substance than hydrogen, a congener in lightness and many other properties, but as yet undiscovered by our terrestrial chemistry. To this hypothetical element the name of helium has been assigned by Lockyer and Frankland, though with rather doubtful propriety. Sometimes, not unfrequently indeed, other lines also appear, among which those of sodium, magnesium, barium, chromium, calcium, titanium, and iron are most common.

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

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

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

### THE CORONA.

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

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



## Recent American and Foreign Patents.

### Improved Scaffold Clamp.

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

### Improved Cotton Press.

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

### Improved Sawmill Dog.

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

### Improved Plow.

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

### Fastener for the Meeting Rails of Sashes.

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

### Combined Fork, Hook, Shovel, and Hoe.

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

### Improved Hillside Plow.

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

### Improved Distance Measuring Apparatus.

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

### Improved Harness Attachment.

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

### Improved Roof Truss.

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

### Improved Cotton Press.

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

### Improved Estimator.

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

### Improved Windmill.

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

### Improved Step Ladder.

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

### Improved Screen Window Blind.

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

### Improved Water Wheel.

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

### Improved Sash Fastener.

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

### Improved Cotton Press.

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

### Improved Process for Filling Fiber in Paper Pulp.

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

### Improved Device for Taking up the Slack of Lines.

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

### Improved Sleeve Adjuster.

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

### Improved Plenum and Vacuum Pumps.

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

### Improved Fruit Protector.

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

### Improved Washing Machine.

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

### Improved Hay Derrick.

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

### Improved Ore Separator.

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

### Improved Feather Renovator.

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

### A Remarkable Trial and Triumph.

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

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

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

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

## Business and Personal.

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



## Notes & Queries

W. H. C.'s idea for driving a propeller by a spring is not likely to prove practicable.—W. E. H. will find directions for making a storm glass on p. 75, vol. 30.—C. B. will find a recipe for fireproofing shingles on p. 280, vol. 28.—W. C. B. will find an explanation of the moon's variations on p. 251, vol. 31.—R. R. R. will find an elucidation of the weight on an inclined plane question in our recent issues.—M. will find directions for temperiug springs on p. 10, vol. 25.—J. H. L. can harden tallow for making candles by the process described on p. 201, vol. 24.—G. E. O. will find Warven's works on mechanical drawing and Davies & Peck's "Algebra" to be good and practical.—R. W. W. will find a description of the philosopher's or hydrogen lamp on p. 242, vol. 31.—C. H. H. will find full particulars as to Colgnet stone on p. 124, vol. 22.—J. M. will find recipes for hard soap on pp. 331, 379, vol. 31, and for bootblacking on p. 283, vol. 31.—J. J. D. will find directions for tanning skins with the fur on on p. 235, vol. 26.—W. P. P. will find a description of processes for preserving wood from decay on p. 319, vol. 31.—J. F. should refer to p. 213, vol. 31, for a recipe for polishing shirt bosoms.—J. M. H. and others can unite rubber to leather by using the cement described on p. 119, vol. 28.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(17) A. F. C. asks: 1. What would be a safe pressure to carry on an upright tubular boiler 15x20 inches, having 52 one inch tubes made of three sixteenths iron? A. A safe pressure would be 100 lbs. per square inch. 2. What would be the bursting pressure? A. About 600 or 700 lbs.

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

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

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

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

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

(23) A. B. C. says: "We have just started a new steam pump in a mine, at 700 feet level. To prevent the steam from exhausting in the shaft, a pipe was fixed to convey it into what we call the suction pipe, and the connection at the suction pipe was a globe valve or chamber, as the valve was taken out, and the exhaust pipe inserted in its place. This was the engineer's plan. I said that I did not think it would answer, as the chamber or pipe where the exhaust steam meets the water was too small, and the steam would cut off the water, or at least some of it; and it so happened that, when they started the pump, it would not pump ½ of the stream it ought to, which proved my words true. He took it away from there, and put it to exhaust in a wooden pipe which brings air down to the bottom of the mine, and it would be just as well if he let it exhaust right in the shaft as in that pipe; for the air strikes it, and it condenses, and as a matter of course fills the shaft with smoke. Now I think I can put the exhaust steam into the suction pipe so that it shall work all right. My plan is to have a larger and a more suitable connection with the suction pipe. Do you not think this will answer? The reservoir stands about level with the pump. The suction pipe is of 4 inches diameter." A. You are just entering on a field in which a great deal of money has already been spent for experiments, namely, condensers for steam pumps. The matter has already been worked out practically, and we think your cheapest and most satisfactory plan would be to obtain a condenser.

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