TORRICELLI'S PRINCIPLE AND MERCURY FOUNTAIN.

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In a preceding article of this series, a variation on a well known experiment was described, in which a plate of glass was held against the mouth of an inverted tumbler full of water by atmospheric pressure. Those of our readers who tried the experiment probably found that the plate of glass was in very unstable equilibrium. It trembles as it holds its position, ready to fall on a slight impulse. By creating a partial vacuum within the glass, by means of a column of water, the plate will adhere strongly to it.

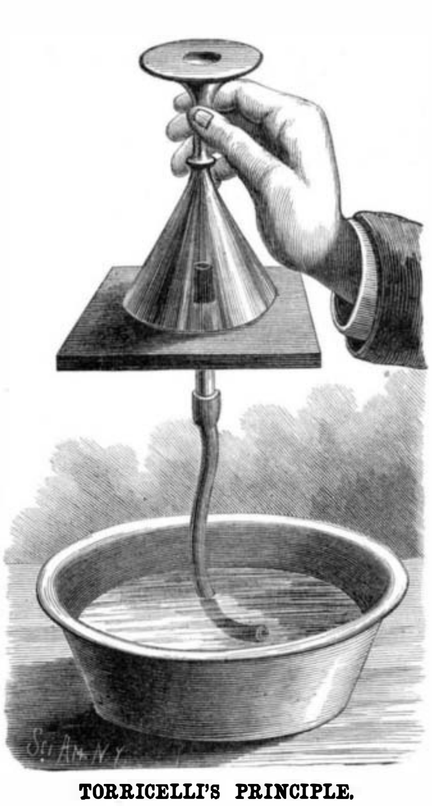
A piece of glass or a perfectly flat piece of thin board will answer for the purpose. A hole is perforated so as to pass through the center, and a short glass tube is fitted therein. If a glass plate is used, the hole can be drilled with a broken file and spirits of turpentine in a lathe or rapidly rotating bit stock. A piece of rubber tubing is slipped over the end of the tube as it projects from the plate. A wineglass or tumbler with a very true edge and a bowl or receptacle for water complete the requirements. The glass is first filled as full as possible of water. By immersion in the bowl, the glass and rubber tubes are also filled, and the lower end of the rubber tubing is pinched or corked so as to close it. The plate is now placed over the mouth of the glass, the tube is released or uncorked, care being taken to keep its open end under water while and after opening it. On raising the glass above the water and inverting it, the plate, when it is a couple of feet above the water bowl, will be found to adhere with considerable tenacity. If the tubing is long enough, it may be raised to any height, and will adhere the harder the higher it is raised. The column of water establishes a partial exhaustion or suction. Its weight is not supported by the glass, but by the air. The glass supports a portion of the weight of the atmospheric column. The air, pressing upwards against the plate, holds it in position.

A very good way to conduct this experiment is to do it over a wash basin. The wineglass and tubing may all be immersed together, the plate put over the mouth of the glass while all are under water, and the glass then may be lifted up and held over the water without fear of the plate falling off.

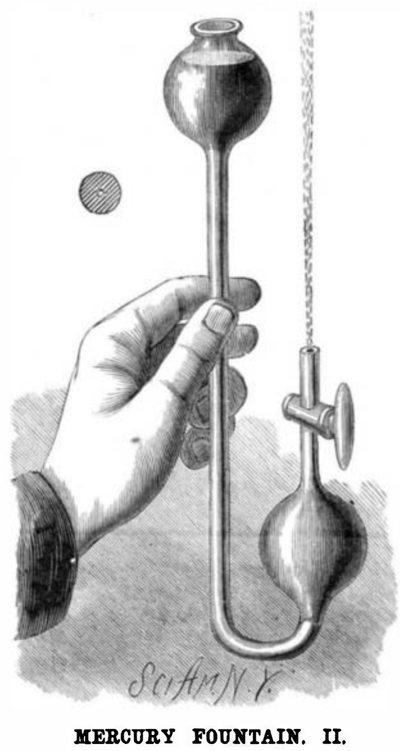
The pressure on the plate is a function of the area of the glass and of the relative height of the water column used as a measurer of atmospheric pressure. The experiment is interesting, as proving that water will not always escape from an opening. If a second hole were made in the plate, air would bubble in, but no water would run out. For this reason hose that is used for the suction pipe of pumps is stiffened by a metal helix, or coiled rod or wire, within it, so as to be incapable of collapsing.

From early times, the principle of suction, so called, has been applied to pumps. It was found that water would only rise about thirty-three feet above its level under the effects of suction. As soon as Pascal and Torricelli had reasoned out the existence of weight in the atmosphere as the cause of water rising in an exhausted tube, the corollary that a column of mercury could only rise to one-thirteenth of this height necessarily followed. A column of mercury one inch in height will produce the same pressure per square inch that a column of water thirteen inches high develops. Availing ourselves of this principle, a comparatively low column of mercury may be made to produce quite a strong hydraulic pressure, and will drive a jet of water far above its own level.

A simple apparatus for this experiment may be made from a bottle, a funnel, and some tubing. A straight piece of glass tubing is drawn out in an alcohol lamp or Bunsen gas burner to a fine straight jet. Another piece has one end bent around and up. Both pieces are passed through apertures in a cork, as shown in the cut. A funnel is attached to the bent one, the bottle is filled with water, and the cork is tightly placed in position in the neck of the bottle. One finger is placed over the end of the jet tube, and mercury is poured into the funnel. This creates a strong pressure. The finger is removed from the tube, when a strong jet of water springs into the air, rising several feet above its source, and presenting the somewhat paradoxical effect of a fountain throwing water above the level of its reservoir. A six inch column of mercury will throw water in this way to a height of four or five feet. As the pressure is so strong, it is sometimes necessary or advisable to hold the cork down, lest it should be blown out.



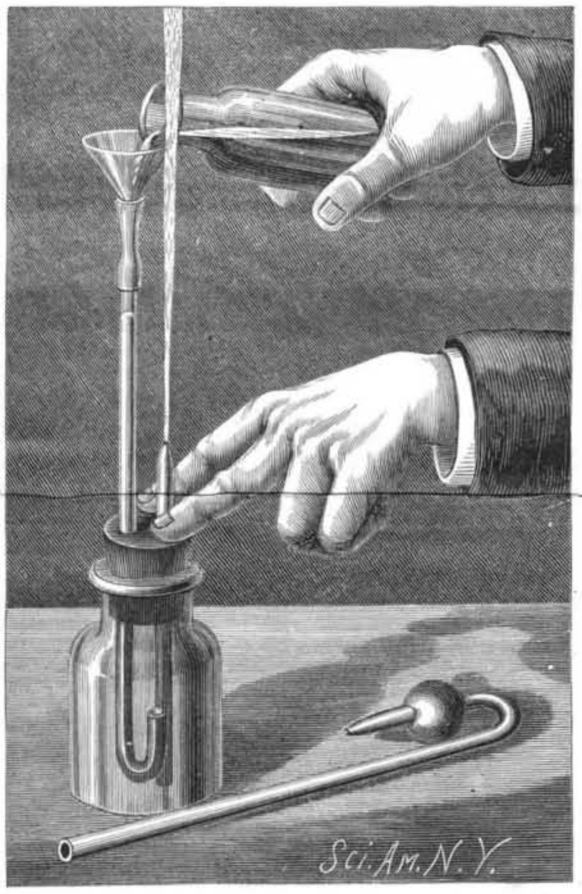
TORRICELLI'S PRINCIPLE.



MERCURY FOUNTAIN. II.

A simple bent tube, with a bulb and jet, shaped as is the one seen in the foreground, may be substituted for the bottle and tubes. A more compact arrangement may be made by a glass blower. The general construction is shown in the cut. A funnel, bulb and a plain bulb are blown upon a tube which is bent into U shape between them. For jet a piece of capillary tube of the section and size indicated is employed. A small glass cock comes between the jet and the water bulb.

To use it, it is partially filled with water, until the lower bulb is full. The cock is then closed and mercury poured in until the upper bulb is full of the metal, or nearly so. Then, on turning the cock, a jet of water is thrown up, it may be nearly to the ceiling of an ordinary room. A good size for the bulbs is two inches in diameter. Strong tubing must be used for the rest of it. A mercury column of six or eight inches in height may be allowed for.



MERCURY FOUNTAIN. I.

In handling mercury, care is requisite on account of its weight. It often introduces the element of instability, where water would be safely held. If it is scattered about, it is not only annoying, but injures gold articles. Hence, in working with it, all jewelry, watch chains, or watches should be removed.

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Mileage of the Circulation.

In preparing lectures on vital or animal mechanics for a Cantor course at the Society of Arts, several practical points of new or renewed study have come before me, some of which are, I think, deserving of brief notice. One of these is the question of the mileage of the blood current of a healthy adult man, in whom the current shall be traversing the conduits of the circulation under the direction of sixty-nine strokes of the heart per minute, at the assumed propulsion of nine feet at each left ventricular pressure.

The distance traversed would, I estimate, be at the rate of two hundred and seven yards per minute, or seven miles per hour, or one hundred and sixty-eight miles per day, or sixty-one thousand three hundred and twenty miles per year. Supposing, therefore, that a man who has lived eighty-four years could have one blood corpuscle floating all that time round his circulating channels—as a planet circulates round a sun—that corpuscle would have performed at the close of the time named the grand tour of five millions one hundred and fifty thousand eight hundred and eight miles. The heat generated by friction in this motion of the blood we may take as included in the normal constant of ninety-eight and four-fifths deg. Fah. What the excess would be when, as in fever, the rate of passage may extend to over double the normal, or fourteen miles an hour, at full tension, can only at present be estimated on data which have to be formulated, and are, therefore, inexact. But here a most important field is open for inquiry, and includes the questions: 1. Is the excess of febrile heat in pyrexia due to increased pulsation at full tension? 2. Is the increased motion due to the high temperature? 3. Are both dependent on one common cause? We really know nothing about pyrexia until these questions are determined. A pigeon lives always at what in the human subject would be the highest pyrexia. Its temperature is 108° Fah.; its arterial pulsations are 140 beats per minute; and it has a surface of body presenting the fullest resistance to conduction. Does this truly pyrexial animal owe its normal high temperature to its rapid circulation? Does its high temperature give rise to its rapid circulation? Or, are the heat and motion dependent on one common undiscovered cause?—*The Asclepiad.*

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Effect of Light and Water Colors.

Mr. William Simpson records in the London *Times* the results of an experiment in which washes of color have been exposed for fifteen years, and portions of the same wash preserved from the light, so that they can now be compared. The list embraces thirty-one pigments, including the most of those generally used by water color artists. The washes were made in stripes upon cards; and the cards afterward were cut in two, so that the exposed and unexposed tints could be compared exactly where they were separated. The exposed slips were pasted on a sheet of paper, and placed in a frame, which was hung on a shutter of a window with an east light. Here they remained for fifteen years.

The following is the list of colors, with Mr. Simpson's remarks: Yellow ocher unchanged; Indian yellow has faded considerably; lemon yellow is not perceptibly affected; gamboge has faded; Newman's permanent yellow unchanged; cadmium yellow, this has not faded, but has seemingly become of a browner tinge. Chrome yellow faded considerably; the slip not exposed seems to have become more orange, but, unfortunately, I had not noted at the time which chrome had been used. Brown pink has faded, but it has stood better than might have been expected from its reputation. Emerald green scarcely changed. Burnt sienna unchanged. Vandyke brown unchanged. Sepia, this shows a very slight tendency to fade. Roman sepia, this may have faded also, but, like the common sepia, the change is not very perceptible. Burnt umber unchanged. Bister unchanged. Brown madder, this color has lost a little of its redness. Light red unchanged. Vermilion shows no change. Indian red unchanged. Crimson lake, this color has all but disappeared from the paper; at one side where the color was laid on deeper a brown streak still remains. Carmine, this, like the lake, has entirely gone, but where the carmine was laid on deeper, a faint brown streak is still left. Madder lake, this color has stood well, but it is now a little less red, and more of a purple. Purple madder, like the other madders, this has stood, but seems to be changed very slightly in tone. Cyanine blue, seemingly unchanged. Prussian blue unchanged. French blue very slightly faded. Cobalt, I can detect no change in this valuable pigment. Ultramarine is, of course, unchanged. Newman's azure is unchanged. Indigo, where there was a rather deep wash of this color the exposed slip shows now an exceedingly light tint of gray; in fact, it has nearly left the paper white, but has not vanished so completely as the crimson lake and the carmine. Lampblack unchanged.

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A CIRCULAR has been issued from the Navy Department directed to all inventors of torpedoes or those interested in the subject, inviting them to communicate with Commodore Sicard, Chief of Ordnance. Seventy-five thousand dollars was appropriated at the last session of Congress for the purchase, manufacture, or testing of torpedoes, and a board of naval officers, of which Captain A. P. Cooke is president, was appointed several weeks ago to examine and test such torpedoes as may be submitted.