J. G. B. says: On January 2, I sent you eight small rough stones, requesting you to inform me what they are, and their value. If you have received them, and No. 6 or No. 8 is a diamond, I would like to sell them, if you would be so kind as to send them to a diamond dealer in New York and take out $200 for your trouble, sending me the rest by express. Answer: J. G. B.'s quartz-diamonds are at his own disposal.

J. S. and D. P. N. say: A., B., and C. wish to carry a stick of timber, 12 feet long and 12 inches square. A. and B. are in front with a hand spike, and C. brings up the rear end alone. Where should A. and B. be under the log, so that each man will have an equal share of the weight? Answer: 3 feet from the end of the bar opposite to C.

S. R. K. says: I have a small lead pipe leading down from a tank in the second story of my house into the cellar, to feed the water pan of my furnace. The lower end of the pipe is so much in contact with the furnace that the water there is a good deal heated. Will this heated water rise, and cold water from the tank pass down, in the same pipe? If this pipe does not pass down from the tank to the furnace by a regular descent, but runs for some distance horizontally, with several small rises and falls in the horizontal part, will that prevent the circulation of hot water up and cold water down, in the same pipe? Answer: The circulation of water in the manner described cannot occur where the pipe undulates as supposed, and in a straight pipe of a small diameter, as we presume this to be, such circulation could only take place very slowly indeed. A very moderate downward current would, we suspect, effectually prevent the ascent of the warm water. In a large pipe leading directly from top to bottom, a circulation would undoubtedly be likely to take place, the warm water being displaced by the heavier cold water, the latter settling at the bottom, the former rising to the top.

C. W. K. says: Imagine a body moving in one direction, then its course to be suddenly changed 180°, returning, in the same line it proceeded in, from the point of reversion. What I wish to know is whether a reciprocating body must necessarily stop when it changes its direction; for instance, a piston head in an engine? Is it a self evident fact that it must stop before returning, or is the following reasoning cogent, and a proof to the contrary? From A to B, two points of conceivable distance apart, are projected two bodies, C and D (one body from each point, towards the other) with sufficient force to carry them through the intervening space between A and B. C weighs ten times as much as D. They meet between the points, both running in the same line. As a natural consequence both bodies are found near B as C, having the preponderance, would convey D backward. Now according to the law of the inertia of matter, C could not have stopped intermediately, if found at B. Then did D stop when it changed its direction when met by C? Answer: It matters little practically whether it is considered that a body, whose direction is reversed, stops during an infinitesimal space of time, or does not stop at all. The question is too nearly a metaphysical one. In the case given, an indentation would be produced in the one or the other, or both bodies, C and D, and, so far as the argument is based upon natural facts, it is not conclusive. D might be brought to a stop while indenting C and then take up its reversed movement, finally moving backward with C. This is one of many examples, frequently presented, in which an argument is based on false premises.

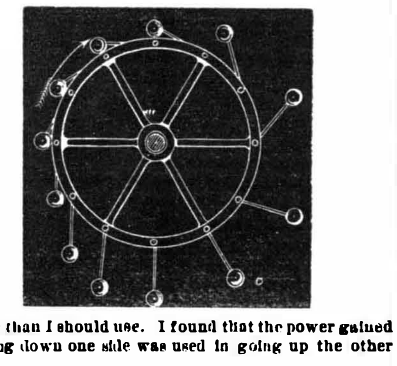
A. L. asks: Will an ordinary local telegraph battery make platinum wire red hot; and if so, how can I attach it? How can I make a galvanic battery out of the same? The telegraph battery is composed of two glass jars, copper, zinc, and blue vitriol. Answer: Why not disconnect the local battery and try the experiment? If you find that two cups won't answer, try more until you accomplish the result.

J. C. C. sends a specimen of boiler scale and asks why it is so hard. "I had it in a bottle of oil of vitriol for five hours, but it would not dissolve. We use about two hundred barrels of water per twelve hours, half of which is sulphur spring and the rest surface water, the largest portion of which runs through sewers accumulating all kinds of filth (human deposits) which makes the water in boilers foam very badly, so much so that the engines suck it up five feet and into the cylinders; but it does not make the pistons pound like some water does. I have put in surface cocks to draw the foam off, but they clog up with mud in two or three days. This scale formed on the boilers before I took charge of them, two years ago, and I have tried nearly everything that will loosen scale, with no effect. About nine months ago, the firm put in a heater and filter, by which I can get the water so hot as to require a small stream of cold water to condense the steam in the feed water, so that a No. 3 Cameron pump will force it into the boilers. There is not much new scale forming, but the old scale remains as fast to the flues as ever. We have hammered as much off as we could, but the boilers are so built that it is hard to use a hammer. They are four feet in diameter, twenty-eight feet long, with 2 twelve and 2 thirteen inch flues in each. We blow out every two weeks, and find the mud drum full of mud, very black and thin. We filter through hay packed tight. I have tried everything except taking the flues out of the boilers, and a steel square linked chain to take scale off. Answer: The boiler incrustation is sulphate of lime or gypsum, discolored with some organic matter. Oxalate of baryta is sometimes sold to purify water, but is too expensive for use on a large scale. If the water could be filtered through alternate layers of gravel and charcoal, it would help. When you are obliged to use such dirty water, the best way is to blow off more frequently, otherwise the deposit of gypsum in the flues will become unmanageable.

F. I. says: I have been reading the lectures of Professor Tyndall in your valuable paper, and am very much puzzled regarding his explanation of the complementary colors. I heretofore understood that the mixture of two primary colors was the complementary of the third. The Professor says that the mixture of the yellow and blue ray produces white light; if so, I would be very glad to know what is the use of the red ray as a component part of the illuminating power of the sun or any other white light. Answer: Professor Tyndall showed by experiment that the yellow and blue rays of the sun when combined produced white light, but he expressely stated that the same result did not follow when yellow and blue pigments are mixed. It was to illustrate this difference that he introduced the experiment.

O. A. B. says: In your article on balancing machinery, on page 33 of the current volume, you give a formula, and proceed to compute the centrifugal force of a crank, weight 600 pounds, with its center of gravity revolving in a circle of four feet in diameter, at the rate of fifty revolutions per minute. Correcting a clerical error, you would have: centrifugal force $=600(4\times 3\cdot1416\times\frac{5}{6})^2 \div(16\frac{1}{12}\times 4)=852$ pounds. A few lines below you say: "Were it attempted to effect a balance by a piece placed opposite, at a double distance, but of half the weight, the counterbalance would have a double centrifugal force, and hence, although a standing balance would be obtained, it would not give a running balance." Let us try it: $F=250\times(8\times 3\cdot1416\times\frac{5}{6})^2\div16\frac{1}{12}\times 8=852$ pounds. Just the same, instead of double, and because it is just the same, it will of course give a perfect running balance, as well as a standing balance. It is thus shown that, in this instance, a standing balance and a running balance are secured by the same conditions, without regard to the *vis viva*. And this is equally true in all cases, as may be shown in any case by applying the formula as above, or it may be proved algebraically in general. This conclusion is of course based upon the supposition that no "couple" is produced by what I may call a diagonal balance. Answer: The erroneous calculation has been corrected and the deductions therefrom have been pointed out and the proper statement of the laws of centrifugal force has already been given at page 81 and in an earlier issue of the SCIENTIFIC AMERICAN. No better proof that our paper has a circulation among the most intelligent of readers than the fact that this problem has attracted such prompt attention, and has elicited so many accurate statements of the principles involved, could possibly be offered.

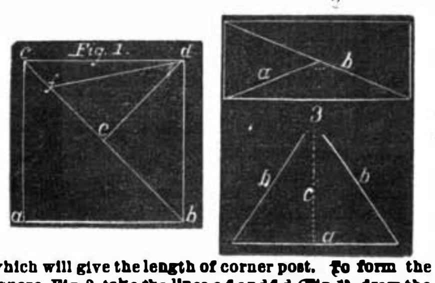
J. O. says: Seeing, in your paper for January 8, a drawing of a "perpetual motion," I will state that I made one, on the same principle but different in construction, several years since. I do not believe in perpetual motion, but I thought I could gain more



power than I should use. I found that the power gained in going down one side was used in going up the other side.

J. R. E. says: Here are two of your subscribers and three or four others in trouble about the velocity of falling bodies. Some would have it that large and small will fall through the same space in the same time, without regard to the resistance of the element they pass through, air or water, and they take Parker for their authority. The others admit this all, theoretically, in vacuum. But they say that there is difference in passing through the atmosphere, and more through water, in favor of the large bodies, owing to the resistance. These last take Comstock for their authority. We would like to have you settle the question. Answer: The abstract laws of falling bodies have been determined with perfect accuracy, both by experiment and by logical deduction from known conditions. When the falling body is uninfluenced by forces other than that of gravitation, when falling freely as if in a perfect vacuum, the velocity can be predicted with perfect certainty and precision. From this fact, it results that astronomy, its calculation being based upon these well established principles, is an exact science, and that astronomers determine the motion of the heavenly bodies, calculate the perturbations produced by their mutual attractions, and even discovered, as did Leverrier and Adams, a new member of the solar system whose distance is so great as, despite its tremendous magnitude, to have been previously undetected by the telescope. In all familiar examples of the effect of the force of gravitation, however, we find the motion of bodies, moving under its influence, to be affected by the action of other and retarding forces, as the resistances of the air and of friction. In any given case, when these resisting forces can be exactly determined, in magnitude and direction, the motion of the bodies can still be determined precisely. In some cases, as that in which the air resists the motion of a body moving with very great velocity, it is difficult, or even impossible, to calculate the resultant motion with exactness, in the present state of our mathematical knowledge. Where no resisting forces occur, the velocity of any falling body can be determined by the following rule: Multiply the hight, in feet, from which the body has fallen by 64¼ and extract the square root of the product. The result is the velocity acquired, measured in feet per second. Or, multiply the time, in seconds, that the body occupies in falling by 32⅙ and the product gives the velocity acquired. For all cases other than that just supposed, the velocity will be modified to an extent which will vary with each individual case. Generally, it may be stated that falling bodies of equal size but differing densities will fall through any resisting medium with differing velocities, in consequence of the fact that the lighter materials offer greater extent of surface to the resistance of the air or other opposing fluid, and, therefore, were retarded to a greater extent than are the denser substances. Where bodies of similar material, but of different sizes, are allowed to fall through a resisting medium, the larger will fall most rapidly for a somewhat similar reason. As an illustration, a sphere of two inches diameter contains eight times as much matter as does a sphere of the same material an inch in diameter, but it only has four times as much surface, and four times the cross section of the smaller ball. It therefore is less retarded and will be found to reach the limit of its fall first. In the air this difference is seldom noticeable; in the water it is more frequently observed, and it is for a similar reason that a large vessel requires less proportional steam power than does a small one driven at the same speed.

C. H. D. says, in answer to T. who asked how to construct a flaring vessel, such as a hopper: Fig. 1. Draw a square a b c d, the size of hopper at the top minus the desired size of hole to be left at the bottom, then draw the diagonal lines c b e d; then measure from e the depth of hopper from thence draw the line f d,



which will give the length of corner post. To form the square, Fig. 2, take the lines e f and f d (Fig. 1); draw the diagonal lines a b, which will give the correct bevel for corner post line a. Fig. 3 is the full size of hopper at the top. Take the length of line f d (Fig. 1), for the lines b b, which gives the angle on which to cut the boards, and dotted line c is the required width. If it is not desirable to use corner posts, cut the ends of the boards to the bevel a b (Fig. 2), and set out the dovetail square from the end.

T. M. says to A. H. S., who asked for directions for building a warm and rat proof house: If you use sand to fill the space between the weatherboarding and plastering of your house, the pressure upon both plastering and weatherboarding can be lessened by inserting pieces of inch board between the studs, like shelves, a foot or two above each other, fastened with nails "toed in" at each end. They should extend to within one inch of the weatherboarding so as to allow space for the sand to run down and fill up. The liability of the sand to run out through cracks or warps in the weatherboarding may be obviated by tacking on to the studding, before the boards are put on, coarse wrapping paper, which can be had in rolls of great length and width at a cheap cost. Nail pieces of board vertically between the ends of the joists to keep the sand from running between the floor and ceiling.

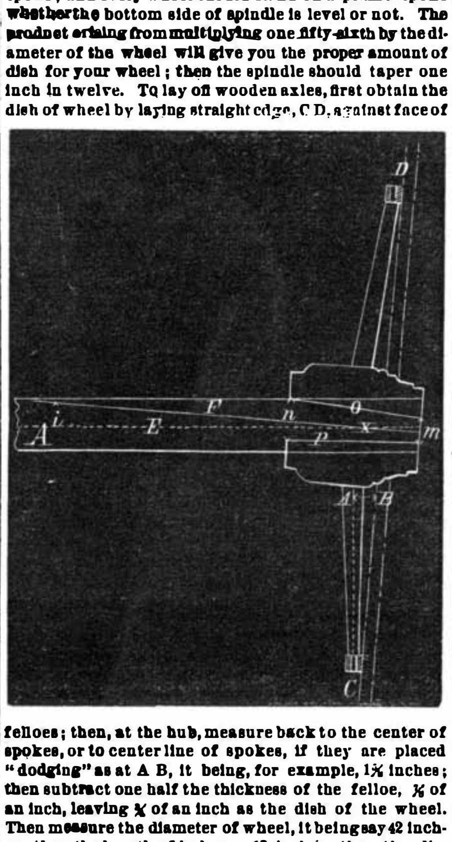
T. M. replies to D. M.'s question about a leaky roof: Your tin roof leaks, probably, because it is so steep that the solder runs down from, instead of up under, the lap; in that case the bond is but slight, and the remedy is a plentiful use of solder. Cover your parapet walls with a tin trough, inverted, (of convenient length), the inner side or flange being deep enough to extend over the roof tin where it reaches up the side of the parapet, and nail it to the joints between the bricks.

H. M. W. says: J. asks for a simple method of detecting explosive oils. The following is about the simplest method extant, and is sufficiently accurate: Pour into a cup about 2 inches of the coal oil to be tested; light a match and, when fairly in a blaze, throw it into the oil. Standard oil (say of 150 degrees) ought to extinguish the burning match, as would water or any fixed oil.

J. E. G. says: The best mode of analyzing such questions as the balance wheel controversy is to take the two extremes into consideration. One would be a perfect and true wheel and the other would be a wheel with the rim lying on the shaft at opposite points of the circumference, which would be no balance wheel at all, and could not be kept in its bearings because of its unequal distribution of weight from the center.

G. B. D. says, in answer to H. & B. who asked how to draw water 400 feet horizontally and 60 feet vertically without a pump: If a pipe or any suitable conductor be placed horizontally with 1½ thickness below the surface of the water, it will naturally fill to the distance of 400 feet as required: at this point a reservoir should be sunk entirely below the pipe; then at the highest point (60 feet) put in an old fashioned wooden pump running its pipe down into the reservoir. The plunger of this pump should work at a point not to exceed 30 feet above the reservoir, and the valve should be near the bottom, so as to be always below the water in the reservoir.

A. B. says, in reply to H. C. K., who asked for a rule for laying off wagon axles, that the length of the spindle should be 3½ times the diameter of the butt. The length of the hub should be nearly one and a half times its diameter. The spindle should taper just so that the bottom side of axle may be straight throughout its whole length, when the wheel stands on a plumb spoke; and every wheel should stand on a plumb spoke whether the bottom side of spindle is level or not. The product arising from multiplying one fifty-sixth by the diameter of the wheel will give you the proper amount of dish for your wheel; then the spindle should taper one inch in twelve. To lay off wooden axles, first obtain the dish of wheel by laying straight edge, C D, against face of



felloes; then, at the hub, measure back to the center of spokes, or to center line of spokes, if they are placed "dodging" as at A B, it being, for example, 1½ inches; then subtract one half the thickness of the felloe, ¾ of an inch, leaving ¾ of an inch as the dish of the wheel. Then measure the diameter of wheel, it being say 42 inches; then the length of hub, say 12 inches; then the distance from center of spoke or line of spokes to back end of hub, 8 inches, the diameter of large end of back box being 3¼ inches; then the small end of front box, which, in this case, should be 2½ inches. Then on axle stick A, make a line, E, the whole length of stick; then measure from end of stick the distance from center of spokes to front end of hub, in this case being six inches, and make point x, then from x measure half the diameter of wheel, or 21 inches, to l on line E. Then measure up the dish of wheel or ¾ of an inch; then draw line F from point last obtained through x; said line will be perpendicular to the face of the wheel, thus bringing the spoke on a plumb line. Now on line F measure each way from x, six inches to points n and m. Then with compasses set at 1⅝ inches lay off from n, the butt of spindle, and 1⅛ inches from m, lay off tip of spindle; then draw lines O and P, which will be the top and bottom of spindle. Then on line E from x, measure the track you wish, and then lay off other end of axle in same manner as described above. If a linch pin is used, allowance must be made for it on end of spindle. Give as little gather as possible, only be sure and give a little. After the wheels are on the axle, they ought to measure not more than half an inch farther apart on back side than on front, measured at the rim on a level line with center of axle. By following these rules you can make wheels track every time and be sure of an easy running wagon. Iron axles may be set by the above rule by using a straight edge with some screws in the ends, one set for either end of spindle.

T. H. C. says that if P. S. will wash his ether, that is, put in a bottle with water and shake it up; then pour off the ether after settling, he will find it will dissolve pure rubber. Perhaps he may be trying to dissolve the vulcanized rubber; if so, he might as well give it up. Washed sulphuric ether will dissolve pure rubber, unwashed will not.

J. E. S. says, in reply to J. W.'s answer on transmission of motion: I saw the thing tested in the summer of 1854, with the result stated in the communication to which J. W. takes exception, however new it may be to him.

A. O. says in answer to L. H. W., who asked how to temper small steel wire, one sixteenth of an inch in diameter and less, and one inch long: You may follow the method in vogue for small screws, pins and needles. Put them upon an iron plate which can be heated from below, or place them in a sheet iron drum, to be turned on a fire like a coffee roaster. With regard to the heat required, it necessarily differs according to the degree of tempering you want to impart to the steel. A yellow tempering color, in its various tints, is imparted to instruments that are to remain hard, such as razors, surgical instruments, lancets, pen knives, etc. Articles that are to possess elasticity and the hardness of a spring, need a violet or dark blue color, and in some cases, especially when a particular hardness is required, as is desirable for the edges of astronomical and physical instruments, it may be proper to conduct the tempering at such a low temperature that no color appears at all.

J. F. says, in reply to M. D. K., who asked for statistics of presses for printing cards, circulars, etc., that he uses a card printing machine that will print at the rate of 6,000 per hour. This is possibly true; but our answer referred to a press for all kinds of work, even printing on the thinnest tissue paper.

COMMUNICATIONS RECEIVED.

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

On the Correlation of Forces. By W. R. S.

On Certain Instances of Combustion occasioned by Superheated Steam. By E. R. D.

On the Secrets of a Kernel. By F. R. R.

On the Creeping Railway Problem. By C. T.

On Fast Printing Presses, and on an Improved Galvanic Battery. By J. F.

On the Recent Boiler Explosions By T. L. L.

On the Rupture of Cylindrical Steam Boilers. By B. W.

[OFFICIAL.]

Index of Inventions

FOR WHICH

Letters Patent of the United States

WERE GRANTED FOR THE WEEK ENDING

January 28, 1873,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]