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THE BUCKEYE AUTOMATIC ENGINE.

The accompanying engravings represent an improved automatic cut-off engine, built by the Buckeye Engine Company, Salem, Columbiana county, Ohio. The manufacturers claim for this machine that it satisfies the conditions necessary for the highest attainable economy in the use of steam, and, at the same time, that it is so simple in construction as to be but a trifle more expensive than an equally well designed throttling engine.

The slide valve, shown in section in Fig. 3, is in one sense a small moving steam chest; the live steam enters its interior through circular openings in its back or cover, and thence passes into the cylinder, whose ports near its ends are alternately brought to coincide with the cylinder ports.

The exhaust takes place at the ends of the valve into the ends of the chest, thence through ample passages into the exhaust pipe. The tortuous exhaust passage, avolved in the use of the common slide valve, is thus avoided. As a result, the indicator cards show a remarkable freedom from back pressure, even at high piston speed, as will be seen from the diagram, Fig. 4. The data forwarded to us in connection with this card are Cylinder 12x20, speed 160 revolutions; scale of indicator 48 lbs. per inch; steam pressure, per gage, 80 lbs.; clearance 2½ per cent; atmosphere 14 lbs.; mean calculated effective pressure, 30¼ lbs.; horse power, 55·23; and water per horse power per hour, 18·52. The reader, from this can make his own deductions as to the operation of the valves

The absence of exhaust passages in the cylinder and valve gives the additional advantage that the face of the valves may be as close to the bore of the cylinder as is consistent with proper strength of material, thus considerably reducing the clearance or waste room.

To the openings in the back of the valve are fitted steam metal self-packing rings, which serve the purpose of insuring a steamtight connection between the interior of the valve and the live steam chamber in the back of the chest. The area of these openings is made just sufficient to hold the valve to its seat, hence it is as nearly balanced as is practicable or desirable. As the valve chest contains only exhaust steam, the engines may be run with the chest lid removed, and any leakage readily detected. The cut-off valve works inside of the main valve, and alternately closes the ports leading to the cylinder. The fixed eccentric operates the main valve, and an adjustable one operates the cut-off valve through the medium of gearing. A small rock shaft, which forms a part of the latter, works in a bearing in the rock arm belonging to the main valve gear and moving with it. The movement of the cut-off valve, relatively to its seat in the main valve, is thus, both as to time and extent, just what its eccentric would produce if the valve worked in a stationary seat, and was attached directly to said eccentric. This arrangement will be clearly seen in Fig. 2, and the general aspect of the engine is shown in the front view, Fig. 1. The eccentric rod of the main valve gear works horizontally, while the cut-off eccentric rod inclines downward, so that its attachment to its rocker arm may be on a level, or nearly so, with the center line of the main rock shaft.

The stem of the cut-off valve passes through the hollow stem of the main valve, and is connected to an upright arm on the cut-off rock shaft, on the end opposite to that to which the eccentric rod is attached. The automatic adjustment of the cut-off eccentric is effected by means of its connection with two weighted levers contained in a circular case on the engine shaft. The outward movements of these levers advance the eccentric forward on the shaft, and two well tempered cast steel wire coil springs furnish the centripetal force which returns them when the speed slackens. It is claimed that the effect of this arrangement is to place the sensitiveness of the governor so far under the control of the engineer that he may, by varying the tension of the springs, adapt it to the most widely varying characters of resistance. For instance, in flouring mills, factories, etc., which are not subjected to any very sudden variations of load, so great a uniformity of speed can be obtained that the variation due to ordinary changes of load and pressure of steam almost defies detection.

Saw mills, rolling mills, etc., which are subjected to very sudden and extreme changes of resistance, will require a slightly different tension to give the most satisfactory results.

We are also informed that the friction of the cut-off valve and gear neutralizes the effect of friction of the joints in the governor, and the result is as high a degree of sensitiveness to minute changes, of load and steam pressure, as though all parts were absolutely frictionless.

All the wearing parts are made of the best material; the wrist pins, rock shaft, etc., are of cast steel. and the connect'ng rod boxes are of the best machine brass and Babbitt's metal. The wearing surfaces and dimensions of shaft, wrist, etc., are proportionally equal to those of the most approved c'a's of engines.

The same manufacturers also build thro'tling engines of like design and finish, and various other styles, adapted for rapid speed and special work. Address, for further information, the Buckeye Engine Company, as above

Fig. 1

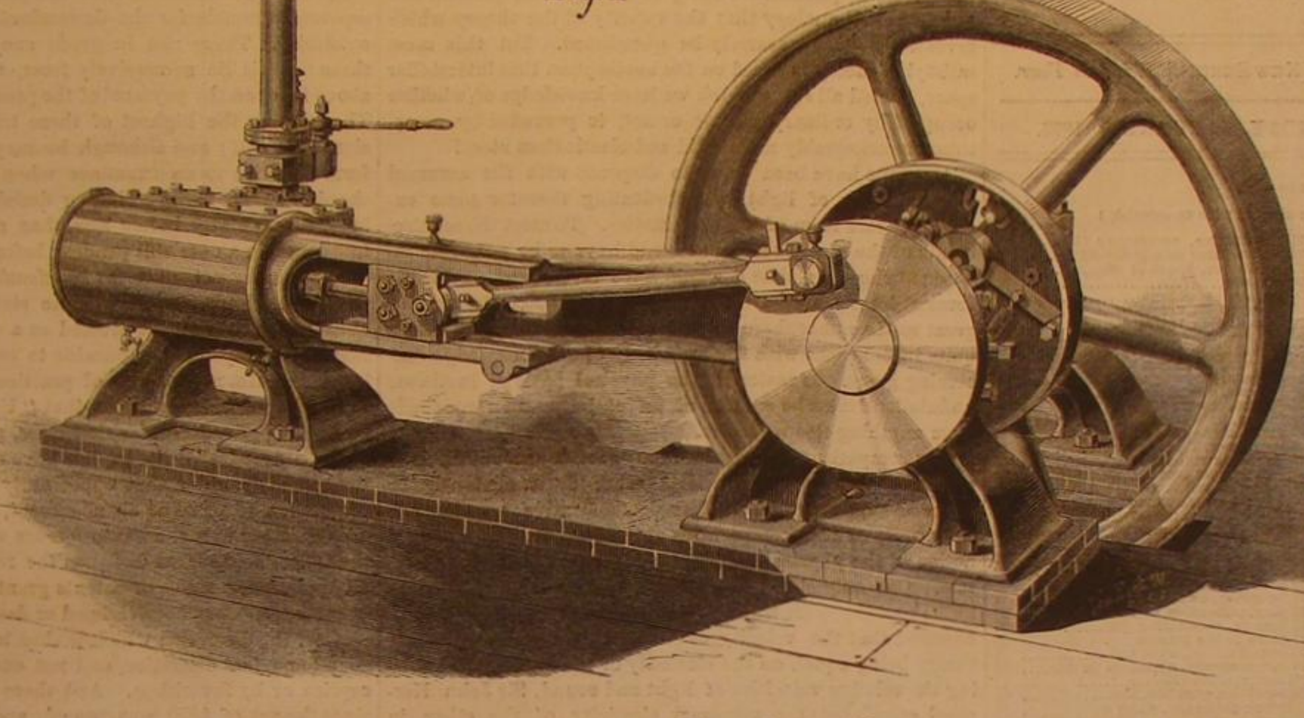
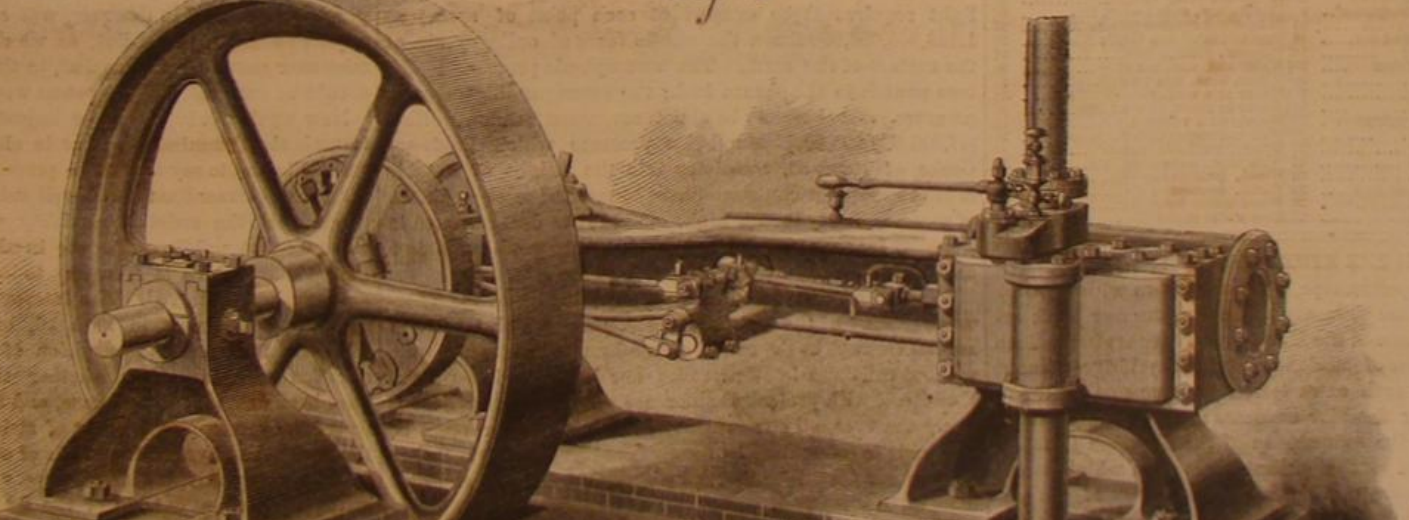


Fig. 2



THE BUCKEYE ENGINE COMPANY'S AUTOMATIC ENGINE.

Fig. 3

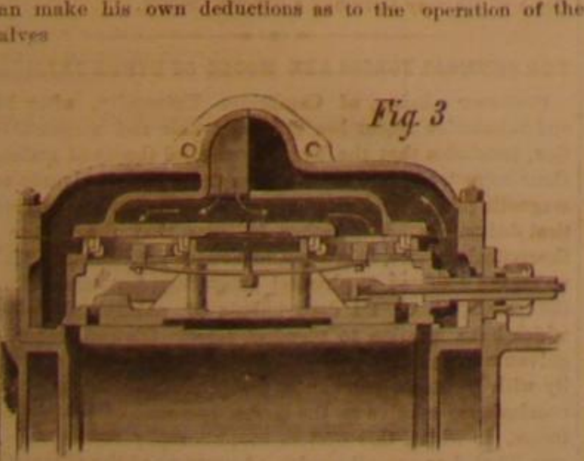
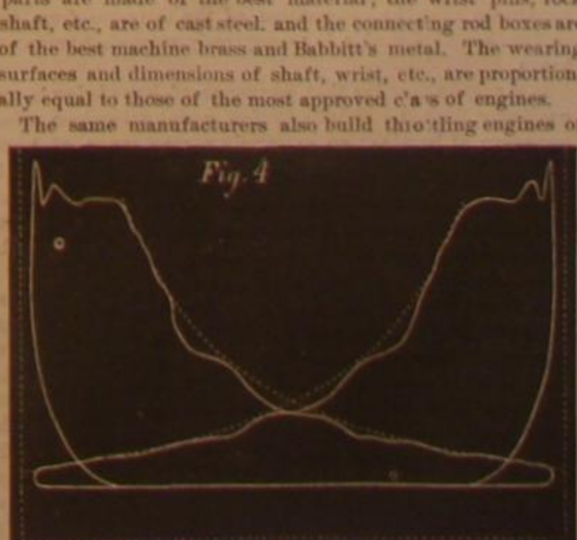


Fig. 4



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NEW YORK, SATURDAY, JANUARY 9, 1875.

Contents.

(Illustrated articles are marked with an asterisk.)

IS THE ETHER MATTER?

Thanks to the spectroscope, it is now known with reasonable certainty that the elements which compose our earth exist also in other parts of the Universe. There are indications also of the existence of substances unlike anything we know; but the fact, that such extra terrestrial elements appear to act on light as our familiar elements do, has given rise to the inference that the composition of the Universe is fairly represented in kind by that of the cosmic atom which we inhabit, in other words, that the substantial unity of the material Universe is practically demonstrated. Limiting the term "material Universe" to the system of things which our senses make known to us, the inference may not be far out of the way; but there are reasons why the term should not be so limited. It would be absurd to suppose our feeble senses able to detect all the powers and properties of elements such as we know in part: it would be still more absurd to assume that our knowledge of the possible range of matter, even in the earth, is anything like exhaustive. To pronounce upon the composition of the Universe from our meager knowledge of it is consequently somewhat presumptuous.

It is easy to perceive that our range of knowledge is exceedingly limited. Relatively few aerial vibrations affect our sense of hearing; an extremely narrow range of luminous undulations are visible to us: and equally limited is our capacity to measure temperature, density, or any other accident of matter. The earth might easily contain numberless kinds and grades of matter so rare or so dense as to be entirely beyond our power of recognition.

For illustration, hydrogen passes through cast iron as water does through loose sand. The resistance which a cast iron ball would meet in its flight through an atmosphere of hydrogen would, on the other hand, be scarcely appreciable. The difference in density between cast iron and hydrogen, though very great, is far from infinite: were it infinite, the resistance which either would offer to the passage of the other would be infinitely slight: to us, *nil*. So with every other sort of matter in a medium infinitely more dense or infinitely more rare than itself. It is possible, therefore, to conceive, as Dr. Young suggests, of series of worlds of different orders, pervading each other, mutually unknown and unknowable, in the same space.

There is in this line of thought something more than purposeless speculation; and if there were not, one could hardly escape it in contemplating the theory of light now generally accepted by the scientific world, a theory involving conditions so astounding that nothing short of a new order of matter seems adequate to meet its requirements. Practically there could not be an hypothesis which would answer the requirements of a perfect hypothesis more completely than that which attributes the phenomena of light to undulations of a highly elastic medium pervading all space. It affords a reasonable explanation of every phenomenon in optics. More than that, it enables the investigator to anticipate effects which no eye has seen. As Fresnel observes: "There are certain laws so complicated and so singular that observation alone, aided by analogy, could never lead to their discovery. To divine these enigmas, we must be guided by theoretical ideas founded on a *true* hypothesis. The theory of luminous vibrations presents this character and these precious advantages; for to it we owe the discovery of optical laws, the most complicated and the most difficult to divine."

It would exceed the limits set for this article even to enumerate the wonderful discoveries made by the theory of undulations, and afterwards verified by experiment, some of the predicted phenomena being so strange, exceptional, and opposed to all analogy that the validity of the theory which revealed them can scarcely be questioned. Yet this most satisfying theory is based on the assumption that interstellar space, indeed all space which we have knowledge of, whether occupied by ordinary matter or not, is pervaded by something inconceivably more solid and elastic than steel!

Attempts have been made to dispense with the assumed ethereal basis of light by substituting therefor some excessively rare form of ordinary matter. To meet the requirements of the case, such a gas would have to be very rare indeed; at the same time it would have to possess an elastic force at least a million million (1,000,000,000,000) times as great as the atmosphere at the earth's surface, conditions quite inconsistent with the main body of our knowledge concerning gases. If material, the physical basis of luminous undulations must be matter of an entirely different grade from anything else we know.

Any comparison between ordinary matter and anything so unlike it as the hypothetical ether must obviously be taken as suggestive rather than demonstrative; nevertheless the results of such comparisons give us perhaps as correct a notion of the physical basis of light as we are able to entertain. Our only clue to its possible qualities lies in the extreme rapidity with which light rays traverse it. It is understood that the velocity of wave motion depends, other things being equal, on the elasticity of the medium. Knowing the relative velocities of light and sound, Sir John Herschel calculated the necessary elasticity of the ether (in other words, the amount of force which the wave theory of light requires to be exerted at each point of space) as 1,148,000,000,000 times the elastic force of ordinary air at the surface of the earth. The atmospheric pressure is fifteen pounds to the square inch; the corresponding ethereal pressure must therefore be about seventeen million million (17,000,000,000,000) pounds, a pressure which Professor Cooke, of Harvard, translates into the weight of a cubic mile of granite. The atmosphere counterbalances a column of mercury thirty inches high. Could it be demonstrated in a similar manner, the pressure of the ether would sustain a column of mercury six times as high as the sun!

These numbers give but an approximate idea of the enormous solidity of the adamantine something which the earth sweeps through at the rate of eleven hundred miles a minute without resistance! It pervades our bodies and we move about in it with perfect indifference. As Professor Jevons justly observes, all our ordinary notions of matter must be laid aside in contemplating conclusions like these; yet "they are no more than the observed phenomena of light and heat force us to accept."

Regarded in the light of ordinary matter, the ether is impossible and incredible; as extraordinary matter, or, as we have imagined, matter of a higher grade, it is consistent and reasonable. If we admit one such higher or lower grade of matter, the door is opened for the possible existence of an infinite series of them.

The contemplation of such possibilities may at least teach us not to be hasty in limiting the scope of the Universe to elements such as we know.

THE WOODBURY PATENT.

The great interest involved in this patent, and the corresponding efforts which have been put forth, both to sustain and to defeat it, have induced inquiry on our part, some of the results of which we shall now lay before our readers. We do not propose to discuss the validity of the patent, but only to refer to some of the extraordinary circumstances connected with its history.

The application—which was for an improvement in planing machines—was filed, June 3, 1848; was rejected, February 28, 1849; was withdrawn and $20 returned to the applicant, October 4, 1852. It then lay as dead as an antediluvian fossil for more than eighteen years, when, on December 5, 1870, a new application was filed by Woodbury for the same subject matter. This was unsuccessfully pressed by different attorneys for more than two years, the applicant in one case at least having offered an attorney $5,000 as a conditional fee, which was declined on account of the hopelessness of the undertaking.

On March 27, 1873, Fisher and Duncan, late Commissioners of Patents, became Woodbury's attorneys, and on April 26 following the patent was allowed. It was issued three days later, which was just two weeks earlier than it would have gone out in the regular course of business in the Patent Office. Such an advance was, it is true, not wholly without precedent; but as it always creates inconvenience and confusion, it is only allowed in very extraordinary cases. We know of nothing in this case that should have given it such a preference.

The main decision allowing the patent to Woodbury was claimed to be justified by the ruling of Judge Fisher in the Gray case. But there, the time which had elapsed between the withdrawal of the old application and the filing of the new one was less than two thirds as great as in the Woodbury case. And as abandonment—which was the vital question in this case—is specially declared by statute to be a question of fact, to be determined by the circumstances of each particular case, this increased length of time was a proper element to be taken into the account in forming a correct conclusion here. But the Commissioner, without taking this circumstance into consideration, and without waiting till the case was legitimately before him, made a written order that it should be decided on its merits, without taking the matter of abandonment into the account at all, which order or decision was fully observed.

Let it be remembered that the statute has provided four separate tribunals for the determination of questions of patentability. These rise in grade one above another, so that three appeals lie successively from one to that which is next above it, upon the payment of the prescribed fee in each case. The next to the highest of these tribunals is the Commissioner himself; and although he may very properly give informal advice to an examiner when consulted by him, he should no more make a binding decision until the matter is brought regularly before him than should any other appellate court, in a case still pending before an inferior tribunal.

But another act, quite as indefensible, remains to be noticed. We have stated that the statute has provided that abandonment should be treated as a question of fact. That rule is made specially applicable to cases like this. Accordingly, the 41st rule of official practice provides, in these old rejected or withdrawn cases, that "Upon the hearing of such renewed applications of either class, patents will be refused if it be found that the parties have abandoned their inventions; and in order that opportunity may be given for the production of proof of abandonment, or of two years' public use, if either exists, an interference will, at the discretion of the Office, be declared between the renewed application and all applications made, or patents granted, in which the device in controversy has been claimed or described."

Now, the discretion which is thus to be exercised means a sound and just discretion, and not one that is controlled by caprice or by favoritism. And there has never been a case since the act of 1870 was passed, and probably there never will be one hereafter, where such an interference, for the purpose mentioned in the rule, was ever more imperatively required than in this. But, as we are informed, the Commissioner gave instructions that, in this case, no interference should be declared, and the patent was issued accordingly.

Now we do not intend to be unjust, or even uncharitable, towards the Commissioner; but in all candor and sincerity, we feel bound to say that these proceedings have altogether been most extraordinary, and well calculated to create a suspicion that the strict impartiality which is so necessary to secure that public confidence in the management of the Patent Office which is necessary to its ultimate success, has not been here observed. The interests of the Office require, not only uprightness in its head, but also the absence of whatever may create a suspicion of the want of it. The question naturally arises whether the same favor would have been extended to this case, and the same alacrity manifested in overstepping the line of strict official propriety, if the matter had been in the hands of other attorneys. Rightfully or wrongfully, the idea of rings within the Office, co-operating with rings outside of the Office, is not unnaturally suggested by the facts of this case than which nothing can be more detrimental to the interests of the Office.

We have written not in malice or unkindness, but with an earnest desire to benefit the Patent Office, and through it, the great body of meritorious inventors whose welfare we believe to be in no little peril. The cheapest and most effectual way of securing uprightness and propriety of action in any public officer is, in a candid and just way, to spread his acts or those of others in like predicament fully before the public. This is well calculated to prevent those mistakes which arise through carelessness or inadvertence, as well as to correct those which may have had a different origin.

THE PHYSICAL FORCES ARE MODES OF ETHER PRESSURE

Professor Challis, of Cambridge University, after long and exhaustive researches upon galvanic and magnetic action, concludes that the hydro-dynamical theory of action is alone correct. The theoretical explanation of galvanic and magnetic phenomena is to be sought by means of mathematical deductions. The author believes that the science of theoretical physics, laid down in Newton's "Principia," is by no means confined to physical astronomy, but comprehends the principles of all departments of natural philosophy which have relation to physical force. His conclusions on galvanic and magnetic action have been reached in conformity with Newton's rules and principles. The author's main conclusions, relative to the *modus operandi* of the physical forces, to which this system of philosophy seems to point, are: That they are all modes of *pressure* of the ether; that the forces concerned in light, heat, molecular attraction and repulsion, and gravity are dynamical results of *vibrations* of the ether; and that electricity and galvanic, and magnetic forces are due to its pressure in *steady motions*.

THE CULTIVATION OF OYSTERS.

The usual method of studying oysters and the oyster trade is to swallow a dozen raw at a market stand., interview the wholesale dealer in regard to the number he handles and where he gets them, chat for half an hour, perhaps, with the master of an oyster sloop then clinch the whole with such information as may be gleaned from the nearest encyclopedia. This is the reporter's method. Much interesting knowledge is gained thereby; but, as we have already seen, more is missed. The most important feature of the business, the cultivation of oysters, is invariably overlooked.

Having seen that, so far from being unknown in this country, as commonly reported, oyster breeding is an industry at once extensive and very important, let us visit the oyster farmer at home, and study the methods of his business, their object, and the effect they have on the development of our much prized and most delicious product of Neptune's kingdom.

First, to the breeding ground.

To the casual visitor, sailing over an oyster plantation, it is the blankest of all cultivated areas. He sees but a waste of water, with here and there a protruding pole, and is but vaguely impressed when assured that as far as his eye can reach the ground is covered with crops in various stages of maturity. Strange farming, under twenty feet of brine! In the middle of a broad bay, perhaps a mile from shore, our tidy craft is put about, and our skipper says we are over a "patch" of twenty acres devoted to this year's spawn. For miles around the Sound is staked off for oyster beds, and hundreds, perhaps thousands, of acres, belonging to other oyster farmers, are in use as breeding grounds. As we drift across our twenty-acre field, a dredge is thrown over, and a moment after the quivering rope tells that the dredge is at work on the bottom. We drift a boat's length, and the catch is hauled in—a bushel or so of empty shells, half a dozen crabs, any quantity of amber-colored "gingles," and perhaps two or three oysters. "Nothing here!" you are tempted to say; but look closer. Every one of those empty shells, every object that has not escaped through the meshes of the net, is covered with rough brown creatures the size of one's finger nail. They are oyster spat, that is, young oysters of this year's spawning, now three months old. They first become visible to the naked eye when about a week old. A gingle the size of a nickel coin carries half a dozen; a nodule of coral as large as a walnut bears twenty; on half an oyster shell you count fifty or sixty, perhaps a hundred or more, if you have patience to distinguish the little ones. Who can number the thousand on a square yard, the millions on an acre, every inch of which is sown with promises of future stews and fries?

OYSTER SPAT.

As we pass to other grounds, the dredge is cast on the gravelly shell-strewn bottom of a swift channel, in a quiet cove, in deep water and in shallow; each time the dredge is filled with rubbish interspersed with old oysters, clams, scallops, and other denizens of salt water. Here and there a bright shell, a pebble, or a bit of coal will show an oyster spat; but a whole dredge full of stuff will carry fewer than a single oyster shell from the breeding ground. It is the old story of Nature *versus* cultivation.

At spawning time last summer, the waters over the several areas were equally filled with microscopic oysters, millions of which were sent adrift by each prolific parent. They swarm free and independent, like other young people, for awhile; but the time soon came when they had to settle for life. At this critical stage of their existence, those on the breeding ground were plentifully provided with enticing resting places, in the shape of clean shells, gravel, and the like, and they settled in myriads. Those which had Nature for nurse had to take their chances, and on the uncultivated grounds the chances were relatively few, notwithstanding the season was an uncommonly favorable one for natural beds. The furnishing of clean stools for the young spat is thus a matter of

SEED OYSTERS—1, 2, AND 3 YEARS OLD.

prime importance in oyster culture, and it is of equal importance that the stools are provided at the right time. The period of spawning varies with the position of the bed, the depth of the water, and other conditions, from June to August. The precise time for each bed must be discovered "with the knife," that is to say, by dissecting the oysters. By this, which is purely an American method of breeding, it matters little how deep the water may be; shells and gravel will sink through a hundred feet as certainly as through ten. The shallow breeding places employed by the French would not answer at all in our climate, no more would their costly and clumsy contrivances for fixing the spawn. There the securing of a few hundred thousand spat is accounted a great achievement. Here it is the least of the oyster breeder's labors to obtain boat loads of them. The trouble is to defend them during the five years of their development.

Examine one of the spat-laden stools. It is obvious that such a crowd of oysters cannot come to any size in so small a space. If left to themselves, few could survive the struggle for existence, and they would be pinched and meager. The oyster farmer does not permit such a waste of seed. Yonder sloop, which has been beating back and forth across our breeding ground, is nearly laden with a worthless-looking cargo, in reality a wealth of seed that would be a small fortune to a foreign breeder. The business of her crew is, primarily, to keep watch against invasion by starfish and other foes of the young oysters. Their coarse-meshed dredges bring up quantities of spat-covered shells which are kept for distribution on other grounds, quite as many spat as can thrive on the ground being attached to stools small enough to slip through the dredges. Next summer the year-old seed will be similarly thinned, the clusters broken up, and the surplus transplanted. The same process will be repeated the year after; the next year the entire crop will be lifted, it happening that the oysters thrive exceedingly well on this particular ground up to their third year, after which their growth is too slow for profit. Transplanted to more favorable ground they increase in size and thickness very rapidly.

PINCHED.

By thus choosing grounds specially suited to the several stages of the oyster's development, the breeder is able to hasten the maturity of his crop, besides securing a higher average of size and quality in the product. On a firm gravelly bottom, for example, where a free circulation of water is maintained under and around the oysters, a crop will accom-

THE EFFECT OF TRANSPLANTING.

plish as much in four years as in five on mud, and the quality will be much superior. Our time is too short, however, to enter upon anything like a thorough study of oyster grounds and their effects upon the growing oysters. They vary as farm lands do on shore, the oystermen of any locality being able to recognize, at sight, the oysters of different beds with-

NATURAL AND CULTIVATED

in gunshot of each other, often those of different parts of the same bed. A novice can tell by its plumpness the cultivated from the natural oyster. Even when the latter has had the best of advantages, and has attained the rounded outline of the perfect oyster it invariably lacks the depth of body, the thickness of meat, which the cultivator strives to attain. It will be very apt to lack, also, firmness of flesh and delicacy of flavor.

We shall return to this subject in our next issue.

THE COMMISSIONER OF PATENTS ON THE PATENT OFFICE TEA SET.

UNITED STATES PATENT OFFICE,
Washington, December 19, 1874.

MESSRS. MUNN & CO.:

Gentlemen:—I do not intend to take any notice of mere criticisms of myself or my official actions, which may appear in various newspapers. In the SCIENTIFIC AMERICAN, bearing date December 26th, 1874, however, there appears under the head of correspondence, on the 404th page, a charge so direct, that it passes beyond the domain of criticism, and becomes libelous. This charge in relation to my connection with the presentation of a tea set, to my predecessor, is an unmitigated falsehood. The facts are that the affair was originated and prosecuted without my knowledge, and during my absence from this city. I never signed the subscription paper for this set, and in fact never have seen it. If my name appears thereon, it has been put there by some one without my knowledge, and without authority from me.

Furthermore, I have not paid, or agreed to pay one single cent for this tea set for General Leggett, and I do not intend to make any payment for this purpose in the future.

I now demand that, in your next issue, you make a distinct and definite retraction of the libelous charge against me, in accordance with the facts in the case. I also demand that you will either compel your correspondent to make such retraction in a letter to be published in your paper, or furnish me the name of such correspondent, that I may make such demand upon him as the circumstances require.

I am prepared and determined to protect my good name and reputation from all libelous charges.

I am, Gentlemen, very respectfully yours,

J. M. THACHER, Commissioner of Patents.

Referring to the letter of our correspondent, page 404, last volume, we find it there stated that "the present Commissioner headed the list with $50."

To any one acquainted with the exalted and honorable character of Commissioner Thacher, his mere assurance that this statement was an error would have been quite sufficient; but in compliance with his desire that we should make the correction very distinct and explicit, we have chosen to use his own vigorous language. No candid person, we think, can read his letter without exonerating him entirely from all connection with the affair to which it refers. By reference to another column, it will be seen that our correspondent also makes the *amende honorable*. Heretofore his information has always proved reliable; how he could have fallen into so palpable an error is to us unaccountable. We regret that the publication of our correspondent's letter should have done the Commissioner an injustice.

Having thus discharged a simple duty in the prompt correction of a matter personal to the Commissioner, it may not be out of place for us to add a few comments, naturally suggested by his letter.

In these degenerate days, when many of our public men are so forgetful of personal honor and integrity as to engage in violations of the law, winking at or concealing its infractions, or neglecting to execute its provisions: at such a time, it is refreshing to find one public officer at Washington, in the person of Commissioner Thacher, who appears to entertain a high and proper sense of his obligations. It is greatly to his credit that he resents with indignation, regarding it as a libel upon his character, the suggestion that he has been, either directly or indirectly, connected with the Patent Office Tea Set presentation. He recognizes the binding force of the statute provided for such cases, so far as he is personally concerned, and evidently desires that the law shall be respected

The statute in question, is as follows:—

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

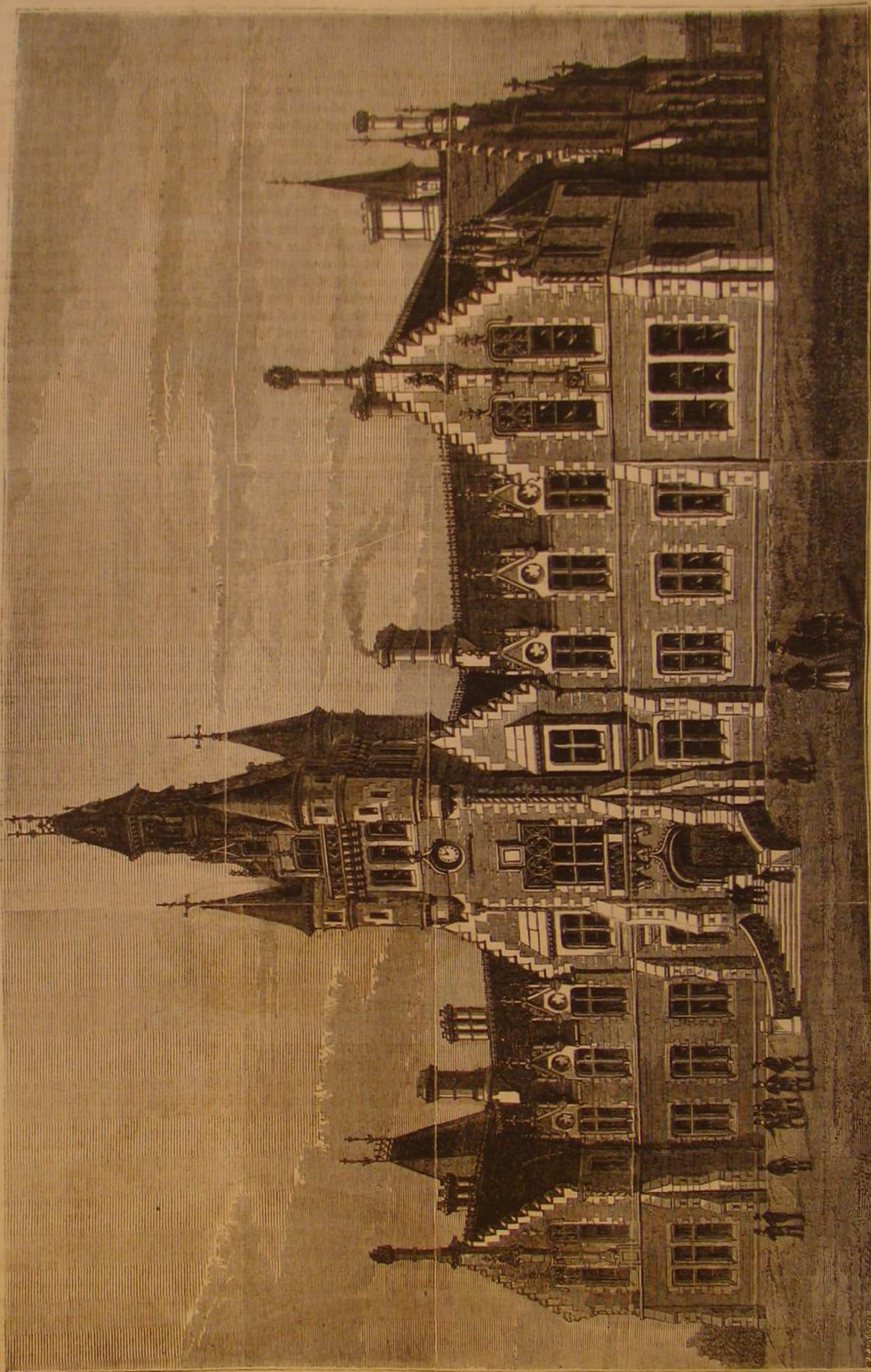
If the erroneous charge of a misinformed correspondent, of infraction of this law, is considered by the Commissioner as a libelous reflection upon his character, as stated in his letter, we may readily imagine with what keen abhorrence he must regard those members of the Patent Office company, who were actually guilty of doing the forbidden thing: with whom he is not only compelled to associate day after day, but even to witness and assist their official actions. Nothing could be more galling than this to a highly sensitive and honorable nature like that of the Commissioner.

All appointments in the Patent Office, except five, are, under the law, made by the Commissioner and the Secretary of the Interior; hence it is the duty of one or both of these officers to see that the law above cited is carried out. But between them they have managed, somehow, up to the present time, to shirk the responsibility. There is a gross violation of duty somewhere. The Commissioner of Patents has at last spoken on the subject, and the legitimate inference from what he tells us is that he would be only too glad to execute the law if he had the power, but considers it not his business, but that of the Secretary of the Interior. We hope the Secretary will now give us his views of the matter. Congress may then be able to determine where the delinquency exists, and apply a suitable remedy.

THE MORGAN HOSPITAL SCHOOL, DUNDEE, SCOTLAND.

We publish herewith an excellent view, selected from the London *Builder*, of an hospital recently erected at Dundee, Scotland. The circumstances attending its establishment are curious, and involve considerations of some importance.

Mr. John Morgan, whose name it bears, died in 1850. On the death of his last surviving sister, on the 15th of January, 1848, certain writings were found in her repositories, executed by her brother, containing some personal bequests of small amount, and declaring it to be his wish that the bulk of his fortune should be employed to establish in Dundee, the place of his nativity, an institution for the education of boys, on the model of Heriot's Hospital in Edinburgh. Previously to the death of his sister, Mr. Morgan had fallen into a state of mental imbecility, and a *curator bonis* was appointed to take the management of his affairs. The writings alluded to passed into the hands of the curator, and formed the groundwork of litigation which subsisted for some years, and ended in their being declared, by a judgment of the House of Lords, to constitute a good and valid bequest of the fortune of John Morgan, or so much thereof as should be sufficient for the purpose of endowing a hospital for the education and maintenance of 100 boys in the town of Dundee. After the appointment of trustees and governors, measures were taken for the construction of the hospital. A site was acquired, and a design, prepared by Messrs. Peddie & Kinnear, architects, Edinburgh, was approved of and adopted by the governors. The site is nearly triangular, and forms a sort of a wedge between two roads, enclosing about five acres. It slopes upwards from the entrance gate, and the hospital is built in the upper and broader portion of the grounds. The design presents a building quadrangular in form, 200 feet in breadth, 150 feet in depth, with an open court inside. The building may be called Flemish Gothic in style, and is two stories in hight, with a center tower rising to the hight of 120 feet, and projecting a few feet from the façade. In the ground floor it contains the main doorway, which is formed in a richly molded archway, surmounted by a crocketed label. Over the doorway, in the second story, is a three-light window, headed with cinquefoil tracery, and opening into a projecting balcony. On reaching the hight of the ridge of the building—the intervening space being filled in with a clock—the tower is corbelled out in the angles into circular turrets, each capped with a steep, slated roof. Connecting the turrets are carved balconies, also corbelled out from the main walls of the tower. From this point the tower rises in a steep roof, formed in two stages, and exhibits in front a carved group of windows, surmounted by an ornamental gablet. The tower terminates in double pinnacles, united by an ornamental crest. On each side of the tower the design exhibits bay windows in the second story, surmounted by steep, crow-step gables. Extending on either side is a range of two-light windows in both stories, the upper being finished by gablets flanked and terminated by pinnacles.



THE MORGAN HOSPITAL, DUNDEE, SCOTLAND.

Dangers of Benzine Scouring.

M. Dumas, at a recent meeting of the French Academy of Sciences, stated that, in examining the process of scouring fabrics as usually practised by cleaners of old clothes (washing in benzine), he had discovered a novel and dangerous cause of fire. Workmen engaged in this industry had frequently complained of the benzine becoming inflamed during the scrubbing; and in order to test the question, M. Dumas caused a piece of cashmere to be dipped in for a length of 18 feet. Every time the stuff partially emerged from the bath, while being rubbed between the hands, a sharp pricking sensation upon those members and on the face was felt; and finally sparks were emitted from the fabric, sufficient, if the scouring had been briskly continued, to have ignited the inflammable fluid.

Hereditary Crime.

Some of the most remarkable statistics regarding hereditary disposition to crime that have ever been collected were lately produced by Dr. Harris at a recent meeting of the State Charities Aid Association. It appears that the attention of Dr. Harris was attracted to a county on the upper Hudson, in New York, in which the proportion of crime and poverty to the entire population was extraordinarily great, there being about one criminal or pauper to every ten inhabitants. The recurrence of certain names among the list of unfortunates also excited his interest, and led him to genealogical investigations which have resulted in the following astonishing statement of fact:

Seventy years ago, a child, having no other name than Margaret, was a vagrant about the locality. There was no almshouse, and it seems that the girl lived as a waif, occasionally helped by the charitable, but never educated and never given a home. She gave birth to children, who became paupers like herself; they increased and multiplied until, up to the present time, nine hundred descendants of the friendless woman can be traced. Of this immense progeny, extending through six generations, two hundred of the more vigorous are recorded as criminals, and a large number as idiots, lunatics, prostitutes, and drunkards. In one single generation there were twenty children, three of which died young, and the balance survived to maturity; but nine were sent to State prisons for aggregate terms of fifty years, and the rest were constant inmates of penitentiaries, jails, and almshouses.

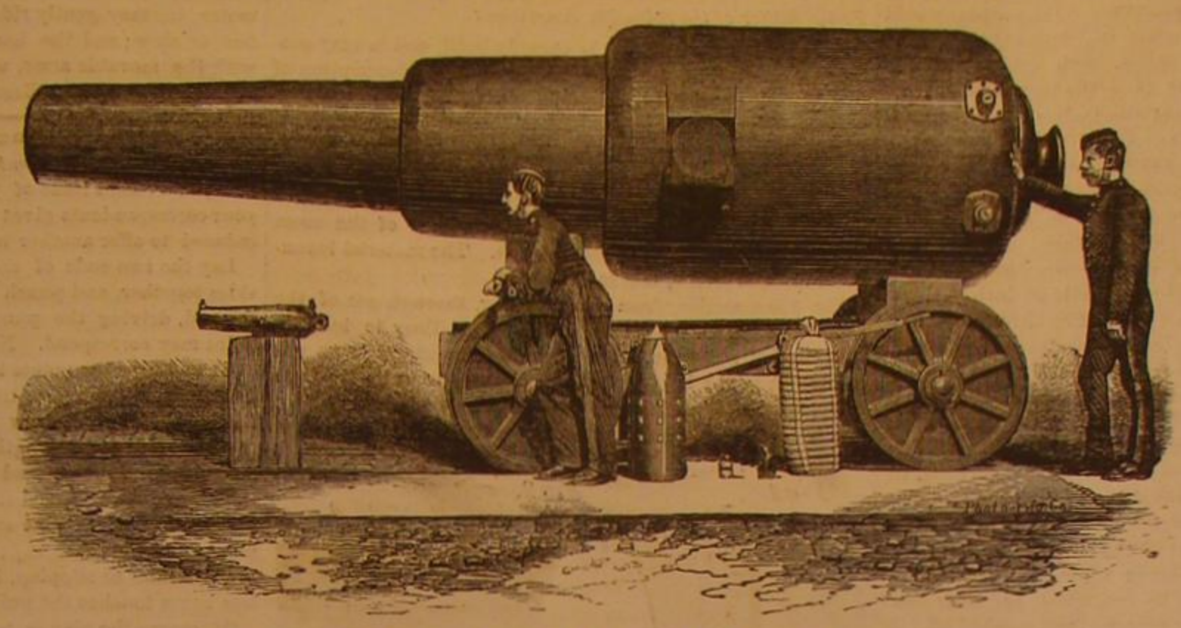
The Theory of Errors of Observation.

Mr. C. S. Peirce, in an interesting article on the laws of errors of observation, and the nature of the so-called personal equation, gives the results of some experiments made upon an entirely untrained observer, a young man about eighteen years of age, who had had no previous experience whatever in observations. He was required to answer a signal consisting of a sharp sound like a rap, his answer being made by tapping upon a telegraph operator's key, nicely adjusted. Both the original rap and the observer's tap were recorded by means of a delicate chronoscope, and five hundred observations were made on every week day during a month. It was found that on the first day the observations were scattered through a very large range of error, the difference in time between the records of the event and of the observation varying in fact between the extreme values from 0·16 to 0·98 of a second. The personal equation proper on the second day was between 0·2 and 0·3 of a second, and from that time it steadily decreased until it amounted only to one seventh of a second; it then gradually increased until the twelfth day, when amounted to 0·22 of a second. While this variation in personal equation occurred, the range of errors or discordances was constantly decreasing, until on the twenty-fourth day the probable error of the result did not exceed one eightieth of a second. This is considered to clearly demonstrate the value of such practice in training the nerves for observation; and he recommends that transit observers be kept in constant training by means of similar observation of an artificial event, which can be repeated with ease and rapidity, it not being essential, he thinks, that those observations should very closely imitate the transit of a star over the wires of a telescope, inasmuch as it is the general condition of the nerves which it is important to keep in training more than anything peculiar to this or that kind of observation.—*Harpers' Magazine.*

The scrapings from oiled floors should be placed in the open air. They are liable to spontaneous combustion

BRITISH NAVAL GUNS.

The armament of the British ship Thunderer is to consist of four 38-tun guns, originally intended for land service, but which have now been completed as naval guns. The accompanying engraving is a faithful representation of the improved *Enfant Terrible*. A comparison of its majestic proportions with those of the pigmy 7-pounder mountain gun, which the artist has introduced beneath, will enable the reader to form some idea of its actual size. The shells and cartridges for both guns will be seen standing between the wheels of the trolly on which the 38-tun gun rests. The 7-pounder is the weapon which gave such excellent results in the Abyssinian war. The dimensions of the 38-tun gun are as follows: Length, 19 feet; diameter at the thickest part of the breech, 57½ inches—being 1½ inches more in this respect than the 35-tun gun; diameter of trunnions, 13 inches; length of bore, 16 feet 6 inches; caliber, 12 inches. The rifling has an increasing twist from nothing at the breech to one turn in 35 calibers at the muzzle. The number of grooves is 9. The cartridge and projectiles are—for the present at least—to be similar to those of the 35-tun gun, namely, of 110 lbs. and 700 lbs. respectively. It is an acknowledged fact that, with the latter, a considerable quantity of the charge is blown out at the muzzle of the gun unconsumed, although, partly with a view of obviating such a difficulty, the weight of the powder employed has been reduced to a minimum. The evident cause of this is the impossibility of obtaining ignition of the cartridge throughout its entire mass in the momentary space of time that elapses before the projectile leaves the muzzle, owing to the extreme shortness of the bore, which is only 13 feet 6 inches in extent. But with the new gun, ample space is afforded for the expansion of the powder gas waves, and for the combustion of the charge, which, it is anticipated, will be entirely accomplished. Thus it may confidently be expected that better results will be obtained from actual practice with this weapon, both as regards range and penetration, than were arrived at in the trials already made with the 35-tun gun. The latter was proved capable of penetrating wrought iron plates 14 inches thick, as well as a backing of 18 inches of timber, and a skin of 1½ inches plate, at 500 yards; also of piercing, and very nearly of penetrating, wrought iron plates 15 inches thick, with a similar backing, etc., at 200 yards. It penetrated 12 inches armor and a similar backing up to 1,700 yards. The 38-tun gun will probably penetrate 16 inches of armor plate, with a corresponding backing, at a distance of 1,000 yards, as the addition of the 7 lbs. or 8 lbs. of powder to the charge—which was before wasted—must of course make a sensible difference in the amount of energy produced.—*The Engineer.*

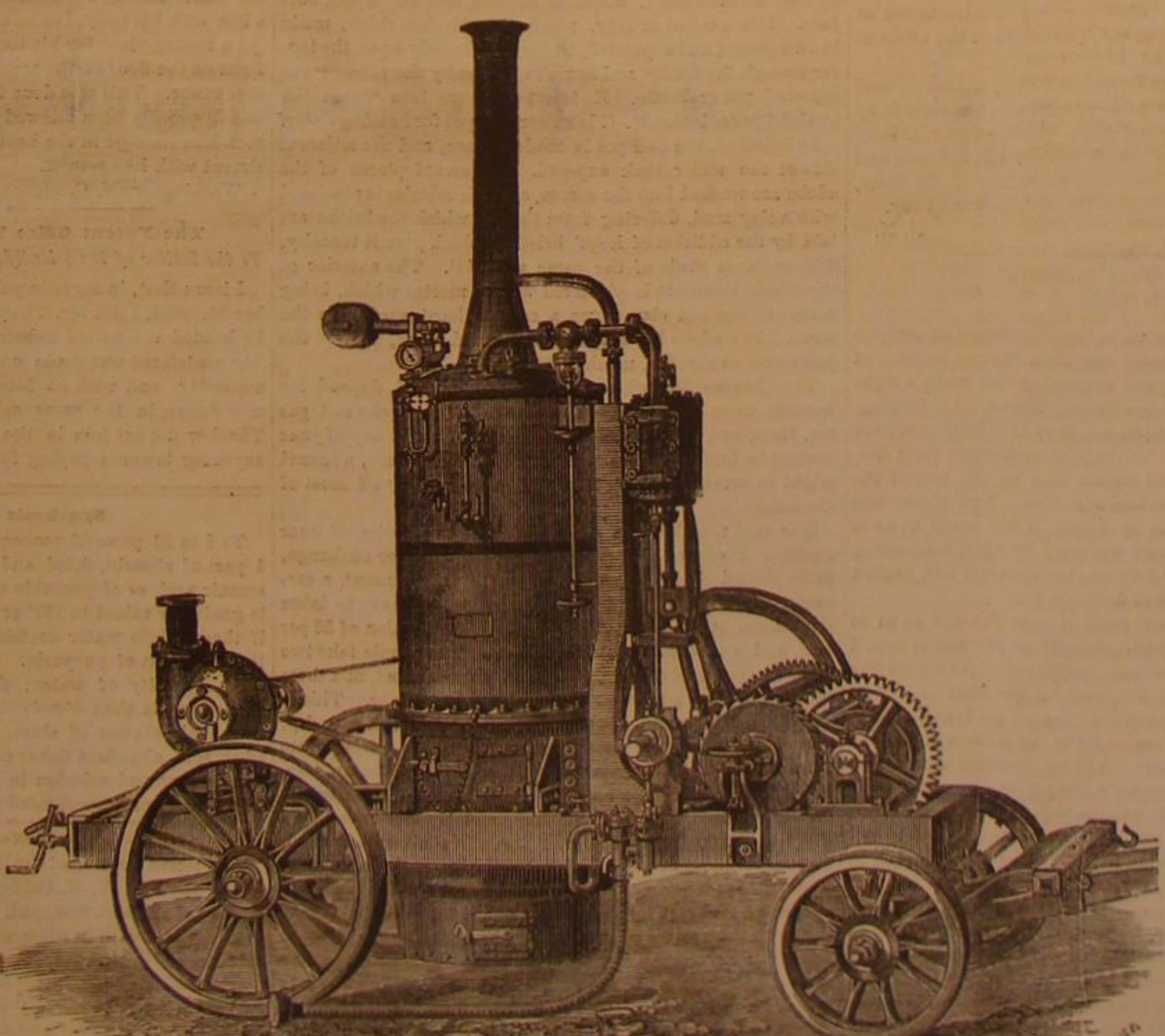


THE BRITISH NAVY 38-TUN GUN.

PORTABLE STEAM WINCH.

The annexed engraving represents a handy little machine which was exhibited at the late Exposition at Vienna. It is a combined steam winch and pump, intended for the use of contractors and others. The whole machine is carried on a rectangular frame of 7 inches by 3 inches channel iron. The boiler is placed in the center of the frame; it is supported by wrought iron brackets, and fired from one side. The engine has a single cylinder, vertical and inverted, carried by light cast iron angle framing, which is bolted to the boiler at its upper end. The winch, in the construction of which there is nothing calling for special mention, is placed on the front of the frame, and driven from the engine in the usual way. A small centrifugal pump is placed at the hinder end of the machine, and is driven by a strap from the fly wheel of the engine, which has a turned rim for that purpose.

The engine can, of course, be used to drive a circular saw or other machinery, external to itself, when required, and is, in every respect, a handy affair. The whole is carried upon four wooden wheels, and fitted with shafts for horse transport. The boiler is intended to work at 90 lbs. pressure.



PORTABLE STEAM WINCH AND PUMP.

Recent Propeller Trials.

A recently published report of comparative tests, made by the Eagle line of steamers, between the Hirsch and the Griffiths propellers, shows a strong preponderance of advantages in favor of the screws of the former system. The steamship Herder was fitted with a Hirsch screw built for an increased speed, and also with a Griffiths propeller. The mean results of ten voyages between Hamburgh and New York show for the Griffiths a speed of 11·59 knots; time under steam, 10 days, 17 hours, 30 minutes; coal consumed on passage, 572 tuns; and 519·05 miles run on 100 tuns of coal. For the Hirsch, 13 knots; 9 days and 13 hours; 505 tuns and 582·79 miles: a gain of 1½ knots per hour, and an economy of 67 tuns of coal.

The Goethe, of the same line, the engines of which, like those of the Herder, are of 600 horse power nominal, was fitted with a Hirsch screw designed for saving in coal. The saving effected was 4 tuns per twenty-four hours, and this although the draft of the vessel was 1 foot 7 inches more than when the Griffiths screw was in place. On board the Lessing, another vessel belonging to the same company, the Hirsch propeller caused a gain of 14·7 per cent in speed.

The official reports of the engineers state that the engines driving the Hirsch screw worked exceedingly smoothly, and that there was a noticeable absence of any vibration.

Utilization of Slag.

During leave of absence in August last, Mr. C. R. Roelker, of the United States Navy, visited the ironworks of the "Georg's-Marien Hutte," near Osnabrück, in the province of Hanover, Prussia, and witnessed there some processes which, from their novelty and usefulness, he thinks will be of general interest

The most important, he says, are those which turn the slag of the smelting furnaces into useful material. This necessary product in the manufacture of iron, which is a source of such considerable inconvenience and expense, has been heretofore used for making road beds; it is also sometimes run into molds and formed into building stones. The process invented by Mr. Hartmann, the former manager of the above mentioned works, turns it into more extensive usefulness.

The high furnaces are provided with a continual overflow for the slag, which runs through a narrow gutter formed in the sand into a shallow pit, through which a small stream of water is kept running. By this chilling process the slag assumes the form of a fine gravel. An endless chain at once lifts the slag out of the pit and loads it upon cars. By grinding this material fine in a cement mill, it is formed into an excellent sharp building sand; the great bulk of it, however, is used, without further reducing its grain, for making bricks.

For this purpose it is mixed with one half of its bulk of mortar in a trough in which three shafts provided with long blades are revolving. It is then shoveled into the brick machines, each of which turn out about twenty-five bricks a minute. These bricks are piled up in the open air for drying, and are ready for use after about six weeks. They continue to harden on exposure to the air, and are said to possess greater strength than ordinary burnt bricks. They are extensively used for all kinds of buildings, their light gray color producing a very pleasing effect, and the roughness of their surface fitting them particularly well for retaining a coating of mortar. They cannot be used, however, for foundation walls, as by the absorption of moisture their cohesiveness is impaired.

The most interesting process is the following: As a thin stream of the fluid slag, falling from a narrow gutter, passes the nozzle of the steam pipe, a jet of steam is blown through it, and by this simple process it is solidified in the form of most delicate fibers, resembling asbestos or spun glass; and it falls to the ground like a loose mass of grayish wool. This material is an excellent non-conductor of heat, and is used for covering steam pipes, boilers, etc. The sole expenditure in its manufacture is that of the steam, the exact amount of which could not be ascertained. The material is sold for about $5 per hundred cwt. The steam pipe is about 1½ inches in diameter, and the nozzle is simply a pipe, flattened and then curved into a semi-circular form, in order to give the most advantageous shape to the steam jet. The steam used has a pressure of about 50 lbs. per square inch.

MERCURIAL OINTMENT IN BOILS AND CARBUNCLES.—Dr. T. Roth lauds, in the *Deutsche Klinik*, the local application of gray ointment in boils and carbuncles, especially the early stages. He anoints the affected part with the ointment four times daily, and thereby reduces the inflammation and "backens" the boil most satisfactorily.

Correspondence.

Snow in the Streets.

To the Editor of the Scientific American:

A huge, heavy roller, about four feet in diameter, with its periphery two inches thick, would probably be the most effective thing that could be used; but the one difficulty in the way would be in the heating of it, heat being absolutely necessary to prevent the adherence of snow to the outer surface. It would not be impossible to heat such a cylinder, but it would be costly and difficult.

The next best shape for a machine for the purpose would be a sledge, made something after the following pattern: Instead of simply the two runners with which ordinary sledges are furnished, I would cover the bottom of a snow sledge with fifteen, placing them two inches apart from each other, thus giving to the runners and their intermediate spaces a width of seventy-three inches, which would be the width of the sledge. The runners should be of oak joists, fifteen inches in depth and from eight to nine feet long. The width of these joists would be reduced at their lower faces to one and a half inches, which lower faces would be covered with straps of wrought iron half an inch in thickness. Between the runners, set some other three and a half inch joists, which, at the rear end of sledge, would almost close up the space between the runners, but would be gradually cut away toward the front so as to leave an opening equal in amount to that closed at rear. From midway to rear these intermediate joists would be shod with a malleable casting, having several deep lengthwise grooves covering its lower face, the object which would be to make corresponding depressions in the pressed surface of snow, thus to afford foothold for horses. The front of the sledge should turn up some three feet, at an inclination or angle of 45 degrees, up which face the runners would be continued; and their final termination should be properly rounded and finished off. It might be well to have two rows of harrow teeth attached to extreme rear of the sledge to act as a thorough roughener to the compressed snow surface. Over the runners should be a flooring of two inch pine plank, the stuff to be twelve inches wide and placed transversely with length of the sledge. The runners should be of oak, and all exposed surfaces of the same would necessarily require to be planed perfectly smooth. Three or four tuns of pig iron properly distributed over the floor or platform would complete the craft.

This is a very rough sketch of the idea, but it may answer a purpose in pointing out a proper direction in which to seek for the machine wanted. These machines, as long as the snow lasted, could be used for the transportation of goods, and every movement of them would have the effect of making an admirable surface to travel over.

Finally, let me say that the true, the only economical and rapid way of getting rid of snow as a street obstructor is by compression, by condensing its loose particles into a thin, solid stratum or layer, into which wheels will not sink and over which horses and humanity can move freely. In short, you must make of the obstruction (snow) a new roadway.

N. N.

The Steel Tool Question.

To the Editor of the Scientific American:

I have been much interested in the discussions on tempering steel tools. My experience has been that no amount of skill and care in hardening and tempering can make a right down good tool of one not judiciously forged. In forging, bring the steel to a mellow heat, and keep it so until you have your tool forged to shape. As the heat declines to black hot, compact your steel by light hammering on the face of the tool, but do not hammer the tool edgewise. Now if the tool is ready to harden, when it is heated it will swell so as to loosen up the compacting that was done by light hammering as it was cooling off. So it follows that whatever will harden the steel at the least heat will do it the best.

I use strong cold brine, and want it near the fire so as to utilize all the heat in the tool. As soon as the tool is cool, I dip it in oil (sperm or whale oil preferred). Now hold the tool over a well burnt-down fire, without the wind on. Hold the tool so as to retain as much of the oil on it as possible. Now tip it up slightly so as to make the oil flow from over the hottest part to the edge. The oil becomes a carrier of heat, and will help to let down the temper (exactly alike every time) from any thick part to a delicate cutting edge. I think the color that comes on the steel under hot oil can be depended upon much more with than without oil, although it (the color) will be a little tardy. In letting down the temper, I want to do it slow enough at last, so that I can lay down the tool to cool off, and not have to dip again. But if it is going too low, I invert it and dip the body part and leave the edge out. There are very few tools in which I like to leave heat enough in the body to let down the temper with, for this reason: as I grind back on the tool, the cutting edge is apt to get a little farther from the outside film of refined steel. This film is harder than the steel under it, so I would leave the tool slightly harder a little way back from the end. Whereas, if you run out heat enough from the body of the tool, you will very soon be at work with a tool altogether too soft.

Bennington, Vt. TAYLOR D. LAKIN.

Inversion of Image on the Retina of the Eye.

To the Editor of the Scientific American:

It is a well established fact that the image of every object is inverted on the retina of the eye. How is it, then, that we see every object right side up? The common explanation in works on optics is that we correct it by habit, that is, that we know that the image of the object is inverted; but by an exercise of the judgment or imagination we correct it. This seems to me to be irrational and unsatisfactory, and I set myself to the task of finding a better solution. In studying the anatomy of the eye, I found that the optic nerves, which spread over the retina of the eye on which images and impressions are made, converge or are collected into a bundle, and cross each other (at the back of the retina, on their way to the brain or sensorium) about as far from the retina as the pupil is.

W. S. TURNER.

Napa, Cal.

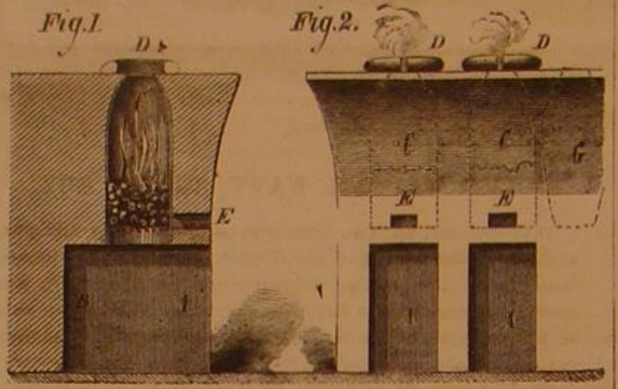
Chinese Cooking Stoves.

To the Editor of the Scientific American:

A Chinese cooking stove is cheaply built, and is very economical of coal. It has occurred to me that a description of it, and of the coal used, might be interesting and profitable to some of your readers.

The accompanying engraving represents the stove, which is used daily in my kitchen, and is a good sample of the common stove used in those parts of northern China where hard coal is used. The stove is built in the corner of the room upon a paved floor, against solid walls. The material is sun-dried brick or adobe, laid in clay mud.

Fig. 1 is a section, from front to rear, through one of the pots. Fig. 2 is a front view, with dotted lines to indicate the interior structure. The scale is 1 to 16. A is an ash pit, which might be opened even to the rear wall; B is the grate, composed of five or six common rods of iron. Above this is a mass of large cinders, about five inches deep. C is



the pot, seven inches in diameter, with hight, from grate to mouth, of fifteen inches. The mouth is about three inches in diameter, and is made in a cast iron plate, six inches square by half an inch thick, which is sunken into the upper surface. D is a collar or ring, about three inches thick, made in two pieces, and separated, as they lay loosely upon the top, far enough for smoke and flame to escape by the sides of the rounded pot or kettle. E is an aperture into which the straight poker is thrust. G is an earthen pot for heating water.

In building, the coal pot is made square, and the adjacent side of the water tank exposed. Afterward pieces of the adobe are worked into the corner, and the interior is plastered with a clay mud, differing from that in which the bricks are laid by the addition of hogs' bristles, which give it tenacity. The collar is made of the same material. The exterior of the whole structure is plastered with a mortar which, being made of lime and clay, gives a smooth hard surface to the stove. The adobe is cheaper than burned brick, and, in the parts near to the fire, much better.

The Chinese live with their doors open, and depend for warmth upon their wadded clothing. The smoke and gas are, therefore, of little account to them. Should any of your readers be inclined to experiment with such a stove, a funnel might be arranged above the stove, so as to carry off most of the smoke.

The coal used here is a flaky, friable anthracite, of poor quality. It costs about $7 a tun, or, allowing for exchange, $8.50 United States currency. To earn this amount, a carpenter or mason, doing first class work, would have to labor sixty days. Coal dust can be bought at a reduction of 25 per cent, and is used more than the pieces. The people take two parts of clay dust and eight parts of the coal dust, mix them thoroughly, and add water to make mud or mortar. This is spread on the ground, about an inch and a half thick, to dry. When partially dry, a shovel cuts or marks the surface into small squares. When nearly dry, these are broken up. Generally, at this stage, a coarse sieve is used, and the cakes, rolling together, lose their corners, and become round. In this form, they burn readily in the stove above described. The advantages of the spherical coals is merely in the fact that they are more easily used than rugged cubical ones.

I see no reason why the poor of our cities in America may not avail themselves of this process, and, buying coal dust at a small price, use the coal balls, as we call them, in common stoves. Perhaps some pieces of coal would be necessary in connection with the balls. But either with or without, it would be a great saving of money.

In the stove which we have described, the common coal dust, wet and mixed with water, is put upon the top of a good fire; a straight poker thrust through this makes a vent for gas, and the fire keeps in with but little consumption of coal.

ISAAC PIERSON,
Missionary of American Board.

Paotinghi, 100 miles south of Peking, China.

The Flying Machine.

To the Editor of the Scientific American:

Allow me to add, to the explanation of my proposed flying machine, published on page 357 of your current volume, the following:

By having the wings revolve in opposite directions, I balance their forces against each other so as to secure the car against a spinning motion, which would attend its flight and its descent if the two wings revolved in one and the same direction.

By disconnecting or separating the arms at the center of the canopy, and giving them an independent action, I am enabled to have one wing shaft incline forwards while the other inclines backwards, and thus to cause the machine to turn round in the air as desired, either to the right or left, and in a smaller or larger circle as the wing shafts are more or less inclined.

Thus it is seen that, with only two wings and a suitable motor, we may gently ride in the air, and fly high or low, fast or slow; and the handles, which are to be connected with the movable arms, will enable us quickly to steer our course in any desired direction.

W. D. G.

Mending Machine Belts.

To the Editor of the Scientific American:

As, in a recent issue of the SCIENTIFIC AMERICAN, one of your correspondents gives his method of lacing belts, I am induced to offer another which I have found valuable.

Lay the two ends of the belt exactly even, with the insides together, and punch one straight row of holes across the end, driving the punch through both pieces so that the holes may correspond. Now take your lace, pointed at both ends, and pass the points in opposite directions through the first hole, still keeping the two ends of the belt together as when punched, and draw the loop tight, observing to keep the ends of equal length. Pass the points through the second hole and so proceed to the last; then tie the ends over the edge of the belt, and the job is done. A belt can thus be mended in half the time and with half the length of lacing required in the usual way; and when the belt is subjected to heavy strains or slipping, it will wear ten times as long, as the lace never touches the pulley faces.

Of course the plan is not applicable when both sides of a belt run over pulleys, nor when the projecting ends would strike anything in their track.

JOS. R. PARKS.

Kansas City, Mo.

Cribbing in Horses.

To the Editor of the Scientific American:

Having seen several communications in your paper on cribbing in horses, I will give you my experience on the subject:

I had a three year old addicted to the habit. I tried various remedies without success, the horse growing worse all the time. Seeing the animal always kept his head nearly in a line with his body, I so arranged the stable that he could not get a resting place for his teeth except on the manger. This I put on the floor of the stall, and kept him confined for a short time. This was done two years ago; and although he has frequently been allowed to exercise in a lot, I have not seen him indulge in the habit. Others have tried the experiment with like results.

B.

Washington, N. C.

The Patent Office Tea Set.--A Correction.

To the Editor of the Scientific American:

I learn that, in my note published in your paper of December 26, 1874, I did Mr. Thacher an injustice by stating that he headed the list of subscribers for the tea set with $50. The statement was made on what was believed to be good authority, and with no intention of wronging any one. I now desire, in the same spirit of fairness, to say that Mr. Thacher did not join in the subscription, and did not give anything towards paying for it.

JAMES.

Synthesis of Purpurin.

To 8 to 10 parts of concentrated sulphuric acid are added 1 part of alizarin, dried and powdered, and 1 part of dried arsenic acid, or of peroxide of manganese. The temperature is gradually raised to 150° or 160° until a drop of the mixture, if thrown into water containing a little caustic soda, gives the coloration of purpurin. The mass is then thrown into a large quantity of water; the precipitate, exhausted with cold water, is then dissolved in a sufficient volume of a cold saturated solution of alum, and deposits, on the addition of an acid, abundant flakes of purpurin, which may be purified by a second solution in alum water, followed by a crystallization from superheated water.—*M. F. de Lalande.*

Monads.

At a recent meeting of the Royal Microscopical Society, a paper by the Rev. W. H. Dallinger and Dr. Drysdale, on the life history of monads, was read. It minutely described a form repeatedly met with in macerations of the heads of codfish and salmon, and traced the development and reproduction in all stages, and was illustrated by drawings. The observations had extended over several years, and had been conducted with the greatest care under various powers up to $\frac{1}{50}$ inch. The results of experiments were also given, and conclusively showed that exposure to temperatures of 220° and 300° Fah. had failed to destroy the germs of these organisms.

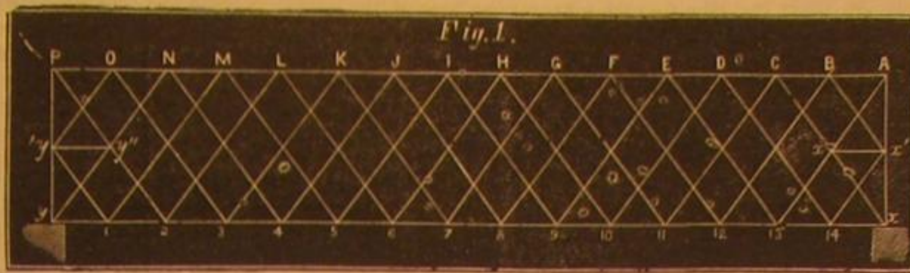
Danger from Excavations.

It is well known that the exposure of large quantities of fresh earth, as attends railroad and canal construction, develops intermittent and typho-malarial fevers. To lessen this, Dr. Stephen Smith, of New York city, offers the wise recommendation that sewers be laid only after November 15 and before June 1; and last Tuesday week the Board of Health, accordingly, resolved that the Commissioner of Public Works be requested to omit all excavations between June 15 and October 1, and that no subsoil be exposed during that time.

Double Lattice Wrought Iron Bridge at Springfield, Mass.

Mr. W. Bartlett, in a letter to the *Railroad Gazette*, says:

Few Western engineers have ever seen or heard of the double lattice wrought iron bridge over the Connecticut river, at Springfield, Mass. A bridge which is so carefully designed in regard to economy and durability is well worth taking notes upon. The notes found in the following running description are reliable, and will be valuable to engineers for reference.



The structure was designed by Charles Hilton, C.E., to replace the old wooden Howe bridge on the Boston and Albany Railroad at Springfield. The piers of the old were used for the new structure. There are seven equal spans, each span being 177·15 feet long, making a total length of 1,240 feet. The spans being all similar renders it necessary to describe one span only.

The span is composed of three trusses, one central and two outside, the object being to carry a double track. The width between centers of outside chords is 31 feet 6 inches; hight, 24 feet 3 inches. There are 15 panels, each 11 feet 9¾ inches long; inclination of diagonal to horizontal, 45½° (intended probably for 45°); width of portal, 14 feet; hight, 18 feet 8 inches from top of rail to crown of arch.

The skeleton engraving herewith (Fig. 1) shows the system of bracing.

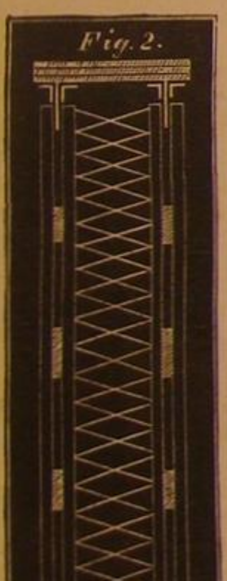
From a bill of material for one span we find the total weight distributed among the several portions of the span as follows:

	Pounds
Chords	140,022·66
Webs	79,372·15
End posts	10,000·00
Stringers	25,200·00
Cross beams	25,200·00
Pier ends	18,921·00
Total weight of bridge proper	300,715·81
Rails	14,400·00
Timber	39,000·00
Total dead weight	354,115·81

which equals 177·06 tuns. This gives almost exactly one tun per foot run for the dead load.

It is worth noting here that, of the 300,715·81 pounds weight of bridge proper, nearly one half is found in the chords, one fourth in the webs, one sixth in the stringers and cross beams, and one tenth in the pier ends.

The side figure shows section at the center of central truss, where the area of top chord is 74·6 square inches, and of lower chord, 65 square inches. The area of top chord (74·6 square inches) is obtained by three horizontal plates, 30 x $\frac{7}{16}$ inches each, two vertical plates, 12 x ½ inches each, and four angle irons, 3 x 3 x ½ inches each. The area of lower chord (65 square inches) is obtained by the same number of similar plates, and but two angle irons, 3 x 3 x ½ inches each, allowing for rivet holes. From these areas at the center, the areas decrease toward the abutments as the stress diminishes; and near the pier ends the horizontal chord plates are replaced by a system of double lattice bracing, the braces being riveted to the outside angle iron, the inside angle having been stopped two panel lengths from the ends.



Of the diagonals, the struts are riveted on the inside and ties on the outside of the vertical plates. The struts are angle irons united by double lattice bracing. The ties are simply angle iron. The struts and ties are firmly riveted together at their intersections.

The vertical chord plates are connected by zigzag bracing, 2½ inches x ⅜ inches at their lower edges.

All rivets are ¾ inches diameter, with a pitch of not less than 2¾ inches.

The lower sway braces are united to chord plates and cross beams by gusset plates.

Stringers are 10½ inches rolled I beam.

The data for computing the strains in the different members are as follows:

Dead load at each joint	11·81 tuns
Live load at each joint	35·43 "
Total dead and live load	47·24 tuns
Length of panel	11·81 feet
Length of diagonal	33·85 "
Depth of truss	24·25 "
Stress allowed for tension	10,000 lbs. per sq. in.
Stress allowed for compression	8,000 lbs. per sq. in.

Paris Green Poisoning.

The question of whether the use of Paris green (arsenite, or aceto-arsenite, of copper) upon potato plants as a means of destroying the bugs will tend to poison the soil, and thus render it unfit to produce vegetation, receives a definite answer from Professor Le Conte, in his paper recently read before the Academy of Sciences. The opinion advanced and concurred in by such high authority as Professors Silliman and Alexander and Dr. Mitchell affirms unequivocally that arsenic and copper are poisons which act with equal energy upon plants and animals. The material diffused upon the leaves of the plants to be protected, which are incapable of absorbing it, is speedily carried into the soil; and if used annually, it is merely a matter of time, how many years will elapse before the soil is poisoned so as to prevent the growth of all vegetation.

Professor Le Conte enters an earnest protest against the present loose yet enormous use of this fearful poison in the hands of uneducated men. It is ordered by Western druggists literally by the tun, and repeated deaths have resulted among farmers through its careless employment.

To this Professor Silliman adds a warning against the too prevalent habit of scattering the substance about dwelling houses as a cockroach poison. The death of several persons in a single dwelling in this city from eating pickles upon which some Paris green had been blown, by a stray draft of wind, occurred quite recently. It should be remembered that the poison contains from fifty-five to fifty-eight per cent of arsenic, and that its deadly effect is as certain as that of the latter mineral. From houses where there are children, the substance should be rigorously excluded. Servants often sift it about on the edges of floors near the mop boards; and we have found it on kitchen sinks, close to the dishes and to food prepared for a meal.

It is well settled that arsenic is dangerous even externally, and experiments have proved that its poisonous effects are developed by a smaller amount inserted in a recent wound than when taken into the stomach. A cut finger, therefore, or a mere scratch on the hands when handling the poison, may serve as a means of the same entering the system.

Paris green, owing to its brilliant color, is employed in so many different uses that to avoid its proximity care is necessary. Professor Alexander, in the discussion which followed the reading of Professor Le Conte's address, said that wall paper has been so thoroughly impregnated with the poison that persons have experienced its effects after half an hour's stay in the room. We have recorded cases of paper hangings which on analysis showed three grains of arsenic to every square foot. Green tarletan, when dyed with the substance, has been found to contain 8·21 grains of arsenic in the same area. In artificial flowers and grasses, *bonbon* papers and boxes, even in the candies themselves, chemical investigation has repeatedly proved the poison to be present. Boxes of toy water colors containing greens, it would seem, are hardly safe children's playthings, as a single cake of paint weighing 38·26 grains has been found to contain 8·89 grains of arsenic. The simplest test for the poison is to put a fragment of the suspected substance in a solution of ammonia. If arsenic be present, a blue color will be produced. For a further test, pour a little of the ammoniacal solution on crystals of nitrate of silver, when the arsenic will appear on the crystals in a yellow deposit. The antidote, as is well known, is peroxide of iron—a tablespoonful to adults every five or ten minutes—together with milk, white of eggs, and other demulcent drinks.

Dr. Le Conte sharply criticised the National Agricultural Bureau for failing to experiment and search out proper remedies for the potato bug, particularly since its ravages were predicted in ample time. Paris green, he certainly thinks, is not a proper nor a safe preventive. The Academy proposes to take active measures against the increasing industrial use of the poison, and before adjourning adopted a resolution appointing a committee to investigate and report upon the subject of the use of poisons applied to vegetables or otherwise for the destruction of deleterious insects and other animals, and also the incautious use of poisons in the ornamentation of articles of food, and for industrial purposes generally, such, for instance, as the coloring of paper.

The Effect of Wind on Sound Waves.

We reverted not long ago to a conflict of opinion between Professors Tyndall and Osborne Reynolds, relative to the proper explanation of the irregularities observed in the transition of sounds under varying conditions of the atmosphere. The former scientist, after experimenting with fog horns and other sound producers, concluded that the unequal range of the sound was owing to the greater or less "acoustic transparency" of the atmosphere, due to the presence or absence of streaks of vapor or unequally rarified air. Professor Reynolds, by similar investigations, was led to the belief that the sound waves, assumed by Professor Tyndall to be quenched, were simply deflected upward and carried over the listener's head, and this lifting he ascribed to the increasing velocity of air currents as the elevation increases, and a direct proportion to the upward diminution of the temperature. For a more extended discussion of these varying theories, the reader is referred to our editorial relating thereto, in the first number of volume XXXI.

The latest contribution in connection with the subject is from a scientist no less eminent than either of the above, Professor Joseph Henry, who, in a paper recently read before the Academy of Sciences, takes direct issue with Professor Tyndall as to the effect of vapor in the air on sound waves, and, at the same time, fails to coincide with Professor Reynold's statement of the upwardly increasing velocity of the air currents. Referring to the fact that sound is heard more distinctly when propagated in the direction of the wind than when in opposition to it, Professor Henry adds that, on the other hand, there are well authenticated cases where sound has been heard a greater distance against the wind; so that the phenomenon is by no means susceptible of ready explanation. The idea that wind accelerates sound in one case, or retards it in the other, has evidently little bearing when it is considered that sound moves at the rate of 700 miles per hour, while a wind of seven miles an hour is sufficient to give a penetrating power, to a given sound, of double the intensity; whereas, from the foregoing consideration, it should have an effect of only one per cent. The only explanation which has been offered for the phenomenon is that, in a river of air of considerable depth moving over the surface of the earth, the lower part moves with less velocity, on account of friction, than the upper part, and that, consequently, the tendency would be to tip the sound wave so as to throw the sound downward toward the earth in the case of the sound moving in the same direction as the wind, and to deflect it upward in case the movement is in an opposite direction, throwing it into the air above the head of the observer. This hypothesis gives a ready explanation of all the phenomena observed, and was fully illustrated by a series of experiments made by Professor Henry in the vicinity of the lightship of Sandy Hook last summer. Two steamers were supplied with whistles producing the same tone, and sent, one to the westward and one to the eastward. A wind was blowing from the west at the time with a velocity of 6½ miles an hour. The whistle on one steamer was heard until it sailed a mile from the steamship on which the observers were stationed, while the sound of the other, which was carried by the wind, was heard 2½ miles. This was in accordance with the most experience of the effect of wind in accelerating the sound waves. At noon, however, the experiment was repeated in a dead calm, and the same effect was observed, the sound from the steamer that sailed eastward being heard two and a half times as far as the sound from the other steamer. Again, in the afternoon, the experiment was tried after the wind had chopped about and was blowing from the east, but the observers were surprised to find no change in the result. Apparently the course of the wind had no effect upon the velocity of the sound. Professor Henry was satisfied, however, that the variation in the wind occurred only at the earth's surface, and that a river of wind was flowing steadily from the west all the time. Next day he repeated the experiments under exactly similar conditions, the wind falling to a calm and then shifting as before. He sent up small balloons at the same time, and found the idea to be correct. A steady current from the west prevailed all the time. By this beautiful experiment, Professor Henry considers the truth of his theory as to the uniform effect of wind on sound to be completely demonstrated.

The fault with Tyndall's experiments was that they were all made in one direction. Last summer Professor Henry placed a large steam trumpet on a steamer. The wind was from the west, and the trumpet was pointed northward. The steamer sailed toward the wind, and carried the sound only 3½ miles, but in sailing in a contrary direction the sound was heard for a distance of eight miles. If Professor Tyndall had observed the sound from one direction only, he would have called the day opaque; if from the other, only he would have concluded that it was quite clear.

Professor Henry's opinion relative to the steady flow of wind from the east revives the idea of the constant easterly current so much discussed during the transatlantic balloon attempts of a year ago. It may be added, however, that, although the aeronauts shared fully in believing the existence of such a vast aerial river, subsequent and repeated ascensions have failed conclusively to demonstrate its presence. It is somewhat difficult, therefore, to reconcile the results, noted by Professor Henry with his small balloons, with those obtained through actual ascents by individuals. Altogether, the subject is like the Tyndall and Draper difference of views on the invisible rays of the spectrum: one of those anomalous instances of doctors disagreeing. With such a triumvirate as Tyndall, Henry, and Reynolds at variance, the humbler physicist is indeed at a loss to determine to which theory to anchor his faith.

A Suicidal Scorpion.

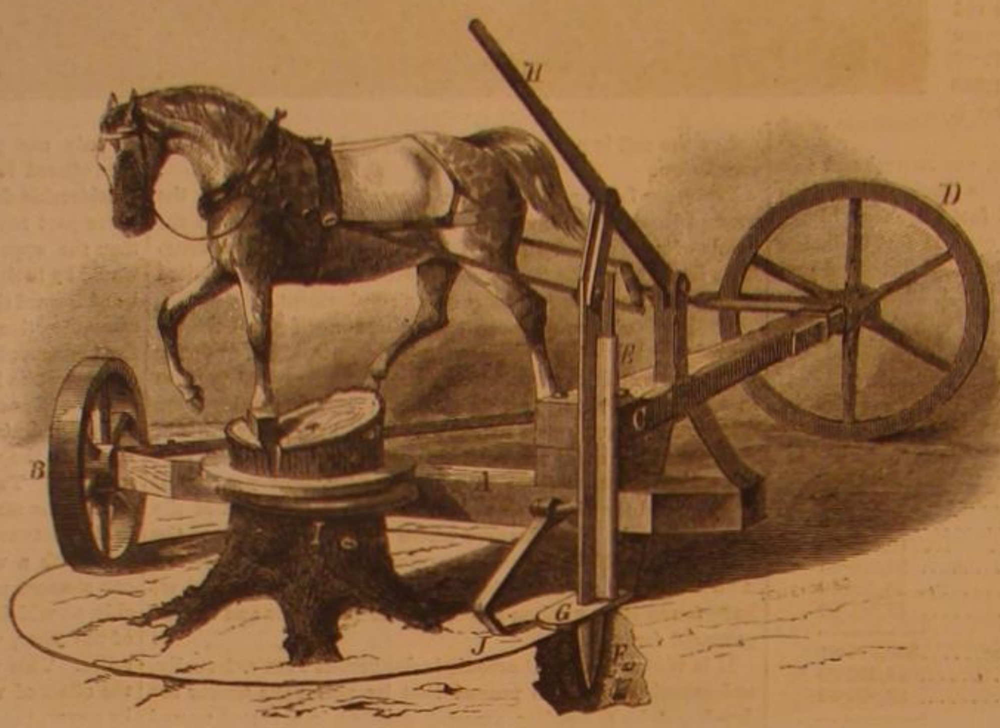
The statement that a scorpion, when driven to bay by its enemies and unable to escape, will kill itself by a blow from its venomous sting has usually been regarded as rather mythical. A well attested instance, however, of the suicide of the insect has lately been published by Dr. de Bellesme. The writer states that, having captured a scorpion, he converged the rays of the sun on its back by means of a burning glass. The insect became furiously enraged, and finally raised its sting and struck itself, dying within half a minute afterward.

WE see it stated that three Dartmouth students, named Colby, Brown, and Dustin, will start for Egypt this month under an engagement with the Khedive for service in the surgical corps of his army. They will reside in Cairo and be attached to the personal staff of the Khedive, who is to pay them $2,500 to $3,500 a year, in gold, and traveling expenses.

IMPROVED GRUBBING MACHINE.

Farmers and others will find in the invention represented in the engraving a useful apparatus for grubbing up the stumps of trees of even considerable size, which will doubtless prove an efficient auxiliary in clearing land. It is constructed and operated as follows: At one extremity of the beam, A, is journaled a small wheel, B; near the other end is a second beam, C, a block being interposed between the two beams to bring them to the proper relative hight. Beam, C, also has a wheel at its end at D, which wheel, however, is larger than that first mentioned. The journal of wheel, D, is hinged to the beam, so that said wheel may be turned back parallel with the beam, for convenience in drawing the machine from place to place. A loop secured to the ends of the hinged journal carries a hook, to which the harness of the horse is hitched.

At the rear end of beam, C, is a slotted guide, E, grooves in which receive the guide plate which is formed upon the upper part of the knife, F. The lower part of the latter passes through a guide slot in a bar, G, which also serves as a shoe for supporting the machine and as a brace to meet the draft strain upon the knife. By operating the lever, H, the knife, through the interposing connecting rods, may be raised from or lowered into the ground and held down to its work. To the rear of beam, A, in such position as to bring the knife at proper distance from the stump to be operated upon, is secured a loop, I, which encircles the stump, as shown.



REYNER'S GRUBBING MACHINE AND EXTRACTOR

In operating the machine this loop is first dropped in place, and a ring is placed above it. A wedge is then driven into the top of the stump so as to fasten the ring, the latter serving both to prevent the loop from slipping off, and also as a band to keep the wedge from spreading the lower part of the stump so as to tighten said loop. The knife is next forced into the ground for five or six inches, so that, on driving the horse around the stump, it cuts off such side roots as may lie in its path. At each round the knife is driven in deeper until all the roots are divided. The hook, J, is then dropped and held down by the foot until it catches upon a root. A few rounds twist off this last, and the stump may then be easily raised from the ground.

Patented through the Scientific American Patent Agency, October 20, 1874. For further particulars address the inventor, Mr. G. E. Reyner, Canton, Iowa.

IMPROVED HORSE DETACHER.

The object of the invention illustrated herewith is to provide a means of instantly detaching a pair or even three horses from a vehicle in case of their running away or becoming fractious. The advantages gained of course are the prevention of the injury or destruction of the vehicle, and of the greater risk of periling the lives of passengers.

Fig. 1

Fig. 2

Fig. 3

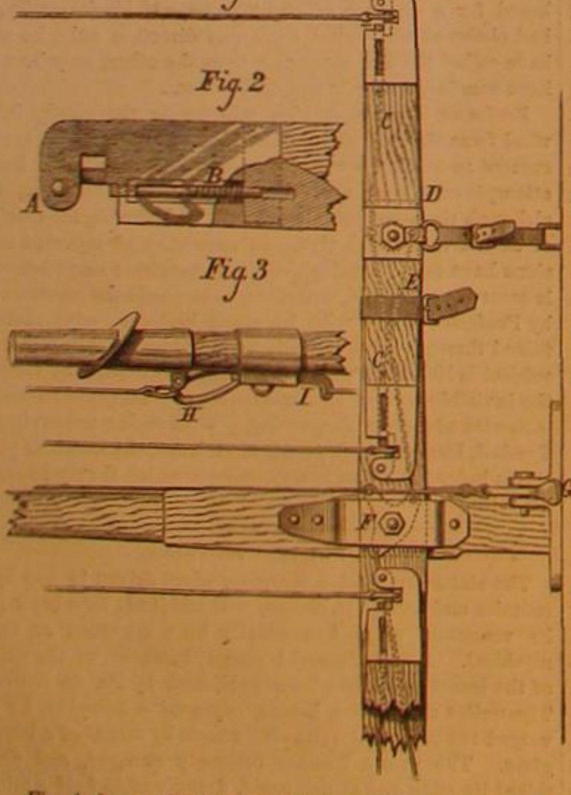


Fig. 1 shows the disconnecting arrangements located on the double tree and front portion of the wagon. Fig. 2 represents in detail the extremity of a single tree, and Fig. 3 is the end of the pole. The traces are provided with loops at their ends which slip over the hinged bolts, A, Fig. 2, at the extremities of the single trees. B is a spring catch which is held in front of said bolt, keeping the same position and thus confining the trace. Chains, C, connect the pair of spring catches, belonging to each single tree, to the sway bar, D; and chains, E, connect the sway bars to two arms of a bell crank, F. The third arm of the bell crank communicates with the detaching lever, G. When this lever is pushed outward, it rotates the bell crank, which thus, by pulling on the chains, E, turns the sway bars; and the latter, through the chains, D, withdraw the catch bolts from before the trace pins, which then, swinging on their hinges, release the four trace loops simultaneously.

H, Fig. 3, is a hook pivoted, as shown, near the end of the tongue, and I is a sliding catch bolt, also operated by the detaching lever, G, through the medium of a connecting wire. This arrangement is for the purpose of detaching a third horse, which may be harnessed to the pole end. Patented through the Scientific American Patent Agency, November 10, 1874. For further information address the inventor, Mr. Anatole Ehret, No. 540 Washington street, San Francisco, Cal.

Hydrocarbons produced on Cast Iron and Steel.

Towards the end of the last century, a French chemist named Proust observed that hydrogen gas, evolved by the action of sulphuric or hydrochloric acid on cast iron or steel, was accompanied by a kind of ethereal oil, which condensed in drops on the sides of the bottle in which the gas was evolved, as well as in the tubes through which it was conducted and the vessels in which it was collected. He also found that not all of this oily product was carried off by the hydrogen gas, but that a considerable portion of it remained in the black carbonaceous residue left by the action of the acids on cast iron. To obtain this portion, it is only necessary to treat the residue with alcohol, and after filtration to add water to this extract, when it becomes milky and the oily substance all separates.

Cloez, in his experiment on this subject, employed a beautiful spiegeleisen, which contained about 4 per cent combined carbon, 6 per cent manganese, some silicon and traces of phosphorus and sulphur. It was reduced to pieces of moderate size, and treated with hydrochloric acid diluted with twice its volume of water. The action of the acid or white iron in the cold is very feeble; to aid it, Cloez placed the iron and acid in a flask on a water bath, the temperature of which was 167° to 194° Fah. Under these conditions, the gas was evolved regularly, and about 600 grains of iron were dissolved daily in a single apparatus. The gas generated was first passed through two Woulfe's bottles with cold water, then through an apparatus containing pumice soaked in sulphate of copper, and afterwards through a two-necked bottle where it came into contact with bromine covered with a stratum of water. With this apparatus the following substances may be collected:

1. The oily liquid, which is condensed in the first two bottles, and which was first observed by Proust. According to Cloez's experiments, the quantity of this substance formed equaled about 1 per cent of the weight of the iron employed.

2. The bromated products formed by the absorption of the hydrocarbons, $C_{2n}H^{2n}$, by bromine. These products are very complex.

3. The liquid and solid products obtained by treating the insoluble residue with sulphide of carbon and alcohol.

The oily liquid obtained directly by condensation is lighter than water, colorless, and very fluid. After two days' contact with fused chloride of calcium, it was subjected to distillation, and began to boil at 248° Fah. About one third of the liquid distils over below 284°, a small quantity between 293° and 320°; and the boiling point of the remainder gradually rises to 392° Fah.

Cloez next endeavored to obtain a pure product out of the most volatile portion of the liquid by fractional distillation, but this was difficult, since he only had 20 to 30 grains of the liquid. He succeeded, however, in isolating a hydrocarbon which distilled completely between 240° and 248°, and had the composition and properties of caprylen or octylen, $C_{16}H_{16}$. Analysis gave: Carbon, 84·92; hydrogen, 14·17; total, 99·09

An examination of the bromated liquid discovered the presence of several homologues, $C_{2n}H_{2n}Br_2$. Cloez separated the bromide of propylen by distillation; but then he sought in vain for the bromide of ethylen, which boils at 444° Fah. The mixture of bromated compounds began to boil at 266°; the temperature rose rapidly to 284° and 295°, where it remained stationary quite a long time; it then rose progressively to 320°, where it again stopped for a while, and then rose gradually until finally it reached 374°. At this temperature hydrobromic acid was given off from the decomposition of the more condensed bromated hydrocarbons. The distillation was not carried any farther. The least volatile portion of the bromated product, which did not distil over, was set aside to be treated with an alcoholic solution and thus converted into more permanent products of more simple composition. He succeeded in this way in obtaining bromide of heptylen, $C_{14}H_{13}Br$, boiling at 130°, and the next member of the series, bromide of caprylen or octylen, $C_{16}H_{15}Br$, boiling at 302° Fah.

In the first bottle through which the gas passed there was deposited on the sides, in addition to the oily product, a solid, perfectly crystallized body, which sublimed without decomposition. Cloez obtained it only in very small quantities, but hopes, on dissolving in hydrochloric acid the whole quantity of 150 kilogrammes of iron, to obtain enough of it to make some investigations and determine its composition.

Before taking up this white spiegeleisen, Cloez operated on ordinary gray iron, but obtained no oily hydrocarbon on dissolving 50 kilogrammes, and only very little of the bromated product, less than $\frac{1}{1000}$ part of the weight of the iron. This small yield represents only a very small fraction of the carbon which is present in a combined state in gray iron.

SHADE ATTACHMENT FOR PLOWS.

Every farmer who has trudged after a plow under a hot sun has doubtless wished for just some such an invention as that illustrated in the annexed engraving. It is simply an attachment readily applied to any convenient portion of the plow, the object of which is to support an umbrella and to allow of the same being adjusted so as always to throw its shade upon the plowman.

A cranked arm is secured in a socket by means of a set screw, and is free to revolve in a horizontal plane. The outer end of this crank is jointed, and provided with an adjusting brace, whereby it may be inclined and secured at any desired angle. A suitable socket, at the upper end of the arm, holds the umbrella handle, retaining the same by a simple spring catch.

The umbrella shade is largely used, in this city, by stage drivers, cartmen, and others whose labor requires them to be constantly out of doors, and it proves a very welcome comfort. It obviates, besides, by warding off the sun's rays, the danger from sun stroke, and is a convenient shelter in case of sudden showers.

This invention was patented through the Scientific American Patent Agency, October 27, 1874, to Jefferson G. Darby, of Fort Motte, S. C.

SIR SAMUEL BAKER'S EXPEDITION.

Sir Samuel Baker, who was commissioned by the present enlightened Khedive of Egypt to proceed into the interior of Africa and suppress the slave trade of that immense wilderness which lies south of the Khedive's territory, has recently published an interesting and valuable book of travels. In describing his journey up the White Nile, he states that he had European vegetables of all kinds. "Having cleared and grubbed up a portion of the forest, we quickly established gardens. The English quarter was particularly neat. The various plots were separated by fences, and the ground was under cultivation for about two acres, extending to the margin of the river. I did not build a house for myself, as we preferred our comfortable barge, which was moored alongside the garden, from the entrance of which a walk led to a couple of large mimosas, that formed my public divan, where all visitors were received. In a short time we had above ground sweet melons, water-melons, pumpkins, cabbages, tomatoes, cauliflowers, beetroot, parsley, lettuce, celery, etc.; but all the peas and beans, and a very choice selection of maize, that I had received from England, were destroyed during the voyage. Against my express orders the box had been hermetically sealed, and the vitality of the larger seeds was gone."

We select an engraving from this interesting book, in which the gigantic aquatic vegetation of the district is well shown, together with the curious rig of the boats used for inland navigation in Africa, of which a yard of immense length, made of one cane stalk, is the distinguishing feature.

VEGETATION ON THE BANKS OF THE WHITE NILE.

THE GREAT WELL AT PROSPECT PARK, BROOKLYN.

The Brooklyn Park Commission have provided, for the needs of the beautiful pleasure ground, a supply of water which enables them to be independent of the Ridgewood water, the yield of which is already well taxed in furnishing the city, with a prospect of a much larger demand in the immediate future. The well is situated under the shadow of Look-Out Hill, the highest ground in the park, on the summit of which a reservoir, 175 feet above the surface, has been constructed.

We give herewith a view of the upper part of the well, by which its ample proportions may be well conceived. Three quarters of a million gallons of water daily flow into the well, to be pumped, by the engine on the platform shown in our engraving, up to the distributing reservoir above described. It will be seen that the well is not, as it is sometimes called, an artesian well, and differs from the ordinary well only in its great size. The water flows horizontally, through pervious soil, till it reaches the intercepting drains, four of which are shown in the engraving (which we select from the *Christian Weekly*), delivering their water into the well. The structure is surrounded by a skylight, and access to the spiral staircase is found on walking into the engineer's office, shown on the left hand of our engraving, immediately over the engine.

THE GREAT WELL AT PROSPECT PARK, BROOKLYN.

The Latest Artificial Butter Process.

La Nature, of recent date, contains a description of a new artificial butter manufacturing process, the invention of M. Mège-Mouriès, which is being practised in Paris. A comparison of the details with those of the compounding of the oleo-margarin butter, made in this city and not long ago fully described and illustrated in these columns, shows the operations to be identical up to the churning. At this point, the oleo-margarin process is to mix the oil prepared from the fat with one fifth its weight of sour milk, and churn in the ordinary way. M. Mouriès' mode of manufacture seems to be a closer copy of Nature. He adds to 110 pounds of the oil about 25 quarts of sweet milk, in which are dissolved the soluble portions of 1,500 grains of cow's udder. This last is very finely divided and macerated for some time previous to use. The mixture, after agitation, transforms itself first into a cream, and, after about two hours, into butter, from which the buttermilk is drained. It is then washed and salted in the usual manner.

MM. Boudet and L'Hote, two chemists who have analyzed the product, give the rather anomalous opinion that the artificial compound is more nearly real butter than the genuine article prepared from cream. It contains less water, and less animal substance apt to turn rancid, than natural butter.

The imitation, it is stated, is largely employed by dairymen in France for adulteration purposes. Its taste is not agreeable, as it savors strongly of the suet.

In this connection we may remark that there is a very simple and sure way of distinguishing genuine cow butter from the oleo-margarin mixture. It consists in dissolving a small portion of the suspected substance in ether, and evaporating to dryness by the application of a gentle heat. The residue has the true butter smell if genuine, which may be greatly intensified by cooking. If artificial, however, the deposit has the easily recognizable odor of suet. A complete description of a test for artificial butter, by Mr. John Horsley, F.C.S., by the use of methylated ether, was given on page 370 of our volume XXXI.

The Slang of the Stock Exchange.

Gamblers of every grade, says a contemporary, have their slang terms to convey to the initiated just what they mean; and however blind it may be to the uninitiated, it is perfectly intelligible to those possessed of the high civilization (?) necessary to "manipulate stocks." Four different forms of contracts are known under the general term of stock privileges. The "put" and "call" are single privileges. The "straddle" and "spread" are double privileges. A "put" is a contract giving the holder the right of delivering a certain amount of stock within a definite time at a stipulated price. A "call" is exactly the reverse of a "put," being a contract giving the holder the right of calling for the stock instead of delivering it. A double privilege is a "put" and "call" on the same stock in one contract. When a double privilege is drawn at the market price of the stock, it is called a "straddle," and costs from two and a half to five per cent premium. But when drawn at a distance of from one to two and a half per cent above and below the market price, it is called a "spread," for which a fixed premium of two per cent is paid. The distance from the market at which a "spread" is drawn depends on the class of stock and the activity of the market.

Unhealthy Plants.

Whenever plants begin to drop their leaves, it is certain that their health has been injured either by over-potting, over-watering, over-heating, by too much cold, or by applying such stimulants as guano, or by some other means, having destroyed the fine rootlets by which the plant feeds, and induced disease that may lead to death. The case is not usually important enough to call in a "plant doctor;" so the amateur begins to treat the patient, and the practice is in all probability not unlike that of many of our household physicians who apply a remedy that increases the disease. Having already destroyed the, so to speak, nutritive organs of the plant, the stomach is gorged with food by applying water, or with medicine by applying guano or some patent "plant food." Now the remedy is nearly akin to what is a good one when the animal digestion is deranged—give it no more food until it reacts. We must then, if the roots of the plant have been injured from any of the above named causes, let the soil in which it is potted become nearly dry; then remove the plant from the pot, take the ball of soil in which the roots have been enveloped, and crush it between the hands just enough to allow all the sour outer crust of the ball of earth to be shaken off; then re-pot in rather dry soil (composed of any fresh soil mixed with equal bulk of leaf mold or street sweepings), using a new flower pot, or having thoroughly washed the old one, so that the moisture can freely evaporate through the pores. Be careful not to over-feed the sick plant. Let the pot be only large enough to admit of not more than an inch of soil between the pot and ball of roots. After re-potting, give it water enough to settle the soil, and do not apply any more until the plant has begun to grow, unless, indeed, the atmosphere is so dry that the moisture has entirely evaporated from the soil; then, of course, water must be given, or the patient may die from the opposite cause—starvation. The danger to be avoided is in all probability that which brought on the sickness, namely, saturation of the soil by too much water. Other causes may induce sickness to plants, such as an escape of gas in the apartment, or smoke from a flue in the greenhouse; but in all cases, when the leaves fall from a plant, withhold water, and, if there is reason to believe that the soil has been poisoned by gas or soddened with moisture, shake it from the roots as before advised, and re-pot in a fresh flower pot. Many years ago, when I used smoke flues in my greenhouses, some kindling wood, carelessly thrown on the top of one of them, ignited, and the smoke caused the leaves of every plant to drop. There were some 3,000 plants, mostly tea roses, in the greenhouse; it would have been too much of a job to re-pot all, but, by withholding water for some ten days, until they started a new growth again, very few of this large number of plants were injured.
—*Peter Henderson.*

OCEAN TELEGRAPHY.

BY GEORGE B. PRESCOTT.

NUMBER I.

If the unexpected discoveries and gigantic works which have been realized during the past half century had not familiarized us with the marvelous, we should consider the accomplishment of ocean telegraphy to be the eighth wonder of the world: a wonder, on account of the almost supernatural results which it furnishes, the numerous difficulties which it has encountered, the physical results which it has produced: and even a wonder on account of the enormous amount of money which has been expended in its development. In discussing the extent of this marvelous system of international communications, it seems proper to consider to whom is due the credit of taking the first steps toward its accomplishment. Up to 1847, no substance suitable for the insulation of a submarine wire was known. During that year, Mr. John J. Craven obtained and experimented with some gutta percha, and discovered its insulating qualities and its adaptability to subaqueous communication. The Trenton, N. J., *State Gazette*, for May 10, 1848, contains the following paragraph: "Gutta percha is now used for insulating telegraphic wires. Mr. Craven has tried it for the old New York and Philadelphia line in the Passaic river, and has been so successful that the company intend to try to cross from Jersey City to New York by laying several wires, thus insulated, under the water." The New York *Tribune* of June 17, 1848, contains the following paragraph: "The wires of the New York and Philadelphia Telegraph have been extended across the Hudson from Jersey City, and are now in successful communication with that place. They are encased in a double covering of gutta percha, and laid on the bottom of the river in the track of the ferry boats."

In 1846, Mr. James Reynolds, of New York, invented a machine for covering wire with india rubber, and during the year 1847 covered a large amount of wire with this substance; but in consequence of the difficulty of drying it (vulcanization of rubber being then unknown), it proved a failure. Early in the spring of 1848, Mr. Craven brought a piece of wire covered with gutta percha to Mr. Reynolds, and asked if he could cover wire with gutta percha with his machine. Mr. Reynolds undertook to do so, and immediately proceeded to manufacture gutta percha covered wire. He covered the cable which was laid across the Hudson river between New York and Jersey City, *which was the first gutta percha cable ever made, and the first submarine wire ever constructed and successfully operated for the transmission of intelligence over a distance of half a mile.*

One of Mr. Reynolds' workmen, named Champlin, shortly after this cable was laid, went to England and communicated the process to the Gutta Percha Company, who at once commenced the manufacture of gutta percha covered wire.

On the 16th of December, 1859, Mr. Charles Vincent Walker, an experienced telegraph engineer, testified before the joint committee, appointed by the British Government to inquire into the construction of submarine telegraph cables, as follows: "I was the first to use gutta percha in England. I advised Mr. Foster, of Streatham, to apply it in our very early difficulties in telegraphing. We purchased and used the first wire covered with gutta percha, on November 11, 1848."

The first submarine cable ever laid in the open sea was laid between Dover and Calais, in 1850. It was a single strand of gutta percha, unprotected by any outside coating, and worked only one day. The next cable was also laid between Dover and Calais, in 1851. This cable contained four conducting wires, was 27 miles in length, and weighed 6 tuns per mile. This cable is still working, after having been down 23 years. The next long cable was laid in 1853, between Dover and Ostend, a distance of 80 miles, and contained six conducting wires, and weighed 5½ tuns per mile. It is still in working order. It 1853 a cable of one conducting wire was laid between England and Holland, 120 miles, weighing 1¼ tuns per mile. This cable worked for 12 years. From 1853 to 1858, 37 cables were laid down, having a total length of 3,700 miles: of which 16 are still working, 13 worked for periods varying from a week to five years, and the remaining 8 were total failures.

On the 6th of August, 1858, the first Atlantic cable was laid between Ireland and Newfoundland. The weight of this cable was 1 tun per mile, and its cost was as follows: Price of deep sea wire per mile, $200; price of spun yarn and iron wire per mile, $265; price of outside tar per mile, $20. Total per mile, $485. Price, as above, for 2,500 miles, $1,212,500; price of 25 miles shore end at $1,450 per mile, $36,250. Total cost, $1,249,235. This cable worked from August 10 to September 1, during which time 129 messages were sent from Valentia to Newfoundland, and 271 from Newfoundland to Valentia. The failure of the cable was mainly due to carelessness in the manufacture and subsequent handling. When the cable was in process of manufacture, it was coiled in four large vats, and left exposed day after day to the heat of a summer sun. As might have been foreseen, the gutta percha was melted, and the conductor which it was desired to insulate was so twisted by the coils that it was left quite bare in numberless places, thus weakening and eventually, when the cable was submerged, destroying the insulation. The injury was partially discovered before the cable was taken out of the factory, and a length of about thirty miles was cut out and condemned. This, however, did not wholly remedy the difficulty, for the defective insulation became frequently and painfully apparent while the cable was being submerged. Still further evidence of its condition was offered when it came to be cut up for charms and trinkets.

The next long cable which was laid was from Suez to India, a distance of 3,500 miles in 1859. This cable was laid in five sections, which worked from six to nine months each but was never in working order from end to end.

The total length of all the cables which have been laid is about 70,000 miles, of which over 50,000 miles are now in successful operation. The 20,000 miles of cables which have thus far failed represent 58 in number. Up to 1865, none of them had been tested under water after manufacture, and every one of them was covered with a sheathing of light iron wire, weighing in the average only about 1,500 pounds per mile. These two peculiarities are sufficient to account for every failure which has occurred. No electrical test will show the presence of flaws in the insulating cover of a wire, unless water or some other conductor enters the flaw and establishes an electrical connection between the outside and inside of the cable; and all cables laid in shallow water should have an armor weighing not less than five tuns per mile.

The core of long submarine cables generally consists of several wires of pure copper covered with alternate layers of gutta percha and Chatterton's compound, the latter consisting of gutta percha, resin, and Stockholm tar. Over this is placed a layer of tarred yarn, and the whole is finally included in a sheathing of iron wire laid on spirally, to give the cable sufficient strength to withstand the strain of paying out, or that to which it may be subjected by the inequalities of the ocean bed. Not infrequently the iron wire of the sheathing is also protected from corrosion by tarred hemp. Figs. 1 and 2 show the construction of the Malta and Alexandria cable. The different layers are so far peeled off as to show the construction. The strand of seven copper wires is shown at the top; then follow three layers of gutta percha and one of tarred yarn, the whole enveloped in the eighteen wires constituting the sheathing. The diameter out in the sea is 0·85 of an inch. Near the shore the sheathing is made stronger, to meet the danger of accident from the dragging of anchors.

Fig. 1.

Including the original 1858 cable, five cables have been laid down between Ireland and Newfoundland, of which only three are now in working order. These three were laid in 1866, 1873, and 1874. The cable of 1865 of a similar type as the above has not been working for over two years.

Fig. 2.

Fig. 3.

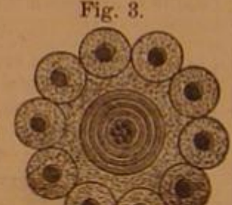


Fig. 4.

The following are the details of construction of the last four Ireland and Newfoundland cables. Fig. 3 shows the section, and Fig. 4 the external appearance and construction, of the 1865 cable in the full size, 1⅛ inch in diameter. Fig. 5 shows the shore end in section. The construction of the 1865 cable is the same as that of all the subsequent ones, with one or two non-essential differences.

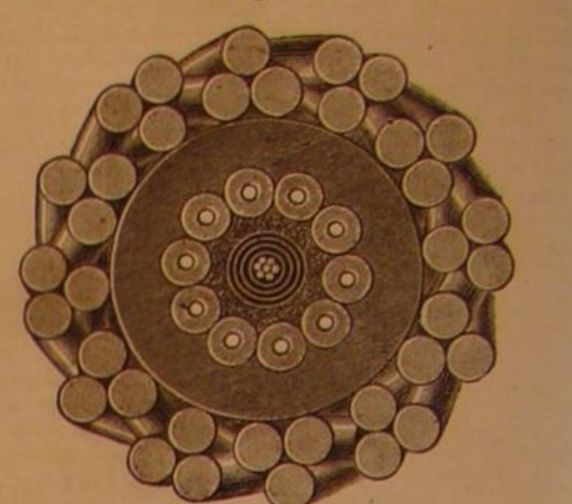
The conductor of this cable consists of a copper strand of seven wires, six laid round one, and weighing 300 pounds per nautical mile, imbedded, for solidity, in Chatterton's compound. Gage of single wire, 0·048 of an inch; gage of strand, 0·144.

The insulation of each cable consists of four layers of gutta percha, laid on alternately with four thin layers of Chatterton's compound. The diameter of core (conductor and insulation) is 0·464 of an inch.

Its external protection consists of ten steel wires, 0·095 of an inch in diameter, each wire surrounded separately with five strands of tarred manilla hemp, and the whole laid spirally round the core, which latter is padded with tarred jute yarn. The weight in air is 35 cwt. 3 qrs. per nautical mile; weight in water, 14 cwt. per nautical mile. Any of the cables would bear eleven knots of itself in water without breaking.

When a telegraph wire at a distant station is disconnected from the ground and placed in connection with one of the poles of a battery, the other pole of which is to earth, a charge flows into the wire at the instant in which the connection is made and, if the insulation of the line is perfect, almost instantly ceases. The needle of the galvanometer makes a sudden deflection, and then returns to its position of rest. If the battery is cut off and the line, at the same moment, put to earth, the needle deflects momentarily in the opposite way, and the charge given to the wire returns and goes to earth. In land lines, this return charge is very slight except upon very long lines, but in submarine cables it is very marked. This return charge shows that a telegraph wire may be charged like a Leyden jar. The wire is the inner coating, the air or gutta percha the dielectric, and the earth or sea the outer coating. The statical charge of which a line of telegraph is then capable shows that the electric force tends to propagate itself not only longitudinally but laterally.

Fig. 5.



The effect of lateral induction is to retard the time of delivery of a signal and to prolong it, so that, although it is a momentary signal at starting, it becomes a prolonged signal at its destination. The mere slowing of the signal would not matter much, provided it was delivered at its destination as sent; but it is not. Each signal at the receiving station takes a longer time to leave the line than it did to enter it. Hence, in a cable, if the sender transmitted at the same rate and with the same apparatus that he does in land lines, the signals would run into each other at the receiving station, and be indistinguishable. Time must be given to allow each signal to ooze out of the cable before another is sent. Retardation increases with the square of the length of the line. The maximum speed of signaling through 2,000 miles of the Atlantic telegraph of 1858 was two and a half words a minute. The copper core had a conducting power somewhat higher than a No. 4 iron wire If the ratio of the thickness of the core to that of the insulating coating be kept the same, the number of words that can be sent varies as the amount of material employed, or as the square of the diameter of the cable. Thus, if a cable be of the same make and of equal length as another, but twice as thick, four times as many words may be sent by it.

The conductor of the Atlantic cable of 1858 consisted of a strand of seven copper wires of No. 22½ gage, weighing 93 pounds per mile, while those of 1865, 1866, 1873, and 1874 have each 300 pounds per mile. The highest rate of speed obtained through the 1858 cable was 2½ words per minute, while through the 1865, 1866, 1873, and 1874 cables they have obtained a speed of 17 words per minute in regular working, and of 24 words per minute upon an experimental test.

THE CONSTITUTION OF THE SUN.

BY PROFESSOR C. A. YOUNG.

Number III—Conclusion

THE ENVELOPE OR CHROMOSPHERE.

The edge of the sun's visible disk is much less brilliant than the central portions, and this fact was long ago recognized by Arago and others, as evidence of an atmosphere of some depth, covering his surface and cutting off a portion of the light.

This lower portion of the solar atmosphere, which is rich in the vapors whose condensation produces the photosphere, and in which most of the dark lines of the spectrum originate, is comparatively shallow, not more, probably, than from 500 to 2,000 miles in thickness.

But it is surmounted to the much greater elevation of some 8,000 or 10,000 miles by the hydrogen and other non-condensible gases which form the rose-colored envelope to which Mr. Lockyer has given the name of chromosphere. This is a sheet of scarlet flame which clothes the whole surface of the sun, and here and there rises in cloud-like forms that ascend to enormous hights above the general level.

The upper surface of the chromosphere is exceedingly uneven, such as fully to justify the expression "a sheet of flame;" for the whole appearance suggests the idea that it is formed of jets of heated gas rushing up from the central fire through countless orifices and rents between the clouds which constitute the photosphere. And yet "flame" is hardly the right word, for in the chromosphere, so far as we can learn, there is no true combustion; the heat does not come from chemical combinations. These solar flames are mere masses of intensely heated gas, absolutely too hot to burn—at a temperature above what chemists call the "dissociation point," where all play of chemical affinity ceases.

Occasionally the up-rising jet attains a very great velocity, and spreads out in the upper regions of the coronal atmosphere into precisely such forms as those familiarly assumed in our own air by smoke and vapors. For many years they were the subject of much discussion, but in 1868 the spectroscope for ever set the question at rest by showing that they are nothing but heated clouds of gas, largely hydrogen. Their spectrum exhibits conspicuously the bright lines of that element, and besides them another very prominent one, which, from the circumstance that its place in the spectrum is very near the two lines of sodium, D_1 and D_2, is commonly referred to as the D_3 line. Many circumstances make it nearly certain that this line is due to some other substance than hydrogen, a congener in lightness and many other properties, but as yet undiscovered by our terrestrial chemistry. To this hypothetical element the name of helium has been assigned by Lockyer and Frankland, though with rather doubtful propriety. Sometimes, not unfrequently indeed, other lines also appear, among which those of sodium, magnesium, barium, chromium, calcium, titanium, and iron are most common.

That the prominences are merely extensions of a continuous envelope had been maintained, on more or less satisfactory evidence, by several astronomers as early as 1855. It is found that the prominences may be broadly divided into two classes, the nebulous and eruptive. The former, in their appearance, closely resemble our terrestrial clouds; of a delicate filmy texture, often enormous in extent, they seem to float in the upper atmosphere, and gradually dissolve away.

The eruptive prominences are composed usually of vertical filaments, are very brilliant, and undergo the most rapid and extreme changes of form. Their spectrum is often very much complicated by the injection of metallic vapors, and the lines are often widened by pressure, and distorted by violent motions along the line of sight. As a rule, these prominences do not attain so great an elevation or magnitude as those of the other class, but in exceptional cases they far surpass them. The ejected filaments have been known to reach a hight of 100,000, 135,000, and, in one single instance, 210,000, miles.

In most cases, the appearance is that of a jet of heated gas issuing through an orifice, under a great but nearly steady pressure; but in those instances where the greatest velocities are attained, the action is almost invariably paroxysmal, and suggests the idea of veritable explosions. It was the jet-like appearance of these eruptive prominences that led Zöllner to the conclusion that the sun must be covered by a shell or crust (*trennungs-schicht*) of some kind, and he concluded it to be a continuous liquid surface. There seem to be almost insuperable objections to this view in its unmodified form: a stable liquid shell, like that of a bubble, of greater density than the underlying gases, would seem to be impossible, considering that it must be everywhere pierced by up-rushing currents from within. But though such a shell cannot well exist in a condition of statical equilibrium, something considerably like it may result from the constant down-pour of the products of condensation. It seems quite possible, or even probable, that the descending masses of mingled liquid and solid matter, falling through increasingly denser layers of gas, resisted and partially upborne by the furious streams of vapors rushing up from below, may unite into sheets or flakes of considerable extent, and form a kind of shell, which, though not continuous, would still answer many of the purposes of a continuous crust, by confining the ascending currents into narrow channels, in this way increasing their velocity, as well as by the pressure due to the resistance offered to its descent. It is quite probable, moreover, that in these narrow channels the mingled gases, expanding as they rise and becoming cooled by their expansion, may have their temperatures lowered below the point of dissociation, in which case explosions would certainly result. Viewed in this light, the phenomena of the chromosphere and prominences appear as natural consequences of the received theories of the gaseous constitution of the sun.

THE CORONA.

Observed at every total eclipse from remote antiquity, and described by Plutarch in almost the same terms as one would now use, it seems to have eluded investigation until recently. It appears during a total eclipse as a radiant glory surrounding the dark body of the moon, intensely bright near the edge of the lunar disk, fading gradually, but not regularly, as the distance increases, and terminating in a very irregular outline, which is perhaps rather more definite than might have been expected. It seems to be made up of brushes of light emanating from the sun, and reaching an elevation which in some cases fully equals his whole diameter. These brushes or streamers are, for the most part, straight and vertical, but here and there are curved into curious forms, like the petals of a flower. The color of the light is slightly greenish (pearly is the term usually employed in describing it), in beautiful contrast with the ruby-colored prominences which blaze at its base, like carbuncles.

As to the nature of the corona, we have as yet no certain knowledge; the principal line in its spectrum apparently coincides with one which has been ascribed to iron; but there are abundant reasons for refusing to believe that it is really due to iron; and if not, the chemists have presented to them an interesting and important problem to ascertain its real origin. The observations of Janssen and Lockyer, in 1871, seemed also to show the presence of hydrogen in the coronal regions. Probably the corona consists of minute particles, solid and liquid, disseminated through a highly rarefied gaseous atmosphere; but to what extent it is composed of meteoric matter rushing toward the sun, or of solar dust thrown upward, and what forces form and direct the streamers and pencils of light, and why the polar regions are left so bare, these are problems of the future, to be classed with the explanation of the aurora borealis and the tails of comets, and, more than probably, require the recognition and investigation of other forces than that of gravitation.

Recent American and Foreign Patents.

Improved Scaffold Clamp.

William Smith, Philadelphia, Pa.—This is a scaffold clamp bar, having flat and perforated feet adapted to be held to poles by a pair of screws. With this clamp the scaffold is made safe, and the ledger boards are not injured.

Improved Cotton Press.

John C. Stokes, Villanow, Ga.—In this vertical press the follower is forced downward upon the matters to be pressed by toggle-jointed levers worked by an overhead windlass, which is operated by a double-acting brake lever, pawls, and a ratchet wheel arranged at one side of the frame. The power can thus be applied by one or more hands standing upon the ground at the base of the machine. The follower is raised by a hand-cranked drum and rope, the latter running up over pulleys at the top of the frame.

Improved Sawmill Dog.

Nathan Hunt, Salem, O.—This an improved dog for holding the last remnant of a log upon a sawmill while being sawn into boards. A block adjusted by a set screw slides on a vertical rod secured beside the knee of the head block. Upon the journal of the block is a sleeve, which carries a claw. By raising a rod attached to the sleeve the claw is forced into the timber, where it is locked in place by screwing the rod into a socket of the sleeve.

Improved Plow.

Adna B. Kellogg, Oakland, Oregon.—This is a point, landside, and a share on the landside, for cutting under the land, constructed of one piece of sheet metal cut out in suitable form, and bent in the shape required.

Fastener for the Meeting Rails of Sashes.

Charles P. Sandford, Mont Clair, N. J.—In this fastening a sliding and revolving bolt is supported in a rotary pillar, and cannot be pushed aside or thrown back from the outside, owing to a rib being cast on the end. The bolt passes through a metal plate secured to the upper sash, and is then turned so as to throw its ribs out of position, thus forming a lock which will also serve to hold the sashes snugly together, and thereby prevent them from rattling.

Combined Fork, Hook, Shovel, and Hoe.

Gardner H. Perkins, Cazenovia, N. Y.—The fork is pivoted between two side plates and is held by pressing against the handle, and by a spring bar, the last secured by a band. To change the fork into a hook, this band is slipped up, and the tines adjusted at an angle to the handle. A flat plate attached to the fork by lugs renders it either a shovel or a hoe, according as it is placed in either of the above mentioned portions.

Improved Hillside Plow.

Minot Ellis, Greenfield, Mass.—By making the mold board in this invention separate from the point, and reversing it by swinging it over instead of under the plow, and bisecting the back part, a furrow can be turned thereby on level land on any kind of soil. For plowing on a hillside, the point and moldboard are reversed while the team is turning round, so that the furrows are all turned down the hill.

Improved Distance Measuring Apparatus.

James B. Thomas, Montgomery, O.—This invention relates to and consists in means whereby the distance from a firearm to the object at which it is to be aimed may be quickly and exactly measured, the sportsman or the army officer thus knowing the precise allowance that is to be made, and which has been carefully obtained by previous experiment. It also allows measurements of land to be readily taken while on hunting excursions.

Improved Harness Attachment.

James D. Truss, Ferryville, Ala.—By this attachment the horse is prevented from throwing his tail over the lines, while it gives him at the same time the proper use of his tail. The invention consists of a round and stiffened strap, which passes over the outer part of the tail, and is buckled, by end straps, to the breeching stays, being also connected, by stays at both ends of the tail, to the back strap, for securing exact and steady position of the tail strap.

Improved Roof Truss.

Uriah G. Spofford, Appleton, Wis.—This consists in the combination of a suspended king post of peculiar construction with the rafters and tie rods, so that by turning nuts, so as to contract the tie rods, the wall plates bear upon the base parts of the rafters, and carry the rafter heads against the head of the king bolt, relieving thereby the wall from the outward pressure of the roof, and raising the roof at the same time.

Improved Cotton Press.

William Koehl, Huntsville, Tex.—Into this cotton press the cotton is transferred in certain quantities by a traveling carriage with removable bottom. The material is then condensed by a vertically moving follower turning in a movable frame on the top part of the press, and finally compressed by a horizontally moving follower, the bale being tied and taken out of the bale box by means of hinged side and bottom doors.

Improved Estimator.

Fredric Maurice Stapff, Stockholm, Sweden.—This invention is one which will find a ready welcome from all engineers, since it substitutes for laborious calculations, by formulæ extremely intricate, a simple mechanical operation, easily performed. The device is a sliding rule so constructed that, by moving certain portions, the necessary results for determining the volume of bodies such as embankments, etc., or of cuts, ditches, and the like, having prismoidal shape, may be instantly picked out through coincidences of lines and similar means. The estimator may also be used for deducing mechanically from a given volume the average hight of the prismatoid containing such volume. Thus applied, it will prove of great use for determining how much the grade of a preliminary railroad line ought to be attached, or how much such a line ought to be thrown to the side for balancing the quantities in the cuts and embankments of a given railroad section, provided the ground on the sides of the preliminary lines has previously been cross-sectioned.

Improved Windmill.

Henry J. Wolcott, Albion, Mich.—This invention is an improvement in windmills whose pivoted wheel sections are automatically adjusted or controlled in position by means of weighted levers. The improvement relates to a slotted disk, which is attached to a sleeve or tube, which slides on the crank shaft, and acts as a guide for the connecting rods of the levers which operate said sections.

Improved Step Ladder.

Jeremiah O. Brown and Orange M. Sweet, Forrestville, N. Y., assignors to Jeremiah O. Brown, same place.—This is a two part adjustable brace pivoted near the foot of the post, and to an upper step of the ladder, to securely hold the post at any angle to the body.

Improved Screen Window Blind.

John P. Clark, Jr., Jackson, Mich.—This is a hinged window frame having an interior bottom hinged part, which may be partially opened, and which is arranged with a blind in connection with a detachable top piece and sliding pane and screen. In hot weather, the screen would be used and the pane taken out, while during the cold season the pane is reinserted and the screw removed. The window would thus furnish a summer protection against mosquitoes, flies, etc., while giving the proper ventilation.

Improved Water Wheel.

Milo E. Washburn, Indian Lake, N. Y.—The buckets are made in two parts, and secured between parallel cone-shaped plates. Each bucket has an adjustable part, which is pivoted through the heads, which may be adjusted to increase or diminish the size of the water issues. The interior openings between the buckets are broad, one portion of the surface of one bucket being concave and curved obliquely, and the surface of the opposite bucket being convex and curved to correspond, so as to make the issue of a curved oblique form. The water, it is claimed, acts by its gravity as well as by the reactive force on the wheel.

Improved Sash Fastener.

William C. Alden, New York city.—In using this device, the lower end of a vertical bar is placed upon the base of the window frame. The plate is raised to the desired hight, and the sash or blind is raised and lowered thereupon. The plate is held by a loop encircling the bar, catching in a corrugation in the rear side of the same. The device is portable and convenient for travelers' uses.

Improved Cotton Press.

William H. Walker, Charleston, S. C.—The upper side of the cross head of a vertical engine is provided with cams to work sectors, which are arranged above the cams and under the beam which raises the platen, so that the lower corners of the sectors to be acted on by the cam hang vertically from their axis, while the others, which act upon the beam, are in a horizontal position. The said cams are so formed that, in the fore part of the operation, they present a descending plane to the rollers of the sector until they are moved a certain distance from the vertical line in order to give the necessary direction to the force. Afterwards the cams ascend as the sectors change their direction, and they rise above the hight of the starting point, so that, besides applying the power to the best advantage in point of the direction, they also cause a greater range of movement to the follower than is due to the movement of the piston.

Improved Process for Filling Fiber in Paper Pulp.

Herman Duemling, Fort Wayne, Ind.—This invention consists mainly in the chemical fixing of the filling material in the fibers of the pulp in the beating engine, or in a separate mixing vessel, by means of the sulphates and silicates of the alkaline earths. A solution of chloride of barium is first added, followed by a solution of sulphate of magnesia, by which an exceedingly white precipitate of sulphate of baryta is obtained. A solution of chloride of magnesium is then introduced to the pulp, and allowed to act thereon, to be then precipitated by a solution of silicate of soda, which produces a white and very voluminous precipitate of silicate of magnesia, which adheres firmly to the fiber. The pulp is then worked up into paper in the usual manner, furnishing a paper of superior whiteness.

Improved Device for Taking up the Slack of Lines.

Hugh Douglas, Dubuque, Iowa.—This is a portable device for stretching slack lines. A forked base frame is provided with a lateral stretching roller, having side ratchets and a retaining pawl, to be operated by a lever with a pivoted pawl. The line is guided and secured when stretched by a pivoted double eccentric, with lever handle.

Improved Sleeve Adjuster.

Alfred Perego, Brooklyn, N. Y.—This device enables the cuff to be readily raised upon the arm and held above the wrist, so that when at work, or when washing the hands, the cuff may be removed from contact with dust or water, and may thus be kept neat and clean. It is a tab, secured at the cuff and arranged to be buttoned to a button on the sleeve when it is desired to raise the wristband.

Improved Plenum and Vacuum Pumps.

Daniel L. Cameron, Madison Station, Miss.—A hollow shaft forms the axis about which a spiral tube is disposed. The supports for the axis are hollow, and there are inlet and exhaust valves at each end of the shaft. The latter is partitioned between the ends, so as to cut off communication through it from one end of the coiled tube to the other. A portion of the coil is filled with mercury as high as the arms of the shaft. By turning the coil, the mercury, flowing along the tube from one end to the other, will create a vacuum in the side and plenum on the other side, and will draw air or water through the inlet valve at one end of the hollow shaft, and expel it at the other end through the exhaust valve. If the motion be reversed when the mercury has traversed the length of the coiled tube, the suction will open the opposite pair of valves, thus producing continuous suction and exhaust.

Improved Fruit Protector.

Aaron S. Dyckman, South Haven, Mich.—An upper platform rests upon cap hoops that hold a wire gauze cover over the peaches or other fruit. The two platforms are clasped upon the baskets and caps by end-threaded rods working in a nut formed in the cross piece. By putting four to six baskets in this crate, they are readily manipulated. The fruit is visible, and yet it cannot be purloined.

Improved Washing Machine.

Adam Cook, Pittsburgh, Pa.—When the clothes are put in the tub with the water and suds, a clamping device, which holds the apparatus in position, is released, and the wash board swung back and lowered thereon. The tub is then rotated or reciprocated by the fly wheel until the clothes are cleaned. The latter are then taken out and passed through the wringer, which is attached to its supporting piece. The bottom of the wash board, and also of the tub, has corrugations for rubbing the clothes.

Improved Hay Derrick.

Christopher Lidren, La Fayette, Ind., assignor to himself and R. Jackson, same place.—In this invention, the beam of the derrick is pivoted to the standard, so as to swing up and down, and the rope is so contrived that the fork is raised and lowered by this action of the beam, and at the same time caused to travel through a greater range than the beam does. For operating the beam, a cam is fitted around the base of the standard, to be revolved by a horse, and a lifting post is combined with this cam and the beam, so as to transmit the motion of the cam to the beam. The cam is also contrived so that it carries the beam, by means of the foot of the lifting post, around over the stack, and lodges it upon another stationary cam inside of the revolving one, down which it returns by gravitation to the place of starting. The revolving cam then escapes from the foot, leaving the horse ready to raise the beam and fork again by continuing in his course, and without backing up.

Improved Ore Separator.

Charles H. Campfield and John M. Hornbeck, Ellensberg, Oregon.—This invention relates to a method of attaching a covering of villous or fibrous fabric of hair to the bottom of an inclined frame. When the machine is adjusted to the proper angle, the friction produced by the bristling surface of the lining is so great that it gives the water and sand a rolling motion, which carries the light, flaky, and floating particles against and gradually into the fibrous projections of the lining. The weight of the water and the gravity of the gold tend to carry the particles down to the base of the bristles, which form so many little pockets for collecting and retaining the gold until removed by the miner.

Improved Feather Renovator.

John C. West, Morenci, Mich.—This is a large drum provided with a steam jacket and longitudinal central tube, the whole so arranged as to ensure a constant circulation of the steam. The steam sections have a common valve, and there are suitable arrangements for treating the feathers by direct admission of steam.

A Remarkable Trial and Triumph.

The triumph of Wheeler & Wilson, at the American Institute, New York, with their New No. 6 Sewing Machine, was remarkable in many respects. Extraordinary and repeated examinations were made, one lasting from 10 o'clock A.M. until 6 P.M. The parts of six machines were ordered from the manufactory, and a machine was constructed of parts selected by the judges, which was then tested on all kinds of work, from gauze to heavy harness, by foot and steam power. The general quality of the Company's workmanship was ascertained by an examination of machines in their warehouses, and the testimony of many disinterested users of the machines, far and near, was procured to ascertain their practical working.

The five judges, in conclusion, unanimously reported the Wheeler & Wilson New No. 6 Sewing Machine "as a machine which, by the proof submitted, we are satisfied must eventually supersede all others now known with which it comes in competition." And they "recommend for it the highest award which it is in the power of the Institute to bestow."

The Board of Managers unanimously approved the report, and recommended for this machine the Gold Medal of the Institute.

The Board of Direction unanimously approved this recommendation, and awarded the Gold Medal to Wheeler & Wilson, the only gold medal awarded for a sewing machine by the American Institute for many years.

Business and Personal.

The Charge for Insertion under this head is $1 a Line.

Notes & Queries

W. H. C.'s idea for driving a propeller by a spring is not likely to prove practicable.—W. E. H. will find directions for making a storm glass on p. 75, vol. 30.—C. B. will find a recipe for fireproofing shingles on p. 280, vol. 28.—W. C. B. will find an explanation of the moon's variations on p. 251, vol. 31.—R. R. R. will find an elucidation of the weight on an inclined plane question in our recent issues. —M. will find directions for tempering springs on p. 10, vol. 25.—J. H. L. can harden tallow for making candles by the process described on p. 201, vol. 24.—G. E. O. will find Warren's works on mechanical drawing and Davies & Peck's "Algebra" to be good and practical.—R. W. W. will find a description of the philosopher's or hydrogen lamp on p. 242, vol. 31.—C. H. H. will find full particulars as to Coignet stone on p. 124, vol. 22.—J. M. will find recipes for hard soap on pp. 331, 379, vol. 31, and for boot blacking on p. 283, vol. 31.—J. J. D. will find directions for tanning skins with the fur on on p. 233, vol. 26.—W. P. P. will find a description of processes for preserving wood from decay on p. 319, vol. 31.—J. F. should refer to p. 203, vol. 31, for a recipe for polishing shirt bosoms.—J. M. H. and others can unite rubber to leather by using the cement described on p. 119, vol. 28.

(1) J. M. asks: 1. What horse power would it take to run a boat 16 feet long by 5 feet beam? A. An engine of ½ horse power would answer. 2. What is the cost of an engineer's certificate? A. See p. 282, vol. 31.

What is camphor composed of? A. It is a crystalline substance obtained from a tree. It contains carbon, hydrogen, and oxygen.

(2) G. G. L. says: I wish to make a large clock dial for my windows, and drive the hands by electricity from a regulator in the shop. Please say how I can make it? A. The electrical part consists of an electro-magnet and armature worked by a battery of two Daniell's cells. The armature is attached to a lever, having a pawl connected at its upper extremity, which moves a toothed wheel. Whenever the regulator closes the circuit, the pawl causes the wheel, which carries the hands, to advance one tooth. The regulator may be arranged to close the circuit every second or every minute, as desired.

(3) J. R. says: 1. Alexander Watt recommends to electroplaters, from personal experience, the following battery: A stoneware jar holding about four gallons receives a cylinder of thin sheet copper, dipping into water acidulated with 2 lbs. sulphuric acid and 1 oz. nitric acid. A solid zinc cylinder is put into the porous cell, which is filled with a concentrated solution of common salt, to which a few drops of hydrochloric acid have been added. What should be the diameter of the copper cylinder inside the stone jar? A. The diameter should be nearly as great as the jar. 2. Should it have a bottom to it? A. It is immaterial whether it has a bottom or not.

(4) C. A. W. asks: How are Callaud's and the Minotti batteries constructed? A. The Callaud battery consists of a glass vessel with a copper plate at the bottom, upon which are placed crystals of sulphate of copper. A zinc plate is suspended near the top and the jar filled with water. The Minotti battery consists of the same materials as the Callaud, and, in addition, a thick layer of sawdust is interposed between the copper plate at the bottom and the zinc plate at the top.

(5) W. L. L. asks: Will electricity give forth a spark sufficiently strong to light a gas jet? A. Yes, whenever it has a sufficient potential. In cold, dry weather, a person may charge himself sufficiently with electricity to light gas with his finger, by walking briskly over a carpet or rug.

(6) R. C. W. and others.—Liquids, complex or otherwise, can be analyzed with the same accuracy as solids. But it is possible so to muddle things that an experienced chemist cannot separate them again; but only by artificial means. Nature never presents such difficulties.

(7) W. C. W. asks: In what proportions shall I mix the acids and alcohols to make respectively sulphuric and nitric ethers? A. The method at present in general use for the preparation of ordinary ether—ethylic ether, sometimes improperly called sulphuric ether—is that known as the "continuous process" of Boullay. It consists in mixing together equal measures of alcohol (specific gravity 0·830), and concentrated sulphuric acid; the mixture is submitted to distillation in a capacious retort, which must be connected with an efficient condenser. Through the tubulure of the retort a tube is introduced, which is in connection with a reservoir of alcohol, designed to maintain a supply of spirit sufficient to keep the amount of liquid at a uniform level in the retort during the course of the subsequent distillation. The temperature is then rapidly raised so as to maintain the liquid in steady ebullition. The liquid which passes over consists almost wholly of ether and water, mixed with a small proportion of alcohol which has distilled over unchanged. The process may go on without interruption until a quantity of alcohol, about 30 times as great as that originally taken, has become converted into ether. Isethionic acid is gradually found in the residue. Nitric ether is obtained by gently heating one volume of nitric acid, of specific gravity 1·40 (to which a few grains of nitrate of urea have been added in order to prevent the formation of nitrous acid), and 2 volumes of alcohol, of specific gravity 0·842; the quantity of the mixture operated upon should not exceed a quarter of a pint; under these circumstances the operation proceeds quietly. The first portion of the distillate contains little except alcohol; but as soon as the liquid which distils over becomes turbid on the addition of water, the receiver must be changed and the nitric ether collected separately: the distillation must be stopped when about three fourths of the liquid has passed over, in order to prevent the ether from becoming mixed with secondary products, which cannot be removed without difficulty. The ether is purified by agitation with a weak solution of alkali, and rectified from chloride of calcium. It burns with a white luminous flame; and if heated to a little beyond its boiling point, it is decomposed with an explosion on the approach of light.

(8) J. C. B. says: A. claims that 1 lb. feathers will be heavier than 1 lb. lead, as the surface of the feathers is larger than that of the lead. Can there be circumstances that will render 1 lb. feathers heavier than 1 lb. lead? A. The weight of a body in a vacuum is increased by the weight of an equal volume of air. Hence, if the feathers displace more air than the lead, they would weigh more, in a vacuum.

(9) A. F. asks: Is there a nozzle, in use by fire departments, that can be made to throw a large or small stream at pleasure? A. Yes. It is quite a common device.

(10) P. W. asks: 1. Can a Leyden jar be charged with voltaic electricity? If so, how? A. Yes. Connect one pole of the battery with the inner coating, and the other pole with the outer coating. 2. Is a simple galvanic Bunsen cell enough to generate electricity to charge a jar? A. One cell would charge it very slightly. 3. How many Bunsen cells does it require to burn metals? A. Fifty cells would burn a small wire. 4. Would it answer the purpose, instead of coating internally, to drop strips of tinfoil in the jar as high as the internal coating should come? A. It would not, unless the strips were connected together so as to be continuous. 5. Should the bottom be coated outside? A. No. 6. Is it necessary for the jar to have a brass cap? A. No. 7. Would an iron wire passing through the cork connecting with metallic filling answer to conduct the electricity? A. Yes. 8. Is it necessary for the rod to have a brass head? A. No.

(11) J. J. J. asks: What makes water in a well look blue when sunlight is deflected on it? A. The blueness is due to a partial absorption of the red and yellow components of the solar ray, leaving the light with an excess of blue, which imparts to it its peculiar tint.

(12) P. T. M. asks: What is the easiest and best way to polish marble, agate, and granite? A. The polishing is differently carried on, according to the nature of the work. For small slabs or objects of an ornamental kind, the highest degree of finish is requisite. Polishing is commenced with pumice stone and water, and with snake stone, after which various rollers or rubbers are employed. If the object be large and flat, the rubber may be a large wooden block faced with thick woolen cloth, or a mere bundle of woolen or other cloth, compressed in a rectangular iron frame, and moved about with a handle. For smaller work, rollers of woolen cloth or list, about 3 inches in diameter are employed; some of these are charged with flour, emery, and a slight degree of moisture, which produces a kind of greasy polish uniformly over the surface. A similar cloth, charged with putty powder and water, completes the process. In some of the more delicate works, crocus is used intermediately between the emery and putty powder.

(13) W. C. B. asks: What is the difference between a high and a low pressure engine, and what effect has the difference on the draft? A. The high pressure engine has no condenser, and frequently discharges the exhaust steam into the smoke pipe, thereby increasing the draft.

(14) J. P. says: I am burning slack under my boiler, and my tubes want cleaning two or three times a week. I am thinking of blowing them out with steam. Will the steam injure them by corrosion? A. No. This is ordinarily a very good plan.

(15) C. S. A. asks: I am using a wire rope, with a windlass and pulleys, subjected to very heavy strain. The rope seems to get stiffer from use. If I heat it red hot and let it cool slowly, it will be more flexible: but will it injure the rope? A. Not appreciably.

(16) B. F. G. says: We are burning Gross creek coal; it is very soft, and very much like the ordinary blacksmith's coal, but is of a higher grade. We find that in wet weather we burn more in weight than when dry. A few days ago I weighed very carefully 500 lbs., dry, and afterwards added ½ gallon of water. I then reweighed it, and found that it had gained 20 lbs. I spoke of this experiment to a friend, and he said that it was impossible for it to gain 20 lbs., as the only weight that the coal could gain would be the weight of the water. Am I or is my friend right? A. Even in the face of the very stubborn facts that you present, we agree with your friend, and question the facts. 2. What is the weight of 1 gallon of water? A. A United States gallon of water weighs about 8·3 lbs.

(17) A. F. C. asks: 1. What would be a safe pressure to carry on an upright tubular boiler 15 x 30 inches, having 52 one inch tubes made of three sixteenths iron? A. A safe pressure would be 100 lbs. per square inch. 2. What would be the bursting pressure? A. About 600 or 700 lbs.

(18) H. K. asks: 1. What, in your opinion, is the best and cheapest method of preventing incrustation in steam boilers? A. In some special cases the tannate of soda seems to act beneficially. 2. What do you think of steam heaters and filters to prevent scales in boilers? A. In general we recommend the use of a good heater and frequent blowing. 3. What is mostly used in the East to keep the boilers clean? Is the water in the Eastern States generally impregnated with lime? A. The water used in boilers at the East ordinarily gives as much trouble from scale as that at the west.

(19) J. C. M. says: With the intention of increasing the capacity of a steam boiler (horizontal, 42 inches in diameter and 18 feet long, with 32 tubes), I introduced some 4 inch tubes under the boiler, commencing just behind the bridge wall and running back the length of the boiler. These pipes had cast iron connections at the bends. I placed them 8 inches below the bottom of the boiler, connected them at the back end of boiler near the bottom, and attached the feed pump near the front, and fed with hot water. The first day they worked well and improved the boiler greatly in steaming capacity; but on the third day, just after starting up, with the first stroke of the pump, the cast iron end on the pipe where the feed pipe was connected burst with a loud report, and for a few seconds nothing but blue steam escaped, and finally water and steam. Thinking the trouble was in pumping in water so near the fire and bridge wall, I changed the connection, putting the feed pipe into the mud drum, and then letting the back connection stay as it was, making a series of circulating tubes. On firing up this time, I was alarmed by a succession of concussions or jars in the boiler that shook the walls; but by firing slowly, we got up steam without any accident. In an hour or two we noticed that the tubes nearest the fire and bridge wall were red hot, and blue steam was escaping from the joints of the connections on the ends of the tubes. We drew the fire and removed the tubes. We found a great improvement by the use of these tubes, and did not like to abandon the use of them. We are at a loss to account for the phenomenon of blue steam being where we expected nothing but water. What is our remedy? A. The trouble seems to have been that the pipes got so hot that they made steam faster than it could be carried off, the circulation being imperfect. It will probably be necessary to use larger pipes, or to discard the return bends, to make the present arrangement successful. The same trouble has occurred with some forms of sectional boilers, whose use has been abandoned on account of the poor circulation.

(20) S. J. P. asks: I have a telegraph instrument, which I wish to attach to a railroad line. Will it work without a relay? A. Not on the main line. A relay will cost about $16.

(21) M. R. H. asks: How can I prevent beech wood lasts, subject to a temperature of 200° Fah., from being affected by the heat? A. There does not appear to be any way to do this, better than well seasoning and drying the wood before using.

(22) H. R. R. asks: A rectangular wooden tank lined with zinc is used in the second story as a reservoir for rain water. Since its erection, we are told that the zinc will soon corrode and the vessel become useless. Is there any way to preserve it, by paint or otherwise? A. The zinc becomes coated with a white oxide which washes off with the water, and by repetition of this process the metal is reduced in thickness and strength. There is a slate paint for application to iron tanks which might be serviceable when applied to zinc.

(23) A. B. C. says: "We have just started a new steam pump in a mine, at 700 feet level. To prevent the steam from exhausting in the shaft, a pipe was fixed to convey it into what we call the suction pipe, and the connection at the suction pipe was a globe valve or chamber, as the valve was taken out, and the exhaust pipe inserted in its place. This was the engineer's plan. I said that I did not think it would answer, as the chamber or pipe where the exhaust steam meets the water was too small, and the steam would cut off the water, or at least some of it; and it so happened that, when they started the pump, it would not pump ⅓ of the stream it ought to, which proved my words true. He took it away from there, and put it to exhaust in a wooden pipe which brings air down to the bottom of the mine, and it would be just as well if he let it exhaust right in the shaft as in that pipe; for the air strikes it, and it condenses, and as a matter of course fills the shaft with smoke. Now I think I can put the exhaust steam into the suction pipe so that it shall work all right. My plan is to have a larger and a more suitable connection with the suction pipe. Do you not think this will answer? The reservoir stands about level with the pump. The suction pipe is of 4 inches diameter." A. You are just entering on a field in which a great deal of money has already been spent for experiments, namely, condensers for steam pumps. The matter has already been worked out practically, and we think your cheapest and most satisfactory plan would be to obtain a condenser.

(24) J. McD. asks: Your article headed suction in your issue of December 5 leads me to make the following inquiry: Suppose a vessel be filled with water, and there be placed in the top of said vessel a tube extending upwards for fifteen feet, and there be attached to said tube two stopcocks, one at either end. If the lower cock be closed, and the air be exhausted from the tube, after which the upper cock be closed and the lower opened (allowing free access to the tube for the water), will the water rise into the tube from the vessel? A. Yes.

(25) W. A. W. asks: 1. How thick ought a cylindrical boiler of cast iron to be, to sustain a steam pressure of 5, and 6, atmospheres? The cylinder is about 10 inches diameter. A. If not more than 12 inches in diameter, make it from ⅝ to ¾ of an inch in thickness; but better still, do not make the boiler of cast iron. 2. What should be the diameter of the safety valve? A. Three fourths of an inch.

(26) W. D. and others: Our opinion is that power will always be got from coal for at least one fiftieth part of the cost of getting it from electric motors, using acid and zinc.

(27) T. C. C. says: I have a pump of which the pipe runs 12 feet horizontally and 8 feet perpendicularly. Would there be any difference in the pressure if the same pipe be all perpendicular? A. Yes, as we understand your question.

(28) E. asks: How much more steam does it require at 100 lbs. per inch to produce the same result with a plain oscillating cylinder, taking steam through the side to full stroke (as it must do), than it does with a stationary cylinder, using a slide valve and cutting off the steam at the most economical point? I think that a better result would be attained with oscillating cylinders than could be attained with the slide valve, provided that the slide valve had no lap or lead, taking steam to full stroke, from the fact that the ports of the oscillating cylinders open almost instantaneously and at a point where the piston is traveling at its slowest: whereas, with the eccentric movement, no such rapid change can be attained. A. There are oscillating engines with ordinary slide valves in use.

(29) J. A. C. says: A saw was burnt, and, as the new one came to the mill, the men remarked: "We'll need a blower to make steam enough to drive that big fellow." I said: "I don't think you will need any more steam for the same work than for the little old one." The men were all against me. All things else being equal, does a large saw require more power than a small one? If so, why? A. All other things being equal, the large saw would require the most power, since the resistance is overcome at the end of a longer lever arm, the lever arm to which the driving force is applied remaining the same.

(30) J. E. G. asks: What is a safe working pressure for a flat cast iron boiler, head ¾ inch thick and 1½ inches in diameter? A. About 50 lbs. per square inch.

(31) W. & B. ask: Is there a treatise published, explaining how to set a steam flue boiler, over a brick arch, so as to use the least possible amount of fuel? A. We do not know of any book that gives precisely the information you want. You will find some valuable hints in Wilson's "Treatise on Steam Boilers," and "Heat and Steam Engines," by Professor Trowbridge. See our advertising columns for booksellers' addresses.

(32) H. C. McE. asks: Enclosed find a piece of scale taken from a boiler. What will loosen it from the boiler? A. The best plan is to prevent the formation of scale by the use of a good feed water heater and frequent blowing. You can soften the scale somewhat, by hauling the fire at night, and leaving the water in the boiler until next morning.

(33) Mc. Bros. ask: Is there a work on the care and management of ordinary steam engines and boilers? A. We do not know of any such work. A great deal of information is scattered through treatises on steam machinery, and appears, from time to time, in scientific periodicals. The most valuable information is, however, unwritten, and can only be acquired by experience.

(34) C. M. B. asks: Can the tone of organ or flutina reeds be changed? If so, how? A. It can be done by changing the length of the vibrating part of the pipe or plate. Most wind instruments are arranged so that this adjustment can readily be made.

(35) M. E. J. asks: What is the rule for setting iron buggy axles, front and behind? A. There is considerable difference of practice; and beyond setting them so that the wheels will clear, we do not think there is any definite rule. Some of our readers will please correct us if we are in error.

(36) J. O. S. says: 1. I wish to build a flat bottomed steam pleasure boat, 16 feet long by 6 feet wide, with side wheels. How will a portable engine work in it, to run by a belt, and how many horse power should there be in proportion to that size boat? A. It will be better to discard the belt. Use an engine of from 2 to 3 horse power. 2. Is any license required to run such a boat on a river? A. Yes.

(37) E. S. S. says: I have some boxwood that I wish to make into croquet balls. It requires the whole size of the stick for a ball. Can it be seasoned without checking for next spring's use? A. Allow it to season slowly, in a moderately cool place at first, and finally in or near a chimney corner.

(38) W. E. H. asks: What is the process of manufacturing the small round glass beads which are sold by the pound? They seem to have no fractured edges. A. They are made from tubes cut into the proper lengths, the sharp edges being rounded by fusing, being heated in sand to prevent their fusing together.

(39) D. H. L. asks: Are the trade dollar coins issued by the United States government stamped or molded, to give the impressions? I wish to make similar medals. A. They are struck; but for your purpose it would doubtless be better to cast them.

(40) G. M. R. says: Suppose a locomotive engine is running at the rate of 30 miles per hour, in full fore gear, and is suddenly reversed to full back gear. Is there much danger of the cylinder heads being blown out? A. No. The danger would be of breaking some of the moving parts.

(41) J. O'C. says: In your answer in regard to belts on pulleys, you say: "Belts will move towards that part of the pulley where the radius is the greatest." I discovered this high side theory to be a fallacy in 1855. Let a main line of shafting be lined up by any of the usual methods; then the countershafts can be made right by moving them until the belts run even on the pulleys. In most cases, this can be done when the machinery is running. It is an expeditious and accurate method. A. You confound two distinct cases. Our remark had reference to two pulleys whose axes were parallel, one of the pulleys having a swell or convexity. Your illustration applies to the case in which the axes of the two pulleys are not parallel, and different principles are applicable. You will find this case ably treated in Professor Rankine's "Manual of Machinery and Millwork."

(42) R. T. asks: Would the compressing of a bale of cotton at a power of 1,000 tuns injure the staple? Would the oily nature of the fiber of the cotton be impaired when compressed so compactly? Would the density of such packing render it more expensive to the manufacturer in giving it the flexibility required? A. We see no objection to any degree of compression, and the ordinary practice in commercial circles confirms this view.

(43) S. S. B. says: 1. It is stated in Auchincloss "On the Slide Valve and Link Motion" that an engine of the Allen type, under Mr. Porter, attained the rapid piston speed of 1,400 feet per minute. Is this correct? A. Mr. Auchincloss is a very reliable engineer, and such a statement coming from him is worthy of full confidence. 2. How far is it from the Battery to Central Park, through Broadway and Fifth avenue? A. About 4½ miles.

(44) C. H. S. says: I am building a steam yacht, length 18 feet, beam 5 feet, cylinder of engine 3x4 inches. What would be the best dimensions of screw to get the highest rate of speed, and how fast could such a boat be driven, provided that she be very sharp and with good lines? A. Screw, from 16 to 18 inches diameter, with 34 to 36 inches pitch. Six or seven miles an hour would be a very good performance.

(45) C. M. B. asks: Would it be safe to make the firebox of an upright boiler of cast iron, cast in one piece and made very heavy? A. No.

(46) W. G. asks: How many square inches has a 7 inch piston? A. About 38·485. To find the area of a circle, square the diameter and multiply it by 0·7854.

(47) W. W. G. asks: 1. What proportion should the suction pipe of a direct-acting steam pump have to the size of the water cylinder? A. Make it so that the velocity of the water shall not be over 800 feet a minute. 2. What is the velocity of water flowing into a vacuum under atmospheric pressure? A. It will depend upon the orifice, being about the same as water would have in flowing into the air under a head of 34 feet, *plus* the head required to overcome the friction in the pipes.

(48) J. M. says: Let there be four steam engines, similar in all respects with the exception of their cylinders. The mean pressure per square inch, the length of stroke, and the number of strokes in a given time are all equal, but the diameters of the cylinders are 8, 10, 12, and 14, respectively. Would the horse power of the four engines be in the proportion 8, 10, 12, and 14? A. Neglecting friction and other prejudicial resistances, the powers would vary as the squares of the diameters of the cylinders.

Are there any steamers provided with two steam engines, and do these engines work simultaneously? A. Such an arrangement is quite common.

(49) J. F. says: I wish to make my greenhouse tighter by puttying the laps of the glass. Ordinary putty comes off after a year or two. Can you suggest a mixture, to be applied with a putty knife, that will adhere permanently and can be removed, when necessary, for repairs? A. Use soft putty, composed of 10 lbs. whiting, 1 lb. white lead, ½ gill olive oil, and sufficient linseed oil to give the mixture the proper consistence.

(50) D. D. P. asks: 1. Which kind of wood is best for railroad ties, oak, chestnut, or other kind? A. Oak is the best material. 2. Which is best to preserve them? A. The Bethel process of preservation, used in Europe, and to some slight extent in this country. 3. How long will one last if prepared with coal tar? A. A proper treatment is said to double the duration of service of a tie, making it last from 14 to 20 years.

(51) M. G. asks: 1. How is brass spun, and what tools are used? A. It is secured to a revolving mandrel on which the pattern is fixed, and pressed up against this with a blunt tool. 2. How many pounds pressure will a copper boiler, 3 feet long, 11 inches in diameter, and ⅛ inch thick, stand? A. About 60 lbs. per square inch.

(52) G. asks: How is lead given to the valve of a hoisting engine, running both ways with only one eccentric? The cam or eccentric rod works on an upper and lower hook of a rock shaft. How much should the valve overlap the port? A. The lead cannot be quite equalized by this arrangement, and you can probably adjust it best by a few trials.

(53) J. M. R. asks: 1. What is the composition of the cheapest brass? A. Apply to a cheap brass founder. We have seen so-called brass of such poor quality that but for its color we should have judged it to be lead. 2. Can bronze be cast in other than clay molds, renewed for each cast? A. Metallic molds are frequently used. 3. Is there any composition of metal which, while cheaper than brass, will be as hard and as tough? A. No. 4. What will prevent common gray iron from rusting? A. It can be covered with varnish or other preparation to keep off the air.

(54) W. J. P. asks: What is the best means for consuming smoke? We have two Cornish boilers, 30 feet long by 6 feet diameter, with return flues 2 feet in diameter, and 5 feet furnace. We use soft coal which throws off a very thick smoke. How can we burn it? A. No general rule can be given. There are a number of patent furnaces for completing the combustion.

(55) C. W. asks: Why is it that, when the water in a boiler gets low, the steam becomes blue? A. It becomes so hot that it does not condense readily.

A friend of mine says that the water is not forced into a pump by the air, for if so, how does the water come up the drive wells? He says that there is no air at the bottom of the well. I think that there is air in the ground that forces the water up in the pump. Which is correct? A. The water rises in such a case from the pressure due to a higher source of supply.

(56) B. & H. say: We have put a mortice bevel wheel on our line shafting. The hangers are bolted to joists in the usual form, but it is very noisy. Is there any way to deaden the sound? A. Use cut gears, and some arrangement to make the shaft run steadily.

(57) B. G. says: Blacksmiths often have broken carriage springs to mend; and after getting them welded, it is difficult to get them tempered again. Please give me a good recipe for tempering them. A. Harden the spring in the usual manner, and draw the temper by heating to a temperature at which oil or tallow will just take fire.

(58) D. B. S. asks: What is the best composition to cast in brass molds, to be hard and strong and take a fine impression of small lines, figures, etc.? A. White metal is ordinarily used for such purposes.

(59) S. G. asks: What will be the flow of water per minute through a pipe under the following conditions: The pipe is 3 miles long, 20 inches in diameter, two thirds full, on a descending grade of 23 feet in the whole distance. The head pressure is no more than enough for the supply. Can you give a rule for such a calculation? A. By the aid of the following rules you can readily solve the example: Measure the length in feet of that part of the girth of the pipe which is in contact with the running water, and the sectional area in square feet of that part of the pipe which is occupied by the water, calling the first quantity b, and the second A. Also measure the length of the pipe, l, and the diameter d, taking both dimensions in feet. You can then calculate a coefficient of friction, f, by the rule. $f = 0{\cdot}005 \times \left(1 + \frac{l}{12d}\right)$, and the total friction, F, will be $F = f \times \frac{l \times b}{A}$. Then, calling the head under which the water is flowing, or the total grade, h, and the velocity in feet per second, v: $v = 8{\cdot}025 \times \sqrt{\frac{h}{F}}$. These formulas will give a close approximation having been constructed from careful experiments. There are, however, so many things that are apt to affect any particular case in practice that an absolute result cannot be obtained except by a test.

(60) R. M. asks: 1. At what heat will fowl's eggs hatch in an oven? A. 102° to 104° Fah. 2. How are hatching ovens constructed? A. You will find a full description on p. 428, *Science Record* for 1873. 3. Are chickens so hatched as strong and healthy as those hatched by a hen? A. If proper care is bestowed upon the eggs while hatching, the chickens will be strong and healthy.

(61) H. A. S. asks: 1. What elements may be detected by the spectroscope? A. Potassium, sodium, lithium, rubidium, cæsium, barium, strontium, and calcium are the elements sought for in the usual course of spectrum analysis. 2. What is the usual charge for spectral analysis, when further examination is not required? A. From $1 to $10, according to the difficulty of the examination and the number of the substances to be examined for.

(62) G. P. asks: What is the best part of the States to go to, to shoot prairie chickens and other game? A. Iowa is considered the best State for prairie chicken shooting; but it is rather late in the season for good shooting at these birds. You would probably get the best sport during this month in the State of Georgia, making headquarters at Savannah. The game would be snipe, woodcock, quail, and duck. In some parts of this State, good wild turkey and deer shooting is to be had.

(63) H. J. E. asks: Has skilled labor advanced or receded in price in the United States since the introduction of factories, machine shops, etc.? A. It has advanced.

How does the gold dollar of the United States compare with the coin of other countries in fineness? A. The law of the United States, passed in relation to this subject, is as follows: "Be it further enacted, That the standard for both gold and silver coins of the United States shall hereafter be such that, of one thousand parts by weight, nine hundred shall be of pure metal, and one hundred of alloy; and the alloy of the silver coins shall be of copper, and the alloy of the gold coins shall be of copper and silver, provided the silver do not exceed one half of the whole alloy. The English pound has 916 grains pure gold in a thousand, the twenty franc piece of France has 899, the Austrian ducat has 986.

What wood is best for lightness, elasticity, and durability? A. Try lancewood. Your other questions are not suited to our columns.

(64) F. E. R. asks: At what speed would an engine having 2 inches bore and 4½ inches stroke drive a boat 18 feet long, 5 feet wide, and drawing 6 inches of water? The engine will have 100 revolutions per minute and 50 lbs. steam. A. The engine would be entirely too small to give a satisfactory result, unless a much higher pressure of steam and greater piston speed were employed.

(65) A. R. & G. K. ask: 1. What number of revolutions is perfectly safe for a 24 inch grist millstone of sectional French burr, imbedded in cast iron band with plaster of Paris? A. Each maker generally gives a table of safe speeds for his mills. 2. How much more power will be required to drive a 24 inch millstone if driven by a 20 feet countershaft than if driven direct from the driver wheel, all things being properly arranged? A. Probably about 5 per cent.

Our water contains iron. Is it safe to use in a boiler that cannot be scoured out or cleaned except by blowing off through the ordinary style of mud valve? A. From your experience, we judge that it is quite safe.

(66) G. W. K. says: I have a foot lathe with only one speed. The driver is 26 inches in diameter by 3 inches face; the driver, on the lathe spindle, is 3 inches in diameter. I want to fix it so as to run a small emery wheel and circular saw, and I purpose to belt from the face plate on to the arbor. How large should the pulley on the face plate be? A. You may have to use a countershaft to get up the speed. A 6 inch emery wheel should make about 2,400 revolutions a minute; an 8 inch, 1,800; a 12 inch, 1,200.

(67) V. M. J. says, in reply to E. M. C., who speaks of difficulty of running his engine on account of heating of bearings: The construction of the engine and the comparative steam pressure has much to do in the case. If the crank is overhung, and high steam pressure is used, 80 or 100 lbs., there will probably be considerable spring to the shaft when the engine is working full, with the size of shaft as given, 3¼ inches. Again, the shaft may not be lined properly, in which case it will be impossible to run without heating or knocking; and although the crank may be in line with the cylinder, it may not be in line with the slides, or the wrist may not put in square with the face of crank. Any one or all of these errors may be the cause of the trouble.

(68) E. B. W. says, in reply to F. J. H., who asked how to calculate the distance between two points on the surface of a globe, angle and radius being given: Multiply the radius by 6·2818, which gives the circumference of the globe; then 360° : the given angle :: circumference : distance between proposed points measured on the surface. The distance measured on a straight line may be found by a simple operation in triangulation.

(69) B. K. W. says, in reply to R. C., who asks if there is any way to test the sourness of vinegar: I find that the pickle manufacturers use the soda test, as follows: Put in a proof glass 1 oz. of vinegar, weigh out a certain number of grains of English bicarbonate of soda, and slowly drop it into the vinegar until it ceases to foam. If it will stand 35 grains, it is fit for their use: but much less strength would do for table use.

(70) A. L. W. says, in answer to R. O. B., who asks for a rule for finding the radius when an arc and its chord are given: The logarithmic sine of ½ the arc is to ½ the chord as the logarithmic cosine of ½ the arc is to the cosine of ½ the arc.

That is: $\log \sin. \frac{arc}{2} : \frac{chord}{2} :: \log. \cos. \frac{arc}{2} : \cos. \frac{arc}{2}$

Then: $\sqrt{\left(\frac{chord}{2}\right)^2 + \cos.^2 \frac{arc}{2}} = radius.$

(71) A. W. S. says, in reply to several correspondents, who asked how to keep cider sweet: Fill a barrel with new cider, plug it up with a cork, and through the cork put a lead pipe. Bend the pipe over and put the other end in a pail of water. This will allow the gas from the cider to pass off through the pipe, and the water will keep the air from getting into the barrel.

W. S. M. asks. What chemicals will keep tallow in solution with crude petroleum at a low temperature?—J. E. W. asks: How can I tin small lead castings?

COMMUNICATIONS RECEIVED.

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

On Mind Reading. By W. E. H.
On Coinage Free of Charge. By A. S. S.
On the Spider's Ingenuity. By I. T. T.
On Patents and Patent Laws. By G. W. P.
On Powdered Fuel. By J. J. S.

Also enquiries and answers from the following:

J. H.—W. B. R.—C. T. S.—V.—A. N. W.—J. F. T.—C. L.—D. de F.—A. R. J.

HINTS TO CORRESPONDENTS.

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

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

Hundreds of enquiries analogous to the following are sent: "Who makes the odontograph, for laying out teeth of gear wheels? Who sells diamond drills? Who sells lithographs of marine engines Who makes the best evaporator, heated by steam Who sells nail making machinery? Who makes drive well apparatus?" All such personal enquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

[OFFICIAL.]

INDEX OF INVENTIONS

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AND EACH BEARING THAT DATE.

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EXTENSIONS GRANTED.

30,877.—CHAIR.—P. J. Hardy.
30,909.—VENTILATED HAT.—W. F. Warburton.

DESIGNS PATENTED.

7,914.—BUTTON CARD.—G. P. Farmer, Brooklyn, N. Y.
7,915.—THERMOMETER BACK.—G. Gano, Cincinnati, Ohio.
7,916.—STEAM ENGINE.—A. Kipp, Jr., Sing Sing, N.Y.
7,917.—MIRROR FRAME, ETC.—G. Lowe, Philadelphia, Pa.
7,918.—POCKET BOOK LOCK.—D. M. Read *et al.*, N.Y. city.
7,919.—CLOCK DIALS.—G. Gano, Cincinnati, Ohio.
7,920.—TRIMMINGS.—G. H. Prindle, Philadelphia, Pa.
7,921.—CHILD'S SLED.—A. Schoenhut, Philadelphia, Pa.

TRADE MARKS REGISTERED.

2,106.—MATCHES.—Early & Lane, New York city.
2,107.—HAIR TONIC.—M. A. Kaier, New York city.
2,108.—WINE.—Kelley's Island Company, Ohio.
2,109.—GLOVES.—Linnemann & Co., New York city.
2,110.—UMBRELLAS, ETC.—T. Miller, New York city.
2,111.—SAFES, ETC.—J. W. Norris, Canton, Ohio.
2,112.—LAUNDRY GLOSS.—G. A. Bassett, Washington, D.C.

SCHEDULE OF PATENT FEES.

On each Caveat	$10
On each Trade mark	$25
On filing each application for a Patent (17 years)	$15
On issuing each original Patent	$20
On appeal to Examiners-in-Chief	$10
On appeal to Commissioner of Patents	$20
On application for Reissue	$30
On filing a Disclaimer	$10
On an application for Design (3½ years)	$10
On application for Design (7 years)	$15
On application for Design (14 years)	$30

CANADIAN PATENTS.

LIST OF PATENTS GRANTED IN CANADA, DECEMBER 3 to DECEMBER 11, 1874.

4,122.—J. B. McCune and R. M. Wanzer, Hamilton, Ont. Improvements in apparatus for sand molding for metal castings, called "McCune's Molding Machine." Dec. 3, 1874.

4,123.—J. Modeland, Ypsilanti, Washtenaw county, Mich., U. S., assignee of A. McNicol, same place. Improvements on cements for rendering leather waterproof, called "The McNicol Cement." Dec. 3, 1874.

4,124.—C. H. Haskins, Milwaukee, Milwaukee county, Wis., U. S., and Z. G. Simmons, Kenosha, Kenosha county, Wis., U. S. Improvements on duplex telegraph, called "Haskin's Duplex Telegraph." Dec. 3, 1874.

4,125.—J. L. Smith, Toronto, P. Q. First extension of No. 825, called "Smith's Combination Roadway." Dec. 3, 1874.

4,126.—J. L. Smith, Toronto, P. Q. Second extension of No. 825, called "Smith's Combination Roadway." Dec. 3, 1874.

4,127.—J. Treat, Boston, Suffolk county, Mass., U. S. Improvement in buckles for supporting stockings, etc., called "The Trent Stocking Buckle." Dec. 3, 1874.

4,128.—G. Rackham, Charlottetown, Queen's county, Prince Edward's Island. Improvements in potato diggers, called "Rackham's Potato Digger." Dec. 3, 1874.

4,129.—S. B. Castle, Syracuse, Onondaga county, N. Y., U. S. Improvements on elevators, called "Castle's Improved Elevator." Dec. 3, 1874.

4,130.—D. Renshaw, Boston, Mass., U. S. Improvements on superheaters, called "The Renshaw Superheater." Dec. 3, 1874.

4,131.—O. V. Flora and J. B. Ross, Madison, Indiana U. S. Improvements on saddletrees, called "Flora's, Eureka Saddletree." Dec. 3, 1874.

4,132.—H. S. Parmelee, New Haven, New Haven county, Conn., U. S. Improvements on automatic fire extinguishers, called "Parmelee's Fire Extinguisher." Dec. 3, 1874.

4,133.—W. H. Foye, Portland, Cumberland county, Me., U. S. Improvements on bill and paper filers, called "Foye's Bill Holder and Paper File." Dec. 3, 1874.

4,134.—B. Levy, New York city, U. S. Improvements on combined overcoats and carriage robes, called "Levy's Combined Overcoat and Carriage Robe." Dec. 3, 1874.

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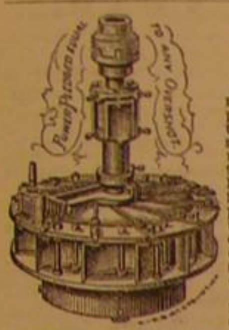

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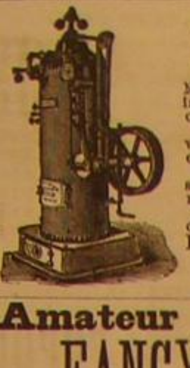

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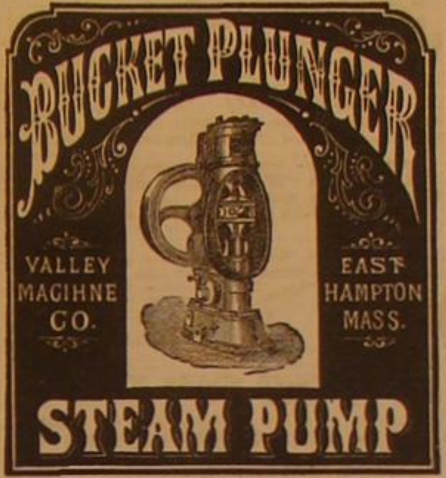

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