times on the same day with the same apparatus, but at different altitudes. If the mercury rose in the tube to a greater height at the bottom of a hill than it did at the top, it must clearly be owing to the greater weight of the longer atmospheric column at the lower level. "It is absurd to suppose," says Pascal, "that nature abhors a vacuum less at the summit of a mountain than it does at its base." On September 19th, 1648, at the time when English fanatics, who had intoxicated themselves with the blood of the Archbishop of Canterbury, were preparing to shed that of the King, M. Perrier, a brother-in-law of Pascal, ascended the Puy de Dome, near Clermont, the highest mountain in France, to ascertain by actual test whether the expected result followed or not. The mercury fell in his tube as M. Perrier ascended the mountain, and when he reached the top it stood three inches lower than it had done at the commencement of the upward journey. The experiment was repeated on different sides of the mountain and at different times, but always, of course, with a similar result. And thus it became satisfactorily established beyond question that the mysterious power which had for so long a time eluded the search of philosophers was merely the pressure due to the weight of the atmosphere.

Within a very few years from the date last named, some of the practical results of the discovery were already realized. In 1654 the air-pump was publicly exhibited before the Emperor of Germany. Perrier himself, after a little observation, saw how Torricelli's tube could be applied to the measurement of the varying pressures of the atmosphere, and the partial prognostication of the weather which is rendered possible; though if he could have seen the clock-faced instruments which now hang in her halls, stupidly marked "Change," "Rain," "Set Fair," etc., as if every different height of the barometer corresponded to its own unvarying weather, he would, perhaps, have paused before putting into the hands of foolish humanity his air measuring machine in the capacity of a weather glass. He also applied it to measuring the altitude of mountains, for which purpose its suitableness was at once apparent.

The establishment of the truth of Torricelli's supposition enabled mechanics, for the first time, to understand the cause of the action of a pump. They must, for centuries, have observed this action, and have noticed its powerlessness at a greater depth than thirty-three feet, and every pumpmaker must in time, as a part of his mechanical training, have become acquainted with the fact. Why, then, did the Florence engineers try to satisfy the requirements of the Grand Duke when they must have known their endeavors would be fruitless? Probably just because they received the order to do so; the risk was not theirs, and perhaps they did not dare to disobey. The cause as well as the fact itself was now understood; it explained also the different results obtained from the same machine at different places. A pumping engine which would raise water thirty-three feet in a city of the plains would be quite ineffective for a similar depth in a mountain town. The fire engine, which does as much in London, can only "draw" from a depth of twenty-two feet in the city of Mexico, and on some parts of the Himalayas, should it be required in that region of eternal snow, not more than eight or ten feet.

Suction Hose.—Suction hose is a flexible pipe attached to the inlet of a fire-engine or pump of any kind. Through it the supply of water is taken into the pump. For durability suction hoses are best made of leather; but with large suctions some difficulty is usually found in getting leather perfectly air tight, and consequently India rubber is more generally used. This is not nearly so durable, the nature of rubber, like that of all vegetable substances, being to perish, a tendency which vulcanizing only partly overcomes. Manual engine suctions are nearly always made of leather, copper rivetted; but steamer suctions of this material are usually bound outside with copper wire, the inside coats being formed in each case of canvas, treated with marine glue, tar, or pitch, and bound over an iron or copper spiral.

Some India-rubber suctions are made with imbedded spirals, by means of which a clear waterway is obtained. The objection to this class of suction is, that the inside coat sometimes strips away from the spiral. In the usual form the metal spiral is exposed inside, being sunk in the rubber just sufficiently to hold the coils of the spiral apart, and to prevent their slipping, at the same time presenting a fairly smooth waterway.

A length of suction hose is tested by fixing it to the inlet of an engine, and closing the strainer end by means of a cap having a vacuum gauge attached. The engine being then worked, the gauge should show and maintain a vacuum of about 14 lbs. per square inch after the pump has been stopped. If this cannot be done, there is a leak. The most likely place is at one of the couplings; the washers should be examined and adjusted if necessary. A defect in the body of the suction can often be located by passing a candle along outside whilst the engine is being worked; the flame will indicate where air is entering. If the defect cannot be found in this way, it will be necessary to apply a slight water pressure from the inside, which can easily be done by attaching the suction to the delivery outlet of the engine.

Water is propelled through the suction pipe of a pump by the act of removing or lessening the pressure of the atmosphere on the surface of the water in the suction pipe. Properly speaking, there is nothing in the operation resembling that of suction. One end of the pipe being placed in the water, and the other end connected with the pump inlet, which is closed by a valve, the stroke of the pump plunger has the effect of partially removing the air in the pipe. The surface of the water being then relieved of a portion of the atmospheric pressure, there is less resistance offered to the water rising in the pipe. The water outside the pipe, having still the pressure of the atmosphere upon its surface, is forced through the suction to supply the place of the excluded air. The water inside the suction rises above the level of that outside in proportion to the extent to which the pressure of air is removed. If, for instance, the pressure of air within the suction is reduced by the first stroke from 14½ lbs. to 13½ lbs., the water will be forced up the pipe about 2¼ feet, because a column of water an inch square and 2¼ feet high is about equal to one pound in weight.

Upon the reduction of the pressure of the air contained in the suction from 14½ lbs. to 13½ lbs. per square inch, it is evident that unless the water ascended the pipe there would be an unequal pressure upon its surface inside and its surface outside the pipe. In consequence of the water rising 2¼ feet in the pipe the