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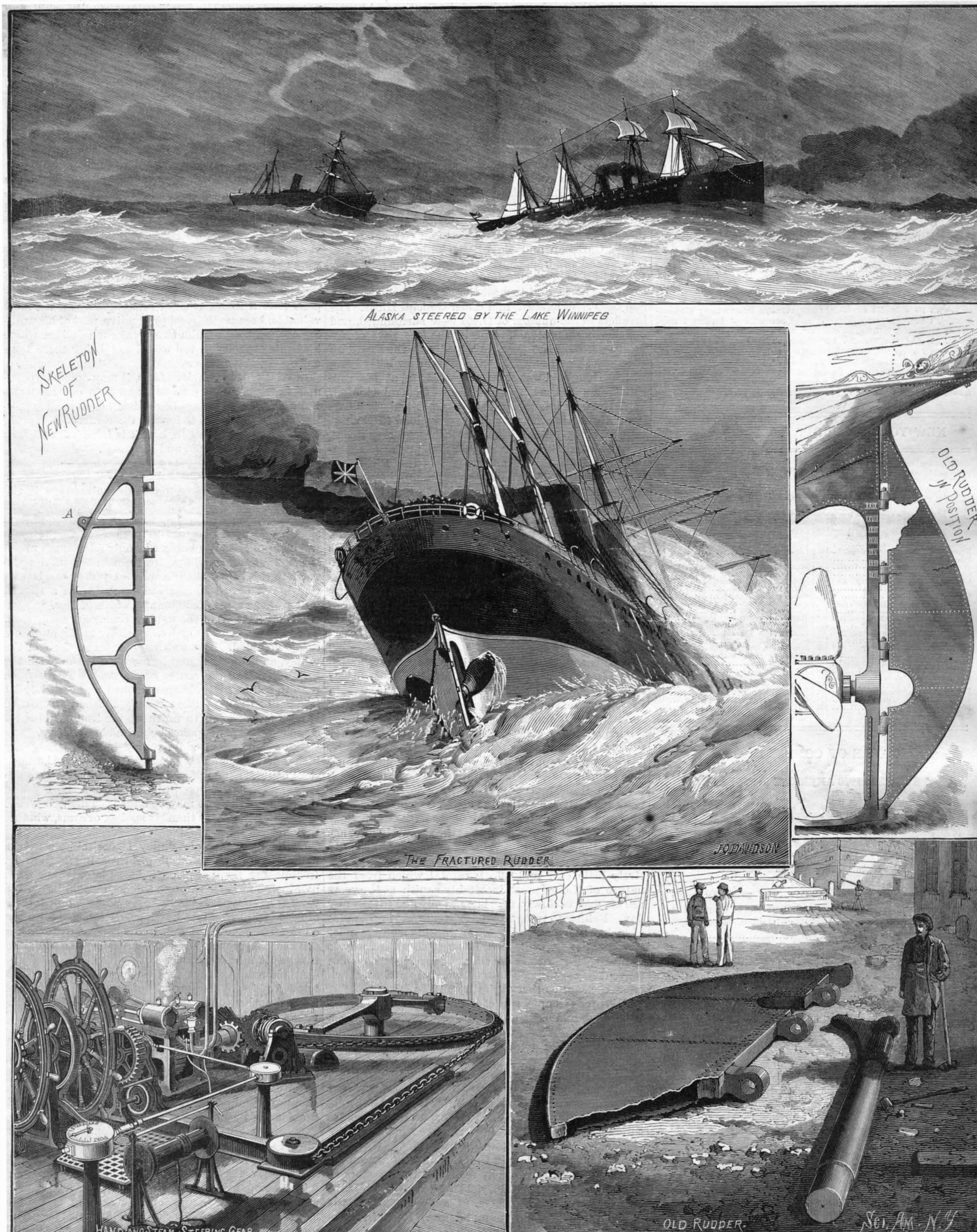

THE STEERING GEAR AND BROKEN RUDDER OF THE STEAMSHIP ALASKA.—[See page 148.]

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NEW YORK, SATURDAY, MARCH 7, 1885.

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(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT,

No. 479,

For the Week Ending March 7, 1885.

Price 10 cents. For sale by all newsdealers.

EL MAHDI.

The man who now confronts the British in the Soudan was made a Khouan, or brother preacher, of the order of Sid Abd-el-Kader about twenty years ago; five years ago he was elected by the council of the order to take command of the army in the South. He was thereupon proclaimed *Mahdime* (sublime), the "arm of the Almighty," and invested with absolute authority over the faithful, whom he promptly invited to join his forces under penalty of death. His name is Mohammed Ahmed. He was born in Dongola, Nubia, about 1840, and was educated at a religious school near Khartoum.

El Mahdi proclaimed his call to fulfill the prophecy touching the coming prophet of the South, and began to organize an army in 1881. The Governor-General of Khartoum commanded him to disavow his pretensions, and sent a small force against him to enforce the command. These the Mahdi soon defeated and dispersed. A second detachment met the same fate; then a column under Reschid Bey was destroyed to the last man. The following January he intercepted an Egyptian corps, on the way to Khartoum, and killed them all; in June, he annihilated another; and still another (under Yousef Pacha) in July. In every case the captured soldiers of the Khedive were given to the spears; native soldiers were absorbed into his own army, when it suited his purpose.

The next year El Mahdi overcame the Egyptian garrisons at El Obeid, the capital of Kordofan, and killed them all, with the European officers in command. As a rule, Christian and Egyptian civilians, with their women and children, shared the fate of the garrisons. From El Obeid the Mahdi invaded Darfur, but returned to his capital to meet the Egyptian army which had been sent against him under General Hicks. The invaders to the number of 11,000 were surrounded, and mercilessly slaughtered. This in the fore part of November, 1883. Last year he wiped out the Egyptian garrisons along the Nile, above and below Khartoum, which stronghold was closely invested and at last captured, despite the heroic defense of General Gordon. With the fall of these fortified posts, particularly Khartoum, the Mahdi has come into possession of steamers, cannon, rifles, ammunition, and other military stores, in quantity sufficient for a severe and protracted campaign; and the failure and retreat of the British relief expeditions—if nothing worse than failure befalls them—completes the record of his military successes, and necessarily adds enormously to his prestige as prophet and warrior.

What the issue will be, time only can determine. False prophet or true prophet, El Mahdi commands the situation; and unless Great Britain is prepared to absorb Egypt and the Soudan, and undertake to establish an Ethiopian India in the heart of Africa, any attempt to punish him in Nubia or to dispute his pretensions in the Soudan will cost more than it will come to.

THE MECHANIC'S CAPITAL.

At this season of the year business men are accustomed to "take account of stock," that is, review their assets in detail and sum up the value of their stock in trade, to discover exactly how they stand, and what courses may be best for their future success in business.

Such is not the general custom of men depending for support solely or mainly on their power to earn wages. They are more apt to let things go as they have gone, unconsciously assuming that they have no assets, no stock in trade, and that it does not lie within their power to materially alter the conditions of their daily life and income, unless, it may be, to strike when their mates do for higher wages. Yet the poorest laborer has capital, the amount and value of which he can usually increase, sometimes greatly increase, with comparatively little care and effort; capital which from the nature of things must inevitably vanish as the years roll on, may be slowly, may be suddenly and utterly any day. Failing to recognize the existence and importance of such working capital, too may working men squander it thoughtlessly, while more allow it to waste away to nothing, with scarcely an effort to arrest, or lessen, or prevent its wastage or destruction, and without much effort to acquire other capital to fill its place.

Take, for example, the case of a young man beginning life as a laborer, and able to earn no more than a dollar a day. What capital has he to take account of?

Of visible stock in trade he may seem to have nothing, not even a shovel to dig with. Nevertheless, he has an actual capital equivalent, if rightly used, to a safe investment of from $5,000 to $10,000—capital that he may increase or diminish, throw away or multiply indefinitely, just as he chooses, just as readily and as surely as the average business man can squander or increase an equal sum invested in trade.

Ten thousand dollars in U. S. 3 per cents (now quoted above par, and accordingly reckoned by investors as desirable as well as safe) yield $300 a year, or, omitting Sundays and holidays, $1 a day. That is the amount earned by our young laborer. It is fair, therefore, to reckon his rude strength, and intelligence sufficient for simple labor, as worth as much to him as $10,000 in government 3 per cent bonds; and it is actually worth more to him than that amount of invested money would be if coupled with inability to earn his living by the use of his hands.

What young laborer, not a fool, would sell his two hands for $10,000? Or would, for that relatively small sum, exchange his vigorous bodily frame for the body of a paralytic?

Youth, health, and a capacity to do are elements of a working capital that many a millionaire would be glad to swap his millions for.

But these are not all the productive elements of a young workman's capital, though they are elements which too many squander without ever estimating their value until they are gone. Wages so small as $1 a day presuppose very little intelligence, very little skill, and no great responsibility. These, for wage-earning purposes, are factors of higher value; and the worker who adds them to his capital will soon find its productive value doubled, tripled, possibly multiplied many fold. And it is always possible for the young worker thus to increase his capital by adding to his knowledge and skill, and still more by proving his fitness for positions of trust and responsibility.

A larger knowledge of mechanics, finer workmanship, the ability to handle new tools, or the acquisition of a new art, which any young mechanic may gain by the improvement of a winter's evenings, may easily add a dollar to his daily wages, and accordingly may be counted as adding another ten thousand to his invested capital.

Since wages measure the worth rather than the severity of one's labors, and nothing adds so much to the worth of labor as intelligence, skill, and trustworthiness, it usually happens that the best paid labor is not the severest or most exhausting. Indeed, it often happens that a man's trusty character is by far the most valuable, because the most productive, part of his working capital, earning him two, five or ten dollars, where his brute capacity to toil would not bring more than one dollar.

In view of these obvious facts, it may not be impertinent in us, at this season, to suggest to our readers—those especially who are beginning life as mechanics—that it is a good time to look to their invested capital, to see what it amounts to, how it is invested, and how it can best be protected and increased.

WEBBED PULLEYS.

If there is no positive, particular advantage in the spoked or armed iron pulley over the center webbed pulley, there is no adequate reason why spoked pulleys should continue to be cast in preference to the plain webbed pulleys. Probably the only advantage urged is that the spoked pulleys are lighter; but there is no truth in this supposition; a webbed pulley can be cast that is not only stronger but lighter than a spoked pulley of the same diameter and width of face.

The advantages of the webbed pulley are easily seen. The patterns can be much more easily made, and more easily moulded. The web may be on one-half of the pulley, and the other half be merely the rim, with the half hub fitting the center of the web. The wooden pattern can be built cheaper webbed, and certainly the iron pattern can be more readily finished and fitted. It is no fool of a job to finish up the iron patterns for a spoke pulley, the spokes being made in halves.

The web of a good sized pulley—one of twenty-four inches diameter and six inches face—need not be more than five-sixteenths of an inch thick; perhaps a moulding for additional strength to run around the inside of the rim next the web may be added. This web would be manifestly lighter than six spokes, or arms, whether they be directly radial or curved.

If the balancing of a pulley is desirable, a web of half an inch thick would allow for turning and truing. In chucking for boring on a face plate, two or three half inch bolt holes through the web would be as convenient as the spaces between six spokes; and instead of having intermediate bearings, as the spoke pulley, on the face plate, the web would make a flat continuous bearing, preventing the chattering that is sometimes so inimical to good work.

An old moulder says that with webbed pulley patterns in place of the spoke patterns, there would be much less breakage from unequal shrinking in the mould than now.

A THRIFTY LIFE INSURANCE COMPANY.

The fortieth annual statement of the New York Life Insurance Company, which is published in another column, makes a very favorable showing, notwithstanding the depression of the last year in nearly all branches of business.

The New York Life Insurance Company has a surplus of several millions of dollars, and its officers and trustees are recognized as among our most substantial and trustworthy citizens.

This company issues all classes of policies, including non-forfeiture, non-contestable on account of suicide, Tontine investment policies, etc. Their rates for premiums, under their different classes of policies, are liberal, and we do not know of a safer company in which a person can insure his life than the New York Life.

COMPLETION OF WASHINGTON'S MONUMENT.

This great obelisk, of which the corner stone was laid nearly forty years ago, is at last completed, capped, and dedicated. The ceremony of deliverance to the President of the United States took place on the 21st of February last, and formed a brilliant event in the history of the national capital.

The structure has the distinction of being the highest spire in the world. It is in round numbers 597 feet in altitude above sea level. It is chiefly built of granite, faced with white marble. The shaft is 55 feet 1½ inches square at the base, walls 15 feet thick, and 34 feet 5½ inches square at the top, where the walls are 1½ feet thick. There is a central well 25 feet square. The total weight of the monument is 81,000 tons. In this week's SUPPLEMENT we give an official drawing of the structure, together with the report of Colonel Casey, the engineer in charge of the work, in which further particulars of the dimensions will be found. It is hinted in certain engineering quarters that the foundations of the structure are insufficient, and if not soon attended to, the monument will be likely to fall. The condition of the foundation forms a good subject for examination and discussion, and we trust it will receive attention by all who are qualified to judge of the matter.

THE ALASKA'S RUDDER.

On another page will be found illustrations showing the nature, place, and extent of the injury to the rudder of the steamship Alaska on her last trip to this port, together with description and dimensions of the new rudder lately made in this city.

The accident was a novel and peculiar one, and forcibly exhibits the suddenness with which unforeseen perils sometimes arise at sea.

The Alaska left Queenstown January 25, and experienced heavy weather from the start. The storm was especially severe on the night of Feb. 2, but abated the next morning, when a new danger arose. The ship, then about 80 miles southeast of Sable Island, suddenly refused to obey her helm, and it was found that her rudder was so broken as to be uncontrollable. In the main, as our illustrations will show, the rudder was intact; but from being a help to the ship it had become a source of grave peril, through being dashed from side to side as the ship rose and fell in the heavy sea. The officers of the ship exhausted their ingenuity in the effort to grapple with new problems which the broken rudder so suddenly presented, then proceeded to navigate the ship as well as they could without it. The sea was so heavy that the customary drag would not avail to steer the ship; and steering by means of the sails was but little more successful. It was impossible to keep the ship's head to the heavy seas, which broke over her and buffeted her about in a manner that would have foundered a less seaworthy craft.

After drifting helplessly for thirty-six hours, the Alaska sighted the steamer Lake Winnipeg, of the Beaver Line, which stood by until morning, and then came to the assistance of the disabled vessel. In the morning (Feb. 5) it was decided to use the Lake Winnipeg as a drag with which to steer the Alaska, and hawsers were passed from the one to the other as for ordinary towing. By deflecting the cables by means of the dragging steamer as described elsewhere, the same effect was produced as is obtained by shifting the helm. One of the cables parted during the next night, compelling the vessel to lie to until morning; but with this exception the improvised steering apparatus worked well, and the two ships proceeded slowly to this port, arriving off Sandy Hook on the morning of the 9th.

The Alaska had on board nearly three hundred passengers, whose safety with that of the officers and crew —to say nothing of the costly vessel and her freight—was imperilled by the accident, and remained in imminent peril for days.

The Alaska is one of the most admirably proportioned and fastest steamships afloat. Her gross tonnage is 8,000. Her engines are of compound inverted, direct-acting, cylinder type, the high pressure cylinder being 68 inches in diameter, and the two low pressure cylinders 100 inches diameter each. The indicated horse-power is 11,000, the highest one on a steamer in the world. The ship has four masts, and is steered by steam. She is built of iron in a series of water tight compartments, and is provided with the most modern methods for insuring comfort and safety at sea.

Yet, as we have seen, by the unexplained fracture of a relatively small piece of metal, this splendid structure, with her enormous power at perfect command, was almost as helpless as a log for many hours. Could anything have been done, with the appliances at her officers' command, to bring the broken rudder under control? The question is submitted to the ingenious readers of the SCIENTIFIC AMERICAN, as one practically worth considering. We should be happy to give space for any feasible suggestions that may be made toward a solution of the problems involved. It may be proper to observe that, had it been possible for the officers of the Alaska to devise a means of grappling and controlling the broken rudder, on the instant, it would have saved not only the present peril to the ship and her passengers, but the cost to her owners of a salvage charge of something like two hundred thousand dollars.

The problem is curious and practical. Inventive reader, how would *you* have gone about to solve it?

Whitworth Compressed Cast Steel.

The following is from the recent report to the President of the Gun Foundry Board:

Upon its first arrival in London, the Board was invited by Sir Joseph Whitworth to examine his works, but with the desire expressed that the visit should be postponed until the close of our foreign investigations. This request was, of course, readily acceded to, and it will be thus seen that previous to the visit to Manchester the members of the Board had received all the impressions that could be produced by viewing the operations at the chief steel factories in France and Russia, and the great factories of Sheffield, in England.

In speaking of the Whitworth establishment at Manchester as unique, and of the process of manufacture at that place as a revelation, reference is specially made to the operation of forging. As to the assorting of ores, and the treatment of metal in the furnaces, there is no intention to draw distinctions; but as to the treatment of the metal after casting, there can be no doubt of the superiority of the system adopted by Sir Joseph Whitworth over that of all other manufacturers in the world. The process here adopted has been kept singularly exempt from scrutiny. Even in the offices of the chiefs of artillery there can be found no information, within the knowledge of the board, which is at all satisfactory upon the subject. Whatever knowledge there is seems to come from hearsay—none from personal observation; and it is only from personal observation that the merits of the system can be fully appreciated.

The system of forging consists in compressing the liquid metal in the mould immediately after casting, and in substituting a hydraulic press for the hammer, in the subsequent forging of the metal.

The flask is made of steel, and is built up of sections united by broad flanges bolted together in such numbers as to accommodate the length of the ingot to be cast. All moulds are cylindrical in form. The interior of the flask is lined with square rods of wrought iron, longitudinally arranged, which form when in place a complete cylindrical interior surface. Where the square edges of these rods meet they are cut away, both on the inside and on the outside, and, at intervals of two inches, small holes are drilled through between the rods, forming a channel way from the interior to the exterior for the passage of gas and flame. The interior is then lined with moulding composition. The flange at the bottom of the flask, as well as that at the top, is perforated with small holes which act as a continuation to the perforations between the segments of the lining for the escape of gas.

The casting is made directly into the mould from the top. On the completion of the casting, the mould is moved (by means of a railway at the bottom of the casting pit, which is a deep trench running parallel to the position of the furnaces) to a position under the movable head of the press, which is allowed to descend until the top is in contact with the metal in the mould, and in this position it is locked; a shower of metal is induced, which ceases almost as soon as commenced, by the complete closing of the mould. The first impress felt by the metal is due to the weight of the head of the press alone. This pressure is gradually increased from below by hydraulic action, applied by four rams upon the table on which the flask rests, until the pressure exerted amounts to 6 tons per square inch. The interval from the commencement of the pressure until the maximum is reached varies with the size of the ingot, being for a 45 ton ingot as much as 35 minutes. During this time the flow of gas and flame from the apertures in the flanges of the flask, at top and at bottom, are continuous and violent, exhibiting the practical effect of the compression. This pressure is applied by the direct action of steam and pumping engines, and is indicated by a dial. At the end of this time the pump is taken off, and a uniform pressure of about 1,500 pounds per square inch is established by attaching an accumulator to the press, and allowed to remain until the metal is sufficiently cooled to insure no further contraction in the mould.

The contraction in length in the mould during the action of the pump, while the maximum pressure is being reached and sustained, amounts to one-eighth of the length of the ingot. After this effect has been produced, there is no farther advantage derived from the pressure in the way of eliminating impurities, but the contraction, in cooling, still goes on, and the pressure by the accumulator is considered necessary in order to follow up the metal as it contracts, for the purpose of preventing cracks being inaugurated at the end and on the exterior of the ingot by the adhesion of particles of the metal to the sides of the mould.

When cooled and reheated, the ingot is brought under the influence of the forging press. This press is hydraulic, with a moving head having the main hydraulic cylinder fixed in it, and it is provided with an arrangement of mechanism for raising and lowering the moving head of the press and for locking the same in any desired position. The press has four hollow pillars screwed part of their length, which are attached to the base of the press by nuts. On the top of the pillars is fixed a cast iron head or table supporting two hydraulic lifting cylinders, the rams of which are fitted with cross heads carrying four suspension bars. These bars pass through the moving head, and are connected at the lower ends by cross bars, which are fastened to the pressing ram. The moving head works between the base and the top or fixed head of the press, and is raised or lowered by the admission or exit of water from the under side of the rams of the lifting cylinders. The moving head can be firmly and rapidly locked at any height from the base which may suit the work to be operated upon. The moving head, as already mentioned, carries a forging or compressing cylinder, which forces a ram down upon the work. By attaching the compressing cylinder to, and making it part of the moving head, a short stroke can be employed when forging objects which may vary in size from a few inches to several feet in diameter.

This in general terms explains the working of the ram. The effect produced by it requires to be seen in order to be thoroughly appreciated, and is altogether different from that produced by the hammer. The heated ingot resists the blow of the hammer, but the insinuating, persevering effort of the press cannot be denied. The longer time (several seconds) during which the effort lasts is a great element in its successful effect. As pressure succeeds pressure, the stability of the particles is thoroughly disturbed and a veritable flow of metal induced, which arranges itself in such shape as the pressure indicates; the particles are forced into closer contact, and the whole mass writhes under the constraint which it is impotent to resist.

The board witnessed the operations of casting followed by that of liquid compression, the enlarging of hoops, the drawing out of cylinders, and the forging of a solid ingot. The unanimous opinion of the members is that the system of Sir Joseph Whitworth surpasses all other methods of forging, and that it gives better promise than any other of securing that uniformity so indispensable in good gun metal.

The latest exhibition of the wonderful character of the Whitworth steel has attracted great attention, and may be stated as indicating the present culmination of his success. From a Whitworth 9 inch gun, lately constructed for the Brazilian Government, there was fired a steel shell which, after perforating an armor plate of 18 inches of wrought iron, still retained considerable energy. The weight of the shell was 403 pounds, the charge of powder 197 pounds, and the velocity about 2,000 feet. The shell is but slightly distorted. The tests of the metal of which it was made show a tensile strength of 98 tons per square inch and a ductility of 9 per cent.

A New Light.

At the last meeting of the Physical Society, some "Lecture Experiments on Spectrum Analysis" were shown by Mr. E. Cleminshaw. The chief point in these experiments was the production of a brilliant light without the use of the electric arc. A small quantity of a solution of the salt to be experimented on is put into a flask in which hydrogen is being evolved by the action of zinc upon dilute sulphuric or hydrochloric acid; the bottle is provided with three necks, one being fitted with an acid funnel, one with a jet, and by the other is introduced a current of coal gas, or better, of hydrogen, by which the size of the flame can be increased and regulated. The jet, which is about one-eighth inch diameter, is surrounded by a larger tube, by which oxygen is admitted to the flame, the result being a brilliant light giving the spectrum of the salt substance, which is carried over mechanically by evolved hydrogen. The spectra of sodium, lithium, and strontium were shown upon the screen; and the absorption of the sodium light by a Bunsen flame containing sodium was clearly seen.

Notice to New Subscribers.

Most subscribers to this paper and to the SCIENTIFIC AMERICAN SUPPLEMENT prefer to commence at the beginning of the year, Jan. 1, so that they may have complete volumes for binding.

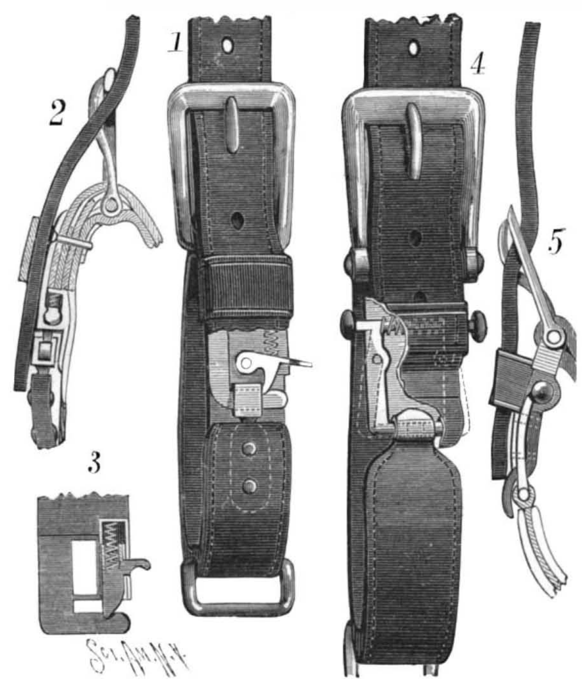
Those who desire it can have the back numbers of either edition of the paper mailed to them, but unless specially ordered, new subscriptions will be entered hereafter from the time the order is received.

Bound volumes of the SCIENTIFIC AMERICAN and SCIENTIFIC AMERICAN SUPPLEMENT for 1884 may be had at this office, or obtained through news agents.

All the volumes of the SCIENTIFIC AMERICAN SUPPLEMENT from its commencement, bound or in paper covers, may be had as above.

IMPROVED SHAFT TUGS.

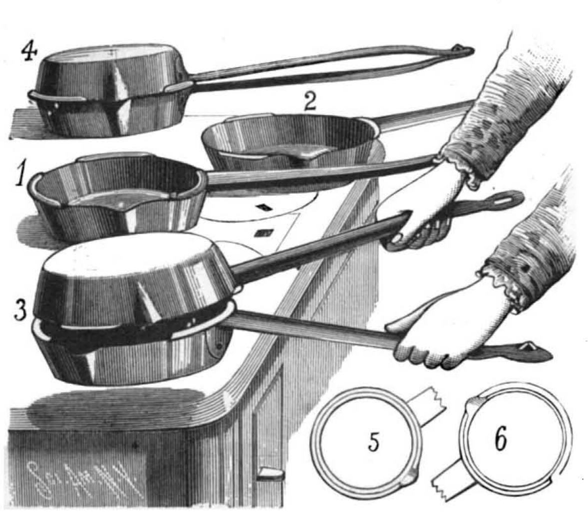
In the accompanying engraving, Figs. 1, 2, and 3, and Figs. 4 and 5 represent two forms of shaft tugs for which letters patent have recently been granted to Mr. Henry F. Bock, of Lansing, Ill. In the first form the shaft loop consists mainly of two straps, between which the buckle and eye are held. The buckle is secured by having its tongue cross bar passed within the curved upper end of a metal plate, the lower part of which forms the base plate of the lock, which is held to the upper end of the loop by rivets. This construction is shown in the sectional view, Fig. 2. The plate takes the strain of supporting the thills off from the outer



BOCK'S IMPROVED SHAFT TUGS.

strap, and insures the durability of the loop at this point. The outside plate of the fastening lies flat against the outer face of the turned-over end of the outer strap, and the same rivets serve to bind together the straps, the back strap loop, and the plates of the fastening. One side of the base plate is made thick, to form a strong bar, which has an arm extending across the fastening in such a position as to allow the passage over it of an eye held upon the opposite end of the loop. In a recess in the fastening is pivoted a spring catch, Fig. 1 (Fig. 3 is a modification of the catch device), whose point passes into a notch in the arm in front of the eye. Any effort of the eye to slip off from the arm will act the more surely to seat the point firmly in the recess. In harnessing, it is only necessary to pass the lower ends of the loops below the shafts to enter the latter within the loops. The eyes are then passed on the arms and locked. In Fig. 3 the catch slides in a casing, being forced outward by a spring.

In the second form the upper end of the fastening is hinged to the end of the loop, the same pin also serving to hold the buckle. Between the straps of the loop is a metal core, bent around to give the required shape to the loop. The end of the core which locks with the fastening has an eye, ranging transversely, that receives the ends of the catches from opposite sides. The catches are pivoted to the fastening, and their upper ends are pressed outward—thereby pressing



BOCK'S FRYING PAN.

the lower ends toward each other—by a spring placed in a bulged portion of the back plate. The lower end of this plate is bent outward to form a cup, to receive the eye of the loop and act as a guard. The upper end of each catch has a side projection, and by pressing them together the lower ends may be separated.

These loops are simple and durable, and can be quickly operated to secure or release the shafts without passing the ends of the shafts through them.

An Engineer's Story of a Brakeman.

The Chicago *Herald* gives the following graphic account of the experience of an engineer on one of our Western railroads as related by himself:

"Several years ago I was running a fast express. One night we were three hours behind time, and if there's anything in the world I hate, it's to finish a run behind schedule. These grade crossings of one horse roads are nuisances to the trunk lines, and we had a habit of failing to stop, merely slacking up for 'em. At one crossing I had never seen a train at that time of night, and so I rounded the curve out of the cut at full tilt. I was astonished to see that a freight train was standing right over the crossing, evidently intending to put a few cars on our switch. I gave the danger whistle, and tried to stop my train, but had seven heavy sleepers on, and we just slid down that grade, spite of everything I could do. Quicker than I can tell you, the brakeman of that freight train uncoupled a car just back of our crossing, and signaled his engineer to go ahead, which he did sharply, but barely in time to let us through. In fact, the pilot of my engine took the buffer off the rear car. Through that little hole we slipped, and lives and property were saved. Now, that brakeman was only a common railroader, yet he saw that situation at a glance. There wasn't time to run his whole train off the crossing nor even half of it—barely time to pull up one car length by prompt, quick work. He kept his wits about him as, I venture to say, not one man in a thousand would have done, and saved my reputation if not my life. He is now a division superintendent of one of the best roads in this country."

Shall We Sleep with Open Windows?

This question introduces a subject upon which there is a diversity of opinion, both among medical practitioners and individuals. "I have had no bad colds since I learned to sleep with my windows open," remarked a gentleman in the office of the *Medical and Surgical Reporter*, the other day. In reply, the editor says that the only "hard colds" he ever suffered from were contracted by sleeping in rooms to which the night air had free access.

The editor adds that it is well known that the bodily temperature sinks slightly during sleep; the physiological functions act with diminished activity; and hence the resistance of the economy to morbific influences is proportionately lessened.

But it is also well known that at night these influences are more potent and noxious. The air is charged with greater humidity; miasmatic and malarial poisons rise to higher levels, and extend with greater rapidity; the chill of the damp night air is penetrating and dangerous; the emanations from organic decay are more perceptible.

Against these the sleeper is less protected than in the daytime. He has divested himself of his woolen external clothing to put on cotton or linen, and lies between sheets of the same material, between which, at the tops and sides of the bed, the air gains ready access to his unprotected surface. If he is restless, he renders such access yet more easy.

A greater risk awaits him. A sudden fall in temperature at night is no unusual occurrence. In summer a thunder gust, in winter a shift of the wind to the north, often reduces the temperature ten to twenty degrees. The sleeper is unaware of this. He remains exposed to it with no further protection than he found agreeable at the higher temperature until he awakes chilled and stiff, perhaps with the seeds of a serious illness already sown.

These are such positive and unavoidable risks that we should counsel a delicate person to be exceedingly cautious how he ventured on the plan of open windows at night, however much has been said in its favor by popular hygienists.

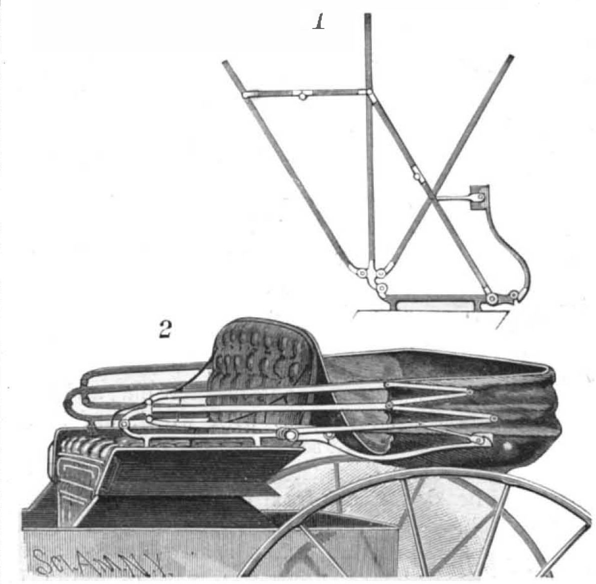
FRYING PAN.

The engraving shows an improved double pan for cooking purposes, consisting of two sections, each of which has a handle and pan body forming a complete pan. The sections are made to engage with and disengage from each other by constructing the rim on the face of one pan body with extended side lips, and the rim on the other with inwardly bent-over flanges, within which the lips may be made to enter by suitably placing and turning one body upon the other; by reversing the turning action, the sections may be readily disengaged. This form provides for a close and locked fit of the two bodies together to constitute a double or shut pan, and for the separate use of each pan without having to couple or uncouple fastenings. The handles form, when united, a light hollow handle having a round or oval section; they are held together by a nipple formed in the flattened end portion of one engaging with an aperture in the end of the other. Instead of a series of flanges on the rim of one pan, there may be only one of a length of about half the circumference of the rim, the other pan being made with a lip extending wholly around the rim, as shown in Figs. 5 and 6.

This invention has been patented by Mr. Henry F. Bock, of Lansing, Ill.

SUPPORT FOR BUGGY TOPS.

An invention patented by Mr. August Witzel, of Deadwood, Dak., prevents the breaking of the back bows of buggy tops as the tops are let down, and also avoids the excessive shaking of the let down top and overstraining of its parts when the vehicle is traveling over rough roads. The top support and buffer consist of a jointed arm and a rubber buffer (shown in the right of Fig. 1) held between side flanges on the outer end of the arm. The short arm section is attached to the buggy by placing it upon the square portion of the stud fixed to the shifting rail, thus holding it against turning. On the stud, at each side of the arm, is an elastic washer, outside of which on the round part of the stud is a washer, beyond which the end of the top prop bar is loosely held by a nut, so as to turn as the top is raised or lowered. The outer end of the arm is connected by a link to the top prop bar,

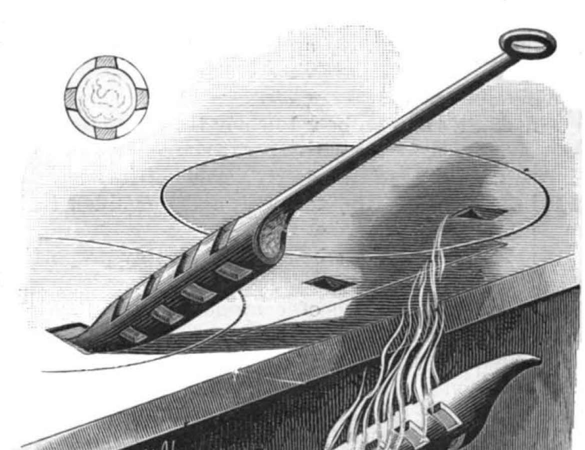


WITZEL'S SUPPORT FOR BUGGY TOPS.

so that when the top is raised the outer arm will also be raised and held by the bar; when the top is lowered, the shoulders at the joint will hold it rigidly in a horizontal position, and the back bow will fall upon the buffer at the end of the arm. This construction gives a substantial support to the top as it falls and afterward, so that it will not be shaken so much as when supported at the shifting rail stud.

STOVE IMPLEMENT.

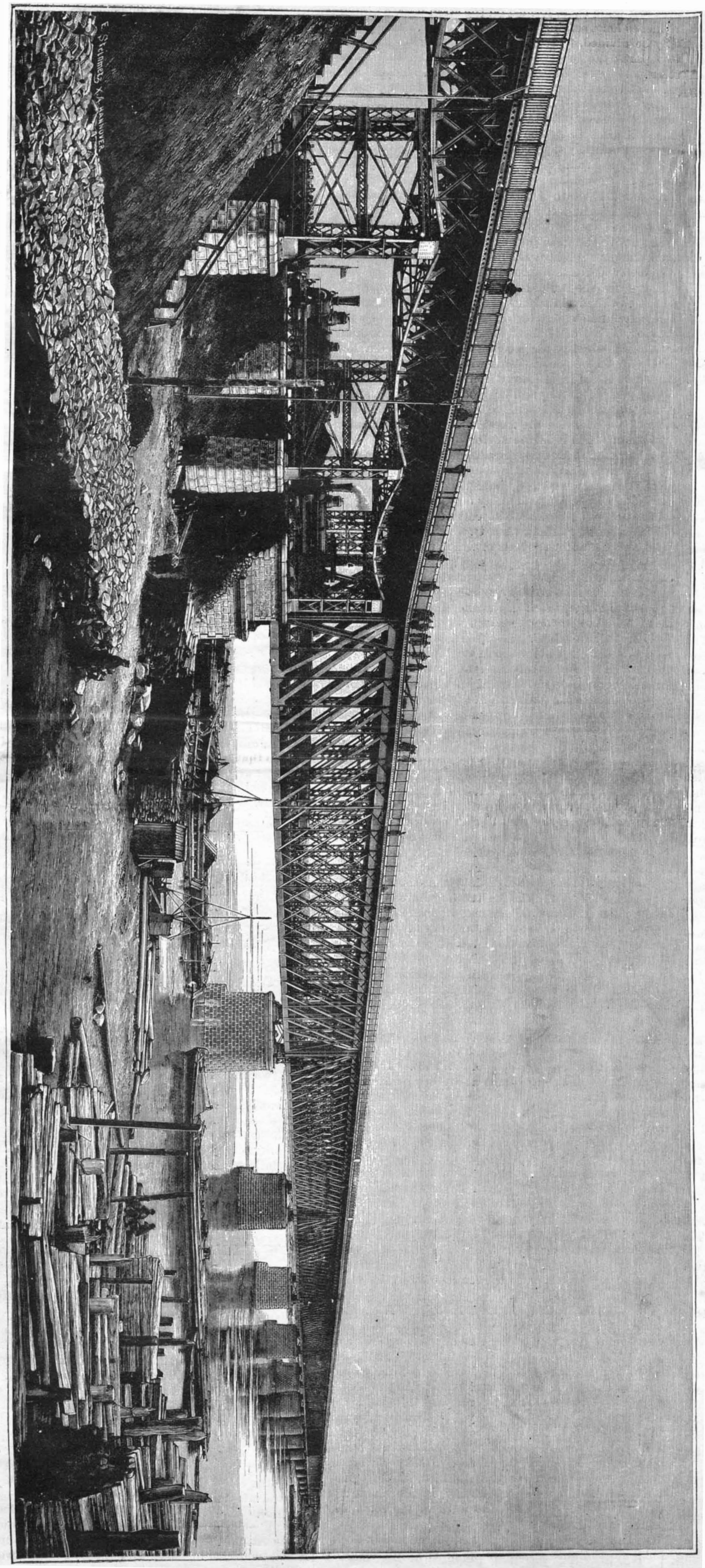
The instrument shown in the engraving, lately patented by Mr. J. P. Welshans of Montezuma, Ind., is adapted for use as a poker and lid lifter, and for a fire kindler and torch. It is made of malleable cast iron, and consists of a handle portion formed with an eye and a hollow or tubular head terminating in a bent point. The head has side slots and an end opening in the upper part, through which it is filled with asbestos, or any suitable combustible material that will absorb oil may be used, cement being employed to keep the material in place. To use the implement for kindling fires, the head is plunged into oil and is then rolled in ashes; in this condition it can be ignited and inserted in the stove, or used as a torch for burning brush, caterpillars on trees, or for illumination. The rear portion of the head may be made to serve as a



WELSHANS' STOVE IMPLEMENT.

reservoir to retain oil, which will be given out gradually.

ACCORDING to Dr. C. Brame (*Repertoire*, Dec., p. 537), oil of peppermint forms a useful application to burns, easing the pain immediately. The part burned is first immersed in water, and then the oil is painted on with a fine camel hair pencil.



ROAD AND RAILWAY BRIDGE OVER THE RIVER DNIEPER, AT JEKATERINOSLOW, RUSSIA.

BRIDGE OVER THE DNIEPER.

We publish a perspective view of the new road and railway bridge over the Dnieper, at Jekaterinoslow, on the Tekaterine Railway, Russia. This imposing structure, with its approaches nearly three-quarters of a mile long, was designed by Professor N. Belelubsky, of St. Petersburg; the ironwork was made by the Brjonsk Iron Works, and erected under the direction of Chief engineer Mr. W. Beresin.—*Engineering.*

Steel Nails vs. Iron Nails.

According to the Chicago *Journal of Commerce*, the monthly meeting of the Western Nail Association, which was held at Pittsburg on Feb. 11, was not a stirring or enthusiastic gathering. There is little in the outlook of the nail trade in the near future that can be called exhilarating, either to the manufacturers or their employes. The price has ruled low for the past year, and the new card rate of $2.25 per keg, which was adopted by the association, little more than covers the bare cost of production. The most that can be said about the matter is that the demand for nails is fully up to the average, and the capacity for production is so much above the highest possible demand that prices must necessarily rule low. What is of more public importance, however, than the present or future price of cut nails is the positive and unmistakable indication that the business is undergoing a revolutionary process. The steel nail is to take the place of the common iron nail. Already one-half of the nails manufactured in Wheeling are made of steel, and the machinery and plant necessary for their manufacture is being erected in every nail center and at nearly every nail foundry. At first there were doubts and objections urged against their use, as there is to every new innovation. The heads flew off in driving, it was said, and carpenters did not believe they would hold in wood as well as the iron nail. A little more care in the manufacture has obviated the first objection, while experience has shown that the last is wholly groundless.

Under present conditions, steel nails can be made ten cents per keg cheaper than those made of iron, where the manufacturer has to purchase his ingots, and where he manufactures the latter himself, the difference in favor of the new nail is still greater. The effect of the new departure in this industry is likely to be more far-reaching than at first would appear probable. The necessary plant is very expensive, and its erection and general adoption will render practically worthless the vast outlay of capital now invested in the old-fashioned nail plant. It does away with the iron puddler and all his works so far as they have any relation to the nail business. Indeed, it is claimed that the puddler with his inflexible scale, which was the controlling element in fixing the prices of all the nail processes, is responsible for the introduction of the steel nail, and that his obstinacy has left him without an occupation in the nail business in the future. Whatever the reasons may be, and however they may affect the present capital invested in this great industry and men who carry it on, it is very certain, concludes the writer, that the steel nail has come to stay, and that in the course of the next five years it will have as completely supplanted the iron nail as the steel rail has its iron predecessor.

Changes a Half Century has Wrought.

When I was a boy, says Mr. George C. Stone, manager of the Vermilion Iron Mines, to a representative of *The Miller*, and that was forty-years ago—I became a clerk in a hardware store. There wasn't a knife, a pin, a lock, a door knob, a hinge, for sale of American make. Everything came from England. The pins were made of two pieces, one little bit of wire being wound around the head of the pin. It often slipped off, and became an unmitigated nuisance. The solid headed pin of to-day is an American institution, and it took a Yankee to make the machine that not only makes it, but at the same time sticks it into the paper it is sold on. The keys in those days for large door locks were huge crowbars six or eight inches long, and weighing a pound or more. You couldn't carry them in your pocket. All locks were of bolts and springs. The tumbler lock was unknown. These little keys we have now-adays—and they are an American device—show how much progress has been made in the use of iron. All the screws used to be imported, and the gimlet pointed screw of to-day, which bores its own hole, was an American innovation.

THE RUDDER OF A GREAT STEAMSHIP.

The steamship Alaska, of the Guion line, noted as being the quickest vessel on the Atlantic, left Queenstown January 25, and when off the Irish coast met heavy weather; the storm increased in violence until February 2, when it began to abate. On the following day it was found that the rudder had been broken. Owing to the rough water, an effort to steer by means of a drag failed, and sail was put on to keep her head to the wind. On the 4th, the steamship Lake Winnipeg was sighted, and on the next day the vessels were connected by two chain cables, about ninety fathoms long, leading from the Alaska's quarters to the Lake Winnipeg's bow, the arrangement of the cables being as shown in the upper view of our frontispiece. Communication between the vessels was maintained by signals—flags being used in the daytime and lights at night. When the Alaska wanted to go to starboard, the Lake Winnipeg was signaled to throw her bow to port; this movement drew the stern of the Alaska in the same direction, causing her to go forward to starboard; the reverse of this operation permitted the Alaska to move to port. During stormy weather, which followed, the cables parted, when the Alaska was steered with the sails until it became again possible to bring the cables into use. The vessels reached New York, February 9.

As soon as practicable the rudder was removed, when it was found to have been fractured at the lower part of the post; an irregularly shaped piece of the blade, between the first and second lugs, was missing. The rudder was also cracked at the second lug, and at a point a little above, and cracks were found in the upper cross rib of the frame, and in the outer rim, a few inches above the cross rib. As there was no way of attaching chains to the blade of the rudder, the complete severance of the two parts rendered it absolutely useless.

The old rudder consists of an iron frame or skeleton, having a length of about 44 feet, and an extreme width of 7 feet 9½ inches, the width of the blade proper at its widest point being 6 feet 9½ inches. The rudder post is 13 feet 2½ inches long, and terminates in a head 11¼ inches in diameter, formed with two longitudinal grooves to receive keys by which it is held to the center of the circle or wheel used to operate the rudder. The back or stock part of the frame is 9½ inches wide by 6½ inches thick; the curved or outer portion is 5¼ inches wide by 3¼ inches thick, and joins the stock at each end. In the lower part of the stock is a semicircular recess, 2¼ feet in diameter, which enables it to clear the outer journal of the propeller shaft as the rudder is moved from side to side. This circular portion is 10 inches wide, of the same thickness as the stock, and is united to the rim by a cross piece 7½ inches wide; just below the second lug is a cross piece 7 inches wide. Upon the back of the stock are four lugs or eyes placed 6 feet 4¼ inches apart, and provided with tapering holes in which the upper ends of the pintles fit. Upon the lower end of the rudder is a pivot 6½ inches long by 5½ inches in diameter, that works in a socket formed in a side projection of the stern post. The latter is a heavy iron column having a square cross section, and carrying the journal for the end of the propeller shaft and four eyes to receive the lower ends of the pintles. The two sides of the frame are covered with iron plates, the rivets in the curved rim passing entirely through, while those in the inner part are tapped into the stock. To prevent the plates from being dented or approaching each other, the open spaces in the frame are filled with wood. The weight of a rudder of this description is about 12 tons.

The new rudder—the frame of which was forged at the foundry of John Roach, and which was finished at the works of McCurdy & Warden, this city—while not varying in general dimensions from the old one, is essentially different, the changes resulting in increased strength in those parts which experience proved to be weak, and in providing a means for operating the rudder in case the rudder post should be broken. The amount of metal at the upper part of the blade has been increased, there are three cross ribs instead of two, and an eye has been formed on the rim at A (shown in the engraving of skeleton of new rudder), to which chains may be attached, should the other methods of moving the rudder become disabled. (It may be stated in this connection that it is customary in building rudders for first-class vessels in this country to provide a series of eyes upon the outer edge of the rudder, so that it could be used even under the most unfavorable of conditions.) The covering plates are seven-sixteenths of an inch thick, the seam being about in the middle of the blade; they are secured by rivets, seven-eighths of an inch thick, spaced 6 inches apart, and extended clear through. The interior spaces are filled with wood.

Extreme accuracy is required in the pivoting of these great rudders, as a simple bolt extending loosely through each pair of eyes, or a single rod passing through all, would not allow the rudder to so quickly and reliably perform all the movements expected of it; and would, besides, increase the wear of the joints without facilitating the work of repair. The rudder eyes rest upon those formed on the stern post, a pintle, 26 inches long, serving to hinge each pair. The pintle may be divided, for convenience in describing it, into two parts; the lower portion—that which enters the stern post eye—is 5¾ inches in diameter, 12 inches long, and is covered with a brass sleeve. The upper portion tapers toward the top, which is threaded to receive a nut; the base of the taper is 5 inches and the top 3¾ inches in diameter. The holes in the eyes on the rudder are accurately tapered to fit the pintles.

Placing the rudder in position is a comparatively easy task: the pintles are put in the rudder eyes, and the nuts screwed down tightly; the head is then carried through the rudder hole in the deck, and the rudder raised until the lower ends of the pintles are free to swing above the stern post eyes. The rudder is guided until the pintles hang suspended directly over the eyes, which they enter as the rudder is lowered.

There are six methods of steering, all of which depend upon the rudder remaining in a perfect condition. The hand and steam steering gear is shown in the engraving. The rudder head is keyed to the center of an iron beam, which extends across a wheel placed a few inches above the deck. This wheel, about 12 feet in diameter, is made of heavy iron plate, and upon its outer surface is a rectangular groove formed by angle irons; just above this groove is an angular one. Immediately forward of the wheel is a double engine, still forward of which is the hand steering gear.

On the engine shaft is a small pinion gearing with a cogwheel on a shaft directly below; this shaft carries a pinion gearing with a large wheel mounted on a shaft extending across (longitudinally of the ship) the frame below the engines. The rear end of the shaft has a beveled pinion meshing with two beveled wheels, one at either side, and the shafts of which make an angle a little greater than 90 degrees. Upon each of these shafts is a drum formed with a spiral groove, in which run the chains that work in the upper or angular groove on the rim of the wheel. The other ends of the chains are attached to powerful springs secured to the opposite side of the wheel. The journals of each of the large beveled gears are made in one casting, bolted to the deck. The springs serve to take up all shock, which would otherwise be transmitted to the gearing, during the sudden striking of the rudder by a wave. This apparatus can be instantly thrown out of gear, without stopping the engines, by moving a lever located in front of the engines.

On the hand wheel shaft are two hand wheels, between which is a pinion meshing with a wheel on a shaft below; the second shaft has a pinion in gear with a wheel on a shaft carrying a chain wheel. A chain running in the rectangular groove leads from one side of the wheel to a pulley, from which it passes to a pulley revolving in a vertical plane, and located in front of the chain wheel over which the chain passes and returns to the large wheel along a similar route. On the shaft of the chain wheel is a sliding clutch by which the hand steering mechanism may be thrown in or out of gear by the simple movement of a lever.

In the steam chest between the engine cylinders is a valve, the shifting of which changes the direction of motion of the engines. Beneath the piston rods is a small shaft, on one end of which is a beveled pinion. A slight movement of this shaft serves, through the intermedium of a lever, to shift the valve. Meshing with this pinion is a second one mounted upon the end of a vertical rod, which is conducted to the wheel house, located in the forward part of the ship. It will be seen that the steam steering gear can be operated from the wheel house. Meshing on one side of the pinion on the shaft moving the lever is a third pinion, the shaft of which leads to a standard where it terminates in a beveled pinion meshing with a similar one on a shaft placed at right angles to the first. The other end of this shaft is held in a standard, on top of which is a dial, the index finger of which shows the distance to either side which the shaft has revolved, and consequently the exact position of the rudder. On the dial are the words "port" and "starboard." The end of the shaft projecting beyond the side of the dial box is squared to receive a hand wheel, which may be used to shift the valve in case the rod leading to the wheel house should fail to work.

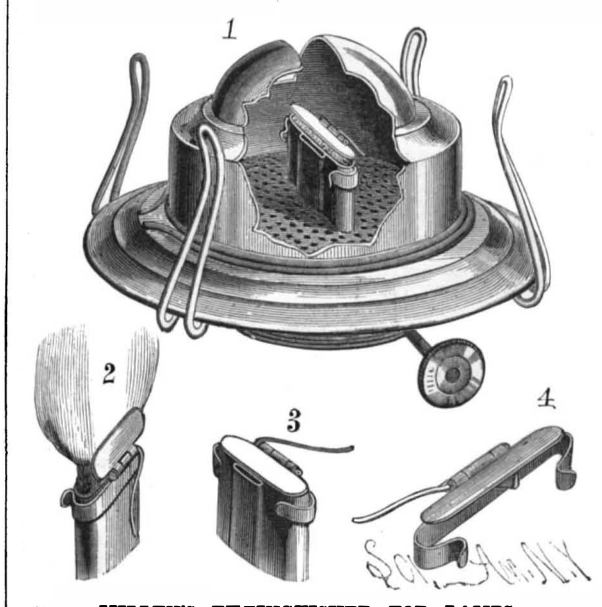
The signals from the wheel house would then be communicated through means of a dial placed in a conspicuous position, on the wall of the compartment, so as to be clearly seen by the man at the small hand wheel. In the center of the dial is a pointer moved by wires extending to the wheel house. In the center of the top of the dial is the word "course," and to the right are the words "steady," "starboard," and "hard;" on the left are the words "steady," "port," and "hard." There are also dials in the wheel house to show the position of the rudder. Should all the devices we have described become disabled, the ship could still be steered by chains attached to the wheel, led through openings in the side walls of the room and guided to a winch.

On February 26 the Alaska was placed in dry dock, and a most minute examination of the hull failed to detect any signs of damage resulting from the severe treatment she experienced while being buffeted by the waves.

EXTINGUISHER FOR LAMPS.

The extinguishing plate is hinged to a narrow strip of spring metal, the ends of which are so formed that the strip can be slipped over the end of the wick tube, as shown in Fig. 1. When in a raised position, the plate is prevented from falling backward by an arm projecting from the hinge and moving with the plate, coming against the wick tube. Upon the under side of the plate is secured a little piece of metal, the weight of which causes the plate to fall forward as the wick is drawn down.

When the wick is raised, it presses against the plate and holds it in a vertical position. The plate makes the flame spread and burn more evenly than it otherwise would, thus producing a much better light. When the wick is turned down, the plate falls forward upon it, instantly extinguishing the flame, and the coal that may remain upon the wick is smothered out, so that the smoke and disagreeable smell produced by ordinary lamp burners when the light is blown out are avoided; the danger of explosion, which sometimes is a direct



MILLEN'S EXTINGUISHER FOR LAMPS.

result of blowing down the chimney, is also done away with.

Additional particulars may be obtained from the inventor, Mr. William Millen, of 431 East 83d Street, New York city.

Cutose.

Cutose, the substance which covers and protects the aerial organs of plants, approaches the fatty bodies in its properties and composition, though distinct from them in certain other respects. Cutose resists the action of energetic acids; it is insoluble in dilute alkalies; neutral solvents have no action upon it, but it is modified by oxidizing agents and boiling alkaline liquids. With nitric acid it yields at first resinous bodies, and afterward suberic acid. Alkalies, and even alkaline carbonates, at a boiling heat dissolve cutose, split it up, and convert it into a kind of soap, soluble in water and insoluble both in excess of alkali and saline solutions. Baryta, strontia, and lime effect the same decomposition. Under the influence of bases, cutose gives rise to two new fatty acids, the stereocutic and the oleocutic. The former acid differs from all known solid fatty acids. It is white, fusible at 76°, almost insoluble in cold alcohol and ethers, scarcely soluble in boiling alcohol. Its true solvents are benzol and glacial acetic acid. On boiling this acid with dilute alkalies, we obtain gelatinous salts insoluble in water. These two acids, when once modified, acquire new properties, which approximate them much to the primitive cutose. They form a neutral substance, which on treatment with caustic alkalies experiences a kind of saponification.—*MM. E. Fremy and Urbain.*

How to Fill a Boiler.

"I filled this boiler when we first started without a pump, and from a well, or reservoir, below the level of this floor." This from an engineer of a stationary, who is a very capable man. "Well, I suppose you used buckets," was the reply. "No, the boiler filled herself." The boiler was new and had just been located, the connections made, and all was ready for a start except the filling of the boiler with water. The force pump had not been connected, and, in fact, had not been placed, when the engineer thought it well to fill his boiler. He built a fire of light stuff in the furnace, after putting in a few pails of water, connected hose with the water reservoir, and after the fire had burned down he opened the connection, and the water came in with a rush, the creation of a vacuum impelling the inrush of the water.

RECENTLY, at Louisville, Ky., after several hours of dark fog, a drenching shower took place, during which small fishes—minnows—fell to the ground.

Correspondence.

How Water May Flash into Ice.

To the Editor of the Scientific American:

Three times during the winter I have seen water instantaneously converted into ice. I have read that water could be reduced to a temperature lower than 32° F., and still not form ice, and have seen water raised above 212° F. which, when agitated, suddenly exploded with such force as to nearly empty the vessel containing it. The instantaneous formation of ice I saw in a large tin pail partly filled with water. There was ice on the floor, cups partly filled with water held thick coverings of ice, but the water in the pail was as clear as crystal. Intending to dip a cupful, I accidentally struck the edge of the pail, and quick as a flash of light there shot from the sides of the pail, toward the center, long, slender needles of ice, beautifully marked on their edges. These needles in a few seconds grew until the water, for an inch or so below the surface, was closely packed with these delicate shoots, which, when my cup reached them, easily shattered.

W. J. R.

Palmyra, N. Y.

[The peculiar phenomenon of the spasmodic setting of crystals is well known and familiar to chemists. It is beautifully shown in microscopic crystallization. Under the microscope the crystallic needles are plainly seen to shoot out like the arrow from a bow. In some species of fungus the same spasmodic effect is noticed in the development of the spores.

Its cause probably lies in the power of the attraction of cohesion, which in this class of phenomena is a resisting power to a change of condition.—ED.]

The Nature of Electricity.

In two lectures recently delivered before the Royal Institution, Prof. O. J. Lodge, F.R.S., endeavored to explain to crowded audiences the modern views of the real nature of electricity. It was often said, he remarked, that we did not know what electricity was, and the statement was still largely true, but it was not so true as it was twenty years ago. Some things were beginning to be known about it, and though modern views were tentative, and might well require modification, nevertheless some progress had been made, and it was not unsuitable at the beginning of a new year of progress and discovery to try and set forth the position of thinkers on electrical subjects at the present time.

It had been discovered by Faraday and Clerk-Maxwell how like the behavior of electricity was to that of an incompressible fluid or liquid. One was not thereupon justified in asserting that electricity was a liquid, but it was perfectly certain that it behaved in many respects exactly like one, and it was, therefore, a step necessary to be made to understand and grasp the analogy between electricity and a liquid—in other words, to develop a liquid theory of electricity. Let them imagine a fish in the deep sea; he was surrounded and permeated by water, but must be completely unconscious of its existence. For a fish near the surface even to postulate the existence of water from the effects of currents and waves would be an act of scientific discovery analogous to our discovery of the existence of the atmosphere; but for a fish in the serene depths of the ocean the discovery of water would be an almost impossible one.

Now, we were living immersed in electricity in precisely the same way, but we were in a more favorable position for discovering its existence, because it behaved for the most part more like a liquid entangled in some elastic medium or jelly than like a freely moving liquid. Substances in which it could freely move about were called conductors; substances in which it was entangled were insulators or dielectrics. Conductors must be regarded as holes and tubes in the jelly, permitting storage and transfer. The jelly was such as only to resist the motion of electricity; it permitted the free locomotion of ordinary matter. The existence of these two classes of bodies, conductors and insulators, had enabled the human race with difficulty at length to discover the existence of this all-permeating liquid. An electrical machine was to be regarded as a pump which could transfer the fluid from one cavity to another; thus charging one conductor negatively, the other positively. Charge was to be regarded as either excess or defect from the normal supply of fluid, causing a strain.

Electrical attraction and repulsion were all explicable by the strains thus set up in the surrounding elastic medium or jelly. The increase of the capacity of a conductor by bringing an earth-connected body near it was accurately representable by thinning the elastic coat surrounding a cavity; and a hydrostatic model of a Leyden jar could be easily made with an elastic bag inside a rigid vessel, with pressure gauges for electrometers; this behaved in all respects exactly as a Leyden jar—exhibiting discharge by alternate contacts and everything. Discharge was typified by a relaxing of the strain and by twisting of the dielectric medium in some place. Certain phenomena connected with discharge suggested obscurely that what we called negative charge was not merely a defect of supply, but was a supply of something of an opposite kind—that there were, in fact, two electricities, positive and negative, which combined together into a neutral liquid. It might be that the other was then composed, and that what we called an electric current was really the simultaneous transfer of the true components of this liquid in opposite directions, and that strains in dielectrics were due to attempted shear of the other. The phenomena of electrolysis strongly suggested and supported this view.

Was any other motion possible to a liquid? Yes, a whirling and vibrating motion. By coiling up a conductor so as to get an electrical whirl, we discovered that we had produced a magnet, and all the phenomena of magnetism could be developed on the hypothesis that magnets consisted of such electrical whirlpools. One whirl had the power of exciting another in neighboring conductors, and these so excited whirls were repelled. In this way could be explained the phenomena of diamagnetism. A disk of copper at the end of a torsion arm was repelled by a magnet until the current induced in it had died away, which was very soon in that particular case; but currents in molecules might, for all we knew, last for ever until actively destroyed. Atoms were already endowed with perfect elasticity—why not with perfect conductivity too?

Finally, electricity in vibration, if rapid enough, constituted light; and it was easy to see that on this hypothesis conductors must be opaque, and that transparent bodies must insulate, which agreed with observation. If a ray of light were passed along a line of magnetic force, it ought to be twisted, as was shown by the pertinacious experimental power of Faraday before the fact could be understood and before the scientific world was ready to receive it. The profound significance of this fact was first perceived by Sir William Thomson, and stated by him in a most powerful and remarkable note, and upon this Maxwell founded his electrical theory of light.

"I have endeavored," added the lecturer, "to give you pictorial and mechanical representations of electrical phenomena, and thus to lead you a step in the direction of the truth; but I must beg you to remember that it is only a step, and that what modifications and addenda will have to be made to the views here explained I am wholly unable to tell you."

Power for Wood Working Tools.

BY WM. LEE CHURCH.

I recently had occasion to make some indicator tests of power in planing mills. As there is a very general misapprehension of the actual power consumed by wood working tools, some of the results may be instructive. The power given is in every instance the *net power of the tool itself*, exclusive of the friction of the shafting. The power for wood working tools is usually a vague estimate from the belt transmission, and is liable to great error. The following results are, on the contrary, actual measurements under the conditions obtaining, and may be relied on as such, however much at variance with preconceived ideas.

The first test was made at the mill, and by the courtesy of Anson Eldred & Son, Fort Howard, Wis. Power: One 14 x 14 inch Westinghouse engine, 280 revolutions.

Total friction of shafting and engine	21·00
No. 38 Sturtevant exhaust fan, 1,000 rev	18·06
14 inch rip saw, cutting 1 inch stuff	5·33
14 inch matcher, on 6 inch pine	21·25
60 inch circular re-saw, splitting 12 inch pine	5·38
24 inch matcher, on 10 inch pine	7·66
Edger, 18 inch saws, one cut, in 2 inch pine	7·68
24 inch circular re-saw, splitting 6 inch pine	5·30
Double siding planer, rabbeting and surfacing two 6 inch pine strips, both edges	11·20
30 inch double surfacer, dressing 24 inches wide	17·00
12 inch moulder sticking one piece 2½ inch ogee batten	12·33

It will be noted that the 24 inch matcher, on 10 inch stuff, required less power than 14 inch matcher on 6 inch stuff. The reason of this lay in the fact that the feed was slower on the larger machine.

The following results were from the mill of F. Blakesley, Schenectady, N. Y. Power: One 10 x 10 inch Westinghouse engine, 339 revolutions:

	Horse Power.
Friction of engine and shafting alone, net	8·97
One No. 31 Sturtevant exhaust fan	8·64
12 inch matcher, on 6 inch spruce	15·21
Same running empty	10·01
24 inch single surfacer, dressing 24 inch spruce	9·75
Roger's No. 2 four side moulder, sticking 2 x 1¼ inch pine	7·28

The following small tools were taken in a group in actual operation:

One 12 inch rip saw, one 16 inch cross cut saw, one 3 side sticker, one tenoning machine, one dovetail and boring machine, one band saw, one gig saw, one 12 inch cross cut saw ....aggregate net 7·02

A further experiment was made to determine the power required to start a planer from a state of rest. The engine, shafting, and blower were first indicated alone, showing 8·97 horse power; the belt was then shifted on a 24 inch double surfacer, and a continuous curve taken until full speed was obtained. The maximum power required to start the planer was 31·2 horse power net, the difference of 18·72 horse power being the amount of power required to develop the speed of the tool over that required to maintain the speed when reached. The above test was, of course, made with the planer running empty.

The above line of experiments indicates that more power is absorbed in driving ordinary planing mill machinery empty than is required to actually dress the lumber.—*Wood and Iron.*

The Band Saw.

A writer in the *Northwestern Lumberman*, who claims to have had fifteen years' practical experience in using band mills, says:

We have been using the band sawmill for sawing logs for the last fifteen years with unvarying success, and at no time have we used a band mill—and we have used nine or ten of them—that had not a sawing capacity of 20,000 feet of 1 inch boards per day of ten hours, and at times we have sawed 30,000 feet of soft wood in ten hours. As to its average capacity, we sawed 6,000,000 feet in one year with one machine, running part of the time day and night.

It has been a great wonder to me that the live, shrewd Northwestern lumbermen have gone on from year to year, for at least the last ten years, without seeing and testing the advantages of the band saw in the manufacture of lumber economically, as regards both the lumber saved and the power required to manufacture a given quantity of boards from a given quantity of logs—scale measure—in a given length of time.

A 60 horse power engine will run three band sawmills with a capacity of 20,000 or 25,000 feet each, per day, with a surplus of power to run the necessary edgers and cut-offs to trim the lumber. Take this as a starting point, then say the mills average 20,000 feet each, and you have 60,000 feet per day of ten hours. On this amount you save in saw kerf—the band saw taking only one-twelfth of an inch—over the ordinary circular saw in use, at least 2,000 feet on each 10,000 feet sawed, which would make 12,000 feet, or one-fifth more lumber from what goes into sawdust, for which in some cases furnaces are erected to burn, the "hells" costing more than one band sawmill.

This 12,000 feet destroyed would at least be worth $10 per thousand, or $120, which is lost per day—or $24,000 in a season's sawing of 200 days. This $10 per thousand is a low estimate for first-class pine lumber, as a considerable proportion would be uppers worth 50 per cent more, which would make it at least $30,000 lost (or saved) in 200 days' sawing.

For instance, say three mills cost $6,500—put up and started, exclusive of power; you would still have a nice little margin of $23,000 on 200 days' sawing, and also have your mills.

To the mill men who value the lives of their men—and we know both the humane and thrifty do—we say we know of fifty band sawmills in use that have never, for the last ten years, fatally injured a man.

Another advantage in the use of band sawmills in pine or any other kinds of lumber: you can saw a taper log or a partly rotten log, and get all the good lumber out of it there is in it, which you cannot do with a gang saw.

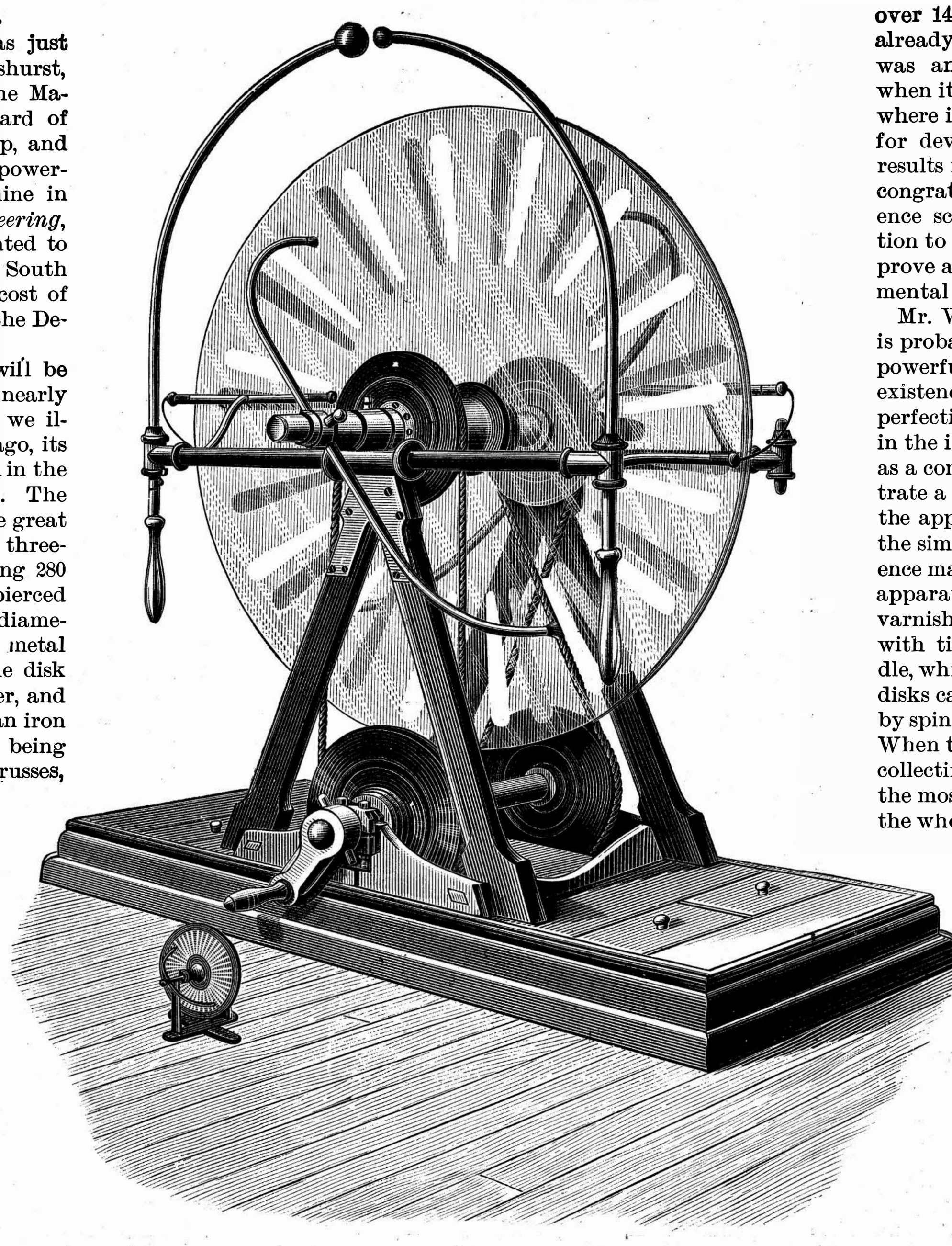
Disinfecting Rags by Steam.

Importations of rags are now permitted where the rags are subjected to a process of disinfection. The process, as conducted by the Paper Stock Disinfecting Company of New York, is as follows: The apparatus consists of a large air-tight box, into which each bale of rags is drawn by means of five screws, which at the same time make five perforations from end to end of the bale. When this is completely inclosed in the box, the opening is closed, and superheated steam is injected through the screws, which are hollow and perforated with holes which permit jets of steam to penetrate through the rags in every direction. An escape in the upper part of the box is provided with a bath intended to intercept the passage of any disease germ into the air. Most germs of life are killed at a heat of 212 or 215 degrees, but the steam employed in this process is raised to 330. An exposure of four or five minutes to this degree of superheated steam heats the bale so that it takes two hours for it to fall below the germicide point of 212. The actual effect of this operation has been recently proved in a most satisfactory manner under auspices which give the results obtained a scientific value. The experiments were conducted under the eye of Major Sternberg, U. S. A., with disease germs (cholera and smallpox) brought by him from the Johns Hopkins University. They were inserted in the interior of two bales of rags, one of which, for the sake of making a comparative test of sulphurous acid and superheated steam, was subjected to treatment in the same apparatus with the former agent, and one with the latter. The germs were then collected, and returned to the Johns Hopkins University, where Major Sternberg found by inoculation of rabbits that the germs treated by superheated steam had been killed, and did not communicate disease, while those treated with sulphurous acid were fatal to the subjects inoculated.

A GREAT ELECTRIC MACHINE.

We illustrate a machine which has just been completed by Mr. James Wimshurst, one of the consulting engineers to the Marine Department of the London Board of Trade, in his own private workshop, and which is, undoubtedly, the most powerful and efficient electrostatic machine in existence. This apparatus, says *Engineering*, has been constructed for and presented to the Science and Art Department at South Kensington by Mr. Wimshurst, the cost of the raw material being defrayed by the Department.

On reference to the illustration, it will be seen that the form of this machine is nearly identical with the smaller type which we illustrated and described two years ago, its points of difference lying in its size and in the construction of the supporting parts. The diameter of the circular plates of the great machine is 84 inches, of plate glass three-eighths inch in thickness, and weighing 280 pounds each. Each of these disks is pierced at its center with a hole, 6½ inches in diameter, and is firmly attached to a gun metal boss, 15 inches in length, carrying the disk at one end and a pulley at the other, and which is bored so as to run freely on an iron tube, 3 inches in diameter, this tube being supported at each end by strong oak trusses, rising from a firm base, also of oak, and which is fitted with lockers at each end, for holding spare parts and accessory apparatus. The heads of the two trusses, or A frames, consist of massive castings of gun metal, which are so shaped as to hold the hollow iron tube and the ebonite rod to which the collecting combs and discharging terminals are attached. The iron tube projects at each end beyond the trusses, and to the projecting ends are attached the brass "neutralizing" rods, which terminate in light wire brushes, shown in the illustration.



THE WIMSHURST SEVEN FOOT DUPLEX ELECTRIC MACHINE.

To the disks, which are well varnished with an alcoholic solution of shellac, are attached, at equal angular distances apart, radial sectors of tinfoil, sixteen on each disk. These sectors are 19 inches long, and have a mean width of 1·65 inches, thus having an area of 31·35 square inches. There is thus on each plate a metallically coated area of 500 square inches, or a thousand square inches on the two disks together.

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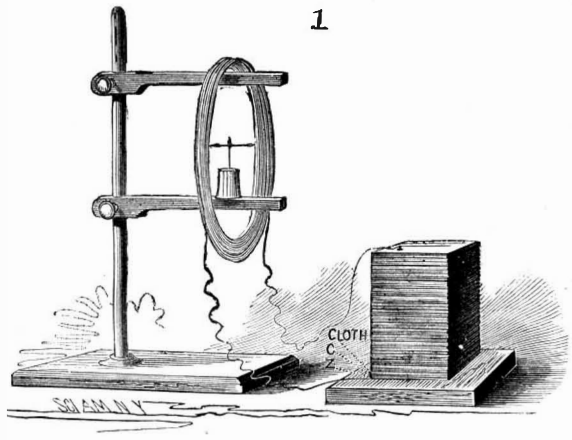

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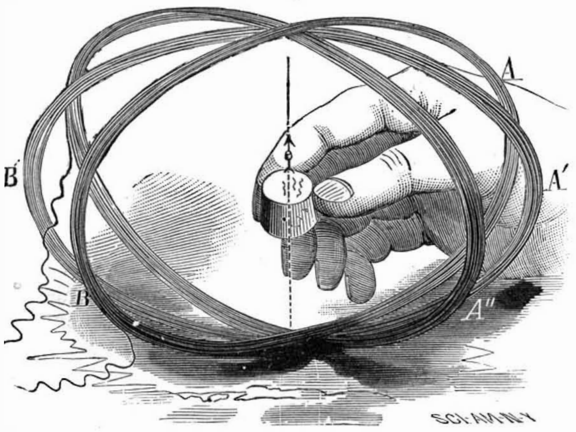

The apparatus may in principle be regarded as a sort of double-acting "Nicholson's revolving doubler," the sectors on the one disk acting as inductors on the other, and *vice versa*, and that the extraordinarily high efficiency of the machine is probably due to the fact that both plates contribute charges of electricity to the collecting combs, and that the sectors on the one disk act as inductors and as carriers respectively to those on the other when they approach the best positions for those respective actions to take place.

The collecting combs are attached to the discharging terminals, as shown in the engraving, by interchangeable brass rods, some being straight, while others are bent, so that their positions with respect to the horizontal diameters of the disks may be varied within a range of about 16 inches, that is to say, between about 8 inches above and 8 inches below the horizontal diameter. The discharging rods or terminals are constructed of brass tubes, 1¼ inches in diameter, and are fitted with terminal balls of different diameters, which are also interchangeable. The distance of these balls apart —and therefore the striking distance of the spark discharge—can be varied by the glass handles with which the discharging rods are fitted at their lower ends, and as these handles have their attachment in a hinge joint, they can be used as levers wherewith to turn the terminal rods around a vertical axis, and thus to vary the distance between their upper ends.

The two disks are rotated in opposite directions by the lower driving gear, shown in the figure; this consists of a horizontal spindle fitted with a winch handle at each end, and carrying a pair of oak pulleys which are connected respectively to the two pulleys attached to the disks by endless cords, one of which, being crossed, causes one disk to be rotated in the opposite direction to the other; and as the height of the bearings of the lower spindle is adjustable, the driving cords can always be maintained perfectly tight.

The principal characteristics of this form of electrostatic machine, and to which its exceptionally high value as a laboratory instrument is due, are (1) that it is readily self exciting in almost every condition of the atmosphere; (2) that the polarity of the apparatus never changes, as it is so liable to do in other forms of induction machines; (3) that the charge is very large compared with the area of the glass employed in the disks; and (4) the small cost at which the machine may be constructed.

Although the great machine which we illustrate in this notice was working in a workshop in which there was a steam engine and boiler at work, and consequently with a considerable quantity of water in the atmosphere, and although it was closely surrounded with lathes and shafting and other metallic conducting bodies, not only did it pick up its charge even before a complete revolution was made, but kept up a constant stream of discharge sparks between its terminals of over 14 inches in length. The results have already proved far more satisfactory than was anticipated before it was tried, but when it is set to work at South Kensington, where it will be under far better conditions for developing its full powers, still higher results may be expected. We may, indeed, congratulate Professor Guthrie and the science schools generally on this new acquisition to the physical laboratory, which must prove a most valuable instrument for experimental research.

Mr. Wimshurst has in his laboratory what is probably the largest collection of the most powerful electrostatic induction machines in existence, having worked for several years in perfecting this class of apparatus. We have in the illustration introduced (partly to serve as a comparison of size and partly to illustrate a very interesting and typical form of the apparatus) a sketch of what is perhaps the simplest and the cheapest electric influence machine ever constructed. This little apparatus consists simply of two disks of varnished glass, 12 inches in diameter, fitted with tinfoil sectors, and mounted on a spindle, which can be held in the hands, and the disks can be rotated in opposite directions by spinning them with the finger and thumb. When this is done—although there are no collecting combs or discharge conductors—the most brilliant effects can be produced, the whole apparatus literally bristling with electric discharges immediately the rotation commences, and one of the most remarkable and not the least valuable features of this beautiful little instrument lies in the fact that it can be constructed in a good, salable, and workmanlike manner and sold at a very small charge.

INTERESTING ELECTRICAL EXPERIMENTS.

To the Editor of the Sci. Am.:

Judging from the interest exhibited by the young people in our public library, on the arrival of the SCIENTIFIC AMERICAN, that readers of that class might find the details of some simple experiments acceptable, I send a description of two such, which can be made without much outlay, with simple, easily attainable materials, and which may even possess some interest for older persons.

FIRST EXPERIMENT.

At any tin shop or coppersmith's can be procured, for a trifle, scraps of sheet copper, zinc, and iron, and at any tailor's a few remnants of cloth or flannel. The other materials needed are about twenty-five cents' worth of No. 22 insulated copper wire and a small magnetic needle, costing perhaps 50 cents; both of which

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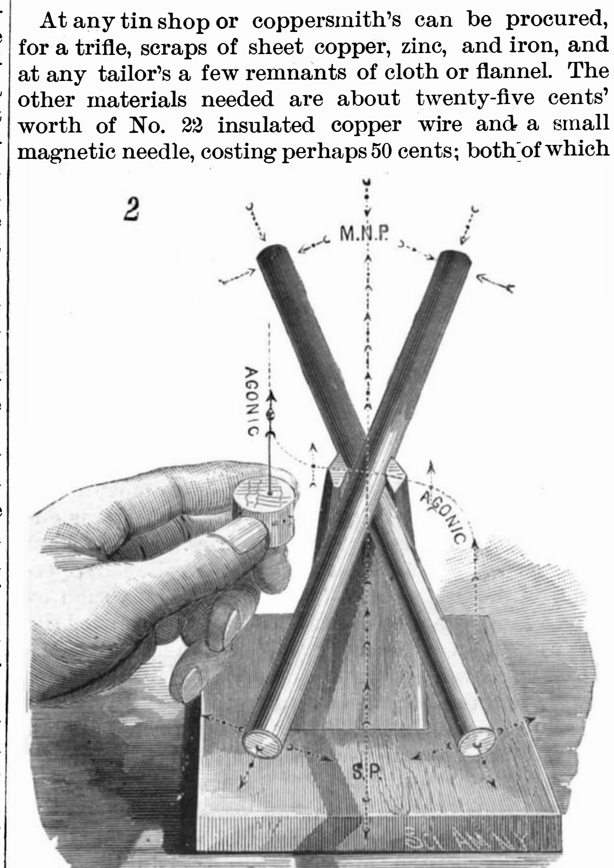


investments may be considered permanent, as the needle and wire can be used for many other interesting experiments. The only additional requirements are a handful of common salt, or, if preferred, one or two cents' worth of commercial sulphuric acid, which, to prevent accident, may at once be mixed slowly with ten times as much water.

The young experimenter may now cut the zinc and copper and cloth into pieces of about two inches square, dipping each piece of cloth into a saucer containing the dilute sulphuric acid. He is now ready to commence piling, on a small block of wood, a square of zinc, then of copper, then of the moistened cloth, until he has from five to ten pairs or more as he may desire, finishing with a square of copper. Instead of the dilute acid, common salt may be sprinkled on both sides of the cloth after moistening with rain water, and the pile then constructed as before. Also, instead of zinc, strips of sheet iron may be used, although the resultant voltaic pile will not be so strong, in other words, have as much electromotive force.

On a wooden stand, similar to a filter stand with two arms, let the coil of wire hang from the upper arm, and the magnetic needle rest in the middle of the coil on the lower arm. To make the movements of the needle more apparent, remove it from its box, and let it oscillate on a stout sewing needle thrust through a cork and placed, as stated, in the center of the coil.

If now the ends of the coil of wire are so placed that one is under the lowest zinc of the pile, in full contact, while the other end of the coiled wire is pressed flat on the upper or last copper square, the needle in the coil will tend to set itself at right angles to the plane of the coil. By reversing the wires, and placing the end which rested on the copper, now in contact with the lower zinc, etc., then the needle will be reversed also, although still coming to rest at right angles to the plane of the coil of wire, or so-called current of electricity.

One source of interest, connected with this experiment, is the fact that it may aid us in understanding the declination of the needle, which varies as the plane of the electrical current varies. It may also aid in our understanding certain dynamical phenomena, by suggesting that the salt water from the ocean (rendered strong brine by evaporation on reaching heated portions of the earth's crust) may occasionally penetrate deep fissures, and there encounter metals such as native gold, copper, magnetite, etc., besides other more readily oxidizable metals, or those prompt to unite with the chlorine of the salt; thus giving rise to electro-chemical action, and furnishing electromotive force for some seismic phenomena.

Diagram No. 1 is subjoined, to make the above experiment more intelligible.

SECOND EXPERIMENT.

Two bar magnets (costing perhaps 50 cents, and useful for many other interesting experiments) are placed across each other, on a block of wood, as in diagram No. 2, with the S. or unmarked ends of each diverging some 23° respectively to the east and west of the geographical north.

Presenting the small magnetic needle, mentioned in experiment No. 1, while held in the hand successively to the north and south ends of the bar magnets, also to points midway between the two influences, it will be found that, besides the four areas of greatest intensity, near the ends of the magnets, there are curved lines, resembling the agonic, or lines of no variation on our globe, anywhere along which the needle will point to the true north, as indicated in diagram 2. There will also be found a point (resembling the magnetic north pole in Boothia Felix) north of which the magnetic needle will turn its marked end to point due south, while south of that point it will turn its marked end due north. An examination of the phenomena exhibited in this experiment may enable the student to understand the general principles of the declination or variation of the magnetic needle (at many places on our globe) from the geographical north and south; especially when he considers that the same effect may be produced by currents of electricity, if, as in diagram 3, the plane of the main so-called current be successively in A B (solstitial), then in A′ B′ (equatorial), and finally in A″ B″.

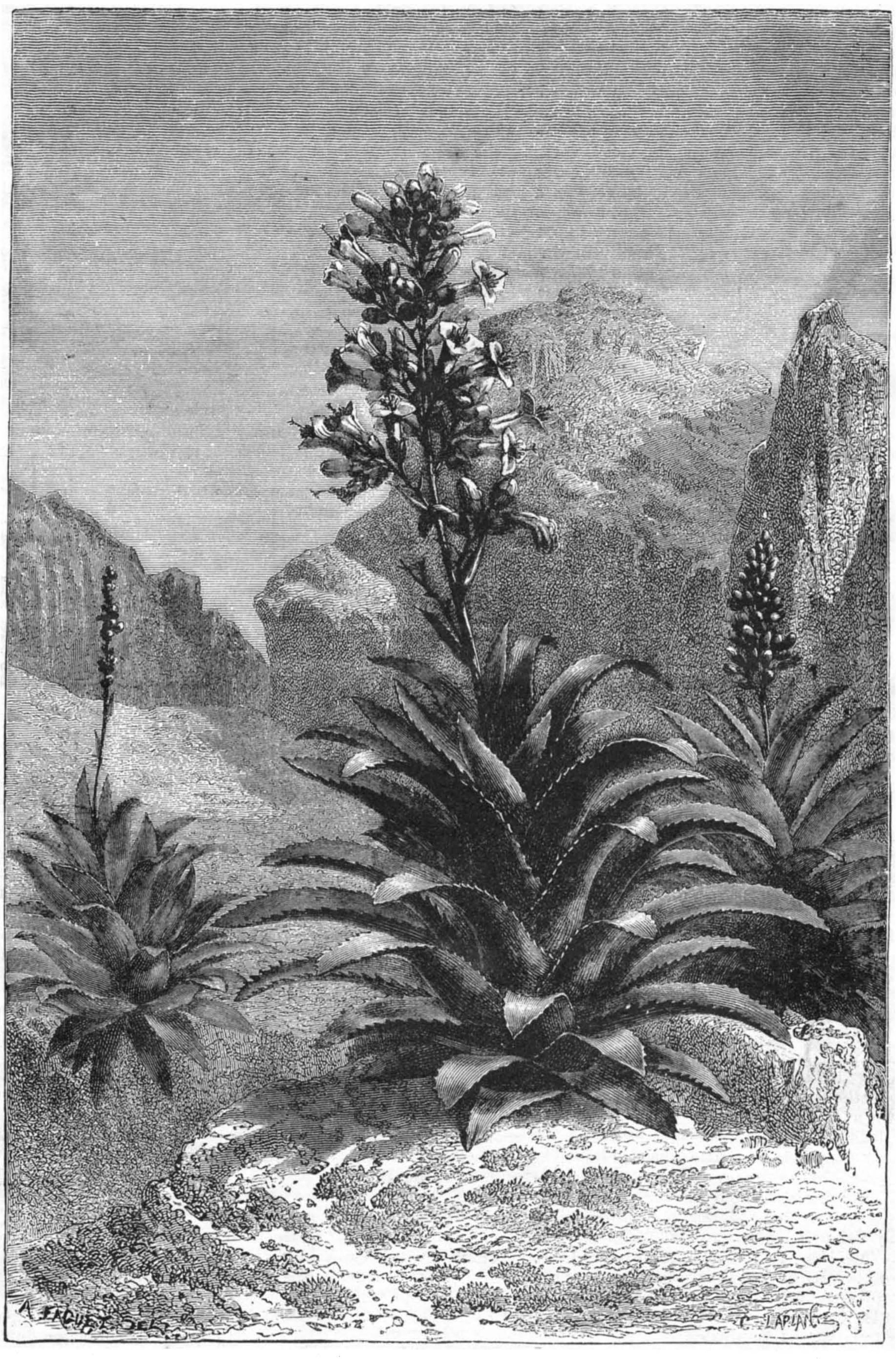
The current A B would necessarily, if strong enough, according to Oersted's discovery, and as shown in experiment 1, produce the same effect, on a small needle, which would be effected by the bar magnet that points in the diagram 2 to the west of the geographical north. The current A′ B′ would produce an effect equivalent to bringing the two bar magnets together; and the current A″ B″ would, in the same manner as if the two bars were made again to diverge, restore the attractive influence (exerted on a small needle) to the region occupied, in diagram 2, by the magnet which points east of north.

RICHARD OWEN.

New Harmony, Ind., December 31, 1884.

A Chance for American Bridge Builders.

It will be seen from an advertisement in another column that the Colonial Government of New South Wales, Australia, is about to build a new and splendid steel railway bridge, for which proposals are now invited. The bridge structure will be 2,900 feet long; the foundations are to be sunk 120 feet below the bed of the river, in water 50 feet deep.



ÆCHMEAS AT HOME.

ÆCHMEAS.

Everywhere there are evidences that a growing interest is being taken in bromeliaceous plants—an interest that should be encouraged, leading, as it inevitably must, to the introduction into English gardens of a large number of beautiful and eminently useful plants of easy cultivation. England alone among European countries where horticulture prevails has hitherto been practically without Bromeliads as ornamental indoor plants.

Next to Billbergias, the Æchmeas are the most useful among genera comprised in the Bromeliad order, although there are several species of Tillandsia and of Vriesia which are of exceptional beauty. Of the genus Æchmea nearly sixty species are described by Mr. Baker in his recent monograph of the genus, of which about a dozen are known in gardens, both in England and in Continental countries. For the following descriptions of these cultivated species I am largely indebted to Mr. Baker's monograph, prepared from living specimens in the Kew collection, and, therefore, more easily understood by horticulturists than any account could be when based on only herbarium specimens. The habit of Æchmeas is generally vasiform (*i. e.*, the leaves clasp tightly by their bases, so as to form a deep cup or vase) with long, leathery, green, spine margined leaves and central flower scapes. In most of the species the flower scape is clothed with large, bright colored bract-leaves, which are often much more ornamental than the flowers themselves. These latter are much smaller than those of Billbergia, and are red-purple, blue, yellow, or nearly white.

Like all the Bromeliads, Æchmeas are natives of distinctly tropical countries, where, either clothing tree trunks in exposed sunny places, or growing upon the ground, they are often met with in abundance.

In the accompanying illustration a rare and interesting species, viz., Æ. paniculata, is shown growing on the ground in a rocky, moist situation. This species is not known to be in cultivation, nor has it been seen wild for many years. It is one of the handsomest of the genus, and should it be again found in the Peruvian Andes, where it was first discovered by Pavon in 1794, its introduction into English gardens would be most desirable.

Æ. BRACTEATA.—A common plant in the West Indies, growing upon trees in sunny positions. Leaves spiny, with broad, sheathing bases, lorate. Height of plant, 2 feet. Flower scape, 1½ feet long, three parts of which are clothed with bright-red sheathing bracts, 3 inches to 4 inches long, the fourth and upper part bearing a branching panicle of numerous small yellow flowers. A large boat-shaped bract subtends and half envelops the lowermost flower branches. A gorgeously colored plant, owing its attractions chiefly to the brilliant red of the large bracts and the contrast between them and the green foliage and the bright yellow flowers. (Syn., Billbergia exudans.)—*Loddiges' Cabinet*, t. 801.

Æ. DISTICHANTHA.—A Brazilian species, with long ensiform foliage, the base of which is broad and sheathing, margins spiny, back of leaves striped with gray. Height of plant, 2½ feet. Flowers in branching panicles about 3 feet long, much crowded, and subtended by bracts; the latter and pea-like flower-buds bright crimson; flowers when open purplish, almost clear blue on first opening. The flowers are succeeded by berries of a bright red tipped with purple, which remain fresh and attractive for several weeks. (Syn., Billbergia polystachya.)—*Botanical Magazine*, t. 5,447.

Æ. VEITCHI.—A species from New Granada, introduced by Messrs. Veitch in 1874, by whom it was distributed under the name of Chevalliera Veitchi. A small plant of erect vasiform habit, with dark green, channeled, spiny-edged foliage, 18 inches high. Flowers on a stout scape, which is about as tall as the foliage and erect, crowned by a compact head or cone of pointed bracts and small flowers, bright scarlet in color. —*Botanical Magazine*, t. 6,329.

Æ. MARIÆ REGINÆ.—One of the handsomest of the genus when in flower. In habit it resembles the last described species, differing in the leaves spreading more and in the flower scape being clothed with bright red reflexing bract leaves, which are 4 inches long by 1 inch in width, margined with spines. The flowers are collected in a cone-like head, the calices being white and urn-shaped, through which the small egg-shaped violet colored corolla protrudes. It is a native of Costa Rica, where it is used at the feast of Corpus Christi for the decoration of the altars in the churches. Its local name is Flor de Santa Maria, from which the scientific name has been taken. Introduced by Messrs. B. S. Williams & Co. The richly colored bracts, which spring from a scape covered with white tomentum and crowned with a cone of white and violet, are strikingly attractive, while in the purple-tinted foliage there is sufficient beauty to give this plant a charm even when not in flower. The flowers are usually borne in the spring, about April.—*Botanical Magazine*, t. 6,441.—*The Garden.*

On Some Causes of Earthquakes.

BY RICHARD A. PROCTOR.

It has been noticed that the Spanish earthquakes have been followed by hurricanes, and many are asking how earthquakes can cause hurricanes. "When an earthquake is succeeded by a hurricane," says the *New York Tribune*, "the inference must be that if the occurrence of the windstorm is more than a coincidence, it must be caused by a profound atmospheric change of pressure, such a change as could only be produced probably by an electrical storm of exceeding violence." This I only quote to show how the question has been raised on the American side of the Atlantic. Of electricity, one may say what Laplace said about the theory of special interference of the Almighty as an explanation of unusual phenomena—"*Ca explique beaucoup de choses.*" It does not seem to have been noticed that the Spanish earthquakes followed a remarkable series of Atlantic storms, and that these earthquakes have continued since the great hurricanes occurred which drove the *Tribune* to the all-explaining electrical theory.

If we consider the matter with a little attention, we shall cease to wonder that great atmospheric disturbances excite subterranean activity. The effects of what seem slight changes of atmospheric pressure must in reality be enormous in modifying the pressures underneath the earth's crust. The barometer often ranges half an inch in height without any great hurricanes following. Taking such a change as this, and supposing that over an area as large as the British Isles, and with the seas between them—say, in round numbers, 100,000 square miles—the barometer stands at 29¼ inches, while on either side, over a similar area, the barometric column has an average height of 28¾ inches; let us consider what difference of pressure is involved, and what are the changes produced if the barometric column is raised half an inch over the British area, and lowered by half an inch over the adjacent areas. The pressure of the air on a square inch, when the barometer stands at 30 inches, is nearly 15 pounds, so that a fall of half an inch (one-sixtieth of thirty) means a reduction of pressure by nearly a quarter of a pound to the square inch. (Or, of course, we may leave the air out of the question, and simply weigh half an inch of mercury in height on a square inch base; this will be one 3,456th part of a cubic foot of mercury, and every one knows that a cubic foot of mercury weighs 848 pounds; the 3,456th part of 848 × 16 ounces is $3\frac{25}{27}$ ounces.) Now in a square yard there are 1,296 square inches, and in a square mile about 3,000,000 square yards. Therefore, at a quarter of a pound to the square inch, the pressure on a square mile amounts to 324 times 3,000,000 pounds, and the pressure on 100,000 square miles to no less than 97,200,000,000,000 pounds. This is 1-54 part too great, because the pressure on a square inch is only 53-54 of 4 ounces. Knock off then a 54th part, getting for the actual difference of pressure due to a half inch rise or fall of the mercurial barometer 95,450,000,000,000 pounds, or in round numbers 42,600,000,000 tons. Can it be supposed to be a slight matter if, as frequently happens, such an enormous pressure as this is thrown upon the area of the British Isles and the seas around and between them, in the course of a few hours, while adjacent areas are relieved of a corresponding weight, and then a few hours later the adjacent areas are oppressed by having many thousands of millions of tons extra weight thrown upon them, while the pressure on the British Isles is diminished in the same tremendous degree? We hear it sometimes described as a remarkable thing that great barometric changes are followed by signs of disturbances in British mines; but when we see that only a moderate and normal change of atmospheric pressure means many thousands of millions of tons added to the pressure on the earth's crust in and around Great Britain, or deducted from that pressure, the wonder seems rather to be that changes so slight are produced by pressures so enormous.

Now, the disturbed areas in the hurricanes of last December were very much larger than those I have just considered, and the differences of atmospheric pressure much more remarkable. The areas of diminished pressure were probably not less than 500,000 square miles, and the surrounding areas of increased pressure fully as large, while the range of the barometer was in some cases fully two inches. This would make the weights added to and taken away from the disturbed areas, sometimes very quickly, no less than a thousand billions of tons. Can we wonder if parts of the earth where the crust is relatively weak and unstable should show the effects of such tremendous changes of pressure as these?

But this is not all. The seas respond to the action of mighty hurricanes, not only by being tossed into waves (which in the open sea are mere risings and fallings of masses of water not themselves carried along), but by being carried in large masses before the winds. Every one knows how a moderate tide is changed into a very high tide by favoring winds, while an expected very high tide becomes a moderate tide when the wind opposes the influx of the water. Along a shore line such as that presented by the Spanish Peninsula toward the west, the water must often be raised two or three feet above its normal level by the action of long continued strong winds from the west. Now, consider one hundred miles of shore line, and the effects of a rise of the sea by only one foot on account of westerly hurricanes, that rise extending only ten miles out to sea. We have, then, a thousand square miles of water one foot deep as the extra pressure upon the crust under that shore line. This gives 27,000 millions of cubic feet of water, each cubic foot weighing 1,000 ounces, or in round numbers about 750 millions of tons of extra water thrown on a shore line only a hundred miles in length. Along 800 miles the additional pressure would be 6,000 millions of tons. This, it will be observed, is very much smaller than the effect due to changes of atmospheric pressure over such an area as the British Isles, but the extra pressure per square mile is nearly twice as great on account of a foot rise in water as on account of a half inch rise of the mercurial barometer. (In the above computation I have taken a cubic foot of water as 1,000 ounces. As a matter of fact, a cubic foot of sea water weighs considerably more, averaging 64½ pounds instead of 62½ pounds—the weight of a cubic foot of fresh water.)

But the rise in the water level due to hurricanes is merely an addition to the rise due to the tides. An extra foot or two due to long continued shoreward winds, added to several feet due to high spring tides, would signify tens of thousands of millions of tons of increased pressure on the Spanish and Portuguese shore line. Moreover, an addition of this enormous weight on one side of a certain definite coast line, while on the other side of this shore line no change at all occurs from this cause, cannot but be a most potent disturbing cause—in a region, too, where the very existence of a shore line indicates irregularity in the structure of the earth's crust beneath.

I take it, then, that we may fairly consider that the external action exerted upon the earth's crust, as the tidal wave sweeps upon a shore line, as winds heap up the seas there, and as atmospheric pressure increases and diminishes—especially during the progress of great storms—must play a most important part in producing subterranean disturbances. At every moment of time millions of millions of tons of matter, in the form of water and air, are being flung hither and thither over the surface of the earth. Can we wonder if, apart from interior causes of disturbance, the crust shows signs of occasional fluctuation?—*Newcastle Weekly Chronicle.*

Proposed Garbage Burning in New York.

To get rid of the ashes and garbage collected in the streets of New York city now requires thirteen dumping stations on the water front and a fleet of scows to carry the refuse to sea, where it is dumped. The quantity so disposed of amounts to about three thousand cubic yards daily, and, in unfavorable conditions of weather, or when those in charge are seeking to shirk their duty, the scows are often dumped so their contents help to fill up the channels of New York harbor. The question of providing a better way of getting rid of this refuse has been a serious one for years, and there is a sum of $50,000 of the regular appropriation which can be expended to this end. It is now proposed, under this provision, to construct furnaces or ovens at or near one of the dumping stations to try and burn up the refuse. The first apparatus will be rather an experimental one, until its economy and the effect of such an incineration factory upon the neighborhood can be determined.

Discovery of the Specific Germ of Diphtheria.

At a recent meeting of the Clinical Society of the New York Post Graduate School, Dr. M. Putnam-Jacobi called attention to the very elaborate and possibly epoch-making investigations, regarding the parasitic nature of diphtheria, which have been made by Loffler.

The result of experiments, conducted with these new bacilli, is summed up by Loffler as follows: They were found in thirteen cases of diphtheria with fibrinous exudation; they lay in the oldest part of the membrane, and penetrated farther toward the tissues than the other bacteria; products of the cultures of them, carried to the twenty-fifth generation, when inoculated under the skin of Guinea pigs and small birds, kill the animals, after the production of a whitish or hæmorrhagic exudation at the point of infection, and extensive subcutaneous œdema. The inner organs remain intact, as do those of diphtheritic patients. Pseudo-membranes were generated by inoculation of the trachea of rabbits, chickens, and pigeons, or of the vagina of Guinea pigs. There are then also evidences of several vascular legions, manifested by hæmorrhagic œdema, by hæmorrhages into lymphatic glands, and effusions into the pleural cavity. The bacilli, he says, have thus the same effects on the animal organism as the diphtheritic virus.

The bacillus which would thus suddenly assume so much of importance to the human race is considered to be identical with the bacillus of diphtheria described by Klebs at last summer's International Medical Congress; and it is a significant fact that two experienced investigators should have thus arrived independently at similar conclusions. The micro-organisms in question are motionless rods, partly straight, partly curved, about the length of the tubercle bacillus but double its breadth, coloring intensely with methyl-blue potassa solution, discoloring again with diluted iodine, except at the two extremities. They are found deep in the tissues, where they are supposed to develop a poison which decays the surrounding tissues, paralyzes the blood vessels, causing congestions, exudations, and finally paralysis of nerve centers and death.—*Medical Record.*

Equilibrium of Forces.

An instrument to illustrate the conditions of equilibrium of three forces acting at a point was lately exhibited at the Physical Society, by Mr. Walter Baily. This instrument consists of a circular disk of soft wood, from the back of which an axle projects. The disk is provided with a graduated circle, and its center marked by the intersection of two fine lines upon a small mirror. Three compound threads, each consisting of two threads connected by a short piece of elastic, are knotted together, the free end of each being fastened to a pin. Two of these pins are stuck into the disk at such a distance from the center that the knotted ends cannot reach the center without stretching each thread, and the remaining pin is then adjusted, so that this condition is fulfilled.

There are now three forces in equilibrium acting at the knot. The angles between their directions are obtained from the readings of the graduated circle where it is crossed by the threads. To determine the magnitude of these forces, the axle of the disk is held horizontally and turned till a thread is vertical, the pin is then removed, a scale pan attached to the end of the thread, and weights added till the knot is brought back to the center. This is repeated with the other threads. It was found possible to show the proportionality of the forces to the lines of the opposite angles with an error not exceeding 1 per cent.

A New Size.

For finishing raw or bleached cotton tissues, particularly for light shirtings, also for starching and dressing warp yarns and skein yarns, instead of the so-called vegetable glue a mixture of potato starch with soda lye is often successfully used; or the soda lye may be replaced by chloride of magnesium. The latter composition is preferable, as the former must be pretty strongly alkaline to preserve its strength. The way of operating is as follows: 50 pounds potato starch are stirred into a sufficient quantity of cold water until all lumps are dissolved, and brought to a boil, when 50 pounds of chloride of magnesium are gradually added under constant stirring, and finally one-half pound hydrochloric acid. After one hour's boiling, clear lime water is stirred in until the mass is no longer acid. After another hour of boiling, an artificial glue is obtained. This size, which must be perfectly neutral before using it, is very cheap and serviceable in finishing silks and woolens. The goods assume a fine luster, and even in washing the finish is not easily destroyed. Wheat starch, corn starch, etc., may also be used; potato starch, however, has the greatest tendency to form an insoluble combination with chloride of magnesium and lime. This mass is used in cases where gum, dextrin, or paste used to be employed; it is no substitute for animal glue, however.—*Woch.*

ENGINEERING INVENTIONS.

A railroad tie has been patented by Mr. William H. Knowlton, of Pottsville, Pa. This invention relates to a metallic tie of special construction, the form of which may be considerably varied, and which may be rolled in iron, steel, or other malleable metal, or cast.

A pile driver has been patented by Mr. Joseph W. Putnam, of New Orleans, La. It is of that class of pile drivers used for railway building, and therefore mounted on a truck or platform car, being so constructed and arranged that a pile may be readily driven vertically or obliquely, a pivoted platform being combined with hinged leaders connected by a double joint with a triangular iron frame, with various other novel features.

AGRICULTURAL INVENTIONS.

A cultivator has been patented by Messrs. Oliver S. Presbrey and Aaron Nall, of Moriah, N. Y. The teeth are attachable as desired, and are so held to their work by a clamp that they will yield on striking a large stone or other obstacle, and thus prevent breaking; they may also be so arranged in a group as to form a shovel plow.

A wheel cultivator has been patented by Mr. William P. Brown, of Zanesville, O. This invention relates to a former patented invention of the same inventor, in which the plow beams were provided with a resilient flexible joint, and with a lifting spring and draught connection that tended to draw the plows into the ground, and covers a further development of the idea and improvement in the construction.

MISCELLANEOUS INVENTIONS.

A camera stand has been patented by Mr. William H. Lewis, of New York city. This invention relates to improvements in portable tripod stands, and covers certain features of construction of the folding legs and means for retaining them in connection with the top or base that receives the camera.

A combined grain separator and smutter has been patented by Mr. Harry L. Martin, of Lancaster, Pa. This invention covers a novel construction and arrangement of parts for a machine to facilitate the cleaning of wheat and other grain, and promote thoroughness in such cleaning.

A folding barrel has been patented by Mr. George F. Knapp, of St. Louis, Mo. This invention provides means whereby the center of the barrel may be securely held while either end is adapted to be opened to examine the contents, and so the hoops may be locked securely or readily unlocked.

A feeding device for carding machines has been patented by Mr. Ernst Gessner, of Aue, Saxony, Germany. This invention provides a device for taking away or feeding regularly and evenly, from a receptacle or bulk box, wool or other fibrous material, carrying it forward to some desired place, or delivering it to another machine, in even amounts.

A rubber stamp hand printing machine has been patented by Mr. Robert Gaiger, of West Hoboken, N. J. It is made with end plates slotted to receive an inking roller, and connected by a socket bar with one or more spring-supported plungers carrying the stamp, and operated by cams with which are connected slotted arms carrying the inking roller.

A stock feeder has been patented by Mr. Elias R. Harman, of Lincoln, Neb. This invention covers a special construction and arrangement of parts for a stock feeder which shall have a separate trough for each animal, and so that all the troughs can be filled uniformly and rapidly, the troughs being easily kept clean.

A sheep stock has been patented by Mr. Francis M. Swartz, of Jacksontown, O. The construction is such that the weight of the sheep pulls on straps and causes hinged side boards to so close down upon him as to make him hold himself, when necessary, for tagging or other purposes, and so that if he struggles he will only be held the more closely.

A machine for sawing stone has been patented by Mr. Valentine G. Barney, of Charles City, Iowa. This invention covers improvements on a former patented invention of the same inventor, the improvements especially relating to devices for feeding the sand and water mixture upon the block of marble or stone, and devices for mixing the sand and water.

A clip for vehicle axles has been patented by Mr. Edmund N. Hatcher, of Columbus, O. The body or strap portion of the clip is of sheet metal of suitable thickness, and of a size to serve as a hood to exclude water and dirt from under the skein body, and to sustain the collar band against endwise pressure, the bolts for the clip bar being welded to the body, and the device forming a combined hood and clip.

A machine for heading bolts has been patented by Mr. John Stacker, of West Winsted, Conn. It is a bolt making machine with devices for upsetting the wires and forming the head in one heat, and for automatically pressing and pinching together the dies for holding the wire while it is being upset, for separating the dies afterward, and pushing out the completed bolt.

A shield for scarfs has been patented by Mr. Gustave Selowsky, of New York city. The shield has a raised central portion on its inner face, this portion being integral with the body of the shield, and having a button hole with a metal lining, so the shield can be used with buttons with different sized heads, and will adapt itself to the varying distance between the button and the top of the collar band.

A cooking stove has been patented by Mr. Charles F. Hanneman, of Ahnapee, Wis. This invention relates to baking ovens with a vertically adjustable bottom plate, and means for admitting steam into the oven, and provides improved arrangements for raising and lowering the oven plate, and improved construction of the steam generator and discharger, making an oven specially adapted for baking bread in the most perfect manner.

A sealskin sack, dolman, and ulster block has been patented by Messrs. Phillip Weinberg, Louis Clark, Jr., and Egbert Winkler, of New York city. It is made with three or more boards secured to each other at their adjacent edges and attached at their ends to end boards, the adjacent edges of two or more of the boards being tapered, with other features, to facilitate the working of the skin as the edges are successively tacked to the block as the work progresses.

A vehicle shaft has been patented by Messrs. John Scott and Amos S. Scott, of Caln Township, Pa. It provides for three horses being hitched on shafts usually arranged for one horse, two thills having a triple tree pivoted on a cross piece of the same, a single tree on the middle and one on each end of the triple tree, and there being straps passed around the ends of the double tree and through loops on the sides of the thills.

A sectional non-conductive covering for tubes has been patented by Mr. William M. Suhr, of New York city. It is formed of two semi-cylinders of plaster of Paris, asbestos, and sawdust, covered on the outside with a layer of felt, which in turn is covered by a layer of thick paper, the covering being formed in sections and delivered dry and hardened ready for application, so a large quantity of pipe can easily be covered in a short time.

A sand and water pump has been patented by Mr. Valentine G. Barney, of Charles City, Iowa. The pump cylinder has a piston fitting closely at its upper end and loosely at the lower end, the piston having a series of apertures extending from the top to the loosely fitting part, to conduct water through the piston into the cylinder to form a sleeve of water around that part of the piston fitting loosely in the cylinder, to prevent wear of the piston.

A panel raising machine has been patented by Mr. Julius Lobnitz, of Madisonville, O. This invention covers improvements in contrivances for mounting, adjusting, and operating the cutter heads, also improvements in the cutters, in the table, and in the contrivance of the chip breaker and the gauges for controlling the work, the advantages being, among other things, to lessen the power required and make smoother work.

A door or window screen has been patented by Mr. Obadiah G. Newton, of Trenton, Mo. Netting is secured to the inside of the frame, and grooves are formed in the netting, in the bottom of which grooves are apertures through which the flies can escape, triangular blocks being placed in the ends of the grooves and in recesses in the frame, to make it easy for flies to escape from a room, but difficult for them to enter.

A mechanism for converting motion has been patented by Mr. Jethro E. Pencille, of Kendall, Pa. It is a lever mechanism combined with a piston and crank shaft, a short piston movement being made to operate a crank of much greater length, to give increase of leverage and power, the device being especially designed for use in connection with a steam engine, and generally applicable for converting rectilinear into rotary motion.

A boot or shoe has been patented by Mr. John Hansen, of Maryville, Mo. The upper is formed of three layers, the middle one consisting of oil tanned and crimped bladder; the bottom edge of the upper layer is turned outward to form a second welt, on which the usual welt is placed, and then sewed to the upper, and at the same time is sewed to the sole with the upper, the counter being placed on the outside of the back leather, and a back stiffener over it, which extends above the counter and over the side seams.

A coffee and tea pot stand has been patented by Mr. Charlie Gracey, of Summit, Miss. It is made to hold the pot securely, and facilitate tilting it, a basket being pivoted between two standards, with slots in the rear and front of the basket for receiving the spout and the handle of the pot, and with apertured lugs through which a pin can be passed, which is also passed through the pot handle to keep the pot in place, while a lamp can be held in the cross piece of the standards.

A guide setter for sewing machines has been patented by Cornelia T. Freeman, of Elizabeth, N. J. The graduated plate has a pivoted pointer for designating the position of the cloth guide, so in case the work is suspended, and the machine used for other stitching, the guide may be easily and accurately readjusted to resume work; the graduated plate also has a stud on its under surface to enter an orifice in the cloth plate for insuring the proper parallelism of plate and cloth guide with the feed of the machine.

NEW BOOKS AND PUBLICATIONS.

TUNNELING UNDER THE HUDSON RIVER. By S. D. V. Burr. Twenty-seven Plates. John Wiley & Sons, New York. Price $2.50.

Although work on this great enterprise has been suspended since July 20, 1883, there are probably as many who are confident of the final success of the Hudson River tunnel (to connect New York and Jersey cities) as there were, in all the early years of the undertaking, that the East River Bridge would be completed. There have been, altogether, some 2,500 feet of the tunnel actually built, at a cost of about $1,100,000, and, at the rate at which work was being pushed at the time of suspending operations, the whole tunnel could be completed, barring any further accident, in two and a half years. Just what has been done, with a description of the obstacles encountered, the experience gained, the success achieved, and the plans finally adopted for the most rapid and economical working, are lucidly described by Mr. Burr, while numerous plates of working drawings are given, which add to the value of the volume. The author's opportunities for thorough investigation were favorable from almost the very beginning of the enterprise. The general plans according to which the tunnel has thus far been built are new, and in this volume engineers have the opportunity of thoroughly understanding them.

Notes & Queries

HINTS TO CORRESPONDENTS.

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

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

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

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

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

Minerals sent for examination should be distinctly marked or labeled.

(1) K. A. R. asks how to tin or galvanize small iron castings. A. Clean the iron castings (or forgings) from scale, sand, and other adherent coating; dip them in a bath of muriatic acid and water—one part by measure of acid and four of water—and immerse them in a bath of melted zinc (spelter); no tin is required. Take them out, and violently shake off the dripping metal. Some use a dip of powdered resin after the acid bath, and before the immersion in the liquid zinc. Block tin melted may be used in the same way as zinc, if you prefer it to zinc.

(2) A. G. H.—The stars twinkle when the atmosphere is disturbed by unequal temperature or the commotion of strata of the atmosphere having different temperatures. You may see a fair illustration of the reality of this phenomenon by looking at a distant light across a hot stove. The twinkle of a star to the eye is the same as the dancing of the star in the field of the telescope, which Newton failed to mention. Stars have their hardest dances in the largest telescopes, when the condition of the atmosphere is favorable. Planets of large visual size do not appear to twinkle, but their telescopic definition is destroyed from the same cause that makes the stars twinkle to the eye or dance in the telescope.

(3) F. L. asks for information: 1. As to the process of canning fruit without being boiled, such as we see in the large groceries put up in large bottles? A. The processes of canning fruit when not dried all involve some sort of heating or partial cooking. The canners claim that there is nothing peculiar about it. With experience there comes a certain amount of skill which cannot be imparted by furnishing receipts. 2. The method of ironing collars and cuffs in the Chinese style? A. The Chinese method of laundrying is given in answer to query 2 on page 330 of SCIENTIFIC AMERICAN, for May 26, 1883. 3. The composition of the baking powders by parts, that is, their ingredients? A. Take:

Powdered cream tartar	30 oz.
Soda bicarbonate	15 oz.
Flour	5 oz.

All well dried; mix thoroughly, and keep dry.

(4) W. S. asks if there was any substance or composition known which would form a glaze for pottery or baked earth, vitrifying at a low heat (between boiling water and melting lead). A. Perhaps the following will answer: Take 100 parts washed sand, 80 parts purified potash, 10 of niter, and 20 of slaked lime, all well mixed, and heated in a black lead crucible, in a reverberatory furnace, till the mass flows into a clear glass. The goods are to be slightly burnt, dipped in water, and sprinkled with the powder.

(5) W. C. M. asks: 1. Whether or not ordinary bricks expand when saturated with water; and if so, the most simple means of ascertaining the fact and demonstrating the same to an unbeliever? A.

Bricks probably do expand very slightly under water as an effect of capillary attraction, but in such an infinitesimal degree that it would be difficult to show without very delicate measurements. 2. Where he can ascertain as to the action of moisture in its effect upon solids as an expansive force? A. We do not know of any special treatise on this subject exclusively, but any general work on physics has more or less bearing on the matter.

(6) E. C. C. writes: In the SCIENTIFIC AMERICAN of Dec. 6 is an article entitled "A Chance for American Inventors," with regard to cleaning the henequin fiber. There are a good many inquiries as to what henequin is; the nearest we can place it is from Hena. Will you say what it is, what it is like, its growth, etc., that will be of benefit to inventors, and perhaps growers of the plant? A. You are right as to origin of word; it is a species of hemp grown principally in Yucatan, and there called Sisal grass, though it is also a native of Mexico, Honduras, and Central America, and has been introduced in Florida. There are two varieties in Yucatan, the *yashqui*, of better quality, and the *sacqui*, giving larger yield. It is easily cultivated on dry and stony land. The annual yield of clean fiber is about a ton to an acre. The native mode of preparing the fiber is to scrape away the pulp from each side of the leaf with triangular strip of hard wood, then washing and sun drying, a very slow and toilsome process.

(7) M. A. M. asks for the form of application of steam in process of feather curling, also what foreign substance, if any, is used in steaming to keep them curled for a long time? A. The process of curling feathers consists in heating them slightly before the fire, then stroking them with the back of a knife, and they will curl. The steaming is for the purpose of cleansing the feathers, as it is necessary to first soften them; and we do not know of any substance used for holding the curl on good feathers, though many substances might be suggested for cheap ones.

(8) E. W. writes: A locomotive has six drive wheels connected to piston on middle or center wheel. Is there more pressure on the rail under center wheels by means of piston pushing down and lifting up while in motion? Or is the pressure all alike on six drive wheels? The wheels all connected together by rods. A. The push and pull of the piston rod is compensated by being attached to the frame of the engine. It lifts the frame when pushing down on the wheel, and *vice versa*, making a slight tendency to rock the engine. There is no perceptible variation in the pressure from the action of the rod. All the wheels bear as near alike as the set of the springs and evenness of track will allow.

(9) B. W. G. asks how to fix an iron pump that has burst in the late cold snap; the crack is 12 or 14 inches long. A new head would cost about $12, so I wish to mend the old one. A. If only a split cylinder, it may be hooped with iron bands bolted on. Otherwise we could not advise without seeing the pump.

(10) P. V. S. asks how the large ocean steamers, for instance such as steamer Ems, of North German Lloyd, running between Bremen and New York, obtain during the passage their supply of water for the use of their boilers? A. Sea-going steamers use salt water. Many have surface condensers arranged for saving the steam used, by condensing and returning it to the boilers as fresh water.

(11) S. K. E. asks the value of the half dollar of 1824. A. The coin is worth 50 cents. 2. If there is any method by which to transfer the ink from small newspaper cuts, etc., to glass slides for magic lanterns? A. We presume you refer to the following, which was devised by Leclerc of Paris: Glass which is thinly silvered is coated with a very thin coat of asphalt. This is done by dissolving Syrian asphalt, such as is sold by photographic dealers, in benzine, and coating the glass with the solution without exposure to direct sunlight. A photographic cliche is laid upon the asphalt coat when dry, and the whole then exposed to the rays of the sun, which will render the asphalt, wherever the latter is exposed, insoluble. The protected asphalt coating is then washed away with benzine, and the silver coating below it with nitric acid, while the drawing or pattern will appear in silvered lines and figures upon the glass.

(12) L. L. F.—The melting point of lard is generally determined by melting it and placing a thermometer in the liquid; a reading is made when the first signs of crystallization appear. The acid test differs, and is determined by titering a given quantity of lard dissolved in alcohol with a standard solution of caustic alkali.

(13) G. H. H. asks: What chemicals or liquids can be put into quart bottle or small box to reduce the temperature in said box say to freezing or nearly so at any season of the year, and would last the longest without renewing or much attention? A. We do not know of any permanent freezing mixture. An excellent compound consists of equal parts water and ammonium nitrate. In the SCIENTIFIC AMERICAN for June 21, 1884, a table of freezing mixtures is given in answer to query 4.

(14) A. B.—To make candied banana the fruit is prepared separately, and allowed to absorb as much sugar as possible from a strong sugar sirup, then it is dipped from time to time into a concentrated sirup made from crystallized sugar, and afterward dried on wire screen. The dipping is continued until crystallization is satisfactory.

(15) W. F. S. asks (1) the number of horse power a 4x4 engine is rated at 300 revolutions. A. Your engine, with 50 pounds mean pressure upon the piston, or from 65 to 75 pounds in boiler, at the rate stated, will be equal to 4 horse power. 2. What size boat and size and pitch of propeller is it adapted for? A. Size of boat 25 feet long, propeller 20 inches, with 4 feet pitch. 3. Will a coil boiler pass inspection, and where can I get estimate of cost, or learn how they must be constructed? A. A coil boiler will pass inspection if properly constructed. Write some of our advertisers for estimates.

(16) W. L.—The motion given to one jumping from a moving car involves no paradox. The conditions are the same as in making a sudden stop when running, viz., bracing the body, and inclining it from the direction of motion. In the case of the rapidity of ascent and descent of a bullet fired into the air, the friction of the air constantly holds a retarding influence upon its velocity, both while ascending and descending, while gravity only retards its ascent and accelerates its descent. The friction of the air upon the bullet is in proportion to its velocity, no matter in which direction it moves.

(17) F. G. C. writes: 1. At a temperature of 50° Fahr. *below* zero, what would be the length of an iron rod which at 100° *above* zero is exactly 100 ft. long? Of a brass rod? Of a copper rod? A. A bar 100 ft. long from +100° to −50° will contract:

Iron	1·18 in. and be	99 ft. 10·82 in. long,
Brass	1·87 in. and be	99 ft. 10·13 in. long.
Copper	1·72 in. and be	99 ft. 10·28 in. long.

2. Is the decrease in length the same for every degree of decrease in thermometer? A. With copper and iron the contraction is supposed to slightly increase with the fall of temperature in the lower part of the scale, or below 212°. 3. What are the alloys, what *per cent*, and how is per cent determined (*i. e.*, by weight, bulk, or value), and of what value are the alloys in U. S. coins? A. Alloys are made by weight. The standard for gold and silver coin is 900 parts pure metal and 100 parts alloy in 1,000 parts by weight. 4. Why does the frost on window panes, no matter how many in a sash, always melt at the *top* first? A. Because the room is warmest at the top. 5. What causes the different forms of crystallization on windows, very large designs bordering on very small ones? A. Because of the different conditions of intensity of cold and moisture of the air of the room. 6. Does *dry* wood shrink or expand by heat and cold? A. Yes; almost infinitesimally. 7. Why is it that in heating a large room (40 x 60 x 20, with furnace), I find it quite difficult—almost impossible—to raise the thermometer above 50° Fahr., while to raise it from 0° to 50° is comparatively easy? A. Because from 0° to 50° is nearer the outside temperature than any required temperature above 50°. 8. Is solid ice affected by cold or *heat* (*not above* 25° *Fahr.*), and if so, in what manner? A. Ice expands and contracts by change of temperature in the same manner as other solid bodies. 9. What is the heaviest substance known, and what is its specific gravity? A. Platinum; specific gravity, 21·5; hammered, 22.

(18) O. S. asks for a compound (metals preferred) that will melt under 150 degrees Fahrenheit. A.

Tin	12	parts.
Lead	25	"
Bismuth	50	"
Cadmium	13	"
Mercury	10	"

(19) J. C. B.—There is no difference in the length of the American and British standard yard.

(20) A. F. A.—French chalk has been used to draw figures on sheets of mica, and then when breathed on will show the drawing white; when the mica is dry it cannot be seen. The same process is probably applicable to slate.

(21) A. A. B.—The etching on railroad lanterns is probably done by the sand blast process. The ordinary process of etching on glass is described in SCIENTIFIC AMERICAN SUPPLEMENT, No. 313.

(22) P. A. S.—A very fair imitation of cider may be produced by using the following receipt: 25 gallons soft water, 2 pounds tartaric acid, 25 pounds New Orleans sugar, 1 pint yeast. Put all the ingredients into a clean cask, and stir them up well after standing twenty-four hours with the bung out. Then bung the cask up tight, add 3 gallons spirits, and let it stand forty-eight hours, after which time it will be ready for use.

(23) A. C. S. asks how many metals there are that have a specific gravity more than that of gold, and their names and specific gravities. A. Gold has a specific gravity of 19·3, iridium 22·4, osmium 22·5, platinum 21·5.

(24) C. W.—Swansea in South Wales, and Cornwall in England, are the principal centers for reducing the low grade ores of copper, silver, and gold. The addresses of the various works may be obtained through our Consul at Liverpool or London.

(25) J. H. E. asks: Which size coal, used in a hot air furnace for heating houses, will give the most heat, same number of pounds being used—"furnace," "egg," or "nut?" Why? Which is the most economical? A. We do not know that there is any more heat in a ton of coal whether it be the furnace, egg, or nut. When there is no difference in price, convenience of attendance upon the furnace is a consideration in favor of the larger coal. The frequency of firing and waste through the grate of unconsumed nut coal with its larger percentage of dust is against its economy for heating furnaces. Which size is best in each instance depends on the furnace and the work it is expected to do.

(26) R. M. F.—Chloride of antimony has been much used for browning gun barrels. Mix with olive oil to a thin creamy consistency. The barrel to be made perfectly clean and free from rust spots or grease, then covered evenly with the mixture, and left until the proper shade is produced, when it may be washed with common soda and water, and rubbed smooth with boiled linseed oil.

(27) R. B. P. writes: I have a large amount of muslin that has been used with stencil colors for review exercises. Though the paints are water colors, they will not wash off. How can they be removed from the muslin? A. First wash with alcohol, then with dilute oxalic acid, followed by ammonia; this will suffice to remove all coloring material. A chlorinated solution of soda likewise will be found satisfactory for removing the coloring.

(28) C. S. C. writes: I have a small side wheel steamer, 40 feet long, 9 feet wide, 3 feet deep, flat bottom, sharp at each end, runs on 14 inches of water. What should be the diameter of wheel and what width bucket, and how many runs per minute? How deep should bucket dip? The length of bucket is 2 feet; engine, 8 horse power. What speed will she make? A. Wheels 9 feet diameter, 3 feet bucket, dip 1 foot at light draught. We could not predict the speed with any certainty; 5 or 6 miles per hour may be accomplished.

(29) E. L. H.—Metallic silver with a frosted surface is the nearest approach to a pure white substance that is a good conductor of electricity, what you require, that we know of. The bisulphate of mercury battery and the chloride of silver battery are both powerful and constant. The bichromate of potash battery is powerful, but not so constant. For light currents the Trouve battery, which is practically dry, is very successful. There is no metal that will prevent the formation of a spark in the commutator of an electric motor. The spark depends in a great measure upon the construction of the motor. In motors made on the principle of the continuous dynamo, there is very little spark.

(30) S. S. W.—Your inquiry has already been answered in the SCIENTIFIC AMERICAN, but, in addition to the reply then given, we would say that a common method of removing paint and varnish from wood is to soften it by means of a flame (gas or alcohol), or by means of a hot iron held near, but not in contact with, the wood. When the paint is thus softened, it may be readily removed from the surface of the wood by means of a broad, thin scraper.

(31) J. G. H. asks: What speed should a 7 inch emery wheel have while truing it with a diamond? A. Thirty to 50 revolutions per minute for a 7 inch wheel.

(32) J. T. asks: 1. Has electricity any difference of action (conductibility excepted) upon wool, jute, and linen? A. We believe not. 2. Has anything been published upon it? If so, where can it be procured? A. See any recent works upon electricity or physics.

(33) H. C. R. writes: I wish to make an iron die to stamp sheet brass. Can I make a deposit of iron on a plaster form coated with plumbago, and then back the deposit up with brass or other metal? If it can be done, what kind of battery should I use, and how should I make the solution? A. We think you will be unable to make iron dies in the manner proposed.

(34) G. F. H.—We think that there is very little difference between the dynamos of lamps of prominent makers. We advise you to write to all of the manufacturers and get their descriptive circulars.

(35) R. L. G.—The opaque lantern or wonder camera is simply an ordinary magic lantern adapted to use ordinary pictures and solid objects instead of the transparent views. The light is concentrated upon the face of the object, and the image is projected by reflected light instead of transmitted light. You will find description of the opaque lantern or wonder camera, and on making inks, in back numbers of the SUPPLEMENT.

(36) C. E. B. asks: 1. What composes the requirements of a locksmith, and what is the opening for one learning the trade? A. Locksmiths, nowadays, are not regarded as first class mechanics. Years ago, when intricate locks and keys were made by locksmiths, it was regarded as a very important and difficult trade; but now a locksmith is required to do little else than to repair broken locks or to fit ordinary keys. 2. How much of No. 16 cotton covered wire does it require to wind the magnets of dynamo machine described in SUPPLEMENT, No. 161? A. From two to three pounds. 3. How must I change the commutator to make a motor of it? A. If the commutator is arranged properly for a dynamo, it ought not to require changing when the machine is used as a motor. 4. Must there be a battery used to excite the magnets in starting machine? A. Generally no; but if the iron of the field magnet is absolutely devoid of polarity, the magnet must be either placed in the magnetic meridian or it must be excited by means of a battery.

(37) E. B.—We think that you will experience much difficulty in covering your boat frame with galvanized iron. Life boats are made of galvanized iron, but the strakes are pressed to shape with a powerful hydraulic press. We think you would do better with wood planking. Linseed oil is preferred for both framing and planking. Upon this you may paint any desired color, using boiled linseed oil only.

(38) G. T. E.—Brass springs must be made of what is called spring brass. If made of annealed brass, they cannot be hardened except by hammering.

(39) C. & C. write: If an engine is run 400 revolutions with 40 pounds pressure, will you have more power by running 600 revolutions with the same pressure? A. Theoretically, yes, provided the boiler will supply steam in proportion. To do this requires more fuel, that costs more money. As these high speeds are impracticable we do not recommend them.

(40) W. M. C.—No one knows whether electricity occupies space, in the sense that physical objects do.

(41) F. N. D. asks if a cast iron gas main will rust on the inside, when it is in constant use for supplying gas, if water that is made to absorb all the salt that it will hold is run through it? The water does not stay in pipe, but runs off at once. A. We think that the application of salt water in the manner proposed would not secure any beneficial result.

(42) J. F. C.—Balloons other than silk may be made of very fine muslin or paper for experimental purposes. Hydrogen gas will lift about 2 pounds to the cubic yard.

(43) G. H. W. writes: I have made an electric machine like the one described in SUPPLEMENT, No. 161; it works well as an electric machine, but I want to make a motor of it. I wound the armature with No. 20 wire instead of 18, because I had the wire. Will you please tell me how I can make a motor of it? I have changed the commutator and tried every way, used one battery to charge the field magnets and three on the armature, but no good. Would it be better to wind the armature with finer wire, if so, what number? A. Your armature would be better if wound with coarser wire, say No. 16, for a motor. You should connect up your armature and field magnet so that the battery current passes through the armature and field magnet in series; then a slight change in the adjustment of the commutator would probably enable you to succeed when using your dynamo as a motor. The commutator may be adjusted so that the dynamo will need no change when used as a motor.

(44) H. M. N. asks: What is the easiest method of polishing irregular curved surfaces of castings? How are copper or brass faucets, pipes, etc., polished? A. This kind of polishing is usually done by means of polishing belts and cloth wheels supplied with suitable polishing powder.

(45) Test for oleomargarine.—In the issue of January 31, answer to correspondents, No. 73, told how to tell oleomargarine from butter. The way is not handy to use as a test. Try this simple and infallible test: Stir a little—half a teaspoonful or less—of the suspected butter in enough sulphuric ether to dissolve it. By the time the grease is dissolved the ether will have been evaporated, and the residuum will show, to smell or taste, whether it is butter, lard, or tallow. Five cents' worth of ether will suffice for several tests.

(46) E. F. K.—The running of the feed pipe through the fire chamber to the back end of the boiler is dangerous. When the injector is not running, the intense heat of the fire chamber generates steam in the pipe, forcing the water out and into the boiler, and allows the pipe to become red hot. In a short time it will split or burn out, and let the water out of the boiler when you can least afford it. Better run the pipe outside the setting and through the back wall, or if you wish to heat the water, make a small coil and place in the smoke flue, so as to take up some of the waste heat of the chimney. Put a check valve next to the boiler feeding at the front.

(47) J. F. S. asks (1) for some reference to published authority, and where obtainable, upon electroplating, such as will enable a good mechanic having some practical knowledge of electricity, chemistry, and batteries to make such batteries, tanks, solutions, etc., as are required in the business of electro-plating with gold, silver, and nickel? A. You will find considerable information given on this subject in SCIENTIFIC AMERICAN SUPPLEMENT, No. 310, under the title of "Electro-Metallurgy." Among the works one of the most recent and complete is "Galvanoplastic Manipulations," by W. H. Wahl. Price $7.50. 2. Is molybdate of ammonia the simplest and best test for sulphur? A. Molybdate of ammonium is generally used as a test for phosphorus. For sulphur, treat the solution with a little nitric acid, heat, and add barium chloride; a white pulverulent precipitate of barium sulphate is indicative of the presence of sulphur.

(48) L. S. asks if an engine 2x3 is suitable for running a canoe 14 feet 8 inches by 27 inches beam; how much power would such engine develop at 40 pounds steam? Would a boiler 12 inches diameter and 13 inches high, made of three-sixteenths inch galvanized iron with heavy copper heads and heated with gasoline, give enough steam for above engine, and would boiler be strong enough? If above dimensions are wrong, please set me right, also as to the make of a light and strong boiler. What size 3 blade screw is best? Also what would speed of canoe be? A. At 200 revolutions per minute, your engine would develop one-third horse power. Your proposed boiler is not large enough. Should be 14 inches diameter, 20 inches high, with twenty-five 1 inch tubes, with the outside of the shell covered into the heating chamber. Better make the boiler of plain iron three-sixteenths inch shell, ¼ inch heads. Tubes expanded in heads. A 12 inch screw will be as large as can be used to advantage. Knowing nothing of the construction or weight of canoe, we can only estimate speed at 5 miles per hour.

(49) C. G. B.—The sudden turning on of steam at high pressure to heating pipes is dangerous to the pipes and fittings. The pipes always contain more or less water when cold, and the sudden accumulation of water of condensation from the inrushing steam upon the cold pipes accumulates water that cannot be instantly drained away; and as water is comparatively a solid body, it dashes along the pipes under the force of the incoming steam, producing concussions like hammering upon the pipes, and in its confined condition produces great strain upon the pipe and fittings, often bursting forth.

(50) W. B. M.—You may return the water of condensation to the boiler under the conditions that you name. You will need 1¼ inch pipe from boiler to near the radiators, and distribute to radiators with 1 inch pipe. The return to boiler may be 1 inch pipe, with ¾ inch branches to each radiator. Only ordinary valves upon the radiators, with a check valve near boiler. If you have air valves upon each radiator and a small blow-out valve near the boiler, so as to get rid of the air in the return pipe when you turn steam into the heating pipes, you will need only one precaution in its management, viz., always remember that the water returns by gravity only, which makes it necessary to keep the steam at the full boiler pressure upon the radiators, otherwise the water will back up into the radiators until the proper gravitating balance is obtained. No throttling of the steam at the boiler valve will succeed with a gravity system.

(51) S. H. asks (1) how to apply loadstone to steel to give it the strongest attractive power. A. You can neither impart to a strong magnet a strong attractive power by the application of loadstone nor increase the power of the loadstone by the application of a strong magnet. 2. Is this the strongest attractive power known? A. An electro-magnet properly constructed and supplied with a suitable current exerts the strongest attractive power. 3. Does magnetic steel retain its power permanently? A. Yes, if it is vibrated or heated. 4. Does rubbing steel to a permanent magnet give it the same power as applying loadstone? A. Yes.

(52) F. A. McL.—Your motor operates by the attraction of the excited armature for the iron of the magnet, and the armature induces magnetism in the cores of the magnets, and as a consequence you get an induced current in the wire of your field magnet.

(53) W. S. W. asks (1) how heavy an object will the strongest magnet to be procured raise four inches, holding magnet that distance from object? A. We do not know that the limit of the power of an electric magnet has ever been determined. Probably with sufficient outlay for electric generators and for the material of the magnet, you would be able to raise several tons a distance of four inches. 2. What would be the size of the magnet? A. This would be entirely a matter of experiment. 3. Where can I procure the strongest horseshoe magnet, or is the horseshoe the strongest permanent magnet? If not, what is? A. The strongest permanent magnets in the market are what are known as the machine magnets. You can buy them from any of our dealers in electric supplies. 4. What metal would the magnet have the most attraction for? A. For a permanent magnet, chrome steel is considered the best; for an electro-magnet, there is nothing superior to the softest iron. 5. What would be the cost of such a magnet? A. It is impossible to say.

(54) E. E. D. asks: Is it a fact that if a tank of water be weighed, and a fish of say 10 pounds placed in the tank, the weight will not be increased? A. If the amount of water is undiminished, the weight of the vessel will be increased by the weight of the fish.

(55) F. B.—Brass is seriously affected by mercury; copper is less affected; and iron is not affected at all. A common way of transporting mercury is by the use of iron flasks.

(56) J. M. A.—Your experiment producing electricity from a cat is quite old.

(57) L. H. asks for a polish with which tool handles, stocking bulbs, and small turned woodwork generally can be quickly and cheaply polished while in the lathe. A. A mixture of boiled linseed oil 2 parts, alcoholic shellac varnish, 1 part, well shaken together and applied sparingly with a cloth to the revolving work, will produce a fine polish.

(58) G. W. H. asks: 1. Would a top weighing one pound while at rest, weigh less while revolving at the rate of 10,000 revolutions a minute? A. The top would weigh the same under all circumstances. 2. Would a one pound weight weigh less at equator than at the poles? A. The difference would be very slight.

(59) C. V. asks how to make a shunt between the armature and field magnets, on a plating dynamo. A. Connect the terminals of your field magnet with your brushes. Unless your field magnet has a high resistance it is not adapted to a shunt, as most of the current from the armature would pass through the wires of the field magnet.

(60) D. E. B. writes: Suppose a cone-shaped piece of steel be placed on the positive and negative ends of a horseshoe magnet, thus joining them and continuing to a point; will that point be negative or positive? A. If the magnet is perfectly balanced, and the armature is symmetrical and of homogeneous material, the point will be neutral.

(61) C. L. P. writes: I have two second-hand magnetos Will they ring bell on a line one mile long? Also, do they depreciate in efficiency by use? Suppose three magnetos in the houses A, B, and C; can any two houses communicate without ringing the bell at third house? Thus: B can call either A or C, but can A call B without calling C, or *vice versa*? A. Your magnetos should be capable of ringing bells on a line much more than a mile in length. If the magnets are of good quality, the machine should mantain its efficiency indefinitely. You cannot communicate in the manner suggested without having what is known as an individual call.

(62) H. W. B. asks: What size electro-magnet and with what size and quantity wire should it be wound in order to get the best results with five cells of gravity battery? A. Make the cores of your magnet ¾ inch in diameter and 6 inches long. Wind half the length of each arm with No. 20 wire to a depth equal to the diameter of the core.

(63) C. H. M. asks why a person will take cold quicker lying down on a bed than if sitting up—yet when they get into or go to bed, they are warmer than while sitting up. A. If you are correct in your statement, it is probably because more vital energy is put forth by people who are not lying down, and in bed one is generally protected by additional clothing.

(64) D. L. asks how to connect two electric bells (not magnetos) on one wire; the line is about ¼ of a mile long. Intend to use spring keys, but cannot figure out how to connect. When the key is pushed, the bell at the other side is to ring, or both. A. Use what is known as back contact keys, and ground the ends of your line through the back contacts and through the bells; take your battery current through the lower contact. If you desire to use a closed circuit, you may place your battery keys and bells directly in the circuit. In this case the keys will be normally closed, as in the ordinary telegraph circuit.

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

E. N. J.—No. 1 appears to be a clay containing shiny particles of mica. No. 2 is a rock consisting principally of the mineral hornblende. No. 3 is a hard silicious rock containing iron silicates as coloring materials.—H. J. B.—The specimens are ordinary clay colored by means of iron oxide, and have no value in New York. In the absence of a better material in your immediate vicinity, it is quite possible that you might be able to utilize them.—E. H.—The sample appears to be gold bearing quartz. The sulphurets are of iron, and possibly lead and silver. The specimen we should consider of value. The expense of an assay would be $5.00.—H. S. D.—The specimen is calcite, or crystallized limestone, and of no commercial value.—H. P. D.—The specimen is too light for kaolin, and is not sufficiently plastic to be of value for the making of pottery. It is probably a mixture of magnesia with clay.—H. P. B.—The mineral sent is staurolite.—A. D. —The specimen is of no value; it contains too much iron. The white variety of long fiber is the most sought after.

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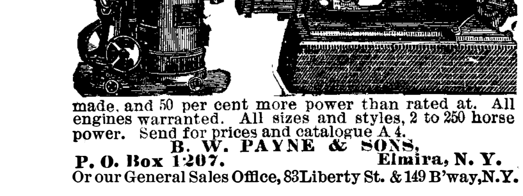

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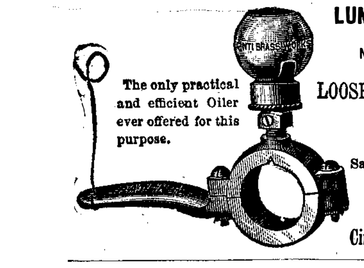

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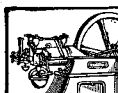

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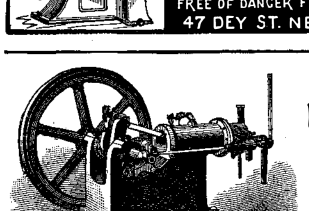

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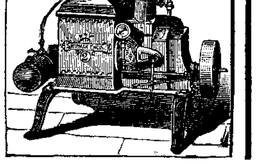

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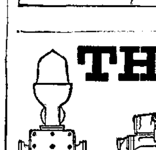

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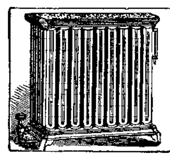

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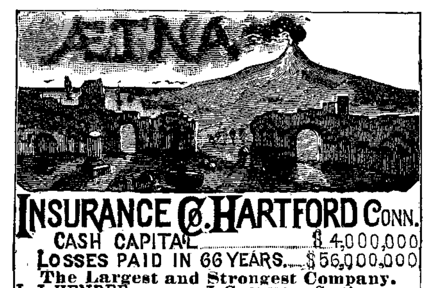

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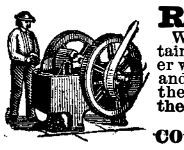

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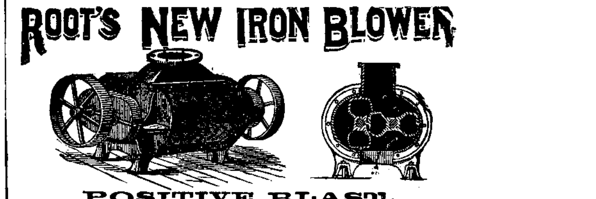

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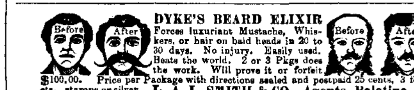

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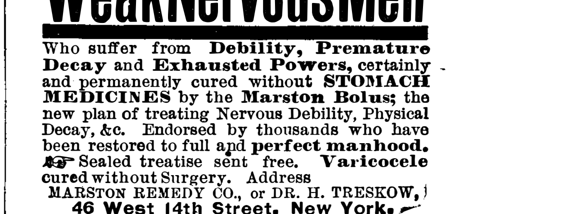

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