just twice the distance from the line of centers as σ", is found, and the plumb line, it is seen, cuts the wheel at 63 deg. 30 min., whose tangent is 2. It is unnecessary to multiply examples, to show that whatever be the force, the distance of the weights from the line of centers will be inversely proportional to the weight, and the plumb line will cut the wheel at the degree whose tangent is directly proportional to the weight, therefore the intensity measured, by the true tangent galvanometer, is proportional to the tangents of the angles of deflection of the needle. To prove the accuracy of my galvanometer, I will give the results of five observations. This instrument has three coils, the first for intensity consists of three layers of No. 32 copper wire, giving 3·1 mile resistance; the second, for common mixed currents, has one layer of No. 28 wire, resistance of .4 mile, the remaining coil for quantity alone, is a simple plate of copper whose resistance is entirely null. The power employed was four cups of Hill's battery, passed through the first coil, then through coil No. 2, against resistances differingfrom 4·1 to 151·1. Isodynamous, or equally intense currents, being obtained, the resistances introduced were 4·1 11·1 41·1 81·1 and 151·1 mile. The tangents of the deflection of No. 1, from 75 deg. to 8 deg. 30 min., divided by those of No. 2 from 40 deg. 10 min. to 2 deg., gave the quotients 4·4 4·3 4·4 4·44 and 4·3. Such results give indications of a very true tangent galvanometer, equaling in accuracy the large, cumbersome and inconvenient instruments that have formerly been used. By intricate computation and by means of tables, results sufficiently reliable for ordinary purposes may be obtained from the common galvanometer, but the labor and difficulty attending such methods render them unavailable for practical use. To employ this improved galvanometer and rheostat for testing the power of a magnet, pass a current through, and note the deflection of the galvanometer, then switch off the current through the resistance coils of the rheostat until the needle settles at the same degree as when on the magnet, the figures on the rheostat corresponding to this degree will show at a glance the resistance. For determining the resistance of a battery cup, pass the current as before, then reverse the poles, thus the mean or average deflection can be obtained and compared in the same manner as when determining that of a magnet.

Squaring the Circle.

From L. D. G. we have an article, in which he claims the solution of the long-mooted problem of "squaring the circle." Upon a critical investigation of his process we think he has misunderstood the problem itself. It is essentially a geometrical, and not a mathematical problem. We regard the squaring of the circle as a question belonging to a similar class with the *ignis fatuus* of the perpetual motion, and like that, incapable of practical demonstration. The efforts of our correspondent seem to have been directed to forming a square of the same area of a given circle. His operation is simple, being merely the finding of the area of a circle from its diameter, and the elimination and defining of the lines of a square containing the same amount of surface. His rule for it is this: "To find the circumference of a circle take eleven-fourteenths of the diameter and multiply by four; or in other words, take forty-four fourteenths of the diameter, which gives the circumference." For large circles this is approximately correct and is easily worked. For small circles of a few inches the fractions will hamper and annoy. The area he finds by "multiplying eleven-fourteenths of the diameter by the diameter. Seven-elevenths of the area of the circle is the area of the square contained in the circle. The square root of the area of the circle will give the sides of a square equal in area to the circle."

There are no sums representing equally any portion ofa circle and the sides of a square, so the attempt to make the two coincide must be forever futile. The decimals for finding the circumference of a circle usually employed are 3·1416+. These may be carried to 3·14159265+, and so on indefinitely, even so far as to two hundred places of decimals, as in the *Engineer* of Sept. 28th. It is manifest that the process may be continued forever, andas no coincidents can ever be found between the elements of a circle and those of a square, the idea of squaring the circle by a geometrical solution is vain.

Correspondence

Salvation of Ships in a Gale.

MESSRS EDITORS:—The occasional occurrence of one of those terrible disasters at sea, the loss of a passenger steamship by losing control of the ship, leads to the inquiry whether there cannot be some practicable means provided or devised to meet these particular emergencies. If the engine of a steamship breaks down during a hurricane, she is lost, no matter how strong she may be or how well appointed; she becomes a helpless mass, lying in the troughs of the sea and presenting her whole broadside squarely to blows which are capable of tossing five and ten-tun blocks of granite about like cord wood; and it is only a matter of a few hours' time for the best of ships to be battered and beaten to pieces.

The loss of the *Evening Star* is owing directly to her becoming unmanageable—her rudder chains became jammed, and being uncontrolable, she was, as a matter of course, soon battered to pieces. The *Great Eastern* broke her rudder a few years since, and was nearly lost, and had she been caught in a regular hurricane she would have been ignominiously beaten to pieces like any other ship. The ship was never yet made that could survive, for any length of time, under such conditions. It was so with the fine new steamship *San Francisco*, which sailed from New York in 1853, bound around Cape Horn for California, with a regiment of United States troops on board; she was overtaken in the Gulf Stream by a heavy gale, and being crippled became unmanageable and at the mercy of the elements, and was soon so battered that the force on board, by bailing and throwing out cargo, could barely keep her afloat for a day or two until ships at hand could get an opportunity to take them off the wreck. While lying in this crippled state, by one single blow of those terrible seas, one hundred and seventy-nine souls, officers and soldiers, were washed overboard and lost. I believe there is a remedy for such cases. If a ship can be kept head to sea, or nearly, so that a sea must strike her sides at an angle, then the whole aspect becomes changed, and a bad sea becomes comparatively harmless; besides, the motion ofa ship becomes much less violent, which not only lessens the strains upon her hull but gives the crew a better opportunity to do something toward repairing or preventing damages. Sailing ships are less liable to become entirely unmanageable than steamers, as, if they ship a sea, no fires are put out, and if one mast or sail gives out they have others left; if the rudder becomes broken or disabled the ship can be managed to a considerable extent by the sails, independent of the rudder, while, if a steamer loses the use of her rudder, what sails she has usually are of little consequence with heavy wheels dragging in the water.

Every passenger steamship should be obliged to carry a heavy iron drag for "lying to" by in such emergencies; this drag should be made in such form that it could be used ordinarily as a water tank, so as not to be useless lumber in the way. It should be braced and made sufficiently strong to stand an external pressure of about 100 lbs. to the square inch, and have a heavy ring bolt in each end; and when such an emergency should arise as to require it as a drag, then the tank should be emptied and closed water tight and shackled to one of the anchors by a chain say 50 feet in length. The tank having been bundled overboard, the anchor is then let go in the ordinary way. After one or two "shots" of chain cable have been paid out, a second tank or drag can be shackled to the cable as before. With several of these drags distributed at intervals, a very elastic mooring would be obtained, owing to the nature of its construction. With two chain cables shackled together and out ahead, with such drags attached, the *San Francisco* and *Evening Star* would have made good weather of it instead of being battered to a mass of kindling wood. Keep a ship head to sea and she will "live forever." These drags are no new experiment, but have at one time and another saved many a vessel. Spars, or something of the sort, are usually lashed to an anchor and let go.

The complaints of the papers about the life boats of the *Evening Star* rolling over and over after being launched, and of the ship being lost when the life boats would float, are all nonsense. These disasters will always occur as often as a steamship breaks down at sea in very heavy weather, and becomes unmanageable. M.

New York, October, 1866.

Iron and Steel.

MESSRS. EDITORS:—The pneumatic or air-blast process, for the conversion of crude molten iron into refined iron or steel, and refined steel ingots, fit for forging or rolling purposes, is now beginning to be brought into practical use by our iron and steel manufacturers. In England the same process has been in use a few years longer than in this country. The quality of our American pig iron is admitted to be well adapted to the use of the air-blast process as a decarbonizing and refining agent for converting crude iron into ingots fit for the forge or the rolls. And our American pig is of superior quality to the English metal made with coke. This mode of converting crude iron with air blast was patented in England by Henry Bessemer in 1856, and for the past few years has gone into general use in that country for the manufacture of refined steel, T-rail, locomotive tire, car axles, boiler plate, etc. The invention was patented in the United States by Christian Shunk, and for which he holds three several Letters Patents, commencing August 28, 1854, and has, therefore, prior title to any in Europe or in the United States; and having discovered and experimented in the use of said process many years previous to that date.

The alleged discovery of Robert Mushet, of England, claiming the use of "manganese and carbon" in the manufacture of steel, is old, the same having been patented in England many years before [see 2d Curtis page 330], and has always been used by steel manufacturers in England and in this country. Nor is it new to add carbon to iron at a high heat to produce steel, which Mushet describes in his alleged patent. That iron, at a high heat, will combine with carbon, and thereby produce steel, has always been known and practiced by steel manufacturers, and is as old as iron and steel itself. And the same mode has always been practiced in the manufacture of steel, by the "black-lead crucible" process for making steel, by adding carbon to combine with the fluid iron in the crucible to produce steel for molding into ingots for forging.

In my pneumatic process, by continuing the air blast a few seconds longer to reduce the carbon, more carbon, or crude metal containing carbon, can be added to increase the carbon again to the kind of yield desired, which goes to show the utility and simplicity of the patented invention; and the same is protected in every mode, and so decided by our courts in similar cases. [2d Curtis. Nisely *vs.* Harford. See also Forsyth's patent, same book, page 109]. It would be just as novel for Robert Mushet to patent the common mode for welding a particular kind of iron or steel by the use of borax—and that would be no novelty at all—as his alleged discovery, as to add carbon to iron at a high heat in the air-blast crucible, to produce steel, a thing known by all steel manufacturers since the first invention of steel. Mushet's alleged discovery failed in England for want of novelty, the thing being known long before. And he failed to introduce it into public use in the United States within eighteen months from its date, as required by our patent laws in relation to aliens; but his alleged discovery was void from the first for want of novelty.

The machinery for rolling steel locomotive tire, etc., patented by Henry Bessemer, of England in 1859, and subsequently patented in the United States, July 1865, was an abandonment in this country by the lapse of time, and the same became public property in the United States.

CHRISTIAN SHUNK.

Greenville, Pa.

DIRT is destructive, as well as disgusting.

Sympathetic Inks.

MESSRS. EDITORS:—Accidentally my attention was drawn to some information given by you to correspondents about sympathetic inks. As this subject may be interesting to many of your readers, and the knowledge it conveys may sometimes usefully be applied as a chemical test, I give here some additional information.

Sympathetic inks are of four kinds: 1. When the writing becomes visible by simply applying heat or atmospheric moisture or dryness. 2. When peculiar gases or vapors make it visible. 3. When solutions of chemical or other compounds accomplish the same thing. 4. When the simple action of light will make the writing or drawing visible (Photographic preparations).

FIRST CLASS.—No. 1. *Red Sympathetic Ink.*—Nitrate of the deutoxide of copper. A weak solution gives an invisible writing, which becomes red by heating.

No. 2. *Yellow Sympathetic Ink.*—Chloride of copper. A very dilute solution is used, invisible till heated. To make it, dissolve equal parts of blue vitriol and sal ammoniac in water.

No. 3. *Yellow and Green Ink.*—Nitrate of nickel and chloride of nickel. A weak solution forms an invisible ink which becomes green by heating when the salt contains traces of cobalt, which usually is the case; when pure it becomes yellow.

No. 4. *Green and Red Ink.*—Chloride of cobalt. A properly-diluted solution will produce a pink writing, which will disappear when thoroughly dry, become green when heated, disappear when cold, and pink again when damp. When often or strongly heated it will at last become brown red.

No. 5. *Blue Ink.*—Acetate of the protoxide of cobalt. When the solution of this salt contains nickel or iron, the writing made by it will become green when heated; when it is pure and free of these metals it becomes blue.

No. 6. *Light Brown Ink.*—Bromide of copper. Perfectly invisible writing, which appears very promptly by a slight heating, and disappears perfectly by cooling. To prepare it, take one part bromide of potassium, one part blue vitriol, eight parts of water. It is better also to discolor the blue vitriol with one part of alcohol.

Amusing Application.—A winter scene may be so executed that the green leaves of the trees and the grass on the foreground are painted with ink made from cobalt and nickel solution, No. 5; the red berries and flowers with No. 1, yellow flowers and fruits with No. 2, and the blue flowers with pure cobalt, No. 5. When such a picture is slowly and carefully heated, the invisible parts of the plants become visible, and it is as if the heat changed the winter into a summer scene. There are several other substances which may be used for invisible writing, which becomes so by heating—lemon and onion juice, milk, diluted sulphuric acid, etc., etc.

SECOND CLASS.—No. 1. *Dark Brown Ink.*—Acetate of lead. A drawing or writing with a strong solution of this salt becomes dark brown by exposure to sulphide of hydrogen gas. I developed once before my class in the Cooper Union, the life-size profile likeness of Mr Peter Cooper, on a large sheet of paper under a glass bell jar; as Mr. Cooper himself was present, and accidentally had taken seat in front of that bell jar, it excited the utmost astonishment among the occasional visitors, who were not posted up about the action of sulphur vapors on lead, till I explained that the likeness had beforehand been drawn by me on the paper with a lead solution, and that sulphide of hydrogen vapors were being developed in the bell jar.

No. 2. *Dark Blue Ink.*—Iodide of potassium and starch. Writing with this becomes blue by the least touch of acid vapors in the atmosphere, or by the presence of ozone. It is in fact the celebrated ozone test. To make it, boil starch and add a small quantity of iodide of potassium in solution.

No. 3. *Light Blue Ink.*—Sulphate of copper. A very diluted solution will produce an invisible writing, which will turn light blue by vapors of ammonia.

No. 4. *Red Ink.*—Soluble compounds of antimony will become red by sulphide of hydrogen vapor.

No. 5. *Yellow Ink.*—Soluble compounds of arsenic and of peroxide of tin will become yellow by the same vapor.

No. 6. *Flesh-colored Ink.*—Soluble compounds of manganese become flesh-colored by the same vapor.

No. 7. *Blood-red Ink.*—An acid solution of chloride of iron is diluted till the writing is invisible when dry. This writing has the remarkable property of becoming red by sulpho-cyanide vapors, and it disappears by ammonia, and may alternately be made to appear and disappear by those two vapors. To make this experiment more striking, take two wide-mouthed jars, one with some liquid ammonia on the bottom, the other with some strong sulphuric acid and sulpho-cyanide of potassium. The last salt is added from time to time in a small quantity.

Amusing Application.—As lead, antimony, arsenic, and manganese, Nos. 1, 4, 5, and 6 above, all become respectively brown, red, yellow, and pink, by sulphide of hydrogen vapors, a drawing may be made with solutions of the salts of those metals, which will show the different colors when exposed to these vapors. However, they do not disappear again, like the sympathetic inks of the first class.

To make the sulphide of hydrogen gas, pour some diluted sulphuric acid on powdered black sulphide of iron.

These are only a few of the great number of sympathetic inks of those two classes which may be made; many new ones may be found by an experienced practical chemist. The number of those belonging to the third class is still larger; to enumerate them all would take more room than this paper can afford, and I will close with only mentioning one of them:

THIRD CLASS.—*Many-colored Inks.*—A very diluted solution of chloride or sulphate of iron used for writing will turn black when washed over with a decoction of gallnuts or logwood, will turn blue by a solution of the yellow prussiate of potash, red by sulpho-cyanide of potassium, etc., or one may write with one of the last solutions, and to make it visible wash it by means of a soft brush with an iron solution.

FOURTH CLASS.—This class belongs to the photographic department. One of the simplest preparations is a diluted solution of nitrate of silver used on paper which has been washed previously with sea-water or some other diluted salt solution. This writing will become black by exposure to light.

There are also numberless other preparations of this class, but for the present the above will be sufficient. P. H. VANDER WEYDE, M. D.

Philadelphia, October, 1866.

NEW INVENTIONS.

The following are some of the most prominent of the patents issued this week, with the names of the patentees:—

CARRIAGE-TOP PROTECTOR.—R. NICKSON, Akron, Ohio.—The object of this invention is to prevent and obviate the wearing away of the tops of carriages, when let down.

MACHINE FOR SCALDING HOGS.—MATHIAS STRICKER, Vincennes, Ind.—The object of this invention is to supply a cheap and convenient device for scalding hogs when butchered, enabling farmers to perform this operation much more expeditiously and perfectly than by the ordinary methods.

COTTON TIE.—J. H. GRIDLEY, Washington, D C.—The object of this invention is to provide a simple, cheap, and reliable fastening for the ends of metal ties or packing bands, particularly those used upon bales of cotton, and it consists in having one or both ends of the band cut or otherwise made in dovetail form, to fit correspondingly shaped flanges made either on the band itself or on a separate piece.

GATE.—HENRY ADAMS, Seattle, Washington Territory.—This invention consists in so hanging a gate that it can be adjusted in hight, so as to swing clear of all obstructions upon the ground.

PLOW.—JAMES HARRIS, Kansas, Ill.—This invention relates to a new and improved double or gang plow, and consists in a peculiar construction of the same, whereby a very strong and durable plow of the kind specified is obtained, and which will admit of a shovel plow being substituted for a breaking or mold-board plow, so that the device may be used as a cultivator when required.

GRAIN KILN.—NICHOLAS WALLASTER, Detroit, Mich.—This invention has for its object to furnish a kiln for drying grain conveniently, thoroughly, and in any desired quantity.

MITER BOX.—J. A. MCKINSTRY, Monson, Mass.—This invention relates to a new and improved miter box of that class in which the tangents are adjustable to admit of the moldings or other articles or stuff to be operated upon being cut or sawed to any desired angle. The object of the invention is to obtain a miter box of the class specified which will be simple in construction, capable of having its saw-guides adjusted with facility and great accuracy, and also capable of having the guides removed without any difficulty when worn by use.

CULTIVATOR.—J. B. HERMAN, Mount Vernon, Iowa.—This invention relates to a new and improved cultivator of that class in which the plows leave a vertical and also a lateral adjusting movement. The invention consists in a novel construction and arrangement of the plows, whereby the plows are retained in the ground or prevented from rising or being thrown out, and a free lateral movement allowed the two inner plows.

BRICK MACHINE.—J. B. GRIDLEY, Albany, N. Y.—In this machine the clay-compressing plunger is held down upon the clay long enough to prevent liability of expansion or rising of the clay when the plunger is raised out of contact with the same, and when the plunger is elevated, its actuating device fails to give it the downward motion until the mold or mud box has received the requisite change of clay. The main wheel or actuator is provided with horizontally-projecting flanges, which, in connection with suitable springs, serve to operate the levers which feed the molds to the plunger. A track is provided for the followers, the wheels of which are so arranged as to prevent wabbling.

CULTIVATOR PLOW.—W. O. GIBSON, Charleston, S. C.—This invention relates to a new and improved cultivator plow designe for weeding and for loosening the soil around growing plants.

SPINDLE STEP.—A. P. KINNEY, South Carver, Mass.—The object of this invention is to obtain a step for spindles and upright shafting generally, which will retain the oil or lubricating fluid, prevents the same being thrown about or scattered, thereby preventing the step and the portion of the spindle or shaft which works therein from becoming dry and consequently from heating, and also preventing parts adjacent to the step from becoming soile or greased by the oil.

THRIBBLE TREE.—J. B. MORRISON, Fort Madison, Iowa.—This invention relates to a new and improved thribble tree or three-horse splinterbar, and consists in a novel arrangement of parts whereby the draft of three horses attached thereto is equalized, and the device rendered capable of being adjusted to suit horses of different sizes, or varying powers of draft.

CORN PLOW.—PETER BARNHART, Chillicothe, Ohio.—This invention consists in the peculiar shape of the beam for a corn plow and in the form of the standards to which the shares are attached and in a movable fender which prevents the ground from being thrown on to the crops, making one of the most economical implements used on the farm.

INTERMITTEMT AND EXPANSIVE GEARING.—LYMAN B. POTTER Putnam, Conn.—This invention consists in the application of a device to spur gearing for the purpose of changing the speed of a wheel while the wheel gearing into it continues its motion without variation of velocity.

MANUAL POWER.—JOHN H. YAGER, Trenton, Ohio.—This invention is to supply a compact and powerful manual power by means of two double levers which operate together upon a double-crank shaft in such manner as to counteract the dead center and convert a reciprocating into an uninterrupted rotary motion, whereby the power applied to the levers is exerted constantly, to the greatest advantage.

CORN SHELLER.—WILLIAM COLWELL, Chillicothe, Ill.—The nature of this invention consists in constructing a corn sheller provided with a toothed cone combined with a cleaning and elevating apparatus, so that the corn is shelled from the cob and fanned or winnowed and elevated to any suitable hight for putting into sacks or wagons.

RAFTING PIN.—THOMAS B. RAYMOND, Saginaw, Mich.—This invention consists of a wedge-shaped pin so formed as to hold a straight rope, thereby removing any necessity for "cleaning" the rope.

CORN PLANTER.—W. H. COX, Virden, Ill.—This invention relates to seed-planting machines, and consists in novel and improved mechanism for dropping single kernels of Indian corn in regular succession in drills, operated by gearing connected with the driving wheels as the machine moves in the field, and also an arrangement for shifting the gearing and arranging the dropping apparatus to work by hand and plant the corn in hills.

SASH FASTENING.—BENJ. S. HYERS, Pekin, Ill.—The nature of this invention consists in so constructing a small wheel the periphery of which is corrugated and is also provided with teeth upon the end at the periphery and placed in a small metal box in such a manner that it may be applied to a window sash so as to fasten the sash at any desired point.

CORN PLOW.—RICHARD C. HOWARD, Lina, Ill.—The nature of this invention relates to an improvement in corn plows which consists in providing a rock shaft provided with levers to which cords are attached by which, through the medium of a lever, the driver is able to throw the plows out of the ground and the weight be brought upon the wheels so that it can be drawn from place to place without the plows coming in contact with the ground.

PISTON PACKING.—WM. G. SNOOK and O. C. PATCHELL, Corning, N. Y.—This invention has for its object to furnish an improved self-regulating piston packing which may be set out with any desired force when and where required by the action of the steam or water in the cylinder.

LOCK.—A. O. MILES, Nashua, N. H.—This invention relates to certain new and useful improvements in a lock previously patented. The present improvement consists in arranging the tumbler frames in such a manner that they may be moved under the action of the key in two different directions, up and down, for the purpose of varying the position of the tumblers relatively with each other, thereby obtaining a positive movement which is reliable and renders the lock far more durable and less liable to get out of repair than hitherto, and admits of the changes being effected through the medium of the key alone. The invention also consists in an improved means for retaining the bits of the key in the latter so that they cannot become detached and lost even when not secured in position to operate upon the lock.

TANNING HIDES AND SKINS.—GEORGE D. WHEELOCK, Freedom, Ohio.—This invention relates to a tanning process, which is based on the use of such chemicals, in combination with suitable quantities of catechu, sumac, or other astringent salts, that a tough, pliable, and heavy leather can be produced in a comparatively short time.