this layer and sustains the water within the vessel.

Here I take a glass tube about three feet long, closed at one end. This I fill with water and then invert, with the open end below the surface of water in this large vessel. The water does not run out of the tube. How is it sustained, then? Evidently by the downward pressure of the air on the surface of the liquid in the outer vessel, this pressure is transmitted to the contents of the tube. If the water should run out of the tube while the open end of the bottle is kept below the water surface in the other vessel, no air could enter, and there would be a vacuum in the tube; that is to say, a space which is devoid even of air. Many centuries ago, people observed this phenomenon, and explained it by saying, "Nature hates a vacuum." Now a question of interest is this: How strong is Nature's hatred toward a vacuum? Is the pressure of the air of measurable or of infinite strength? This query has been answered by an experiment which we cannot well repeat here on this occasion. A tube, thirty-six feet long, was filled with water and inverted in water, and the liquid within the tube immediately fell to a height of thirty-four feet, leaving an empty space—a vacuum in fact—in the top of the tube. To account for this phenomenon, the saying arose, "Nature does not hate a vacuum beyond thirty-four feet."

Instead of experimenting with so long a tube, we will take here (Figure 5) a tube 36 inches long, fill it with mercury, and then invert it in a vessel of the same liquid. The mercury, or quicksilver falls in the tube to a height of nearly 26 inches at this altitude; but at the sea level, the column would have been 30 inches high, a vacuum being found in the upper part of the tube. Now, quicksilver or mercury is 13½ times heavier than water, and the height at which the water stands in the inverted tube, viz. 34 feet, is just 13½ times higher than the mercury column which reaches 30 inches only. The pressure of the air at the sea level, therefore, is just sufficient to sustain a column of mercury 30 inches high, and one of water, 34 feet high. If the mercury tube had a cross-section of one square inch, and the mercury within stood 30 inches high, there would be within the tube, 30 cubic inches of mercury, and this would weigh about 15 pounds; hence we usually consider the atmospheric pressure at sea level to be about 15 pounds per square inch. At this rate the air pressure in the palm of the hand, say five inches long and three inches broad, would be about 225 pounds. The pressure on the lid of a box 40 inches square would be 24,000 pounds; and the pressure on the body of a man of ordinary size would be about 15 tons. We are usually unconscious of this great power, owing to the fact that the pressure manifests itself equally on all sides of objects—on the back of the hand as well as the palm, and even within the interstices of the flesh; on the lower side of the box lid as well as above; and on all sides, including the inside of the human body.

Fig. 5.

Reference has been made several times already to the fact that the mercury column in the experiment last performed, is higher at the sea level than at a greater altitude. This is so because the air becomes rarer as we ascend above the earth's surface, and the pressure that it exerts is correspondingly less. Such an instrument—a tube of proper length filled with mercury and inverted in mercury, constitutes the Barometer, a device designed to indicate the degree of atmospheric pressure under any particular circumstances. By carefully noting the readings of a barometer it will be found that even at the same station, the air pressure is variable. By considering such variation some prognostication of the weather may be made, though no definite rules have been adduced. Many people claim for the barometer more than the instrument deserves; and say that it is a sure indicator of the weather changes, whereas in reality the instrument simply reveals the fact of the change in atmospheric density, and these changes we interpret, not always rightly. In consulting the barometer with a view of determining the weather forecasts, attention must be paid to the place at which the observation is made. Thus, in London should the barometer register as low as 29 inches, heavy storms would be expected, while in Utah, the barometer column seldom rises above 26½ inches.

While speaking of barometers, passing attention might be called to an instrument of common sale known as the Storm Glass. It consists of a short sealed tube of glass, containing a chemical solution of a crystallizable solid. The accompanying instructions are to watch the solutions, and as the appearance of the crystals change so will the weather vary. Remembering the tube is of rigid glass and hermetically sealed, the fact is at once clear that no variation in atmospheric pressure can possibly affect the contents of the tube. The instrument is a pretty ornament, and a good selling article; but its farther use as a barometer would be hard to find.

There are many common instruments dependent upon air pressure. We have here a glass tube (Figure 6) in which a bulb has been blown. By inserting the lower end in liquid and applying suction above, the tube may be wholly or partially filled; and the contents may be easily kept within or allowed to drop or to flow by applying the finger at the top and controlling the ingress of air. Such an instrument is called a pipette, and is of great value in transferring small quantities of liquid from one vessel to another.

Fig. 6

The Syphon (Figure 7) is another simple but efficient device. It consists of a bent tube, one arm of which is longer than the other. By inserting the short arm in a liquid and then applying suction at the other end till the tube is filled, the flow may be started, and this will continue till the liquid has sunk below the entrance to the tube. Syphons of modified form may be made, so as to produce fountain sprays and the like. Upon this principle intermittent springs are believed to operate, the water gathering in a cave within the earth until it finds an outlet through a syphon-shaped channel, and then continuing to flow till it has sunk below the entrance to the outlet conduit.

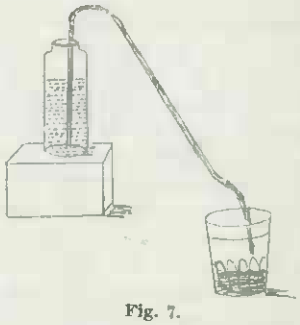

Fig. 7.

But far more impressive results in air pressure experiments may be made by the aid of the air pump