driver on the ground, is too frivolous a device to be regarded as an invention, and a patent for it is void.

NEW BOOKS AND PUBLICATIONS.

THE TRANSIT OF VENUS. By George Forbes, B. A., Professor of Natural Philosophy in the Andersonian University, Glasgow. With Numerous Illustrations. New York: Macmillan & Co., 21 Astor Place.

This work gives a most lucid explanation of the expected observations of the transit, pregnant as it is with results of the highest importance to physical science. The particulars of the various parties of observation and the engravings of the instruments, many of which latter are especially designed for this occasion, are replete with interest, and will repay the student, as well as the general reader, for a careful perusal.

A FOURTH CATALOGUE OF DOUBLE STARS, giving Forty-Seven Double Stars Newly Discovered by S. W. Burnham.

In December, 1873, Mr. Burnham published his third catalogue of the double stars, and shortly afterwards followed up with the present publication, first given to the public in the June issue of the Royal Astronomical Society's "Notices." Mr. Burnham's observations were, in all but one instance, made with a 6 inch Clark reflector, the exception being *tau Orionis*, a star so distant that the 18½ inch refractor of the Dearborn Observatory was necessary to reveal its duplicity.

THE AMERICAN EDUCATIONAL ANNUAL, a Cyclopædia or Reference Book for all Matters Pertaining to Education. Volume I., 1875. New York: J. W. Schermerhorn, 14 Bond street.

A valuable book of statistics, carefully compiled and well arranged.

Inventions Patented in England by Americans.

[Compiled from the Commissioners of Patents' Journal.]

From September 18 to September 28, 1874, inclusive.

ANVIL BED.—A. Hitchcock, New York city.

ELECTRIC ALARM.—A. S. Howe, Utica, N. Y.

HEATING FEED WATER, ETC.—R. Berryman (of Hartford, Conn.), Newcastle-on-Tyne, England.

HORSESHOE.—R. F. Cooke, New York city.

KNITTING MACHINE.—J. Bradley, Lowell, Mass.

MAKING ASPHALTUM MASTIC.—R. Skinner, San Francisco, Cal.

MAKING GAS.—F. H. Eichbaum, Detroit, Mich.

ORDNANCE, ETC.—R. R. Moffatt (of Brooklyn, N.Y.), Liverpool, England.

REVERBERATORY FURNACE.—E. Heiligendorfer, Eureka, Nev.

TELEGRAPH.—M. Gally, Rochester, N.Y.

TILTING COAL WAGONS, ETC.—J. W. Upsan, Tallmadge, Ohio.

WEAVING FRINGE HEADINGS.—J. T. O'Brien *et al.*, Brooklyn, N.Y.

Recent American and Foreign Patents.

Improved Tobacco Press.

James M. Gaston, New Albany, Ind.—This invention consists of the molds and follower for pressing tobacco into plugs, arranged between upper and lower rollways, slightly converging, and provided with means for forcing the mold and follower along, and wedging them powerfully together between said rollways. There are cross partitions between the ends of the molds, contrived to recede before the ribs of the follower and thus allow said ribs to extend the whole length of the group of molds whereby the necessity of fitting the ribs accurately to the molds, which would otherwise exist, is obviated; and moreover it allows of shifting the molds for making plugs of different lengths, and employing the same ribs with molds of any length. A contrivance of the end partitions is added for removing them and the mold bottoms and sides, for changing them to any required length. The inventor has furnished us the figures in deta of the capacity of his machine for making plug tobacco, of various sizes' in one day. We have not room for his statements; but if they are accurate (which we do not doubt), his invention is very important to the tobacco manufacturers. We shall probably publish engravings of the press, with detailed descriptions, in a few weeks.

Improved Fire Arm.

James B. Thomas, Montgomery, O.—This invention consists in attaching to fire arms of any size or kind a measuring instrument by which the exact distance of an object may be quickly and accurately obtained, the army officer or the sportsman being thus enabled to make the precise allowance for the rise or fall of projectile that characterizes his fire arm at varying distances. The surveyor or backwoodsman can also thus conveniently carry on his shoulder his means of defence and a perfect instrument for measuring regularly shaped sections of land.

Improved Car Pusher.

Edward Little, Alva S. Bailey, and Frederic L. Clarke, Paxton, Ill., assignors to Edward Little and Alva S. Bailey.—This is an improvement on the car pusher for which a patent has been granted to Alva S. Bailey, under date of June 3, 1873, so that the car sill may be held firmly, without possibility of detachment, during the forward motion of the car, while the clutch part gripes firmly the rail and slides readily along the same with the motion of the car. The invention consists, first, in providing the upper end of the slide beam with a pivoted sill clamp, which is readily adjusted to every thickness of car sills; and, secondly, in an improved spring rai clutch applied to the lower end of the main beam.

Improved Fertilizer Distributer and Seed Planter.

Mark Cooper, Greenville C. H., S. C.—This is an improved machine so constructed as to open a deep furrow, grind and distribute a fertilizer in said furrow, and cover it with soil. It also opens a shallower furrow above the fertilizer, distributes the seed in the furrow, and again covers it with soil.

Improved Miter Box.

Edwin Knock, Vermont, Ill.—This invention relates to boxes for guiding the saw in sawing miters and other angles in doing woodwork of various kinds. An adjustable plate is moved toward or from a main plate by suitable mechanism, according to the width of the piece to be sawn, and may be adjusted to saw at any angle from a right angle to almost any other desired.

Improved Iron Ship Builder's and Boiler Maker's Gage.

James McPhail, Ellis, Kan.—Two guide rods have a gage head sliding on them, fastened by means of a plate and hinged clamp. A slotted hole gage is held on the rods, having a fixed hole and a slide plate also with a hole. The holes may with it be adjusted to any desired distance from each other. The boiler plate is secured against the previously adjusted guide, so as to bring the lap edge in position to have the location of holes determined by the hole gage. The movable plate is moved to or from the gage hole, and the whole instrument is then moved along the lap edge until the hole in said plate comes where the gage hole had been, and thus the places for hole after hole are indicated at uniform intervals.

Improved Pile Cutter.

Isaac E. White, Brooklyn, N. Y.—In this invention, the saw frame is made independently adjustable in a shifting frame, so as to permit the adjustment of the saw shaft or of the frame, or of both.

Improved Track Clearer.

Thomas C. Churchman, Sacramento, Cal.—A scraper raises the snow from directly over the rails and delivers it to a vertical rotary cylinder, whereon are fixed strong spiral flanges, which, being turned from the center of the machine outward, beat the snow off at the sides, and at the same time screw it upward, so as to pack it into the sides of the cut when the snow is as deep as the hight of the cylinders, or throw it to the top when not so high. The cylinders are hollow, perforated in the shell, and have a steam pipe entering the interior chamber through the top journal, for delivering steam to heat them. Below the scraper is a perforated pipe receiving steam from the boiler through conducting pipes, to heat the scraper for softening the snow.

Improved Fare Box.

Cassius M. Cooledge, Rochester, N. Y.—This box is designed to be carried by the collector to the passengers, who are to deposit the exact fare therein. Glass in the side and top enables the collector to see that the passenger deposits the proper amount. The money is placed upon a wing through an opening and slides to a lower compartment, being allowed to do so by the conductor turning a handle and so moving the partition. By the same operation a bell is caused to ring.

Improved Potato Digger.

Paul Dennis, Schuylerville, N. Y., assignor to himself and David Craw, same place.—The plow is placed in a diagonal position, and its ends are inclined so as to be parallel with the length of the machine. The rear end of the plow is provided with a guard, to prevent the potatoes and soil from passing off at the same end, and the forward end also has a guard for the same purpose. The lower side of the plow is made nearly flat, and in its rear part is a longitudinal T groove, in which works a bar, to which are attached fingers. The throw of this shaker bar is to be adjusted as the condition of the soil may require. A lever, operated by the driver from his seat, operates a shaft to which is attached two cams, which, when the free end of the lever is moved to the rearward, press down upon the axle, and thus raise the frame and its attachments, throwing the machine out of gear. To the shaft is also attached a hook, which, when the free end of the lever is moved forward to allow the frame and its attachments to move downward to throw the machine into gear, will pass around and beneath the axle, and lock the frame in place.

Improved Adjustable Pitch Board.

Joseph Noll, Poughkeepsie, N. Y.—This pitch board is made of metal, with sliding and slatted sides. It is arranged in such a manner that the pitch and width of tread may be adjusted along the slatted sides of a rectangular corner piece, and set rigidly, by suitable clamping screws and connecting pieces, to be readily used on either side.

Improved Lawn Mower.

Alvah P. Osborn, Seneca Falls, N. Y., assignor to Eugene A. Rumsey, same place.—The stationary cutter or cutter bar is provided with curved and projecting guards that prevent the grass from getting beyond the ends of the knives before it is cut. In order conveniently to adjust the cutter with respect to the rotary knives, it is pivoted to the head, and fastened at the upper end of the guard by a screw bolt and nut.

Improved Car Coupling.

George D. Burton, New Ipswich, N. H.—There is a socketed buffer and a solid headed one for entering the socket. The former is bell-mouthed, so that the latter will enter readily for self-coupling; and it has vertical shoulders just inside of the mouth for locking the solid buffer after entering the socket by means of notched pawls which are pivoted to side recesses just behind the head. The forward ends enter freely, and have springs to push them out as soon as the notches pass the shoulders. To unfasten the pawls, they are connected by a cord with a shaft extending up to the platform or to the top of the car, and arranged to turn for winding the cords on and off.

Improved Revolving Harrow.

Henry N. Dalton, Pacheco, Cal.—Mechanism is provided which causes the rollers to revolve uniformly; and as the harrow is drawn forward, one roller will be revolved by the revolution of the other roller, so that they will stir the soil evenly. Levers enable the harrow to be adjusted to work at any desired depth in the ground, or to be raised away from the ground for convenience in passing from place to place.

Improved Mechanism for Propelling and Steering Boats.

Andrew J. Emmons, New York city.—This invention consists of a vertically adjustable cylindrical compartment at the stern of the boat, which is rotated by a lever or tiller, and provided with a steam cylinder for rotating the screw shaft, supported in bearings connected to the compartment. The lever may be geared in any suitable manner, and the boat jointly propelled and steered by means of the screw. For entering locks or for other purposes the compartment may be turned under a full right angle from its exact position, and thereby the screw carried to one side, being protected against injury in this position.

Improved Current Wheel.

Michael McCarty, Pueblo, Col. Ter.—This invention consists of a current wheel arranged at the outside of a float which is arranged in a slip in the river bank, or between two piers at right angles to the current, so that it can be floated out to extend the wheel into the current, and back to withdraw it therefrom, for stopping and starting the wheel, and regulating it to the force of the current. A full description and illustration will be found on page 223 of the current volume of this journal.

Improved Aerial Propeller Wheel.

Lewis A. Boswell, Talladega, Ala.—This is an aerial propeller wheel in which the fans are mounted horizontally on a hub of a vertical axis, so as to revolve on their own axes independently of each other. An arm moves against a stationary cam and turns the vanes edgewise to the wind at the time of beginning the return movement, so as to offer little or no resistance while going backward, and a spring and chain are combined with each vane arm in such manner as to turn the vane back so as to take the wind when the vane begins the forward movement, at the moment the arm escapes from the cam.

Improved Machine for Welding Together Sections of Tubing.

James Sadler, New York city.—This machine is for welding boiler tubes when they are to be repaired by attaching pieces of tubes to their ends. It consists of two short cylinders on the ends of two rotating shafts. The tube is welded between the said rotating cylinders. The upper cylinder is made adjustable and governed by a pressure lever and spring attached to an adjustable bracket.

Improved Seed and Fertilizer Sower.

James Codville, Woodstock, Can.—The invention consists of a hopper conveying the seed to the sliding seed-dropping bar, to which motion is imparted by the supporting wheels, intermitting pinion, and crank rod, jointly with pivoted weighted elbow pipes. Said sliding seed bar has feed cups for regulating the quantity of seed, and feeding it to the swinging elbow pipes thereon for distributing the seed or fertilizers broadcast over the ground.

Improved Car Coupling.

Howard Daniels, Morley, Mich.—This invention consists of a rest for the lower end of the coupling pin in advance of its hole in the drawhead, a little shoulder in front of the hole, and a spring rest on the front of the car above the drawhead. The whole is so arranged that the pin, being set on the rest for the foot and leaning against the spring rest, will be thrown into the hole to fall and secure the coupling link self-actingly as soon as the buffer is pushed back against the spring under the car by contact with the car to be coupled.

Improved Lubricator.

Joseph W. Reed and Martin V. Osborn, Kalamazoo, Mich.—This invention relates to providing air openings in connection with a discharge pipe and regulating cock or plug; and also to a non-heat-conducting substance interposed between the case or cylinder and its lining. When the plug has been turned for lubricating, the oil descends into the cylinder by its own gravity as the plug is turned to open the ports and bring the air passages to register with each other to admit air to the cavity.

Improved Heating Stove.

Anna Wheeler, Brownville, Neb.—There are two hot air chambers on opposite sides of the fire chamber, from which the hot air is led away for heating different rooms. The air enters these chambers from heaters or flues located on the sides, and, to some extent, over the fire, so as to make very direct application, and through pipes, partly at the sides and partly under the fire. The chambers are divided horizontally by a partition, and the air from the lower portions, which are more exposed to the heat than the upper portions, is allowed to pass directly into other chambers through openings. There are two sets of pipes, each receiving the air from one heater, and conducting it down and through the fire chamber to the hot air chamber of the opposite side. The partitions separating the chambers have a hole with a damper, to be opened or closed at will, to pass the hot air from one to the other, as may be required in different cases; and the escape passages have dampers to regulate the escape of heated air, whereby it can be directed into conducting pipes.

Improved Water Wheel.

Abisha B. Reniff, Bingham's Mills, N. Y.—In this turbine wheel, the water is admitted through a horizontal annular stationary chute rim to a horizontal annular bucket rim of the wheel. The buckets are arranged radially to the axis of the wheel between two circular plates which converge from the top downward a third, or a little more, of the width, and then continue parallel to each other to the bottom, either with or without converging side plates to the chutes. The buckets incline forward about one third of their length, and backward the rest of their length in straight lines.

Improved Toy Dart.

Edwin B. Morgan, Paterson, N. J.—This is a dart to be thrown by a spring connected to the handle by an elastic cord, which serves both for the said spring for throwing the dart and for a recoil spring to return it to the operator, and thus to save running for the dart each time it is thrown. The object is to provide an entertaining toy for children.

Improved Car Axle and Bearing.

John Baille, Milwaukee, Wis.—This invention has for its object to improve the construction of the axles and bearings of cars, locomotives, and other vehicles in such a way as to prevent lateral motion in said vehicles, and the consequent end friction and wear of said axles and bearings. The invention consists in the combination of two parts, one an axle arm having a peripheral concavity formed longitudinally upon the arc of a circle, and the other a bearing block, the under side or wearing surface of which is longitudinally convex correspondingly.

Improved Portable Screen.

Henry L. Leach, New York city.—This invention consists of a box frame placed on wheels, which is provided with an inclined adjustable screen, and with hinged and detachable doors at the rear end for getting at the dust, and emptying the same, as required. An illustrated description of this device will shortly appear in our editorial columns.

Improved Pruning Hook.

Edward E. Stedman, Ravenna, Ohio.—The blades are made of a single piece of steel, which is bent in the center at right angles for the space of one inch, to allow it to be attached to the end of the handle. The two cutting edges face each other, thus allowing the pruning hook to be worked up or down, or by pushing or pulling. The blades are parallel to the staff or handle, but in different planes, and have a curved edge. This arrangement adapts the implement for use in such a manner as to often prevent slipping at the commencement of a downward cut.

Improved Letter Box.

William D. Dana, Phœnix, assignor to Wells M. Peck, same place.—This invention consists of the application of a signal bell to a drop letter box, together with contrivances by which the cover of the orifice through which the letters are dropped into the box will be made to cause the bell to strike when the cover is moved to open the orifice for dropping the letters in, and thus give notice of the arrival of the mail.

Improved Device for Turning Locomotive Crank Pins.

Andrew J. Schindler, Hornellsville, N. Y.—This is a tool carrier, called a quartering tool, mounted on a boring bar, which is arranged in such relation to the center of a lathe for turning and boring locomotive wheels that, when the wheel is centered in the lathe, the quartering tool will, by being revolved and fed along by the boring bar, turn off the crank pin exactly parallel with the axis of the wheel. This is done whether the wheel itself be true or not.

Improved Combined Desk, Seat, and Table.

David Francis, Birkenhead, England.—In constructing this article of furniture to serve several uses, the standards are made of wrought iron welded and riveted together. A bar of extra strength is inserted in the upright portion of the back, to give greater strength, and to form a knuckle, to which a movable top is hinged. The movable top is furnished with plates formed in L iron, with ratchet and tongue, the latter riveted on. Plates are secured to the top by four strong iron screws, and to the standards by a bolt running through the said knuckle, a longitudinal slot being provided at the end of the tongue. The bolt has a head at one end and is secure at the other by means of a split pin, with ends turned round the bolt. By means of the longitudinal slot at the end of the tongue, the top can be moved to any angle, and secured in position by means of the teeth and ratchet. The seat is secured to each standard by flat round-headed bolts and nuts. To make the desk and seat more rigid, and freer from rocking, stays are fixed to the under side of the seat, and secured to the standard by bolt and nut, and to the seat by bolt and nut and strong iron screws.

Improved Ticket Clasp.

Hermann Lücke and Philipp Brümmer, Worcester, Mass.—The clamp is formed by bending and doubling over an extension of the main plate. A spring, which curves over the clamp, latches in the hook, which secures the device to the clothing, and protrudes through the clamp. A point is cut from the clamp, which extends through an orifice in the plate to puncture the ticket, and prevents it from being withdrawn. There is also a spring hook, at the lower end of the main plate, upon which baggage checks and similar articles may be safely confined. A pencil holder is besides added, it being a lateral extension of the plate, bent in a circle to form an eye and hold the pencil by friction. A thread cutter is provided, formed of a piece of metal, separate from the plate, but attached thereto by means of solder, having a curved slot therein. In the slot is fixed a steel blade. The thread to be cut is forced down into the acute angle of the opening, and is severed by its contact with the edge of the blade.

Improved Reciprocating Winnower.

Henry Keller, Sauk Center, Minn.—This invention relates to improvements in the reciprocating winnower or fanning mill patented by the same inventer under date of June 24, 1873, by which the grain may be separated as to fineness and delivered directly to suitable measures, and also the whole mill stiffened and braced in a more perfect manner. The present device consists mainly in the arrangement of spouts supported in the frame below the fan box for delivering the winnowed grain in connection with the lower separating screens supported in the shoe, and provided with spout-connecting guide straps. The grain is thus continuously and steadily separated from the chaff, assorted as to fineness, and fed to the receiving measures.

Improved Ditching Machine.

Jordan W. McAlister, Woodson, Ill.—The ditching wheel is made with three or more flanges upon its face. The central flange is attached to the center of the outer ends of the spokes. The tyres are then put on, and afterward the side flanges. This construction leaves the face of the wheel entirely smooth, so that the plows or scrapers will encounter no obstructions in removing the soil from said wheel. In bearings in the front vertical bar of the frame, works the rear end of the draft shaft, the forward part of which passes between four vertical angle iron posts of an upright frame. To the latter is bolted a horizontal plate, which is slotted to correspond with the space between the posts of the frame, so that the shaft may not be obstructed in its up and down movement. The forward part of the plate passes through a slot in the bolster, and has four pairs of friction wheels pivoted to it, which rest against the front and rear sides of the said bolster. The plate and vertical frame may be moved laterally, to keep the ditching wheel in line with the ditch, should the bolster, axle, and wheel deviate from said line. The ditching wheel may be raised from the ground for passing out of and into the ditch, for turning, and for passing from place to place. Suitable mechanism, governed by a lever, enables the ditching wheel and its frame to be inclined to one or the other side to keep them vertical should the surface of the ground, and consequently the bolster plate and frame, be inclined.

Improved Skate.

Reginald H. Earle, St. John's, Newfoundland.—In this device there are slotted pieces penned to the foot plate, which are pushed apart or drawn together to grasp the boot by a suitably pivoted lever acting upon a longitudinal plate through inclined slots, in which projections on the flanged grasping arms pass. The fastening apparatus on the heel is operated by moving a screw in the shank of the skate; and the entire mechanism is such that the skate may be easily adjusted or removed without requiring the use of an extra key or wrench.

Improved Oval Lathe for Finishing Hats.

Carlos W. Glover, Danbury, Conn., assignor to the Tweedy Manufacturing Company, same place.—There is a hollow arbor, the journals of which revolve in uprights, and which carries a fly wheel. The ends of a crosshead work in bearings formed in the fly wheel, and to it is attached a spindle, which passes longitudinally through the hollow arbor, and is made smaller than the cavity of said arbor, and tapering, so that it may have an oscillating movement therein. The end of the spindle has a screw thread cut upon it to receive the hat block. The screw thread also carries a crank arm, the crank pin of which enters a hole in a ring, which fits into, and works in, a ring groove in a plate. With this arrangement, when the crank is in a vertical position above the spindle, as it moves through the first quadrant, the spindle moves downward, bringing the center of the spindle into line with the center of the hollow arbor. As the crank moves through the second quadrant, the spindle moves upward, and again moves downward through the third quadrant, and upward through the fourth quadrant having thus two upward and two downward movements during each revolution. The effect of this is to keep the upper side of the work always in the same horizontal plane.

Improved Brake for Steering Wheels.

John P. Geisler, Dubuque, Iowa.—A swinging bar is so arranged as to be pressed by a lever, through the medium of a triangular block, against the rim of the wheel. When the pilot presses with his foot on a treadle, the long end of the lever will be raised and the brake will be applied. The amount of pressure which he thus applies determines whether the wheel is to be suddenly stopped or simply retarded. The back motion of the lever is produced by a spring. When the brake is applied, the opposite side of the rim of the wheel bears against the end of a timber, which prevents the straining of the wheel and adds to the friction and power of the brake. The parts of this brake are duplicated to allow the pilot to stand either to the right or left in operating the wheel.

Improved Life Raft.

Bernard Almonte, Great Barrington, Mass.—This raft is composed of four, more or less, sections, hinged to each other and to a central keel, and made of planks. Each section is provided with a keel, and on each side of each keel is an air chamber of waterproof material. These sections, being thus hinged together and to the keel, fold up when not in use. Latches hold the sections on the same plane, so that they form a broad platform when on the water. When launching the raft, one of the sides is let loose from the davit hook, allowing it to unfold and hang by the side of the vessel, where the latches are adjusted so that, when it is launched, it is ready for use.

Improved Harrow.

Martin McNitt, Mound Station, Ill.—In this invention, the teeth of the rear bar of the series are adapted to assume an angle or position different from the teeth of the other bars. The result is that the teeth of the rear bar may be set at different angles, and hence be brought into action even when the others are out of action altogether.

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ANSWERS TO CORRESPONDENTS

C. H. does not send his name and address.—J. G. can bend sleigh runners by following the directions on p. 43, vol. 30.—C. K. will find recipes for waterproof glue on p. 379, vol. 30; for polishing iron and steel on p. 133, vol. 31.—H.C. K. will find a description of ice-making machinery on p. 243, vol. 30. Pure butter needs no artificial coloring.—F. C. M. will find instructions concerning induction coils on pp. 215, 218, 363, 378, 379, vol. 30.

(1) T. S. K. asks: What will be the proper size of a boiler for a cylinder 1½x3 inches, and what will be the size of the flues for such a boiler? Of what plate should it be made, and what amount of horse power will it give? A. You do not give sufficient data.

Will calcined plaster be fit for cores for small castings? A. Yes.

Will white metal wear as well, for a small engine, as brass? A. Yes.

(2) J. C. S. asks: Given the diameter of a circle, how can I find the length of a chord that will cut off one third of the area? A. The chord is about 0·961 of the diameter.

(3) H. W. asks: 1. Of what size and how set should a boiler be to run an engine of 1 inch bore by 2½ inches stroke at 200 revolutions per minute at 15 lbs. on the square inch? A. Vertical boiler 12 inches in diameter, 3 feet long, with 6 tubes, 1½ inches in diameter. Set it upright, with fire underneath, and casing around. 2. How thick should it be to hold 45 lbs. steam? A. One eighth of an inch. 3. Of what size should the safety valve be? What should be the distance between the notches, each notch denoting 5 lbs.? A. One quarter inch diameter. Distance between notches depends upon the weight.

How much steam will one gallon of water produce if confined in the same space? A. One gallon.

(4) G. E. asks: I wish to construct a small steam engine to run on a lathe of 7 inches swing. How large a cylinder will be necessary? What should be the area of ports? What should be the diameter and weight of fly wheel? What proportion should the connecting rod have to the length of stroke? A. Make the engine to develope about ½ horse power. Ports 1-20 area of piston. Fly wheel, 6 miles diameter; weight, 15 lbs. Connecting rod, from 2½ to 3 times length of stroke.

Is there any work published for amateurs or others on the construction of small engines? A. There is no such book; but you will find many valuable hints and suggestions in back numbers of the SCIENTIFIC AMERICAN.

(5) B. R. asks: 1. What is meant by lap and lead of a steam engine, and what is the proper method of setting a slide valve? A. Consult Auchincloss on "Link and Valve Motions." 2. What power would a high pressure engine of 16 inches cylinder by 20 inches stroke, at a pressure of 60 lbs., running at 40 strokes per minute have, and what power would the same engine have with a condenser? A. You can answer this by multiplying the mean effective pressure of steam on piston by distance in feet that the piston moves in a minute, and dividing by 33,000.

What is a good work on bird stuffing? A. Brown's "Taxidermist's Manual."

(6) C. M. C. says: I am operating an engine with a cylinder 8½ inches by 14 inches stroke; the bed frame sits fair on top of boiler. There are two 6 feet driving wheels; the crank shaft is 8½ inches in diameter; the bearings of the crank shaft are 5 inches in length. The wristpin is 3 inches in diameter and 3 inches long. Key up the connecting rod as I may, the engine has a thump that can be heard 200 yards off at all speeds up to about 160 revolutions; above that speed the thump appears to cease; but as soon as the speed slacks, it commences again. If I tighten up the connecting rod brasses, they heat and cut in spite of all the oil that we can put on them; if I leave them slack, they cut without heat. The main journals will also heat if a little tight, and cut if slack. I have tried every plan that I have ever heard of. I have run it tightened up and slack. I have lengthened my main rod and shortened it. I have put in liners until the strap key would hardly enter. I have tightened my cylinder rings, and I have run them loose, and all to no effect. What shall I use for it? A. It appears from your account that the valves are not set properly. Possibly the piston may be loose. An indicator diagram would be very apt to show the cause of the trouble.

(7) J. W. E. asks: 1. If I have a number of blocks of ice, about 2 feet square and 1 foot thick, frozen all round 1 or 2 inches in thickness, there still being 8 or 10 inches of water in the center, and I store these cakes all together in an ice house, will they freeze solid? If so, will they keep as well as if they were frozen solid before being stored? A. They will not freeze solid. 2. Is there any book published on ice, or the proper construction of ice houses? A. We do not know of any. See answer No. 29, p. 251, vol. 31.

(8) H. C. asks: Please give me a formula for preparing cotton, to be not so explosive as gun cotton, yet to burn rapidly and leave no perceptible ash? A. Sulphuric acid of specific gravity (1·70, 6 ozs.; dried nitrate of potassa 3½ ozs.; water 1 oz. Mix the acid and water in a porcelain vessel, and add the pulverized niter, gradually stirring with a glass rod until the lumps disappear and the mixture becomes transparent. Place a thermometer in the mixture, and when it indicates between 140° and 100° Fah., the cotton should be immersed. Take 60 grains clean cotton, separate it into 10 or 12 bolls, and immerse the bolls separately; and leave the whole in the mixture for 10 minutes. The temperature should fall to 140°. Float the cup on boiling water, and maintain it between 140° and 150°. At the expiration of 10 minutes, lift the cotton with glass rods, and squeeze out the acid quickly; and dash the mass into a large vessel of clean, cold water, separating the mass so as to wash it thoroughly and quickly; complete the washing by immersion for several hours in running water, then spread it out to dry spontaneously.

(9) G. H. R. asks: What is the method of obtaining the latitude of any place by the use of the box or pocket sextant? Is there any work which explains the use of the sextant? A. You will find the information you desire in Loomis'" Astronomy."

(10) B. A. C. asks: How is lead pipe made? A. It is forced over a die by hydraulic pressure.

(11) H. M. asks: I am about building a cheap rain water cistern. 1. Is it practicable to dig my cistern to the required dimensions, and then to cement directly on the walls without the use of bricks, giving it two or more coats? If it can be done, would it make a substantial job? A. It is not safe to attempt the construction of a cistern on the plan you propose; but if your soil is hard enough to stand to the line when your excavation is made, you can line it with a 4 inch wall of brick laid up in cement and plastered with the same on the face. If this is laid hard up to the bank, it will make a tight cistern. 2. I wish to raise the water with a pump; can I construct a pump by rabbeting the sides together, using square buckets? A. If you inquire the price of pumps, you will find it more economical to buy one than to make it and risk the chance of failure.

(12) H. D. S. says: I am building a small engine, 1x2 inches. What sized boiler should I use, to run it, driving a sewing machine? Would copper or iron be best? A. Make one 12 inches in diameter, 2 feet high, with 6 flues, 1½ inches in diameter. Either copper or iron ⅛ of an inch thick will answer, the former being more durable of the two.

(13) G. A. B. asks: Suppose a rope is stretched moderately tight between two trees, and a weight of 140 lbs. is suspended from the center, what is the strain in pounds on the rope on each side of the weight? Is it 70 or 140? A. If t = tension of rope, w = weight, a = angle between parts of rope on each side of the weight, then $t = \frac{w}{2\cos.\ a}$. From this equation you will see that the tension of the rope is equal to the weight when the angle is 120°.

(14) D. H. E. asks: Will a stream 3 inches square in cross section under 8 feet or 6 feet head, afford power to run a 50 saw gin? A. No.

(15) M.A. asks: If a wheel rolls down an incline with nothing but inertia to resist its descent, where is its axis, theoretically? A. The axis is a line passing through the center of inertia of the wheel, which generally nearly coincides with the geometrical center.

(16) F. O. S.—In general, machinery can be driven with less power by belting than by gear wheels.

(17) H. W. G. asks: 1. What does the best flint and crown glass cost per lb., such as is used in the best achromatic object glasses? A. Chance's flint glass, such as is used in making small object glasses for telescopes, costs $2.50, and crown glass of the same quality $3, per pound. Camera glass, which is less expensive, is used for cheaper achromatic lenses and photographer's tubes. 2. To calculate the earth's distance from the sun by the transit of Venus, does not Venus' distance from the sun (or what is more likely, from the earth) have to be known before the problem can be solved? A. The relative distances of the planets from the sun being computed from their times of revolution by Kepler's third law, the earth's distance is to Venus' distance as 1,000 is to 723. The ratio of Venus' distances from the earth and sun is as 277: 723, and Venus' parallax measured on the sun's disk is in miles 2·61 times the distance in latitude between two observers on the earth. The linear value of a second of arc at the sun being about 460 miles, the solar parallax, or angle which the earth's radius subtends at the sun, will be about 9 seconds of arc, and his distance 91,500,000 miles.

(18) J. H. S. asks: How can I obtain a certificate as an engineer? A. You must apply to the local supervising inspector in your district. 2. To whom should complaint be made of a steamer, run, on an inland lake, by a common machinist who never ran an engine of any kind before, and is not a competent man in any way? A. To the inspector.

(19) M. M. asks: What is the best way to regild parts of a mirror frame? A. See p. 96, vol. 30.

How is it that when the moon is visible the aurora is not? Has the moon anything to do with the appearance of the aurora, or is it merely a coincidence? A. The light of an aurora is usually so faint that it is not visible except on dark nights.

Are atoms all of one and the same size? A. No.

(20) D. B.—The cost of an analysis would be larger than such a recipe would be worth.

(21) T. C. asks: In a small spring of water, near where the water emerges from the ground, I found a crab similar to the salt water crab, but of a darker color. Can you tell me how it came in such a place? A. A. Your description is too indefinite. It might have been a fresh water shrimp.

(22) H. W.—Filtering water through brick is commonly done, and is a most efficient method.

(23) H. I. H. asks: What is the rule for finding the number of square inches in any circle? A. Square the radius in inches and multiply by 3·1416.

(24) C. S. B. says: I have discovered a new rule for the solution of a certain kind of equation which I think preferable to the one usually given in the text books. It is applicable to all equations which can be reduced to the following form: $(x^2+ax)^2 \times b(x^2+ax) = c$. The rule usually given in books is this: Reduce by inspection the given equation to the above form; then consider the compound term as a single quantity, find its value by completing the square and extracting the square root of both sides of the equation, from which the value of x is easily found. My rule is this: Extract the square root of the left hand member of the equation as far as possible, which will show you a numerical quantity that must be added to the left hand member of the equation to complete the square, add this quantity to both sides of the equation, extract the square root of both sides, and you have an equation from which the value of x is easily found. The advantage of this rule above the one usually given is that it is sometimes very difficult to reduce the given equation to the above form, whereas that necessity is obviated by the last rule. A. We do not know that we understand your method thoroughly. We append two examples which are readily solved by the ordinary method. If you will send us solutions in accordance with your rule, we shall be better able to compare it with the old method. 1. $\frac{4x^2}{7} + \frac{2x}{7} + 10 = 19 - \frac{3x^2}{7} + \frac{58x}{7}$

2. $a^2+b^2-2bx+x^2 = \frac{m^2x^2}{n^2}$

(25) J. G. W. asks: Where can I get any information that will aid me in foretelling the weather by the aid of a barometer? There are times when the mercury is well up in the tube, and yet considerable rain falls without much falling of the barometer. At other times when the barometer is falling, there is no rain. A. Read T. A. Jenkins' pamphlet on the barometer, thermometer, hygrometer, etc.

(26) M. A. asks: 1. Why is it that the contact breaker in an electro-magnetic machine stops and makes the current jump, very nearly stop, and then jump again? Is it because the platinum is not good? A. The spring and face of the hammer should be perfectly clean, as should also all connections. The trouble may lie in your battery and not in the coil. We do not understand your other question. Copper, not iron, wire is used in the coil.

(27) S. K. S. asks: How large a tube would be required for the barometer referred to on p. 331, vol. 30? A. From 3 to 4 feet long.

I made a storm glass according to the rule given on p. 234, vol. 29, but could not tell anything by it, the liquid remaining cloudy all the time. On the lowering of the temperature, it would form crystals like snow flakes. A. Your trouble is probably due to impure chemicals. These glasses are not considered as absolute indicators. Some claim that they are affected by electrical disturbances.

What is meant by the power of spy glasses, 10, 15, 25, etc.? In the last instance, does it mean that an object 25 miles off can be seen as plainly as it would if it were only one mile distant with the naked eye? A. Yes but this is not absolutely true, as the intervening atmosphere, with its varying density and humidity, is never taken into account.

(28) I. T. O. says: I tried to make marine glue after the recipe you give in your book; I first put the rubber in one bottle and the shellac in another and then poured, as I thought, enough ether on each to dissolve it; I put them on a warm stove, removing the corks to let the gas escape. Both bottles took fire and burst. A. Fill your bottles with ether, stopper tightly, and keep in a cool spot for forty-eight hours. The bottles, because of their extremely volatile and inflammable contents, should be kept cool, and at a safe distance from fire of every kind. We are sorry for your accident.

(29) O. S. C. asks: 1. How can a permanent gold color be given to metallic lead? A. By alloying it with a certain percentage of copper. 2. How can the specific gravity of metallic lead be increased? A. The specific gravity of pure lead is unalterable, but an alloy of lead with either gold or platinum may be made, the specific gravity of which will be greater than that of lead alone.

(30) H. D. M. asks: 1. How can I apply paraffin to heavy canvas to make it waterproof? A. Saturate with solution of paraffin in naphtha. 2. How shall I make it of a dark color? A. The paraffin is first melted and then digested for a short time with coarsely powdered or bruised anacardium nuts, the fruit of the *anacardium orientale*. This nut contains a black vegetable fat, which combines intimately with the paraffin.

(31) L. L. G. asks: Why does a piece of lead pipe become filled with holes when it runs through certain soils? A. There are many mineral salts which, when dissolved in water or when brought into contact in a moist condition with lead, corrode it. Which salts are present in the water or in the ground through which your pipe runs could only be determined by analysis.

(32) H. F. asks: What is the specific gravity of ordinary vulcanite, vulcanized for 2 hours under a temperature of 320°? A. We will determine the specific gravity of such a piece of vulcanite; but we have none at present in our possession.

(33) C. G. H. asks: 1. If a man built an engine, boiler, and boat, and put them together, would he be considered fit for an engineer, to run said boat? A. This is a question that could only be answered by the inspecter. 2. What does a boat's certificate cost? What does an engineer's certificate cost? A. Licence for boat costs $25. Licences for captain, pilot, and engineer, first class, $10 each, second class $5.

(34) D. O. asks: In what part of Europe did the first locomotive engine run? A. In France, in 1769.

(35) L. P. asks: What proportion should the cooling surface of a condenser bear to the heating surface of a boiler? A. From one half to two thirds. Use thin tubes.

I send you a specimen of boiler scale. Of what is it composed? A. The scale seems to be formed from water containing salts of lime. It is probable that the use of tannate of soda would be advisable.

(36) M. M. asks: How should a square piston or abutment of a rotary engine be packed, and what kind of material is best for the packing? A. This is a matter that has engaged the attention of inventors for many years, and is, as yet, undecided.

(37) G. L. M. asks: Is there a simple solution of this problem: The area of a segment and the radius of a circle being given, to find the chord? A. We do not know of any rule.

(38) J. C. says: 1. I wish to make a flat bottomed sail boat, about 15 or 16 feet long, with center board. How wide and how deep should I make it to be nicely proportioned and safe? A. She should be 6 feet wide and 2 feet deep. 9. How can I bend the boards for the sides, having no steam box? A. You can either do it by making saw cuts, or by working it out in the proper shape in short lengths and jointing together. 3. About what sized sail could she carry for speed and safety? A. About 8 feet high on the mast, with boom 11 feet long. You can add a topsail, if you find that the boat will stand it.

How is gold lettering done? A. Attach the gold leaf to the leather by pressure, then take the required letters (which must be of brass and heated), press them singly and heavily on the gold leaf, having first smeared the face of each letter on a greasy rag.

(39) J. B. asks: What quantity of water would be required to supply an engine of the following dimensions: 2 cylinders each 16x18 inches, working with 35 lbs. per square inch, at 100 revolutions per minute? A. You do not send sufficient data. You should state the point of cut-off.

(40) B. W. D. asks: Are there any self-regulating mills in use, so that, when the wind gives a high speed to the fans, they can be changed to present less flat surface to the wind, and consequently diminish the motion, and *vice versa*? A. Yes.

(41) J. C. asks: If the wind has a velocity of 1 mile an hour, it will exert a pressure on 1 square foot of surface equal to 0·005 lbs. On a surface 5 feet square, will the pressure be more than 25 times as great? A. Multiply the pressure per square foot by the number of square feet in the surface.

Where can I find a description of the Mammoth Cave, Kentucky? A. See p. 321, vol. 25.

(42) J. R. W. asks: When was ammonia gas first applied as a motive power? A. We could not give you the date of the first patents, without a search; 1859 was, we believe, the date of the earliest patent for an ammoniacal engine that attracted much attention.

What is the principal difficulty in using compressed air as a motive power? A. Its cost. Tests with this motor have not been very extended.

(43) H. F. M. asks: What sized engine will be required to propel a boat 70 feet long by 6 feet beam at the end and 12 in the center, against a current of 2 or 3 miles per hour at low water, and 4 or 5 miles at high water, the boat drawing 6 inches of water with considerable rake at bow and stern? The boat is to go empty up and come down loaded. A. An engine with a cylinder 12x12 inches.

(44) J. C. K. asks: What should be the diameter of an upright iron shaft 3 feet long, 2 feet 6 inches between bearings, with 4 levers each 10 feet long with a horse hitched to the outer end of each? The shaft should be of such size as to resist torsion. A. Allowing that each horse will exert a force of 200 lbs., the diameter of the shaft, to resist wrenching, should be about 4 inches.

(45) W. S. F. asks: How can I make a good and cheap boot blacking? A. Take ivory black 2 ozs., sweet oil ½ tablespoonful, and brown sugar 1½ ozs. Mix them well, and then gradually add ½ pint of small beer.

What colored liquid preparation (red preferred) can I place in small quantities in a bottle of alcohol and have it always remain on the surface and not become mixed with or dissolved in the alcohol? A. We know of none.

If a bag made of white rubber were filled with oil, what effect would the oil have on the bag? Would it soak through the rubber or rot it, in time? A. This depends upon the kind of oil used. For instance, sweet oil would have very little effect upon the rubber, while petroleum would dissolve or destroy it in a very short time.

(46) B. C. W. says: 1. I have a hydraulic press necessarily exposed to frost, sometimes as low as −5° Fah. What liquid can I use which will not congeal at this temperature, alcohol and kerosene being objectionable? Will glycerin diluted with water do? If so, in what proportion? A. The solution you speak of is much used where it is necessary for the liquid employed to stand a low degree of temperature. An aqueous solution of glycerin of specific gravity 1·034, containing about 10 per cent of glycerin, freezes at 30° Fah. With 60 per cent of glycerin, of specific gravity 1·127, the freezing point of the solution is below −31° Fah.

(47) S. W. asks: 1. During what period, after the death of Julius Cæsar, did the Romans (owing to a misunderstanding of the theory of the Julian year) intercalate a day every third instead of every fourth year? A. For 36 years. 2. In what year was the intercalary day changed from its position between the 24th and 25th of February to the end of that month? A. We cannot give you the date; but it was probably in the time of Pope Gregory XIII. Perhaps some of our readers can furnish the information.

Which do you consider the best work (not too costly) on astronomy, containing the mathematical formulæ and tables for calculating the planetary motions, and tables of the lunar perturbations? A. We do not think there is any single book that covers this ground. We can recommend Norton's and Bartlett's works on astronomy.

(48) M. C. asks: What will remove fruit stains from linen, etc.? A. Try hot soap and water; if not successful, try lemon juice; if again unsuccessful, try oxalic acid.

(49) J. H. F. asks: Would an achromatic object glass 1½ inches in diameter, and of 30 inches focus, answer the same purpose for a telescope as the meniscus described by B. on p. 7, vol. 30? A. It would be much better. Cheap achromatics are made of camera glass, and the lenses ground several at once upon the tool.

(50) J. S. A. says: Some clergymen take their regular full meals on Sunday and attend to their duties the same as other clergymen who eat very little food, and that of a light kind, till the Sabbath is over, when they take a full and substantial meal. Which is best for health? A. This is best solved by experiment. As a general rule, men of well marked bilious temperaments require more food than those of the nervous temperament. The best rule, however, is to eat at regular hours.

Some telegraph posts produce a sound which is much like that of a steamboat's whistle in the distance. The sound can be heard when the weather is perfectly still and at a distance of from five to ten yards. These posts are cedar and stand in a sandy soil. Their wires are connected with the post by glass insulators. What produces the sound? A. The wire forms a mammoth æolian harp; and when drawn unusually tight, an almost imperceptible breeze will cause it to give off this low murmur.

(51) H. J. J. says: I am running 5 fifty horse power tubular boilers. Our water is hard; and for three months in the year (the time I use the hard water) I find that scale accumulates to the thickness of 1-16 of an inch. I am pumping all of the feed water from a large hot water tank, containing one half water from the well; when the exhaust water from the trap does not heat it to 100°, I use a little direct steam. Yet the scale continues to form. Would you recommend the use of sal soda in the hot water tank to soften the water before pumping the same to the boilers? If so, in what proportion to every 100 gallons of water evaporated? A. We think that the soda, even if effective would be a very expensive remedy. Some other form of heater might be better, or perhaps you could trap more of the condensed steam. We advise you to consult an expert.

(52) O. M. says: Olmsted's "Astronomy" says that the next transit of Venus will occur on December 8, 1874, while all late accounts say it will occur on December 9. Possibly both are correct, according to the side of the 180° of longitude from Greenwich from which it is viewed. Is this the case? A. Yes. The astronomical day commences at noon, and is half a day behind the civil day. The transit of Venus commences astronomically at Bombay on December 8 at 18h. 42m., Irkutsk, on December 8 at 30h. 40m., Pekin, December 8 at 24h. 29m., Yokohama, December 8 at 23h. 0m., Melbourne, December 8 at 23h. 28m., Auckland (New Zealand) December 9 at 1h. 24m., Honolulu, December 8, at 3h. 4m., and is not half over at sunset. At the Cape of Good Hope, Alexandria, and Kazan the transit commences before sunrise. See Comer's "Navigation Simplified."

(53) S. H. asks: 1. What is the power of a field glass of 2¼ inches diameter of about 8 inches focus? How far could I recognize a person with it? A. Perhaps ten times as far as with unassisted vision. Short focus field glasses cannot equal telescopes in power. 2. What is the rule for computing the power of a glass? A. Divide focal length of objective by focal length of ocular.

(54) C. P. says: I read that, as alcohol can be converted into steam with much less fuel than water could, it would be economical to use it, provided a method of saving it by condensation could be devised. Is it safe to use it in a boiler used for heating purposes only, where all the vapor is condensed in the radiators and pipes and returned to the boiler? Should you deem it safe to use naphtha instead of water in the boiler, and would the steam, gas, or vapor made by heating it cause an explosion, if there were no actual contact of flame or fire? A. Both of the liquids mentioned would be dangerous if used with ordinary apparatus. The great difficulty in using volatile liquids is the prevention of leakage.

(55) J. W. B. asks: Is there any process by which fine grit of flint or quartz can be removed from fine earth or chalk deposits? A. By agitation in proper vessels with water and decanting off the liquid, holding only the finest particles in suspension from the heavier particles remaining at the bottom.

(56) C. B. asks: Please give me a recipe for printer's roller composition. A. Melt glue in water, and add molasses to keep it soft. Let cool, and you will see if it be of the right consistence. More molasses will be needed if it be too stiff. More glue is necessary in warm locations, as the composition readily softens as the temperature rises. Some makers use glycerin in combination with the molasses.

(57) S. C. asks: 1. Which is the best work on the medical use of electro-magnetism? A. "Galvanism, Animal and Voltaic Electricity," by Sir W. S. Harris, is both cheap and comprehensive. 2. Is there any difference in the currents of a medical battery and of a magneto-electric machine? A. In the former the current is stronger and more even.

(58) H. asks: Can the following problem be solved? If so, what are its roots? $x+y=xy$. $x^2-y^2=xy$. A. It cannot be solved by any of the ordinary rules of algebra, since there is only one independent equation for two unknown quantities. Moreover, from casual inspection, we are inclined to think that the independent equation is untrue.

(59) O. K. asks: How can I prevent rust on polished steel tools? A. Melt 1 oz. paraffin in 1½ ozs. petroleum, and apply with a linen rag.

(60) E. D. E. asks: What is the process for crystalizing flowers, grasses, etc.? A. One process is to thoroughly dry the flowers and grasses, and then allow them to soak in a strong solution of alum.

What are the ingredients and proportions of the compound used for marking the name or brand on unbleached cottons? A. Iodide of potassium 1 oz., iodine 6 drams, water 4 ozs., dissolve. Make a solution of 2 ozs. ferrocyanide of potassium in water. Add the iodine solution to the second. A blue precipitate will fall, which, after filtering, may be dissolved in water, forming a blue ink.

Will a pure gold stud blacken a shirt bosom? A. Yes.

(61) M. C. asks: By what part of their bodies were the Siamese twins connected? A. The connecting link was an extension of the sternum of each; it was 4 inches long and 2 inches broad.

(62) J. C. K. says: According to Dr. Ure, amber is a solid mineral, disseminated in sand, clay, and lignite formations. In another place I find it under the head of resins, and described as procured from the vegetable kingdom. It has been elsewhere described as procured by diving, the divers tearing it from a reef. Is there more than one kind of amber? A. Amber occurs often in beds of wood coal, but is chiefly found after storms on the coasts of the Baltic, between Konigsberg and Memel. It consists of a mixture of several resinous bodies, which have not been accurately examined. There is but one variety.

(63) J. B. asks: How can I make a lac or paint to turn German silver black, and stand handling without losing gloss or color after drying? A. There is one simple method by which artists may be enabled to obtain all the different tints they require. Infuse 1 ozs. of gum guttæ in 20 ozs. essence of turpentine; and 4 ozs. dragon's blood and 1 oz. annatto, each in a separate dose of essence. These infusions may be easily made in the sun. After 15 days' exposure, pour a certain quantity of these liquors into a flask; and by varying the doses, different shades of color will be obtained. Black japan varnish, we think, would answer your purpose very well, and may be made as follows: Boiled oil 1 gallon, umber 3 ozs., asphaltum 3 ozs., oil of turpentine as much as will reduce it to the required consistence.

A barrel of cider vinegar nearly 3 years old was found to have turned black, the cause of which is attributed to the barrel having been burnt too much when new. What will make the vinegar clear? A. If the supposition is correct, the vinegar may be cleared by filtering.

(64) W. B. says: I find that my tea kettle becomes caked up with scale very often; in six weeks it will become one quarter inch thick, if left undisturbed. Is the water (from a well) likely to produce gravel, if drank without being boiled? A. There is no danger from this source. 2. How can I soften it for washing purposes, as it has been so dry here that we have run out of rain water? A. Boiling the water will render it softer, by expelling the carbonic acid and depositing the carbonate and a portion of the sulphate of lime held in solution.

(65) A. M. T. says: 1. How can I make an electrical machine with a glass plate 1 foot in diameter and ¼ inch thick? A. Suspend your glass plate between two wooden supports, by an axis passing through its center, which is to be turned by means of a glass handle. The plate should revolve between two sets of cushions or rubbers, of leather or silk, one set above the axis and the other below, which can be pressed by means of screws as tightly against the glass as may be desired. The plate also passes between two brass rods, shaped like horseshoes and provided with a series of points on the sides opposite the glass; the rods are fixed to larger metallic cylinders which are called the prime conductors. Each rubber must be connected by a chain with the ground. 2. Will it do to make it of insulated wood coated with tinfoil? A. Yes. 3. Would a Leyden jar placed to the prime conductor be of any value? A. Yes. 4. Which is the simplest way to make one? A. It consists simply of a wide-mouthed bottle, lined inside and out to within about three to four inches of the top with tinfoil. A stopper of dried wood closes the mouth, through which passes a brass rod surmounted by a brass bell. A fine wire connects the inside coating of the jar with the end of the brass rod. 5. What is the rubber composed of, and how can I amalgamate it? A. The cushions may be made of silk stuffed with horsehair. Use common bisulphuret of tin amalgam on them. 6. How can I fix the axis firmly to the plate? A. The axis may be of light wood; the hole in the center of the glass plate should be square. 6. In Carré's electrical machine, described on p. 362 of vol. 28, how is the condenser made and applied to the machine? A. You will find that condenser described on p. 363, vol. 30. A Leyden jar would perhaps answer your purpose. 8. Cannot shocks be taken from the prime conductor without it? A. Yes. 9. What is the distance of the brass knob from the prime conductor, in Carré's machine? A. The distance is not mentioned. 10. How are the ebonite disks made? A. Ebonite is rubber heated with half its weight of sulphur.

(66) Q. A. S. says: Imagine an engine made like an ordinary steam engine, but with an opening in the valve larger, and the ports larger, so that the air could go in freely, to be driven by atmospheric pressure. The exhaust is connected by a slide valve arrangement with two drums or chambers, which are heated to produce a vacuum. The idea is that the vacuum produces a suction which draws the air out of the cylinder from in front of the piston head, alternately and instantaneously, so that the atmospheric pressure of 15 lbs. to the square inch can drive the piston head back and forth, as steam does. How much actual pressure would there be on the piston head to drive it, provided a vacuum existed in front of the piston head? I know that a perfect vacuum only exists theoretically: but suppose that the drums are made so large and heated in such a manner as to suck the air out from in front of the piston head rapidly, and strongly, would this suction add to the atmospheric pressure and give the engine more power, or would there remain in the cylinder in front of the piston head a certain quantity of air, which would offset the atmospheric pressure on the back of the piston head to the extent of 4 or 5 lbs. pressure, and leave an actual working atmospheric pressure of only 10 lbs. to the square inch? A. Air expands about 1-491 of its volume for 1° Fah. that it is heated, and its pressure is inversely as its volume. Knowing, then, the temperature of the air in the drums, you can easily calculate the pressure, which will be the back pressure in the piston. There is, properly speaking, no such principle as suction. If the pressure on the side of the piston is less than that of the atmosphere, the unbalanced pressure of the atmosphere will tend to move the piston.

(67) E. A. W. asks: How many cubic feet are there in a perch of stone? The stonemasons say 6¾. A. Webster gives the same figures; but a "rod, pole, or perch" is 5½ linear measure, which makes 30¼ superficial measure, which does not agree with 16½ feet solid in any respect.

(68) J. G. P. asks: How can I make a good bronze on polished steel or iron, such as hardware trimmings and the like? A. To 1 pint methylated finish, add 4 ozs. gum shellac and ½ oz. gum benzoin: put the bottle in a warm place, shaking it occasionally. When dissolved and settled, decant the clear liquid and keep it for fine work. Strain the residue through a fine cloth. Take ¼ lb. powdered bronze green, varying to suit the taste with lampblack, red ocher, or yellow ocher. Take as much varnish and bronze powder as required, and lay it on the article, which must be thoroughly clean and slightly warm. Add another coat if necessary. Touch up with gold powder according to taste, and varnish over all.

(69) P. T. B. asks: How can I produce a verde bronze on brass? A. Dissolve 2 ozs. nitrate of iron and 2 ozs. hyposulphite of soda in 1 pint water. Immerse the articles till they are of the required tint, as almost any shade from brown to red can be obtained; then wash well with water, dry, and brush. One part perchloride of iron and 2 parts water mixed together, and the brass immersed in the liquid, gives a pale or deep olive green, according to the time of immersion. If nitric acid is saturated with copper, and the brass dipped in the liquid and then heated, the article assumes a dark green color.

(70) G. W. H. asks: Can you describe the sights used in the late rifle contest at Creedmoor, between the Irish and American teams? A. The back sights were disks with small holes in them, moved vertically on parallel bars by means of a screw. The bars were graduated and furnished with a vernier, and were attached to the stock of the rifle. The foresights were shaded by an almost circular cover. 2. Can you explain the plan of scoring? A. The scoring was according to the Wimbledon system, namely, 4 for a bullseye 3 for a center, and 2 for an outer.

(71) T. C. says, in answer to W. F. M. (No. 13, p. 203, vol. 31) in regard to using a ¾ inch pipe a short distance from the spring and then adding a ½ inch pipe: If you place a 1 inch pipe leading from the spring for about 2 rods, and then add the ¾, and then the ½ for the remainder of the distance, you will have a larger and more steady flow of water.

(72) M. P. B. says, in answer to F. A. McG.'s query: Why does a belt run to the highest point? A belt, in passing over a pulley, inclines to the outline of that pulley. This outline on a taper pulley crosses the line of the belt obliquely, which throws the first point of contact higher on the pulley than it is at the central point. As the first contact soon becomes the central point, the belt runs up.

(73) M. P. S. says, in answer to J. B. G. who asks how to make music by rubbing the fingers on the top edges of goblets: I have in my possession a musical instrument of rare purity and sweetness of tone, called an harmonicon, which was made by my father very many years ago. The sounds are produced by thin flint glass hemispheres, supported by glass stems, and varying in diameter from 2½ to 7 inches, each one giving an absolutely perfect and unchanging tone. The instrument has a compass of three full octaves, with the semitones, [and is enclosed in a mahogany case, making a handsome piece of parlor furniture. Any composition, not too rapid in movement, can be played by a skillful performer. The tones far surpass in delicacy and sweetness any known instrument, uniting the softness of the æolian harp to the power of the violin. The pitch of each glass is determined in the blowing, and can be but slightly varied by cutting the glass lower at the edge. Water deadens the sound, and robs it of all its exquisite *timbre*. Many thousands of glasses had to be made before the perfect instrument was produced. It may be interesting to mention that, by means of these glasses, my father was enabled to divide a semitone into sixteen clearly defined intervals, the difference between any two successive glasses being so slight as to be almost undistinguishable.

(74) J. C. P. says: To make a carpenter's bench, take three pieces of 2x5 inches stuff, 3 feet long for supports for top. Take two 12 inch boards, 12 feet long and 1 inch thick, for sides; nail the side boards firmly on to the ends of the 2x5 cross pieces and put on a top of suitable material, and you have a bench without legs. Then take four pieces of 2x5 inches stuff of the desired hight for the legs, and frame a piece 1x3 inches across each pair of legs, 6 inches from the bottom of the leg, putting the legs at the proper distance apart for width of bench. Cut a fork or slit in the top end of each leg, so as to straddle the cross piece at the ends; put a 3½ x ⅝ inch bolt through each leg and the side board, and you have a good solid bench, that can be taken down in five minutes by simply removing the four bolts. It can also be taken through any door or window, or down or up stairs, or to any place required, thus saving a great deal of worry incident to trying to move the old style of bench. Besides, it is more easily made than any other form in use.

(75) G. M. says, in reply to A. O. W.'s query: Is there anything to make spelter flow more easily on copper? To do this, and on thin brass also, I file or rasp block tin into the spelter and borax (a small quantity), using my judgment for the mixture.

(76) A. S. says, in reply to N. S.' query: How can I put solder up in small bars, the size of knitting needles, without molds? Make a narrow trough of sheet iron about two inches in length, and punch a row of holes about 1-16 inch in diameter, ⅝ inch apart in the bottom. Affix a handle. Pour the solder from the ladle (quite hot) through the trough, at the same time moving the ladle and trough together rapidly over a plate of iron. He will find after practice that he can make the bars in this way very rapidly.

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

F. C. R.—No. 1 is a quartzite, containing hematite. No. 2 is principally iron pyrites and hematite.—J. B.—Your minerals and fossils were not received.—R. W. Z.—No. 1 is decayed shale, with red ocher. No. 3 is composed principally of red oxide of iron. No. 5 is a carbonate of iron. No. 4 is specular iron ore. No. 5 is menaccanite. No. 6 is iron pyrites. No. 7 is hematite. No. 8 is aragonite. No. 9 is shale containing red oxide of iron, with seams of carbonate of copper. No. 10 is marcasite.—W. M. D.—No 1 is magnetic oxide of iron. No. 2 is titaniferous iron ore.—H. W.—It is iron pyrites in quartzite.—T. T. R.—No. 3 is a quartzite, depending upon a layer of dark sandstone, containing scales of iron pyrites. No. 4 is iron pyrites distributed in gray quartz rock. No. 5 is a schistose rock containing iron pyrites, quartz, and hornblende.

D. E. R. says that a man recently bought a whisky barrel, to haul water in; and after bringing it home, a child got hold of some matches, and tried to ignite them by scraping on the barrel head. He succeeded in igniting one, and in exploding the barrel with a report which was heard four miles off. How came an explosive gas in a whisky barrel?—C. A. G. asks: How can I take oil stains out of brown stone or freestone?—J. C. M. asks: Can you give me a recipe for razor strop paste that will not cause the strop to become glazed in cold weather?—E. M. asks: 1. How do plumbers burn two pieces of lead pipe together, with a bolt and without the use of solder? 2. How do plumbers make a nearly square bend on the end of a large pipe?—E. B. G. says: Nearly every black bass I have caught since last spring has been full of worms in the gills, and all through the flesh; they appear like small white specks curled up in the flesh, but, when taken out, are alive. Fifteen years ago I caught a three pound bass full of worms about half an inch in length. Some old fishermen tell me that they are always so. Can any one give me information on this?—I. asks: Will goldfish breed in an aquarium?—A. P. asks: How can I deodorize rubber?—S. T. W. asks: Where can I find tables of the variation of the needle at the State capitals for the last fifty or one hundred years?—J. K. asks: Can you tell me of a good varnish to put on tracing cloth or paper that will allow of its being washed or cleaned after using in a machine shop.—R. C. W. asks Is rubber ever used instead of leather as a packing for hydraulic presses?

COMMUNICATIONS RECEIVED.

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

On Plumbers. By C. C. D.
On the Sczaroch. By C. R. S.
On the Crystallization of Carbon. By W. T.
On a Small Engine. By H. D.
On Life and Matter. By R. L.
On the Phylloxera. By J. L.
On Machinists' Tools. By C. M. B.
On Practical Mechanism. By R. E. W.
On the Jewish Race. By S. E.

Also enquiries and answers from the following:

T. J.—A. W.—W. H. B.—C. S.—J. J.—A. R. T.—T. B.—D. S. H.—C. I.—J. H. F.

HINTS TO CORRESPONDENTS.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Enquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasure in answering briefly by mail, if the writer's address is given.

Hundreds of enquiries analogous to the following are sent: "Who makes watch and clock springs? Where can sharpeners for cotton gins be obtained? Who sells celestial maps? Where can hand machines for making cordage be bought? Who sells artificial insulators? Which is the best battery for telegraph sounders? Where can small malleable iron castings be procured? Who sells glass oil cups? Who makes a cow milking machine? Where can filters for maple sirup be obtained?" All such personal enquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

[OFFICIAL.]

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September 29, 1874,

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Windmill, W. H. Wheeler 155,397
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Yoke clasp, neck, W. D. Gibbs 155,437

APPLICATIONS FOR EXTENSION.

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

31,030.—SAUSAGE STUFFER.—A. Nittinger. Dec. 13.
31,183.—CULTIVATOR.—D. S. Stafford. Dec. 30.

EXTENSIONS GRANTED.

30,191.—PAPER BAG MACHINE.—H. G. Armstrong.
30,215.—HARVESTERS.—T. N. Foster. Two patents.
30,233.—MARTINGALE RING.—De W. C. Lockwood.
30,234.—PLANING VALVE SEATS.—C. B. Long.

DISCLAIMERS.

16,648.—WAGON GEARING.—E. Huson.
30,191.—PAPER BAG MACHINE.—H. G. Armstrong.
102,462.—COOKING STOVE.—R. M. Hermance.
149,045.—WHIP SOCKET FASTENER.—G. L. Laffin *et al*.

DESIGNS PATENTED.

7,777.—PRINTING TYPE.—H. Ihlenburg, Philadelphia, Pa.
7,778.—PRINTING TYPE.—P. A. Jordan, Philadelphia, Pa.
7,779 to 7,781.—GRAVE GUARD.—A. Rank, Salem, O.
7,782.—SHIRT.—H. Heath, Brooklyn, N. Y.
7,783 and 7,784.—PRINTING TYPE.—H. Ihlenburg, Phila., Pa.
7,785.—OIL RESERVOIR.—L. F. Smith, Philadelphia, Pa.

TRADE MARKS REGISTERED.

2,000.—FERTILIZERS.—Baugh & Sons, Philadelphia, Pa.
2,001.—FLAX WEBBING.—Boston Mills, Boston, Mass.
2,002.—HAT TIPS.—Christy & Co., London, England.
2,003.—EYE BALSAM.—W. M. Olliffe, New York city.
2,005.—WHISKY.—Shields & Co., Cincinnati, O.

SCHEDULE OF PATENT FEES.

On each Caveat	$10
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On application for Design (14 years)	$30

CANADIAN PATENTS.

LIST OF PATENTS GRANTED IN CANADA, SEPTEMBER 30, to OCTOBER 6, 1874.

3,880.—E. F. Herrington, West Horsick, Rensselaer county, N. Y., U. S. Improvements on harvester pitman guides and holders, called "Herrington's Harvester Pitman Guide and Holder." Sept. 30, 1874.

3,881.—I. E. Thompson, Stanbridge, Missisquoi county, P. Q. Improvement in apparatus for cooking vegetables, etc., called "Thompson's Vegetable Steamer." Sept. 30, 1874.

3,882.—A. V. M. Sprague, Rochester, Monroe county, N. Y., U. S. Improvement on can openers, called "The Sprague Can Opener." Sept 30, 1874.

3,883.—T. A. Williamson, Knowlton, Broome county, P. Q. Improvements on milk vats, called "Williamson's Packed Pan." Sept. 30, 1874.

3,884.—H. A. Mandersen, township of Maria, Bonaventure county, P. Q. Improvements on sleighs and carriages combined, called "Manderson's Combined Sleigh and Carriage." Sept. 30, 1874.

3,885.—I. Lund, township of East Oxford, Oxford county, Ont. Improvements on corn huskers, called "Lund's Corn Husker." Sept. 30, 1874.

3,886.—C. Barlow, Cookshire, Compton county, P. Q. Improvement in a machine for turning cheeses, called "Barlow's Cheese Turner." Sept. 30, 1874.

3,887.—A. Rodgers, Muskegon, Muskegon county, Michigan, U. S. Improvements in circular saw mills, called "Rodger's Circular Saw Mill." Sept. 30, 1874.

3,888.—J. W. Jones, London, Ont. Composition of matter to be used in the preservation of eggs, called "Jones' Eggnolia." Sept. 30, 1874.

3,889.—W. W. Clay, J. Kay, and T. McCash, Paris, Brant county, Ont. Improvements on wood-drying apparatus, called "Clay, Kay, & McCash's Wool-Drying Apparatus." Sept. 30, 1874.

3,890.—A. O. Kittredge, W. H. Clark, and W. I. Clark, Salem, Columbiana county, O., U. S. Improvement on a machine for marking lines of bend of sheet metal for molding, called "Kittredge, Clark & Clark's Improved Machine for Marking Lines of Bend of Sheet Metal for Molding." Sept. 30, 1874.

3,891.—G. Scott, Montreal, P. Q. Improvements on a machine for lifting wheeled vehicles and other heavy weights, called "Scott's Carriage Lifting Jack." Sept. 30, 1874.

3,892.—T. H. Foote, New York city, U. S. Improvements in telegraph instruments, called "Foote & Randall's Improvement in Telegraph Instruments." Sept. 30, 1874.

3,893.—G. Fye, St. John, St. John county, New Brunswick. Improvements on harvesters, called "Fye's Harvester." Oct. 1, 1874.

3,894.—C. S. Fuller, O. M. Morse, H. J. Burdick, Oswego, N. Y., U. S., and S. Howes, A. Badcock, N. Badcock, and C. Ewell, Silver Creek, Chautauqua county, N. Y., U. S. Improvements in middlings purifiers, called "Fuller's Improved Middlings Purifier." Oct. 1, 1874.

3,895.—O. M. Morse, C. S. Fuller, H. J. Burdick, Oswego, N. Y., and S. Howes, A. Badcock, N. Badcock, and C. Ewell, Silver Creek, Chautauqua county, N. Y., U. S. Improvements in middlings purifiers, called "Morse's Improved Middlings Purifier No. 2." Oct. 1, 1874.

3,896.—H. J. Lingenfelter, Glen, Montgomery county N. Y., U. S. Improvements on portable furnaces, called "Lingenfelter's Portable Furnace." Oct. 6, 1874.

3,897.—A. F. Andrews, New Haven county, Conn., U. S. Improvements in annealing and toughening iron, called "Improvements in Annealing and Toughening Iron." Oct. 6, 1874.

3,898.—A. Rodgers, Muskegon, Muskegon county, Mich., U. S. Improvements in devices for moving and barking logs, called "Rodgers' Log Mover and Barker." Oct. 6, 1874.

3,899.—A. Rodgers, Muskegon, Muskegon county, Mich., U. S. Improvements in grate bars, called "Rodgers' Grate Bar." Oct. 6, 1874.

3,900.—P. K. Dederick, Albany, N. Y., U. S. Improvements in horse powers and hoisting machines, called "The P. K. Dederick Horse Engine." Oct. 6, 1874.

3,901.—A. O. Kittridge, W. H. Clark, and W. T. Clark, Salem, Columbiana county, O., U. S. Improvements on a mallet for smoothing sheet metal, called "Kittridge, Clark & Clark's Improved Mallet for Smoothing Sheet Metal." Oct. 6, 1874.

3,902.—J. Bradley and W. H. Pearson, Lowell, Middlesex county, Mass., U. S. Improvements on knitting machines, called "Bradley's Variety Knitting Machine." Oct. 6, 1874.

3,903.—A. Schulte and Myer Stern, New York city, U. S. Improvements on head and face protectors, called "Schulte's Head and Face Protector." Oct. 6, 1874.

3,904.—H. T. Hotchkiss, Rock Island, Stanstead county, P. Q. Improvements on mop wringers, called "Hotchkiss's Mop Wringer." Oct. 6, 1874.

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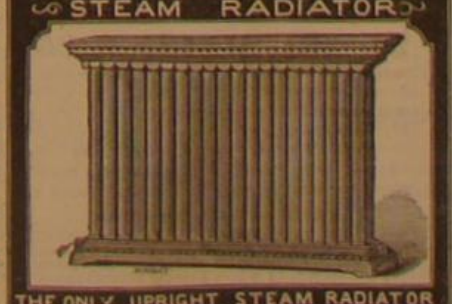
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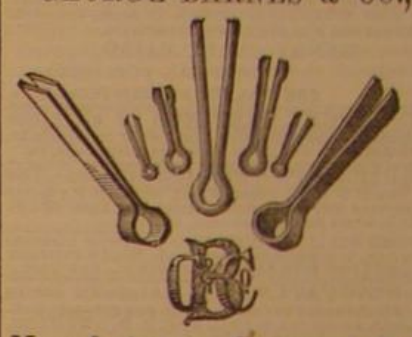
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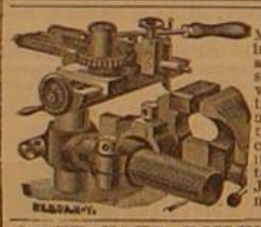
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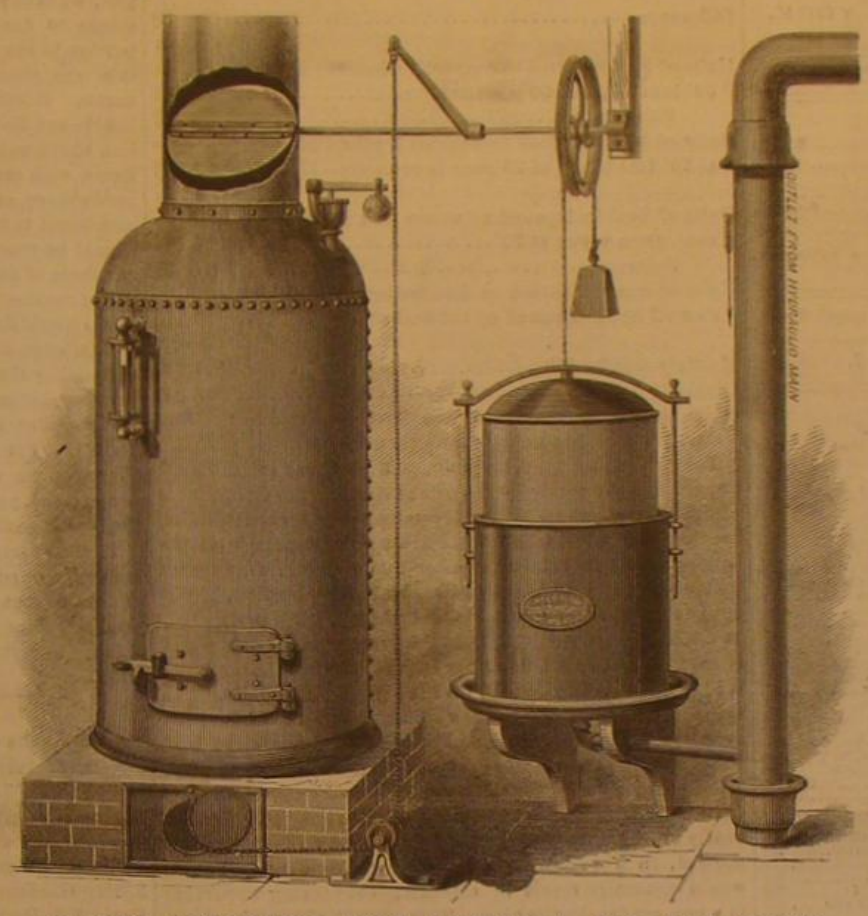
AUTOMATIC FIRE GOVERNOR FOR GAS WORKS.

The invention illustrated in the annexed engraving consists in a common gas governor, connected with the outlet of the hydraulic main, and also with the dampers in the chimney and under the fire. The arrangement is such that as soon as the engine does not exhaust fast enough, a slight pressure, being left on the retorts, is communicated to the governor, causing the latter to rise, thus opening the dampers at both of the above named points, and putting on all draft until the requisite speed is obtained. The pressure then being removed, the drum descends, closing the dampers, and preventing the fire making more steam until a future supply is once more required.

The disposition of the simple mechanism is clearly shown in our illustration, so that detailed reference to the various parts is unneeded. It will be seen that, as the governor is controlled by the pressure of gas on the hydraulic main, the amount of steam will vary, according to the make of gas—whether it be ten, fifty, or a hundred pounds—and all without any attention on the part of the men, except to replenish the fire.

The Yonkers (N. Y.) Gas Light Company have had the apparatus in successful operation for several months past, where it can now be inspected. It is claimed to dispense with the engineer in many places, besides performing his work in a better manner; to save fuel, as burning to waste is prevented; to preserve the boiler, since the door need not be opened except when the fire requires renewal, and to obviate the use of compensators and engine governors.

The invention was patented through the Scientific American Patent Agency, August 4, 1874, by Mr. James Slade, of Yonkers, N. Y., who may be addressed for further information.



SLADE'S AUTOMATIC FIRE GOVERNOR FOR GAS WORKS.

IMPROVED COAL SCREEN.

The invention which we illustrate herewith will be found a very convenient device for use in coal yards, since it allows of the separation of the coal from the adhering dust and small particles with much less trouble to the workman than is necessitated in employing the ordinary screen. It consists of a box having an inclined open front portion for the reception of the screen, which last is supported by the projecting ends of its side pieces resting against the bottom portion of the box, while its upper part is sustained by levers, A. These levers are pivoted to the side walls of, and inside, the box, and are adjustable so that the screen may be inclined to any angle, as required by the quality and size of coal, ore, sand, or other material to be treated.

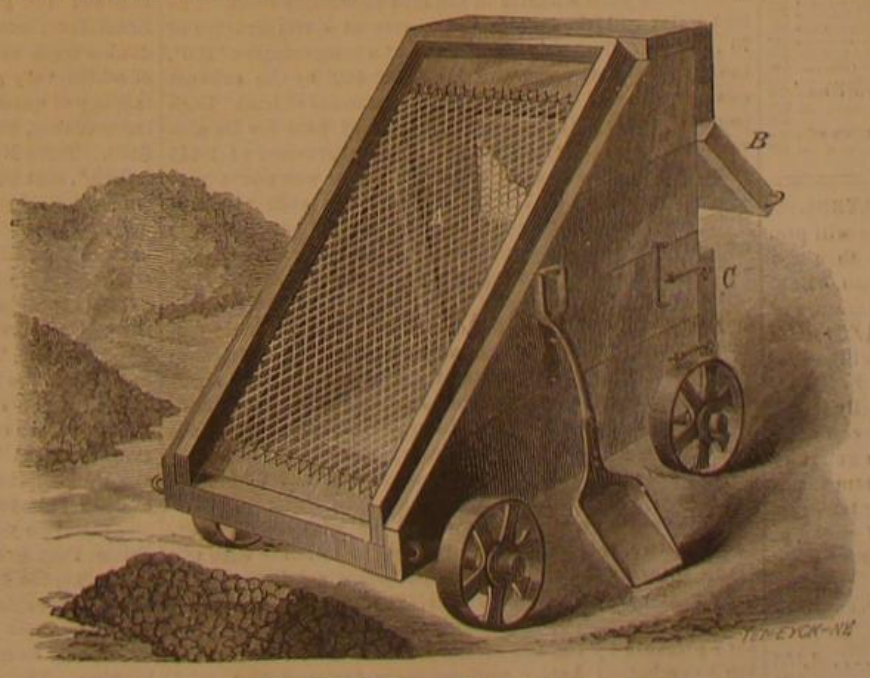
The rear portion of the box has an upper hinged door, B, which is provided with suitable latches, and there is also a detachable door, C, secured by hooks and staples or other convenient fastenings. The apparatus is mounted upon trucks, so as to render it readily transported from point to point in the yard.

As the material is thrown against the screen, the fine stuff falls through and into the bottom of the box. When a quantity has accumulated, the upper door, B, is opened, and a rake is introduced to draw the screenings to the rear of the receptacle. As soon as the latter is full, the device is wheeled away to the dumping spot, the lower door also removed, and the contents withdrawn.

This simple arrangement prevents the laborious carrying of heavy screens about a yard, and, besides, preserves the yard free from unsightly heaps of dust and refuse to collect. Since there is no possibility of anything passing through the screen, except small fragments, the waste of good coal—which often happens through pieces from the screened heap becoming mixed with the sifted stuff, and requiring too great a loss of time to pick out separately—is avoided.

The doors may be arranged at the side, or a trap may be provided at the bottom, as most convenient.

Patented through the Scientific American Patent Agency, by Mr. Henry L. Leach, of foot of E. 36th street (E. R.), New York city, who may be addressed for further information.



LEACH'S COAL SCREEN.

Consumption of Wood by Railroads.

At the end of 1873, there were reported 71,564·9 miles of main lines, and 13,512 miles of sidings and double tracks, making 85,977·9 miles of railroads within the United States. Of the main lines, 5,462·3 miles were in the New England States, 14,209 in the Middle States, 33,905·9 in the Western States, and 2,681·3 in the Pacific States. Upon these roads locomotives were running, and a large proportion of them used wood for their fuel. The number of ties used varies from 2,200 to 2,800 per mile. If we take 2,500 as a mean, we find that 212,693,500 pieces of timber, eight feet long and from six to eight inches between upper and lower surfaces, are required to supply this single item.

The durability of ties varies with the kind of timber, soil, climate, and use, ranging from four to ten years. Taking six as an average, the amount required for annual supply must be 35,448,750 pieces, or 94,530,000 cubic feet. In considering this, we must remember that a large amount of waste occurs from hewing, and from leaving the upper parts of trees, some of which are used as firewood, the remainder being a total loss. It must also be borne in mind that the demand for timber by railroads, besides for ties and for fuel, is very great, including fencing, bridges, buildings, and structures of various kinds; that the risk from fires is exceptionally great, and that our requirements in this direction are increasing even more rapidly than our supplies are wasting.—*National Car Builder.*

A New Plaster Bandage.

A surgeon connected with the Southern Dispensary, in Brooklyn, N. Y., has recently invented a new method of applying the plaster splint, which, according to the *Tribune*, promises to be an important improvement. A common merino sock is drawn upon the foot and leg. It may extend as far up as is necessary to include the fractured locality. A small rope is run down the back seam in the center of the leg, around the heel and over the toes, returning up the middle of the instep and front of the leg. Six or seven pieces of flannel are then cut out to fit the leg and foot, allowing for shrinkage. The ends of the bones having been carefully adjusted, the stocking, upon which the rope has been attached as described, is drawn upon the foot and leg. The flannels are soaked in warm water and applied, the plaster of Paris paste being rubbed in with layer after layer. After the last layer has been applied, the plaster is allowed to set. When the plaster has become hard, the splint is perfect, and the patient can get about, on crutches, very comfortably. If the leg swells, and it is necessary to remove the bandage, the whole thing can be done inside of three minutes. The cord that has been run around the stocking now forms a line of division in the splint. To remove the splint, all that has to be done is to slip out the cord and slit up the stocking along the line where the cord was. Then the splint, divided in halves, can be removed as though it had been laid upon the limb to obtain a cast. Considerable time is thus gained by using this method of applying the plaster splint. When the broken limb becomes inflamed, it also is extremely painful and very tender to the touch. The slightest jar sends a thrill of pain through the body of the patient, who has sometimes been obliged to be chloroformed to enable the surgeon to remove a plaster splint applied with a bandage. By the new method, the limb need hardly be moved or touched.

Natural Gas for Fuel.

Messrs. Rogers & Burchfield, the makers of a well known brand of sheet iron, at Leechburg, Pa., produce weekly about 70 tuns of such iron; to make this amount 9,100 bushels of coal, or 140 bushels per tun, would be required if they used coal for fuel. They have now been using gas for seven months, procuring it from an abandoned oil well, 1,250 feet deep, situated about 1,000 feet from the works, and from which the gas is conveyed by a three inch pipe. The branch pipes leading to each furnace are half an inch in diameter. They have one battery of four boilers, driving an engine of six foot stroke, thirty inches in diameter, at the rate of forty-five strokes per minute, which furnishes power for six pairs of sheet rolls and one bar train, steam being taken from the same boilers to drive two hammers; another boiler furnishes steam for a blowing cylinder, which supplies the blast for seven knobbling fires and one refinery; another boiler furnishes steam for a small engine driving the rolls for the manufacture of tin plate. This is all done by gas, which is also applied directly in five puddling furnaces, in which the waste is three or four per cent less than with coal, and the quality of the iron is greatly improved; they also furnish gas for four sheet furnaces, and find it much superior to coal, the waste in these furnaces being about five per cent less than with coal; and further advantages gained are softer iron and a finer surface to the sheet. They have three large annealing furnaces, where they anneal in airtight boxes, putting about ten tuns in each box, requiring about ten hours to complete the process of annealing, at a saving of about one half in annealing boxes; and in the tinning establishment the pots of tin, into which the sheets of iron are dipped, are also heated by gas.

To use gas there is no change required in the construction of puddling furnaces, except that they use the patent water necks. These necks are an absolute necessity in using gas for fuel, as without them the intense heat, generated by the

gas, destroys the lining of the stack and melts off the dampers as fast as they can be replaced. The grate bars, the manufacturers state, never burn out, and the puddler's tools last about three times as long as they did when coal was used. In furnaces where the water necks cannot be used, they are compelled to use a jet of steam to lessen the heat.

Their production has increased about thirty-three per cent since they began to use gas, and the iron made commands from $10 to $20 per tun more than the same class of iron manufactured at the Apollo works, where they use coal, the iron being made from the same class of stock. These facts were communicated to the American Iron and Steel Association.

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GAIN FROM THE USE OF FEED WATER HEATERS.

In an ordinary boiler, one pound of average coal will produce by its combustion between eight and nine thousand units of heat that are available for generating steam. Supposing the feed water to enter the boiler at a temperature of 32° Fah., each pound of water will require about 1,200 units of heat to convert it into steam, so that the boiler will evaporate between 6¾ and 7¼ pounds of water per pound of coal. Better results than these are often realized, especially in the case of tests, but the figures given above are believed to correspond with those of ordinary practice. The amount of heat required to convert a pound of water into steam varies with the pressure, as will be seen by the following table:

Units of heat required to convert one pound of water, at the temperature of 32° Fah., into steam at different pressures:

Pressure of steam in pounds per sq. inch, by gage.	Units of heat.	Pressure of steam in pounds per sq. inch, by gage.	Units of heat.
1	1,148	10	1,155
20	1,161	30	1,165
40	1,169	50	1,173
60	1,176	70	1,178
80	1,181	90	1,183
100	1,185	110	1,187
120	1,189	130	1,190
140	1,192	150	1,193
160	1,195	170	1,196
180	1,198	190	1,199
200	1,200		

If the feed water has any other temperature, the heat necessary to convert it into steam can easily be computed. Suppose, for instance, that its temperature is 65°, and that it is to be converted into steam having a pressure of 80 pounds per square inch. The difference between 65 and 32 is 33; and subtracting this from 1,181 (the number of units of heat required for feed water having a temperature of 32°), the remainder, or 1,148, is the number of units for feed water with the given temperature.

In the use of an ordinary non-condensing engine, in which the steam is exhausted directly into the atmosphere, each pound of steam, as it escapes, carries off the greater part of the heat that it has received in the boiler. This can be rendered plain by an example: Suppose the feed water enters the boiler at a temperature of 70°, that the pressure of steam is 90 pounds per square inch, and that the back pressure in the cylinder, under which the steam is exhausted, is 1 pound per square inch:

Temperature of feed water	70
Subtract	32
Difference	38
Units of heat required to convert 1 pound of water at 32° into steam at 90 pounds pressure	1,183
Subtract	38
Units of heat required to convert 1 pound of water at 70° into steam of 90 pounds pressure	1,145
Units of heat in 1 pound of steam at 1 pound pressure, from water at 32°	1,148
Subtract	38
Units of heat imparted to feed water, that are carried off by each pound of exhaust steam	1,110
Multiply this by 100	111.000
Divide by 1,145	96 941

which is the percentage of the heat, imparted to the feed water, that is carried off by the exhaust steam.

There remains, then, only about 3 per cent of the heat, imparted to the water by the combustion of the coal, that is utilized in the engine. This is a rather serious consideration for the steam user, who may figure up his account with the boiler and engine somewhat after this manner: One tun of coal costs $6.50, and evaporates, by its combustion, 15,000 pounds of water, at a cost for fuel of $0.00043+ per pound. When the steam resulting from the evaporation of this water is used in the engine, 96·94 per cent of the heat imparted to it by the fuel is exhausted into the air. This is the same as throwing away 14,541 pounds of the water that has been evaporated, leaving 459 pounds for useful work, so that really each pound of water used in the engine costs $0 014+. There are very many engines running today to which this account will apply, engines that are sending into the air nearly all the heat imparted to the water by the fuel. We showed, in a preceding article, how considerable saving would generally result by attaching condensing apparatus to a non-condensing engine. This cannot always be done, however; but there are means by which some of the heat carried off by the exhaust can be utilized. The most obvious method is to turn the exhaust steam into vessels through which the feed water passes, so that some of its heat may be imparted to the water, which will then require the consumption of less fuel for its conversion into steam. There are a number of heaters in the market which are guaranteed by their manufacturers to deliver the feed water into a boiler at the temperature of 212°, and we can state from our own experience that this is not an uncommon result, while a temperature of at least 200° should be realized from the use of any good heater. It may be profitable to consider the effect of attaching such a heater in the case previously cited. The feed water will then enter the heater at a temperature of 70°, and be delivered into the boiler at a temperature of 200°, having had its temperature increased 130° by the exhaust steam, which has lost a corresponding amount of heat. Each pound of water will require 1,015 units of heat for its conversion into steam of 90 pounds pressure, instead of 1,145 units, which were needed when the heater was not in use. This gives a gain of 130 units of heat for each pound of water evaporated, being 11 35+ per cent less heat than was required when the feed water was pumped into the boiler at a temperature of 70°. Each pound of exhaust steam, also, instead of carrying off 1,110 units of heat into the air, will only take 980, or 11 71+ per cent less than it formerly did. The account previously given will now figure up as follows:

The combustion of one tun of coal will evaporate about 16,900 pounds of water, at a cost of $0.00038+ per pound. In the engine, an amount of heat corresponding to about 16,300 pounds of the steam is thrown away in the exhaust, leaving 600 pounds for useful effect, at a cost of $0.0108+ per pound.

These examples, which correspond well with cases in ordinary practice, will enable our readers to estimate with tolerable accuracy the results that will be realized from attaching a heater in any given instance. It will be observed that, in the case supposed, no allowance was made for increased back pressure by the use of the heater. This was because the hypothetical heater was properly designed. A good heater does not increase the back pressure in the piston. There are many forms of the apparatus, however, that offer so much resistance to the escape of the exhaust steam, as to more than neutralize the gain that would otherwise be derived from their use. It is easy to see, for instance, that if the introduction of a heater increased the heat of the feed water 10 per cent, but also increased the back pressure so as to call for the expenditure of 12 per cent more fuel, the arrangement would be anything but economical.

A SPECIAL EDITION OF THE SCIENTIFIC AMERICAN.—ONE HUNDRED THOUSAND COPIES.

We shall, during the coming month of December, issue a special edition of the SCIENTIFIC AMERICAN, aggregating one hundred thousand copies, which will be gratuitously circulated among manufacturers of all kinds, machinists, mill owners, and, in brief, representatives of all industries in the United States and in Canada. At considerable outlay of time and expense, we have procured a list of one hundred thousand names, embracing the leading business men of the above important classes; and to each individual a copy of the SCIENTIFIC AMERICAN, enclosed in a separate wrapper and prepaid, will be mailed. The item of postage alone will thus cost the large sum of two thousand dollars, and the issue will find its way into every post office in the country.

Our motive for printing this extra edition, at an outlay of some six thousand dollars, we do not desire to conceal, nor could we do so even if such were our wish. Our aim is to increase our subscription list; and in pursuance of this object, we take such means as will enable others beside ourselves to derive benefit from the enterprise, in direct proportion to the amounts they invest in its furtherance. To this end, therefore, we propose to admit a few advertisements. It will readily be apprehended that, since the publishers are distinctly pledged to print the large special edition above noted, and to mail the same (prepaid) to names selected with care and judgment, every person having goods, productions, or ideas to bring to the notice of the class above mentioned is here furnished with the means. Moreover, it should be remembered that the names to which we refer are not those of our regular subscribers, but of business men not accessible through the ordinary newspaper channels.

We would direct especial attention to the fact that, although a circulation of 100,000 copies is guaranteed, there is every probability that this will be greatly exceeded. Our offer of last year included a circulation of but 60,000; but before we had supplied the demand, 120,000 copies were printed and mailed. For this immense excess, we imposed no extra charge upon our advertisers. The same course will be adopted this year. The extra benefit is given freely to those firms who send us advertisements for the special edition.

To the enterprising manufacturers and inventors who advertise in our regular columns, and indeed to everybody at all conversant with the advantages of a good medium, we need not point out the benefits to be derived from our proposition. For further particulars, see advertisement on another page.

COST OF TUNNELS.

"Among the various plans for disposing of the Jones' Falls stream or improving its channel, which have been presented to the council committee, is one by J. E. Sudler, civil engineer, proposing to divert it by a tunnel from a point beyond the city across to the valley of Gwynn's Falls, and thus throw its waters into the middle branch of the Patapsco, or Spring Gardens. This tunnel would pass in good part under Druid Hill Park, and through a rock formation which, it is believed, lies beneath all the hills in that quarter. Never having looked to diversion in that direction, and without pretending to have examined into or formed any judgment in the premises (the plan lately suggested by the mayor in his special message to the council for improvement within the city being still pending), it may yet be worth while to inquire into what has been the cost of like tunneling, accomplished in other parts of the world. The aggregate cost of this tunnel for Jones' Falls, the length of which is 16,000 feet, is put by its author at $2,300,000, or $145 per lineal foot, which is a fraction over $2 per cubic yard. With regard to other tunnels already in existence, their cost is given as follows: The great Mont Cenis tunnel cost about $300 per lineal foot, including equipment of road, etc. The Kilsby double track railroad tunnel (England), in the construction of which very great difficulties were encountered from the tapping of quicksands, cost $262.50 per lineal foot. Bletchingly tunnel, for a double track railroad in England, cost $120. Terre Noire, on the Paris, Lyons, and Mediterranean railroad, cost but $50 per foot; and the very difficult Hauenstein tunnel, between Basle and Berne, Switzerland, cost $133 per lineal foot. The Hoosac tunnel, through a formation of mica slate and quartz, with working shaft upwards of 1,000 feet in depth, cost $300 per lineal foot.

These tunnels were all completed several years ago, and the cost per cubic yard of material excavated varies from $1 50 to $14. The difficulties met with in their execution have led to the invention of improved apparatus, by the use of which the cost of boring, drilling, etc., is reduced from 100 to 300 per cent. The diamond boring machine was thoroughly tested by Captain Beaumont, R. E., in Lancashire and Cumberland. At Stoughton, the borer reached a depth of 689 feet in two months, that could not have been got at in less than two years by hand labor. In the Clifton tunnel, Bristol Port and Channel Dock Railroad, in hard mountain limestone, the drills advanced at the rate of two inches per minute—outside diameter of boring, two inches. The machine advanced at about five times the speed that could be attained by as many men as could find room to work at a heading. The motor is compressed air. Dynamite is used for blasting, and found to answer admirably. With the aid of these machines the work of tunneling through the hardest rock presents no difficulties of any extraordinary character, and may be executed at a cost very little, if any, greater than the excavation of the same material in open cutting."—*Baltimore Sun.*

To the above, may be added the cost of that portion of the Underground Railway, in New York city, now nearly completed, on Fourth Avenue, between 44th street and Harlem

river at 133d street, a distance of about 4½ miles. This railway has four tracks, and consists chiefly of open cuts and tunnels, but includes a massive stone viaduct 60 feet wide, 30 feet high at greatest elevation, and about 6,500 feet long. The open cuts are about 66 feet wide, walls included, and from 10 feet to 14 feet deep, spanned at the street crossings by splendid iron bridges. The tunnels are of three kinds, brick arches, flat iron beam tunnels, and rock tunnels. They consist of three parallel tunnels, one central and two separate side tunnels, all occupying a space under the streets of about 70 feet in width by 30 feet in depth. At about every half mile are roomy passenger stations and waiting rooms, also constructed underground, lighted from the sidewalks. Altogether this is one of the finest examples of underground railway construction in the world. It has been in progress for the past two years, and will be finished in January next. The total contract price of this great work, including stations, bridges, ballasting, viaduct, tunnels, changes of water pipes and sewers, is $6 395,070, being at the rate of a little under $285 per lineal foot. Considering the large size, this is a very moderate cost; and for once the city of New York, which pays one half of the bill, has not been cheated or imposed upon.

We recently made a personal inspection of the work from beginning to end, carefully examined all the details of construction, and were much gratified to observe the extreme care taken to render every portion solid and enduring. We shall in our next commence a detailed account of the entire line, drawings for which have been kindly supplied to us by the officer in charge. These papers will be read with interest by civil engineers in all parts of the world, as they involve many practical examples of the most recent construction, executed under the supervision of individuals of eminence in the profession.

EXPLOSIVE WOUNDS FROM NON-EXPLOSIVE BULLETS.

The use of explosive bullets in war is forbidden by international agreement. During the Franco German war, the French were repeatedly accused of violating this humane compact; and the charge, though indignantly denied, seemed to be justified by the nature of the wounds which the German surgeons had to deal with. Where the ball entered, a small round aperture would be observed, while its course within the body would frequently be marked by a fearful shattering of bones, and its aperture of exit would show a ragged opening that one could thrust his fist in. Only by the explosion of the ball on striking the bone, it was thought, could such mutilation be possible. The accused have now the full though tardy satisfaction of having their innocence thoroughly established by German investigations.

In a paper read last year before the German Surgical Congress, Professor W. Busch, of Bonn, called attention to the fact that wounds such as had been attributed to explosive bullets were made by the Chassepôt bullet fired at short range. He explained the phenomenon by supposing that the ball became melted and broken up by forcible contact with the bone, and acted like a mass of shot on the parts beyond. That the ball would be heated by the sudden arrest of its motion, full or partial, could not be doubted; and the spreading of the ball in star shape when fired against an iron target was urged as proof that the heating may be sufficient to melt the lead.

Dr. Augustus Küster was not satisfied with this explanation, and has since been conducting experiments on gunshot wounds in animals at the Royal Military School at Spandau, the results of which have been published in a late number of the *Berliner Klinische Wochenschrift*. In making the experiments, a large target was placed behind the animals (horses and wethers), so that the condition of the bullets could be observed after their passage through the bodies. The distances were five, twenty, one hundred, and eight hundred paces. The arms used were a muzzle-loading sporting rifle throwing a pointed bullet, the needle gun, and the Chassepôt, Mauser, and Henry-Martini rifles. The animals were first killed by a volley from all the weapons, and subsequently the carcases were used for further experiments. Omitting details of interest only to surgeons, the results of the investigation may be summed up as follows:

1. There is no essential difference in the action of bullets on the living and on the dead body. Heretofore the opinion has been that gunshot wounds are more extensive in the living than in the dead body, and that by the wound it can be told whether the injury was done before or after death—a position no longer tenable. Owing to the greater toughness of the skin of animals, the aperture of exit is not so large as in the human body; the destruction of the flesh and bones, however, is equally extensive.

2. The extent of the destruction is in inverse ratio to the distance, and in direct ratio with the initial velocity of the bullet. The sporting rifle made the simplest wounds. Then followed the needle gun, the Chassepôt, and the Mauser rifle, which produced frightful destruction of the bones and soft parts.

3. The destruction of the tissue is produced by the lead becoming heated and broken up, but without being melted. The bullet is mechanically divided, leaving the finer particles of lead in the recesses of the wound, while the fragments of larger size pass out along with pieces of shattered bone, flesh, etc. Most of the Chassepôt and Mauser bullets, which have the greatest initial velocity, passed through the animals' bodies reduced by one half or more, and greatly altered in shape, making on the target an irregular impression, surrounded by a crown of small pieces of lead, carrying fragments of bone, muscle, hair, etc. The wounds made at short range were frightful.

4. The injuries described are made only by bullets of soft lead. The Henry-Martini rifle stands alone in using a ball of hard lead, or lead mixed with tin in the proportion of twelve parts to one. The initial velocity of the ball thrown by this rifle is almost as great as that of the Mauser, yet the wound produced by it is very much smaller. It makes a clean hole through flesh and bone neither shattering the bone nor leaving splinters of lead in the course of the wound. In one case only did Dr. Küster find a Henry-Martini bullet much misshapen, and that time it remained sticking in a bone. On but one occasion, when fired at a hundred paces, did it fail to pass through the longest diameter of a horse, while the Mauser bullets frequently remained in the wounds, owing to the greater resistance they had to overcome in consequence of their greater misshapement.

Having shown that bullets of soft lead fired at short range act just like explosive bullets, and that a close combat with them can be nothing but a horrible butchery, Dr. Küster protests against their use; and as a duty to a brave opponent, he takes pains to say that the French stand thoroughly acquitted of the charge of having committed an act of unworthy and interdicted barbarity.

WHAT TEMPERATURE KILLS?

At the present stage of enquiry, the very important biological question whether life does or does not ever appear otherwise than as a product of antecedent life plainly hinges on the simpler question: What temperature kills? In other words, what degree of heat is certainly fatal to living matter? A boiled egg will not hatch, boiled seeds will not germinate; no animal or plant thus far experimented on has been found to survive exposure to boiling water. Yet the appearance of living forms within hermetically sealed flasks, the contents of which have been boiled ten minutes or more, has been observed by too many trustworthy witnesses to be longer doubted. The question to be settled is: Are there any forms of living matter, germs, seeds, or what not, that can endure 212° of temperature by Fahrenheit's scale? And if so, what higher temperature certainly kills them?

The first to attack the problem with scientific thoroughness and care was the acute and learned Abbé Spallanzani, something over a hundred years ago. At that time Needham was advocating the doctrine of spontaneous generation, on the strength of experiments similar to those which later investigations have made familiar. Spallanzani repeated the experiments, and found that the lower infusoria certainly would appear within closed vessels previously subjected to boiling heat. The organisms themselves were killed by a temperature of 108½° Fah. Unwilling to accept the conclusion arrived at by Needham, the Abbé assumed that the unknown germs of the infusoria must be able to withstand the higher temperature, and thereupon set to work to discover whether the difference in the capacity of resisting heat, imagined to exist in this case between parents and germs, could be justified by the establishment of similar differences in heat-resisting capacity between other parent organisms and their germs. By a careful series of experiments, he found that, while frogs and tadpoles perished at 111° Fah., frogs' eggs appeared in some cases to resist the temperature of 131° Fah., none, however, surviving 144½° or upwards. Aquatic salamanders and fish were likewise killed by water having the temperature of 111°. Silkworms' eggs and the eggs of the elm moth failed to germinate after being heated to 140° Fah. The developed worms died at 108½°. Leeches perished at 111°; the *nematoids* known as vinegar eels, at 113°; other aquatic worms at 111°, and water fleas at 107°. Thus, while about 110° Fah. sufficed to kill matured forms, their eggs were not killed under about 140° Fah.

Observations on seeds and plants were conducted in a similar manner, the water being heated slowly and the seeds and plants taken out as soon as the desired temperature was attained. Not one seed germinated after exposure to boiling water. Of the corresponding plants a few survived a momentary exposure to 156°, none the temperature of 167°. (The grades of heat experimented with differed for the most part by 5° Réaumur, or 11½° Fah., so that the thermal death point was not precisely noted.)

From these experiments it was manifest that (1) eggs can endure a higher degree of heat than the animals from which they are derived: (2) a similar difference exists between plants and seeds: (3) seeds and plants resist higher grades of heat than eggs and animals. Not a single living thing, however, egg or seed, animal or plant, survived a brief exposure to a moist heat of 212° Fah.

To the dryness of seeds was evidently due their ability to withstand heat better than eggs. Certain eggs resemble seed in that they may be dried and yet develope after being placed in a suitable damp medium. Might not the germs of the lowest animalcules likewise withstand desiccation, and in a dry state excel seeds in power to bear heat, as the seeds excel eggs? Inasmuch as the germs in question were invisible and unknown, they could not be subjected then to the test of certain experiment; and on the ground of their hypothetical existence and power, Spallanzani was able to refuse assent to the probability of the germless origin of living matter in the cases under consideration.

Unfortunately for the panspermatist position, Spallanzani's assumptions are not merely not sustained but are positively contradicted by more recent investigations. Professor Burden Sanderson shows that, so far from being able to withstand desiccation, the germinal particles of *bacteria* are killed by simple exposure for three days to dry air of the low temperature of 104° Fah., and that the fully formed animalcules are deprived of their power of further development by thorough desiccation. Further, Dr. Charlton Bastian (who reviews this question of the thermal death point of matter very fully in the *Contemporary Review* for September) has shown that all direct experiment, on the power of *bacteria* and their germs to withstand heat, leads to the conclusion that they are both killed by a brief exposure to a moist heat of 140° Fah. Many investigators, working independently of each other, and often without reference to the origin of life question, coincide in showing that, with certain peculiar exceptions, the temperature of 140° Fah., with moisture, is fatal to living matter.

In very many, if not most, cases the death point is much lower. Thus according to the observations of Spallanzani, Max Schultze, and Kühne, simple aquatic organisms die under temperatures ranging from 104° to 113° Fah. According to Kühne, elements of the cold-blooded frog are killed at 104°. Stricker and Kühne agree in fixing the thermal death point of the tissue elements of warm-blooded man at 111°; that of the tissue elements of plants, according to Max Schultze and Kühne, is from 116½° to 118½°: while Spallanzani, Liebig, Tarnowski, and others find that eggs, fungus, spores, and *bacteria* germs are killed at temperatures between 122° and 140°.

The exceptional cases are the *confervæ* and allied organisms observed by Dr. Hooker in Sorujkund, flourishing in a hot spring of the temperature of 168° Fah.; others in water of 174°, as observed by Captain Strachey in Thibet; in 185°, as observed by Humboldt in La Grinchera; 190°, as observed by Dr. Bremer in California; and 208°, or 4° below the boiling point of water at sea level, as observed by Descloizeaux in Iceland.

"It is a well known physical fact," says the late Professor Wyman, commenting on the examples of life at high temperatures above given, "that living beings may be slowly transferred to new and widely different conditions without injury; but if the same change is suddenly made, they perish. In the experiments made in our laboratories, the change of conditions is relatively violent, and therefore liable to destroy life by its suddenness."

Even if it were possible for living organisms to withstand suddenly the temperature to which these exceptional growths have become inured through long periods of time, the difficulty attending the appearance of living forms, in hermetically sealed flasks which have been previously heated as high as 275° Fah., as recorded in Dr. Bastian's latest experiments, would not appear to be greatly lessened. The evidence is overwhelmingly against the survival of living matter after prolonged boiling, much less after exposure to a temperature sixty degrees higher.

SCIENTIFIC AND PRACTICAL INFORMATION.

WORKING MEN'S HEALTH.

From a report of Dr. Waller Lewis, a noted English physician, regarding the health of French working men, it appears that the percentage of deaths from consumption, in 1,000 cases collated, is for various trades as follows: Exposed to vegetable or mineral emanations, 176; to dust and fine particles, 145; sedentary occupations, 140; employed in close workshops, 138; exposed to hot and dry air, 127; requiring active muscular exercise, 89; requiring exertion of voice, 75; working in open air, 73; exposed to animal emanations, 60; the remainder being made up of persons working in a stooping posture, exposed to sudden movements of the arms, or exposed to watery vapors. Concerning the effect of various employments on the eyesight, it seems that the sense is injured by those working with polished metals, looking glasses, etc. The smallness of objects and intensity of direct or reflected light is also a cause of impaired vision; while astronomers who study the sun have become totally blind, and opticians who daily exercise and test spectacles, etc., engravers, watch makers, etc., are liable to amaurosis and amblyopia.

THE POPULATION OF CHINA.

Abbé David, who has recently devoted some years to the the exploration of Chinese territory and the study of the people, says that the estimate of statisticians that the total population of the Chinese Empire is but 100,000,000 souls is entirely incorrect. The error is due to the terrible ravages made in certain small political divisions, which have rebelled at times, and in which wholesale massacres have reduced the inhabitants to one half and in some cases one fifth their former numerical strength. The province of Kiangsi is, however, the least populated, and the average of each canton therein is 4,000 people. There are 4,345 cantons, making an approximate total of 17,380,000 inhabitants. Among the 18 provinces of the Empire, it is certain that several largely exceed Kiangsi in population; but taking the above given aggregate as a unit, there must be at least 300,000,000 individuals in the country.

ACTION OF SULPHURIC ACID ON LEAD.

From recent experiments by H. A. Mallard, it appears that acids below 61° Baumé, concentrate by boiling until they attain a temperature of 433° Fah., or that at which acids at 61° Baumé boil. They then attack lead, producing sulphurous acid and some sulphate of the metal. Acids above 61° Baumé and below 65·5° Baumé concentrate by ebullition up to 780° Fah., the boiling point of acids of the latter density, when they attack lead, producing sulphate of lead, sulphurous acid, and a little sulphur. Acids of 65·5° Baumé at 482° Fah. also attack lead, producing the results last mentioned.

THE EAST RIVER BRIDGE.—It is expected that in four weeks from this date the Brooklyn tower of the East River bridge will be completed. On October 24 a hight of 259 feet had been attained, and there were seven more courses, about 14 feet, of stone to be added. The anchorage on the Brooklyn side is also in a forward state.

PEAS THREE THOUSAND YEARS OLD.

In the course of late explorations in the ancient ruins of Egypt, General Anderson, an English traveler, found, inclosed in a sarcophagus beside a mummy, a few dry peas, which he preserved carefully and, on his return to Great Britain, planted in the rich soil of the Island of Guernsey. The seeds germinated, and soon two little plants appeared, from which, at maturity, sufficient peas were gathered to plant quite a large tract of ground in the following season.

Some of the plants thus raised have attained a hight of over six feet, and have been loaded with blossoms of exquisite odor, and of a delicate rose tint. The peculiar feature of the growth is the stem, which is small near the root but increases greatly in size as it ascends, requiring a support to sustain it upright. The pods, instead of being distributed around all portions of the stem as in the ordinary plant, are grouped (as shown in our engraving, extracted from the London *Graphic*) about the upper extremity.

The vegetable, it is said, belongs to the ordinary garden variety; but from its presenting the very distinctive differences above noted, it seems worthy of close botanical examination. The peas are of remarkably fine flavor, excelling in delicacy those of the choicest known varieties.

Discoveries by the Wheeler Exploring Expedition.

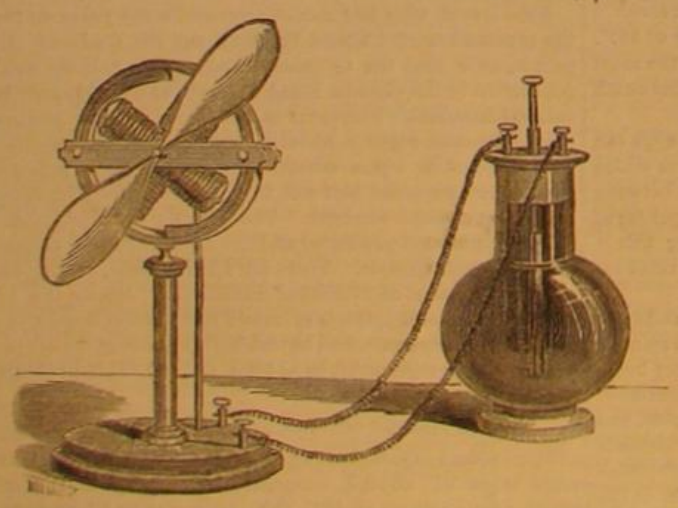
Professor Cope and Dr. Yarrow, of the Wheeler Expedition, have unearthed, in the valleys of the San Juan river, another immense deposit of fossil remains of prehistoric animals. A large number of vertebrates of enormous size, and of genera unknown to Science, have been found, together with others of very rare species, including skeletons of mastodons and mammoths, in a very perfect state of preservation. The fruits of the discovery are not yet classified and arranged, so that a complete list cannot be given; but specimens have been forwarded to Washington, where, we understand, the naturalists have already begun work upon them. The entire collection is said to be a most valuable contribution to palæontology, and will add greatly to our knowledge of that branch of Science. We notice, also, that the investigations as to the living animals of the country explored, are meeting with excellent results. As many as 1,000 birds' skins have been obtained, including several of new varieties of birds. Five new species of fishes, it is said, have also been discovered.

Waterproofing Compound.

This compound is prepared by melting paraffin and adding gradually a suitable drying oil, stirring well to insure intimate mixture; it is then poured into molds the shape of bricks or blocks, and allowed to cool. The fabric to be rendered waterproof is rubbed over with a block of the compound, warming the rubbing face gently if the atmosphere is cold, and then ironing the cloth with a warm iron, or passing it between hot rollers. The application of this compound to leather and textile and felted fabrics is said to give excellent results, as, although it renders the cloth thoroughly waterproof, it is not impervious to air.

THE AERIAL SCREW.

Under this name, M. De Fonvielle has constructed an apparatus for testing the powers of various electric batteries. Using a winged screw, in the form of a ship's propeller, he is enabled, by counting the rotations, to ascertain accurately



the power of any motor which he may apply to it. Our engraving shows clearly the manner of its use. With a screw of 12 inches diameter and a motor of three magnets weighing about 2 lbs. each, a speed of rotation of 5 turns per second was obtained from a battery equivalent to 6 Grove's elements. The speed can be minutely and precisely adjusted by varying the battery power, and experiments on the size and pitch of the blades of propellers can be readily made. The inventor, in *La Nature*, recommends it to Mr. Bowdler's notice, believing that it would be useful to him in his military balloon experiments, of which we gave an illustrated description on page 67 of our current volume.

Apparatus for Breathing Rarefied Air.

M. Bert, whose interesting researches of the effects upon animal life of compressed and of rarefied air we have fully described, suggests a simple device for use by travelers ascending high mountains or by aeronauts. It consists of a Y tube, one arm of which is connected with an oxygen bag made of inelastic material. The other arm is open to the atmosphere; and in a rounded portion inside, near its junction with the balance of the device, is a small balloon of elastic material filled with ordinary air. The mouth is applied to the end of the straight part of the Y. As the elevation of the person using the apparatus increases, the ball in the tube expands, owing to the decreased air pressure, and hence closes the orifice leading to the surrounding atmosphere. The supply for the lungs is therefore drawn in a greater proportion from the oxygen receiver, enabling the functions of respiration to continue without uneasiness.



PLANT GROWN FROM A MUMMY PEA.

Non-Corrosive Pipes and Plates.

A recent patent by W. A. Shaw, of New York city, has for its object to protect tubes or metal plates from corrosion by associating with them other metals or alloys, the presence of which renders the entire combination passive. It is known that the presence of platinum protects iron from corrosion, and that zinc will partially protect iron and copper. An instance of the last named fact is the well known application, by Sir Humphrey Davy, in sheathing vessels.

One method of carrying out the present invention is to make a pipe or tube of any one or more of the ductile metals, by drawing, rolling, or by pressing said metals out of a cylinder through a die. At the same time this operation is being performed, a ribbon, band, or wire of a protecting metal or metals is drawn through the die with the tube under treatment, emerging therewith, either wholly or partially inlaid within the inside surface of the tube. One or more such bands may be thus inlaid, and they may be alike, or of different metals. The inlaid bands may be embedded in the shell of the pipe, so as to be flush with the surface thereof, or they may be allowed to project, so as to present a greater amount of protecting surface.

It is alleged by the inventor that, when strips of lead and tin are simultaneously exposed to the action of water, the presence of the tin effectually protects the lead from corrosion, and that there is practically no corrosive action upon these metals when associated in this manner.

Changes of the Sun's Apparent Diameter.

The question of whether the sun's apparent diameter is subject to any changes which can be detected by observation is discussed in the *American Journal of Science and Arts* by Professors Newcomb and Holden. The calculations of these astronomers indicate that during some years (1864 and 1870, for instance) there was a tendency to a ten hour vibration of the solar diameter. The conclusion, however, is that this correspondence cannot be attributed to anything but chance.

New Railway Refrigerating Car.

Trial was made recently on the Great Western Railway, Eng., of a car, the invention of Captain Acklom, for the transport of meat in a purer and colder air than in the ordinary close cars, so as to preserve the freshness of the carcases. The car does not differ much in appearance from an ordinary railway wagon, and the patentee claims that it can be built at little more expense, and filled on occasion with any class of merchandise for which an artificially cooled temperature is not required. The body of the car consists of a double paneling of galvanized iron network, with the space between filled with two couches of inodorous absorbent felt, the outer one four layers thick, and the inner one, an inch apart from it, but a single layer. The mesh of the external panel is much larger than the corresponding mesh inside, in order to permit free ingress to the heat and atmosphere. The inner panel alone forms a ceiling to the chamber, and is covered with the felt, but with an interval of a couple of inches between its surface and the arched outer roof. The object of this arrangement is to admit the passage of a current of air when the car is in motion. Underneath is a tank from which water is driven by a forcing pump to a covered galvanized iron gutter, running round the edge of the roof, between the panels; the outer felt is lipped in this gutter, so that the water is bound to percolate through it to a metal-lined groove below, which returns the drip to the tank. The atmosphere coming in contact with the saturated felt causes evaporation, and lowers the temperature within, while the single inner layer of dry felt preserves the meat from moisture; and it is a curious fact, the warmer the weather is, the quicker the evaporation, and consequently the cooler the interior. The carcases are strung up on a row of double hooks inside, as in a butcher's stall, and it is stated that one car can carry those of 17½ bullocks, or eight tuns of meat. The trial may be pronounced satisfactory, although the car is still susceptible of improvements, the thermometer suspended within it having registered only 62° Fah., while that of the outer atmosphere was ten degrees higher. Captain Acklom undertakes to supply provisions sound and sweet to the salesman, even in the heat of the dog days, and to carry fish and newly killed meat two or three days, if necessary, untainted. Poultry, milk, vegetables, and fruit can also be transported, in all their freshness, in this felt convenience.

M. DE GROOF'S PARACHUTE.

On page 99 of our current volume, we mentioned the death of Vincent De Groof, who was thrown, from a flying parachute of his own construction, from a hight of 80 feet to the ground and instantly killed. We now publish an engraving of the invention, which was, in general plan, an imitation of a bat's wings, the framework being made of cane, and the intervening membrane of stout waterproof silk. "The wings were altogether 37 feet long, with an average breadth of 4 feet. The tail was 18 feet by 3 feet. These wings were inserted into two hinged frames, attached to a wooden stand, upon which the aeronaut took his place. He had three levers, which he worked by hand, to give his machine propul-



sion or guidance, as might be required. His theory was that, having started from a given hight, he could manage his descent so as to reach the earth by a sort of inclined swooping motion, without risk of concussion."—*Illustrated London News.*

The result to the constructor is given above.

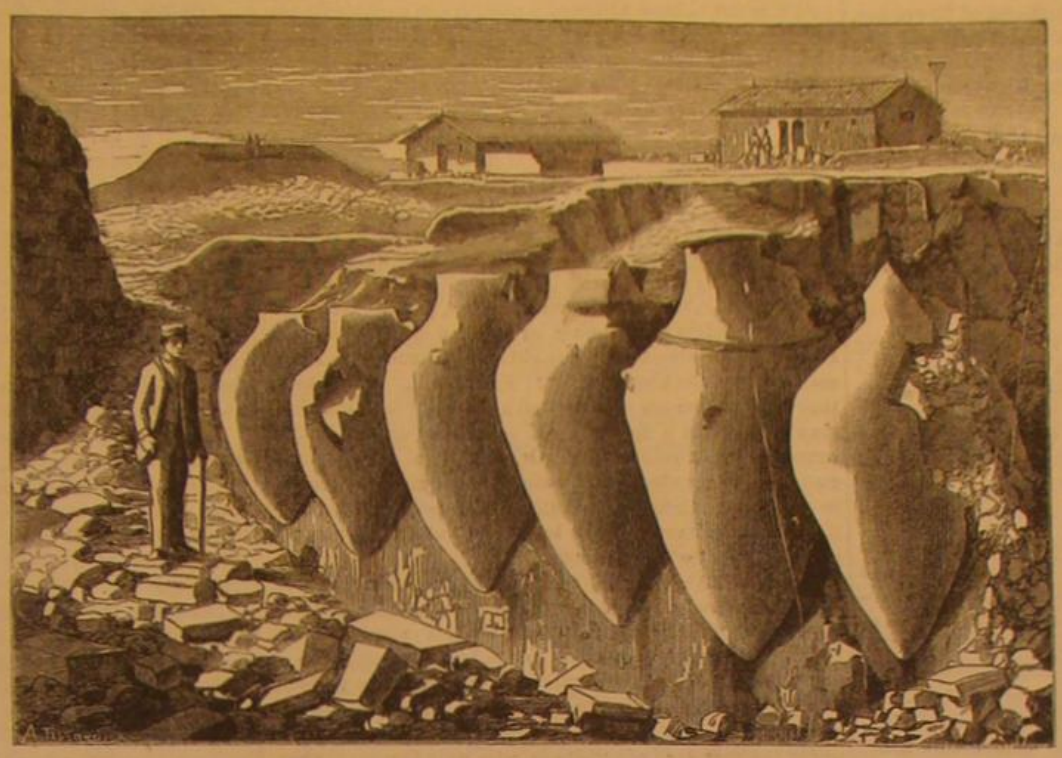
THE Metropolitan Railway of Constantinople is nearly completed. The brickwork of the tunnel, from Pera to Galatz, has been finished, and the rails are now being laid.

THE RUINS OF TROY.

The researches of Dr. Schliemann, on the supposed site of the city of ancient Troy, have recently been rewarded by discoveries which have a worldwide interest, proving not only the existence of the city, so often and so strenuously asserted to be purely mythical, but the general accuracy both of the Homeric and Virgilian, the Greek and Latin, accounts of the people, their celebrated citadel, and its ten years' siege. These revelations prove incontrovertibly that the site of the city, supposed by Herodotus, Xenophon, Plutarch, and many other writers to be on the hights now called Hissarlik, was accurately laid down by those writers.

Indications of a destruction by fire, terrible enough to have justified Virgil's tremendous description, have also been found; and the Trojan goddess (Minerva) is exhibited, in the form of her favorite owl, on vases and earthenware utensils, on metal implements and trophies, and in every possible form.

Several large earthen jars, of peculiar shape, were discovered by Dr. Schliemann; and we publish an engraving of them *in situ*, for which we are indebted to *La Nature*.



EARTHENWARE JARS FOUND IN THE RUINS OF TROY.

New Steamer.

A new and economical steamer, named the Ferdinand Vandertaelen, has lately been built and tried at South Shields, England. Her length is 273 feet; breadth, 34 feet, and depth, 24 feet 6 inches. The diameters of the cylinders are: high pressure 32 inches, and low pressure 60 inches, 3 feet stroke, working pressure, 70 lbs. per square inch; the maximum power developed was 395 in the high pressure and 408 in the low pressure engines, making a total of 803 indicated horse power. The coal burnt during the test was at the rate of 880 lbs. per hour, or 1·54 lbs. per indicated horse power per hour. The speed of the ship, ascertained by the patent log, was 11 knots per hour.

Predicted Failure of the Bessemer Swinging Saloon.

Our own experience at sea in all sorts of weather and in all kinds of boats—from a fisherman's coble in a chopping sea to the Irish mail boats in a gale—leads us to hold as a matter of faith that rolling does not cause sea sickness in even the most delicate organization, and that pitching does. The original Bessemer saloon provided for pitching as well as rolling, but the saloon as fitted on board the Bessemer can move athwart ship only, and consequently deals only with rolling. Mr. Bessemer has, in a word, abandoned the idea of contending with the true cause of sea sickness, and confined his attention to combating what is a very secondary evil indeed, if it can be called an evil in any sense as regards the causation of sea sickness. This being the case, a passenger on the deck abreast the saloon will be just as likely to escape the horrors of a Channel passage as if he were in the saloon, except in so far as the rolling of a vessel of such great width may in a measure approximate, in its effects on any one standing near the bulwarks, to the pitching motion of a shorter ship. The reason why pitching causes discomfort is, physicians tell us, because the contents of the abdomen rise by their own inertia, to speak a little incorrectly, against the descending diaphragm. The motion of a pitching ship in a gale is very considerable. Thus it has been shown that the taffrail of an American liner often falls through a vertical space of 30 feet in about one second when running in a heavy sea. The effect of such a drop as this is, beyond all comparison, more severe than anything rolling produces. We do not think that Mr. Bessemer was unwise to abandon that portion of his original scheme which dealt with pitching. It is very difficult, indeed, to see how, on the one hand, he could have retained it and a reasonably light draft of water together, and, on the other, of what possible utility it would be in his ship. The swinging cabin is already amidships, and will therefore have the least possible motion; and what remains, consisting as it does of the bodily rise and fall of the ship as she mounts a wave or it passes from beneath her, could not be affected by any mechanical expedient placed at mid length. To be really useful, the swinging saloon should be nearly as long as the ship, and at the same time narrow; and it should be so balanced, like a scale beam, and so geared that, however much the bows and stern of the hull rose and fell, the swinging deck would remain approximately horizontal. Thus, suppose that such a saloon was fitted to an Atlantic mail steamer, then a passenger berthed aft, instead of rising and falling through a range of 20 feet or so, perhaps six or eight times a minute with varying velocities, would always remain practically at rest, the ship alone rising and falling. Again, if it were possible, a small saloon near the bow might be mounted, say, on a hydraulic ram, and caused to apparently rise and fall, but really to remain motionless, while the ship pitched. In a saloon fitted in this way we believe that perfect immunity *from* sea sickness, or nearly so, might be secured. But Mr. Bessemer has done nothing of the kind, and his swinging cabin will be correspondingly inefficient. Whatever comfort the passengers within it may enjoy will be due not to the action of the cabin, but to its position in the mid length of the ship, where vertical motion is reduced to a minimum.—*The Engineer*.

Preserving Gum Arabic Mucilage.

A writer in the *Journal of Pharmacy* states that the instability of mucilage of gum arabic may be overcome by mixing with tolu water. Tolu water is prepared by rubbing two fluid drams saturated tincture of tolu with four drams carbonate of magnesia, and then adding two pints of water, and filtering. It is believed that tolu prevents changes in liquids upon the same principle and as effectually as benzoin obviates rancidity in unctuous substances. Its preservative influence might be utilized in the preparation of many sirups and mixtures which are remarkable for instability.

UNIVERSAL ANGLE BRICKS.

In order to build oblique angles in constructing brick walls, the usual plan is to have bricks specially made for the purpose (if the work be carried on during the brick-making season), or else to have the ordinary shaped bricks ground to the required form. That this entails trouble, delay, and expense, masons and architects are generally well aware; and hence no further reasons are needed for directing attention to a recent invention, which is designed to obviate the difficulties mentioned.

Fig. 1

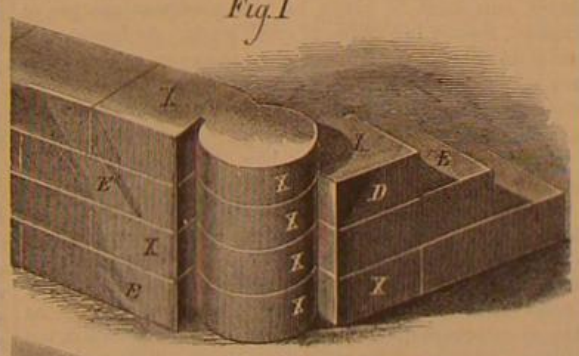


Fig. 2

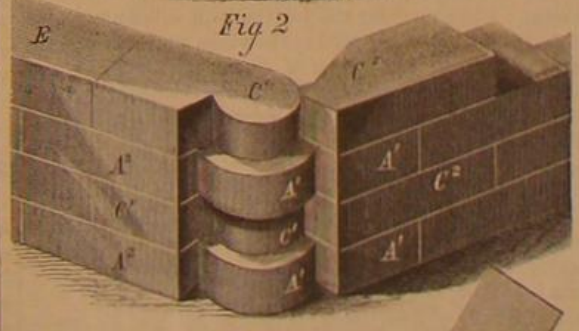


Fig. 3

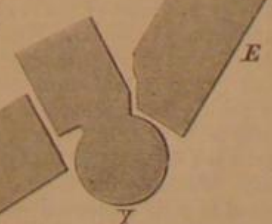
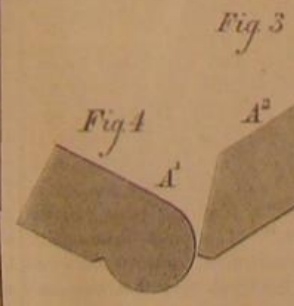


Fig. 4



It is proposed to manufacture the brick in the forms marked X, A^1, A^2, in Figs. 3 and 4. With X, an ordinary brick, with one corner broken off (laid beside it, as shown at E, Fig. 3) forms an acute angle. Referring to Fig. 1, the same shape, X, is combined with whole bricks to make an obtuse angle. It should also be noticed that the method of laying the bricks results in forming a perfect bond; thus, in Fig. 1, the second brick, X, from the top, instead of having its square portion directly under the corresponding part of the brick of like shape immediately above, has it on the opposite wing of the angle, at D. The fourth brick also has its square end on the same side, and the intervening space is filled with a common brick, E. In Fig. 4, both bricks are of particular form. A^2 has one end formed to certain angles, and A^1 is somewhat similar to X, though having certain easily detected points of difference.

In Fig. 2 a combination of forms A^1, A^2, C^1, and C^2 is shown, the mode of making the bond being as already described. Thus bricks of forms C^1 and C^2 are uppermost then forms A^1 and A^2 succeed, and so on alternately.

In Fig. 1 the result is a neat angle, ornamented beside with a beading; while in Fig. 2 the bead is rendered more ornate by alternating the forms A^1 and C^1. A handsome finish is thus given to the junction of the walls.

These bricks are, of course, susceptible of a variety of modifications in form, adapted to different classes of structures. It will readily be seen, however, that the principle is such as to enable any desired angle to be built without changing the figures of the bricks as produced by the manufacturers.

The inventor is Joseph E. Billings, of 33 School street, Boston, Mass., to whom all communications with reference to obtaining rights to manufacture, or for further information with regard to the uses and capabilities of the bricks, may be addressed. Patented September 1, 1874.

We understand that arrangements are now in progress for manufacturing in New York, Boston, and Philadelphia.

Mind Reading.

The professors of Yale College, New Haven, Conn., have lately been entertained by the performances of J. R. Brown, the mind reader. The learned professors indulged in hiding coins, pencils, cards, etc., in books, corners, and drawers. Brown was then placed *en rapport* with the hidee, that is, he took the hand of the person who hid the article, or took hold of a line held by that person. Brown, although blindfolded, would lead the individual to the exact spot, and find the article. Professor Thacher purposely imagined a pain located under his nose. Brown immediately placed his finger in the precise spot. Professor Marsh imagined a particular word, wrote it on paper, and gave it to another person. Brown spelled it out at once by pointing to the respective letters in an alphabet written on a blackboard. The venerable Ex-President Woolsey concealed a coin under some books, but his mind was probably hazy, for Brown could not quite find it, though he came near the spot. But when put *en rapport* with a younger man, Professor Whitney, Brown immediately found the coin. Professor Brewer placed a tape measure in a distant apartment; Brown promptly went, blindfolded, to the place and found the article. Professor Fisher gave a pencil case to Professor Johnson, who gave it to Professor Thacher, who concealed the article. Brown led the latter directly to the spot, and found the pencil. Professor Lyman held a paper on which words were written by Professor Fisher, and, blindfolded, Brown spelled the words without difficulty! Having witnessed so many of these curious experiments, it is to be hoped that the learned professors of Yale will be able to explain how they are done.

Artificial Bone Black.

The only process which allows of producing artificial decolorizing charcoals, approaching, in their properties to bone black, consists in impregnating woody matters with phosphate of lime dissolved in hydrochloric acid. The phosphates are thus distributed as they are in natural bones. The mass thus prepared is ignited. The difficulty consists in obtaining products of a sufficient density and mineral richness, and free from foreign salts. The charcoal obtained has to be washed in excess of water to remove chloride of calcium, if poor coprolites have been employed. The author uses the coprolites found in small granules in the gray phosphatic chalk of Ciply.—*M. Melsens.*

In our article on the hydraulic ram, page 259 of the current volume, the first part of the description of Fig. 4 should read as follows: The pipe, A, leads to a source of supply higher than the ram, and the pipe, B, connects with the place which is to be drained. The distance from the end of the pipe, B, to the valve, D, must not be greater than the hight to which water will rise in a vacuum.

From a late report of our diplomatic representatives in Paris, it appears that the commerce of the United States with that city reaches an aggregate of seventy millions of dollars per year.

ASTRONOMICAL NOTES.

OBSERVATORY OF VASSAR COLLEGE.

For the computations of the following notes (which are approximate only) and for most of the observations, I am indebted to students. M.M.

Positions of Planets for November, 1874.

Mercury.

Mercury rises on the 1st of November at 8h. 37m. A. M., and sets at 5h. 39m. P. M. On the 30th, Mercury rises at 5h. 23m. A. M., and sets at 3h. 33m. P. M. It cannot, therefore, be seen in the early part of the month, and in the latter part should be looked for in the morning.

Venus.

Venus is at its greatest brilliancy on the 2d of November, when it comes to meridian or souths at about half past two in the afternoon. It rises on the 1st at 10h. 22m. A. M., and sets at 6h. 36m. P. M. On the 30th, it rises at 8h. 25m. A. M., and sets at 5h. 7m. P. M.

It should be observed in the early part of the month, and can be seen, a very conspicuous object, in the southwest.

Mars.

Mars is not well situated for observation. It rises on the 1st at 3h. 11m. A. M., and sets at 3h. 21m. P. M., coming to the meridian in the daytime. On the 31st, Mars rises at 2h. 48m. A. M., and sets at 2h. 6m. P. M.

Jupiter.

Jupiter is not well situated for observation; and according to the *American Nautical Almanac*, its satellites cannot be seen before the 5th of November. It rises on the 1st at 4h. 46m. A. M., and sets at 4h. 2m. P. M. On the 30th, Jupiter rises at 3h. 21m. A. M., and sets at 2h. 22m. P. M.

Saturn.

Although Saturn is very far south in declination, it is well situated for observation, and will richly repay any one who looks at it, with the aid only of a small telescope. The ring is so situated that the base can be seen both above and below its plane, and on fine evenings the division of the ring can be traced. A telescope whose object glass is two or three inches in diameter will show the ring, and possibly the largest satellite, Titan. With a large telescope, the other satellites are seen as very minute points of light.

Saturn rises on the 1st at 1h. 10m. P. M., and sets at 10h. 46m. P. M. On the 30th, Saturn rises at 39m. before noon, and sets at 9 o'clock P. M.

Uranus.

Uranus rises at 11h. 22m. P. M., and sets at 1h. 28m. P. M. of the next day. On the 30th, Uranus rises at 9h. 28m. P. M., and sets a little before noon the next day. As it is in northern declination about 17°, it attains a good hight, and can be seen on the meridian in the early morning.

Neptune.

Neptune cannot be seen without a good telescope. On 1st, it rises at 4h. 32m. P. M., and sets at 5h. 40m. A.M. On the 30th, it rises at 2h. 36m. P. M., and sets at 3h. 42m. next morning.

Sun Spots.

The record is from October 2 to October 19 inclusive; but owing to cloudy days, photographs have been taken only on the 2d, 3d, 5th, 9th, 12th, 16th, 17th, and 19th. On the 2d a group of spots, comprising three of good size and several smaller, was seen within the eastern limb and below the center. Pictures of the 3d and 5th showed the same group moving across the disk with the revolution of the sun on its axis. On the 9th, the same group appeared just within the western limb, the three largest spots elongated and the faculæ very marked. Two pairs of small spots were also seen following the group, one above and the other below the sun's equator. On the 12th, all the spots seen in the last picture had disappeared except the lower pair, which had increased in size. On the 15th, appeared another pair, of about the same size as those last seen, and a single spot just within the eastern limb. On the 16th, the same spots, with another nearer the eastern limb, and on the 17th still another at the east and lower. On the 19th, no change was perceived except that caused by the sun's motion.

Barometer and Thermometer.

The meteorological journal from Sept. 20 to Oct. 17 gives the highest barometer, Oct. 15, 30·36; the lowest barometer, Sept. 29, 29·46; the highest thermometer, Sept. 25, at 2 P. M., 73°; the lowest thermometer, Oct. 15 at 7 A. M., 27·5°.

Amount of Rain.

The rain which fell during Sept. 20 amounted to 1·8 inches.

The rain which fell during the night of Sept. 28 and the day of Sept. 29 amounted to 0·42 inches.

The rain which fell during the day of Oct. 2 amounted to 0·11 inches.

The rain which fell between the night of Oct. 6 and the morning of Oct. 9 amounted to 1·5 inches.

The rain which fell during the night of Oct. 9 and the day of Oct. 10 amounted to 0·21 inches.

Effect of Gases in the Coagulation of the Blood.

MM. Mathieu and Urban give the following conclusions as the results of their studies into the above subject: Blood deprived of carbonic acid by exosmose or by any other process does not coagulate until it regains the gas thus lost. The affinity of the blood globules for carbonic acid is evident. The coloring matter of the blood fixes the gas as readily as it does oxygen. Both oxygen and carbonic acid gases are occluded in the red globules. The coagulation of the blood by supersaturation is produced in pulmonary asphyxia, after a stoppage or extreme slowing of the circulation and after inflammation. The examination of different processes of spontaneous coagulation happening during life establishes a relation between the formation of fibrinous clots and the accumulation of carbonic acid in the blood, or the alteration of the organs charged with the elimination of the same.

Correspondence.

The Plumber's Defence.

To the Editor of the Scientific American:

Bearing cheerful testimony to your general fairness, candor, and good nature, it is to be regretted that they have failed you in treating this tender subject. Our unfortunate occupation seems to have achieved a painful and unenviable prominence of late, by being made the target of savagely jocose and furiously sarcastic attacks.

Just complaints of the imperfect work of plumbers may be accounted for by the amazing want of judgment the owner of a house containing modern improvements displays in the selection of a plumber. If he becomes the owner of a horse, the blacksmith who shall shoe him is chosen after a most thorough investigation into his merits, and after consultation and advice with posted friends. If he be the possessor of a fine watch, the artificer who shall regulate, clean, and repair it is selected with great care, and on no account will it be entrusted to a new or unknown party. But if the same man builds a new house, or buys an old one requiring repairs to its plumbing, straightway he rushes round to search after—the best plumber? Far from it. He has heard that all plumbers are robbers, and he is going to find a cheap man if it takes a month. Of course he succeeds, and of course he gets a botched job. Or, more fatal blunder still, purposing to save bother, he permits or requires the builder to include plumbing in his estimate, thereby making it to the strong interest of the builder to put in the cheapest plumbing that will pass inspection.

No one but an expert can tell by inspection whether plumbing is well or ill done. The incompetence of architects and building superintendents in this respect is well known and frankly confessed by the best of them, who do not feel obliged (as third rate men generally do) to know everything. The writer has known of pipes one and two grades lighter than the specifications called for being put in under the very eyes of architects, who were thoroughly honest and could not have been suborned to wink at the evasion had they known it.

The employment of the cheapest mechanics who can be made to pass muster and the too rapid pushing of the work make it impossible to thoroughly test the material and workmanship as it progresses. Solid or leaky joints are not the worst, though perhaps they are the most annoying, effects of a bad job of plumbing. They are apparent at once, and the contractor is obliged to put them in order; but a job put up with light or inferior material runs very well for a while, until constant expansion by continued pressure produces a burst. This is no sooner repaired than another appears, and another, and the jobber who has been called in (and who may be an entirely different party from the one who did the original job) gets all the blame of not being able to "fix a pipe so that it will stay fixed."

Much complaint is made of the exorbitant charges of plumbers, mainly in jobbing or small work. As honest mechanics do not make exorbitant charges any more than honest men pick pockets, it only remains to explain why honest charges are sometimes high. A customer calls to say that a faucet is out of order. Desiring to find out accurately what is to be done, you ask how it operates: "Oh, it just drips constantly; won't shut off!" "Well, does it turn to a stop, or will the handle revolve continually?" He "don't know." You suggest sending a new faucet, in case it should be needed. With a look of excessive sharpness, he exclaims: "No, you don't. Your men would soon find a way to make it necessary. A little packing is all you want." As a decent self-respect stops argument here, the workmen are sent out. Upon reaching the job (perhaps miles away), the thread is found to be stripped or the wings worn off, and the faucet worthless. The helper is dispatched for a new one and the time charged. When the bill is presented, the agony is fearful. "Your man just sat around and talked to the girls, while the boy went after something. Do you suppose I am go'ng to stand that?" Another customer drops in and says that his wife wants a plumber sent up. "Don't know what's the matter. Reckon its something about the cocks." A man with proper tools for soldering, packing, etc., is sent up, and finds that a water closet or drain is choked, or perhaps that the gas leaks; and the tools he has (usually a good load) are not at all that he needs. More delay and more of the running, which so exasperates the unfortunate customer. Who is to blame?

It is true that much incompetence and dishonesty do exist, and probably will until competence and honesty are better paid. The mechanic who promptly, faithfully, and carefully looks after his work is worthy of his hire, even if the price is a little higher than that of the incompetent and careless. Probably the touchstone of the whole matter is contained in your aspiration for "a plumber who will do his work well at a moderate cost." If a man thoroughly and faithfully superintends his workmen, he is no more responsible for the original cost of his work than his customers are. His materials, of lead, iron, brass, and copper manipulated to a high degree, are expensive in the nature of things, and bills including these will necessarily be large. If your wish could be modified to a desire for a plumber who will faithfully execute his work and be content with a reasonable profit, it may be confidently expected that by patient searching you will find him out.

When it becomes the practice to bestow upon honesty, ability, and industry the premium which they earn and deserve parties who can "fill the bill" will abound.

I feel that the spirit of the foregoing remarks has a wider range and larger application than the immediate subject of discussion. C. C. DEWSTOE.

Cleveland, Ohio.

The Machinery at the Fair.

To the Editor of the Scientific American:

Your correspondent "Esor," writing in your issue of October 17, concluded his remarks, in regard to an axle lathe of our manufacture, as follows:

"On the tool post, however, is a taper washer, by means of which to regulate the hight of the turning tool. With such a washer, it is impossible to put this lathe to the full duty it will perform, because, the face of the washer not being parallel or level with the face of the holding screw, the tool is not so firmly clamped as a heavy duty will require. The centers are not yet turned up, indicating that it is not intended to put any work on the lathe, an omission to be regretted."

We take no offense at just criticism; but we beg to demur to the statement that "it is impossible to put this lathe to the full duty," etc. Very nearly two hundred and fifty of these lathes, built by us in the past thirteen years, all with substantially the same arrangement for adjusting and holding the tool, have been put into operation in the United States, Canada, Cuba, and South America. No complaint has ever reached us as to difficulty in holding the tool.

Twenty complete and well fitted axles have in a number of shops been turned on one lathe in ten hours; even this has been exceeded in some instances; in one case, twelve were turned in five hours. This we consider tolerably "heavy duty," and think the tool must have been "firmly clamped" at pretty short intervals, without much delay or difficulty.

As regards the omission to put work into the lathe during the exhibition, it would plainly be impracticable, in such a place, to supply it with material, even for a small proportion of the time: a circumstance which we regret as much as any one. WM. B. BEMENT & SON.

Philadelphia, Pa.

Rapid Railway Traveling.

To the Editor of the Scientific American:

A train consisting of three cars, drawn by engine 97, driven by Joseph Losey, ran from Easton, Pa., to Jersey City, a distance of 74 miles, in 79 minutes running time, an average of 56¼ miles per hour. This does not show full speed, as three stops were made; and although I have deducted the actual time that was lost at the stations, there has been no allowance made for slowing down and getting under headway again. The distance from White House to North Branch, $4\frac{9}{16}$ miles, was run in exactly 4 minutes. The road between the last named points is comparatively straight and level; the time was taken accurately at both stations, and by stop watches on the train.

The engine, an anthracite coal burner, was originally of the Grant pattern, with 16 inch cylinders. She has been rebuilt, and her cylinders now are 17 by 22 inches, and her drivers are 5 feet 10 inches over the tyres.

Hampton Junction, N. J. CHARLES WARD.

The Eucalyptus and the Phylloxera.

To the Editor of the Scientific American:

I have been informed that the Tasmanian blue gum tree (*eucalyptus globulus*) is acclimated in the southern portion of France. In that territory, possibly in the immediate vicinity of trees of that species, there are large numbers of cultivated grapevines. Perhaps it would be well to examine the grapevines so located and ascertain if they are exempt from the ravages of the phylloxera. The blue gum trees appear to be suitable for the vineyard: they grow rapidly, straight, and firm, and would afford an admirable support for the wire; they cast no injurious amount of shade, and are known to be an antidote for that vapor of parasites called miasma.

New York city. ROBERT BRUCE STUART.

Cable Telegraphy.

To the Editor of the Scientific American:

In your last issue you print a paper read before the British Association by W. K. Winter on an improvement in cable telegraphy.

Allow me to state that the principle shown was invented by myself and patented both in England and this country some three years ago. It is used by the Automatic Telegraph Company of New York. THOMAS A. EDISON.

Newark, N. J.

The surgeons of the Hotel Dieu at Montpélier, France, have had for some time past a queer case on their hands, of a young man who swallowed a fork. The fork still remains somewhere in the body, and, strange to say, occasions no particular inconvenience to the patient, although over a month has elapsed since the accident took place. At the same hospital an individual, while in a state of delirium, lately ate a thermometer, glass and all. The doctors are sorely perplexed for a way to extract the intruding objects.

A RECENT patent for a map consists in having those portions intended to represent the rivers, lakes, and oceans filled with actual water. This is done by attaching the map to a back of wood of sufficient thickness. The rivers, etc., are dug out, filled with water, and glazed. Such maps may be hung upon the wall in the usual manner.

PRACTICAL MECHANISM.

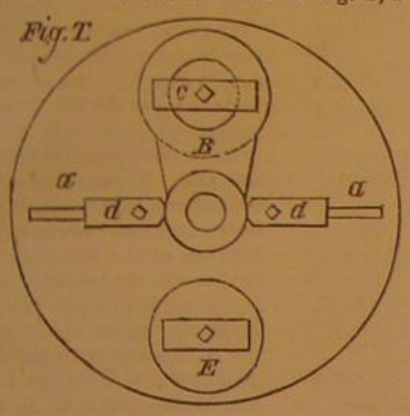
NUMBER XII.

BY JOSHUA ROSE.

TURNING CRANKS.

A crank having a plain surface on its back should have such surface planed true. The large hole should be bored first, the crank being clamped with its planed surface to the chuck plate of the lathe, when the hole may be bored and the face of the hub trued up. To bore the hole for the crank pin, clamp the face of the hub of the crank, which has been trued up, against the p'ate of the lathe (the crank pin end of the crank being as it were suspended); then bolt two plates to the chuck plate, one on each side of the crank at the end to be bored, and place them so that their ends just come in contact with the crank end, as shown in Fig. T, *a a* being

Fig. T.



the chuck plate, B the crank, C the clamp holding the turned face of the inside hub of the crank to the chuck plate, and *d d* the plates steadying the end of the crank to be bored, so that it shall not move its position on the face plate (or chuck plate) from the pressure of the cut, and E a weight bolted to the chuck to counterbalance the heavy end of the crank. It is obvious that, if the crank be a heavy one, two or more plates may be used in place of the plate or clamp, C. A crank chucked in this manner will be practically true providing the chuck plate be true, even if the cut taken off the back by the planer were not true, or even though there had been no cut taken off the back, and the crank had, in consequence, been sprung in the first chucking; because the face of the hub (or boss, as it is sometimes called) will, under any circumstances, be true with the hole, both having been turned at one chucking; and even if the crank were twisted in chucking, the face will follow the hole and remain practically true with it. This face, being in the second chucking bolted to the face plate of the lathe, will be held as true as is the face plate, and cannot spring from the pressure of chucking; neither can the crank pin end spring in the second chucking, because it does not receive any strain from either bolts or clamps. Furthermore, if the face plate is out of true across its face (that is, hollow or rounding), the last hole bored in the crank will, if chucked in this manner, be out of true to only the same degree as is the face plate.

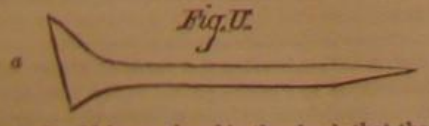
If, on the other hand, both holes of the crank are bored by clamping the planed face of the crank against the faceplate, merely turning the crank end for end to bore the last hole, the holes in the crank will be, when finished, out of true with each other to twice the amount that the faceplate of the lathe is out of true, or to twice the amount that the planed surface is itself out of true, from being sprung in chucking on the planer, from having its skin removed, or from other causes. If the face plate of a lathe is known to be hollow or round in the plane of its face, a piece of paper or other substance, of the thickness necessary to compensate for the defect, may be placed behind the crank and between it and the face plate, in the position requisite to effect such compensation.

Weights sufficient to counterbalance the overhanging end of the crank should be bolted to the face plate on the side opposite to such end, as shown at E, Fig. T.

BALL TURNING.

The best method of turning balls, such as are sometimes used for the valves of pumps, is as follows: The ball should be cast with two round stems on it, so that the stems can be placed between the centers of the lathe while the ball is roughed out, which may be done by a front tool for brass, cutting the ball down to within $\frac{1}{32}$ inch of the required diameter, and gaging it as nearly round as can be done by the eye and a pair of callipers. If, however, there are several balls to be turned, a gage may be made by filing out a segment of a circle (equal to, say, $\frac{1}{4}$ of its circumference) in a piece of sheet iron about $\frac{1}{32}$ of an inch thick. After the ball is roughed out, the stems must be cut off, care being taken not to cut them off too deep. The next operation is to chuck a block, of tin or of equal parts of tin and lead, and to bore a hole in it equal to about $\frac{9}{10}$ of the diameter of the ball, into which hole the ball may be lightly tapped with a piece of wood, so that the chuck will revolve the ball and hold it sufficiently firmly to admit of its being scraped by a hand scraper, shown in Fig. U, *a* being the cutting edge.

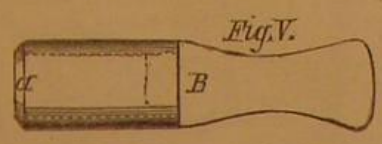
Fig. U.



The ball should be so placed in the chuck that the scraper marks will cross the turning marks already on the ball; and the scraper may then be applied, taking off just enough to take out the marks left by the tool when the ball was turned between the centers. The ball is then taken from the chuck by tapping the former lightly with a piece of wood, and is replaced in the chuck in such a position that the part of the ball which has just been scraped will now be inside the chuck, when the exposed half of the ball may be in turn trued up with the scraper; which being done, the ball is again removed from the chuck and replaced in such a position that the turning marks will be directly across the previous ones on that half of the ball, the scraper being then applied in the same manner as before. The ball being again removed from the chuck and replaced so that the part last scraped will be inside the chuck, the process of scraping is repeated, when the ball will have been made round except in so far that some of the scraper marks may be a little deeper than others. The positions in which the ball has been turned during the four chuckings may be clearly understood by making a comparison of the ball to the earth, the stems representing the north and south poles. The turning marks made while the ball was between the latter centers will be in the same relative position as the lines representing longitude. The first two turnings in the chuck will leave the turning marks in the same relative position, as the lines representing latitude, and the second two turnings in the chuck will again represent the lines denoting longitude. The operation of scraping may then be repeated, the ball being reversed indiscriminately in the chuck and scraped very lightly and as evenly as possible, after which the ball cutter may be applied.

A ball cutter is a hardened steel tube with its outside edge beveled off so as to cause the inside edge to form a

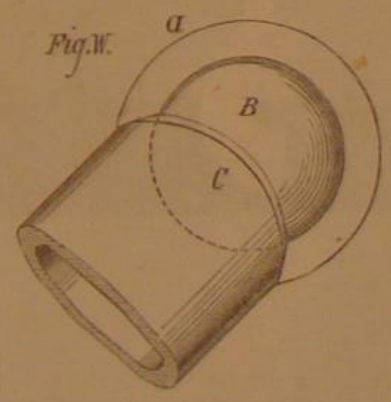
Fig. V.



cutting edge, as shown in Fig. V, *a* being the cutting edge and B the handle. It should be made as follows: A piece of cast steel tube about 4 inches long must be bored out, true and smooth, to a bore equal to about $\frac{1}{4}$ of the diameter of the ball it is intended to cut. The outside of the tube must then be trued up so that the metal will be of equal thickness all over, which will render the tube less likely to warp during the process of hardening. The end of the cutting end of the tube must be beveled as shown in the illustration when the tube must be taken from the lathe and hardened right out, care being taken to dip it endwise and evenly in the water, so that its contraction in cooling may be even, which will reduce to a minimum its liability to crack or warp.

The next operation is to grind it out true again, for the bore is almost certain to have warped a trifle in hardening. The grinding is performed by a lap in a manner to be described in remarks upon laps and lapping. The lapping being completed, the handle may be fitted to the tube and the cutting edge ground on a grindstone, taking care to only grind sufficient off the beveled edge to sharpen it, and revolving the cutter so that it will be ground evenly and smooth. The cutting edge should stand at a right angle to the bore, and may be gaged by applying a square to the outside and across the cutting edges of the cutter. The grinding completed, the oil stone may be applied, when the cutter will be ready for use, Fig. W showing the manner of its applica-

Fig. W.



tion, *a* being the chuck, B the ball, and C the cutter.

The cutter, when forced by hand against the revolving ball, trues it up exceedingly smooth and true; the ball being reversed, the operation is repeated in all directions in the chuck which may be; done without stopping the lathe, and then continued until the ball is true, which may be readily known, because the cutter will cut the high parts of the ball easily, taking off large shavings; but when the cutter edge bears equally at all parts on the ball, it will scarcely do more than polish it. When the ball is nearly finished, but a slight pressure must be placed upon the cutter, and the ball must be more frequently reversed in the chuck.

TURNING PISTONS AND RODS.

A piston should first be bored to receive the piston rod. The next operation is to rough out the body of the piston rod and to then fit it to the piston. The piston is then made fast to the rod, by the key, the nut, or by riveting, as the case may be and the piston and rod should then be turned between the centers. By this means, the piston is sure to be true with the rod, which would not be the case if the piston and rod were turned separately. In turning the piston follower, that is, the disk which bolts to the piston head to retain the rings in their places, slack back the dogs or jaws of the chuck after the roughing out is complete, taking the finishing cuts with the jaws clamped as lightly as possible upon the work; because when the jaws of a chuck are screwed upon the work with great force, they spring it out of its natural shape.

PISTON RINGS.

The rings of metal from which piston rings are turned should have feet cast upon one end, which feet must be faced up true by taking a cut over them. The ring should then be chucked by bolting the faced feet against the chuck plate, so that the ring shall not be sprung in chucking, as it would be if it were held upon its inside or outside diameter by the jaws of a chuck. The inside and outside diameters of the ring may then be turned to their required dimensions, and the end face may be trued up, when the piston rings may be cut off as follows:

First introduce the parting tool, leaving the ring sufficiently wide to allow of a finishing cut after cutting the ring nearly off; introduce a side tool, shown in Fig. 22, and take a light finishing cut off the side of the ring, and then cut it off. The end face of the ring in the lathe may then be trued up by a finishing cut being taken over it, when the parting tool may be introduced and the process repeated for the next ring.

Piston rings are sometimes made thick on one side and thin on the other side of the diameter, the split of the ring being afterwards cut at its thinnest part, so that, when the ring is sprung into the cylinder (which is done to make the ring fit the cylinder tight and to cause it to expand as it wears, thus compensating for the wear), its spring will be equal all over and not mainly on the part of the diameter at right angles to the split, as it otherwise would be.

The process of turning such rings is to face the feet of the ring from which they are to be cut, and then turn up the outside diameter to its required size. Then move the ring on the face plate sufficiently to cause it to revolve eccentrically to the amount of the required difference between the thickest and thinnest parts of the ring, when the inside diameter should be trued out, and the rings cut off as before directed.

The object of turning the inside bore after and not before the outside diameter of the ring is turned, is that, during the process of cutting off the individual piston rings, the bore of the ring will be true, so that the parting tool will not come through the ring at one side sooner than at the other; for if this were the case, the parting tool, from its liability to spring and its broad cutting surface (parallel to the diameter of its cut), would be apt to spring in, rendering the cutting off process very difficult to perform; because if the piston ring is cut completely through on one side and not on the other, it will probably bend and spring from the pressure of the parting tool, and in most cases break off before being cut through at all parts by the tool.

The inside diameter (or bore) of piston rings is frequently left rough, that is to say, not turned out at all; but whenever this is the case, the splitting of the ring will in all probability cause one end of the ring (where it is split) to move laterally one way and the other end to move the opposite way, causing the vise hand a great deal of labor to file and scrape the sides of the ring true again. The cause of this spring is that there is a tension on the inside of the ring (where it has not been bored), tending to twist it, which tendency is overcome by the strength of the ring so long as it is solid; but when it is split, the tension releases itself by twisting the ring as stated.

Cider.

This is the month when fine clear cider may be made, but later in the year perhaps the best cider is made. To have good cider, says the Maryland *Farmer*, the apples ought to be sound, clean, and somewhat mellow, and there should be perfect cleanliness in all the operation of grinding, etc. The barrels ought to be clean and free from all taint or bad smell. Keep the barrels full, during fermentation, with cider of the same making kept for the purpose. As soon as it ceases to actively ferment, draw it off into other barrels and at the same time strain it through a blanket or muslin—common cotton—and when it ceases fermenting, add to it 4 lbs. of mustard seed or as some recommend, sulphite of lime; then bung down.

A small gimlet hole might be bored through the bung to let off for a few days any excess of gas, and then stopped up tight. To have it extra fine, it should be racked off the third time. Good cider always commands a high price, and it is admitted to be a wholesome and temperate beverage.

KEEPING APPLES.

A correspondent of the Boston *Cultivator* kept 1,200 barrels of apples, mostly Baldwins, in his cellar last winter, by daily expelling the stagnant air and replacing it with pure. He attributes the early decay of apples largely to a vegetable miasma in the air, which is communicated to it by vegetable evaporation under certain conditions. The effect of this miasma is first seen in minute specks on the apple.

AN unfortunate trouble exists between the proprietors of the Troy, N. Y., iron works and their puddlers, owing to a reduction in the wages of the latter. The puddlers have refused to accept the reduced wages. A dead lock consequently prevails. If the puddlers do not accede to this new scale of wages, the whole works threaten to shut down. This is not a pleasant prospect in view of the nearness of winter.

A SPECIMEN of the ore recently taken from the new silver mine at Wolcottville, Conn., contained from eight to ten ounces of silver to a ton, with a small percentage of gold. An effort is being made to form a joint stock company, for the purpose of developing the mine.

IMPROVED STUMP SAWING MACHINE.

Settlers in wooded districts of the West, or farmers generally, who contemplate clearing off some of their timbered land during the present fall or in the spring of the coming year, will find in the annexed engraving a new saw represented, which will, without doubt, prove an efficient aid in accomplishing the labor of cutting off the stumps. The blade leaves the stumps with a concave top, which serves to retain moisture, so that the rotting of the lower wood is considerably facilitated, while the division may be made as deep as six or eight inches below the surface of the ground if it be desired.

An ordinary saw is employed, sprung in arc shape and clamped to the ends of a swinging frame, A, which is applied by a central sleeve to a smooth shaft, sustained in a supporting frame. The saw frame is provided at its ends with handles so as to be worked by one or two men. A cord attached to its center passes over a pulley, B, on the supporting frame, and carries a weight which produces the forward feeding of the saw into the stump.

The supporting frame consists simply of inclined legs pivoted to and secured by nuts on the ends of the horizontal shaft. The elevation of the latter above the ground and the consequent raising or lowering of the saw is provided by spreading the legs and fastening them in the required position by arc-shaped guides, C, and set screws. The lower ends of the legs are connected longitudinally by base runners, D, in order to gain increased stability to the frame, and to admit of steadier seating on the ground. Suitable handles on the legs serve to carry the machine from stump to stump.

The mode of arranging the apparatus, its size, and various other points of detail are plainly indicated in the engraving and require no further explanation. The inventor states that he has used the device with perfect success, cutting off the stumps below, even with, or above the ground with rapidity and ease.



ELSTON'S STUMP SAWING MACHINE.

Patented through the Scientific American Patent Agency, September 8, 1874, by Mr. James A. Elston, of Elston Station, Cole county, Mo., to whom letters for further information may be addressed.

Bronzes of Copper and Tin.---The Chinese Gong Metal.

Bronzes containing from 18 to 22 per cent of tin, heated to redness and suddenly cooled by plunging into cold water, have their density increased by the process; but when a specimen which has been so treated is again heated to redness and annealed, or very slowly cooled, the density is reduced. The latter effect is much less marked than the former and a piece of such bronze, subjected alternately to sudden and to slow cooling, has its density notably increased by a few repetitions of the operations. This result does not occur when a bronze containing only from 6 to 12 per cent of tin is submitted to the same series of processes. When alternately, either with annealing or with sudden cooling, the sample is submitted to such mechanical operations as simple compression, the stroke of a coining press, or, in the case of bronzes poor in tin, to extension in a rolling mill, the density of both classes of bronzes is augmented. Both the mechanical and heating actions contribute to this effect, which, in bronzes rich in tin, is more marked with sudden than with slow cooling. Bronzes rich in tin are softened by sudden cooling, while the reverse effect is produced in steel, in which also the density is diminished by the operation, instead of being increased, as in the bronzes.

A discovery of considerable industrial value is announced in Mr. Riche's paper. It is known that bronze containing about 20 per cent of tin cannot be wrought at ordinary temperatures, and that at a bright cherry red heat it crumbles under the hammer. The author has, however, found that at a dark red heat, or a little below it, this alloy is as malleable as iron, and may be hammered into thin plates with the greatest ease. Availing himself of this observation, he has been able, in conjunction with M. Champion, to fabricate gongs, which are, in chemical composition, external appearance, and sonorous properties, identical with the famous Chinese instruments.

Facts about Copper.

Mechanical actions, alternating with either slow or sudden cooling, produce in pure copper an increase of density when the heating has taken place without access of air, and a decrease in the contrary case. Brass has its density increased by sudden cooling and by mechanical actions, but diminished by annealing; while similor, which contains a much smaller proportion of zinc, undergoes no sensible change of density by these processes. Some experiments are described, proving the permeability to liquids of cast iron, by Mr. Riche, who finds that copper melted and run into the mold at a low temperature is also capable of absorbing liquids, a property acquired likewise by rolled copper after heating in charcoal. This property is not possessed by copper which has been cast at an elevated temperature, or heated with access of air, or alloyed with a small quantity of iron. The introduction of a small quantity of iron greatly increases the tenacity and hardness of copper, without interfering with its malleability.—*Journal of the Chemical Society.*

A Mine of Liquid Sulphur.

In the vicinity of San Martino, near Palermo, Sicily, a mine of liquid sulphur is being worked, or, in other words, large collections of the substance are being made at points where it flows from the fissures in the rocks in quantities of from 400 to 500 hundredweight per day. The sulphur comes from a burning mine within the mountain; and in order to give it time to cool, so as to admit of gathering it, the outlets are frequently closed for brief periods. Quite recently, on opening one of these closed fissures, it was found that the sulphur had disappeared; and in order to renew the flow, it was suggested to tunnel down toward the mine. Hardly was the work begun, however, before the pressure in rear of the obstructing mass became too great for the latter to withstand, and a terrific explosion ensued, hurling the workmen into the air, killing five and badly wounding six more.

MOAT'S IMPROVED LOCK.

The peculiar feature of the novel lock illustrated herewith is that no key, unless specially adapted to performing three distinct functions, namely, the throwing of a main tumbler and guard plates, the bolt, and the latch tumbler, can possibly open it. This will be more evident from the fact that the key holes are closed by guard plates before the motion of the other parts takes place, so that the introduction of implements for throwing the bolt and releasing the tumblers is at once prevented. The action of the key on the parts of the lock, in either direction, is the same, so that no intermeddling or tampering with the open lock is possible.

Fig. 1

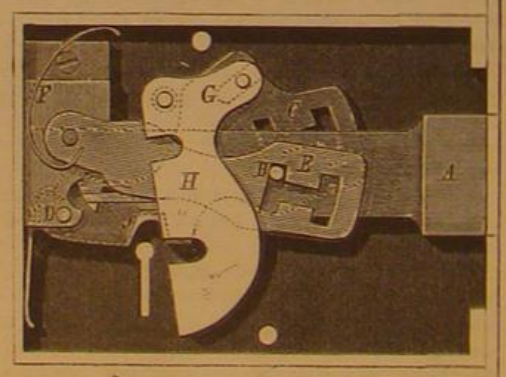


Fig. 2

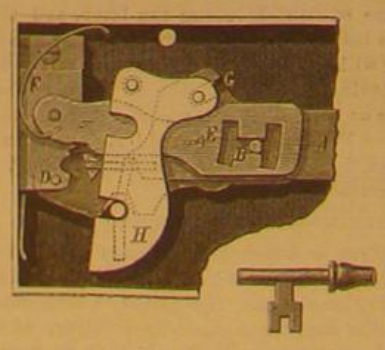


Fig. 3

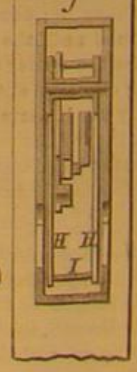


Fig. 1 shows the position of the working parts with the key hole open, and Fig. 2, the same with the guard before the latter. Fig. 3 is a vertical transverse section of Fig. 1. The form of the key is represented beside Fig. 2. A is the bolt, which is thrown by the key engaging in a recess at the rear part of the same. By means of pins, B, on each side, the bolt connects with the double T-headed slots shown in the main tumbler, C, which is pivoted at D and acted upon by the adjacent band spring, and in the latch tumbler, E, which is thrown by its separate spring, F. The tumblers, it will be observed, are thrown in opposite directions, so as to lock over the stop pins, B, of the bolt.

The main tumbler has, at G, a recess which embraces a pin of the double guard plates, H, which are pivoted above the bolt, and swing at both sides of the same, immediately under the outer side plates of the lock case. These plates are braced with lateral bars, I, Fig. 3, and have slots which enable them to pass over the stem of the key when the same is placed in the key hole. The turning of the key causes, first, a catching of the spurs over the part, J, Fig. 1, thereby carrying down the main tumbler, C, so as to release one of the stop pins, B, from the slots in said tumbler, and to throw the guard plates, H, around the key stem, thereby closing the key holes completely. The key next engages with the bolt recess (see dotted lines, Fig. 2), and raises also the latch tumbler, E, from the opposite stop pin, B, so that the bolt is free to be thrown for closing or opening the lock. The spring action on the main and latch tumbler carries them instantly, on the completion of the bolt movement, back over the stop pins, and throws the guide plates sidewise from the key holes, producing thereby the rigid and secure position of the bolt, besides the opening of the key holes for the key.

Patented through the Scientific American Patent Agency, August 25, 1874. For further information address the inventor, Mr. E. Moat, Watertown, Mass.

Elie de Beaumont.

The death of the oldest of French statesmen, M. Guizot, is closely followed by that of Elié de Beaumont, the greatest as well as one of the most aged of French geologists. M. de Beaumont was born in 1798; and after successfully conducting an extended series of metallurgical explorations under government auspices, he became in 1824 a mining engineer. From 1829 to 1833 he rapidly rose through the position of Professor in the School of Mines of the College of France, and finally became Engineer-in-Chief. At the death of Arago, M. de Beaumont succeeded that *savan* as perpetual secretary of the *Académie des Sciences*, and he was subsequently made a senator of the empire by Napoleon III.

M. de Beaumont's labors have resulted in the publication of several works, in one of which he endeavors to prove that mountain chains are to be classed according to the direction of their range, all those lying parallel with the same great circle of the earth, wherever they may be found, having been uplifted suddenly during the same geological epoch. The features of no fewer than ninety-five systems of mountains are accurately described in the last edition of this book. His geological researches in France have added largely to the knowledge of the resources of that country, as well as to general learning in the science. M. de Beaumont died on the 24th of September last.

Progress of Telegraphy in the United States.

The annual report of the Western Union Telegraph Company, just published, shows 175,135 miles of wire, and 71,585 miles of line in use, with 6,188 telegraph offices. The total receipts for the year were $9,262,653; expenses, $6,755,733. The Stearns Duplex telegraph apparatus, by which messages are sent both ways on one wire and at the same time, are in extensive operation.

But the past year has produced an invention still more wonderful than the duplex. Thomas A. Edison, and George B. Prescott, the electrician of the company, have discovered processes and invented apparatus by means of which two messages can be sent in the same direction, and two others in the opposite direction, simultaneously upon one and the same wire. This invention, which they have christened the quadruplex, is in successful operation between the New York and Boston offices, and is satisfactorily performing an amount of work upon one wire quite equal to the capacity of four wires worked with the ordinary Morse apparatus: so says the president.

A NEW device for registering the fares of street railroads has been introduced in Philadelphia. It is a portable receptacle for money or tickets, and resembles in size a large powder flask. The conductor presents the machine to the passenger, who puts in his fare in cash or a ticket, whereupon the conductor presses the spring, which works the register and sounds an alarm bell.

THE SOUTHPORT AQUARIUM AND WINTER GARDEN.

A few miles to the north of Liverpool, on the Lancashire coast, England, is a newly grown watering place, Southport. Its beauty and salubrity have gained it renown among the inhabitants of the scores of manufacturing towns in its immediate neighborhood; and it has become a very popular resort, being within a short railway journey of the homes of many millions of people. The Southport folks have recently embellished their town with a building comprising an aquarium, a winter garden, a music hall, and a large covered promenade. The conservatory or winter garden, shown in our Fig. 1, is a large and graceful structure of iron and glass, and contains not only a fine collection of rare tropical and other plants, but also birds and animals, making a nucleus for an extended zoological exhibition. This has been wisely entrusted to the care of Mr. Frank Buckland, the friend of all living creatures and the editor of *Land and Water*.

The aquarium, Fig. 2, is excellently arranged, being mainly lighted through the tanks containing the specimens, so that they may be seen to advantage. It is a solid and imposing structure. The exterior of the building, with the entrance gates and a portion of the grounds, are shown in Fig. 3.

"The edifice," says Mr. Buckland, "must be inspected to obtain an idea of its beauty. In general outline it reminds us of the Crystal Palace. One side only of this crystal palace is at present in existence, but there is ample space (now occupied by houses) to complete the other wing.

Adjoining the dome is a promenade, which at the night of opening was so full that it was almost impossible to move about. On the walls of this were exhibited some of Mr. Rolfe's fish pictures. Here also was exhibited a salmon caught by the rod in the Ness, 32 pounds in weight. I cast him. Mr. Rolfe painted him in his best style, and we conjointly had the pleasure of presenting him to the aquarium. He is represented as lying in a basket on straw, and the deception, to those who had never seen Mr. Rolfe's works before, was very satisfactory, the difficulty being to prevent people from tapping the fish to see if it was real. A glass case is being prepared for its reception.

The aquarium cannot be seen from above ground. The space underneath the winter garden is entirely occupied by an immense tank for sea water; it communicates with two other tanks which are used as occasion requires.

The sea water is supplied from the public baths, whence it is conveyed by means of a pipe; abundance of water is available from this source. The aquarium itself is partly under the promenade and partly under the winter gardens. Under the promenade are twenty-two tanks, the light being let in from the top by day, and illuminated by gas at night.

The fish in the various tanks are as follows: Congers, ling and codling, mullets, father lashers, sea trout, wrasse, anemones and whiting, dog fish, gurnards, crayfish and crabs, whiting, rays and soldier crabs, soles, turbots and flukes, monkfish, topers, lobsters, king crabs, octopus, *Maia squinado* and edible crabs, stickle backs and anemones, bass or seaperch, cod, salmon, great lake trout, and gold schlei or golden tench, and large dog fish.



SOUTHPORT, ENGLAND.—Fig. 1.—THE CONSERVATORY.



Fig. 2.—THE AQUARIUM.

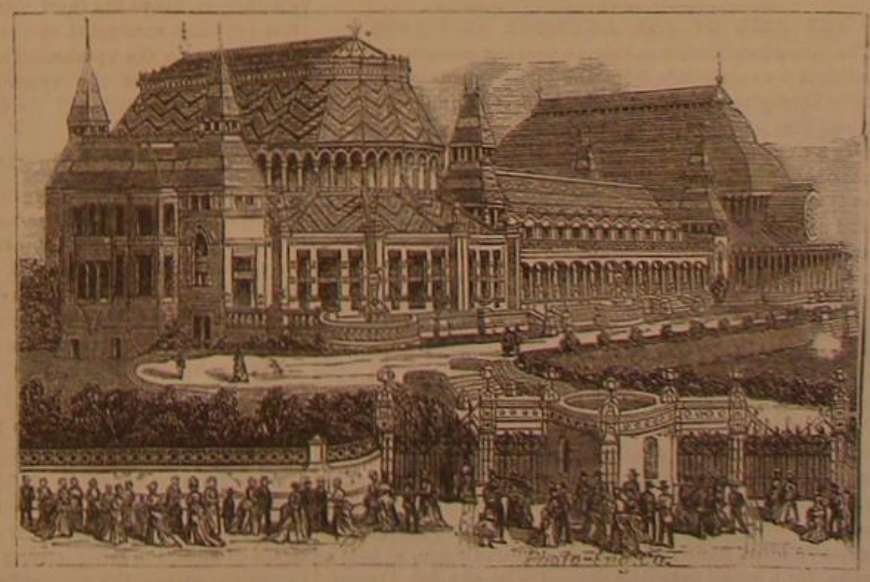


Fig. 3.—EXTERIOR OF THE BUILDING.

There are also some very handsome table tanks and aquaria, containing collections of anemones, gobies, fifteen spine sticklebacks, prawns, and Norway lobsters. Orders and regulations have been laid down by the board as to feeding the fish, cleaning the tanks, etc. There is a seal tank, and some fine specimens of the sea trout.

AN Illinois editor returns thanks for a centipede sent to him by mail from Texas, "it being," he says, "the first cent of any kind that we've received for several weeks."

SULPHUR IN SICILY, AND ITS REDUCTION FROM THE ORE.

BY PROFESSOR G. VOM RATH.

The strata in which the sulphur occurs belong to the tertiary formation, and, according to Mottura, to the miocene epoch. They extend over a large portion of the island, the greatest length from east to west being about 100 English miles, and the greatest breadth, 53 to 56 miles. Within this large tract, the sulphur formation appears in groups. The oldest rocks of this tract are sandstone, which rest upon gneiss and slate. On these sandstones are marl beds, which resemble keuper marl; then follow limestones both jurassic and cretaceous, and eocene nummulitic limestone, with a peculiar porous limestone in crags and ridges. On the top of the latter is a foraminiferous marl of marine origin, after which follows a stratum of tripoli, upon which is a stratum of calcareous marl, which is in some places more argillaceous, in others more calcareous. This is the stratum which contains the sulphur. The sulphur formation is generally covered over with immense masses of gypsum, on which again is a foraminiferous marl. Then follows the pliocene formation, blue clay, and yellow breccia.

It is probable that the quite extensive deposits of salt, found in widely distant portions of Sicily, were formed at the same time as the deposits of sulphur. The rock salt enclosed in the clay strata is often very pure. The deposits of sulphur are not usually of great extent, and do not seem to be in immediate communication. The sulphur impregnates the strata of clay and limestone, appearing either in irregular threads and veins, or in layers three to six feet thick, alternating with the layers of rock, or in round concretions from 0·4 to 0·8 of an inch in diameter. Barytes and imperfect crystals of calxspar accompany the sulphur, and, more rarely, beautiful crystals of celestine. Sometimes the sulphur strata enclose whole stems of fossil wood. The thickness of the sulphur deposit, in its frequently recurring changes, often remains very constant, and indicates an equally regular change in the conditions under which it was deposited; it almost reminds a person of the changing seasons. The fishes found in the sulphur marl enable us to recognize the sulphurous strata as formed by fresh water.

Parodi states that the average percentage of sulphur in the sulphur rock of Sicily is 12·5 per cent. When it contains less than 6 per cent of sulphur, it does not pay for mining and smelting. In 1871, Sicily produced 150,000 tuns of sulphur, probably nine tenths of that produced in the whole world. This production is continually increasing. That this natural wealth does not prove a greater blessing to the country and its prosperity is principally due to the circumstance that in Sicily the property on the surface cannot be released from that of subterranean treasure, and this circumstance results in a number of other evils, which do not permit mining to emerge from its great and almost inconceivable imperfection.

The number of sulphur mines in Sicily is upwards of 600, not more than half of which are worked at present; and of these, only about 50 are of considerable importance.

In looking for the sulphur deposits, a soft kind of gypsum, formed by the decomposition of the sulphur-bearing lime or calcareous marl, plays an important part. In general, the sulphur is combined with gypsum, and the presence of the latter renders it probable that the former is near. To reach the deposits, inclined shafts are dug, having an inclination of 25° to 50°, seldom steeper, and more seldom horizontal. Neither horizontal galleries nor vertical shafts are employed, since the former would not reach the sulphur soon enough, and the latter would require the use of some sort of machinery; and wood is lacking for this purpose, as also for timbering and frame work. Steps are cut into the inclined plane, and when it is not steeper than 45° the steps reach all the way across; but when steeper, two steps are cut side by side, alternating with each other. The young laborers climb up and down these high, narrow, and slippery steps, panting, groaning, and sweating—carrying on their heads and backs heavy bags filled with sulphur ore. They make from 16 to 18 ascents and descents daily, to and from a depth of over 200 feet.

By this pitiable method, at least a million tuns of sulphur ore are annually brought up into the light of day by boys and youths. Nay, too, the little drippings of water are collected in stone jugs, and brought up in the same laborious manner. The mine is almost always abandoned when it reaches the water level. The temperature in these is very high, 111° Fahrenheit, and, owing to the moisture in the air, it is almost unendurable. The diggers (*picconieri*), owing to the heat, work naked, or only wearing a small apron. The sulphur rock is so soft that it is cut out with a large instrument like an ax. The roof of the mine is supported by pillars, so that a considerable portion of the ore is left standing, to secure the structure. In order to obtain the mass of the pillars, they are weakened more and more, until, at an unexpected moment, the roof falls. The fallen and broken mass is left for a time, until it adheres together; shafts and galleries are then dug through it to get at the pillars. When the sulphur-bearing strata lie one above another, there is a double set of pillars. Through errors in the ground plan and ignorance of mining surveying, it generally happens that the pillars in the upper gallery do not agree with those in the gallery below. As the stone is often soft and brittle, it is no wonder that they frequently break through.

The condition of the sulphur miners is extremely deplorable. The manner of living in populous spots miles distant from each other, instead of in villages, is peculiar to that country, and the majority of the mines are far distant from

human dwellings. Neither manager nor contractor consider it a duty or necessity to erect a roof to protect their workmen, so that they sleep in the open air in pleasant seasons, exposed to the damp dew; while in winter they sleep in the foul atmosphere in the mine itself, exposed to the dangers of being buried alive. In cases of sickness, the unfortunates have no assistance, and the families of those who die, or are killed, are exposed to the greatest misery. As regards education and moral instruction, the working classes are entirely neglected; there are no schools, savings banks, or associations for mutual aid. The consequence is that the society which grows up about the sulphur mines is in every respect an abandoned class, ripe for crime. The mines are a refuge for evil doers from the whole island.

The sulphur is prepared throughout Sicily by melting the stone in *calcaroni*, where the combustion of a portion of the sulphur furnishes the necessary heat to fuse the remainder. The liquid sulphur drips down to the bottom, and flows out into molds intended for its reception. In building a calcarone, a spot is selected at the side of a hill, and a cylindrical furnace built, from 20 to 40 feet in diameter, and a few yards in hight. The walls are supported in the rear by the earth, and in front project in a semi-circular form. The hearth of the furnace has a double inclination, from the hill toward the front and from the sides toward the middle, so that the liquid sulphur collects in one place, and through a perforation in the inner wall it reaches the outlet. The bottom is pounded down hard like a threshing floor. The interior is filled with sulphur ore, the larger pieces being thrown in just as they are, and the smaller ones are formed into cakes, so that the melted sulphur will flow down through it more readily. When the cylinder has been filled, the pieces of sulphur ore are heaped up in a cone above the mason work, and covered with the burned pieces from a previous operation.

A calcarone will hold from 175 to 1,750 tuns. In charging the furnace, several vertical flues are left open, which serve in part for kindling the fire, and in part to keep up the combustion at the beginning of the operation. The pile is ignited by throwing burning wood or bundles of straw down these openings. When the whole mass gets to burning, all the openings are closed; and the operation, which lasts from two to four weeks, according to size, is attentively watched, and the combustion controlled by the cover on the heap. The temperature is kept at a proper hight, above 240° Fah., since sulphur melts at 240°, and remains a thin fluid up to a temperature of 320°. The melted sulphur is drawn off through a hole a foot wide and two feet high, in the front of the furnace, which is previously stopped with clay. The sulphur is run into wooden molds, the bottom and sides of which are moistened so that the sulphur cake will not adhere so tightly.

This method of obtaining sulphur is attended with a great deal of loss; experience shows that the highest yield of a calcarone is 70 per cent, although it does not usually exceed 50 per cent of the total amount of sulphur. The crude sulphur is worth from $1 80 to $2 per 225 lbs., so that the fuel consumed is worth at least twice as much as English coal would cost in Italy.

In producing sulphur in Sicily, only those resources to be found on the spot are made use of: no wood for framing, no machinery for raising the ore and water, no coal for smelting. Any one who would attempt to introduce any improvement in mining or reducing the sulphur would encounter great difficulty, arising chiefly from relations of proprietorship, and in the social status of the country. Legislation is the only help. Notwithstanding the immense store of natural sulphur on the island, it will be seriously impaired, by the progress in other countries which now make oil of vitriol from pyrites, unless some change is effected in the state of affairs.

THE FAIR OF THE AMERICAN INSTITUTE.

The American Institute Fair is proving remarkably successful, if we may judge from the large crowds which constantly throng the building. The display is unquestionably the best that has been made for many years; and since it includes a number of industrial processes carried on in presence of the visitors, it calls forth a much more lively interest than it would were it restricted to mere exhibition of completed products. At one portion of the hall, ivory turners are at work, making billiard balls and carving ornaments; at another a newspaper office is shown in full operation, from the editor vainly endeavoring to seize vagrant ideas—a difficult task, and one we should unhesitatingly decline under the the circumstances, for we doubt if we could work with a bevy of bright eyed damsels staring at us—to the finished sheets deftly piled by the swift-running press. There are tailors cutting out garments by machinery, brush makers manufacturing brushes of all kinds, scroll saws cutting out wooden ornaments and trinkets, engravers making illustrations similar to those in our pages, confectioners cooking candy, and even an old gentleman who cuts your profile likeness in black paper, and does it admirably too, in half a minute, for a small consideration. Up in the Art Department are large volumes, each leaf of which shows an application of one the numerous tints imprinted on a well known chromo. By studying the pages the visitor can learn in a very short time just how the very handsome works of art which Mr. Prang exhibits are made, and how laborious the task must be.

There are a number of interesting shoemaking and leather-working machines in the main hall, and a superb display of leather. Hides tanned by the best American processes are brought in direct competition with those imported from Europe, and the special medals which are offered for excellence have tended to highten popular interest in the exhibition, apart from that excited by its partaking of the nature of an international contest. A new object of curiosity has been recently added in the shape of the winning boat of the Columbia crew at the Saratoga Regatta, last summer. It lays across the hall, gaily decorated with blue and white ribbons. The youngsters seem to be especially pleased with a variety of miniature steam machinery exhibited in operation. There is a steam fire engine which throws a needle-like stream for several yards, steam propellers which travel quite rapidly about a tank of water, and a small machine shop, including lathes, saws, etc., the tools all run by a tiny boiler. Mr. Hawkins, the Superintendent of Machinery, also aims at popularity among the children, for he has lately devoted his ingenious button mold machine to the manufacture of some queer games, which are very interesting, and beside has produced skipping ropes of a remarkable and hitherto unknown pattern.

The Fair as a whole is admirable, and the exhibitors have fairly outdone themselves in the elaborate and tasteful plans adopted in showing their contributions. The management is open to improvement, particularly with reference to allowing the woodworking people to howl their wares like country showmen, to the individual with the perfumery who squirts cold spray into peoples' ears or eyes, and in regard to that ugly drapery on the roof; and there are ridiculous advertisements which talk about "enormous fish" in that little fountain; but generally, however, we find a great deal to praise and very little to condemn.

A recent stroll through the Machinery Department has filled our note book with descriptions of a score or more novelties, some of which below described will doubtless prove interesting.

THE MACHINE TOOLS

of the New York Steam Engine Company are well worth critical examination. Many of them are in actual operation thus affording excellent opportunities for the mechanic to watch their practical employment. There is a chucking and turning lathe, by which a hole can be bored or chucked 20 inches in diameter; and by means of a new slide turning rest, a pulley can be turned, having a diameter of from 8 to 30 inches. This machine has a gap bed. In the upright drills there is a steel drilling spindle attached to a gibbed head which moves up and down with the spindle, giving the latter a very long bearing at every point. A number of machines which have been illustrated in our volumes are exhibited, notably a hand crank drill, a slotting machine, and a gear-molding machine. The shapers have their cutting bars placed on edge in adjustable guides. The vibration or spring of the tool is prevented by placing the widest section of the bars directly opposite the cut. The box-boring machine is arranged so that either of two bars may be used independently. A side rest is provided for each bar, and four boxes in each rest may be simultaneously operated upon. The 9 inch bending rolls exhibited are so constructed as to be kept in constant contact with the plate, and their springing at the centers is prevented. There are a number of other machines of which our limited space necessitates omitting mention.

THE BOILERS,

employed to supply steam to the main engines, are of the Howard safety type. Five tiers of tubes which incline upward to the rear are connected to vertical sections by boring small holes in the extremities of the tubes and allowing the cast metal of the sections to flow in, forming a perfectly solid joint. The parts of the vertical sections are bound together by stay rods passing through and set up with brass nuts; and the caps opposite the parts where the tubes enter are similarly attached by rods passing lengthwise through the tubes. Above the second tier is a fire brick diaphragm, in rear of which the heat passes and then encounters another diaphragm, above the third tier. The products of combustion are then conducted to the front of the boiler, whence they return to the uptake. The three lower tiers of tubes are for water and the upper ones for steam, the latter, through the disposition of the heat, becoming highly heated. There are three

CURIOSITIES IN THE MACHINE DEPARTMENT.

The first is a large tank provided with windows and filled with water. In this the Myers rotary engine is soon to rotate a good sized propeller, and brilliant lights are to be placed so as to shine down and through the water. This is an ingenious way of loading the engine and, besides, showing its adaptability to marine purposes. The tank, however, looks somewhat fragile; extra riveting might improve it.

Another application of the diamond to industrial use is found in the second of our trio of curiosities. It is

THE DIAMOND BAND SAW.

There is little in the construction of this machine, save perhaps its extra heaviness, differing from that of the ordinary woodworking tool. The blade, however, instead of being a single strip of metal, is a band covered with small straps of steel, the latter strung on the former, like beads. In certain straps the diamonds—borts or carbons—are secured so that three straps containing diamonds may come together, and then an interval to the next set occurs of some eight inches. There are of course other ways of arranging the diamonds, which need not here be described. The machine cuts a curve or scroll in stone as easily as the ordinary band saw goes through wood. A certificate published by the inventor, Mr. Herbert Cottrell, of Newark, N. J., says that the blade cut through Newark brown stone, measuring 3 feet 2½ inches one way and 3 feet 3 inches the other, making a superficial surface of 1,501½ square inches, in 22 minutes time.

THE ICE CREAM MACHINE

of Messrs. Dixon and Tonstill is the *last* odd invention of the three. The prepared materials are dropped into a can arranged above like the oil reservoir of a bolt cutter. They flow through a tube into a horizontal cylinder which is placed in a tub and covered with ice and salt. Inside the cylinder is a helicodal knife, which scrapes the edges and also forces out the frozen material through one end. Both cylinder and knife are rotated by simple gearing. It is quite curious to watch the materials enter one part of the machine, and quickly emerge in a frozen condition from another, in the shape of excellent ice cream.

There are two

PIPE CUTTING AND THREADING MACHINES

which deserve notice. One is that of the Chase Manufacturing Company, illustrated on page 131 of our last volume. In this the pipe is held stationary in the vise, and passes through the center of a gear, the rotary motion of which is imparted to the die in the die box by means of guides, upon which the die box freely slides forward as the die passes upon the pipe. When cutting pipe, the tool post, with the cutter, has an automatic feed.

The manufacturers of the other machine are N. W. Frost & Co., of Cohoes N. Y. The apparatus is in three pieces, readily taken apart and put together. One portion forms an excellent vise; another is inserted above and carries the handle and a pinion; and the third is the gear wheel, in which the pinion engages, and which turns the dies and operates the feed. The machine does excellent and rapid work, and is very simple and strong in construction.

THE MAXIM AUTOMATIC PUMPING ENGINE

is a novelty recently added. It consists of a little steam boiler heated by gas, which warms and regulates its own feed and controls the fire. It runs a little pump, placed above, which is said to be capable of forcing from ten to twelve barrels per hour to a distance of one hundred feet, at a cost not over 6 cents.

New Camera Lucida for Drawing.

It is known that the construction of the *camera lucida* is founded upon the simultaneous perception of two images—that of the object and that of the pencil. Various means have been employed to arrive at this result. In that of Sömmering, it is a metallic mirror smaller than the pupil; that of Amici is constructed on the principle of reflection on a plate with parallel faces; that of Wollaston, at present most in use, consists in a prism, of which the edge, dividing the pupil in two parts, permits the object to be seen by the upper half, and simultaneously the pencil by the lower portion. In all these systems the fusion of the images is somewhat difficult to seize, especially for certain points of the reflected image. Govi, Professor of Physics at the Royal University at Rome, proposes to cover with a thin layer of gold the reflecting surface of a prism, and to apply upon this, with Canada balsam, a second prism with like angles. Although this layer of gold is sufficiently transparent to allow the luminous rays to pass, its power of reflection is considerable, and it gives images of great brightness. We have thus a perfect means of superimposing, without fatigue to the eye, two different images—the one direct, and the other reflected. The principle is the application of that property of thin plates—metallic or otherwise—to transmit simultaneously direct rays, and to reflect rays which arrive obliquely from another source.

Dr. Robertson, of Georgetown, Mass., thinks that the popular idea that hot or cold drinks are apt to crack the enamel of the teeth is incorrect. He has ascertained by experiment that it requires a change of temperature of 160° Fah. to crack the enamel of an ordinary tooth. The teeth are never subjected to such a great change as this in the use of hot or cold liquids.

THE first passenger train making the complete circuit of St. Louis lately passed over the bridge and through the tunnel. The regular locomotive being exchanged for one of the smoke-consuming engines used by the tunnel company, the train passed as comfortably as though traveling in the open air.

THE SAW CONTEST AT CINCINNATI.—In our account of the saw premium contest at the Cincinnati Exposition, the 16 good boards, 10 x 20, sawn in two minutes and forty-four seconds, should be described as 16 x 20, making a still greater result than we reported.

THE Canadian way of measuring a tree is said to be as certain as it is grotesque. You walk from the tree, looking at it from time to time between your knees. When you are able to see the top of a tree in this way, your distance from the root of the tree equals its hight.

A LAWYER'S ADVICE TO A PUPIL.—"When the facts are in your favor, but the law opposed to you, come out strong on the facts; but when the law is in your favor, and the facts opposed to you, come out strong on the law." "But," inquired the student, "when the law and the facts are both against me, what shall I do?" "Why, then," said the lawyer, "talk around them."

LEATHER PULP.—A process of pulping leather in engines, similar to those used for beating rags in a paper mill, is now in use in Massachusetts. By rolling it into sheets under considerable pressure, a product of great tenacity, homogeneity, and closeness of texture is obtained, which is, moreover, perfectly waterproof.

Recent American and Foreign Patents.

Improved Harvester.

Andrew Jamison, Taylorstown, Pa.—The feature of this invention is a reel mounted on a pivoted lever, which tilts or raises the finger bar so that it may be adjusted to various hights, thus adapting the machine for use either as a reaper or as a mower.

Improved Steam Bell Ringing Apparatus.

Charles H. Hudson, Dubuque, Iowa, assignor to himself, Pierce H. Sutton, Edwin Smedley, and Orren F. Hodge, same place.—This is a steam engine designed for ringing bells on locomotives. When the bell is in motion, a bell crank will press a tube down on the rod and force the piston to the bottom of the stroke, and thereby close the exhaust and open the inlet ports. When the crank has passed the center of the stroke, the steam admitted by the movement of the valve ring presses the piston up and throws up the bell. The tube connection allows the bell crank to move freely upward after the piston has reached the end of its stroke, cut off the steam, and open the exhaust port. The return swing of the bell is followed by the same action of the parts.

Improved Subsoil Plow.

Ira M. Griffin, Maryville, Mo.—This plow will open a wide double furrow The subsoil plow plate is secured to a standard, which is curved upward and forward, and its forward end is bolted to the upper part of another standard, several holes being formed in the latter standard to receive the said bolts, so that the pitch of the subsoil plow may be readily adjusted as may be required. The plow standard may be adjusted at discretion. The handles are attached to the double mold board.

Improved Belgian Zinc Furnace.

Theodore Hierta, St. Louis, Mo.—The disadvantage of the high Belgian furnace consists in the fact that, in order to have heat enough for the reduction of the ores in the upper retorts, the lower ores were exposed to an excessive temperature, which caused the too rapid deterioration and destruction of the furnace lining and the retorts. The present invention is intended to obviate these defects, and consists in the arrangement of a series of flues in the front, rear, and side lining of the furnace for drawing in cold air near the lower part of the same, heating it up during the passage through the flues, and introducing it at about the middle of the hight of the furnace through small apertures in the lining to the interior, to mingle well and thoroughly consume the gases of combustion.

Improved Door Fastener.

James Black, East Popperell, Mass.—This invention consists of a spring bolt with projecting roller end, which slides in a socket set into the door, and fastens the door by means of an angular plate with suitable inclines applied to the casing. A catch of the socket face plate projects into a recess of the spring bolt, and retains the same inside of the socket during the time the door is open.

Improved Rein Holder.

James Lowth, Chicago, Ill.—This is a movable spring clamping bar, pivoted and supported centrally, under which the reins may be respectively drawn in opposite directions. The construction is also such that the reins together may be drawn through or between bars and only toward the driver.

Improved Burial Case.

William S. Wood, Newtown, N. Y.—This invention relates to the construction of metallic burial cases, whereby the operation of putting the parts together is facilitated; and it consists in an eyelet or short tube inserted into the screw holes of the upper surrounding stay iron for holding the stay iron and the cover of the case together and the packing in position before the screws are inserted.

Improved Spring Bed Bottom.

Francis E. Lord and Herman K. Blanchard, Readsborough, Vt.—These wire springs have their median parts resting on slats and ends passed around under cross bars, then through the latter, and, finally, bent over, made parallel with and carried up through the slats.

Improved Treadle Motion.

Julius H. Thayer, Cold Hill, N. C.—The heel and the toe portion of the treadle are both pivoted to the axis, to be worked by rocking the foot. The heel part has an arm extending about as far as the toe piece, and having the usual connecting rod for turning the crank shaft connected to it, while the toe piece has a rigid arm rising up by the side of the connecting rod to its middle, and connected at its upper end to a connecting rod by a short connecting link. The upper end of the arm swings forward and backward across the connecting rod, and delivers the pressure of the foot on the toe piece against it transversely at the time it is passing its centers, thus carrying it past the centers.

Improved Device for Drilling Water Mains.

George B. Hand and John Carroll, Scranton, Pa.—A tubular piece has a screw-threaded socket at one end and a screw-threaded stem at the other. A screw cap is screwed to said stem, and the drill spindle passes axially through both the said socket piece and cap. There is a collar upon the drill spindle, against which the cap is made to bear to feed the spindle to its work, and also to prevent gas or water escaping around the drill.

Improved Boot and Shoe.

Michele Deross, New York city.—The uppers of this boot or shoe, which is intended for summer wear, are of straw or analogous vegetable material, braided or plaited so as to assume the proper shape. The material is attached to a leather inner and outer sole, so as to form a durable connection

Improved Burglar Alarm.

Adolphus Reimers, Lowden, Iowa.—An arm is applied to a block, which is placed in such position that the slightest motion of the door or window may produce the dropping down of the block and, thereby, the release of the parts for giving the alarm, which are arranged at the front side of said block. They consist of a spring hammer, a projecting pin for setting the hammer end thereon, and one or more paper percussion caps, which are held by a band spring firmly on the block. The dropping of the device releases the hammer and discharges the percussion caps, the detonation of which gives the alarm.

Improved Fireproof Safe.

Edward H. Parker, Poughkeepsie, N. Y.—A top reservoir is called into action at a certain temperature, by fusible metal melting in a valve, so that water therein rushes through connecting Z tubes and valves into a main tank, and, after filling the latter, into the door tank. Inside valves allow the gradual escape of the steam formed in the tanks, but retain the water on whatever side the safe may be thrown. When the safe remains in its upright position, the steam of the main tank escapes through the top part of the vertical valves and the reservoir, that of the door tank through the tubes opening at the bottom of the door. If the safe falls in any direction, the reservoir is detached and the steam makes its exit directly through the entrance tubes. If the safe falls on its top, the steam escapes through the tubular stem of the vertical tank valves, while the water is prevented from escaping by the conical plugs being seated in the funnels of the casings; and generally, in whatever position the safe may fall, suitable arrangements admit of the escape of the steam while preventing that of the water.

Improved Tug Buckle and Hame Clamp.

James Wilcoxon, Morrisonville, Ill.—The clasp surrounds the hame, and takes the place of the old staple and hame hook. It is movable on the hame, up and down, so as to bring the draft at the proper point. A catch is secured to the joint pin, which closes into a recess in the clasp to secure and hold the same in the desired place on the hame. When the hame is on the collar, the catch is held in place by the latter. By this arrangement, the tug can be lengthened or shortened at the hame, and the point of draft can be brought to bear in the proper place on the collar or shoulders of the horse.

Improved Whip Tip Ferules.

Edward B. Light, Westfield, Mass., assignor to Edward B. Light & Co., same place.—This is a device for connecting a whip tip with the stock, consisting in a ferule having teeth formed in the sides thereof and adapted to be driven the whip tip and stock.

Improvement in Process and Apparatus for the Manufacture of White Lead.

Ludwig Brumlen, Hoboken, N. J.—This process of manufacturing white lead from metallic lead consists in moistening the material in a suitable revolving cylinder with a solution of acetate of lead, oxidizing it by the introduction of heated air, combining the oxide with heated carbonic acid by the introduction of the same, and of removing and precipitating the white lead by a solution of acetate of lead and the uncombined carbonic acid from the cylinder.

Improved Machine for Cutting Roll Paper.

Ignatz Frank, New York city.—A ring-shaped cutter-carrying plate is rotated by a crank handle. Two cutting knives are pivoted at diametrically opposite points to the base plate and guide bands, which are attached by fastening screws to said plate, in such a manner that the cutting blades slide between them and the plate, being secured in open position sidewise of the central aperture by pivoted spring catches, which are forced with their hook ends through holes of the guide bands into holes of the knives. Strong spiral springs on the knives force the same toward the center of the aperture when released from the hook catches. Projecting handle ends of the knives serve to carry the same back into side position, to be held by the catches for adjusting the roll in the central aperture. The rotation of the cutter-carrying plate, in connection with the action of the springs on the knives, cuts the roll paper in rapid and even manner.

Improved Mold for Sugar.

A. H. William Schrader, Hoboken, N. J.—This mold has its top, body, and double bottom detachable, the inner bottom being perforated. An air passage is made through the center for the purpose of cooling the sugar during the process of crystallization.

Improved Corn Planter.

Lafayette E. Askew and William H. Sangster, Greenville, Ky.—In this planter, the seed-delivering devices are operated through the medium of a star or rimless wheel, which is turned by the advance of the machine. To the shaft, within the hopper, is attached a cross bar, the arms of which are cam-shaped. These agitate the seed in the hopper and enter alternately a slot in a plunger, so as to raise said plunger twice at each revolution of the wheel. The plunger, when released from the cams, is forced down by a bent spring. Plates are so formed that, when the plunger is raised, a cavity will be formed between them and the lower end of the plunger of such a size as to contain enough seed for a hill. As the plunger descends, its lower ends forces the plate apart, and allows the seed to drop to the ground.

Improved Running Gear for Wagons.

William L. Booth, Concord Station, Pa.—The rear bolster and the rear end of the reach are pivoted to the rear sand board and rear axle. The forward bolster and the forward end of the reach are pivoted to the forward sand board and the forward axle. The pivoted rear bolster is connected with the reach by two chains, so as to be always held at right angles with said reach. The rear hounds receive the rear ends of braces which pass beneath, and are secured to, the axle, and their forward ends are secured to the said hounds. The upper braces pass over the sand board and along the upper side of the hounds, to also serve as a facing for said hounds. The front fifth wheel frame is provided with a swiveled perforated ball, and the connection between the forward hounds and the axle is strengthened by brace straps.

Improved Double-Acting Pump.

James Robertson, New York city.—The tube with which the pipe is connected is separated from the lower valve chamber by a valve. From this tube a passage leads to the upper valve chamber, from which it is separated by a valve. From the lower valve chamber a passage leads into the lower part of the piston chamber, and from the upper valve chamber a passage leads into the upper part of the said piston chamber. The upper end of the lower valve chamber is closed from a valve, from which a passage leads to the head of the pump. The upper end of the upper valve chamber is closed by a plate, which is held down to its seat by a screw, which passes through a screw hole in the bar, the ends of which are placed beneath lugs cast upon the head. As the piston moves upward, a vacuum is formed in the lower valve chamber, which causes the water to pass up through the passage, raise the valve, pass into said chamber, and thence through another passage into the lower part of the piston chamber, to be forced out by the next downward movement of the piston. The same upward movement of the piston forces the water in the upper part of the piston chamber to raise the valve, pass into the head, and flow out through the spout.

Improved Bag Fastener.

Scott Wellington, East Saginaw, Mich.—A strap, the ends of which are attached to a plate, passes around the mouth of the bag. At points upon the strap are eyes through which a cord passes. Spring clutches attached to the plate receive the cord and hold it when the ends are drawn together. By compressing the springs, the cord is readily released.

Improved Paper Pulp Screen.

John S. Warren, Fishkill on the Hudson, N. Y.—The essential feature of this machine is a revolving cylinder, formed of segment plates of a larger circle than the completed cylinder, united at their edges and working in connection with the screen, which revolves in a contrary direction, thus producing a pulsating current, the whole operating in the vat.

Improved Bucket Ear.

Julius F. Vogt, St. Louis, Mo.—The ear is made with the ordinary ball eye, below which it is forked to straddle the stave, in which position it is fastened by a single rivet beneath the upper hoop. The ear is thus directly on the top of the bucket stave, and allows the bail to be connected in such a manner that the bucket dips, when lowered to the water, with greater facility than when attached by the ordinary ears.

Improved Fishing Tackle.

Henry L. Sprague, Tottenville, N. Y.—This invention consists of a spiral spring secured and contained in a hole passing through the sinker. The line is attached to each end of the spring, and the degree of expansion of the latter is limited by a cord. When the hook and line is set, the elasticity and yielding of the bait caused by the spring gives the fish courage to endeavor to obtain a better hold, and thus secures the hook, which leads to his own capture.

Improved Toy Attachment for Childrens' Carriages.

John D. McAnulty, Philadelphia, Pa.—This is a little contrivance whereby two dancing and one revolving figure may be operated for the amusement of children while riding in a child's carriage, the apparatus being attached to the front of the carriage and the mechanism geared with one of the wheels of the carriage by a belt.

Improved Cotton Bale Tie.

William H. Tillery, St. Helena Parish, La.—The band for baling the cotton is provided at both ends with side recesses, preferably alternating at the sides. These are inclined at one end, and curved in semicircular shape at the other end, in such manner that they form, with the edge of the band, hooks. The recessed band ends are slipped over each other, and tied by a link-shaped clasp, which is carried over in lateral position, and then diagonally into the connecting recesses, until two corresponding hooks catch at each side around the side pins of the clasp, cross over the same, and lock the band firmly thereto.

Improved Millstone Dress.

Madison Vandegrift, Cincinnati, O.—This invention consists in an improved millstone dress, formed of a circle furrow and two circles or sets of straight furrows, the inner or eye furrows being made with a greater draft or inclination than the outer or skirt furrows. This greatly facilitates the passage of the chaps from the eye to the skirt of the stone, and at the same time improves the ventilation.

Improved Paddle Wheel.

Henry Reynolds, Albany, N. Y.—This invention consists of two wheels made fast at a short distance apart on the same rotary shaft, having their respective sets of buckets arranged obliquely thereacross, and having the opposite points of corresponding buckets of the two wheels arranged above or below and at an obtuse angle to each other. It is claimed that by this construction the same amount of bucket space will be constantly submerged so that the action of the wheel will be uniform.

Improved Watch Case Back.

Henry Birns, Jersey City Hights, N. J.—A blank of the size and thickness required is punched out of any sheet metal commonly used for watch cases, and first struck up with an outer flange. The blank is then transferred into a die whose punch has a tapering rim, with a slightly projecting central spring piston, which together form an angular recess with inclined side. The stroke of the punch on the flange of the blank carries the same to the inside, under the same inclination as that of its rim, and produces thereby a solid snap of triangular shape, which increases thickness toward the outer circumference of the cap or back, and strengthens the same at the point of greatest strain.

Improved Furnace for Burning Kilns.

George C. Surls, Rochester, Pa.—This invention relates to a heating furnace for brick, drain pipes, and earthenware kilns, in which an intense and regular degree of temperature is required for burning the wares, and in which the cheapest kind of fuel may be used. The furnace has double arches placed over the fire box, which form an air space, connecting with front air flues for heating up the air and conducting the same by rear flues to flues connecting the furnace with the kiln, so as to produce the intermixture and complete combustion of the fire gases on their entrance to the latter.

Machinery for Washing, Bleaching, and Dyeing Skins.

Thomas Golden, Cutchogue, N. Y.—This is a drum formed, as to its periphery, of bars, which are V-shaped on the inside to scrape the skins open the pores. The bars are attached at their ends to the heads of the drums. There are also similar V-shaped bars on the inside for scraping the skins. The drum has a door at the side for putting the skins into it and taking them out, and is provided with gear to swing it up out of the tank and over one edge of the latter to dump the skins out into a cart to save the labor of taking the skins out by hand. Pipes are attached to introduce steam and water to the bottom of the tank to regulate the temperature. The machine is to be used in the several processes of tanning and dressing such skins as calf, sheep, deer, goat, seal, and all kinds of light skins and hides, known as washing, liming, tanning, raising, alumming, and softening with water, lime liquor, or pure drench, tan liquor, alum, soft liquor or sumac, or any of the liquors used in tanning or dressing leather. It is also useful for bleaching and dyeing of cloths.

Improved Portable Post for Tents, etc.

Henry D. Goldsmith, New York city.—The two parts of the post are made tubular, and of such sizes that the upper part may be inverted and passed into the other part. Upon three sides of a short sleeve, into which the lower tube fits, are formed lugs to which are pivoted stakes, which are readily forced into the ground. Plates are provided which limit the depth to which the stakes can enter the ground, and at the same time adjust themselves to any unevenness of the surface. At the upper end of the highest tube is a cap having a hinged clamp and plate for holding the horizontal rod which supports the tent.

Improved Sheathing for Buildings.

Rowell Colby, Freeport, Ill.—This invention consists in a fireproof roofing or sheathing for buildings, which is formed of metallic or paper sheets and a filling of mortar. The sheathing is placed along the lowermost part of the surface, and a cleat is tacked along the upper edge. A coat of mortar is then applied, so as to fill up the space above the cleat. The sheathing is next folded over cleat nails and mortar, and another strip is placed along the upper edge, and fastened in a similar manner by a cleat and nails along and with the edge of the lower strip. This operation is continued until the whole surface is neatly finished, the upper course being fastened by a cleat or strip of the paper or other material nailed over the same.

Improved Watchman's Time Check.

Carl Pfisterer, Ehingen on the Danube, assignor to Theodore Hahn, Stuttgardt, Germany.—This control apparatus is set by placing a pointer indicating the number of stations against a starting figure on the dial. Another pointer showing the number of rounds is also set against the highest figure on the dial. The several keys are secured in the places or stations to be visited by the watchman, who carries the clock with him, introducing each key in the regular order into the case till all stations have been visited. The rounds will be indicated on the second dial as each trip is completed. Should any station be omitted, the next key will not work the instrument, and will compel, therefore, the watchman to return to that station for bringing the time check in regular motion.

Improved Tool Handle.

George Carlisle, Attleborough, Mass.—A tip, made of horn or similar hard material, is attached to the handle, and has a broad shoulder and a central tenon, the tenon being of less diameter at the shoulder than at its end, and tapering or curved from the end to the shoulder. The hole in the handle is made of the size of the end of the tenon. A ring of steel, with its ends of equal diameter outside, but with the inside to correspond with the shape of the tenon, is inserted in the handle outside of the tenon mortise, so that, as the tip is forced down, the wedge section of the ring causes the wood about said mortise to hold the tenon tightly.

Improved Hydrant Cover.

James McKnight, Brooklyn, N. Y.—Spring catches are provided on the cover extending down in the hydrant, and are held out in notches in the latter by a cam suspended on a spindle projecting from the under side of the cover. The upper end of the spindle terminates in a socket on top of the cover, and is turned by a wrench. The cam is held in position for keeping the catches in the notches by friction.

Improved Earth Auger.

Washington Smith Jones, Meridian, Miss.—A lower borer plate is formed of two symmetrical halves of cast iron connected around the recessed part of the shaft by means of semicircular collar extensions which embrace the shaft, and are firmly attached thereto by a sleeve. The sleeve is slipped over the collars and keyed to the shaft by a cross pin. A second screw plate is attached to the shaft, at a suitable distance above the end plate being also made of symmetrical halves, and which serves mainly to take off the weight of the earth from the lower plate, and lift a greater quantity on hoisting the auger. The detachable guide drum or band is also produced of two equal parts, constructed of V-shaped plates with collar extensions, and applied consecutively to the various recessed parts of the shaft above the plates by a sleeve and cross pin. Strong radial arms are applied to each plate, and a semicircular band, having the same radius as that of the lower plates, is suitably and firmly connected to their ends. The ends of one half drum are provided with stationary sleeves, into which projecting parts of the ends of the corresponding half drum fit, producing thereby on the attaching of both parts a full drum for guiding the auger in the required straight direction. The guide drum is transferred with the increasing depth of the borer plates to the upper part of the shaft, and the straight direction of the auger easily controlled.

Improved Well Auger.

Robert J. Gardner, Carlisle, Ark.—This invention consists in combining, with a shaft having a radially slotted bottom and edge-turned knives, a sliding top-closed cylinder and fast ring, whereby an earth auger is formed whose cutters take off successive shavings or thin slices of soil which are rapidly transferred into the cylinder. The latter continues to rise on the shaft until it strikes the fixed ring, when the auger is withdrawn and emptied of its contents. By this peculiar construction and combination of parts, the auger is enabled to do its work with singular neatness, efficiency, and economy of labor.

Improved Wood Bending Machine.

Augustus F. Marshall, Black River, N. Y.—This is a machine for bending wood for chair backs and the like by the use of a movable crosshead and screw for working it. It is an improvement on the patent granted to same inventor September 5, 1871. It consists in the combination of two screws with the crosshead for working it, in a manner calculated to avoid the cramping and binding of it with the ways. The screws are geared with a countershaft, and are both turned alike, so that one will not overrun the other. The invention also consists of such arrangement of the stirrups the former, its carrier, and the die in which the back is bent, that the arms are bent while the former is being moved out of the die for bending the back to adjust it for receiving the next bar.

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ANSWERS TO CORRESPONDENTS

G. W. P.'s description of the double star is too vague to allow us to recognize it.—C. J. K. will find descriptions of some breech-loading cannon on pp. 149, 402, vol. 27.—A. H. will find a recipe for silver-plating solution on p. 170, vol. 30.—W. H. B. will find directions for transferring pictures to glass on p. 43, vol. 30.—J. H. M. will find a recipe for quick-setting glue on p. 33, vol. 31, and for a cement for wood and glass on p. 274, vol. 30.—J. T. will find directions for galvanizing cast iron on p. 59, vol. 24.—C. H. S. will find directions for keeping eggs on p. 378, vol. 30.—T. C. W. will find a recipe for waterproof paper on p. 346, vol. 30.—D. G. & S. are referred to p. 107, vol. 29, for directions for annealing steel.—We do not understand what J. A. F. means by a vacuum cylinder to a steam engine.

(1) C. S. asks: Please tell me how I can photograph on tin. A. The process is the same as that of preparing glass negative plates; the difference is due to the dark background, which reverses the shades and thus renders the picture positive.

How is lithographing done? A. The stone used in lithography is a limestone (carbonate of lime) of a very hard and compact texture, admitting of being ground to a fine surface. The stone must have the qualities of imbibing both water and grease or oil, the crayon used in drawing upon it being composed of grease, wax, soap, shellac, and ivory black, which is also the composition of the ink used in printing, with little variation. The stone, having the picture drawn upon its smooth surface with the prepared crayon, is wet with water. While the stone is still wet, an inking roller is passed over its surface. While the wet part of the stone refuses to take the ink, the crayon lines, being of a greasy nature, will take a portion of it from the roller. The stone is then ready for printing.

1. How can I make albumenized paper, and how sensitize it? A. Ammonium chloride 200 grains, water 5 ozs., albumen 15 ozs. The mixture should be well beaten, and the froth that forms skimmed off and placed in a flat vessel to subside. To sensitize the prepared paper, coat one side evenly with a solution of 60 grains of nitrate of silver in 1 oz. of distilled water. This latter operation must be performed in a dark room, or by candle light. 2. With what do photographers fix pictures taken on glass with collodion, before transferring to the paper? Do they remove the collodion that is not acted upon? A. Either solution of hyposulphite of soda or cyanide of potassium. The picture should first be developed by pouring over it a solution of sulphate of iron in water. 3. Does iodine come in a liquid or solid form? A. Solid.

(2) W. C. asks: 1. Will thin sheet lead resist the action of sulphuric acid for an unlimited period, at ordinary temperature, so as to be a safe receptacle? A. It is so used in the lead chambers of a sulphuric acid manufactory. 2. Will it in the same way resist nitric acid? A. No. 3. Can it also be used to contain muriatic acid? A. No.

(3) J. A. H. says: I have read your abstract from Mr. Chase's article on "Fishing by means of Explosives." 1. Will common gunpowder, gun cotton, or dynamite do for such a purpose? A. Yes. The quantity used depends much upon the depth of water. 2. Should the cartridge wrapper be thick metal or will varnished paper do? A. Paper will answer the purpose.

(4) P. M. asks: How can I transfer ordinary engravings to glass? A. Fix the printed surface to the glass with ordinary paste. Etch with liquid hydrofluoric acid of specific gravity 1·14. At the end of 3 or 4 minutes wash off the paper, and the design will be found reproduced upon the glass.

(5) J. S. says: You say that the point of a wagon wheel touching the ground comes to perfect rest, the wheel being in motion. Do you claim that one part of the wheel is going fast, another slow, and another standing still? If so, is it the same with friction pulleys and idle wheels? Can one part of a solid wheel stand still and another part be in motion? A. Each point as it reaches ground is at rest with respect to any fixed point in the earth, but has the same rate of angular motion as the other points in the circumference.

(6) O. M. R. says: I am making hydrogen from sulphuric acid and zinc in a cylinder for oxyhydrogen light. The cylinder is coated with vulcanized rubber. Why cannot I use (in place of the zinc) iron turnings? A. You can use iron. But iron in dissolving in dilute sulphuric acid does so with the formation of froth, and the evolution of certain oily hydrocarbons. The solution, moreover, soon becomes saturated with ferrous sulphate, which soon crystallizes. You will have trouble and will find that it is less satisfactory, except in the matter of cost, than zinc. 2. What quantity of acid will it require to consume 1 lb. of iron, and what volume of gas will be produced? A. It will take 28 ozs. strong oil of vitriol, and 5 cubic feet and 1640 cubic inches of gas will be evolved.

(7) J. C. P. asks: How can I temper No. 16 brass wire, so as to make spiral springs? I have tried hammering and heating, and failed every time. A. There is a brass wire, already tempered, made specially for springs.

(8) B. O. says: I wish to solder a piece of metal about an inch square, to the side of an iron kettle; it is to be a sort of bed piece to which a hasp is to be attached, capable of sustaining a weight of 15 or 20 lbs. Is there means by which I can make this attachment? A. Braze it by the ordinary method, using spelter and borax.

Is there any machine for bending or twisting wire, by which I can manufacture wire loops to be soldered to tin vessels? A. Use a solid block of iron, in which put three pegs in the required position, and bend the wire, by hand, alternately round the pegs to form the desired loop.

(9) L. M. S. asks: 1. Can water be electrified so as to be sparkling? A. No. 2. Will electricity settle muddy or sooty water? A. No. 3. Would electricity aid in bringing butter quickly in churning? A. No. 4. Would air, forced or pumped into an ice cream freezer while freezing, make ice cream lighter or smoother? A. No.

(10) J. B. asks: 1. Is it possible to cast brass in cast iron or wrought iron molds without heating the latter before the process of casting? I want to obtain a smooth underside of the casting, to render filing and planing unnecessary. A. There are facing sands and compositions for molding smooth castings which answer for the purpose you mention better than any other device. 2. Would plumbago be a non-conductor good enough to prevent explosion if rubbed on the inner sides of the mold, or would a mold, made of plastic graphite, render a very smooth casting without wearing out fast? A. Yes.

(11) P. S. V. asks: Will sulphur water when used in a steam boiler cause a scale of sulphur inside? A. It would not be advisable to use this kind of water. Possibly the sulphur could be removed by some of the feed water heaters in the market.

(12) A. H. asks: Are brass tubes drawn or rolled in grooved rolls? A. They are drawn. 2. Could tubes be rolled by inserting a steel rod (inside of tube) in grooved rolls, the grooves being graduated like holes in a wire draw plate? A. The plan you mention is practicable, and is, we think, in use.

(13) A. McG. asks: How can I clean an oil painting that is injured by dust and particles of wrapping paper? A. We can recommend the following: Take the picture out of frame, lay a coarse towel over it for 10 or 14 days; keep it continually wet until it has drawn out all the filthiness from the picture; pass some linseed oil which has been a long time seasoning over it, in the sunlight, to purify it, and the picture will become as lively on the surface as new.

What is best for cleansing and burnishing church plate? A. Try the following recipe: Plunge the article into this solution: Hyposulphite of soda 1 lb., sal ammoniac 8 ozs., solution of ammonia 4 ozs., cyanide of potassium 4 ozs. Let it remain one half hour, wash, and rub with buckskin. The cyanide of potassium is very poisonous. It may be omitted, but then the solution is not so active. No powder is necessary in polishing.

(14) C. S. J. asks: What is a test for arsenic in wall paper? A. Marsh's test is the simplest. Put several small pieces of the suspected paper, with water, in a flask containing small pieces of metallic zinc; make the liquid acid by sulphuric acid. This immediately attacks the zinc, generating hydrogen. Through the cork in the top of the flask, pass a glass tube, drawn to a fine point at the outer end. After the hydrogen has been evolved for a short time, ignite it at the outer end of the glass tube; bring a polished surface of porcelain in contact with the flame of hydrogen, if there be any arsenic present, it will be combined with the hydrogen, and the flame will color the porcelain with the black arsenical mirror.

(15) J. R. M. says: A shopmate says he can make a single tap that will cut 4 different threads, 8, 16, 24, and 32. How is it done? A. A tap cannot be made to cut different threads unless it has removable teeth. It may be used as a tool in the lathe, and thus cut a double or triple thread; but this would only be a curiosity, as a tap used as a tool chaser would be a most unmechanical device. An ordinary tap, used as a tap, will only cut a thread of one definite number to the inch.

(16) O. P. asks: 1. How can I find, on the surface of a revolving cutting iron, the exact shape for striking any given molding? A. Your best plan will be to mark out with compasses, squares, etc., on a piece of sheet tin, the molding required; then cut out the same and use it as a gage. You can make a male and female gage from the sheet tin. 2. If a cutter make a given pattern of molding when revolving on a cutter head 6 inches in diameter, would not the same cutter, if used on a cutter head 6 feet in diameter, produce molding of a different form? A. No.

(17) J. H. L. M. asks: Has a vacuum ever been produced in a steam engine without using the exhaust steam? A. Not to our knowledge.

(18) A. H. asks: How can I prepare the glasses for a camera? A. To make small lenses, prepare a vertical crank arbor with a screw thread for chucks cut on the top, to be worked by a treadle. The frame supports a tub of wet sand through which the arbor rises. Lead-faced chucks are cast of proper curvature, and the lens is held upon the chuck by a wooden handle attached with pitch, while sand and water are applied. Convex lenses may be cemented to the chuck by drops of pitch half an inch apart. When rough ground, they may be finished with a brass or iron grinder, worked with emery alternately on the lens and on another grinder which fits it. Finally apply rouge with pitch polisher, as we have before directed. Flint glass disks may be cemented to a chuck and turned in a lathe with the end of a three cornered file ground to 60°, dipped in water acidulated with sulphuric acid, until the glass touches a brass tool all over. It may then be ground, stuck to a handle with sealing wax, and polished with rouge against a sealing wax polisher revolving in the lathe. The wax is removed with alcohol. For flat surfaces, as of prisms, three brass chucks must be continually worked upon each other while the surface is ground upon one of them. For photographic cameras, any glass will do, as some diffusion of focus is requisite. For telescopes and microscopes, it must be faultless. To photograph at the visual focus of a telescope the object glass lenses may be separated one thirtieth of the focal length; or better, the plateholder may be racked in a marked distance found by trial, or a view tube lens may be placed outside the focus. To photograph the moon, planets, and stars, a nitrate of silver bath, 35 grains to the ounce of water, must be used with a collodion containing iodide of cadmium. For the sun and portraiture, a bromized collodion may be used with a 90 grain silver bath. The plate is dipped into a weaker bath before exposure. The dark room shoul be well lighted through buff-colored envelope paper. For stars, the plate is lighted a moment by an argand burner 3 feet off, before exposure.

(19) M. W. asks: 1. How is printer's poster ink made? A. A good common ink for this purpose may be made as follows: Take 16 ozs. varnish, 4 ozs. linseed oil well boiled, 4 ozs. clear oil of turpentine, 16 ozs. fine lampblack, 2 ozs. fine Prussian blue, 1 oz. fine indigo. Boil one hour. 2. Are there machines for printing entire flags at one impression? A. Small machines for this purpose are, we believe, in use in this city.

(20) M. H. P. asks: Would it be practicable to draw water a distance of 100 feet length and 18 feet fall, with a suction pump and cement pipe? A. It can be done with a good pump and well laid pipe.

Is a brass kettle injurious for cooking fruit preserves, etc.? A. Not if it is clean and bright at the time of use.

In what way can light cassimere pants be washed? A. Dissolve a little curd soap in water, and mix a little clarified ox gall with it. Rub the mixture on all the spots of grease and dirt, and rub it in with a stiff brush; then brush the garment, and sponge with the same mixture well diluted with warm water. Rinse in clean water, and hang up to dry.

(21) P. M. K. says: 1. An engine has a 12 inch cylinder x 24 inches stroke, and runs at 75 revolutions. It is filled with two main slide valves; and a cut-off slide valve works on back of main valve, cutting off at ⅓ stroke. The travel of the main valve is 2½ inches. No. 1 valve has ⅝ inch lead on steam and ¼ inch lead on exhaust, with ⅛ inch lap on steam and no lap on exhaust end. No. 2 has no lead on steam and ⅛ inch lead on exhaust, with ⅜ inch lap on steam and ⅛ inch negative lap on exhaust, or both exhaust ports are open ⅛ inch when the valve is on the mid stroke. Which of the two valves is the best, all other conditions being the same? A. The first. 2. An engine is fitted with ordinary double slide valve (no cut-off attached) which has equal lead; but it will not cut off equally, following 1½ inches further on the out stroke than on the in. How is this? A. It is on account of the angularity of the connecting rod.

(22) N. O. A. asks: 1. Does it preserve a tooth permanently to have it filled, provided it is done well? A. Yes. 2. Is silver as good as gold for filling in every respect? A. No.

(23) M. H. B. asks: What is the best plan of setting up the follower rest, to an engine lathe, for the purpose of turning slender iron rods, of different size? Will one guard do, or will it take a different one for every sized rod? I tried a forked guard, but for some reason it did not work satisfactorily. A. A common plan is to have a plate composed of two forks, which can be adjusted for different sized rods. This holds the work in all directions, the effect of moving the adjusting screws being to make the square opening between the forks larger or smaller.

(24) M. asks: 1. How do you find the mean effective pressure per square inch on the piston of a steam engine? A. From an indicator diagram. 2. What is the most economical speed for a piston? A. This depends on a variety of circumstances, and would require more space for the discussion than we can give in these columns. 3. What book will give me the formulæ for the proportion of the parts of a high pressure engine? A. We can recommend Van Buren's work on "The Strength of Iron Parts of Steam Machinery."

What is the reason that, on taking a kettle of boiling water off the stove, one can bear his hand on the bottom for a short time, but after that the heat becomes unbearable? A. On account of the protection afforded by the soot.

Can an imponderable agent have any momentum? A. Yes.

(25) W. T. E. S. asks: How long would a reservoir containing 1,388 cubic feet, filled with air compressed to 300 lbs. to the square inch, last 8 men, who are in an air tight room containing 240 cubic feet of air, supposing that the compressed air is let in as required, and the foul air let out? A. From 4 to 5 hours. We do not think that your plan for a torpedo boat is novel.

(26) C. S. asks: What is the action of steam? I was before an examining board, and that question was put to me and others. A. It is rather difficult to answer a question of this general nature, but the action of steam may be compared to that of a compressed spring.

(27) R. I. asks: What would the pressure of air be to the square inch in forcing 2,500 cubic feet per minute through eight round openings, 4 of 1 inch and 4 of 1⅛ inches diameter? A. You will find rules in Weisbach's "Mechanics," by which you can make the calculations.

(28) W. S. B. asks: How far will a person have to stand from the roots of a tree 100 feet high that the top may be just visible, the earth being level with the exception of its natural curve? A. About 1¼ miles.

(29) E. P. R. & Co. ask: Would it be practicable to take steam from a boiler 550 feet distant to run a 10 horse engine, the boilers (of course doing other work) being of 160 horse power? A. The plan is perfectly practicable, and often adopted. If the pipe is properly protected and trapped, the loss will be trifling.

(30) L. G. D. says: I wish to draw strips of common steel one fourth of an inch thick and four inches wide to a tolerable cutting edge. This is done by hammering when hot and drawing to an edge. Would it be possible to do it by passing the steel between two steel rollers, made tapering so as to draw the steel plate to an edge? Could one man thus sharpen a strip of steel by turning a crank connected with one of the rollers? Can common soft steel ¼ inch thick be brought to an edge in this way when cold? A. We do not think you could get a very good edge in this way; and if the machine were worked by one man, the operation would be very slow.

(31) J. H. says, in commenting on our answer to A. B. & C., who asked if water can be raised by a siphon above 34 feet: You answer "No." I differ in opinion from the above answer. I say that the atmospheric pressure has nothing to do with the movement of the water through the siphon, the pressure being the same at either end; and I am fully satisfied that, if the long leg of the siphon contains sufficient weight or volume more than the short leg, water can be raised to any required hight. A. Your theory would answer very well if the column of water were connected together after the manner of a rope; as it is, we prefer to hold to the original explanation. Should you doubt it, however, you can readily make the experiment.

(32) U. Z. L. asks: What is the best method of removing rust from iron and steel? A. Use an emery block, with oil; such blocks are supplied by the makers of emery wheels.

(33) A. Z. L. says: 1. I am building a steamboat 27 feet long, with 6 feet beam and about 32 or 33 inches draft. Are these last dimensions in proportion to the length? A. They will answer very well. 2. I have a four horse power boiler and 2 one horse power engines which I propose to connect to a propeller shaft. What should be the size and pitch of the propeller? A. Try 30 inches diameter, 3½ feet pitch. 3. At what rate would the above engine propel the boat? A. 5 or 6 miles an hour. 4. Can I attain a speed of 18 knots an hour with a boat of the above dimensions? A. So small a boat could hardly carry the machinery for such a speed.

(34) W. H. B. asks: Can a barrel that has had vinegar in it be cleaned for keeping beef in? A. Yes, by using a strong potassa lye, and then thoroughly cleansing with water.

(35) N. S. asks: 1. How can I make a good silver-plating fluid? A. Dissolve 1 oz. nitrate of silver in 3 pints distilled water. Add strong solution of cyanide of potassium until no further precipitation takes place. If too much cyanide is added, it will redissolve the precipitate. Pour off the supernatant liquid, and wash the precipitate carefully. Now add strong solution of cyanide to dissolve the precipitate. Make one gallon with distilled water. The solution should have a moderate excess of cyanide, and it must be filtered before using. 2. What is a good simple way of plating with a battery? A. See pp. 75 and 133, vol. 30.

(36) C. says: In No. 9, current volume, you give the specific heat of carbonic acid as 0·2163, water being unity. What is the specific heat of carbonic acid gas? If one pound of this gas were placed in a tight tin vessel at a temperature of 120° Fah., immersed in another vessel containing one pound of water at 70° Fah., and allowed to remain until cooled by the water, at what degree would the two temperatures meet, no allowance being made for loss of heat? A. The number given is the specific heat of the gas. Let x = number of degrees which the 1 lb. of carbonic acid gas must lose: then $120° - x = 70° + 0{\cdot}216x$, $1{\cdot}216\,x = 50$, or $x = 41{\cdot}12$. And $120° - x = 78{\cdot}88°$, $70° + 0{\cdot}216\,x = 78{\cdot}88°$, which is the point at which the temperatures would meet.

(37) A. D. B. asks: How can I prepare chemical paper for telegraphic purposes? A. We believe the fluid used is a solution of ferrocyanide of potassium. 2. Can the solution be used as a writing fluid, with a pen, so that the paper would only be sensitive where covered with the writing? A. It may be used with a pen, but not a steel pen. 3. Where paper is a non-conductor, does the solution render it a conductor? A. Yes.

(38) A. H. Y. asks: 1. What property is there in some well water which destroys the lead pipe of a pump? A. Lead is corroded by pure water when it is exposed to the united action of the air and water. The water dissolves the oxide of lead. In case the water contains certain mineral matters in solution, its corrosive action on the lead is increased; other mineral salts diminish its corrosive action. A chemical analysis of the waters of your well would show exactly to what ingredient this corrosive action upon the lead was due. 2. Why does a lead pipe in a manure vault crumble to pieces? A. The manure in decomposing forms nitrates, nitrites, and certain ammoniacal salts, all of which exert a corrosive action upon the lead. 3. I often find that some water will act very quickly upon block tin pipe, filling it with little holes from which a fine dust is procured. What is the cause of this, and what is the dust? A. The white body is an oxide or other compound of tin, resulting from the causes above described. 4. Is block tin pipe poisonous to water, like lead? A. No.

(39) F. O. asks: How can I dye feathers to a red color which will be waterproof, to be used on fish hooks? A. Take 1 oz. Brazil wood in powder, ½ oz. alum, ½ oz. vermilion, and 1 pint of vinegar; boil them up to a moderate thickness, and dip the feathers (they having been previously steeped in hot water) into the said mixture. As to your other question, address Seth Green, Esq., Rochester, N. Y.

(40) C. S. T. asks: Is oleomargarin the proper name for butter manufactured from beef suet? A. It is a proper name, being derived from two of its principal constituents. 2. Is there any difference between the oil of beef suet (when it is separated from the stearin) and butter oil? A. If we clearly understand your meaning, the olein is the same in both substances. The olein found in butter was considered by Bromeis to be of a peculiar kind, which he termed butyrolein; but Gottlieb has shown that the difference in properties between the olein acid obtained by Bromeis from butter and that obtained from ordinary olein depended simply upon the oxidation which it had undergone during the process adopted in preparing it.

(41) J. L. asks: How can I make an aolian harp? A. See p. 330, vol. 28. The strings should be drawn tight.

(42) T. G. G. asks: What are the characteristics of asbestos or amianthus? A. Asbestos is a variety of hornblende or amphibole, which is a silicate and aluminate of magnesia, lime, and protoxide of iron, with a variable proportion of fluorides of calcium and potassium. It is soluble in a mixture of certain proportions of hydrofluoric and sulphuric acids.

(43) N. N. B. asks: At what parallel of longitude does each day begin and close? A. At 180° east or west of Greenwich.

(44) R. C. D. and others ask: Is there any way of bleaching beeswax without going through the long and tedious process of sun bleaching? A. It may be done by means of nitric acid; but chlorine, though it destroys the color, cannot be employed for this purpose with advantage, for it was observed by Gay Lussac that a substitution of chlorine for a portion of the hydrogen occurs under these circumstances. When candles made from such wax are burned, irritating vapors of hydrochloric acid are evolved.

(45) A. D. L. asks: To find the coefficient of friction in a moving body, do you divide the weight required to move the body by the weight of the body? A. Yes. As to your pendulum query, consult a work on analytical mechanics.

(46) J. K. B. asks: 1. What is the most accurate method of finding the throw of the eccentric for any travel of valve? A. The throw of eccentric must be the width of the steam port added to the amount of lap on the valve; hence the travel of the valve or (what is the same thing) the stroke of the eccentric must be twice the width of the steam port added to twice the amount of lap on one side. 2. What is the most accurate method of proportioning slide valves for any width of ports? A. A slide valve should always have at least ¼ inch lap, so as to give a free exhaust, the width of the exhaust port of the valve being 1-16 or 1-32 less than the width between the steam ports of the cylinder face. Additional lap must be added if working expansively is desired. 3. What is the most accurate rule for calculating the pressure on slide valves? A. If the faces of the valve and seat are fitted steamtight, the entire pressure will be the product of the entire area of bearing surface and ports in inches multiplied into the pressure per square inch maintained in the steam chest. This, multiplied into the coefficient of friction between the two surfaces, will give the force required to move the valve under such pressure when unbalanced. But as there are few valves which remain accurately fitted, any method of balancing slide valves should provide for experimental adjustment.

(47) C. M. A. says: I am about to build a small cottage building, which I wish to construct as economically as possible, and at the same time to introduce some modern conveniences. Among other things I propose to place my cistern on the second floor, so as to take the water over the house. Now a cistern of the requisite capacity, say 75 barrels, if lined with sheet lead or similar material, would be quite expensive. I propose to make a rectangular box of plank, of the requisite dimensions, to lath it inside across the grain of the plank, and then to apply a good coat of water lime cement. The cistern is to be located over an unfinished room, so that in case of possible slight leakage no harm would be done before the leak could be stopped. To guard against freezing, I will put at least 1 foot of dry sawdust over the whole thing. Can this be done effectively? A. We have no confidence in the kind of tank that you propose; the swelling and shrinking of the plank would cause the cement to crack. A better plan would be to construct a circular tank of 2 inch plank in staves, largest at bottom, and secured with strong iron hoops that may be driven down upon it if the wood shrinks. A tank like this can be made tight without a lead lining. If your house is tight, the water will not freeze more than ¾ inch thick on the top, and you will not require any special protection for this.

My rooms will most of them be as small as to make stoves inconvenient. I propose, in place of a furnace, to place one of the largest sized cast and sheet iron cylindrical stoves in the cellar, and to enclose this with a brick wall distant 1 foot all around, and make connection with this space by pipes to the open air on one hand, and to the rooms above on the other. The space to be heated will be about 14,500 cubic feet. What is your opinion as to the practicability of this? A. Your stove enclosed in brick is a proper heating furnace, but the number of cubic feet of air heated will be in proportion to the number of square feet of heating surface provided, and the latter may be increased in your case by introducing, by means of elbows, two or three joints of smoke pipe within the air chamber.

(48) C. G. asks: Cannot the poke root plant, which grows in such great profusion throughout the South and West, be made to subserve some useful purpose, rather than be treated as a troublesome weed? As all know who are acquainted with it, the berries have an abundance of juice of a beautiful deep red color and thousands of gallons could be obtained annually. It makes a beautiful ink, but it fades after a little time. I have tried putting in copperas, alum, etc., but they only precipitate the coloring matter. How can this beautiful color be utilized? A. The poke root (*phytolacca decandra*) is an indigenous plant, with a very large perennial root, and is used in medicine. "The root abounds most in the active principles of the plant. It should be dug up late in November, cut into thin transverse slices, and dried with a moderate heat. As its virtues are diminished by keeping, a new supply should be obtained every year. The berries should be collected when perfectly ripe, and the leaves about the middle of summer, when the foot stalks begin to redden. The berries contain a succulent pulp, and yield upon pressure a large quantity of fine purplish red juice. They have a sweetish, nauseous, slightly acid taste, with little odor. The coloring principle of their juice is evanescent, and cannot be applied to useful purposes in dyeing, from the difficulty of fixing it. Alkalies render it yellow; but the original color is restored by acids. The juice contains saccharine matter, and after fermenting yields alcohol by distillation. The dried root is of a light yellowish-brown color externally, very much wrinkled, and, when in transverse slices, exhibits on the cut surface numerous concentric rings, formed from the projecting ends of fiber, between which the intervening matter has shrunk in the drying process. There is no smell; the taste is slightly sweetish, and at first mild, but followed by a sense of acrimony. The active matter is imparted to boiling water and alcohol. From the analysis of Mr. Edward Donelly, the root appears to contain tannic acid, starch, gum, sugar, resin, fixed oil, and lignin, besides various inorganic principles. It is emetic, purgative, and somewhat narcotic. As an emetic it is very slow in its operation, frequently not beginning to vomit in less than one or two hours after it has been taken, and then continuing to act for a long time upon both stomach and bowels. The vomiting produced by it is said not to be attended with much pain or spasm, but narcotic effects have been observed by some physicians, such as drowsiness, vertigo, and dimness of vision. In overdoses it produces excessive vomiting and purging, attended with great prostration of strength, and sometimes with convulsions. It has been proposed as a substitute for ipecacuanha, but the slowness and long continuance of its action wholly unfit it for the purposes which that emetic is calculated to fulfil. In small doses it acts as an alterative, and has been highly recommended in the treatment of chronic rheumatism. The dose of the powdered root, as an emetic, is from 10 to 30 grains; as an alterative, from 1 to 5 grains. A saturated tincture of the berries prepared with diluted alcohol may be given in rheumatic cases, in the dose of a fluid drachm three times a day. An ointment, prepared by mixing a drachm of the powdered root or leaves with an ounce of lard, has been used to advantage in *psoriatinea capitis* and some other forms of cutaneous disease. It occasions at first a sense of heat and smarting in the part to which it is applied. An extract made by evaporating the expressed juice of the recent leaves has been used for the same purposes, and acquired at one time considerable repute as a remedy in cancer."—*U. S. Dispensatory.*

(49) O. C. asks: Is there any waterproof varnish by which paper can be fastened to glass so as to let gaslight penetrate through and show printed figures on the paper? A. Ordinary dammar varnish will doubtless answer your purpose.

(50) W. H. S. asks: How can I make muriatic salts of nickel? How can I make the solution of the salt? A. Chloride or muriate of nickel is formed by dissolving the oxide of nickel in hydrochloric (muriatic) acid. On evaporation it yields green hydrated crystals; by heat it may be obtained as a yellowish-brown anhydrous mass. It is soluble in distilled water.

(51) X. U.S. asks: How can I dissolve glass, and harden it? A. Ordinary glass is converted into a semi-fluid mass at high temperature. When heated with a quantity of carbonate of soda or potassa, it is converted into a soluble form, known as water glass. It cannot be re-hardened in the way you desire. We do not understand your other question.

(52) E. R. M. & P. W. ask: Is there any compound or solution (except iron or steel) that will act as an insulator between a permanent magnet and a piece of iron or steel? A. A short interval of space.

(53) G. A. M. says: A thermometer was sent to me a long distance by rail, and I find that the mercury in the tube is separated into three portions. I think air is in the tube. Please tell me how to get the mercury together. A. If you cannot do it by shaking or jarring the mercury together, open the upper end of the tube, form around the opening a small funnel with clean wax or paraffin. Gently heat the bulb with a spirit lamp, which will force a portion of the air out of the tube, then allow the tube to cool; repeat the operation several times, or until the mercury is together. The mercury is then heated to boiling, the vapor of which soon expels the remaining air and moisture. The tube, being now full of expanded mercury and mercurial vapor, should be hermetically sealed.

(54) W. W. asks: Can common family soap do any harm in the cylinder of an engine? Being out of grease some time ago, I used some chunks of common soap as a lubricator. I found it much superior to any grease I have used; but I am told by some that it leaves a residue behind, and blocks up the cylinder passages, etc. A. We cannot recommend the use of soap for this purpose.

Where can I get tables of the decimals of an inch, or how can I reckon them? A. Decimals decrease by tens; common fractions are expressed in decimals as follows: thus $\frac{1}{2} = 0{\cdot}5$; $\frac{1}{4} = 0{\cdot}25$; $\frac{1}{8} = 0{\cdot}125$; $\frac{1}{12} = 0{\cdot}0833$; $\frac{1}{32} = 0{\cdot}0625$; $\frac{1}{64} = 0{\cdot}03125$, etc. To reduce decimals to common fractions, use the figures as a numerator, and put 1 for the decimal point and as many ciphers as there are figures for the denominator. Thus $0{\cdot}25 = \frac{25}{100}$, $0{\cdot}03125 = \frac{3125}{100000}$, etc.

(55) M. S. P. C. says: In shops where they cut glass there is a powder used for polishing, made by burning tin until it is nothing but dross. This dross is heavier than the tin was originally. If you take 126 lbs. of tin, it will weigh (after burning) 126 lbs. How do you account for it? A. In burning, the tin is converted into the oxide, or, in other words, it absorbs a certain amount of oxygen from the air. The same is true with all metals when burned in contact with the air.

(56) J. W. P. asks: 1. About how long a time will 3 Leclanché cells last on an open circuit of 70 feet, where the circuit is closed only a second at a time 15 or 20 times a day? It is used to ring a tapping bell. A. From 6 to 12 months. These cells are in use in our office, and work six or seven bells or sounders. The cells have not been touched, we believe, for ten months past. 2. About how long a time will a Leclanché cell last on a closed circuit? A. This depends a great deal upon the resistance of the line and the sounders, etc. 3. Is there any loss of electricity at the press knobs where the metal touches the wood, or at any other place where the wire may happen to touch wood only? A. The loss would be imperceptible on a short line. 4. If two cells can do the required work, will the battery last a longer time if I use three cells? A. No. 5. For telegraph wire, will lead water pipes, running into a well, make a good ground circuit? A. No.

(57) W. H. D. asks: How can I make copper gas cylinders for the oxygen and hydrogen gases, so as to dispense with the use of bags and pressure boards, in using lanterns? A. There are several varieties of these cylinders; one consists of a cylindrical tank about 2 feet in diameter and 3 feet in hight. Into this is placed in an inverted position a similar vessel, of a few inches smaller in diameter. The apparatus is filled through connections in the upper head of the inner vessel, by displacement of water. Another form is that of a cylinder, constructed of very strong boiler iron, containing only one small opening for connections in the upper head, which is governed by a screw valve. The gas is forced into the tank by means of an air pump, until the pressure per square inch is not less than 300 lbs. The latter are very convenient.

(58) J. P. G. asks: How can I silver the surface of several panes of fine glass, so that they may appear white and brilliant? A. See p. 203, vol. 30.

What is the process of canning fish? A. One process consists in placing the fish, after being cleaned, in open vessels, which are then set in a steam chest, and the contents subjected to the action of steam at 212° Fah., for five hours, after which the fish are removed, drained, cooled, and packed with oil in metal boxes of marketable size, which are then closed and soldered, after which the closed boxes are heated by steam from 217° to 220° Fah. for five hours, according to the size of fish. By this method the fish may be preserved without vinegar or spices.

(59) J. C. H. asks: 1. Is the mind located in the brain? A. The mental operations are carried on by corresponding actions in the brain. 2. Can the mind be located at all? Some physiologists hold to the doctrine that the mind is separate and distinct from the soul, while others say the mind is a power with which the soul is endowed. Which is correct? A. These are metaphysical subtleties, not recognized in the treatment of the subject as a part of positive experimental science. 3. When a person is deranged, is it the mind of that person which is impaired, or are the channels through which the mind operates, to receive knowledge from external things, injured? A. Both the centers and avenues of mental impressions and sensations are essential to that healthy and harmonious operation of the mental faculties which characterize a state of mental vigor.

(60) H. J. F. asks: Why do the legs on the bottom of the old fashioned fireplace kettles burn in the middle? A. In order that iron may burn, it is not only necessary that it should be brought to a high temperature, but also that it should come into contact with the oxygen of the air at the same time, and these conditions are only realized in the middle of the leg.

(61) I. W. F. S. asks: Can you inform me of any way of causing fermentation, suitable for baker's yeast, without using stock from previous making? A. Fownes states that if wheat flour is mixed with water into a thick paste, which is to be slightly covered in a moderately warm place, it begins, about the third day, to emit a little gas and a disagreeably sour odor; about the sixth or seventh day the smell changes, much gas is evolved, accompanied by a distinct and agreeable vinous odor; and it is then in a state to excite vinous or panary fermentation, and may be at once used for that purpose, or formed into cakes, dried, and preserved for future use. Wort fermented with it forms a large quantity of yeast.

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

A. C. S.—It is iron ore, containing a notable quantity of titanium. It cannot at present be smelted with pecuniary advantage.—G. A. F.—A qualitative analysis made upon 100 grains of this pyrrhotine, which closely resembles the niccoliferous pyrrhotine of the Gap Nickel Mine, did not demonstrate the presence of nickel. It should be properly analyzed. A large quantity might show a valuable percentage of nickel.—W. H. McC.—It is a variety of kaolinite; it might be used perhaps, in the manufacture of pottery.—H. L.—It is magnetic pyrites.—G. F. B.—They are tourmaline, muscovite in quartzite, and biotite.—M. W. H.—No. 1 is neither gold nor iron pyrites; it is mica. No. 2 contains 80 per cent of lead.—H. S.—No. 1 is galena and blende. No. 2 and No. 3 are galena. No. 4 is calcite or carbonate of lime. No. 5 is ferruginous quartz. No. 6 is marcasite.—G. L. L.—It is iron pyrites.

E. D. K. asks: How can I dye morocco leather white, and how is the gloss given to morocco and other leather?—S. R. S. asks: How can I pare fruit by heating?—G. W. S. asks: How are broomsticks painted, striped, and waved?—H. K. asks: What preparation is used to put a hard and glossy finish on ax handles?

COMMUNICATIONS RECEIVED.

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

On Automatic Cow Milkers. By J. E. G.
On Scorpions. By D. E. R.
On the American Institute Fair. By L.H.R.
On the Retrogression of the Sun. By C. H. B., and by H. B.
On the late Charles M. Keller. By A. M.
On Steam Engines. By W. P. P.
On Cooking Oatmeal. By W.
On a Calculating Machine. By E. K. W.
On Railroad Employees and their Pay. By B. G. G. J.
On the Phylloxera. By L. W. G.
On a Boiler Explosion. By S. H. H.

Also enquiries and answers from the following:

Q.—W. M. S.—E. R.—G. T.—N. M. L.—R. S. T.—F. U. M—N. T. D.—R. W.—T. P.

HINTS TO CORRESPONDENTS.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Enquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasure in answering briefly by mail, if the writer's address is given.

Hundreds of enquiries analogous to the following are sent: "Who sells the best stove for heating a workshop? Who manufactures knives, and gold and silver trinkets? Who makes steam indicators? Who publishes a book on making glass? Who makes carbon plates for batteries? Who sells a book on wax fruit and flowers?" All such personal enquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

[OFFICIAL.]

Index of Inventions

FOR WHICH

Letters Patent of the United States

WERE GRANTED IN THE WEEK ENDING

October 6, 1874,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

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APPLICATIONS FOR EXTENSION.

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

31,077.—HOISTING DEVICES.—J. J. Doyle. Dec. 23.
31,525.—HOE BLANK MACHINE.—N. Brand. Feb. 10.

EXTENSIONS GRANTED.

30,250.—ORE SEPARATOR.—W. O. Bourne.
30,297.—CAR LIGHT.—R. Cathcard.
30,345.—IRON CHIMNEY TOP.—J. Pettengell.
30,357.—PLOW.—M. G. Slemmons.
30,371.—EXTENSION WASH BENCH.—S. Wiswell.
30,376.—BOOT CUTTING MACHINE.—E. T. Green.

DISCLAIMER.

30,357.—PLOW.—M. G. Slemmons.

DESIGNS PATENTED.

7,786.—GRAVE GUARD.—A. Rank, Salem, Ohio.
7,787.—NECK TRIMMING.—A. A. Rockwell, N. Y. city.
7,788.—KEYS.—A. L. Runyon, New York city.
7,789.—BILLIARD TABLE.—J. E. Came, Boston, Mass.
7,790.—PHOTOGRAPHIC CHAIR.—W. D. Gatchel, Cincin., O.

TRADE MARKS REGISTERED.

2,005.—IRON.—Burgess Works, Portsmouth, Ohio.
2,006.—CALICO PRINTS.—Coffin *et al.*, Philadelphia, Pa.
2,007.—WELT TRIMMERS.—I. A. Dunham, Brockton, Mass.
2,008.—LINIMENT.—Thomas & Co., Brooklyn, N. Y.
2,009.—MEDICINE.—Bliss *et al.*, Des Moines, Iowa.
2,010 & 2,011.—WATCHES.—Courvoisier & Co., N. Y. city.
2,012.—RICE STARCH.—C. R. Fowler *et al.*, N. Y. city.
2,013.—SHEETING.—J. C. Howe & Co., N. Y. city.
2,014.—MEDICINE.—J. S. C. Rowland, Hartford, Conn.
2,015.—GLOVES.—Wirbel *et al.*, New York city.

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CANADIAN PATENTS.

LIST OF PATENTS GRANTED IN CANADA, OCTOBER 6 to 8, 1874.

3,905.—J. C. Ford and H. R. Ives, Montreal, P. Q. Improvements on carriage jacks, called "Ford's Improved Carriage Jack." Oct. 6, 1874.

3,906.—F. G. Johnson, Brooklyn, Kings county, N. Y., U. S. Improvements on snow excavators and removers for railways, called "Johnson's Snow Excavator and Remover for Railways." Oct. 6, 1874.

3,907.—A. Rodgers, Muskegon, Muskegon county, Mich. U. S. Improvements on balance slide valves, called "Rodgers' Portable Slide Valve." Oct. 6, 1874.

3,908.—J. D. Fraser, Pictou, Pictou county, Nova Scotia. Improvements on a machine for propelling boats, called "A Vibrating Propeller for Vessels." Oct. 6, 1874.

3,909.—S. B. Peugh, Salem, Washington county, Ind., U. S. Improvements in carriages for plows, called "Peugh's Improved Plow Carriage." Oct. 6, 1874.

3,910.—T. Sandall, Charlottetown, Prince Edward's Island. Improvement on link motions, called "Sandall's Link Motion." Oct. 6, 1874.

3,911.—A. Wyman, Barnston, Stanstead county, P. Q. Improvements on horse hoe, weed cutter, and potato digger combined, called "Wyman's Horse Hoe, Weed Cutter, and Potato Digger Combined." Oct. 6, 1874.

3,912.—F. Leadbeater, Detroit, Wayne county, Mich., U. S. Improvements on grain separators, called "Leadbeater's Improved Grain Separator." Oct. 6, 1874.

3,913.—G. Grimshaw, Minneapolis, Hennepin county, Minn., U. S. Improvements in carriage and wagon springs, called "Grimshaw's Carriage and Wagon Spring." Oct. 6, 1874.

3,914.—J. W. McPherson, McGillivray, Middlesex county, Ont., W. Grundy, and C. Cosens, Lucan, Middlesex county, Ont. Improvement in fences, called "McPherson's Movable Fence." Oct. 6, 1874.

3,915.—F. Weymann, Naples, Italy. Improvements on machines for treating or preparing meal, called "Machine for Preparing Meal." Oct. 6, 1874.

3,916.—W. J. F. Liddell, Milwaukee, Milwaukee county, Wis., U. S. Improvements on horse powers, called "Liddell's Horse Power." Oct. 6, 1874.

3,917.—E. Rowland and G. E. Rowland, Manchester, Lancaster county, England. Improvements in fire bars for furnaces, called "Rowland's Oscillating Furnace Bars." Oct. 8, 1874.

3,918.—O. M. Morse, C. S. Fuller, H. J. Burdick, Oswego, Oswego county, N. Y., U. S., and S. Howes, A. Babcock, N. Babcock, and C. Ewell, Silver Creek, Chatauqua county, N. Y., U. S. Improvements in middlings purifiers, called "Morse's Improved Middlings Purifier, No. 1." October 8, 1874.

3,919.—W. H. Bennett, New York city, U. S. Improvements on a paper file and binder, called "The Yankee Letter File and Binder." Oct. 8, 1874.

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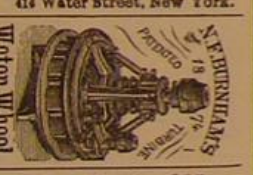


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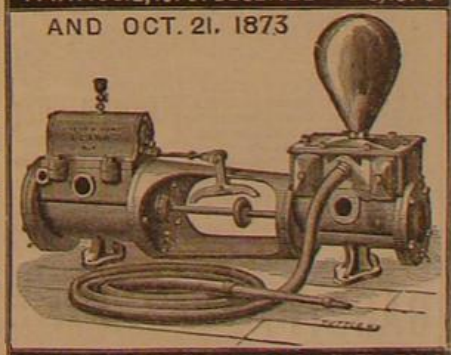
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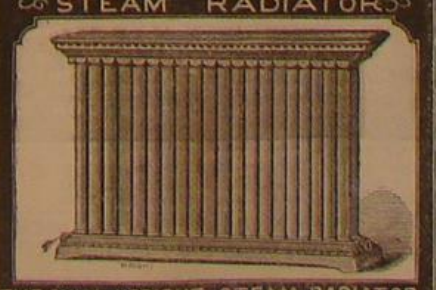
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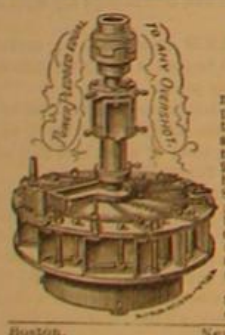
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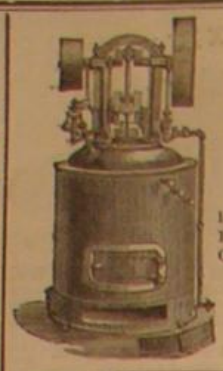
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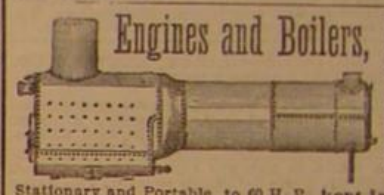
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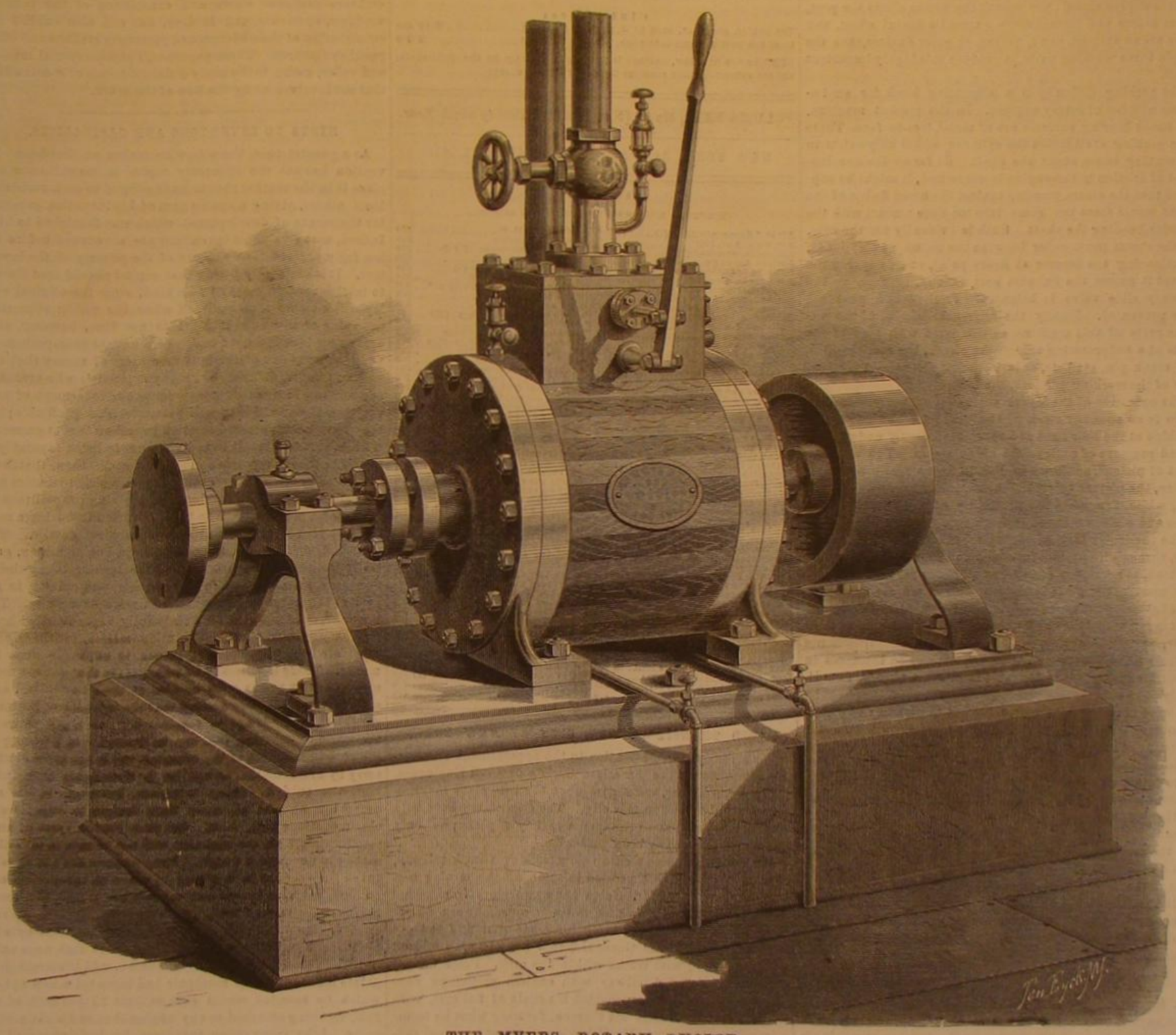
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To fail has been far more frequently the fortune of inventors of rotary engines, than to succeed. So frequently, indeed, and from so various causes has this been the case, that most engineers adhere to the opinion that with the reciprocating engine the rotary can never enter into successful competition, much less prove a formidable rival.

The question of to what extent the machine we are about to describe can cope with the rotative engine of corresponding power in economical use of steam alone, we leave to future consideration in connection with the records of tests soon to be instituted. In this article, we desire to direct attention to the mechanical construction as probably the simplest arrangement ever devised for the rotary engine.

A perspective view of the engine is shown in Fig. 1. From Fig. 2 it will be seen that the cylinder is divided by a diaphragm, A, and that the shaft, B, passes directly through. Each of the two compartments of the cylinder contains the working parts of a separate engine; and as both are exactly alike, the longitudinal section, Fig. 3, may answer for either. C is the piston, one end of which is made to encircle the shaft, while the other terminates in flukes, forming a broad surface which bears against the inner periphery of the casing. The piston also passes through a cylindrical oscillating guide, D, which is secured in the ring, E. The ring is not attached to the shaft, no power whatever is transmitted through it, and it simply serves as a guide and to give capacity to the cylinder. It is held in place by resting in one annular groove in the diaphragm and in another in the cylinder head, so that, as seen in Fig. 2, when the cylinder head is in place, the three edges of the piston take against the diaphragm, the head, and, as above noted, the inner periphery.

Fig. 2

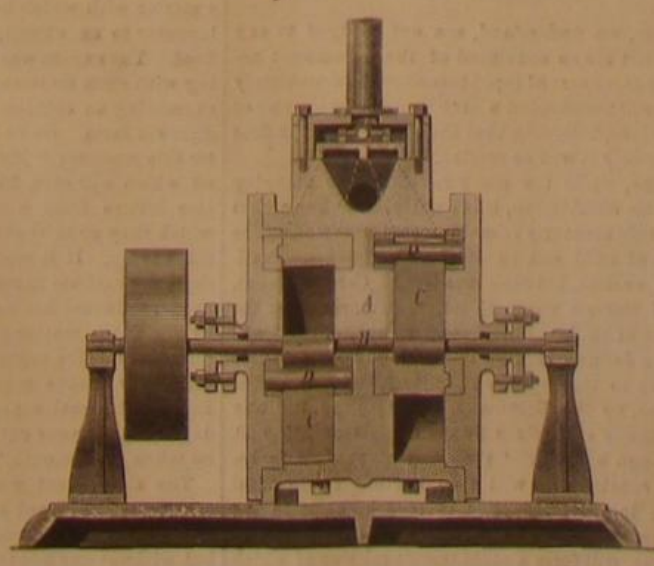
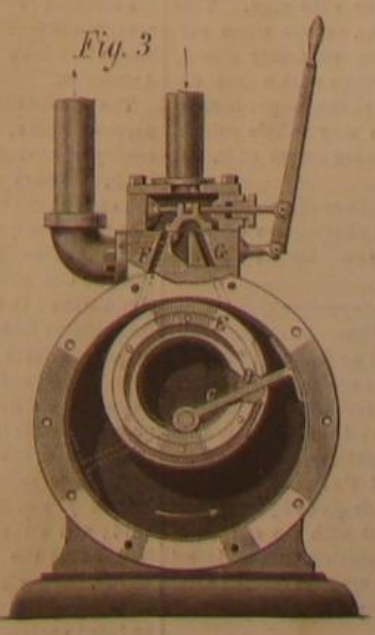


Fig. 3



The ring is disposed eccentrically to the shaft; and as, at its highest point, it is in contact with the cylinder between the ports, F and G, it forms a constant abutment for the steam. The latter, entering between this abutment and the piston, acts directly upon the piston, which, being merely a lever arm as regards the shaft, of course turns the same, traveling in the direction of the arrow. In passing the abutment part of the ring, the flukes

fit into a recess, so that the contact between the abutment and cylinder is always maintained. The reversing gear, by which steam is admitted to either port by means of a common D valve, is operated by the hand lever shown.

The most important points in the rotary engine are no clearance and tight joints which, while avoiding friction, are slow to wear. An English contemporary, speaking of the sliding abutment plan, and allowing the abutment to have the same velocity as the piston, says that, in an engine 9 feet 8 inches in diameter, having 86 square inches of piston surface and making 60 revolutions, such an abutment could not completely close until the piston had moved four inches away from it. This four inches represents clearance, which is waste, for in rotaries there is no compression.

In the Myers mechanism, there is no clearance. The abutment is always closed; the instant the piston clears the port, steam enters and immediately exerts its useful effect, and there are no springs, cams, valves, or other devices, save the simple three working parts, to produce this highly important result.

The packing difficulty is a stumbling block for an immense number of rotary engines. In the present machine, the broad bearing surfaces are of metal, face to face. There is no packing at all inside the cylinder, and it only exists in the stuffing boxes about the shaft. So far as the development of friction in the engine is concerned, it might be supposed that the steam, pressing against the broad flukes of the piston, would force the same into too close contact with the cylinder, bending the shaft. Such is evidently not the case, for the steam must enter between the piston and cylinder, so balancing the former at every point, except during the instant it passes the exhaust port, exactly, in fact, as the ordinary slide valve is balanced. Friction and wear are thus prevented. Finally the aggregate friction of the various parts of this machine, as compared with that of the parts of a reciprocating engine (the piston, the rod, the gibs, the crank pin, etc.), is, as is apparent from the very fewness of the working portions, the less.

The operation of the Myers engine is perfectly noiseless; there is no pound or clack whatever, and the 50 horse power machine at the Fair runs and reverses instantly under half a pound pressure of compressed air or steam. The arrangement of pistons, as shown in Fig. 2, forms really a double engine, the pistons being 180° apart, thus ensuring even motion, while it suggests the possibility of any number of engines and pistons being thus combined.

The particular form of engine represented in our engravings, through its prompt reversing and capability of holding the load, is especially adapted as a hoister for mines, elevators, and like uses. It is besides well suited for the working of steering gear, or the driving of propellers in vessels. As it is remarkably compact, occupying a minimum of floor space, it will doubtless prove valuable in establishments where economy of room is an object; and in instances in which, for example, it is desirable to attach a circular saw directly to the shaft.

A word may be added with reference to economy of steam, to point out that the tendency of the pressure within the cylinder is to force the abutment up and so obviate leakage. If the other leakage about the piston edges is prevented, there seems no valid reason why the engine should not be as economical as a reciprocating machine at full stroke. All that is necessary to provide for expansion is to arrange a cut-off at the reversing valve. Of this, however, more hereafter. For the present, we dismiss the subject with the opinion that the engine is of unquestionable merit; and if future tests prove this probable economy of steam, we can predict for it a well deserved success. The inventor is Mr. Edward Myers, and further information regarding the machine may be obtained by addressing the Myers Engine Company, No. 6 Cortlandt street, New York city.

Breathing through the Mouth.

A fact which cannot be too frequently impressed on the mind, says the *Science of Health*, is "that the pernicious habit of breathing through the mouth while sleeping or waking is very hurtful. There are many persons who sleep with the mouth open, and do not know it. They may go to sleep with it closed, and awake with it closed; but if the mouth is dry and parched on waking, it is a sign that it has been open during sleep. Snoring is another sure sign. This habit should be overcome. At all times, except when eating, drinking, or speaking, keep the mouth firmly closed, and breathe through the nostrils, and retire with a firm determination to conquer. The nostrils are the proper breathing apparatus—not the mouth. A man may inhale poisonous gases through the mouth without being aware of it, but not through the nose."

The editor should, in this connection, have directed the attention of his readers to the patent anti-snoring device illustrated in these columns some time ago. By its use, the above troubles are all obviated.

Crystalization of Tin.

A fine crystalization of tin is obtained as follows: A platinum capsule is covered with an outer coating of paraffin or wax, leaving the bottom only uncovered. This capsule is set upon a plate of amalgamated zinc in a porcelain capsule. The platinum is then filled completely full of a dilute and not too acid solution of chloride of tin, while the porcelain is filled with water acidulated with $\frac{1}{20}$ of hydrochloric acid, so that its surface comes in contact with the surface of the liquid in the platinum. A feeble electric current is set up, which reduces the salt of tin. The crystals formed after a few days are well developed. They are washed with water and dried quickly.

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RAPID TRANSIT IN THE CITY OF NEW YORK.

We recently called attention to the appointment of a special committee of the American Society of Civil Engineers, to receive, consider, and report upon the best plans for providing rapid transit in this city. The Committee have held several meetings, and examined a variety of plans; but only a few new ones have been presented.

Mr. Davis proposes a cheap elevated single track railway, of narrow gage, like that used in some of the mining districts of England. Mr. Nolan has a two story iron bridge railway. Mr. De Puy's plan is an iron framework placed over the street, with sidewalk for passengers and railway in the middle. Mr. McGonegal would have an arch of iron over the street, with tracks within the arch. Peter Cooper suggests an elevated railway with endless propelling rope and cars. Mr. Speer presented his chain of flat cars, with little houses and chairs set thereon, forming what he terms a traveling sidewalk. Mr. Schuyler exhibited his canal railway, through private property, estimating the cost at eight to ten millions of dollars from City Hall to Harlem, eight miles. Mr. Church advocated an arcade railway, four tracks, to cost a million and a half per mile. Mr. Gardner urged his elevated railway along the rivers, with warehouses. Our readers are familiar with most of these plans, as they have heretofore been illustrated and described in the SCIENTIFIC AMERICAN.

The Committee, we understand, are not pledged to any particular plan, but are so convinced of the paramount necessity of having some sort of rapid transit road immediately built, that they will recommend a hard times railway, one of the economical plans, believing that the cheaper it is in first cost the more quickly it will be erected.

In the meantime, while the many inventors are planning and the Committee considering, it is gratifying to know that rapid transit in this great city is making real progress. The magnificent line of solid and substantial underground railways on Fourth avenue, between the Grand Central Depot, 42nd street, and Harlem river, 4¼ miles, authorized by the State Legislature of 1872, is now almost completed, and will open for traffic in January next. The continuation of these tracks down town to the southern limit of the city, at the Battery, 4¼ miles, by the Broadway Underground Railway Company, was finally authorized by the Legislature, May 10, 1874; and although but a brief time has elapsed, it is believed that the construction will soon begin. These great works, having a total of 8½ miles in length, built in the strongest manner, under the direct supervision of the most eminent engineers, will form a rapid transit railway of which the citizens of New York may well be proud. Our engineers will do well to lend all possible influence in favor of their early completion. Over these tracks, passengers may be safely conveyed, at high velocity and for low fares. Nothing about these roads will be experimental or uncertain. Their capacity for traffic will be enormous; they will in all respects be adequate, convenient, and satisfactory to the public.

We commence on another page a series of articles descriptive in detail of the Harlem section of the Underground Railway, from which our readers will gain some idea of the magnitude and importance of the work. As the most recent specimen of American railway engineering, the plans are worthy of study, and will undoubtedly command the attention of civil engineers everywhere. Our articles will not only embrace sectional views and dimensions of the tunnels, viaducts, open cuts, and bridges, but will also exhibit the construction of the underground passenger stations and other peculiar features. These papers will possess special interest and value, owing to the many different forms of construction that are involved along the line of the work.

HINTS TO INVENTORS AND CAPITALISTS.

As a general rule, the man who makes an important invention has not the necessary capital to manufacture and place it in the market; hence he is obliged to seek assistance from others, giving up some part of his invention in return for the means of development which was furnished to him. Indeed, many valuable inventions are abandoned before being fully perfected, on account of the poverty of the inventors. It is eminently fitting that capital should lend its aid to intelligence, in cases of this kind, since the original outlay will be more than returned when the public appreciate the value of the new idea. It is not true, however, that every new idea is a good one, and a useless or imperfect invention forms one of the best devourers of money that can well be imagined. There are many capitalists who are ready and anxious to furnish means for the advancement of new projects, if assured they will be useful and profitable; but they have been deceived so often by schemes that promised well, that it is difficult to induce them to listen favorably to anything that is presented. It would seem, then, that there should be some middle ground upon which inventors and capitalists could meet, making and receiving propositions by means of a third party who is well versed in business matters and also fully acquainted with technical details. The capitalist, for instance, although a good business man, generally has not the experience and the technical knowledge necessary to enable him to form a thorough opinion in regard to the value of a mechanical device or process. The inventor, even allowing that he is fully acquainted with all the matters to which his invention relates, can hardly be considered the most suitable person to expatiate upon its merits. There is a trait in human nature that causes most men to have a pretty good opinion of their own ideas, and our readers must have noticed that the inventor of the most worthless article is apt to consider it of as much value to the world as anything that can be desired. In listening to the enthusiastic talk of the inventor, one is apt to be carried away by his remarks, unless he is thoroughly acquainted with the subject. Many inventors, however, before approaching a capitalist, carry their designs to experts and obtain opinions from them. But even with a score of such recommendations, the capitalist will not be safe in investing money to develope a design. Many experts are not as careful as they should be in giving opinions on inventions, and no one, however honest and capable he may be, can assert positively, without a trial, that a new machine will be successful. He can frequently discover fatal defects by simple inspection, but he cannot safely assert that none exist. A little incident, which lately occurred, will illustrate these points more fully. A mechanic had invented a new cut-off, which he asserted would save at least 25 per cent of the fuel, on being attached to any engine that had a plain slide valve. Like many other inventors, he had exhausted his means in obtaining his patent and building one machine; but it had been examined by several engineers, who thought very favorably of it, and expressed these favorable opinions in writing, so he considered that it would not be difficult to obtain what money he needed. After interviewing a few capitalists, he met one who seemed quite favorably impressed. The latter, however, rather distrusting his own judgment in a matter with which he was so little acquainted, sent the inventor to an expert, promising to accept his report as final. The expert was a man who was accustomed to dealing with such matters, and was moreover rather cautious in expressing an opinion in cases in which he could readily discover facts. So he addressed the inventor, somewhat after this manner: "My friend, you say that you have a cut-off which will save 25 per cent of the fuel, and you have also letters from a number of well known engineers, in which they state that they believe the invention will effect this saving. If it really does, it is a valuable device, and I shall not hesitate to recommend the gentleman, who sent you to me, to invest his money. I will propose a plan to you, by which the matter can be definitely settled. There is a plain slide valve engine, near here, that has been running for nearly twelve months, and a careful record has been kept of the coal consumed and the power developed each day. Attach your cut-off to this engine, and let the record be taken for a month."

The attachment was made; and for several days, as the coal account did not seem to diminish, the inventor kept making slight alterations when the machinery was stopped, but without any apparent benefit. After two weeks his fa

miliar face was no longer seen around the premises; and when the month had elapsed, the apparatus was removed and is still on storage, waiting for a claimant.

Many more such examples could be cited, and there are few consulting engineers who have not met with a number of such cases in their experience. But the trial to which this cut off was subjected was made in the interest of no one, being intended simply to determine the truth in regard to its value.

CHLOROFORM DANGERS.

The death of another patient in the dental chair, while under the influence of chloroform, again attracts public attention to the dangers attending the use of that anæsthetic. This latest accident occurred in Boston, and the opinion of the physicians points to the fact that the lungs of the deceased were affected by consumption, and hence unable to throw off the influence of the volatile spirit. However, the jury impaneled at the coroner's inquest ignore in their verdict the previous condition of the patient, and, while asserting that the death was due directly to the inhalation of the chloroform, add that, owing to our present lack of knowledge regarding the same, its use as an anæsthetic is utterly unjustifiable. They also recommend legislative enactments to prevent its administration.

The distressing effects of sulphuric ether upon a large class of patients, more especially those of extreme nervous temperament, have been the cause of the preference given to chloroform by many physicians. It is argued that the latter anæsthetic is not dangerous so long as the inhaler's heart is not affected, and that its more speedy action in producing insensibility is eminently advantageous in many surgical operations. But these claims in its favor, it must be conceded, are greatly outweighed by the consideration that, while there are repeated instances of death being the direct sequel of the administration of chloroform, there is no record of ether ever having produced fatal results.

It does not appear needed, however, that legislation should interfere to check the use of chloroform, since the growing tendency of the medical profession is in favor of pure ether as a substitute, or else a mixture of chloroform, ether, and alcohol, which, we understand, produces good results without causing the dangerous depressing effect of the chloroform or the nausea of ether. The employment of nitrous oxide in dental surgery is also greatly extending; and since it is both a harmless as well as an agreeable anæsthetic, it possesses peculiar advantages in connection with the rapid operation of removing teeth, or, in fact, with almost any case in which a minute or two of time is ample for the purpose.

As regards the proper treatment of patients who fall into a dangerous syncope while under the influence of chloroform, there is some difference of opinion among physicians. The most recent mode of procedure (which the eminent French surgeon, Dr. Nélaton, not long since deceased, as well as Dr. Sims, of this city, both state to be very efficacious, having in six different instances saved the patient's life) is as follows (we extract it from the *Tribune*). These surgeons had come to the conclusion that death from the inhalation of chloroform was immediately caused by a want of proper determination of blood to the brain. "The want of this stimulant to the brain's action rapidly led to the suspension of other vital organs of the economy. When, therefore, M. Nélaton's patient, upon whom he was operating, suddenly ceased to breathe, he caused his legs and body to be elevated, the head hanging downward. The blood, by specific gravity, tended to the brain. Artificial respiration was kept up, and after a time the patient again began to breathe of his own volition. He was laid back upon the table, and the operation was about to be continued, when it was noticed that he had again ceased to breathe. The same process was gone through with, and again the patient was resuscitated. A third, and even fourth, time he relapsed into the state that would have been death, and each time his breathing was restored by this process. The fifth time he relapsed, the effects of the anæsthetic had almost passed off; and, while the patient was suspended in the air, head downward, and when artificial respiration had just ceased, with the returning regular breathing he asked M. Nélaton why they were holding him in that extraordinary position. The operation was finished without further administration of the anæsthetic, and it resulted successfully. In the other cases the patients were resuscitated, the medical men having charge of them testify, by the same process. These cases are considered enough to demonstrate, with a reasonable degree of certainty, the proper treatment to be followed in cases of syncope and approaching death, from the inhalation of chloroform."

MASTERS AND MEN.

Great captains have not always been those best able to plan brilliant campaigns or best able to make the most of the varying vicissitudes of war. But whether great in strategy or not, they have always been men who could get the best work out of their followers: captains whose presence was inspiration, whose commands were prophetic of victory because certain to be carried out.

"Who ever saw such tactics?" grumbled the veterans of Italy, when the young Corsican knocked their enemies right and left with his handful of men, winning victories not so much because of his audacity and military genius, as because his soldiers could be depended on to do what they were sent to do. Then, as afterward, the great secret of his success lay in the unbounded personal devotion he inspired in those by whom his victories were won, a devotion which he took great pains to justify, by honoring faithful service to the utmost.

The great captains of industry have ever been of like position. They have succeeded, not because they excelled their rivals as marketmen or financiers, but because they could get more and better work, and trustier service in every way, from the men they employed. The best work wins, other things being equal. This is one of the great lessons so strikingly enforced in Parton's lecture on "Kings of Business," a lecture crammed with illustrations of successful enterprise, drawn very largely from direct study of the operations of American business kings.

At the Cambria Iron Works, where 7,000 men are employed making iron and rails, the President of the company was asked the secret of such a great development of business. The reply was: "We have no secret. *We always try to beat our last batch of rails.*" This persistent endeavor to excel, not others only but themselves, is the master key to the success of many.

Another lesson is that the surest way to turn out uniformly good work is to employ good men and treat them well. Said the manager above quoted, the other day: "We find that the more we do for our men, the better they do for us." In this Saxon sentence, the experience of hundreds of business kings is crystalized. Justice wins justice. The rudest workman will do more honest work gladly for the man who does the fair thing for him and his family, than the hardest driver can get by other means. The wisest selfishness is just if not generous: a lesson which small men never learn.

The country is full of illustrations. We have in mind two establishments of the same sort, within cannon shot of each other, which may stand as types of the extremes of management in this respect.

Half a century or so ago, a sterling business king became controller of a new establishment for mining and manufacturing purposes. The country was new, rough, and unattractive; yet a thriving village soon sprang up, with stores, churches, schools, and all the other accompaniments of a well-to-do and self-respecting community. The men employed were carefully selected, well paid, and fairly treated. The works were eminently successful; their various products soon won an honorable name, not only throughout this country, but abroad; and the brand of the establishment was a guaranty that every article was what it should be.

The king died. The heirs were of the meanly selfish sort, caring only for their immediate income, and taking no interest in the works save to get out of them all that they could with the least trouble to themselves. They lived at a distance, and regarded their employees merely as parts of a great machinery. What they were or how they lived, they did not care. The management of the works was committed to agents, subject to the minutest control from headquarters. Naturally, meanness could command only mean tools, and the character of the directors was soon stamped upon everything connected with the works. Merit ceased to be regarded. The good men whose honest work had contributed to the success of the father soon drifted away, to be replaced by men of lower grade, themselves to be displaced by those yet lower. The strongest claim for service was irretrievable indebtedness to the company, or pliability at the polls, in gratifying the petty political ambition of the managers. Irregular working, strikes, breakdowns, and other business drawbacks became common; and after some years of decadence, the once thriving business collapsed in utter failure. Meantime, the exodus of the honest and saving had depleted the village of all that had made it worth living in. The school degenerated, the church became the playhouse of window-breaking boys, the stores were closed or turned to groggeries, and a low-lived rabble made life miserable in the place of a once respectable community. As this town went down, the adjoining village rose. The owners of the works, round which the village clustered, lived among those they employed, and sought to surround themselves with the best men they could get. Still more: they sought to make their workmen better for being in their employment. Thrift was encouraged, and the unthrifty systematically weeded out. The men were made to understand that they were expected to be better off at the end of each year than at the beginning. Not to be so, accidents excepted, was to hazard their continued employment. Yet the unfortunate, the sick, and the bereaved were looked after with a kindliness that could not be misinterpreted. The wives of the partners—genuine ladies—made it their business to know and visit the women folk of all the employees, winning their confidence and esteem by sisterly service in times of trouble, and aiding them at all times by judicious counsel, or, if need be, with more substantial help.

It is needless to describe the development of a village where the ruling influence bears steadily toward good government, good schools, good society, sobriety, and universal thrift. Floods destroyed and fires laid waste now and again, but help was always ready for the deserving; and though surrounded by colonies of rude miners, colliers, and the like, and largely composed of men of rough employments, the village became and remains a worthy representative of our best manufacturing towns.

It is needless, also, to describe the prosperity of the business by which and for which the town exists. In employments of such a nature that the indifferent or evil-disposed can destroy or waste in five minutes more than he can earn in a day, the advantage of careful, honest, trustworthy, and interested help is enormous. By dealing justly with their men, the rising company gained while their meaner rivals lost, and won a handsome fortune and the lasting esteem of their men whom they had helped to competence and comfortable homes; while the others were hated for the poverty they engendered in their descent from wealth to merited bankruptcy.

That men have been mean, hard, grasping, and ungenerous to their help, and yet have amassed wealth is undeniable, just as generals have won victories with mutinous soldiers; but these cases are relatively rare, and the success so won is not only precarious, but liable to most unexpected reverses. Our great manufacturing establishments have not been built up by such management. As Parton tersely puts it:

"Traverse the world over, search the history of our race in all times; and wherever you find a man truly superior to his fellows, a natural king of men, born to command, you will find him attentive to the interests, and to the feelings, and to the dignity of those who execute his will. If he is not man enough to be so from good feeling, he is man of business enough to do it from policy. If there is any one here who snubs persons dependent upon him, begrudges them their just compensation, cares nothing for their interests or their honor, that man is not naturally a master; he is one by accident only: he belongs, by birth or breeding, or both, to the class of the defeated and the servile. He is merely a beggar on horseback, and perhaps stole the horse."

THE DEVELOPMENT OF SUBTERRANEAN HEAT.

A gentleman engaged in the mining of lead, a Mr. Ewing, of Joplin City, Mo., has written for an explanation of some curious phenomena which have recently occurred in his vicinity. They took place in sinking the shaft of a lead mine. The shaft had been sunk 96 feet, and a drift, located about 16 feet above the bottom of the shaft, had been driven about 40 feet. At the time the work was going on, nothing unusual was experienced; but a short while after, the temperature of that portion of the drift situated about two thirds the distance from its opening into the shaft, along a space of 15 feet, began to augment. It finally rose to 102° Fah., while the temperature at the mouth of the drift and in the body of the mine remained at 60°. The miners, on attempting to cut another drift through that portion of the earth which thus incressed in temperature, at right angles to the former, were compelled to stop work on account of the oppressive heat. "In one minute's time after entering the warm space, a person will sweat freely. No bad effects are felt, the lamps burning as freely as on top, and the air being good. In the heated portion of the drift, its walls are covered in spots with a substance in appearance like mold from dampness. It proves, on closer examination, to be a greasy or waxy substance, which at a lower temperature becomes as solid as clay, and resembles tallow and beeswax mixed together. It dissolves readily in water, and dyes cloth yellow."

At the time of receiving the specimens which accompanied the letter, they were quite hard, though friable, and appeared like a hardened, unctuous, greenish yellow clay. It was evident, from the fact that a change had taken place after the earth in the drift had been exposed to the atmosphere, that we ought to find the results of this change by an analysis of the substance, and thence be able to infer the original bodies out of which it had been formed. It proved to consist of: Silica and clay, 9·499; sesquioxide of iron, 25·170; protoxide of iron, 0·438; sulphuric acid, 31·640; water, 33·030. Total, 99,777, which were probably combined as: Silica and clay, 9·499; protosulphate of iron, 0·918; hydrated persulphate of iron, 72·960; hydrated sesquioxide of iron, 5·880; water, 10·520. Total, 99·777.

These analyses reveal, in a very striking manner, the cause of the remarkable liberation of heat. A large amount of pyrites has existed finely disseminated throughout the earth. On exposure to air and moisture, it has absorbed both with great rapidity. We have no determination at hand, giving the number of thermal units equivalent to the oxidation of one pound of iron pyrites, and the subsequent conversion of the protoxide and sesquioxide of iron into hydrated sulphates; but it must be a large number, as shown by the great elevation of temperature. Although we are not aware of such a phenomenon as this having occurred in sinking a shaft in lead mining yet similar occurrences are common in coal mines, and have produced many serious accidents. In the great piles of "slack" heaped up around the mouths of the pits of the Lehigh & Wilkesbarre Coal Company, many small pieces of sulphur can be found, produced by sublimation from the decomposing pyrites. It is said that on sinking a pail of water into one of these slack heaps, the water may be made to boil, and cook an egg. The heat thus developed, operating upon the finely divided carbon of pyritous bituminous shales, may at times reach to the hight of rapid combustion.

The subject is one full of interest, and of high importance, as affording one explanation of volcanic action, and of the occurrence of sulphur deposits in connection with these phenomena. It is stated by Lyell that, when moistened iron filings and sulphur are buried in the ground, in the course of a few hours the temperature rises, the ground is swollen by expansion, and finally flames arise, or there is an explosion. By the hypothesis of similar chemical actions on a great scale, certain geologists have endeavored to account for all earthquake and volcanic disturbances. A. R. L.

We are gratified by receiving a large number of letters, from subscribers to the Scientific American, approving of the folding, cutting, and pasting of the paper. These features add to the expense of publication; but we believe that our old patrons will influence enough new subscribers to compensate for the extra cost.

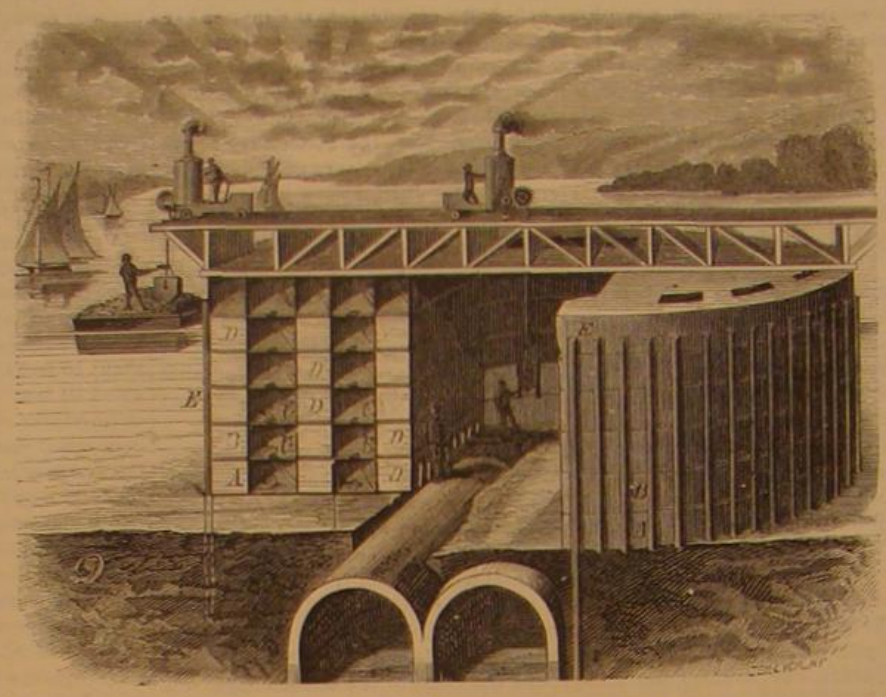
The consumption of coal per train mile on the London and South Western Railway shows an average of only 28·0 pounds, against fully 45 pounds on the eight other principal British lines.

NOVEL PLAN FOR BUILDING SUBMARINE STRUCTURES.

Mr. Jerome Wenmaekers, a Belgian engineer, is the inventor of a new plan for the construction of quays, tunnels, and similar submarine structures, which appears to us to present many meritorious and valuable advantages. The invention has been patented September 8, 1874, through the Scientific American Patent Agency; and *from* Mr. Wenmaeker's drawings, we have prepared the annexed engraving, which will render the proposed construction readily understood.

A number of caissons are built either in segment or in circular form, but providing for a large opening or shaft in the center when several are superposed. The material is iron, with iron partitions, some of the subdivisions formed by the latter being used to hold ballast, while others are employed for machinery, storage, etc. Each caisson, after being built, is slung to a strong arched structure which extends between two boats, and is thus transported to the place at which the submarine excavation, for a tunnel, for example, is to be begun, or rather to meet a short commencement of the tunnel which is run from the shore in the ordinary manner.

The ballast compartments of the first caisson, A, whether it be composed of several segments or one piece—are loaded, and the tier lowered a short distance below the water surface. Then a second caisson, B, is brought up, placed on top of the first, the whole is allowed to become submerged, and a third tier is added, and so the work progresses until a huge coffer dam is formed, rubber joints at the sections of which render it thoroughly watertight. By opening suitable valves, water is admitted to the ballast compartments, C, and also to water chambers, D, pumping engines being used for the purpose if needed. By this means it is claimed that a resistance is imparted to the entire structure sufficient to insure its standing against storms or heavy currents.



WENMAEKER'S SUBMARINE BUILDING.

For the purpose of preventing the washing off of the bed of the body of water below the dam, a double series of piles, E, guided in staples, is driven around the circumference. The water in the center of the structure is then pumped out, and the earth is excavated in the space exposed. After a quay or tunnel section equal to the inner length of the dam is completed, the water is pumped out of the compartments, the piles are drawn, and the whole structure, which then floats, is towed to another point, where the work is continued in connection with that already done.

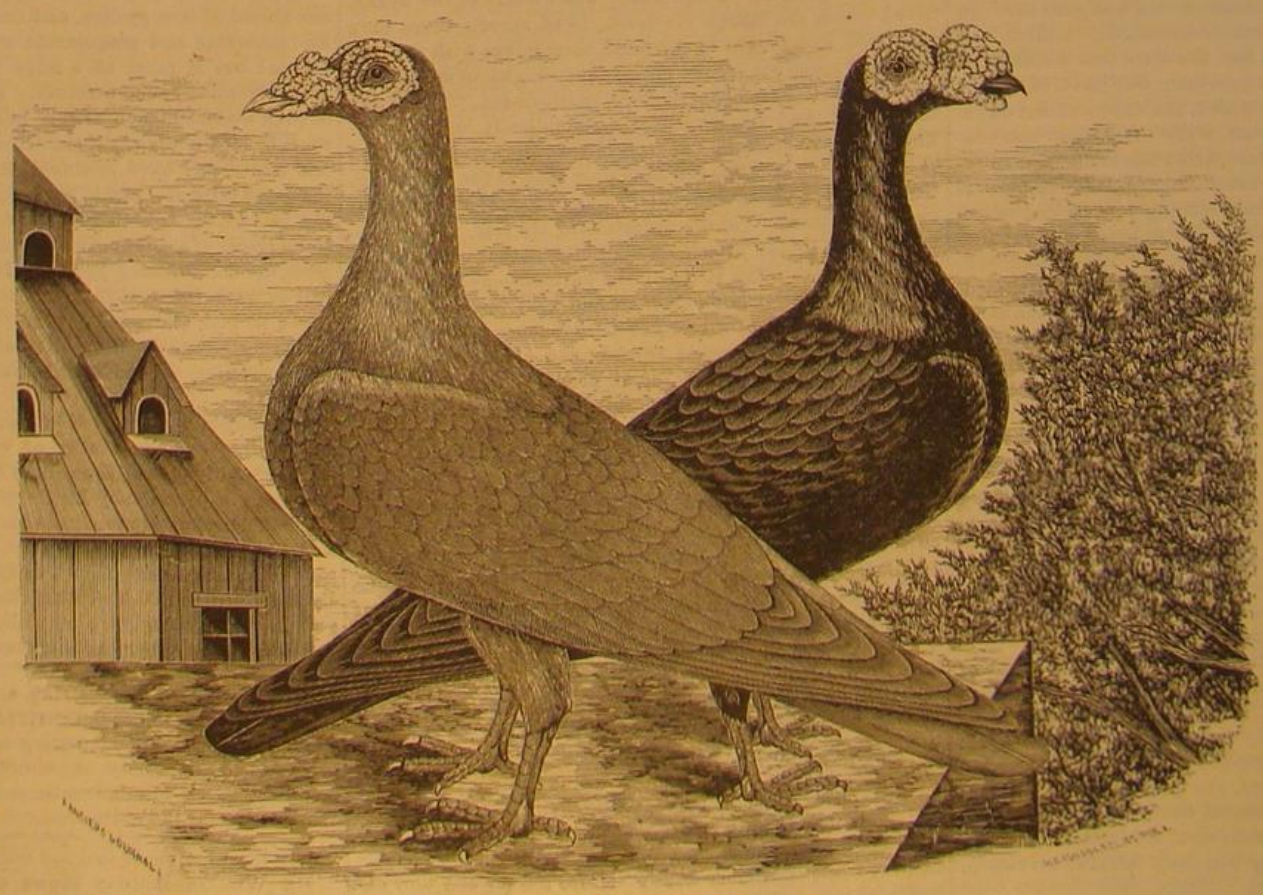
The building of quays is accomplished by not completing the circle of the dam, but leaving an open space which is filled by the masonry, so that the structure keeps moving further into the water as additional length is given to the quay. The invention does not apparently involve so great an expense as many systems which have been devised for similar purposes, while it has the important advantage of capability of being repeatedly used, as the sections maintain their entirety and are not difficult to transport wherever needed.

CARRIER PIGEONS.

The large numbers of carrier pigeons used during the Franco-Prussian war, for the transmission of despatches, and their more recent proposed employment for carrying messages during a transatlantic balloon voyage, have been the means of exciting a wider public interest in in these curious birds than has existed for many years past. In Holland and France, the breed is carefully guarded, and in all the European countries fine specimens of the birds find ready buyers. Prussia has a pigeon communication between her capital city and the fortresses of Metz and Strasbourg. In Paris many of the daily journals receive news of events transpiring in the Legislative Assembly, at Versailles, through the carrier pigeons, in preference to using the telegraph. The birds traverse the distance in from fifteen to twenty minutes, and the intelligence thus reaches the newspaper offices much more quickly than would be the case were the despatches obliged to wait their turn for transmission by the telegraph operators, or otherwise delayed by official formalities.

The long employment of the pigeons as news carriers has been the means of proving conclusively that no instinct guides them back to their cotes. On foggy days they will not attempt to return, nor during the night, except at times when there is a clear atmosphere and a full moon. When released, the bird flies upward and then circles around until it sees certain features of the landscape which it recognizes as being adjacent to its home. These it has learned to know during short flights which it is allowed to make during the training period; and therefore the instant the surroundings of its abode, often extending over a radius of several miles, meet the pigeon's eye, it at once travels with wonderful velocity in their direction. It is said that, when a bird fails to remember any portion of the landscape beneath it, it will fly for some miles without any reference to course, and then circle about again, and this will be repeated until a familiar object is caught sight of; or else the bird becomes exhausted, gives up the search, and never returns.

The accompanying engraving, from the *Fancier's Journal* (a most excellent paper of its class, published in Philadelphia), represents a pair of carrier pigeons, imported from England by Mr. John Yewdall, of the latter city, at a cost of $225. They are probably the finest birds in the country. Fine pigeons like these, are able to travel about 36 miles per hour.



CARRIER PIGEONS.

Telegraphic Cables.

It is evident that a new invention, in connection with the manufacturing of telegraph cables, is needed, and a good opportunity for the exercise of ingenuity in this line now exists. *Engineering* says that portions of a cable laid in 1860, between France and Algiers, were dredged up in 1871 in 400 fathoms off Minorca, and the outer covering of steel and hemp, similar to the Atlantic cable, found to be completely destroyed, so that the piece would only bear a few fathoms of its own weight. This was on a soft muddy bottom. The Falmouth and Gibraltar, laid in 1870 and repaired this year, was found chafed through at a depth of 1,000 fathoms. The Direct Spanish cable failed suddenly in the Bay of Biscay, and was found for a mile to be swallowed up in the ground in a depth of 1,300 fathoms, as if by volcanic action, the bottom being stiff blue clay.

If there is any part of the Atlantic crossed by the Atlantic cables having the same species of bottom as that where the Algiers cable of 1860 was dredged up, there would be a certainty of the cable decaying to such an extent that, if lying also over a ridge, it would eventually break. Nor does it seem so entirely improbable that volcanic action or movements of the ground, similar to that which undoubtedly occurred in the Bay of Biscay and also in the Persian Gulf, may occur on some portions of the route. The question of the *teredo* also arises. Cables in the Mediterranean have been found attacked by these insects at great depths; but in these cases probably from the cables thus examined not having been submerged long enough, the boring was only slightly into the surface. In shallow water, cables have been found with holes bored through the gutta percha down to the copper wire, thus entirely destroying the insulation.

Thus a piece of cable laid in Kurrachee harbor was found bored down to the copper, the insect having got in in places where the outer protecting wires were a little open; more recently, too, the cables in the Irish Channel have been found attacked. Two wires in the Dublin and Holyhead cable, laid in 1871, have just been found thus injured, and are rendered useless. This cable has each of its outer sheathing wires covered with a coating of tape, and thus the actual iron wires do not touch each other, so that the insect is able to pass between them. The Atlantic pattern of cable is still more open to the attack of the insect, as the outer steel wires, being each covered with a thick coating of Manilla hemp, are separated from one another by more than their own diameter. We have no experience yet of this insect having attacked an Atlantic cable; and should this ever occur, the pattern of all future Atlantic cables will have to be entirely revised. The pattern of the cables used on the principal lines in the Mediterranean and on the Direct Spanish, where the steel wires touch each other, would be a much safer one in localities where the attacks of this insect are to be feared.

But should the danger be found to extend to the Atlantic, it is doubtful whether the insulation of such important lines should depend even on the certainty of the outer wires touching one another throughout. In the case of the Wexford cable, where the outer covering consisted of iron wires, supposed to touch throughout, the insect has found out places where they are a little open, and has thus been enabled to insinuate itself, destroying the insulation by boring through the gutta percha. It is evident that, in these localities, at least a more certain protector than the iron wires is required. Some four years ago, Mr. F. C. Webb devised the application of a thin steel armor to the insulated wire, but it has never yet received any practical application. Something of this sort must, however, be adopted wherever the attacks of the *teredo* have to be resisted.

Wet Boots.

What an amount of discomfort wet boots entail, and how well we all recall the painful efforts we have now and then made to draw on a pair of hard-baked ones which were put by the fire overnight to dry! Once on, they are a sort of modern stocks, destructive of all comfort, and entirely demoralizing to the temper. The following plan, it is said, will do away with this discomfort:

When the boots are taken off, fill them quite full with dry oats. This grain has a great fondness for damp, and will rapidly absorb the least vestige of it from the wet leather. As it quickly and completely takes up the moisture, it swells and fills the boot with a tightly fitting last, keeping its form good, and drying the leather without hardening it. In the morning, shake out the oats and hang them in a bag near the fire to dry, ready for the next wet night; draw on the boots, and go happily and comfortably about the day's work.

THE UNDERGROUND RAILWAY, NEW YORK CITY.

In London the Underground Railway system has been in operation for eleven years, and so great has been its success, so fully does it meet the requirements of the population, that every year adds to its extension. Opened in 1863 with a section of 4¼ miles, from Bishop's Road to Farringdon street, it has been constantly extended, until now it has a length of about 13 miles; while new extensions, costing some twelve millions of dollars, are this year in progress of construction. Many millions of passengers are annually conveyed over these underground tracks, which extend beneath the streets in all directions, uniting the principal centers of trade, intersecting all the great railway lines, and, by their marvelous capacity for traffic, facilitating the enormous transactions of daily business, for which London is so renowned.

It is gratifying to know that this system, so thoroughly tried by long experience, so certain and fruitful in promoting municipal life and prosperity, is about to be inaugurated here in New York. For many years it has been urgently needed, but it is only within a very recent period that the construction was actually begun. The Underground Railway in New York is projected to run from the Harlem river, on the north, down through the heart of the city, under Fourth avenue and Broadway, to the Battery, 8¾ miles. It will, in course of time, naturally have other extensions, among the most obvious of which are tunnels under the North and East rivers, to Jersey City and Brooklyn.

Before entering upon the details of this new railway, we would call the attention of our readers to the remarkably advantageous natural position of New York city, for the purposes of business and commerce, and to the location of some of the other great and interesting engineering works besides the Underground Railway, which are now going on in our midst. Referring to the diagram, Fig. 1, it will be seen that New York city occupies a narrow tongue of land, surrounded on both sides by deep rivers, with illimitable dock room, and a magnificent land-locked bay, more than sufficient to accommodate the commerce of the world. At the Narrows, the gateway to the Lower Bay and the ocean, some of the most massive fortifications are in progress, and the shores on either side, for long distances, bristle with lines of fifteen inch cannon in readiness for defence. The bay and ocean prospects from the hights at the Narrows are superb, and are not surpassed even by the far-famed views of the Bay of Naples. At the left stand the shores of New Jersey, where the Erie, the Pennsylvania, the New Jersey Central, and other great railways from the North, South, and West concentrate. The traffic is at present all conveyed over the river by ferry boats. The freight cars are run upon the decks of great barges, and towed across by tugs, a most convenient, quick, and economical method.

The new docks, which are to surround the water fronts of New York, are now in course of construction, and embrace engineering works of great magnitude. The docks are to consist of iron, granite, and artificial stone, and will involve expenses to the amount of a hundred millions or more of dollars.

On the right is seen the position of the great suspension bridge between Brooklyn and New York, built at the joint expense of the two cities, and expected to cost from fifteen to twenty millions of dollars. This will be the largest suspension bridge in the world, the clear span between the towers being 1,600 feet. The towers are now approaching completion

Further up the East River, the Hell Gate Rocks are specified. Here it is that the important work of tunneling the bed of the East river is now going on, for the purpose of removing its rocky bottom, which impedes navigation. The general plan of the work is to honeycomb the rocks with tunnels, then fill them with nitro-glycerin and explode the mass, thus deepening the river. This work, costing an immense sum, has been in progress for three years past, but no time has been fixed for the grand final explosion. Still further north runs the Harlem river, over which various fine bridges, and underneath its bottom various tunnels, at the extremities of our city avenues, are soon to be constructed, to accommodate the wants of a fast-increasing population.



FIG. 1. DIAGRAM SHOWING THE POSITION OF THE BAY AND CITY OF NEW YORK, FORTIFICATIONS, SUSPENSION BRIDGE, HELL GATE WORKS, NEW DOCKS, UNDERGROUND RAILWAYS, ETC.

In the middle of the city lies Central Park, which, with its lands, roads, and architectural structures, has, so far, cost the city over eight millions of dollars. Along the banks of the North River, above the Central Park, but communicating therewith by noble drives and avenues, new parks have been laid out, in addition to which there are over thirty miles of pleasure roads and avenues, Museums of Art, of Natural History, Zoological Gardens, and other public establishments, projected and in progress. Taken altogether, there are few places where so many important improvements are going on as in New York, and there can be no question but that in due time it will become one of the most attractive cities in the world.

Turn we now to a consideration of one of our latest and best city improvements—the underground railway system, the objective of which is the Grand Central Depot, which is located at the junction of 42d street and Fourth avenue. This is the great railway center of the city. Here terminate or begin the tracks of the New York Central and Hudson River Railways, which, with their connections, reach to the far South and West, extending even to the shores of the Pacific Ocean, and receiving direct tribute from all parts of the country, save the immediate Southern seaboard regions. Here also center the tracks of the Harlem Railway, which reach northerly to Canada, and of the New York, New Haven, and Hartford Railway, extending easterly to Boston, Maine, New Brunswick, and Northeast Canada.

The Grand Central Depot building is an immense structure, the largest of the kind in this country. Its length is 690 feet, breadth 240 feet, hight from railway grade to center of glass roof, 109 feet 7 inches. This depot, together with the adjoining car sheds, engine houses, freight depots, and coal yards, covers an area, in round numbers, of 830,900 square feet, or a little over nineteen acres.

The existing northerly section of underground railway extends from the entrance of the Grand Central Depot, on 45th street, northerly, under the surface of Fourth avenue, to the Harlem river, at 133d street, a distance of 4¼ miles, where the track rises to and crosses a fine railway bridge over that stream. This portion is now almost finished, and is expected to be opened for traffic in January. The southerly portion, known as the Broadway Underground Railway, from the Grand Central Depot to the Battery, was finally authorized by the Legislature, in May, 1874, and will be pushed as soon as the financial requisites, now in progress, are settled.

The northerly portion has been built by the Harlem Railway Company, under the supervision of a State engineer commission, consisting of Alfred W. Craven, C.E., Allan Campbell, C. E., the Engineer of the Department of Public Works, and the Engineer of the New York and Harlem Railway. The commission appointed to supervise the construction of the southerly portion, under Broadway, consists of George S. Green, C.E., Allan Campbell, C. E., and James P. Kirkwood, C. E. On the completion of these two sections, the city of New York will possess a magnificent continuous line of fast railway tracks, 8¾ miles long, through its center, over which passenger and freight trains of every class may travel from Harlem to the Battery at the highest speed, and at the cheapest rates, without disturbance of inhabitants.

The Underground Railway commences, as we have stated, at the north front of the Grand Central Depot, and here, for a short distance, the tracks for the accommodation of the cross street traffic are spanned by bridges, the first of which, at 45th street, is placed directly in front of the entrance of the depot. See engraving, Fig. 2. The gradients, depths, character of works, and position of the road bed, in respect to the surface or grade of Fourth avenue, are given in our profile diagram, Fig. 3.

To a very great extent, the work now in course of construction on Fourth avenue, must be regarded as the necessary consequence of the building of the Grand Central Depot, and the centering of the great railways we have mentioned at one terminus. The authority for the work was



Fig. 2.—THE UNDERGROUND RAILWAY IN NEW YORK. THE FIRST BRIDGE AND GRAND CENTRAL DEPOT, 45TH STREET.

passed by the State Legislature on the 14th of May, 1872. By the provisions of the act, the New York and Harlem Railway Company is directed to construct open cuts, bridges, tunnels, and a viaduct, at certain specified places, to lay temporary tracks, and alter the grade of the cross streets wherever necessary; the gas, water, and sewer pipes are ordered to be removed by the corporations owning them, and the Mayor and Aldermen of the city forbidden to obstruct, and authorized to adopt and facilitate, the work; the total expense of which is to be borne in equal proportions by the city and the railway company; that sustained by the city to be raised by a tax on real and personal property. A Board of Engineers was also created, who should have entire control and charge of the work, receiving, in return for their services, $8 for every day employed. In accordance with the requirements of the act, a Board of Engineers was appointed consisting of Alfred W. Craven, Allan Campbell, the Engineer of the Department of Public Works, Edward H. Tracy, and the Engineer of the Harlem Railway Company, the late Isaac C. Buckhout.

Estimates, plans, and specifications were prepared and bids opened for the work in the same year. Of all the bids offered, that of Messrs. Dillon, Clyde & Co. was selected, this firm contracting to do the work in the manner required for the sum of $6,395,070, or $285 per running foot, which was proportioned as follows:

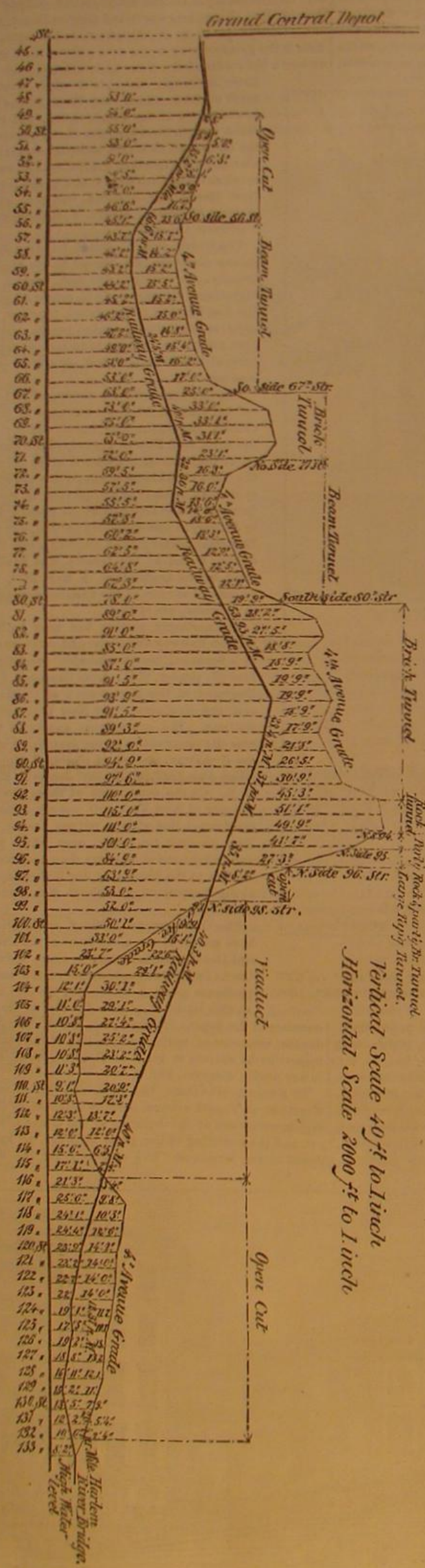
Earth excavation and embankment	$579,000
Rock excavation in open cut	701,000
" " " tunnels	255,000
Retaining walls	1,013,000
Parapet walls	100,000
Foundation walls	238,400
Granite coping	134,700
Plank used in foundation	70,000
Piling used in foundation	182,200
Concrete	23,800
Removal of sewer, water, and gas pipe	300,200
Drain pipe	6,800
Ballasting	57,000
Brickwork in arches, etc	708,500
Blue stone	34,300
Bridge from 79th street, exclusive of parapet, coping, excavation, and drain pipe	334,100
Iron bridges and approaches	388,000
Wrought iron	498,500
Cast iron	23,500
Iron railing	79,200
Felting	36,500
Temporary track	50,000
10 per cent for contingencies	581,370
Total	$6,395,070

Late in the fall of 1872, ground was broken and the work commenced by the contractors and their sub contractors, under the supervision of the Board of Engineers already mentioned, with Mr. I. C. Buckhout, of the Harlem Railway Company, as Superintending Engineer, Mr. W. L Dearborn, C.E., as Resident Engineer, Mr. F. S. Curtis, C. E., Principal Assistant, and a corps of four Division Assistants, Messrs. Geo. S. Baxter, C E, S. F. Dayo, C.E., Sevene Lee, C. E., and Milford Berrian, C.E. The names of the sub-contractors will be mentioned in connection with the work done by them.

We will briefly give the general plan of the work, and then pass to a detailed description of its parts, premising that, for the drawings which we publish and for much valuable information, we are indebted to the courtesy of Mr. F. S. Curtis, the principal assistant resident engineer, and to Mr. Horan, the chief of the drafting department.

In plan, the work consists of a four track railway, reaching from 42d street to the Harlem river, a distance of four and a quarter miles, and, with the exception of that portion passing over the viaduct on the Harlem flats, everywhere sunken below the level of the street, and covered in with tunneling over as large a part of the distance as the grade of the road and the grade of the avenue will admit. On that portion of the line which is covered with tunnels, three kinds of tunneling have been used, depending upon the character of the ground and the difference between road grade and avenue grade. Thus wherever sufficient headway could be obtained, arched brick tunnels are used; wherever the headway was too small to admit of an arched tunnel, a flat top beam tunnel is used; and where the headway was too small to permit the use of the beam tunnel, open cuts, spanned at the street crossings by iron plate girder bridges, sixty feet in width, were of necessity resorted to. The third kind of tunnel referred to is the rock tunnel at 92d street. The reason for the use of these three kinds of tunneling will, perhaps, appear more evident by a glance at the accompanying profile, Fig. 3, which, being so greatly reduced, will throw into bold relief the various grades used on the railroad and the avenue, and the difference between them, and will afford a good idea of the various species of work involved. It will there be noticed that the grade of the road begins to fall gradually from 45th to 48th streets, and that from this point to 57th street it increases rapidly, falling in this space 25 feet, 66·6 feet in the mile, which is the heaviest grade on the road. From 57th to 59th streets the grade runs level, then rises to 70th street through a hight of 15 feet and 9 inches, is again level to 71st street, falls between 71st and 73d streets 2 feet 4 inches, or 22·36 feet in the mile; is once more level to 74th street; rises 32·5 feet, or 53·9 in the mile, to 86th street, at which point begins the long descending grade which crosses the viaduct and extends to 129th street, falling in the distance 69·8 feet, after which begins the up grade, which reaches the street level at 133d street and Harlem Bridge.

At 56th street the railway grade is 13·6 feet below avenue grade; and at this point, the headway not being sufficient for an arched brick tunnel, a beam tunnel commences and extends to point 24 feet 9½ inches south of the south side of 67th street. Here the railway is 25 feet below the street; and the ground rising rapidly, a headway is obtained sufficient for an arched tunnel, which extends to a point 29 feet 2 inches north of the north side of 71st street, where the beam tunnels again begin and reach to 27 feet 7½ inches south of the south side of 80th street, where the ground commences to rise rapidly and the brick tunnels once more appear, ending at the beginning of the rock tunnel at 92d street. This tunnel is about 550 feet long and is followed by the partly rock and partly brick tunnels, which end at a point 31 feet 6 inches north of the north side of 95th street, and from this point to north side of 96th street extends a tapering tunnel formed by three tunnels passing into one. At 96th street the difference of grade is about 27 feet; and from this point, the land falls so rapidly to the Harlem flats that at 97th street the difference of grades is but 8 feet 2 inches, and consequently from this point to 98th street extends an open cut, ending at the south end of the viaduct, which reaches thence to the middle of the block between 115th and 116th streets, or a little over 717 feet short of a mile. [We shall continue the subject in our next and future numbers with various illustrations of the works.]



Vertical Scale 40 ft to 1 inch
Horizontal Scale 2000 ft to 1 inch

FIG. 3.—THE UNDERGROUND RAILWAY IN NEW YORK. PROFILE OF THE SECTION FROM 45TH STREET TO HARLEM RIVER. DISTANCE 4 1-4 MILES.

Correspondence.

The Crystalization of Carbon.

To the Editor of the Scientific American:

You refer, on page 247 of your current volume, to a new idea of making artificial diamonds by crystalizing carbon. It strikes me that the almost constant co-occurrence of native platinum or gold with diamonds is not merely fortuitous, and these metals may have something to do with the crystalization of carbon. It is a sufficiently proved fact that, at very high temperatures, chemical affinity is much modified, and perhaps disappears; the same modification may be a result of high pressure. Undoubtedly, in former geological ages, the atmospheric pressure was much higher than it is now, as is proved by the fact that liquid carbonic acid is enclosed in rock crystals. But a great pressure is also produced by a high column of water; and this may be one of the circumstances under which carbon is now crystalizing in the form of diamonds.

Let some one try a series of experiments, in which chloride of platinum, $PtCl_2$, or gold may act under the highest possible pressure on a suitable hydrocarburet (containing a maximum of carbon and a minimum of hydrogen), and see if such a decomposition as the following is possible:

$$2C_n H_m + mPt Cl_2 = 2mH Cl + mPt + 2nC,$$

in being greater than m, whereby Pt would fall down as a regulus, and C would crystalize as diamond.

If this be Nature's process of forming diamonds, the muriatic acid is of course washed away and deposited elsewhere in muriates; while the native metal and the diamonds are retained in the place of formation or carried along by the mechanical action of water. The highest pressure may be obtained by compressing water at a temperature of over 39·2° Fah., if only a material can be found for a vessel that can endure this pressure. It being desirable that the walls of the vessel are translucent, perhaps rock crystal or fluor-spar could be used. But as the hydrocarburet is lighter than water, some means must be found to hold it, close to the bottom of the vessel (perhaps by means of a bladder, through which exosmosis takes place), in contact with the solution of chloride of platinum. Perhaps some liquid other than water may be desirable; but it must be lighter than the hydrocarburet, and not affect either the latter or the solution of platinum.

There is another series of experiments: It is generally known that air dissolved in water contains more oxygen than atmospheric air. Now, ozone is a modification of oxygen, produced, probably, by a denser formation of the atoms. The oxygen of the air in the water is probably turned into ozone by a high pressure, which would decompose the hydrocarburet by taking away the hydrogen and leaving the carbon, which would crystalize in the liquid. This process may have taken place where no platinum is found associated with diamonds. According to my opinion, it is worth trying whether one of these processes, or perhaps both combined, will have the result, so long sought for, of crystalizing carbon before our eyes.

W. THIESE.

Rochester, N. Y.

Professor Tyndall and the Buddhist Philosopher.

To the Editor of the Scientific American:

In your issue of October 3, page 208 of your current volume, under the caption "Candle Flames and Streaks of Cloud," you quote the Buddhist philosopher: "It cannot be said that he (Buddha) is here or there; but we can point him out by the discourses he delivered. In these, he lives;" and you add: "Science has no further word to offer."

Both the ancient philosopher and the modern professor have erred in making the destiny of man analogous to the transmutation of the correlated forces, heat, light, elec

tricity, motion. There is another law which Science cannot disregard. Life, whether vegetable or animal, does not necessarily become "extinguished as the flame." It becomes latent in the seed. It is there ready to resume its normal law of growth whenever the proper conditions are presented. It would be in accordance with strict deduction, from observed facts in the vegetable, to expect that the animal also, when planted, would return to its renewed form. This expectation is constantly disappointed as to the lower animals and generally as to man. But another series of facts must be also weighed by Science. A large part of our race has always expected a continued existence; and this expectation has been confirmed by human testimony to the rising from the dead of a certain Man who also raised others from the dead; and after thus proving his right to know, He declared that all others would eventually be raised to life again, having been planted (as it were) in the ground. Science must of necessity inquire: 1. Whether the facts of this resurrection and this assertion of a competent witness are duly proved according to the rules of evidence. 2. Whether the statement that growth may be resumed, after cessation for a great length of time, accords with this law of latency as found in plants. Science cannot concern with this as a matter of faith; but it cannot disregard facts duly proved by credible and competent witnesses. Taking up the subject in this line of hard logic, we believe it is to be shown beyond reasonable doubt that the destiny of man is not to melt into the "infinite azure," nor "to be extinguished as the flame," but to live again and to participate again in the affairs of this world. The mode of his return to life and the manner in which he will participate in the future world's affairs are not subjects for discussion here. A belief in the resurrection of a material and organized body leads one very far from the orthodoxy of the churches; but it brings the ascertained facts of Science and the literal words of Scripture into an harmony that does not seem to have been suspected by the scientists or the doctrinaires. E. X.

Lunar Acceleration.

To the Editor of the Scientific American:

There are good reasons why astronomers do not accept the theory of the above named phenomenon, published by your correspondent, Mr. John Hepburn, on page 260 of your current volume.

It has not yet been demonstrated that the sun's orbit is anything like a circle or an ellipse; but there is every reason to believe that his orbit is of a more complicated character, that it is without any period, and is not confined to any one plane. It is believed, also, that his motion is comparatively so slow that the change of direction of his course in 25,800 years amounts only to a small fraction of a degree. Unless your correspondent can prove the fallacy of our fundamental theories of dynamics, he dare not maintain that the sun is rotating in a circular orbit without a central body whose attraction is many times greater than the resultant of all attractions from the rest of the so-called fixed stars. Without the sun's orbit be in the ecliptic, and of a circular or elliptic form, it is as absurd to speak of a retrograde motion as it is to speak of an above and below, of a before and behind, of a right or left hand side of the Universe.

There is no doubt but the travel of the terrestrial poles and the precession of the equinoxes have a common cause. If we depict the travel of either pole, as observed on a stellar globe, we find that for any one time both poles occupy directly opposite positions, and that the phenomenon can be produced by no other motion than a gyration of the earth's axis, of which the precession of the equinoxes is a necessary sequence. This being an established fact, I am unable to see what the alleged retrograde motion of the sun has to do with the explanation.

The period for a complete revolution of the recession of the eclipses is somewhat less than 19 years, and that of the precession of the equinoxes about 25,800 years, which is apparently not quite the same rate, as your correspondent states. Evidently the two phenomena have not a common cause, though they are results of the same principle, and have long ago been satisfactorily explained and experimentally demonstrated by the gyroscope.

Your correspondent subsequently takes refuge in a hypothetical and rather exorbitant increase of the motion of the sun, which no astronomer can take for granted on this ground only. Next he confounds increased with increasing motion. A rotation that makes 31° for 30°, 62° for 60°, and 93° for 90° is simply increased, not accelerated, as it would be if it would make 31° for 30°, 64° for 60°, 99° for 90°, according to the laws of accelerated motion. Lastly, he commits the mistake of referring the angle he found to the diurnal, instead of the annual, rotation of the earth. If he makes his calculations in accordance with the laws of dynamics, he will find no agreement whatever between his theory and the observations of astronomers.

I am afraid that the question is still open.

Philadelphia, Pa. HUGO BILGRAM.

The Potato Bug.

To the Editor of the Scientific American:

Several paragraphs in relation to the potato fly (*cantharis vittata*) have appeared in the SCIENTIFIC AMERICAN, and are now going the rounds of the press. It is strange that an insect well known to the medical profession for the last nineteen years, and which but twenty years ago amounted, in extensive districts of this country, to almost a scourge, should now have become so great a stranger. Under the head of "Potato Flies," the United States Dispensatory says (I quote from the ninth edition, page 171):

"Within the limits of the United States are several species of *cantharis*, which have been employed as substitutes for the *c. vesicatoria*, and found to be equally efficient. Of these, only the *c. vittata* has been adopted as officinal. * *

* The potato fly is rather smaller than the *c. vesicatoria*, which it resembles in shape. Its length is about six lines. The head is of a light red color, with dark spots upon the top; the feelers are black; the elytra or wing cases are black, with a yellow longitudinal stripe in the center, and with a yellow margin; the thorax is also black, with three yellow lines; and the abdomen and legs, which have the same color, are covered with a cinereous down. It inhabits chiefly the potato plant, and makes its appearance about the end of July or the beginning of August, in some seasons in great abundance. It is found on the plant in the morning and evening, but during the heat of the day descends into the soil. The insects are collected by shaking them from the plant into hot water, and are afterwards carefully dried in the sun. They are natives of the Middle and Southern States. * * If the potato fly has been found more speedy in its effects than the *cantharis* of Spain, the result is, perhaps, attributable to the greater freshness of the former. It may be applied to the same purposes, treated in the same manner, and given in the same doses as the foreign insect."

Black River Falls, Wis. E. S. WICKLIN.

Aniline Black Dyes.

To the Editor of the Scientific American:

Of late years the importance of aniline black to calico printers and dyers has steadily increased, and I think it may be of some interest to your readers, among whom you must have many printers of fabrics, to know something of the best methods of printing it and the *rationale* of the process.

Aniline black is produced upon cloth by the application of a mixture of a salt of aniline with a chlorate (usually chlorate of potassa) and generally a little sulphide of copper. Now the great causes of trouble in the process are the following:

I. Injury to the doctors (scrapers) and rollers by crystals of chlorate of potash.

II. Weakening of the cloth by the action of the acid.

III. The great difficulty of getting a steam color.

The first of these difficulties is avoided by the French printers by using chlorate of baryta instead of potassa, and in England by the use (in some works) of chlorate of soda, a very much more soluble chlorate than that of potassa, and one which can be procured perhaps as cheaply. The two last difficulties are insurmountable or nearly so, and it has been proposed to use an acetate of aniline instead of the chlorhydrate; but I have found by experiment that acetanilide is formed, which gives no black color with oxidizers.

By carefully aging in very damp rooms, the second difficulty may be surmounted; but the third, the production of a sufficiently cheap aniline black to steam without tendering the cloth is not yet a solved question. M. B. C. G.

Boston, Mass.

Cribbing in Horses.

To the Editor of the Scientific American:

Noticing an article and illustration in your valuable paper sometime ago, on the subject of cribbing in horses, I send the following plan of eradicating the habit:

Cribbing is caused in the first place by some foreign substance being pressed between the teeth, or by the front teeth growing too close together, thus causing pain. The horse, to avoid this, instinctively pulls at any hard substance, thus spreading the points of the teeth, and by that means affording temporary relief. To remedy this fault, it is only necessary to saw between the teeth with a very thin saw; this relieves the teeth of all side pressure, and effectually ends the trouble. The gulping of wind and the gurgling in the throat are effects that will cease with the removal of the cause.

Elmira, Ohio D. COOK.

Improvement in Gas Retorts.

To the Editor of the Scientific American:

I have a wrinkle to impart to those of the gas fraternity who use clay retorts. It is well known that clay retorts, when first fired up, are very open and porous, causing considerable loss in the yield of gas; and the same thing happens when they become coated with carbon on the inside and have been recently burned out. If those who use such retorts will, when they are new, coat them (both in and outside) with a solution of silicate of soda, of the consistence of ordinary sirup, the difficulty will be entirely removed. It is hardly necessary to add that the coating should be done before setting, and allowed to dry thoroughly.

Frankfort, Ky. M. L. JONES.

[For the Scientific American.]

CRUCIBLES.

The excellence of a crucible depends on the ready expansion and contraction of the ingredients of which it is made. The best crucibles are composed of the following compositions, which are of two kinds, namely, with and without plumbago.

WITHOUT PLUMBAGO.

Three parts by measure of the Stourbridge best crucible clay, two parts cement, consisting of old used-up fire bricks, and one part hard coke. These ingredients must be ground and sifted through a one eighth inch mesh sieve; the sieve must not be finer, otherwise the pot will crack. This composition must be mixed with sufficient clean cold water, trodden with the bare foot to the consistency of stiff dough, and allowed to stand for three or four days well covered with damp cloths, to admit of its sweating and the particles of clay becoming thoroughly matured. It is then ready for use, and must be blocked by hand on a machine. Dr. Ure, in his "Arts and Manufactures," gives drawings and methods of working the machine.

Owing to the coarseness of this composition, the pot cannot well be thrown on the potter's wheel; and in no instance an it be made by pressing.

The crucible must not be burnt in a kiln, but merely highly and thoroughly dried before being placed in the furnace for use. For brass and copper melting, it will stand one good hard day's work; but care must be taken to replace the pot again in the furnace after the metal has been poured. If the pot be not allowed to go cold, it will last for several days. It will, with the greatest safety, stand one melting of wrought iron. The cost, when made on the steel manufacturer's own premises, is about forty cents per pot, each pot holding from 100 to 120 pounds of metal.

HESSIAN CRUCIBLES.

Good Hessian crucibles are composed of two parts of the best German crucible clay and five parts pure fine quartz sand. This composition must be sifted through a one eighth inch mesh sieve; it is then tempered and trodden with the bare foot, as before described. When ready for use, it is pressed into different sizes of crucibles, which, when thoroughly dry, are placed in the kiln or furnace and burnt hard.

ANOTHER COMPOSITION.

Two parts best Stourbridge crucible clay, three parts cement; sift through a one eighth inch sieve. Temper as before described and block by hand on the machine. When thoroughly dry, it is placed in the kiln and burnt hard. These crucibles are principally used for melting gold and silver, and also for dry analysis.

The best and most perfect fire clay for crucible making is nearly always found in the pavement of coal. Some of the Pittsburgh fire clays, and those found to exist in the pavements of some of the Pennsylvania coal mines, are excellent fire clays. But the various compositions cannot be described, as they are as numerous as the different kinds of clays.

WITH PLUMBAGO.

The Birmingham soft tough pot consists of two parts of the best Stourbridge crucible clay, three parts plumbago, and one part cement, consisting of old used-up crucibles ground and sifted through a one eighth inch mesh sieve.

ANOTHER COMPOSITION.

Four parts of the best Stourbridge crucible clay, three parts plumbago, two parts hard coke, and one part cement, consisting of old pots ground and sifted as before. Where old pots cannot be had, the above composition must be burnt hard, ground, and sifted. The scales or chippings of the insides of gas retorts are far superior to the best common hard coke. But where scales and chippings cannot be had, hard coke is the best substitute. All the ingredients of this composition must be sifted through a one eighth inch sieve (but not finer), tempered, and made as before described. When thoroughly dry, it is placed in the kiln and annealed, but not burnt hard. This composition makes a pot (for melting the hardest metal) which cannot be melted at any pitch of heat, nor can it be cracked with the most sudden heating and cooling. It is regularly known to stand fourteen and sixteen meltings of iron, even wrought iron. I have often made it to stand more than that.

Any steel manufacturer can make the pot on his own premises at a cost of $1.20 or thereabouts, the pot holding from 100 to 120 pounds of metal. J. D.

Houston, Texas.

Utilization of Silk Rags.

According to *Les Mondes*, one of the wealthiest English velvet manufacturers, Mr. Lister, worked his way to success by years of patient labor in search of a way to utilize silk rags. He began by buying up all such waste at less than a cent a pound; and up to the year 1864, he had expended the immense sum of $1,312,500 in fruitless efforts to find a process. Nothing daunted, Mr. Lister continued his experiments; and within the past ten years, he has discovered a way of making the refuse into fine velvet. He carries on this industry at Manningham, Eng., in an establishment which employs not merely 4,000 workmen, but 283 travelers in all parts of the globe, whose sole business is to buy the silk waste. The factory is said to have cost nearly $3,000,000.

The practice of patenting imitations of articles of standard excellence is growing in favor at the Patent Office. A patent lately granted is for producing an imitation of Russian sheet iron. This is done by hammering the sheet between anvils and hammers that have indented surfaces, so as to give the sheet a mottled appearance. Another patent is for an imitation Swiss window shade, in which the lace work is imitated by stencils.

JOHN LAIRD, M. P.—The death of Mr. John Laird of Birkenhead, Eng., occurred on the morning of Thursday, October 29. He was the son of William Laird, of Greenock, Scotland, and was educated the Royal Institution, Liverpool. He was well known as an enterprising and successful ship builder. We shall probably publish a portrait of him next week.

SULPHATE OF COPPER OPTICS.—If we receive the solar light reflected by a large crystal of sulphate of copper upon a sheet of platinum or tin plate, placed at a small distance from the crystal, the sheet assumes the color of metallic copper upon the part which receives the reflected light.

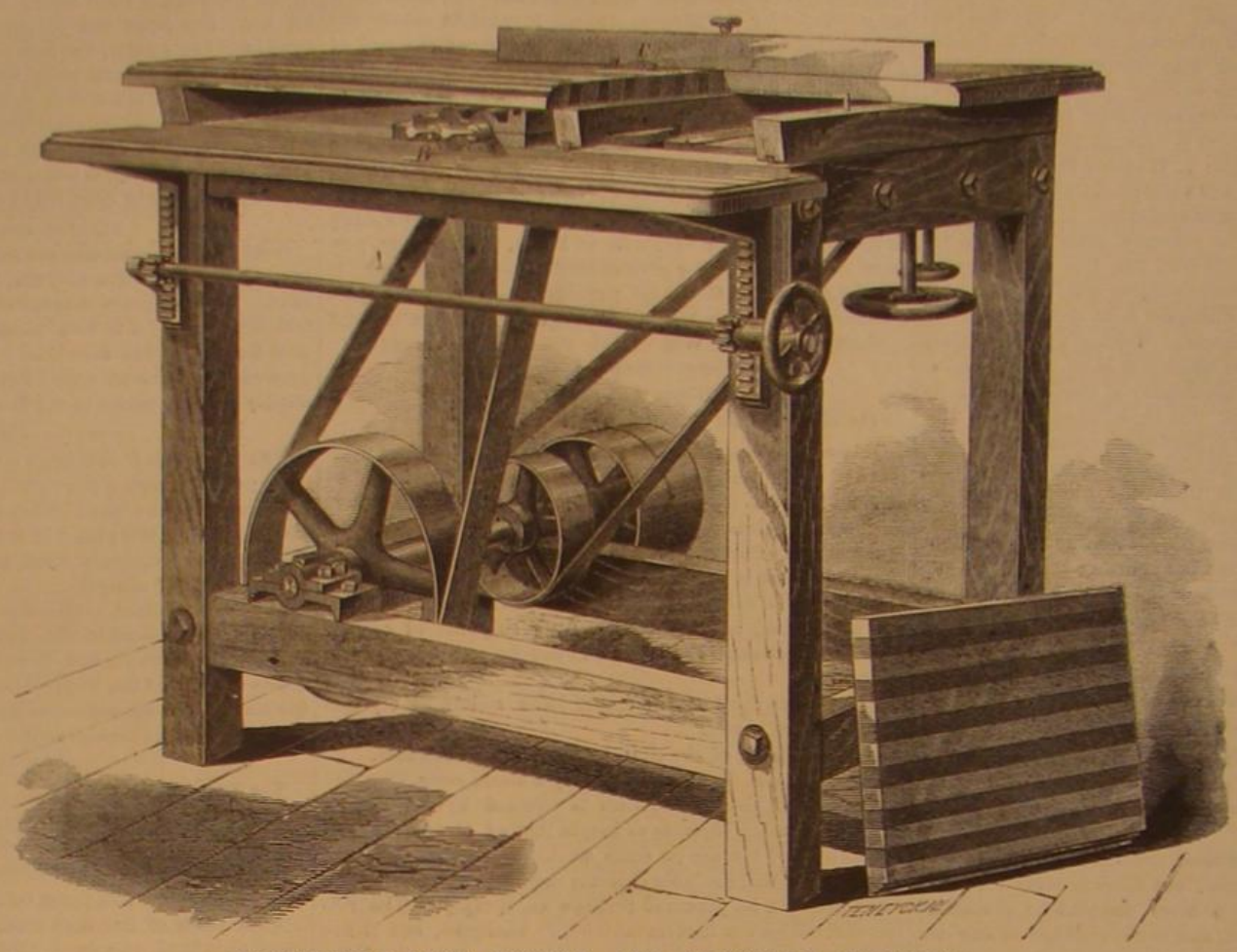
IMPROVED SASH BORING AND GROOVING MACHINE.

We illustrate herewith a machine for boring and grooving sashes, which allows the operator to prepare the work ready for the cord at one handling and without changing his position, the entire job being performed in a space a foot square. It is claimed that the apparatus saves three fourths of the labor necessitated by the ordinary process.

Two mandrels are driven by the belt, A, and carry the pair of bits shown at B, for boring the holes. The groove is made by the saw, C, attached to one of the mandrels. In front of the saw a single mandrel sets and serves to bore through from the groove to provide for the reception of the cord.

The machine is constructed of maple or ash, and is put together with joint bolts. The top is made of walnut and ash strips, 1¼ inches square and glued up. The countershaft and the mandrels—the latter of cast steel—run in the best Babbitt metal. Two groovers and sash and blind bits, complete, are furnished, together with a ten inch circular saw, which adapts the machine for all ordinary light sawing, in addition to its capability of boring blinds, grooving shutters, rabbeting doors, etc. The detached piece, shown leaning against the frame on the right, serves to fill up the space on top of the apparatus when it is used as a common saw table The floor space occupied is two feet wide by three and a half feet in length.

For further particulars address the manufacturers, Messrs. J. H. Blaisdell & Co., 405 Commerce street, Philadelphia, Pa.



BLAISDELL'S SASH BORING AND GROOVING MACHINE

IMPROVED SURFACE BLOW-OFF.

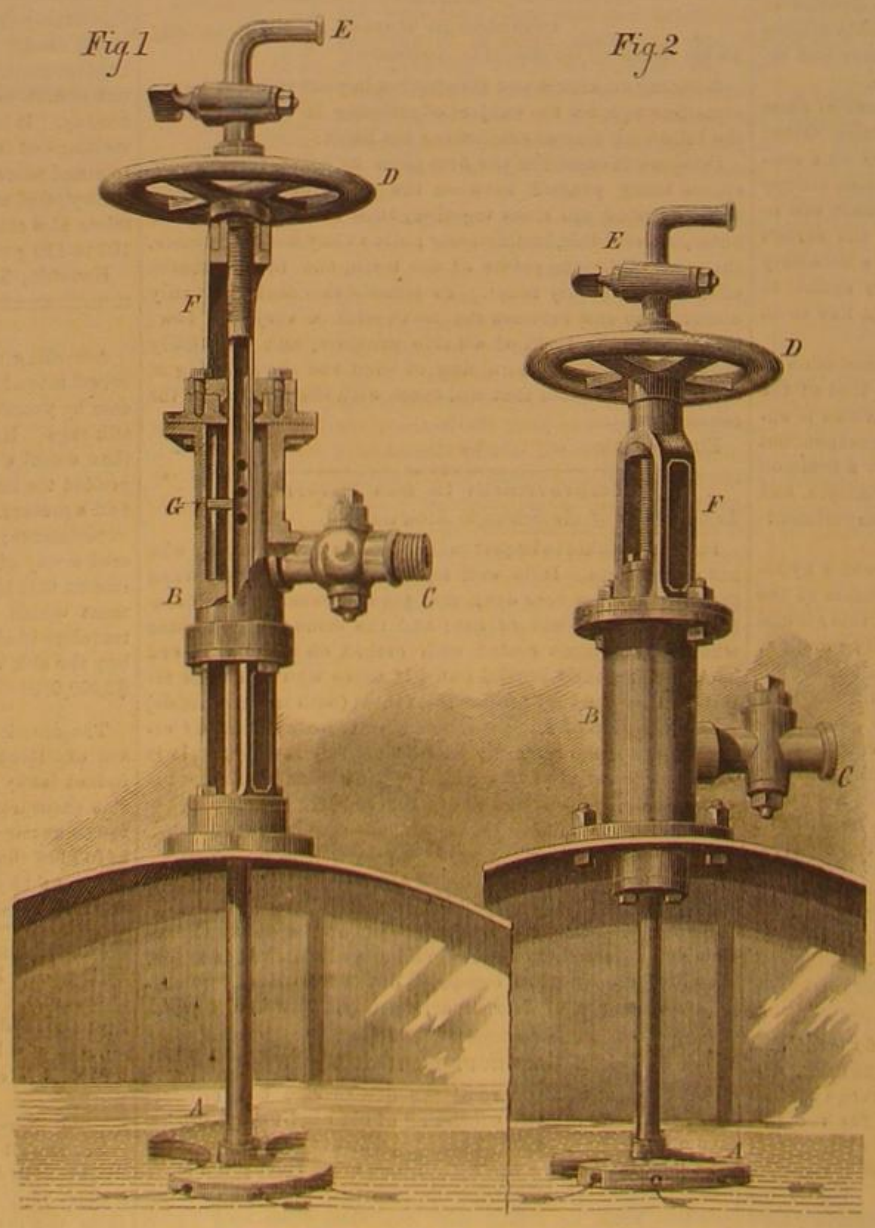
By using the novel surface blow-off represented in our illustrations, it is claimed, the engineer is enabled to tell exactly how much water is in his boiler, whether scum and foreign substances are or are not being forced out, and, in case of the water being lost, he is provided with a means of readily finding it to the last moment of safety.

The engravings represent the invention in section, Fig. 1, and also give an exterior view, Fig. 2, the latter figure differing from the former, however, in that the stuffing box, which surrounds the tube attached to the float or skimmer, A, is arranged inside instead of outside the boiler shell, and also in some readily perceived details of construction. The device is placed on top of the generator, as shown. The skimmer is a hollow flat box provided with side openings for the admission of the surface water. The tube by which it is suspended extends upward through a chamber, B, and is there perforated so that the water may enter said chamber and escape through the blow-off cock, C. The tube continues on upward, passing through suitable stuffing boxes, and terminates in a screw and wheel, D, surmounted by a test cock, E. As shown in Fig. 2, the wheel and screw is supported in a nut on the standards, F, above the chamber, B. The object is to allow of adjusting the skimmer to any height above or below the water level, as desired. The test cock, by ejecting when opened either steam or water, according to the position of the skimmer, indicates the location of the latter and, of course, the water level in the boiler. The main tube is made of sufficient length to allow for the entire range of water level, so that the skimmer may be shifted up or down, as required by the hight of water, without interrupting the flow.

At G, on the main tube, Fig. 1, a stud is provided, which enters a groove in the side of the chamber, B. This serves to prevent the main tube from turning by the nut above.

The inventor states that by this device the scum which rises to the surface of the water may be so thoroughly expelled that a boiler thus provided, and running without cleaning for a period four or five times longer than other generators unprovided, will still keep cleaner than the latter. He also informs us that he has practically tested the invention upon the boilers of a sugar plantation in Cuba, of which he is the engineer, with excellent success. The apparatus is especially adapted for marine boilers, particularly those upon steamers which make long voyages. It can be arranged so as to be operated from any part of the vessel.

Patented through the Scientific American Patent Agency, September 1, 1874. For further particulars address the inventor, Mr. Robert Waugh, Ingenio San Joaquin, Pedroso, Isle de Cubs, or John M. Wiemann, Box 2,524, New Orleans, La.



WAUGH'S IMPROVED SURFACE BLOW-OFF.

Railroad Fire Engines.

The Central Pacific Railroad Company employ no less than than four fire trains on the mountain route across the Sierra. The first is stationed at Blue Cañon, the second at Emigrant Gap, third at the Summit, and the fourth at Truckee. Each train consists of a locomotive and three or four water cars. These cars are about the same length as an ordinary freight car, and formed of two inch plank; they are very strongly put together, as nearly watertight as possible, and elevated above the track about four feet. Each car will hold 3,000 gallons of water, or not far from 100 barrels—equal in weight to 24,000 pounds. The locomotives are arranged with powerful pumps that throw a steady stream, and do equally as good work as the best steam fire engines used in any of the large cities. Leather hose three inches in diameter is used, which, when not in use, is wound upon a large reel mounted on one car of each train. These trains are kept in constant readiness to proceed with all possible speed to the locality of the fire, upon the first alarm. All of the 25 miles of shedding between Emigrant Gap and Truckee is thoroughly deluged with water once a week. In sprinkling the sheds, the pipe man stands on the pilot in front of the engine, which moves slowly along at the rate of two miles an hour. In this work five men are sufficient to manage a train. Since the introduction of the fire alarm telegraph, with 32 different stations between Emigrant Gap and Truckee, the danger of any very disastrous conflagration in the sheds is nearly or quite obviated.

New Chiming Machine.

The art of constructing carillons, or machines for playing tunes on peals of bells, is being much practised in Europe. *Iron* says: The new carillon or chiming machine which has been fixed in the parish church, Leek, by Messrs. Gillett and Bland, of Croydon, England, was lately opened. The carillon machine is fixed in the same chamber as the clock, to which it is connected by means of a lever. On being slightly pulled, the lever dislodges a pin, which instantly sets the machine in motion, and the tune commences playing. It is constructed to play fourteen tunes on eight bells, the tenor weighing one tun, and the whole peal about 4½ tuns. This apparatus is on an entirely new system. The motive power is obtained by weights of about half a tun each, which are suspended from an iron barrel by a steel line. At one end of this barrel is a wheel running in gear with a pinion, driving a spindle, upon which are fixed twenty cam wheels, kept constantly revolving, ready to do the heavy work of lifting the hammers the instant they are released by the musical barrel, which is also kept revolving by a series of wheels similar to a musical box. The levers arranged at the top of the machine are, at the musical barrel end, connected with the hammers above (by means of wire lines and cranks) and the key frame in front of the barrel; and directly the ends of the lever are released by the small brass pins pricked upon the musical board, the other ends of the levers, with the points of the arms attached to them, fall upon the revolving lifting cams and are instantly raised into the striking position and locked by the key frame at the other end, so that the two actions of releasing the hammers by the musical barrel and again lifting by the cams are perfectly simultaneous, and therefore very rapid passages in the music can be played. It will give some idea of the slight tension required for letting off the heavy hammers and the remarkable effectiveness of the mechanism when we state that the musical barrel is made of hard wood, only ten inches in diameter, studded with brass pins one eighth of an inch square; and the whole machine does not occupy more than a quarter of the space that the old one did.

BARROW-IN-FURNESS (ENGLAND) AND ITS FOUNDER.

The rapid rise of Barrow-in-Furness, on the east coast of Lancashire, England, from a little fishing village to a port, a commercial and manufacturing town, and the center of an iron-making district of enormous wealth and prosperity, has been already described on page 22 of our volume XXX. Barrow has recently been the scene of the annual meeting of the Iron and Steel Institute; and it is seen that, even since our recent account of its industries, many important extensions and improvements have been made.

The iron business at Barrow has undoubtedly been called into existence by Mr. Bessemer's renowned invention, for which the Cumberland hematite ores are especially adapted. The wealth of two mighty landowners has been brought into the trade, but the brain and soul of the enterprize (for its various manufactures must be looked upon as one) has been James Ramsden, the manager of the local railroad, who projected the Barrow Steel Company, enlisted the necessary capital in the cause till its works became the largest Bessemer refinery in the world, constructed the docks, brought the jute manufactory into operation to employ the females of the ironworkers' families, and remained, throughout, the central figure of the busy scene. More than two years ago, Mr. Ramsden became Sir James, the Queen having knighted him in recognition of his services to manufacturing industry. He became Mayor of Barrow; and during his year of office, his fellow townsmen commissioned an eminent sculptor to execute a statue of him, in his robes of state. The statue (of which we publish an excellent representation) is of bronze, and is 11 feet high. At the same time, a portrait of the same gentleman was hung in the town hall.

One of the most flourishing enterprizes at Barrow is the yard of the Barrow Iron Shipbuilding Company. The works are arranged for the construction of fifteen vessels at one time, and a large graving dock is completed. Two thousand men are employed here, and the full force of the works will number seven thousand. An ocean steamship company is already incorporated, and six steamers of 4,000 tuns each are being built for it; five more of similar size for the East Indian trade, are contracted for by the company. The extent of the shipbuilding works and yards, and their proximity to the ocean and to the railroads, are well shown in the excellent engraving (from the London *Graphic*) published herewith.

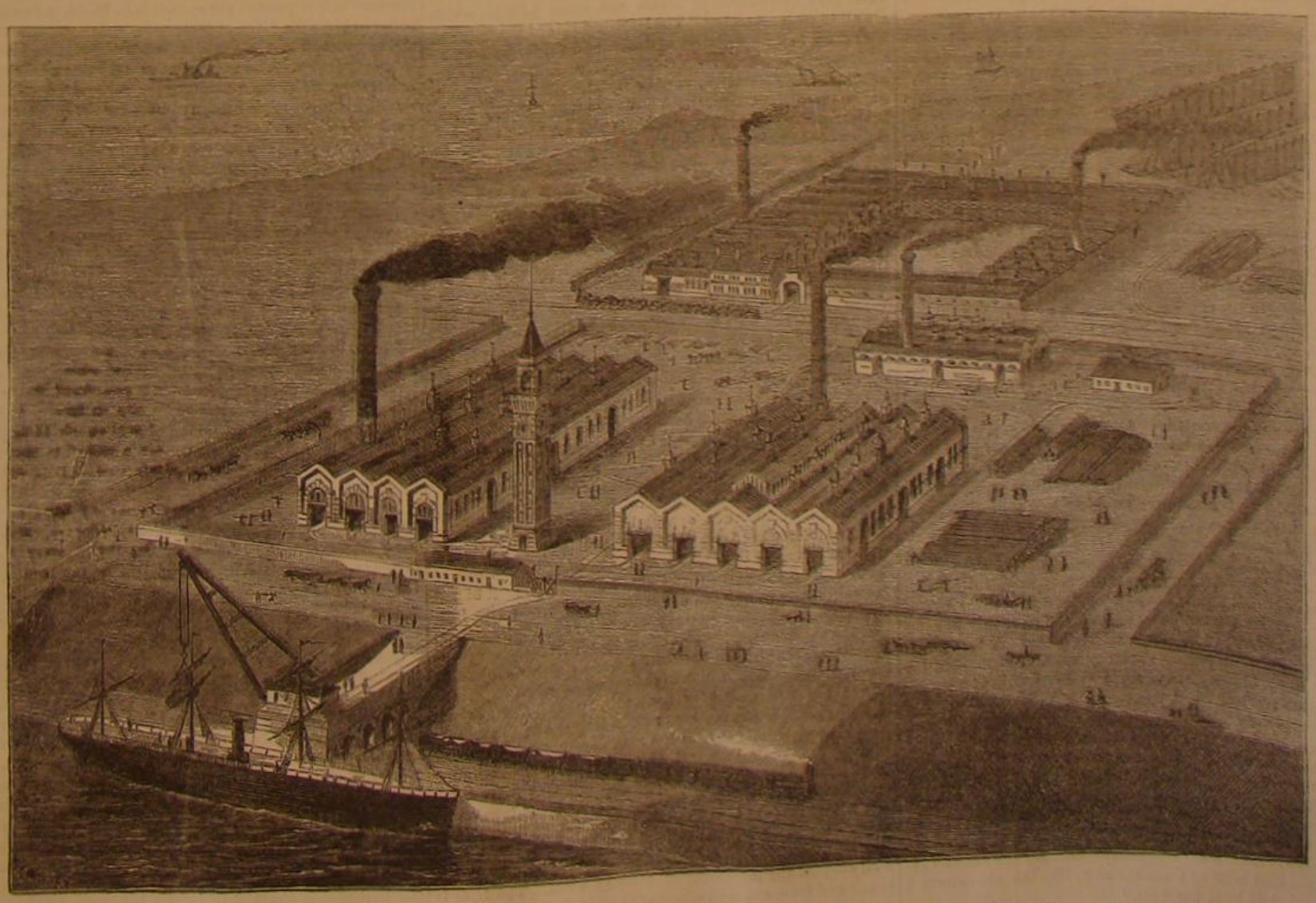


STATUE OF SIR JAMES RAMSDEN.

The Early Days of Daguerrotyping.

The following amusing account of the early practice of taking sun pictures (from the pen of Mr. M. P. Simons, in Anthony's *Photographic Bulletin*) will doubtless bring to mind the similar experiences of some of our readers:

"I will give, as they occur to me, a few thoughts and incidents touching the early days of daguerreotyping. Whilst Daguerre was still in his laboratory working out his magic picture-making process, almost every mail from Paris brought over something of this mystery of mysteries, which was soon translated and studied out by the curious experimenters attracted by its novelty. No one after seeing the first of these smoke-like pictures could possibly have anticipated that Daguerre's process would ever reach the dignity of an art. The process was then, of course, still an undeveloped mystery; and then for some cause or other the published accounts of it received were not clear nor definite, and, as a matter of course, those who took hold of it in its early stage had a good deal to contend with, being obliged to fill in and work up a picture (so to speak) from indistinct outlines. Ah! those were the days of trials and many tryings of contingencies, of slow iodine, slow cameras, and consequently long sittings; when an artist might very easily have taken his dinner while his sitter was sweating out a picture in the sun. This, then, should have been called "long" as well as "high" art. Few were able to sit long to be "taken off" quietly, and fewer still could go through the mysterious operation without receiving a bunged eye or having some other feature knocked into a condition not the most flattering to be handed down as one's facsimile. But these long, tedious, distorting sittings are now past, thanks to sensitive bromine and the science of optics. Long before I ever thought of becoming an artist, I recollect hearing one day that some one in the city was making a very curious kind of likeness, described to me as being on looking glass or steel, and very true to life. My curiosity soon led me to the mystic establishment of Mr. Cornelius to see these marvelous mirrors of Nature. The first one I took in my hand to examine must have had an electric effect upon me. I was perfectly amazed, and for the time being completely entranced with their odd and novel appearance. I could not imagine how under, or rather how in, the sun they were made without hands or pencil. It seemed to me the very hight of jugglery, throwing likenesses from the face and catching them upon polished plates. It was a mystery then; how much less of a mystery is it now? A few years later, while I was preparing to go in to the art business myself, in connection with "Old Sol" as a silent partner to do the light work, Mr. Langenheim was busy fitting up for the same purpose his *atelier* in the Philadelphia Exchange, which he did in good style for that early day. His fittings up, art appurtenances, and furniture were useful and comfortable. But the most important of all was that the lenses he used were the best that had yet made their appearance. Mr. Voigtlander, of Vienna, had just introduced his celebrated lens, and had constituted Mr. Langenheim, his brother-in-law, sole agent for this country. This gave Mr. L. quite a start and a decided advantage over his contemporaries. I at once saw that he was getting ahead of me fast, much faster than suited my youthful aspirations: so one day I took it into my head to make him a professional visit to ascertain if possible the cause of his great success, for up to that time I was not aware of there being any difference whatever in the quality of lenses. I supposed (as the most of our patrons did, and, it would seem, some do still) that the whole thing depended entirely upon the sun, ignoring skill and quality of tools as mere moonshine. I found Mr. L. quite busy making better pictures, and in much shorter sittings, with his quarter size Voigtlander than I was able to do with my half size Plumb. My second visit



THE WORKS OF THE BARROW-IN-FURNESS IRON SHIPBUILDING COMPANY.

to the rooms of Mr. L., a few months later still, was on a dark, rainy afternoon. I found him this time without sitters, though as busy as ever in that mysterious "no admission room," finishing up his day's work and preparing for the next. This suited very well, as it gave me a fine opportunity to scrutinize more carefully his little lens, without being in anybody's way. There were quite a large number of these tubes and lenses of the different sizes, as they are usually gotten up, lying about on shelves and tables, waiting for lucky purchases. But the one Mr. L. himself used interested me the most of all; it was tube, lens, and camera box combined, done up in brass, and reminded one of a small telescope—the only one of this description I have ever seen—and although, as it appears, not a success, it was to my notion a perfect beauty from head to foot, and I fell dead in love with it at first sight. No child ever lookod with more covetous eyes at toys in the shop windows than I did at this unique, brass-clad camera. The price of it was not extravagantly high either; yet I could only look at it, wishing all the while it were mine. I never in the whole course of my life felt so much the real want of the wherewithal as then, nor so effectually broke the tenth commandment. I left the Exchange that day with a heavy heart, though with a fixed determination to have without delay a Voigtlander lens, even if I had to sell my almost anything I possessed; and I went to work with renewed energy to that end, which was soon accomplished. Our business in those days did not fortunately lie altogether in making faces, but also (as you are aware) in teaching others how to make them, or how to spoil them (whichever is the most proper.) Of this sort of thing I already had my hands full, and it now steadily increased. I frequently have had under my own special care at one time six or eight young and old aspirants to high art, some rubbing or scratching away at plates, some polishing and coating, while others were sitting as patient models to those more advanced in the mysteries of the art. This state of things kept going on until I at length became quite alarmed, fearing that the art I had adopted as a profession would soon be teetotally ruined by too much competition, and in order to check it a little I advanced my terms for tuition. But this, strange to say, had the contrary effect. My valuable instructions, as it seemed, were appreciated according to the price I put upon them, for they flocked in upon me thicker and faster than ever (let those who think to increase their business by making cheap pictures take a hint from this). Here was a dilemma for me, and how to get out of it I did not know. I was afraid to raise my price again for fear it would have the same effect, and I had no room for any more. I often look back to those dark, foggy days of the art, when the teacher not infrequently was in turn taught by his pupil, and wonder how we made out so well as we did, for it was certainly "the blind leading the blind" over again. We stumbled and fumbled more over our dark experiments than we ever did in our dark room, and yet with our feeble assistance a great many managed to grope their way into the art, who in a little while made for themselves no ordinary name in the profession. But then there were also many others who promised much and performed but little. It was quite amusing to see the big worded signs that were so plentifully swung out about the city by these freshly made artists. I will here give a description of one which will answer for the most of them: "John Smith, artist, daguerreotyping taught, and improved apparatus for sale. N. B.—Likenesses taken in cloudy weather." This last was useless information for anybody who had ever seen John's pictures hanging at his door, for they were all more suggestive of clouds than of anything else. John was one of my promising young pupils. It had been but a few weeks since he had left the profession of dentistry to woo the sun, preferring drawing faces to drawing teeth. On some of these signs was the following liberal invitation: "Free exhibition; walk up"—but they did'nt say how high up which I suppose was on account of their extreme modesty; they would rather that their patrons should find out for themselves how high their art was, though they should lose their breath in the effort of reaching it. These few casual incidents and recollections of the art, occurring under my own notice, and although not by any means a complete picture of the times, but only a sketch and, as the artists say, merely rubbed in with neutral colors, may still serve to give some little idea of the Daguerrean art and its pioneer profession, prior to the year 1842. At that period or thereabouts the art received a new value by the timely discovery of the gilding process, which gave to the daguerrotype a rich golden tinge, and, as we now well know, an unquestioned permanence, falsifying all prophecies to the contrary. This was an auspicious era in the daguerrotype art, and thenceforward it made greater advances than ever towards the perfection to which it ultimately attained. Between the years 1844 and '54 there were a great many most excellent daguerrotypes made—I think (I hope I may be excused for thinking so) that I made some few myself, and have only to refer to my early patrons to prove that I also got off many that were poor; I rather suspect that they were too Rembrandtish for the time. I often think of my first sitters with of pleasure and sorrow: sorrow that I was compelled to sit many of them so often to so little purpose (artistically speaking), and pleasure because they were such patient sitters, ever ready to make allowance for the many failures incident to this bewildering, soul-stirring process; and if such a thing were at all possible, I would gladly retake many of them, as a sort of conscience-soother, not that their pictures were so far below the then average, but because the then average was so low. But alas! this cannot be. My old register reminds me that most of them are now, like the old camera I then used, laid by in the dust."

THE FRANKLIN INSTITUTE EXHIBITION.

No. I.

If the measure of the success of the approaching Centennial is at all to be gaged by that which has been achieved by the Exhibition now open in Philadelphia, the impossibility of its failure is assured. A single city, representing but a fractional part of the nation's manufacturing powers, has produced an exhibition of which the country at large may well be proud. The same has been done in a number of other cities throughout the country. Any single one of the most successful of them might fairly be taken as representative of the characteristic industries of our land. What then may we not fairly expect when the combined wealth of all sections of the country is collected in the huge exhibition grounds at Fairmount, and contrasted with the products of the entire civilized world?

On the 14th of September the Franklin Institute, having obtained the temporary occupancy of the immense building at Thirteenth and Market streets, formerly occupied as a freight depot by the Pennsylvania Railroad Company, opened an exhibition of arts, manufactures, and machinery. Notwithstanding the openly expressed fears of the timid, the energy and good sense of the managers succeeded in transforming the previously unsightly building into one of the most convenient and beautiful temporary exhibition halls ever occupied in the city. The full confidence which the managers had in its success was shown in the liberal expenditures that were incurred in order to make the buildings not only suitable for the Exhibition, but also beautiful and attractive to the visitors. At first the size of the building, covering, as it does, over two acres of ground, led to the belief among the less prudent that ample space could be obtained up to the time of opening. Too late, however, have they discovered their mistake. The applications came in so rapidly that soon all available room was appropriated, and at the present time over five hundred applications have been rejected for want of space.

Those who recollect the Exhibition building only as a freight depot would be surprised at the marvelous change that has been effected in so short a time. Entering at the main door on Market street, the visitor finds himself in a broad aisle, the roofing of which is gaily decorated with flags of all nations. The exhibits or gas fixtures and chandeliers, which occupy the two extremities of this aisle, add much to the general effect of the decoration. At night, when all two thousand odd lights are burning, the general effect is exceedingly fine. The entire right hand side of the building, occupying rather more than half its area, is devoted to the exhibition of machinery in motion. Two lines of shafting of $2\frac{7}{16}$ inches diameter supply the requisite power. One line is driven at the speed of 120, and the other at 240, revolutions per minute. The inconvenience often experienced at former exhibitions in regard to a want of uniformity of motion has been obviated by all the driving pulleys being supplied by the Institute. The steam power is furnished by the various boilers that are on exhibition, of which there are quite a number. At the extreme southeast corner of the Exhibition, a large leaden tank has been erected to hold the water for a full exhibit of steam and other pumps, which are all in active working. The left hand side of the building is devoted to the exhibition of household goods, philosophical instruments, drugs, dyestuffs, and chemicals, fine arts, printing establishments, sewing machines, carpets, fancy goods, mantels, carriages, and hosts of other articles. Steam heaters, stoves, and ranges occupy the extreme northeast corner of the building.

Having now obtained some idea of the ground plan of the building, we will now examine in detail some of the most interesting features of the Exhibition. As it will be impossible, in the necessarily restricted limits of a single letter, to describe all the exhibits, we will select here and there those which we believe will be the most interesting to the general run of our readers.

Beyond all doubt the feature of the Franklin Institute is the machinery. This fairly outstrips all other classes of exhibits. Nor should this occasion surprise. Not only is the Institute mainly designed for the promotion of the mechanic arts, but Philadelphia is unquestionably one of the centers of the country for the production of machinery and machine tools. In this way, then, has been produced the finest exhibition of machinery in motion ever shown in Philadelphia, perhaps in America.

The steam boilers are all placed on the ground floor, some dozen odd feet below the general level of the Exhibition floor. In the space thus appropriated are collected some of the most interesting features of the Exhibition. The Pennsylvania Diamond Drill Company have on exhibition one of the Leschot diamond-pointed steam drills. The drill of the one exhibited contains ten diamonds, and bores a two inch hole through marble at the rate of one foot in sixty seconds; through sandstone, at the rate of one foot in fifty-five seconds. The actual working of the drill always attracts crowds of the curious. The following important advantages are claimed for this drill over the ordinary steel drill, driven either by hand or steam power: The diamond drill, furnishing as it does a solid core of the rock penetrated, is of great value in prospecting mineral or other lands, since it brings up an actual section of the strata. In this way a far more accurate idea of the nature of the rock is obtained than when it is brought up either broken or pulverized, as in the ordinary methods. This feature gives the drill great advantages over all others for coal and mineral lands. The drill is also well adapted for the boring of artesian wells. The bore is round and true, and will admit of the introduction of a tube nearly as broad as the hole itself. A nine inch hole, 357 feet deep, has been successfully bored for the Wilkesbarre Coal Company, in the Empire mine.

THE HYDRAULIC BRAKE.

Nearly opposite the diamond drill is a large working model of the McBride hydraulic brake. Ordinary sized car wheels are run at a rapid rate by belting, and stopped at will by the application of the brake. The principal advantrges claimed are simplicity and hence diminished cost, and general efficacy, the brake being very powerful. The power is taken directly from the boiler. Under each car is placed a cast iron cylinder of suitable size, furnished with a piston, to the rod of which the brake levers are attached. To prevent the freezing of the water in the brake cylinders and pipes, mixtures of glycerin and water are employed, the relative proportions of the two being determined by the severity of the climate of the country through which the road runs. The cost of rendering the water non-freezing is comparatively slight, since but a small quantity of the glycerin is required: and when the pipes, etc., are once filled, no more is required except in case of accident or leakage. A peculiar feature of the brake is the almost instantaneous transmission of the power and its undiminished efficacy at the end of a long train. The very slight compressibility of water allows the same force to be applied to the last car of a long train as is applied directly to the car in connection with the engine. No other limit can be found to the number of cars the brake can thus stop, except the power of the locomotive to draw them. Since the power employed to work the brake is derived from the steam pressure against the water in the boiler, the locomotive boiler being tapped below the water line, the power is not actually less. During the operation of the brake, the gage does not indicate the loss of as much as half a pound of steam. We understand that the hydraulic brake is in successful operation on the West Chester road.

THE BOILERS.

In this portion of the Exhibition building, as we have already mentioned, are the boilers which furnish the steam for the various engines. Among a number of others we notice the following, namely: Shearman's improved upright tubular boiler, which claims as its distinctive features economy of fuel and space, cleanliness, convenience, safety, and cheapness. It claims to produce one horse power with twelve square feet of heating surface.

The well known Harrison steam generator is represented by a large boiler. The advantages of this form of generator, as our readers are probably aware, are security from destructive explosions and economy of fuel. A combination of cast iron hollow spheres, each eight inches outside diameter, and connected together by curved necks, with rebate machine-made joints, are held together with wrought iron bolts with caps at the ends. Each boiler is tested up to 300 pounds to the square inch by hydraulic pressure. The safety of the boiler is to be found in the number of joints that can give, in case the pressure of the steam becomes too great; while at the same time, the mode of connection of the hollow spheres of cast iron allows of great pressure without leakage. Experiments have been made in which a pressure of 850 pounds per square inch failed to rupture the boiler or start the joints. This boiler gets up steam quickly and can furnish superheated steam without the addition of extra apparatus. The number of small parts of which it is constructed offers great facilities for transportation and erection, no large opening being required for the introduction of the boilers. The largest can be put through an opening one foot square, when desired.

The Wiegand patent safety sectional steam generator also exhibits a large working boiler. The peculiar advantages it possesses are safety from dangerous explosions, economy of fuel, and a rapid generation of steam. The practical test for the efficiency of the boilers is to be found in the fact that they are now in use by a number of large manufacturing establishments throughout the country who know the requirements of a good steam generator, and who would not permit a poor instrument to remain in their works. With an hourly consumption of ten pounds of coal per square foot of grate surface, the area of which is 22 square feet, an hourly evaporation of 117·8 pounds of water is effected for every square foot of grate surface. The total evaporating power of one pound of coal equals 11·22 pounds of water. The Ætna grate bars are attached to this boiler, and apparently give general satisfaction. It is exhibited by Mosely & Metzgar.

The Keystone Portable Forge Company have an excellent display of portable and stationary forges, either for hand or power. They also exhibit their rotary positive pressure blowers, which they claim to be the most powerful blowers known. Lovegrove & Co. have a fine display of gages, etc.

THE STEAM HAMMERS.

Quite a lively effect is produced in the basement by the working of the steam hammers, one exhibited by W. Bement & Son, and the other by Wm. Sellers & Co. The latter is peculiarly light and graceful in appearance, when its power is taken into consideration. It is the old "Morrison steam hammer," with a number of improvements which the Messrs. Sellers have since added. The hammer is formed of a long bar of wrought iron to which the piston is welded, forming, in fact, a part of the piston itself. No side guides are employed, the bar being guided by the top and bottom cylinder heads only. The advantage thus gained is apparent. The entire space below the cylinder is free, and the workmen is enabled to handle his work more effectually than when two of the sides are occupied. At the same time the hammer head and die are more effectually guided

and the frames subjected to a less severe strain. An improvement has been made in the shape of the hammer head and the mode of its attachment. By increasing the sectional area of the piston rod toward the hammer head, the greatest mass of the metal is brought nearest the point of impact, and a much greater efficiency is thus given to the blow. Again, the hammer head, instead of forming a continuous piece with the piston, is now attached to the lower cylindrical end of the hammer bar by a circular taper key, thus preventing the breaking of the bar by concussion. A modification of the ports of the steam chest allows the use of a supplemental valve which throttles the exhaust steam below the piston, but does not affect that above it. In this way the hammer is enabled to strike quick, light blows for finishing, since, the exhaust above the piston being unaffected, the hammer can rise as quickly as before; but in coming down, its force may be regulated by the cushion of steam on which it descends. This compressed steam re-expands on the up stroke, and thus effects an economy of the steam power. We have seen one of these 300 pound steam hammers drive a pin in a beam by a dozen or more blows. In this instrument the workman has as perfect control of the rapidity, force, and character of the blow as if he were enabled to actually wield the hammer in his hand, and control it directly by his will.

Recent American and Foreign Patents.

Improved Invalid Bedstead.

Henry Bull, Newport, R. I.—This bed bottom is provided with rollers, and adapted to be slid on and off rails which are hinged to the bedstead at one end, and may be lowered at the other by a windlass or other suitable means. On said bed bottom are hinged pieces and a fixed apertured seat piece, so that, when extended, the said hinged pieces form part of the floor, and when otherwise adjusted one of them drops down, and the others are elevated and connected by hooks to adapt them to support the patient.

Improved Friction Brake.

Elisha C. Sanders, Westerly, R. I.—This invention consists of a friction clamp, of two independent parts, one of which is stationary and has contrivances whereby the other part is fastened to it, so as to hold the drum against being turned by the strain to which it is subject. The other fastening device is so contrived that by the revolving of a tappet against it the pressure is relaxed so as to let the drum turn a little. The pressure is varied by a screw and a spring, so as to subject the drum to more or less resistance; and the tappet wheel employed for relaxing the pressure will become fast or slow, and otherwise varied to suit the requirements of the case. The invention is especially intended to be employed as a let-off attachment for looms, in which case the relaxing holder will be raised once for each beat of the loom by the tappet wheel.

Improved Pegging Awl.

Michael Fichter and John P. Dexheimer, Lawrenceburgh, Ind.—The handle is made hollow from its upper end nearly to its lower end. It has a square hole extending from said cavity to its lower end, into which the shaft stem or holder fits. The lower end of the shaft is split, to form jaws to receive the shank of the awl, which jaws are drawn together to clamp the said shanks by a nut made with a polygonal flange to receive the wrench. When the nut is screwed on the awl, neither can move up or down or turn in its holder.

Improved Hay Press.

William H. Penniston, Fox, Mo.—This is an improved device for operating the beater in beater presses so as to make it prompt in its action, and so as to diminish the amount of slack rope when the beater falls, and thus lessen the distance the horse has travel to again raise the said beater, and consequently to lessen the time required to complete the bale.

Improved Nut Lock.

Clark Hutchinson, Tonica, Ill.—This is an improvement in means for preventing the turning of nuts on screw bolts; and it consists in cutting the screw thread transversely and tying a wire around the bolt at that place. By means of a channel the wire is prevented from working upward, while it securely locks the nut.

Improved Spring Bed Bottom.

Henry Whiteside, Jr., Ottawa, Canada.—This is an improved bed bottom frame, formed of paralliel side bars and transverse bottom slats arranged in a lower plane. The means of support and connection between them consist of blocks and bolts. The blocks serve to keep said slats and bars equidistantly separated and support the latter on the former, the slats resting on the cleats of the side rails of the bedstead when the bed bottom is in use.

Improved Cross Head for Locomotives.

William A. Alexander, Mobile, Ala.—This invention consists in the arrangement of a detachable wrist pin placed into side recesses of the cross head, and fastened suitably thereto. It consists further in arranging the jaws of the crosshead at a certain angle or inclination to the horizontal axis of the same, and placing thereon adjustable slotted wedge pieces for setting the top and bottom plates squarely thereon, and securing them by means of screw bolts.

Improved Billiard Table Leveler.

George C. Brotherton, San Quentin, Cal.—This invention consists of legs, separated into two parts near the top, and connected by dowel pins and an adjusting screw, all so contrived that the screw may be readily turned by a pin introduced into holes in the head through a slot in the side of the leg. The slot may be covered by a pivoted or sliding panel or other piece of ornamental work. The head of the screw is fitted into a metal cap, fixed in the top part, and a metal nut for the screw is fitted into the lower part of the leg.

Improved Gin Saw Filing Machine.

Wiley J. Johnson, Hernando, Miss.—In this machine there is a triangular file head, having three holes for files at unequal distances apart, and arranged to shift around on the stock. The stock race is pivoted centrally and in line with the crank shaft, so that it may be turned to any angle.

Improved Spike Extractor.

William Devine, Brownsville, Tex.—A gripe or grapple is formed of hinged jaws which are connected to a tube which is swiveled to the hoisting or jack screw. By turning the jack screw, the tube and grapple will be raised vertically, thereby drawing the spike.

Improved Razor.

Ferdinand Erdmanski, Hiawatha, Kan.—This is a detachable blade which is inserted into the supporting back part of the razor. It is fastened thereto by its hinged top half, which is secured by a suitable slide piece on the lower or main part. The steady position of the razor blade is secured by means of pins of the main part of the supporting frame, passing through symmetrically arranged holes of the blade into recesses of the hinged part.

Improved Grist Alarm.

Joseph H. Curtis, Charlton, Iowa.—This invention provides, for the conducting spouts, hoppers, and other parts of the mill, an automatic alarm, which is operated by the pressure of the grain, flour, or bran on the valve part, indicating, by the ringing of a bell, the interruption of the supply. When the supply of grain, flour, etc., is steadily kept up in the spouts, hoppers, etc., the pressure on the valve will carry the clapper away from the bell, and prevent thereby the ringing of the same; but as soon as the pressure is discontinued, the rotating shaft will strike the bell stem and give the alarm, so that the miller has ample time to supply the spout before the burrs run empty or other parts of the mill machinery are stopped.

Improved Link Motion.

John Sandall, Jr., Charlottetown, Can.—This link is formed in two parts each part being connected with an eccentric, and both parts communicating with a central eccentric, by the rod of which the two parts are made to operate as though hinged together.

Improved Ironing Table.

William O. Donnell, Pittsburgh, Pa.—This ironing board is adapted to be attached to a vertical wall and supported in a horizontal position by means of a hinged brace.

Improved Nut Lock.

James U. Fisher and Hiram W. Fisher, Penn Station, Pa.—The locking plate has a reduced part which is bent up at the end. Said part is inserted into a groove in the bolt from the upper side of the nut, and its lower end is turned up on the under side of the same. The lower side of the nut has a circular rabbet, which receives the end of the hook plate where it is subject to no friction in turning the nut; then the nut is turned home, and the part of the plate is bent over and on the edge of the nut, thus effectually locking the device.

Improved Paneling Machine.

William Cobban and Charles H. Smith, Bloomer, Wis.—This invention consists of a carriage adapted to hold the boards on which panels are to be raised, so as to present them sidewise and endwise to a pair of rotating panel-raising tools. A clamp is provided, which both holds the boards in place and springs them out of wind, so that they will be dressed exactly alike on both sides all around the edges.

Improved Ornamental Chain for Necklaces, etc.

Saintemme Diolot, New York city.—This invention consists in a chain constructed of alternating closed rings and opening spring links, the latter being made of two separate links, soldered to each other at one side, so that the free ends of both links join by their spring action at opposite sides into socket-shaped connecting ends. The closed links are then readily inserted.

Improved Clothes Line Fastener.

Joseph Hill, Wabash, Ind.—This invention consists in making a clothes line fastener of a flanged plate having a projection, a lock piece having a diagonal slot, and a bolt having an oblong head. This construction enables it to be attached to, and detached from, a fence, paling, or wall with great facility, while it allows the line to be secured and quickly made fast.

Improved Wagon Seat.

Stephen G. Peabody, Champaign, Ill.—This invention relates to providing a wagon seat with an improved attachment for connecting it to, and supporting it upon, the wagon body.

Improved Bouquet Holder.

John Boyd, New York city.—This is a small ornamental receptacle, pressure of the lid of which on the stem of the bouquet retains the same firmly in the holder, while it admits of the instant removal and replacing by releasing the lid. The cavity of the holder may be employed, if desired, for taking up a small quantity of water, by which the flowers may be kept fresh for a longer period of time.

Improved Adjustable Picture Frame Suspender.

Albert Gorrell and Robert J. McClure, Holmesville, Ohio.—Wires or strips of woods are attached to the back of the frame, so as to allow adjusting rings to slide freely thereon. At the lower ends of the wires are used eyes, to which the ends of the suspending cord are attached before being passed through the rings. As the latter slide readily up or down, the points of suspension are thus readily and very quickly adjusted up or down the back.

Improved Storage Box for Firemen's Implements.

Thomas A. Colgan, Brooklyn, N. Y.—This invention consists of storage boxes for containing firemen's implements, located in convenient positions throughout the fire districts, and sunk in the sidewalk or roadway. The boxes have a corrugated or roughened top, and are provided with hooks, brackets, or slings for the reception of axes, pikes, and the like. The contrivances for locking them are such as to be readily opened with a hydrant wrench.

Improved Cone Sawing Machine.

Junius Harris, Titusville, Pa.—This invention consists of a cone saw in the form of a tapered tube, with teeth on the large end. The tube is slitted along one side from end to end, to allow it to expand and contract, and near the large end is fitted between a cone on the shaft for turning the saw and a corresponding collar, which is secured to the cone by a screw passing through the slit. At the other end, it is connected to a sliding collar on the shaft, provided with a lever, by which the saw is shoved forward along the cone and collar to the work, and expanded and drawn back and contracted suitably for sawing bungs and other conical articles. The invention also consists of a table top for holding the work to the saw, contrived with a hinge joint and a foot treadle for working it, so as to press the work up to the centering point in the end of the shaft over which the saw works, to hold the work at the beginning, and to drop down to discharge the sawn pieces.

Improved Suspension Truss Bridge.

Jacob B. Bausman, Minneapolis, Min.—The cables are made of wire, and semi-cylindrical in form. The chords are each of two sections of [iron, placed parallel with each other, and confined together by a covering plate. The truss posts are confined to the chords, and are connected to the foot blocks by dowels, as are also the transverse stay pieces. The cables pass through the foot blocks, and are connected at each end with swivel or socket yokes, which connect them with the anchor bars. The side diagonal braces fit into lozenge-shaped recesses in the bottom of the foot blocks, or slip over projections at the same points. The transverse diagonal braces are held in place by the dowels of struts. The posts and strut bars are made of star iron, which form gives them remarkable strength, stiffness, and durability. With the exception of the tension bars at each end, the cables are continuous throughout each span. Owing to the manner in which the lower connections are made with the foot blocks, the trusses can be adjusted from the roadway, and the structure can be erected, when the same may be desirable, without employing substantial scaffolding, as is usual in the erection of bridges, the use of screw bolts being confined to points which are easily accessible.

Improved Rockers for Cradles, etc.

Phineas R. Strong, Colchester, Conn.—This invention consists of cradle rockers with additional pieces pivoted to them in such a manner that they produce, when folded to form extensions of the rockers, a cradle, while a standing crib is obtained by turning them in upright position as extensions to the standards or feet.

Improved Steam Trap.

Josiah Anoney, Mamaroneck, N. Y.—The feed water vessel is provided with a tube, passing centrally therethrough, having slots and a valve, which shuts off the steam that enters an enlargement through the live steam inlet. A float surrounds the tube, and, sliding thereon, lifts a valve rod. As usual, the float rises with the inlet of water, unseats the valve, and admits steam, which forces the water to the boiler. As the water falls, the valve closes and water rushes in. By interposing the tube between the valve rod and the float, the said rod can always move with perfect freedom, and without receiving any interference from the float.

Improved Adjustable Knife for Cutting Hat Boxes.

William Marx, New York city.—This is an improved knife for cutting out hat boxes, so constructed as to enable a number of boxes to be cut at one operation, and which may be readily adjusted to cut larger or smaller boxes, as may be required. The knife is adjusted for cutting different sized boxes by detaching end knives and replacing them with longer or shorter ones. The shorter end knives have a wedge-shaped plate attached to their outer side to bring them into proper position to give the box the proper flare, and make the bottom of the proper size.

Improved Burial Case Fastener.

William S. Wood, Newtown, N. Y.—This invention is to provide means for holding burial cases fast in their boxes when they are packed and being transported or stored, and it consists of a bracket of wood and metal, made in any form so that it will hold the case by entering screw holes on the sides or ends of the case, which are made for fastening the body of the case together.

Improved Method of Protecting Crops from the Chinch Bug.

Leman H. Faunce, Montrose, Ill.—A ditch, about a foot deep, is made around the field in which the crop is growing, or in which the bugs have been hatched, by plowing two or three furrows in the same place, and then drawing a small log along the ditch until the dirt is reduced to fine dust. In the bottom, a rod, more or less, apart, are set small tin cans, made with funnel-shaped tops. The cans are sunk in the bottom of the ditch until their tops are a little below the surface of the ground. The bugs, in seeking to enter or leave the field, pass into the ditch; and being unable to ascend the other side of the ditch readily they begin, after a time, to pass longitudinally along it, and fall into the cans. The latter, at convenient times, are taken up, and the bugs are emptied into hot water and destroyed.

Improved Operating Car Brake.

William C. Shearer, Savannah, Ga.—This invention consists in augmenting the friction of brake shoes, and thus facilitating the braking of a train of cars by combining with the ordinary rock shaft a long arm whose bifurcations have end pulleys, over which and a pair of pendent fixed pulleys passes a chain that connects the rear car with a spirally grooved winding drum on the tender.

Improved Sewing Machine Case.

William Salisbury, Wheeling, W. Va.—This invention relates to a mode of constructing the box and table of a sewing machine so that the cover of box may be conveniently applied as an extension to the table, and so that the drawers or apartments may be easily attached together or detached for convenience.

Improved Hand Car.

Montgomery Crossman, Marshall, Mich.—Hitherto the levers of hand cars have been connected by means of suitable rods, with a double crank axle. The attendant disadvantages of such arrangement are avoided in this invention, which consists in the construction and arrangement of parts, more particularly in connecting the levers with a single wrist pin on a toothed wheel, which is fixed on a short shaft arranged in a plane above and in rear of the driving axle of the cars; also in the means for shifting the power from one axle pinion to another, and thus varying the speed.

Improved Asphalt Pavement.

Edwin E. Glaskin, Boston, Mass.—This invention consists in forming a new material, for roofing, paving, and other like purposes, from an asphaltic dolomite as a base. The process consists in treating said base by first subjecting it to the action of heat, then adding naphtha or oxydized petroleum, and albertite coal and sesquioxide of iron. The final step consists in adding a fresh quantity of the basic material, to wit, the dolomite.

Improved Seed Planter.

Charles Frankish, Abilene, Kansas.—This invention if an improvement in the class of corn and dropping devices adapted for attachment to the beams of an ordinary turning or furrowing plow. The improvement relates, first, to the means of attachment of the coulter or pilot wheel and seed-dropping devices to the plow beam; secondly, to the construction and arrangement of parts for adjustment of the wiper for the revolving seed cylinder; thirdly, to the adaptation of parts for removal of said cylinder from its case and from the shaft of the revolving pilot wheel.

Improved Door Check.

Daniel Gundelfinger, Jefferson City, Mo.—This invention relates to means whereby the knobs of doors may be prevented from striking the paper, paint, or wall of a room, and may be secured in a position that will not allow the door to be swung back by a draft of air or accidental force. The invention consists in placing a spring catch on the door, which receives the end of a notched arm projecting from the wall, said arm being adapted to fold, and being provided with its own lock.

Improved Bale Tie.

John Colley, New Orleans, La.—This invention consists of a notched plate fastened to one end of the hoop permanently. It receives the hook of the other end in its notch, and has a bolt for fastening said hooked end which swings around into the hook on a pivot, and then slides lengthwise a little on a rivet. The end is notched to engage the rivet, and the hole for the pivot on which the bolt swings is slotted to allow the bolt to slide. The two rivets are headed down, so as to hold the bolt fast.

Improvement in Folding Tables, Beds, etc.

John N. Valley, New York city.—This invention relates to that class of tables which, for convenience and portability, are intended to fold up when not in use and be laid away in a small space, and is a new and improved arrangement which may equally as well be applied to either a table, bed, lapboard, stand, or any other similar article of furniture. It consists in the arrangement of the legs, which are attached by means of metallic straps to transverse pieces under the table, and folding inwardly, said sets of legs being braced and locked in position by a hinged brace attached to a longitudinal board under the table by similar metallic straps.

Improved Washing Machine.

James B. Farrar, Carbonton, N. C.—This invention relates to certain improvements in washing machines. It consists of a bench or table having at one end a transverse opening in which are disposed two spring-seated and vertically adjustable rubbers connected with back plates which are detachably fastened to the bench or table. The clothes are fed from a tub of water on said table through the mouth formed by the two rubbers, and pass through a slot in a horizontally reciprocating slide below the rubbers, by means of which the clothes are subjected to a sufficient amount of rubbing and squeezing to cleanse them thoroughly, the said clothes passing below into a tub of rinsing water under the table.

Improved Traction Engine.

Edward P. Gowles, Wequiock, Wis.—This invention relates to the construction of wheel hubs and axles, whereby the wheels are adapted to be vibrated or adjusted with reference to the direction of motion of the engine. It also relates to the means for effecting the adjustment; and lastly, to an arrangement for varying the speed. For running the machine fast when light, it is geared directly with the axle; but for running slower, when loaded, and still slower for drawing plows and the like, a countershaft is provided, which will gear with a train, by suitable interposing mechanism, according to the speed required. The wheel of the train which turns the rear axle is connected to it by a universal joint, like the traction wheels, except that this wheel can vibrate in every direction to allow the axle to rise and fall independently of the boiler.

Improved Lever Escapement for Watches.

William G. Schoof, Clerkenwell, Great Britain.—This invention consists in the planting—in place of the common notch of the roller, and a single pin or jewel in the lever acting on each side of the notch alternately—of a jewel or other pallet in the middle of a small crescent-shaped recess at the edge of the roller. This jewel engages two upright pins of the lever, and performs the unlocking action in connection with or without a ruby pin near the center of the roller. The resilient or elastic banking of the lever is obtained in connection with banking pins of a pivoted lever plate, and a yielding spring action thereon, which gives way when banking occurs. The resilient action may also be produced by mounting the spring upon the lever as a substitute for the spring plate, and using stationary banking pins at both sides of the lever.

Improved Whiffletree.

Andrew J. Dibble, Franklin, N. Y., assignor to himself and Daniel Miller, same place.—The end irons are made in the form of a socket, and have hooks upon their forward side cast in one piece with the body. In the end, and opposite the point of the hook, is a hole extending entirely through said irons, in which is placed a block which is held out against the said hook by a coiled spring, the rear end of which rests against an adjusting screw.

Improved Corn Planter.

James R. Hall, John S. Hall, and John G. Mole, Xenia, Neb.—The seed hoppers are attached to the upper ends, and open into the cavity of standards. A plate is placed in the cavity, and its lower part curves rearward. It is hinged to another plate, the lower end of which is bent back at an angle, and rests against the dropping slide, against which it is held by a spring. The device thus forms a cut-off to prevent any more seed being carried out by the dropping slide than enough to fill its dropping cavity. The levers which operate the dropping slide pass so as to be struck by blocks attached to the spokes of the center wheel. The marker may be folded alongside the seat across the axle and frame, when not in use.

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ANSWERS TO CORRESPONDENTS

W. S. will find a recipe for a black finish on brass on p. 208, vol. 26.—F. J. F. will find details of the effects of ammoniacal vapor on p. 266, vol. 31. We cannot tell you of a remedy for the eruptions.—S. A. F. will find full directions for skeletonizing leaves on p. 123, vol. 29.—J. L. will find a recipe for glue that dries rapidly on p. 33, vol. 31.—D. H. M. will find that the directions on p. 353, vol. 24, are complete.—P. F. S. will find full particulars of the German offer of a premium for a railway coupling on p. 162, vol. 29.—J. S. & Co. should refer to p. 59, vol. 24, for directions for galvanizing iron.—C. F. B. and F. M. H. should see p. 250, vol. 31, for a description of the prismatic fountain.—J. G. can bend timber by the process described on p. 43, vol. 30. To tan buffalo hides with the hair on, see p. 59, vol. 28.—V. will find full descriptions of various forms of unsinkable boats on p. 155, vol. 31.—H. B. T. will find details of the process of making artificial butter on p. 119, vol. 30.—A. & Co. will find directions for putting a black finish on iron on p. 123, vol. 29.—H. T. S. will find a recipe for leather cement on p. 368, vol. 30.—P. H. W. will find directions for gilding on glass on pp. 90, 279, 283, vol. 31.—W. E. will find a description of the process of malleablizing iron on p. 138, vol. 29.

(1) F. D. asks: If a bell glass be inverted in a dish of water, and a piece of meat suspended inside, how will the air affect the meat, the vessel being airtight? A. It will supply oxygen to the tissues of the meat, which will slowly undergo decomposition. 2. What effect will the water have on the meat? A. It will supply the atmosphere around the meat with moisture, and retard the desiccation. 3. What chemical can be put into the vessel that will destroy the decomposing property of the air? A. None which is cheap and easily used. 4. If I place ice in the vessel, will it aid in keeping the meat? A. Yes.

(2) C. T. M. asks: What will counteract the effects of sulphur in my jewelry show case? I have had vulcanized rubber goods in it, and the effect is to be seen on my gold and silver goods. A. Try standing several trays of quicklime in the case.

(3) J. S. T. asks: What is the best method of preparing annatto for coloring butter? Is any other ingredient used with it? A. Annatto contains a coloring matter which is sparingly soluble in water, but freely so in alcohol and ether. Potassa dissolves producing a deep red color; and on neutralizing the solution with an acid, it falls as an orange precipitate. The fixed oils also dissolve the coloring matter of annatto.

(4) J. S. M. asks: What metal is best to use in the seat and face of a steam engine governor, to prevent cutting? A. Hard brass is the best material; but there is none that will not cut under some circumstances.

(5) J. H. asks: Which will give more power, a 9 feet overshot water wheel, or a breast wheel using the same amount of water? A. In ordinary cases if both wheels were well designed, they would have about the same efficiency.

(6) C. W. G. says: On p. 220, vol. 31, I read that S. T. says: "To find the power of a spring, attach a pulley and cord, with weight, and find how many pounds your spring will raise one foot high in a minute." Would not a similar rule be good to determine the power of a steam engine? If I am obliged to run up the weight more than a foot, should not the final result be divided by said number? Should the pulley be of the same size as the crank circle and keyed directly on the engine shaft? A. The method you speak of will answer, but is not ordinarily very convenient. The pulley can be made of any size.

(7) M. G. says: I have set up 5 stoves which had 6 elbows in the pipe. Pipe from the stove to chimney was 7 inches in diameter with 6 inches entrance in chimney. They all draw well. I have now set up a stove with a similar pipe with a 7 inch entrance in chimney; this smokes the rooms. Can it be possible that there is a draft downwards in the chimney, so that the smoke from the stove pipe descends? A. If the draft of the chimney were good with the six inch pipe, there is no reason why it should not be so with the seven inch pipe, unless the latter is pushed so far into the chimney as to reach the back of the flue, in which case, of course, it would be effectually closed. The pocket formed by the closed fireplace is of course filled with air, and it is not likely that the suction upon this, caused by the ascending current in the flue, could materially affect the draft of the latter. The stove pipe itself, however, may be closed with soot.

(8) A. B. asks: Is it possible to form two numerical squares that shall be to each other as 5 is to 4? A. No.

(9) R. B. W. asks: 1. What are the right proportions of curvature for the concave and convex disks of flint and crown glass, to correct all chromatic and spherical aberration in a 3 inch achromatic object glass for a telescope, focal length being about 4 feet? A. Outside curve of crown lens, 32·25 inches radius. Ditto of flint lens, 67·16 inches. Inside curve proportional to the dispersive powers of the two lenses, varying with different glass. 2. Is there any book giving directions as to forms of lenses, and degrees of curvature, for making of telescopes, etc.? A. "*Praktische Dioptrik*," J. J. Prechtl, Vienna, 1828, is a complete manual for making achromatic telescopes. The method of local correction, the use of a covered tunnel and artificial star, with tramway to carry the lens, and Faraday's method of clearing melted glass by sprinkling platinum sponge over it, are the chief improvements since.

(10) D. J. M. Y. asks: Does the force of gravity increase or decrease on approaching the center of the earth? A. It increases.

(11) W. H. Jr. asks: What are the comparative tensile strengths of cast and malleable iron? A. Wrought iron has from 2 to 3 times the tensile strength of cast iron.

(12) L. M. D. asks: How is the accuracy of a mercurial barometer tested? A. Usually by comparison with some standard instrument. Read T. A. Jenkins' pamphlet on "The Barometer," etc.

(13) S. N. M. says: Mädler, Mitchell, and other astronomers estimate the velocity of the sun in space at 21 miles a second. On p. 208, vol. 31, you state that velocity at 4 miles a second. Is this a typographical error, or have you later and more reliable observations as authority? A. Struve estimates the sun's velocity at 150 million miles a year, or about five miles a second. Airy thinks it is 27 miles a second. Maps of telescopic stars are now being made, to settle this question 100 years hence.

(14) W. B. F. asks: Is there any machine, device, or means by which one unskilled in mining can with certainty test a locality for gold or other metals? A. There is none.

(15) A. F. H. asks: How can I make a terrestrial telescope, 36 inches long? How long ought the focal length of the object glass to be? A. The focal length of an achromatic objective should be about fifteen times the aperture. A set of eyepieces usually consists of several powers between ten and fifty for each inch of linear aperture, and of one high power of one hundred for each inch of aperture. A terrestrial eyepiece should be of low power. Change all the dimensions of any one of those we have given, uniformly, by simple proportion, and construct your terrestrial ocular thereby.

(16) A. F. C. says: I have a 2½ inch achromatic telescope of 44 inches focus; and with the Huyghenian eyepiece, I get a power of about 80. How high a power will it stand, and how must I construct the eyepiece? A. Working powers run from ten to fifty per lineal inch of aperture. Powers occasionally used on fine nights may run from fifty to one hundred per inch of aperture.

(17) C. W. B. says: A beam is hung by two rods, one at each end, from and parallel to a similar beam. If I shorten one rod, will the suspended beam hang directly under the other as before? A. No. The suspended beam will be deflected towards the shorter rod, and the strain upon the shorter rod will be greater than that upon the longer rod in proportion to the disparity of their lengths.

(18) E. A. B. says: I have a well in a cellar, 42 feet deep and 17 inches in diameter. The ceiling or floor over cellar is 7 feet 6 inches; the kitchen adjoins the room over the cellar. I wish to provide a way to deliver water from the well, into the kitchen, above the floor if possible, at a point about 20 feet from the well, and to have the pump for this purpose at the point of delivery. The lift will not be less than 50 feet. How and with what description of pump can I do this? A. Perhaps the simplest plan would be for you to place a lift and force pump in the well at not more than twenty-five feet above the water, and arrange to work it by means of pulleys and belts operated by hand power in the kitchen. You would require two belts—one running vertically and one horizontally—and a crank at the pump handle and one in the kitchen.

(19) G. W. M. asks: 1. What is the proper size to make the cores of a telegraph magnet? A. About 2 inches long by ⅜ of an inch in diameter. 2. With what sized wire shall I coil it? A. Use No. 22 wire.

(20) J. Q. A. asks: Is there any possible way of controlling a watch so as to make it run exactly, or not to vary more than one hundredth part of a second in twenty-four hours? A. It never has been done. We are not prepared to assert that it can not be.

(21) R. L. J. asks: What is black brimstone, and is there any other name for it? A. When sulphur or brimstone is moderately heated, it passes into a transparent and nearly colorless liquid; but when the temperature is raised to 482° Fah., this liquid becomes thick and of a dark brown color.

(22) J. S. N. asks: In a hard coal furnace, the acid or gas formed in burning Scranton or Lehigh coal condenses and rots out the pipe, especially when the smoke pipe crosses a cold hall. I have tried common stove pipe, Russian iron, and zinc coated iron, with about the same result. Is there any metal I can use? Will copper, coated with zinc or tin, resist the corrosive action? A. Zinc would hardly answer. Tin would do better; copper would probably stand some time, but its rusting would be accelerated by other causes. Sheet lead would resist the acid vapors, but might not answer so well in other respects. A silicate pipe would do.

(23) P. M. O'F. asks: Are a perspective view and photograph of the same object, from the same point of view, identically alike? To this you answer, no. Please state in what the difference consists. A. In a photograph, parts of an object which are much nearer than others are unduly magnified. 2. Are there any rules by which a draftsman may obtain, without copying from a photograph, the same general outline of an object as can be obtained by photography? A. It might be possible to make rules for the purpose mentioned, but we have never seen any, the ordinary methods for perspective drawing being generally considered better.

(24) F. C. M. says: I have been trying to make a galvanic battery as proposed by Mr. W. M. Symons on p. 309, vol. 31, but without success. Can you aid me? A. Your battery, if constructed as directed, could not possibly have been a failure; and although when in operation you could not feel the current, by applying the terminal wire to the tongue you might be able to detect its presence by taste or sensation. 2. How can I construct one of sufficient power to give a weak current or shocks? A. A small induction coil will best answer your purpose, full directions for the construction of which you will find on pp. 218, 315, 378, 379, vol. 30.

(25) J. B. H. asks: 1. Are coins molded or stamped? A. They are stamped. They could be molded. 2. Can molds or dies be made without the use of engraving, and how? A. The dies are struck from a master die, which is engraved. 3. What kind of metal is best to make the molds of? A. Soft steel is generally used.

(26) H. S. asks: What temperatures are required to volatilize, respectively, gold, silver, zinc, antimony, lead, and copper? A. The question whether certain metals volatilize during the roasting of the same, we cannot definitely answer, owing to very little data upon the subject. Gold melts at 2364° Fah., and Napier considers it to be volatile at a very high temperature; it also volatilizes when remelted in crucibles, especially when combined with copper. If the fused gold has been covered with a layer of bone ash, the ash will be covered with volatilized gold of a purple color. The microscope does not reveal globules of gold in this coating, but grains of gold may be obtained by smelting; so that the question of whether gold is volatile, in a finely divided state or in combination, is still unanswered. According to Deville, gold volatilizes when melting auriferous platinum, and may be collected by condensing the gold vapor. Silver melts at 1904° Fah., and can only be volatilized by electricity or the oxyhydrogen flame. Zinc melts at 770° Fah., and volatilizes at 2264° Fah., and burns at 932° Fah., forming ZnO, which is not volatile. Antimony melts at 806° Fah., and volatilizes at a bright white heat. Lead melts at 626° Fah., boils and volatilizes at a white heat, air being excluded. Copper melts at 2426° Fah.

(27) M. H. McK. asks: Which is best for deafening a floor, filling from the lining of the deafening up level with the joist or leaving a space under the floor? A. It is best to leave an air space above the deafening, for two reasons; it will both deafen better and be less liable to cause a dry rot in the floor plank.

(28) H. S. G. asks: Can I put one water wheel under another to use the water twice over, in a deep fall? A. There is no novelty in this plan. One wheel is better than two when it can be conveniently employed; but sometimes, on account of the great size that would have to be given to one wheel, two are used.

(29) N. S. J. asks: How can I analyze water? A. Apply to a chemist. The knowledge of the method would not aid you without the necessary skill.

(30) P. & B. ask: What is the proper shape for a piece of steel, so that when one end of it is bolted firmly to a solid piece of wood and the steel struck, the sweetest and most voluminous tone may be heard? A. A flat bar, supported on the ends on ropes of straw, is ordinarily used.

(31) W. P. asks: Why does not a pump raise water 26 feet perpendicularly in a mill which is more than 700 feet from the river? A pump in a mill near the bank raises water 27 feet. Is the friction too great for the 4 inch pump, or are we at too great a hight from the water? Shall we put in another or larger pump, or sink the pipe? A. The great length of your pipe causes so much friction that your pump runs away from the water. The remedy is to provide a tank or reservoir at the distant mill and a force pump at the mill on the bank; the water will then be driven through the pipe instead of drawn through it, and the friction can be easily overcome. The water, being discharged into the tank at the distant mill, can thus be taken up by the pump stationed there and supplied where required

(32) A. V. D. V. says: I hold that the following: 7×8×2×5×0×5×6=6,300: is correct. My friend argues that 210×0=0 and so on, the answer being 0. Please give us your opinion. A. Your friend is right. You may get a clear idea of the matter by imagining 0 to be a fraction whose numerator is 1, and whose denominator is infinitely large.

(33) W. H. H.—The recipes for colored stars for rockets were from eminent authority, and are correct in every particular.

(34) C. M. C. says: Atmospheric pressure is estimated at 15 lbs. per square inch. If a boiler capable of bearing only 100 lbs. pressure in the open air could be placed in a vacuum, would it not burst at 85 lbs. pressure? In other words, should there be an increase of 15 lbs. made on the bursting pressure of a boiler on account of the resistance of the atmosphere? A. This allowance is always made in proportioning a boiler, by taking the pressure of the steam to be that shown by the steam gage, while the pressure in reality, is on an average 15 lbs. greater than this.

(35) T. C. W. asks: 1. Is paper a good conductor of cold? A. Paper is a very poor conductor of heat and (although it is not the usual way of regarding the subject) of cold. 2. Please name a few good conductors of cold. A. All the metals are good conductors.

(36) G. H. M. asks: Can gas carbon be consumed, or by any means converted into the gaseous state, as the other forms of carbon are when made to deflagrate with niter or other oxidizing agents? At present it resists this treatment. A. It can. When placed in the galvanic focus, it is completely consumed.

(37) T. J. M. & O. H. G. ask: On. p. 300, vol. 31, you say that muriate of ammonia, in vapor, is taken by inhalation for bronchial affections, etc. How is the vapor produced? A. The vapor of ammonium chloride may be obtained in many ways, but perhaps the following is the safest for this purpose: Place a small quantity of ammonium chloride (common sal ammoniac) in a flask, or better still, an iron bottle, and heat strongly. The vapor should be inhaled as it comes over, for if allowed to cool it will gradually condense.

(38) J. S. asks: How high would a balloon have to ascend to get outside of the earth's attraction; and what would become of such a balloon? Would it not float in the endless space for ever? A. A balloon could not possibly ascend to more than 30 or 40 miles, the limit of our atmosphere.

(39) W. W. A. asks: How can I manufacture starch from potatoes? A. In order to extract the starch, the tubers are first freed from adhering earth by a thorough washing, and are then rasped by machinery. The pulp thus obtained is received upon a sieve, and is washed continuously by a gentle stream of water, so long as the washings run through milky. This milkiness is due to the granules of starch which are held in suspension. The milky liquid is received into vats, in which the amylaceous matter is allowed to subside; the supernatant water is drawn off, and the deposit is repeatedly washed with fresh water until the washings are no longer colored. The starch is then suspended in a little water run through a fine sieve to keep back any portion of sand, and, after having been again allowed to settle, is drained in baskets lined with ticking; the mass is then placed on a porous floor of half baked tiles, and dried in a current of air, which is at first of the natural temperature; the drying is completed by the application of a moderate heat.

(40) A. S. G. says: In your reply to J. B. T., (No. 53 in No. 13, vol. 31), your first answer amounts to saying that a vessel will be of the same weight when full of air as when exhausted. This does not seem possible; the vessel would, of course, weigh the same as the materials of which it is composed; but when it is exhausted it would be buoyed up by the external air to just the amount of the weight removed. A. A vessel with a capacity for 60 gallons, when exhausted of air, would weigh nearly an ounce lighter than when full.

(41) W. M. C. asks: What can I put into flour paste to keep it from souring? A. See p. 219, vol. 30.

What is the best motive power for a heavy leather manufacturing machine? A. Steam.

How can I find the weight of a bin of stove coal from the cubic feet of the bin? A. By first determining the weight of a known measure of the material (say one cubic foot) and then multiplying the number of cubic feet contained in the pile by the weight obtained.

(42) B. asks: Are not metallic lamps far safer than the glass ones? A. Glass lamps are conceded to be the safest where burning fluids containing light or volatile oils are used, because of their poor conductivity of heat.

(43) J. P. G. asks: 1. Is ozone poisonous? A. Yes. 2. Is it dangerous to breathe or inhale it? A. Yes. 3. If its fumes were generated in a tight place or room, would it be necessary to remove all eatables to prevent their being impoisoned? A. Not necessarily.

Can a family use water drawn through lead pipes for 20 years without being poisoned? A. Whether the lead acts upon the water depends upon the character of the water. Some waters affect lead, others do not. A very simple chemical test will answer this question.

(44) G. D. F. asks: How can I improve spectacles that are dull and scratched, and make them magnify more? A. There is no other way than to have them reground and repolished.

(45) C. D. C. says: I have been very much bothered with my nickel solution. After an article has been in the solution about an hour, japan-colored streaks appear; and when the plating has been polished, the parts that were clear in the solution stand out in relief equal to the thickness of the plating, no nickel of any thickness having been deposited on the dark spots. The inside of the vat was first covered with black varnish (some kind of preparation of coal tar). The tar got dry on the sides but not on the bottom. I then coated it over with hot asphaltum and turpentine, but the tar mixed with the asphaltum and raised air bubbles in the liquid. The solution had the smell of turpentine and asphaltum. The thing did not work any better, so I filtered the solution and scraped the vat clean inside, but it still works as described. What can I do to clean the liquid and make it work well? A. This is a question best answered by some one who has encountered and overcome such a difficulty in nickel plating. The plan followed in similar cases by chemists is to filter, either through common filters or others having an absorptive action on coloring matters. Further impurities are sometimes gotten rid of by a partial evaporation and crystallizing the pure salts out.

(46) O. H. H. asks: 1. What will remove grease, iron rust, and stains from cloth? What will take out printing ink without injuring the goods? A. The best method is to saturate the spot with benzine, which is a solvent for both grease and printer's ink, and then cover the spot thickly with powdered French chalk, which will absorb it. Repeat if necessary.

(47) J. B. asks: Why will a perspective view taken from a given point not be identical with a photograph taken from the same point? A. Because the method by which objects are represented on paper by the rules of perspective drawing is essentially different from that by which the same objects are projected on a plane surface by the operation of lenses. See our answer to P. M. O'F., No. 23 on p. 344.

(48) A. S. asks: How is an odometer attached to a wheel? A. It generally has a clamp. If not, it can be tied.

Will you please tell me where that engine is that has a cylinder about 108 inches in diameter by 14 feet stroke? A. There were several such cylinders in vessels belonging to the Pacific Mail Steamship Company a few years ago. Whether or not the vessels are still in service, we cannot say.

(49) B. & Co. say: We want to put a whistle on a building. Will a tin boiler holding three gallons of water furnish steam enough to blow the whistle when desirable? A. It will not be very satisfactory unless quite a small whistle is used.

(50) E. W. W. says: A friend of mine claims that there is really no such an apparatus as a suction pump, that water is brought through such a pump altogether by air pressure, and not by suction. Is he right? A. Yes.

(51) M. W. says: I dissolved some tungstate of soda in water, and wet splinters with it and dried them. They would burn about as they would if wet with alum water. How should the tungstate be used? A. It is necessary that the wood be immersed in the solution until the outer pores become well filled.

(52) H. T. S. asks: Will a piston head give the same power if made of a wedge shape, as if it had a plain straight face? A. Yes.

(53) J. B. R. asks: How can I find the specific gravity of any fluid with a specific gravity bottle? A. By finding the weight of a bottle full of the fluid at the given temperature. Then specific gravity —

$$\frac{\text{weight of bottle filled with liquid} - \text{weight of bottle}}{\text{weight of bottle filled with water} - \text{weight of bottle}}.$$

(54) H. J. H. asks: At how much greater pressure are steam boilers tested by hydraulic pressure than would be a safe steam working pressure? A. One third, commonly. 2. What proportion of the effective heating surface should the fire grate surface be? A. From 1-90 to 1-11, according to character of boiler. 3. In what state is a boiler capable of bearing the highest pressure, heated, as when steam is up, or cold? A. Generally when heated. 4. What is tensile strain in steam boilers? A. It is the strain tending to rupture the boiler. Your other questions will be answered in a forthcoming editorial on the strength of boilers.

(55) J. B. S. asks: Is soluble glass manufactured in this country? A. Yes. By liquid or soluble glass is understood a soluble alkaline silicate. Its preparation is effected by melting sand with much alkali, the result being a fluid substance. The various kinds of water glass are known as: Potassa water glass, soda water glass, double water glass, and fixing water glass. Potassa glass is obtained by the melting together of pulverized quartz or quartz sand 45 parts, potassa 30 parts, powdered wood charcoal 3 parts, the molten mass being dissolved by means of boiling in water. Soda glass is prepared with pulverized quartz 45 parts, calcined soda 23 parts, carbon 3 parts; or (according to Buchner) with pulverized quartz 100 parts, calcined Glauber salt 60 parts, and carbon 15 to 20 parts. Double water glass (potassa and soda water glass), according to Döbereiner, is prepared by melting together quartz powder 152 parts, calcined soda 51, potash 70 parts. For technical purposes, a mixture of 3 volumes of concentrated potassa water glass solution, and 2 volumes of concentrated soda water glass solution, is employed. By the name of fixing waterglass, Von Fuchs designates a mixture of silica well saturated with potassa water glass and silicate of soda. It is used to fix or render the colors permanent in stereochromy. Water glass is an important product in industry. It is used to render wood, linen, and paper non-inflammable. It is also used as a cement: in this it is equal to lime, and indeed is known as mineral lime. Another application of water glass is in the painting of stone and concrete walls, and in the manufacture of artificial stone. An interesting and important application of water glass is in the new art of mural and monumental painting, termed by Von Fuchs stereochromy or solid color.

(56) O. C. asks: If heat comes from the sun, how is it that a sunglass does not get hot when held so as to set fire to an object on the side opposite the sun? A. The action of the glass is simply to condense or concentrate to a focal point all the rays of light and luminous heat that fall on its surface. Therefore, the greater the diameter of the lenses, the higher will be the temperature at the focal point, the temperature of the glass remaining the same. Burning glasses are, in many cases, made of pure rock salt, which, because of its diathermancy, transmits with equal freedom the dark and the luminous heat rays, as well as those of light. Heat is a form of motion. The old caloric hypothesis has long since been abandoned.

(57) E. D. D. asks: What is heat? A. It is defined in Watt's "Dictionary of Chemistry" as follows: "The word heat is used in common language, both as the name of a particular kind of sensation and to denote that condition of matter in which it is capable of producing this sensation to us." You will see that heat is defined by stating its effects, since the exact nature of it is not known.

Is there such a thing as an absolute vacuum? What would be the temperature of as perfect a vacuum as could be made? A. See article entitled "A Perfect Vacuum," p. 400, vol. 28.

(58) J. W. W. asks: Has the premium yet been awarded for the best means of propelling canal boats without agitating the water? A. Yes.

In what degree does gas expand on being heated? A. About 1-491 of its volume for each degree Fah. that its temperature is increased.

(59) G. H. M. asks: How can I prepare the percussion powder for brass cartridges? A. Take fulminate of mercury 6 parts, chlorate of potassa 6 parts, and antimony 6 parts.

(60) G. D. H. asks: 1. What are the duties of a bridge engineer? A. He must be able to design and construct bridges. 2. In what manner, and by whom are such men usually employed? A. They are employed by railroad and other companies, city authorities, highway commissioners, and private parties. 3. What is the customary mode of obtaining and of doing the business of that profession? A. By offering your services to those who are in need of them, and demonstrating that you have the requisite skill and experience for the work to be done. 4. What is the best way for a graduate of a school in engineering to acquire a practical working knowledge of any branch of his profession, and of getting established in it? A. The best way to acquire practical knowledge is to practice.

(61) D. B. C. says: 1. I want to build a steamboat, to run against a current of about 3 miles per hour. I wish to make the boat 12 feet wide and 18 long, with a draft of 18 inches. I have two 8 horse engines that make 300 revolutions per minute, and I propose to gear them down to 100 per minute. A. It would probably be better to gear down to a slower speed of wheel. 2. Shall I have to get a license from government? A. Yes. 3. What will it cost? A. It will cost about $40.

(62) J. W. R. asks: What is the best composition to put on a 35 foot furnace chimney, to protect it or make it last? A. There is a black varnish made from mineral oil that seems to answer very well.

(63) A. R. asks: Will a centrifugal water mill go in a vacuum? A. Yes.

Would an ordinary rocket, exploded in a vacuum infinitely large, ascend? A. Yes.

In boiling hay for paper stock in a tub with a loose cover, would there be any economy in using steam under 45 lbs. pressure instead of 30 lbs., the steam being allowed to escape in the hay through openings in the pipe? A. No.

(64) G. W. A. says: I wish to get up a metallic substance to put up cotton in. I want something light, but tough and strong, and thinner than zinc. Zinc is too costly. Can you tell me what metal or combination of metals will answer my purpose? A. You ask rather too much, in requesting us to do your inventing. You should make experiments with different materials until you find what you want.

(65) W. J. A. says: I have a three inch drive well with six feet of water standing, but two or three strokes of the pump empties it. I have a pump with a two inch suction pipe. The well worked very well when first sunk, the pump having one inch suction pipe. I think it is caused by corrosion of the sand screen. I had a well borer to examine it, and he said that it was caused by leaving the mouth of the well open, and he plugged it up. That I found created considerable back pressure on the pump, and at the same time did not give the desired results. Do you think if the well had been closed in the first place it would have retarded or prevented the corrosion? A. Probably your suction is choked, and that causes all the trouble. If there is plenty of water in the spring, it will only be necessary for you to use non-corrosive screens, of brass or galvanized iron.

(66) P. H. W. says: I wish to put a new screw to a steam yacht, the length of which is 42 feet, beam 7 feet. She draws 22 inches forward, and 26 aft. The wheel I now have is 38 inches in diameter, with 5 feet pitch (2 blades). Would I gain anything by using a 4 bladed screw, 36 inches in diameter and of 5 feet pitch? A. A three bladed screw would doubtless be the best.

(67) H. N. asks: 1. Is it safe to run a 3x8 engine at 300 turns per minute? A. Yes. 2. If so what power will such an engine give under 100 lbs pressure? A. About 9 horse power, with 100 lbs. mean effective pressure. 3. What should be the size of the boiler (upright tubular) and thickness of shell? A. Boiler with 130 square feet of heating surface; shell, about 3-16 of an inch thick.

(68) A. T. S. says: I am building a small engine 1¾x3 inches cylinder. What kind of piston packing is best, and how should it be put on? A. For so small a piston it is generally sufficient to make it solid, with a few grooves. 2. Could I use hemp packing without burning it, using steam at 75 lbs.? How is rubber packing applied? A. You can use either hemp or rubber packing by making a recess in the piston, and neither will be liable to burn out, with proper care. 3. What is the rule for getting size of steam and exhaust pipes? A. Make the steam pipe ¼ inch, and exhaust 5-16 inch, diameter.

(69) S. E. T. D. says: Does a pendulum of a certain length require a certain weight? If so, what should be the weight of a ball to a pendulum making one beat in a second? A. Any weight will answer if the mechanism is adapted to it.

(70) T. C. says: I have built a small pleasure yacht. Length of keel is 25 feet, beam 6 feet 6 inches, depth of hold 3 feet 10 inches. Cylinder is 6x5 inches, and boiler 60x36 inches, with 130 tubes 1¼ inches in diameter and 2 feet long. I drive a 30 inch Delamater wheel. I have driven her 6 miles against a flood tide in 44 minutes, with a pressure of 120 lbs. steam. I propose to lengthen her. How many feet should I add so as to get the utmost possible speed out of her? A. We would not recommend lengthening the boat more than 5 or 6 feet, and probably the present screw would answer. 2. Will the boat be as strong as it was before being lengthened? A. You can make the boat as strong as before by proper construction. 3. Am I required by law to have a licensed engineer and pilot? A. It will be necessary to have a licensed engineer and pilot according to the requirements of the steamboat law.

(71) A. H. K. says: My son is desirous of learning engineering, both practically and theoretically. Would you advise his attendance at some school of design? A. He can obtain some practice in a technical school; and you will find the Stevens Institute of Technology one of the best. After his graduation, it would be well for him to enter a general machine shop and work there for some time.

(72) C. P. N. asks: How is fermentation controlled, so as to keep carbonic acid gas in the beer, that it will sparkle when filled into the glass? A. By keeping the beer in closed vessels, so as not to allow the gas to escape.

(73) G. F. B. asks: How can I construct a Leclanché galvanic battery? A. The battery consists of an ordinary porous vessel of unglazed earthenware, into which is placed a plate of carbon which is surrounded by a mixture of carbon and peroxide of manganese, tightly packed and sealed with a layer of asphaltum. The cup, thus prepared, is placed in a glass vessel, surrounded with a strong solution of chloride of ammonium (sal ammoniac) to about half its hight. A rod of amalgamated zinc is now placed in the jar, which constitutes the negative pole and completes the arrangements of the cell.

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

A. B. C.—It is muscovite. It contains no silver.—P. C. K.—No. 1 is biotite. No. 2 is garnet and tourmaline. No. 3 is quartz and tourmaline. They contain no silver.—R. H. C.—No. 1 is red hematite. No. 2 is horn blende. No. 3 is iron pyrites.—A. C. B.—A qualitative analysis of your mineral shows the presence of oxide of iron, chlorine, sulphuric acid, soda, lime, magnesia, and carbonic acid.—J. L. B.—It is tremolite.—J. E. B.—It is not red but yellow ocher, with a certain percentage of clay. You must have it properly analyzed before the value per ton can be given.—C. P. D.—A qualitative examination showed that, while the specimen sent consisted of a considerable amount of hydrated sesquioxide of iron, yet it also had a large amount of insoluble earthy matter, and we should hardly pronounce it, from the analysis thus far made, a yellow ocher in the proper sense of the word. It would be necessary to make a further analysis and determine the percentage of iron present.—We have received three specimens without any letter, name, or address. No. 1 is mica in decomposed granite. No. 2 is anhydrous sesquioxide of iron. No. 3 is calcite.—We have received 16 specimens in a wooden box, unlabeled. Two are very valuable fibrous brown hematite. Two are impure yellow jasper. Twelve are valuable chromite, and are excellent ore of chromium.

E. R. M. & P. W. ask: What will destroy the smell of naphtha in which rubber has been dissolved?—H. P. says: A lady friend of mine has a pair of scissors, which she uses constantly, and which were used by her mother fifty years ago. The polish upon them is exquisite, and they look as though they just came from the factory. On the contrary, a pair of very beautiful scissors, whose original polish was as perfect as that of the old ones, and which were presented to her two years ago, are dull and tarnished. She showed me also a surgical knife that was brought over at the same time as the scissors; nothing could be more beautiful than the polish, which neither time nor use has dulled while some more modern instruments require constant attention to keep them clean. Can you explain it?—J. H. asks: How can I weld steel?

COMMUNICATIONS RECEIVED.

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

On Developing a Country. By T. H. B.
On the Szaroch. By C. R. S.
On a Friction Brake. By W. G.
On Constant Batteries. By L. B.

Also enquiries and answers from the following:

C. M.—E. L.—R. R. R.—J. H.—A. Y. F.—P. R. G.—C. G.—F. Q.—R. L. B.—A. G.—C. H. S. D.

HINTS TO CORRESPONDENTS.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Enquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasure in answering briefly by mail, if the writer's address is given.

Hundreds of enquiries analogous to the following are sent: "Where are computation tables published? Who sells horseshoe magnets? Who makes calculating machines? Where can good washing machines be obtained? Who sells a rapid knife cleaning machine?" All such personal enquiries are printed, as will be observed in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

[OFFICIAL.]

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October 13, 1874,

AND EACH BEARING THAT DATE.

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Press, steam and hydraulic, J. F. Taylor (r)..... 6,085
Printing patterns, J. D. McDonald..... 155,879
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Salt, manufacture of, O. E. Pohl..... 155,971
Sash fastener, P. Bradford..... 155,924
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Saw, hand, H. Howson..... 155,950
saw set, J. Leggat..... 155,875
Saw setting and filing device, W. Weber..... 155,819
Sawing machine, crosscut, J. Thompson..... 155,902
Sawing lathe, machine for, B. F. Haley..... 155,832
Sawing machine, scroll, J. E. Brown..... 155,854
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Scale stock frame, S. Hatfield..... 155,946
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Seat and table, folding, W. Tetley..... 155,901
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Sewing machine attachment, J. W. Robards..... 155,976
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Sewing machine quilters, W. B. Null.....155,885, 155,886
Sewing machine take-up, J. V. D. Eldredge (r).. 6,087
Sewing machine trimmer, W. H. Springer (r)..... 6,089
Shaft coupling, J. F. Light..... 155,837
Shank-cutting machine, I. Frechette..... 155,937
Shingle block sapper, etc., Bassett & Nichols.... 155,850
Shingle machine, F. A. Huntington (r)..... 6,082
Shoe, S. A. West..... 155,909
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Shutter fastener, D. F. Hutchinson, Jr..... 155,801
Sifter, coal and ash, H. A. Luscomb..... 155,959
Sole-nailing machine, McKay & Fairfield..... 155,962
Spindle step, W. Mason..... 155,878
Spinning mule, self-acting, McCreery & Crighton 155,804
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Steering apparatus, J. L. Cathcart..... 155,926
Stocking supporter clasp, R. Eberle..... 155,863
Stone, slag for artificial, W. H. Smith..... 155,990
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Toy paper cracker, V. Platz..... 155,970
Tray, hog, P. Weil..... 155,908
Truss, J. L. Rowe..... 155,891
Tubing coupling, E. W. Wolfe..... 155,006
Valve for steam, water, etc., Peet & Poland..... 155,811
Valve, safety, E. H. Ashcroft..... 155,821
Vegetables, etc., preserving, Holgate & Tupper 155,949
Vehicle wheel, H. Bender..... 155,918
Wagon body, F. Clemens..... 155,861
Wagon standard and bolster, J. Skeen..... 155,987
Wash tub stool, V. Royle..... 155,978
Washing machine, J. B. Farrar..... 155,935
Washing machine, W. Hilton..... 155,869
Washing machine, D. Kunkel..... 155,873
Water closet, W. Stockton..... 155,914
Waterproofing composition, T. Butler..... 155,856
Weather strip, C. A. Judd..... 155,967
Womb supporter, J. Maas..... 155,839
Wood for pavements, etc., treating, A. Brisbane 155,788
Wool, destroying vegetable matters in, F. R. Joly 155,802

APPLICATIONS FOR EXTENSION.

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

31,102.—CAR SPRING.—T. F. Allyn. Dec. 30.
31,128.—HOISTING APPARATUS.—E. G. Otis. Dec. 30.
31,152.—EVAPORATOR.—G. F. J. Colburn. Jan. 6.
31,168.—GAS REGULATOR.—C. L. Herring. Jan. 6.
31,204.—FARE BOX.—W. B. Bartram. Jan. 6, 1874.
31,211.—SEWING MACHINE.—L. W. Langdon. Jan. 6.

EXTENSIONS GRANTED.

30,381.—DAMP.—J. E. Ambrose.
30,400.—SOCKET COUPLING.—E. P. Gleason.
30,415.—GAS REGULATOR.—J. G. Leffingwell.
30,442.—FILING GIN SAWS.—S. Yeatman.
30,446.—MAGAZINE FIRE ARM.—B. T. Henry.

DISCLAIMER.

30,400.—SOCKET COUPLING.—E. P. Gleason.

DESIGNS PATENTED.

7,791.—WAIST BELT.—G. G. Bates, New York city.
7,792.—TABLE CUTLERY.—C. W. Hill, Derby, Conn.
7,793.—STAIR PLATES.—W. T. Mersereau, Orange, N. J.
7,794 & 7,795.—C. T. Meyer *et al.*, Bergen, N. J.
7,796.—CARPET.—C. A. Righter, Philadelphia, Pa.
7,797 & 7,798.—SCREW HEADS.—W. M. Smith, W. Meriden, Ct.
7,799 to 7,802.—HITCHING POST.—J. Davies, Muskegon, Mich.
7,803.—STOVE DOOR.—I. A. Sheppard, Philadelphia, Pa.

TRADE MARKS REGISTERED.

2,016.—LICORICE PASTE.—D. V. Arguimban, Br'klyn, N. Y.
2,017.—CIGARS.—J. S. Bailey, Providence, R. I.
2,018.—WAX LEAVES, ETC.—A. De E. Bloodgood, N. Y. city.
2,019.—CARRIAGES.—J. B. Brewster & Co., N. Y. city.
2,020.—SOAP.—Colgate & Co., New York city.
2,021.—WRITING INKS.—C. L. Lochman, Carlisle, Pa.
2,022.—COUGH MEDICINE.—C. A. Pelton, Middletown, Ct.
2,023.—FERTILIZERS.—Piedmont Guano Co., B'more, Md.
2,024.—SHOVELS, ETC.—B. Rowland & Co., Phila, Pa.
2,025.—HOSIERY.—J. A. Guivet, Paris, France.
2,026.—HAIR RESTOR.—Tilton *et al*, San Francisco, Cal.
2,027.—RUBBER COMPOUNDS.—Whalebone Rubber Co., New York city.

SCHEDULE OF PATENT FEES.

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On application for Design (14 years).....$30

CANADIAN PATENTS.

LIST OF PATENTS GRANTED IN CANADA,

OCTOBER 8 to 16, 1874.

3,925.—O. A. Howland, Toronto, York county, Ont. Mode of carriage on allied land and water routes in substitution for lockage and canals, called "Howland's Improved Mode of Carriage on Allied Land and Water Routes." Oct. 8, 1874.

3,926.—J. L. Joyce, New Haven, New Haven county, Conn., U. S. Improvements on boots and shoes, called "Joyce's Protection Toe." Oct. 9, 1874.

3,927.—A. S. Babbit, Keeseville, Essex county, N. Y., U. S., and H. L. Isham, Plattsburgh, N. Y., U. S. Improvements on washing machines, called "Babbit's Belt Washing Machine." Oct. 9, 1874.

3,928.—J. Sears, Chicago, Cook county, Ill., U. S. Improvements on soldering apparatus, called "Sears' Patent Aero-Gas Soldering Copper." Oct. 9, 1874.

3,929.—J. E. Billings, Boston, Suffolk county, Mass., U. S. Improvements on bricks, called "Billings' Universal Angle Brick." Oct. 9, 1874.

3,930.—E. Weston, Buffalo, Erie county, N. Y., U. S. Improvements on steam boilers, called "The Weston Boiler." Oct. 9, 1874.

3,931.—G. M. Robinson, St. Armand, P., Q., assignee of J. and G. Bacon, Medina, Wis. Improvement in weather strips, called "Bacon's Weather Strip." Oct. 13, 1874.

3,932.—D. Francis, Birkenhead, Chester county, England, Improved arrangements or apparatus convertible into a desk, seat, and table, called "Francis' Convertible Desk." Oct. 13, 1874.

3,933.—G. Angst, Zurich, canton of Zurich, Switzerland. Improvements on knitting machine, called "Improvements in Knitting Machines." Oct. 13, 1874.

3,934.—E. Wasell, London, Ont. Improvements in bridge building, called "Improved Trussed Girder Bridge." Oct. 13 1874.

3,935.—L. D. Hurd and F. G. Butler, Bellows Falls, Rockingham, Windham county, Vt. Improved clothes pin or clamp, called "The Climax Clothes Pin." Oct. 13, 1874.

3,936.—J. W. Gamewell, Hackensack, N. J., U. S., M. G. Crane, Newton, Mass., U. S., and E. Rodgers, Boston, Mass., U. S. Improvements in electro-telegraphic non-interference repeaters, called "Electro-Telegraphic Non Interference Repeater." Oct. 13, 1874.

3,937.—Wm. Cahill, Syracuse, Onondaga county, N. Y., U. S. Improvements in combined reversible kneeling and foot bench, called "Cahill's Combined Reversible Kneeling and Foot Bench." Oct. 13, 1874.

3,938.—M. Attenborough, Sherbrooke, P. Q. Improvements on a machine for ventilating rooms, called "Attenborough's Balance Ventilating Sashes." Oct. 13, 1874.

3,939.—W. T. Bunnell and A. G. Ronan, Ottawa, Ont. Improvements on clothes wringer, called "Bunnell & Ronan's Clothes Wringer." Oct. 13, 1874.

3,940.—W. A. Whiting, New York city, U. S. Improvements on machine for binding and wiring hat frames, called "Whiting's Machine for Binding and Wiring Hat Frames." Oct. 13, 1874.

3,941.—J. Abell, Woodbridge, York county, Ont. Improvements in threshing machines, called "Abell's Improved Revolving Grate." Oct. 13, 1874.

3,942.—H. C. Kerstine, Cleveland, Cuyahoga county, O., U. S. Improvements in grate bars, called "Kerstine's Grate Bars." Oct. 13, 1870.

3,943.—D. W. Baird, Geneva, Ontario county, N. Y., U. S. Improvement on concealed jointed braces or stays for carriage tops, called "Baird's Concealed Jointed Top Brace." Oct. 13, 1874.

3,944.—G. W. Vosburgh, Eau Claire, Eau Claire county, Wis., U. S. Improvements on harness pads, called "The Eau Claire Collar Pad." Oct. 13, 1874.

3,945.—H. Gnosill, Hamilton, Ont. Improvement in beer faucets, called "Gnosill's Improved Beer Faucet." Oct. 13, 1874.

3,946.—W. H. Cowell, Buffalo, Erie county, N. Y., U. S. Improvements on games to be played with picture cards, called "The Puppet Show of Punch and Judy set to Cards." Oct. 16, 1874.

3,947.—E. Cliff and R. Vase, New York city, U. S. Improvements in elliptic spring, called "Cliff's Elliptic Spring." Oct. 16, 1874.

3,948.—J. Eaton, Mill Island, Sidney Township, Ont. Improvements on rail fences, called "Eaton's Suspended Rail Fence." Oct. 16, 1874.

3,949.—Jacob Shupe, Berlin, Waterloo county, Ont. Improvements on knives for straw-cutting machines, called "The Sickle Edge-Cutting Knife." Oct. 16, 1874.

3,950.—S. K. Ellis, Waltham, Middlesex county, Mass., U. S. Improvements on skirt supporters, called "Ellis' Nonpareil Skirt Supporter." Oct. 16, 1874.

3,951.—A. D. Cable, Montreal, P. Q. Improvements on lifting jacks, called "A. D. Cable's Improved Jack." Oct. 16, 1874.

3,952.—E. Dering, Lockleys, near Welwyn, Herts county, England. Improvements on the manufacture of rails for rail tramways, etc., and on rail joints for the same, called "Dering's Improved Rails and Rail Joints." Oct. 16, 1874.

3,953.—D. B. Herrington, Detroit, Wayne county, Mich. Improvements on motor and brakes for sewing machines and other mechanism, called "Herrington's Excelsior Motor and Brake." Oct. 16, 1874.

3,954.—E. A. and C. W. Jones, Centerville, St. Joseph county, Mich., U. S. Improvements on fruit dryers, called "E. A. & C. W. Jones' Fruit Dryer." Oct. 16, 1874.

3,955.—J. H. Baner, Scranton, Luzerne county, Pa., and B. G. Morgan, Hyde Park, Luzerne county, Pa., U. S. Improvements on process for treating sounding boards, called "Baner's Process for Treating Sounding Boards." Oct. 16, 1874.

3,956.—E. and C. Gurney, Hamilton, Ont., assignee of G. R. Prowse, Montreal, P. Q. Improvement in cooking ranges, called "Gurney's Improved Cooking Range." Oct. 16, 1874.

3,957.—A. Chambers, Marylebone Road, Parish of St. Marylebone, Middlesex county, England. Improvements on railway signaling and apparatus therefor, called "Chamber's Improved Railway Signal Apparatus." Oct. 16, 1874.

3,958.—R. McIntosh, Montreal, P. Q. Combined refrigerator and show case, called "McIntosh's Preserving Show Case." Oct. 16, 1874.

3,959.—C. A. Hussey, New York city, N. Y. Improvements on journal bearings, called "Hussey's Journal Bearing." Oct. 16, 1874.

3,960.—C. A. Hussey, New York city, U. S. Improvements on self-supplying mucilage brushes, called "Hussey's Self-Supplying Mucilage Brush." Oct. 16, 1874.

3,961.—C. Schulenburg, Detroit, Wayne county, Mich., U. S. Improvements on billiard tables, called "The Wolverine Billiard Table." Oct. 16, 1874.

3,962.—A. Cameron, Colborne Village, Northumberland county, Ont. Improvements on horse rakes, called "Cameron's Horse Rake." Oct. 16, 1874.

3,963.—A. S. Brooks, Ovid, Clinton county, Mich., U. S. Improvements on halters, called "Brooks' Eureka Halter." Oct. 16, 1874.

3,964.—G. W. Lloyd, Detroit, Wayne county, Mich., U. S. Process for hardening bricks, called "Lloyd's Process for Hardening Bricks." Oct. 16, 1874.

3,965.—G. Stackpole, Elizabeth, Union county, N. J., U. S. Improvements in steam flash engines, etc., called "Stackpole's Steam Flash Engine." Oct. 16, 1874.

3,966.—R. H. Fenwick, Boston, Suffolk county, Mass., U. S. Improvements on skirt boards, etc., called "Fenwick's Folding Household Articles." Oct. 16, 1874.

3,967.—H. Beaumont, Toronto, Ont. Car coupling, called "Canada Car Coupling." Oct. 16, 1874.

3,968.—R. W. McGee, East Oxford Township, Oxford county, Ont. Improvements on machines for making bricks, called "The Dominion Brick Machine." Oct. 16, 1874.

3,969.—E. H. Ashcroft, Lynn City, Mass., U. S. Improvement in safety valves, called "The Ashcroft Safety Valve." Oct. 16, 1874.

3,970.—T. Jones, Harewood House, near Tavistock, England. Improvements on the art or process of preventing dry rot and decay in timber for building and other purposes, and for rendering the same uninflammable, called "Dr. Jones' Process for Preventing Dry Rot and Decay in Timber, and for Rendering the Same Uninflammable." Oct. 16, 1874.

3,971.—J. T. Hennaman, Baltimore City, and D. O. Salmon, Syracuse, Onondaga county, N. Y., U. S. Improvements on cigar machines, called "Hennaman's Cigar Machine." Oct. 16, 1874.

3,972.—N. Lemirze, Montreal, P. Q. Improvements on a mortising boring and drilling machine, called "Lemirze's Combined Mortising, Boring, and Drilling Machine." Oct. 16, 1874.

3,973.—J. I. Thorneycroft, Church Wharf, Chiswick Parish, Middlesex county, England. Improvements on screw propellers, called "Thornycroft's Propeller." Oct. 16, 1874.

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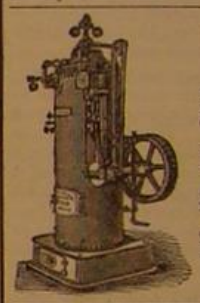
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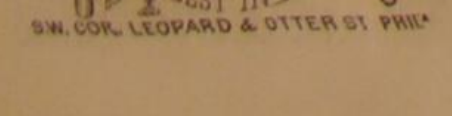
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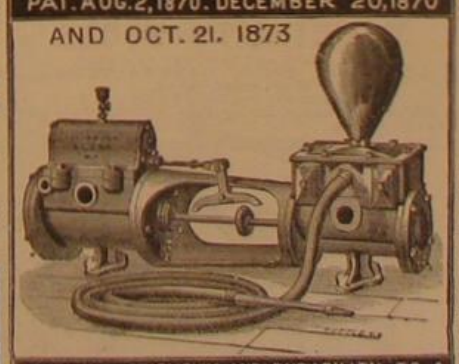


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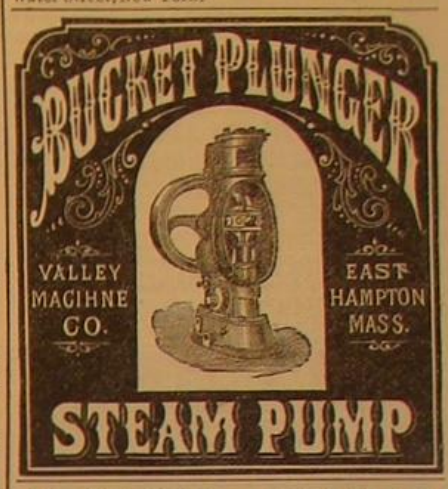
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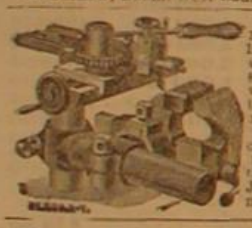
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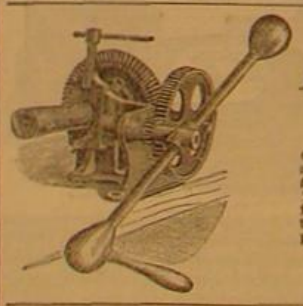


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