APPARATUS FOR ILLUSTRATING THE LAW OF THE REFLECTION OF LIGHT.

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A simple apparatus for illustrating the equality of the angles of incidence and reflection, and which can be used to demonstrate the law to a number of persons at once, is here illustrated. Besides its simplicity of construction, it possesses the feature that a true reflection of light is used. Sometimes a marble is employed to represent a light ray, and is shot against a flat surface from which it rebounds, and the angles are determined. This gives a representation of the law only, not a demonstration. The methods involving the production and reflection of a parallel beam of light, either from the *porte lumiere* or the calcium light, are very beautiful, but demand a somewhat extensive apparatus, or sunlight. These are not always attainable. In the apparatus shown, a candle is the only source of light needed, and it is sufficient to show the experiment to a roomful of auditors. The room need not be darkened, although a slight degree of obscurity is better. Such as can be produced by ordinary window shades is enough.

A piece of wood is sawed out into a portion of a circle slightly more than a semicircle. At the center of the diameter, which is parallel to the rear line, an inch hole is bored. Into this a circular pin of wood is fitted. The upper portion of the pin is cut away, back to its diameter, so as to leave exactly one-half of the cylinder intact. This portion should be about an inch long.

It is placed in the hole, and is made exactly vertical by wedging if necessary. The plane surface, where the half cylinder is cut away, faces the circular and front portion of the board, and by means of a straight edge is placed as nearly parallel as possible to the line of the back. The pin must be fixed very securely in this position, either by glue or by a screw driven in from the back.

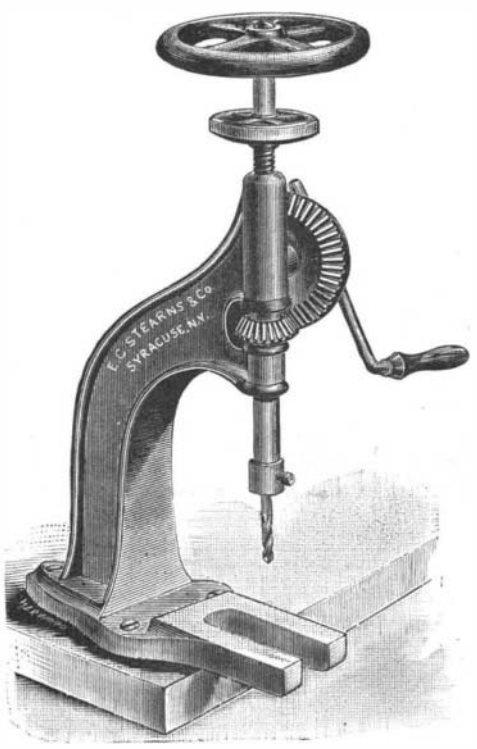
A small piece of looking glass is temporarily attached to the flat surface of the pin. A fine, perfectly straight wire or delicate plumb line is held in front of it near the line of the circle, and is shifted until it covers its reflection in the mirror. The position it occupies is the zero of the divisions, and is so marked on the edge of the circle. From this as a starting point, equal divisions are laid off to the right and left, and numbered in corresponding series. If divisions of equal linear length are used, they will necessarily be equiangular.

Two strips of thin wood are perforated near one end with a hole just fitting the round portion of the pin. Near the front of one strip, a hole is bored of such size as to hold a candle. Near the front of the other, a screen of wood with a half inch hole is secured, over which hole a piece of white paper is pasted. Three or four inches back from the candle on one strip, and from the screen on the other, wooden blocks are secured, which are perforated, and receive convex lenses of correspondingly short focus. Meniscus lenses such as used by spectacle makers answer perfectly. The holes in which they are set should be recessed with a shoulder for the glass to fit against, or rings of pasteboard may be glued on either side to hold them in. A tolerable fastening may be obtained by gluing each lens directly to the face of the wood, the holes being made slightly smaller. It is far preferable to use the other method of setting them in the wood. As one strip rides upon the other, its outer end, by a batten or brass-headed upholsterer's tacks, must be raised to keep it level. The lenses must both be at the same elevation. Hence, for the reason just mentioned, one must set slightly lower in its block. The center of the hole in the screen must correspond with the height of the center of the lenses.

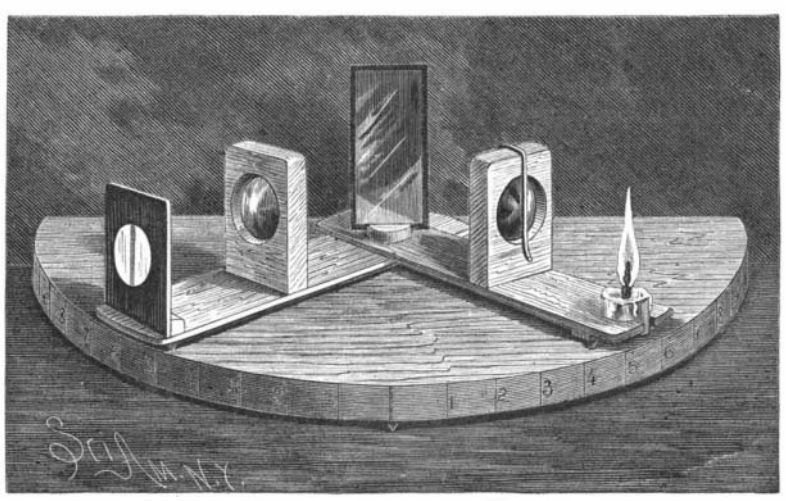
A piece of wire, which should be of spring temper, is bent so as to spring over the lens on the candle bar across the center of the face of the glass, but not touching it. Finally, to secure steadiness, the board should rest upon three feet. Brass-headed tacks such as already mentioned will answer for this purpose. In general terms, the distance from the candle to its lens, and from the other lens to the screen, should be equal to the focal distances of the lenses. The exact relative position is best found by trial, the blocks not being finally fixed until the position has been experimentally verified. The apparatus is used in the manner now to be described, and the relative positions of the lenses is tried in the same way.

The candle is lighted, the mirror is put in place, and the strip is moved until its end comes over any desired number. The other strip with the screen is now moved around until over the corresponding number on the other side of the zero mark. As it reaches this position, the aperture in the screen becomes brightly illuminated, and the shadow of the wire appears crossing the center of the circle. Thus the angles being equal, the light is manifestly reflected at an angle equal to that of its incidence. The lenses must be set so as to bring out the projection of the bar sharply, and to secure good illumination the candle must be placed well below the bottom of the lens. The strips may be moved about from number to number, but the shadow or projection of the wire will only appear crossing the illuminated disk when the numbers correspond.

A piece of looking glass an inch wide and an inch and a half long is large enough, but a larger one is to be recommended. By a rubber band or other fastening it must be secured with its back firmly against the flat surface of the pin. It should correspond in height with the lenses, and the plane of the quicksilver or silvering on its back should correspond with the true diameter of the circle.



STEARNS' NEW BENCH DRILL.



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Organic Matter in the Soil.

In all well cropped soils, the roots of the crops, together with portions which remain upon the soil, especially when grass is raised, form a gradually increasing amount of organic matter, which becomes incorporated with the soil by plowing and tillage, and adds greatly to the capacity of the soil. The presence of organic matter in the soil increases its fertility by equalizing the amount of water which the soil will retain, so it defends the plants against drouths. It not only absorbs water like a sponge when it rains, but in dry weather it abstracts moisture from the air, which it yields to the plant; besides, it arrests and retains certain kinds of plant food, which might otherwise be washed away or down through the soil by rains. Again, by its color, it absorbs the heat of the sun, and thus warms the soil; and by its slow decomposition, which is going on all through the growing season, it produces carbonic acid gas, which, being dissolved by the water, aids in dissolving and preparing other constituents of the soil to be taken up by the crops. Organic matter is, therefore, to be increased in soils in which it is not naturally too abundant, in every economical way. Hence composts consisting largely of such organic constituents as straw, leaves, swamp hay, sods, weeds, peat, swamp muck, and wood mould, are to be recommended, quickened with stable manure or with wood ashes or lime, in place of concentrated fertilizers, which supply only the constituents supposed to be removed. Those articles, in the form of bone dust, ashes, potash salts, etc., may well be added to any compost, and are thus often most conveniently applied to the soil.—*American Agriculturist.*

NEW BENCH DRILL.

The new feature of the drill here illustrated consists in the spindle being fed down quickly to the work by simply turning the crank, and by reversing the motion of the crank, the spindle is as quickly drawn from the work. It is 24 inches high, drills ⅛ to ½ inch hole square with the bed plate. The run of the screw is 3½ inches. The drill stock is $\frac{13}{16}$ inch in diameter. Each drill is furnished with a chuck, which attaches to the spindle, and will hold a ⅜ round drill, or the ordinary square tapered shank or brace drill. The balance wheel weighs 6 pounds, which is sufficient to carry an ordinary drill smoothly, and is not heavy enough to break small drills. The bearings are carefully finished with standard size reamers, and all parts are interchangeable. The crank has an extension for large drilling, and all allowances have been made for strength and durability. Excellent material and workmanship are manifested in the construction, making a useful and attractive and highly finished nickel plated machine.

For further particulars address the manufacturers, Messrs. E. C. Stearns & Co., Syracuse, N. Y.

The Pinsk Marshes.

There is in Russia a district as large as Ireland, known by the above title, and wholly impassable from the size and number of its morasses, in addition to which it is covered with an impenetrable forest of undergrowth and tangled jungle, and consequently was utterly useless. To make this vast extent of land available for the purposes of pasturage and agriculture, all that was required, apparently, was a thorough system of draining and clearing, as the land itself, as land, was found good for the proposed purposes. Accordingly, the Russian government has gone to work with a will, and is now, and has been for some time past, energetically engaged in both these useful and important operations, and the work has been crowned with marked success. At present, 4,000,000 of acres have been reclaimed; and during next year, it is proposed that 300,000 more shall be taken in hand by means of 120 miles of canals and dikes. It is further reported that upward of 600,000 acres of once useless bog are now good meadow land, while 2,000,000 acres of impenetrable jungle have been brought into cultivation. In addition to all this, the engineers have built 179 bridges, sunk 577 wells, and surveyed and mapped 20,000 square miles of land. If such a scheme as this can be so successfully carried out by Russia, why should not some such plan be tried in Ireland? A scientific contemporary, referring to this question, says: "The amount of bog in Ireland would, of course, be child's play to the Pinsk marshes, for somehow we are always confronted with bog as the chief source of Irish difficulties. If its annihilation will pay so well in Russia, it ought to do so equally in Ireland; nor should we forget that an undertaking of such magnitude would bring immediate and constant work from the very outset to half the able-bodied population of the country." The suggestion is worth the attention of all interested in the prosperity of Ireland.—*Chambers's Journal.*

A Field for Work under the Sea.

A writer in one of our contemporaries suggests the development of submarine navigation as one of the works of the future. He contrasts the amount of time and thought which has been expended upon the solution of the problem of flight with the little that has been done in the other field. Men have ever shown themselves more anxious to rival the birds than to cope with the element of the fishes. Dædalus' flight from Crete and the fatal melting of the wings of Icarus, his fall and death, are features of one of the most famous legends of antiquity. But we do not read of Dædalus, or of any other inventor of his day, constructing a submarine vessel. Yet under the waters all is peace, where on the surface the floating ship is exposed to the maximum wave action of the unstable element. The character of instability disappears from the ocean at a small depth, and thirty or forty feet down it is the type of constancy of conditions. The prediction is formally made by the writer in question that in the future this mode of journeying will be extensively indulged in. Then Jules Verne's work will read like a prophecy, and twenty thousand leagues, and many times that, will annually be sailed under the sea. Such are substantially the conclusions of our writer. Whether they will be verified or not must be left, we fear, to future generations to see.

To Restore Gloss to a Silk Hat.

When a silk hat becomes wet, or from other causes has lost its smoothness and gloss, cleanse it carefully from all dust, then with a silk handkerchief apply petrolatum evenly, and smooth down with the same handkerchief until it is dry, smooth, and glossy. This will make a silk hat look as good as new.