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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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(Illustrated articles are marked with an asterisk.)

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 × 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 × 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 1,178·6° + [0·305(320° − 212°)] = 1,211·5 units of heat. Each pound of steam, therefore, communicated to the water which condensed it, in this example, 1,211·5 − 115 = 1,096·5 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) × 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, $X = \frac{\frac{10600}{205} - 10}{\frac{1096.5}{205} - 1} = 9.59$ pounds of steam, and 10 − 9·59 = 0·41 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 1,211·5 − 200 = 1,011·5 thermal units, while each pound of water takes up but 320 − 200 = 120 units of heat.

95,900 × 1,211·5 =	116,182,850
4,100 × 120 =	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, $\frac{11667.5}{966.6}$ = 12·07 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 $X = \frac{\frac{9600}{180} - 10}{\frac{1146.6}{180} - 1}$ = 8·07 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.

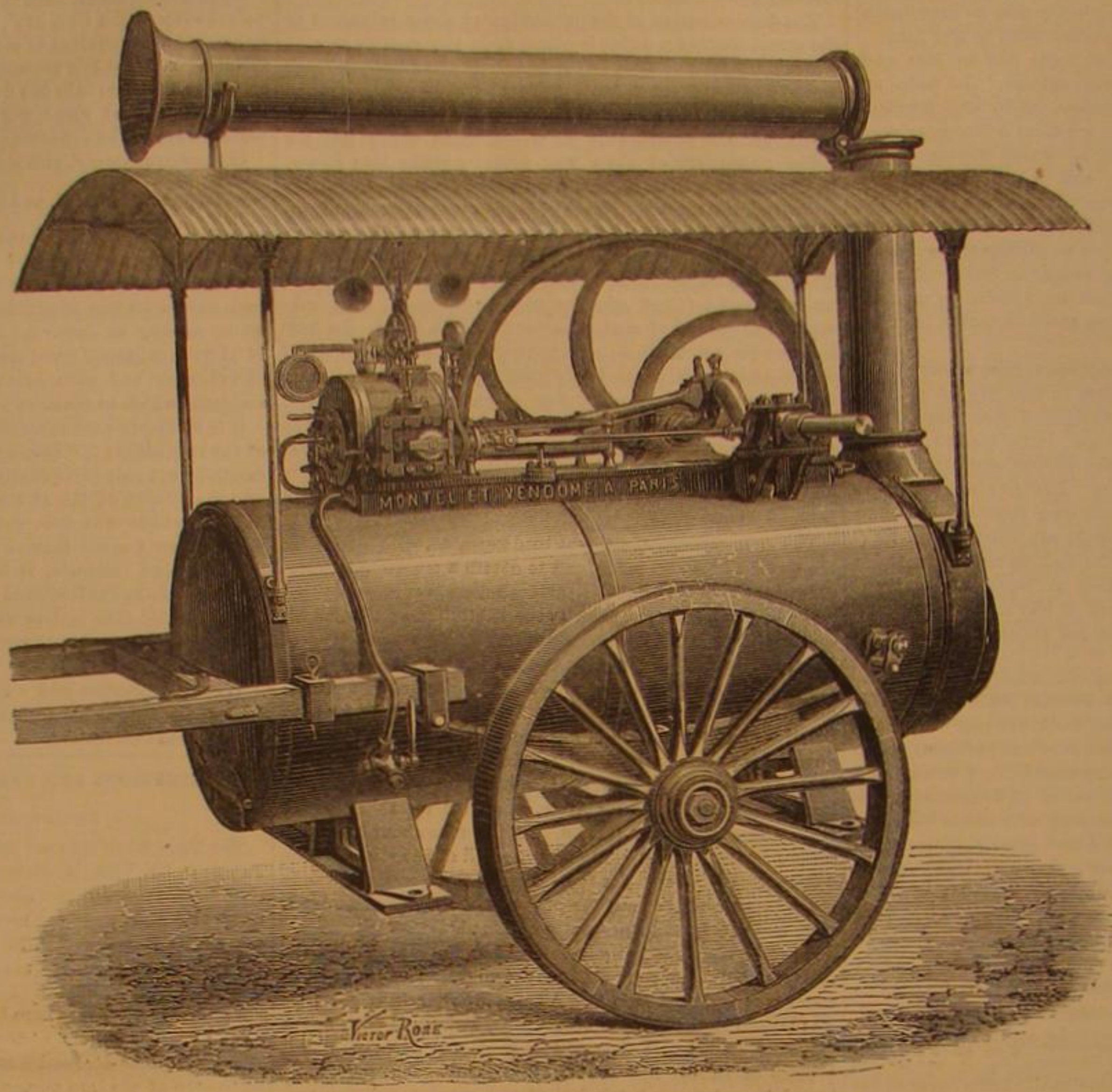
NEW PORTABLE ENGINE.

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.

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.



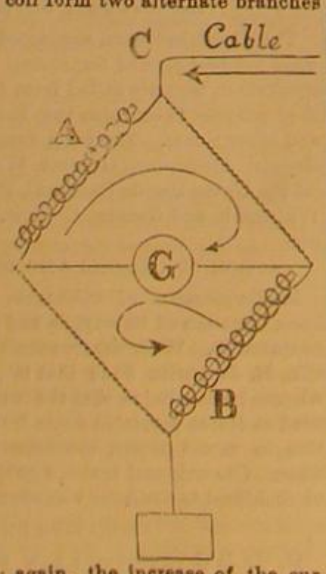
MONTEL AND VENDOME'S PORTABLE ENGINE.

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*:

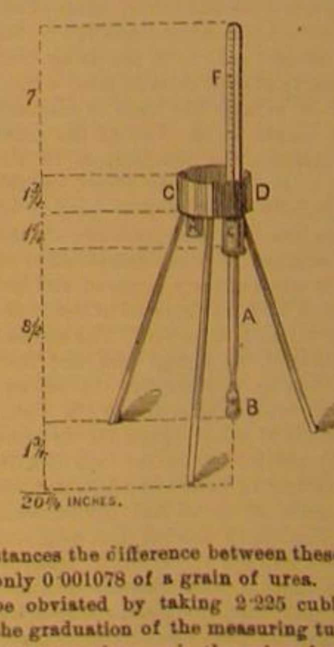
We find it most advantageous to use a solution of hypobromite, prepared by dissolving 3·5 ounces of common solid caustic soda in 15 cubic inches of water, and adding 1·5 cubic inches of bromine. This mixture gives a rapid and complete decomposition of the urea.

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.

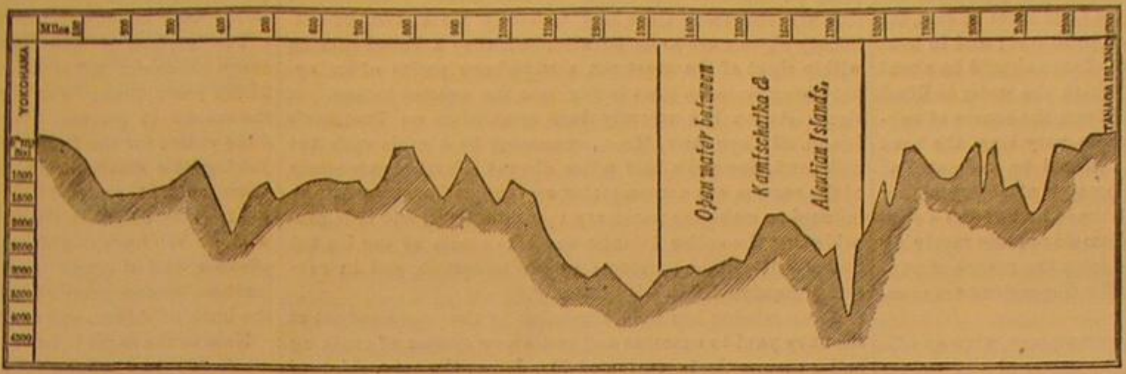


Three tenths of a cubic inch of a 2 per cent standard solution of urea gave, without correction: 2·25, 2·22, 2·22, 2·23, 2·215, 2·25, 2·22, 2·215, 2·22, 2·226, 2·215, 2·225, 2·225, 2·22, showing a mean of 2·225 cubic inches.

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 correspondent 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 position 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 Oonalaska. 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 2,050 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,

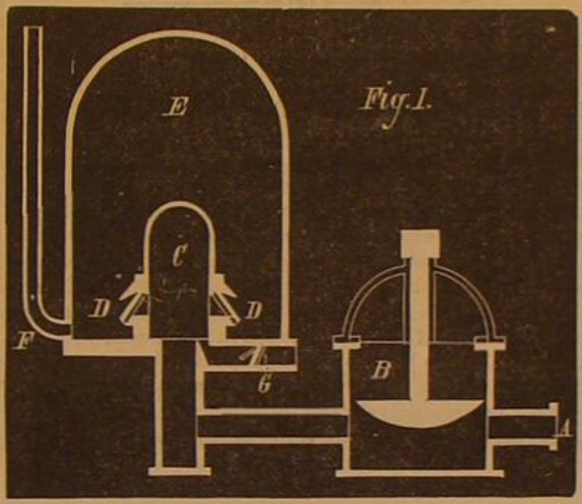
with its basaltic columns, which is scientifically interesting. But, taking everything into consideration, should this place be selected as an intermediate station, the operator whose headquarters it will be is not likely to regard it as a paradise. Although the practicability of the northern route is 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.

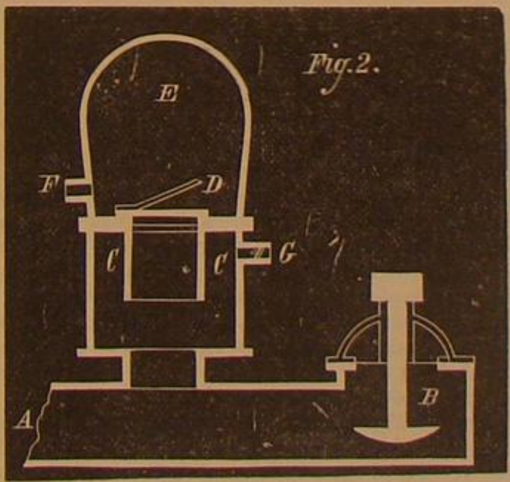
We arrived at Ounalaska on July 29; everything most satisfactory to date, as far as the accomplishment of our work is concerned. A line will next be run back to Tanaga island outside, or to the southward of the islands; then from here to where we left off last fall, and then to San Francisco, where the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

THE HYDRAULIC RAM.

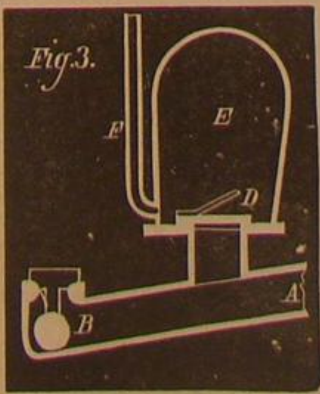
Many of our readers, on shutting the cock in a water pipe where there was considerable pressure, must have observed that the sudden arrest of the motion of the water caused a shock, sometimes producing sound and jarring the pipe.



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

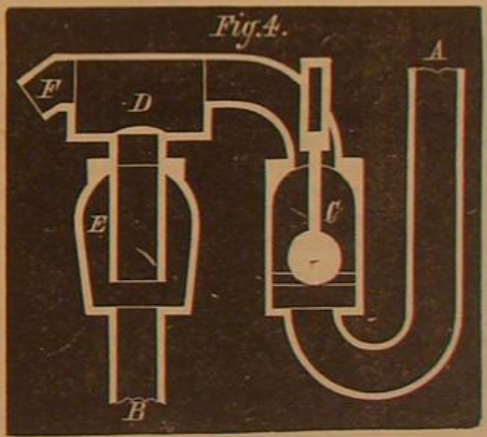


blow may not be suddenly arrested. Whitehurst, an Englishman, contrived a machine, in 1772, for raising water by utilizing its momentum when the discharge was suddenly



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 considerable 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 $\frac{1}{15}$ 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 1,250 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 71½ 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 Sczaroch.

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.

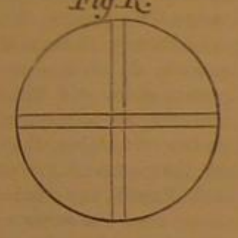
LATHE WORK.

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.

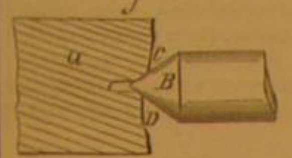
Such clearance is best accomplished by drilling a small hole in the central part of the work centers; it may, however, be done by using a center punch of a more acute taper than is the lathe center, or by cutting out the centers by means of a square center, as will be hereafter described. The drilling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

Fig. 41.



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.

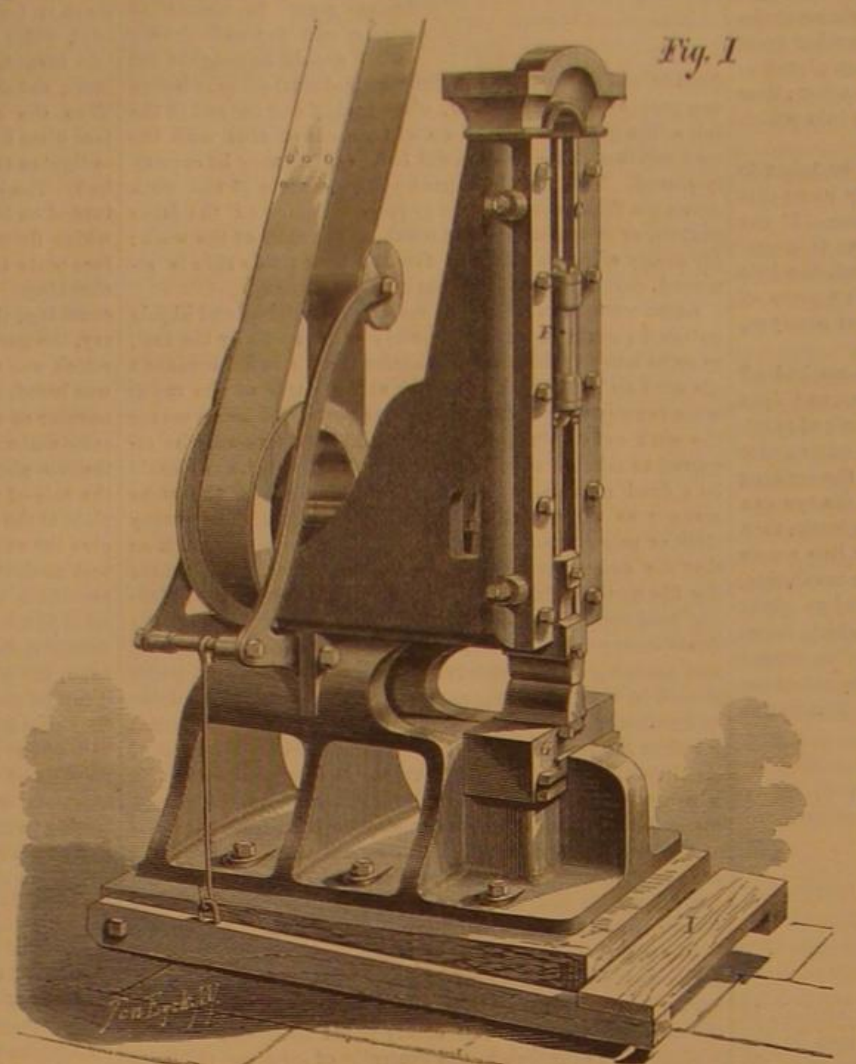
The annexed engravings represent the spring forge hammer of Mr. Hotchkiss, in which air is used as the elastic medium, and the principle of which has already been applied, during the past fifteen years, to a wide range of purposes; and it is capable of still further extension. Such hammers can be made 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.

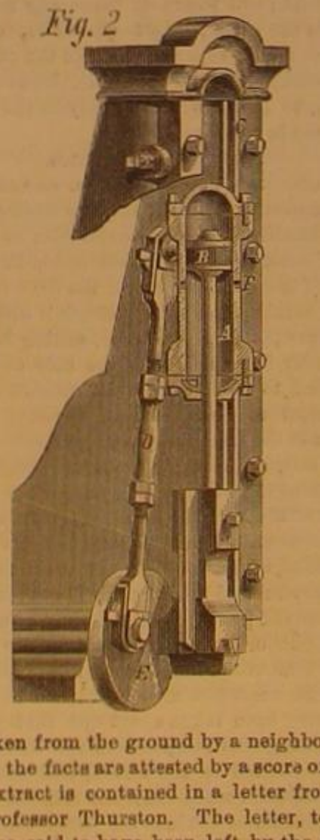
For further particulars, address Messrs. D. Frisbie & Co., manufacturers of the machine, 26 and 28 Grand street, New Haven, Conn.

Fig. 1



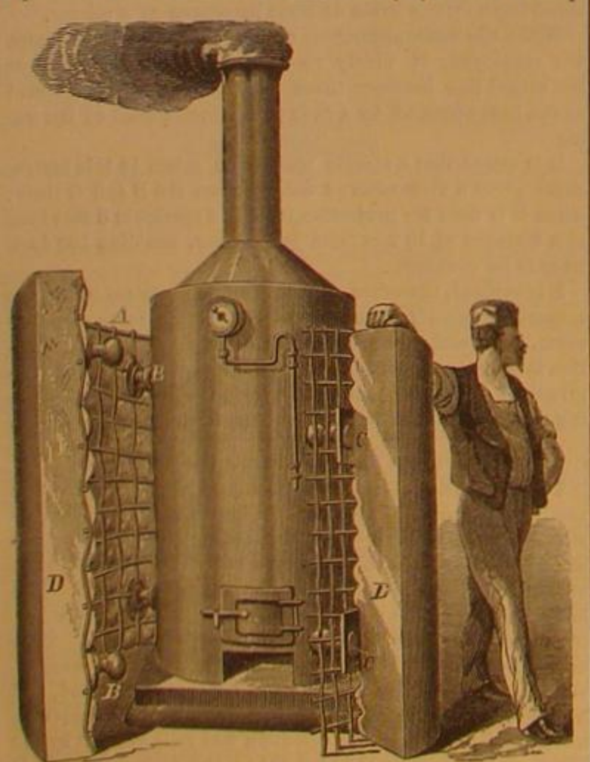
HOTCHKISS' AIR SPRING HAMMER.

Fig. 2



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 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.

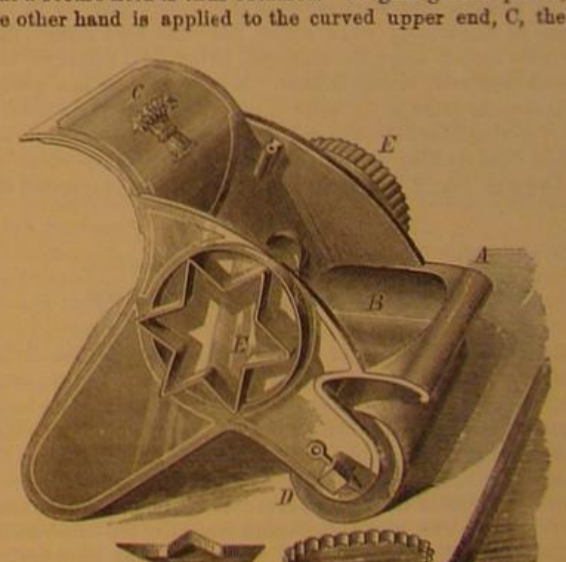
The Friedrich der Grosse, which has just been launched is the seventh iron-cased frigate of the German navy, and the eighth being expected to leave the stocks early next summer, the autumn of 1875, or, at the very latest, the spring of 1876, will see a rather formidable squadron assembled off the Oldenburg 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 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 tablelike 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 VICTORIA REGIA WATER LILY.

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.

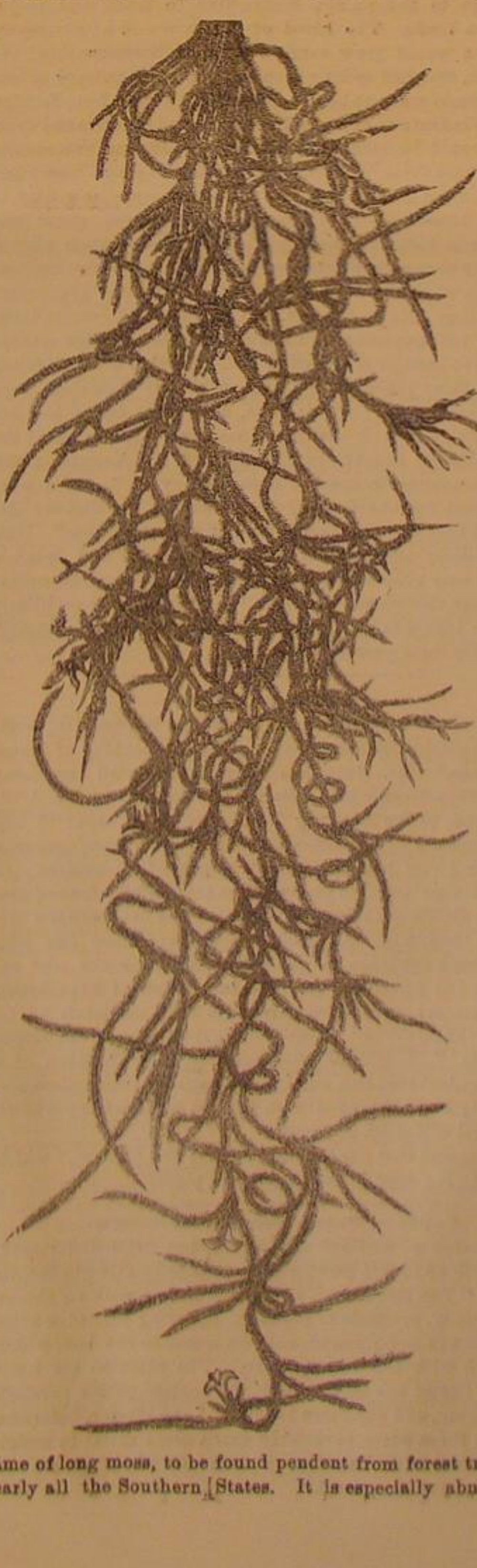
Importance of Salts in Food.

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 8 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 dissyllable 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 electric 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 hook-shaped cutting blade slides 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 small 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.

Business and Personal.

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 78° and 258°, 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 distillate 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 30 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, 3 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 beat 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 ¾ 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 ¾ 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 eye-lens, 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 8 ozs. of water. Dissolve 800 grains nitrate of silver in 4 ozs. of water. Add silver solution to an ounce strong ammonia until brown oxide 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 non-productive? 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 eye lens 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? Well'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: $2\times 0=1\times 0$; 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 divisor $=0$. 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 $x+y=y$, 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.]

Index of Inventions

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September 22, 1874,

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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:

31,082.—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. Vanderslice *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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On application for Design (14 years)	$30

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 "Gamoini'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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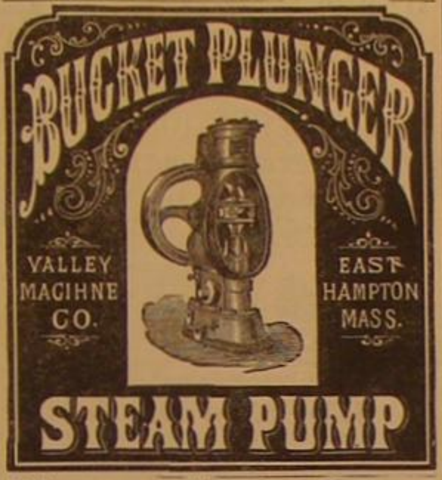

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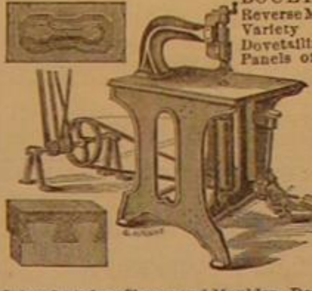

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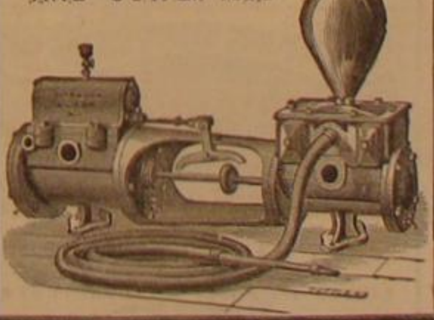

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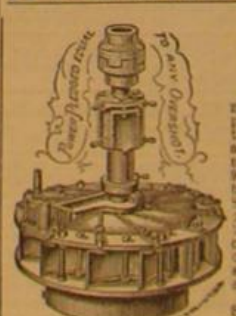

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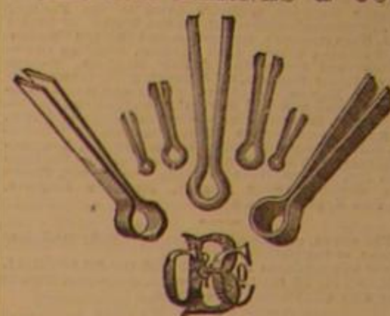

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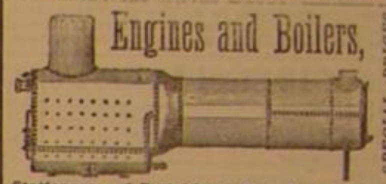

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