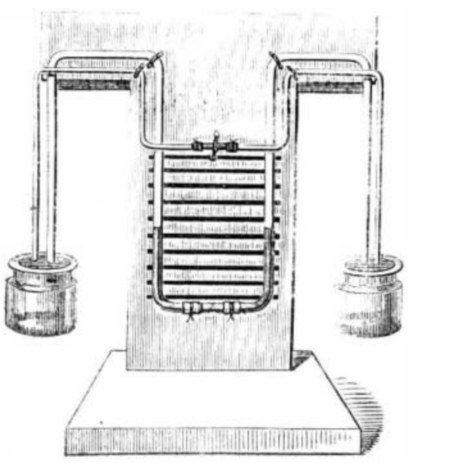
A HOME-MADE DIFFERENTIAL THERMOMETER.

In the proceedings of the British Pharmaceutical Conference for 1868, Dr. Matthiessen's Improved Differential Thermometer with pendent bulbs is described and illustrated. This instrument is adapted for illustrating many fundamental facts relating to heat, and is now commonly employed in lecture experiments by our leading chemists and physicists.

We have much pleasure, says the *Chemist and Druggist*, in calling the attention of chemical students to a simple but effective modification of Matthiessen's thermometer, in which two wide-mouthed bottles and a few pieces of glass tubing are made to serve the purpose of the costly work of the glass-blower. The construction of this home-made apparatus is plainly shown in the following engraving.

The small bottles represent the glass bulbs of the original instrument. Each of these bottles is closed by a sound cork, through which two glass tubes pass. These tubes are bent into a series of angles by the aid of a gas flame, and their free ends are connected by pieces of india-rubber tubing. The ends of the smaller glass tubes do not meet, and their india-rubber connecting piece is furnished with a pinch-cock. The two wider tubes are also connected by a piece of india-rubber tubing. This joint is made merely to avoid the difficulty of bending a single length of glass tubing into the required form. Some colored liquid is introduced into the central portion of the main tube, and the whole arrangement is attached to a wooden stand bearing a scale formed of dis-



tinct horizontal lines. The hight of the apparatus is 1 foot 7 inches; the greatest width, 1 foot. Two-ounce bottles are used for the air vessels, and they are supported at the hight of about 5 inches from the ground, the main tubes rising 10 inches above the corks.

The instrument will not indicate general changes of temperature, but only differences between the temperatures of the two air vessels. If one of the air vessels is exposed to a higher temperature than the other, the air contained in it expands, and drives the colored liquid in the tube towards the cooler vessel. The relative hights of the two columns of liquid in the vertical portions of the tube are plainly indicated by the scale attached to the stand. By opening the pinch-cock, the pressure upon each column of liquid is equalized, and the level is thus adjusted for a new observation without loss of ...

The following instructive exp[illegible] which our younger readers may repeat with profit, will illustrate the use of this sensitive instrument in physical research:—

LATENT HEAT.

I.—*Disappearance of Heat during Liquefaction.*—Place the air vessels of the thermometer in two tumblers containing water at the ordinary temperature. Having noticed that the level of the colored liquid is undisturbed, throw into one of the tumblers some sodium sulphate (Glauber's salt). The solution of the salt is attended by a reduction of temperature, which is at once made evident by the movement of the colored liquid towards the cooler vessel.

II.—*Latent Heat of Water.*—Fill a vessel with coarsely-powdered ice, and allow it to stand in a warm room until much of the ice has melted. Place the air vessels of the thermometer in tumblers containing equal quantities of luke-warm water. Then add to one portion of the warm water a weighed quantity of the unmelted ice, and to the other portion an equal weight of the ice-cold water. The rapid rise of the colored liquid, in the vertical portion of the tube next the tumbler containing the ice, will prove that a given weight of ice has a much greater cooling effect than an equal weight of ice-cold water.

III.—*Evolution of Heat during Solidification.*—By slowly cooling a solution of sodium sulphate, saturated at a high temperature, it is possible to obtain a cold supersaturated solution, which will crystallize suddenly on agitation. On plunging one of the air vessels of the thermometer into such a solution, which has been cooled down to the temperature of the surrounding air, the evolution of heat during the crystallization of the salt will be manifested by the movement of the colored liquid towards the cooler air vessel.

These three experiments illustrate fundamental facts relating to heat. When matter passes from the solid into the liquid state, heat disappears or becomes *latent*, and ceases to affect the thermometer; in other words, *sensible heat* is converted into *potential heat*. Conversely, when a liquid becomes solid, its potential heat is reconverted into sensible heat.

SPECIFIC HEAT.

IV.—*Oil and Water.*—Into two tumblers introduce equal quantities of warm water, and test the equality of temperature in the two portions by means of the thermometer. Now add to one portion a given weight of cold water, and to the other portion an equal weight of cold olive oil. Mix the liquids by moving the thermometer up and down. The mixture of oil and water wi l be found to be warmer than the water, although its bu k is sensibly greater. [The greasy bottle should be clea e with a little benzole after this experiment.]

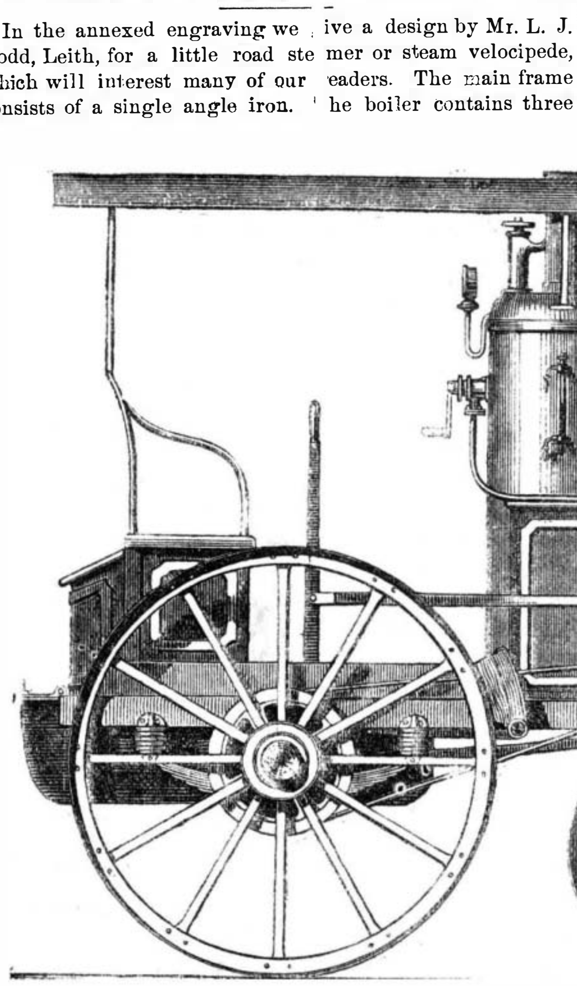
V.—*Zinc and Lead.*—Take qual weights of zinc and lead attached to threads, and havi g raised them to the temperature of 100° C. by immersion n boiling water, plunge them for a few seconds in equal bu ks of cold water contained in two tumblers. On placing th air vessels of the thermometer in the tumblers, the mov nent of the indicating liquid will show that the zinc in coo ng has parted with more heat than the lead.

VI.—*Relation of Combining Weights to Heat.*—Repeat the last experiment, but instead taking equal weights of zinc and lead, take weights havin the ratio of the combining weights of these metals (Zn= 65, Pb=207). On plunging the air vessels into the tumble s of the warmed water, there will now be no disturbance of t e indicating liquid; in other words, the thermometer prove that 65 parts of zinc and 207 parts of lead evolve sensibly he same amount of heat in cooling through a given range of temperature.

The last three experiments illustrate very forcibly the difference between heat and te perature. The temperature of a body affords no indication the actual quantity of heat it contains. A pint of water m y raise the mercury of an ordinary thermometer to the ame degree as a gallon of water, but it is obvious that th larger volume of the liquid contains the greater amount f heat. Equal weights of different substances, in underg ing a similar alteration of temperature, evolve or absorb very different quantities of heat. These quantities of heat expressed relatively to the quantity required to raise an qual weight of water from 0° to 1° C. are called the *specific heats* of the various substances. Now the specific heat of c ive oil is much lower than that of water, consequently, in Experiment IV., the oil robs the warm water of comparativ ly little heat, and the resulting temperature of the mixt re is higher than that of the mixture of warm and cold ater in the other tumbler. Again, the specific heat of zinc i much greater than that of lead, consequently the mass of z c used in Experiment V., gives out more heat in cooling t an the mass of lead. The last experiment illustrates the i portant chemical fact that the combining weights of the ele ents are comparable quantities in their relations to heat. Thus, 23 parts of sodium, 108 parts of silver, 65 parts of nc, 207 parts of lead, and 210 parts of bismuth, give out o absorb sensibly the same quantities of heat in passing th ough the same range of temperature.

ONE-HORSE ROAD STEAMER T CARRY TWO PERSONS.

In the annexed engraving we ive a design by Mr. L. J. Todd, Leith, for a little road ste mer or steam velocipede, which will interest many of our eaders. The main frame consists of a single angle iron. he boiler contains three



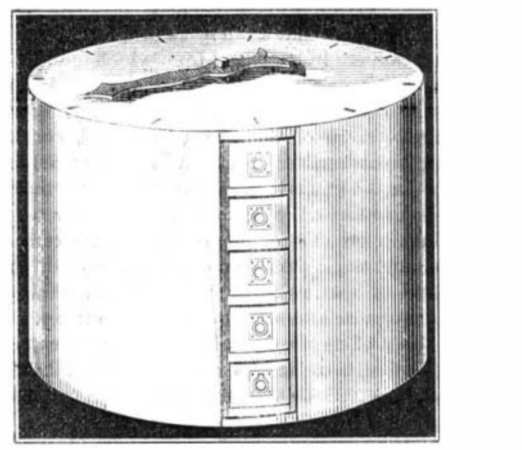
quarters of a square foot of grate surface, and about 16 feet of heating surface. The coal bunkers are situated on each side of the boiler. The driver's seat is made long enough to contain two persons, and is hinged at the top to form a locker inside. There is a tool chest at the back of the seat with hinged lid. The water tank is placed below the frame, and has a filler standing out behind. The driving wheels are four feet in diameter, and have steel tires one quarter inch thick; on to the boss of each driving wheel is fixed a grooved driving pulley fourteen inches in diameter. The main axle is cranked to clear the tank, and each driving wheel runs loose on it. The main bearing springs are fitted with rubber washers; there is also a brake on each wheel worked by a foot lever. On the main frame, to the forward side of each bunker, are fixed two plummer blocks which carry a double-throw crank shaft. The steam cylinders two and a half inches diameter by four inches stroke, are fixed to the top of each bunker; there is no reversing gear, but a single eccentric working forward and cutting off at five eighths. On each end of the shaft is fixed a friction cone carrying a grooved pulley six inches diameter, and from this pulley motion is communicated to the driving wheel by a half-inch gut cord, thus allowing the engine to turn with facility. The single leading wheel is carried in a fork fitted with a volute spring and rubber washer, and governed by levers as shown. The boiler is fed by a No. 1 brass injector placed through the foot plate. The engines are covered from the weather, and it will be seen that there is plenty of power to ascend a considerable incline. As regards speed, it could be guaranteed to run 100 miles per day of ten hours over any high road in England, which, with a good driver, might be considerably increased. In conclusion it may be stated that it is the duty of the man on the right to drive and steer, and, if necessary, work the brake, and the one on the left to fire the boiler and look after the water.—*The Engineer*.

Correspondence.

The Editors are not responsible for the Opinions expressed by their Correspondents.

Universal Screw and Brad Box.

MESSRS. EDITORS:—A desideratum in all cabinet and coach makers' shops is an arrangement of boxes or drawers in which to keep screws, finishing nails, etc.



In the accompanying drawing, you will see the plan upon which I made a screw and brad box for my own use. And regarding the efficiency of the arrangement I can say it fully meets the demand. It is of a circular form, though not necessarily so; the casing inclosing any number of rotary shelves which have a post passing through their centers, the post working in the lower and upper circular boards of the casing. The shelves are separated to the required depth of the drawers. Facings or small strips reaching from the lower to the upper shelf, being fastened to each shelf, serve to brace the shelves, and also form side rails for the drawers, of which there will be as many on a shelf as there are of facings.

The post upon which the shelves are fastened, passes through the top board of the casing far enough to fasten a [illegible] on it. This top casing is numbered with the length of screws, brads, etc., etc., in such a manner that when the pointer—turning which of course turns all the shelves—strikes the length of screw or brad as numbered, the screw or brad drawer is at the vertical opening, which may be closed when not in use, by a door. For screws, of which one length has different thicknesses, there may be as many drawers used, one above another, as there are thicknesses of screws, and the drawers then numbered with the thicknesses. One circular row of drawers will serve for brads; the rest may be devoted to screws.

J. B., JR.

New Franklin, O.

Girdling Fruit Trees.

MESSRS. EDITORS:—Seeing in your paper of February 19th a notice from the Boston *Journal of Chemistry* on the recovery of fruit trees after being girded, I beg to inform you that in Europe the practice is quite common, and it is very common to serve individual branches so, every gardener knowing that a branch so served will be covered with blossoms the following year.

C. H. H.

Thomaston, Conn.

The Value of a Practical Journal.

MESSRS. EDITORS:—For years I have taken the SCIENTIFIC AMERICAN by subscription and through news agents, and since you cannot be insensible to the vast good and pleasure you render your readers, it may not be amiss for me to say