hold of these schemes; and, in fact, the only wonder is that the numbers mentioned above have allowed themselves to be inveigled or forced into it.

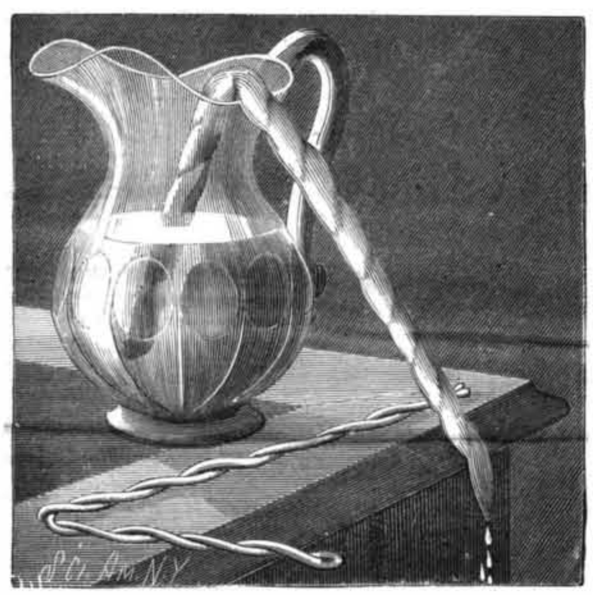
THE CAPILLARY SIPHON.

T. O'CONOR SLOANE, PH.D.

The experiment illustrative of the mechanics of a drop of water given in a recent issue of this paper exemplifies very well the action of films, or capillary force. It is a magnified illustration of a force that usually is only seen exercised on the smallest objects. In the pores of blotting paper or of a lamp wick, where the liquid columns are of almost infinitesimal area, it becomes visible. In larger tubes its action is almost null. If a dry and tubular substance, one that water can wet, has one end immersed in a vessel of water, the fluid will rise to a considerable height. If the object is bent into the shape of a siphon, and its free end is carried below the level of the water, hanging down outside of the vessel in question, it becomes a true siphon. By capillary force its pores are filled with water. Drops begin to form at its free end, and capillary action ceases as far as the porous substance is concerned. The action was dependent on the existence of surfaces of water concave toward their direction of motion. As soon as these disappear, capillary action with reference to the tubes is impossible. The porous substance now represents a mass of narrow tubes, and the water in the longer arm by true siphon action pulls over the fluid from the vessel, and delivers it drop by drop from its end.

A simple method of constructing a capillary siphon is shown in the cut. A piece of wire is doubled and bent into the proper shape. This serves as a framework, and around it strips of muslin are wrapped. Placed in a pitcher as shown, it soon becomes charged with water, and if time is given, it will empty the vessel. A towel placed in a pail of water and hanging over its side will empty it if the end falls below the bottom of the vessel. Otherwise it will draw the fluid down to the level of its own outside dependent end.

The reason for illustrating this very simple experiment is its practical value. In the treatment of inflammation of glands, notably of the mammillary glands, irrigation is often prescribed. At home this is usually effected by hand, wet cloths being applied to the place and continually renewed. This involves incessant attention. If, however, a cloth is spread over the seat of inflammation and a slow dripping of water upon it is maintained, the same result is reached, only in a more perfect manner. To this end the arrangement just described lends itself admirably. The wire frame can be made as long as necessary, so as to lead the drop



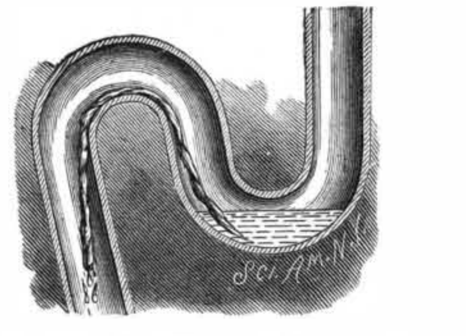
CAPILLARY SIPHON.

wherever desired, and a slow drip can be maintained by the hour on any place. An early use of this application for a period varying from several hours to one or two days may prevent many weeks of sickness. For personal attendance, always more or less uncertain, it substitutes definite mechanical action.

The same siphon may work to the detriment of health. A plumber's trap depends for its efficacy on its filling of water. If some threads get into it and are carried over the bend, as shown in the next cut, they may form a capillary siphon, and in time empty the trap and admit sewer gas.

The pressure producible by this form of siphon depends, as in any siphon, on its effective height. The measure of its force may be determined by experiment. A test tube, six or eight inches long, has a doubly perforated cork fitted to it. A little colored water is placed in the bottom of the test tube. A few drops of ink will answer as the coloring agent. A glass tube of small bore is arranged to pass through one of the holes in the cork tightly. A lamp wick is rolled up longitudinally and is passed through the other. It must also fit tightly, and should reach down nearly to the bottom of the test tube when the cork is in place. It is well, before putting the cork finally in place, to thoroughly wet the wick.

The cork, with the tube and wick passing through it, is placed in the neck of the tube. The wet wick, if of proper size, will fill so perfectly the aperture in the cork, through which it extends that air will not be able to pass. The outer end of the wick is placed in a vessel of water supported well above the test tube, and the whole allowed to stand. In a few minutes the



CAPILLARY SIPHON EMPTYING TRAP.

siphon will begin to work, and water will be carried by it into the tube. As the cork is supposed to fit tightly, and must do so for the success of the experiment, and as the small tube and wick both pass tightly through it, air cannot escape. Hence as water is siphoned into it, the pressure of the air increases, and the water rises in the small tube. This is the indicator or gauge of pressure. The smaller the bore of the gauge tube, the quicker the water will rise in it. If all is rightly proportioned, the pressure will show in five minutes, and in an hour the water in the gauge tube will rise up four or five inches.

It is well, before showing this experiment, to cause the lamp wick to act as a siphon for a few minutes, delivering water into some other receptacle. This acts as a trial of its efficiency, and if it operates well, then the success of the definite experiment may be safely relied on. The preliminary trial should be made with the wick passing through the cork. It is essential that it should tightly fit the aperture in the cork, but, at the same time, it must not be so squeezed that the passage of water will be interfered with.

As it delivers water very slowly, the water entering the test tube forms a layer on the surface of the water already present. If the outside vessel for supplying water is filled with clear water, the appearance of the layer of transparent fluid on the colored layer below is of interest. The pressure tube should dip well into the colored fluid, as the object in coloring the water is principally to cause the slender column to show well. If only slightly immersed, the uncolored water delivered by the siphon may enter it, making its column hard to discern.

The New York Elevated Railroad Structure.

The patrons of the elevated railways are, no doubt, deeply interested to know that the structure on which they ride daily is sufficiently strong to endure the strain to which it is subjected, and to that end I beg you to insert this communication, embodying a few facts, in reply to your editorial of October 14, headed "The Elevated Railways."

The "L" lines consist of thirty-two miles of structure, all of which is double track. They are divided into spans about forty feet long, each span being independent, and the ends of the girders resting upon transverse girders supported by wrought iron columns in one type of construction, the girders resting upon the columns.

The material is the best refined iron for bridge purposes, and has a tensile strength of not less than 50,000 pounds per square inch, the rapid transit act requiring that the strains on the compression and tension members be limited to 9,000 pounds per square inch, the shearing strain on the rivets to be not more than 7,000 pounds per square inch, a maximum deflection of the girders to be not greater than 1-1,500 of its length, the columns so proportioned as to have a factor of safety of five, and the foundations not to have a greater weight come upon them than 2,000 pounds to the square foot.

With the increased weight of the engines now in use, necessary to draw five loaded cars, in no case is any portion of the structure strained anywhere near the limit above referred to.

In a series of experiments made by the eminent English engineer Fairbairn, he concluded that a light plate girder of 20 feet span, if subjected to 100 daily deflections equal to one-quarter of its breaking load, would last 300 years. Now, our structure having a factor of safety from six to ten, the latter on Second Avenue, what may we expect as to the life of the "L" roads? Surely, not so serious a condition of things as set forth in your editorial.

We have during the past four years re-enforced the Sixth Avenue pin-connected structure so as to keep up the high factor of safety required by our charter, and fit it for the type of engines now in use. The Third Avenue line is undergoing the same additions, three-fourths of the work being completed. The Second Avenue line is designed for engines much heavier than those we are now using.

The elevated structures cannot consistently be compared with iron bridges of surface roads:

1. The spans of our structure are small in comparison.
2. The trains are much lighter.
3. The engines less than one-half as heavy.
4. The speed is from one-half to one-third less than on surface bridges.
5. A long train causes no greater strain than a short one, because one car only, or an engine and part of a car, can be upon a pair of girders or bridge at a time, no matter how long the train.

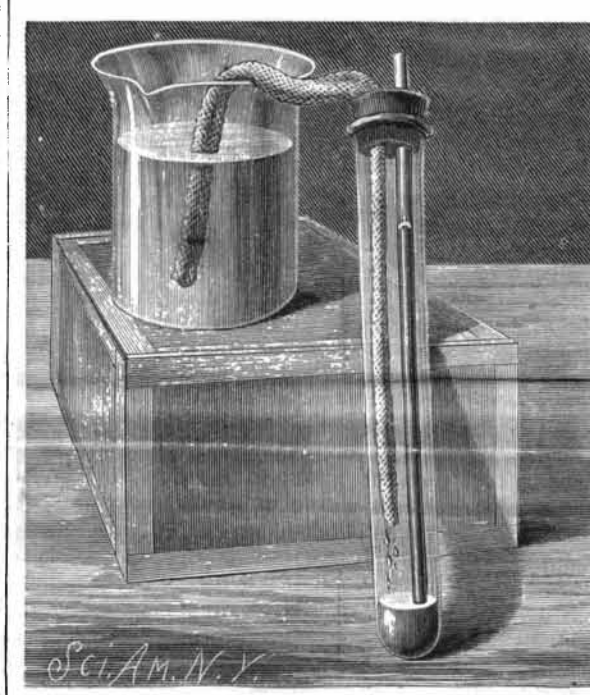
Pieces of iron taken out of the structure recently and carefully tested show that no deterioration has taken place.

A board of eminent engineering experts and builders of iron bridges made a thorough investigation, March, 1885, and reported that the structure was in better condition at the time than when first opened for business. Associated with these gentlemen was Professor Thurston, of the Stevens Institute of Technology, now connected with the scientific department of Cornell University, who made tests of the iron, and reported that there were no signs of crystallization, and was surprised at the uniform good quality of the iron submitted to him for testing.

A large and efficient force of men is employed by the company night and day to inspect the track and structure. Constant improvements are being made to relieve the structure from undue shocks, such as replacing fifty and fifty-six pound rail with steel rail weighing seventy pounds per yard, and the best devices for rail joints are being tested.—*F. K. Hain in New York Sun.*

A Gigantic Gas Holder.

Messrs. Ashmore, Benson, Pease & Co., Limited, of Stockton, have had for eighteen months in course of construction the largest gas holder in the world. It is designed by Messrs. George & Frank Livesey, engineers to the South Metropolitan Gas Company, and is being erected at their new works at East Greenwich, London. This gas holder, when completed, will considerably exceed in cubical capacity any other gas holder



PRESSURE PRODUCED BY CAPILLARY SIPHON.

in existence. The height of it, when inflated, will be 174 ft., and the diameter of it 250 ft., and it is calculated to contain 8,250,000 cubic feet of gas. It is constructed in four tiers, which telescope into one another, so that when not in use they lie flush with the ground in the concrete tank, which is excavated to receive them. The area covered by the holder is rather more than one acre in extent; its roof is without internal support, except when lowered, when it is supported by a wooden framing fixed in the tank, and on which it rests. To keep the holder in its proper position, there are 28 wrought iron standards, at equal distances round it, rising to the height of 178 ft., up which the guide rollers work. The total weight is approximately 1,700 tons, included in which is a considerable amount of steel. This holder will be the only one in the world exceeding in size either of the Birmingham corporation gas holders, illustrated in the SCIENTIFIC AMERICAN, vol. lv., No. 10.

FLOWERS.—It is estimated that about 100,000 species of flowering plants are now known to botanists.