

in a moment of sudden danger; and used every argument to persuade me, that the present safety of the ship was due to the very timely and friendly interference of this aerial demigod; and that no accident could possibly have happened to the sails, while the seamen were at prayers, as long as the light glowed stationary on the mast. Had the light, he continued, descended gradually from the mast-head to the deck, and from thence to the keelson, as he had often seen it, the event would have prognosticated a gale of wind or other disaster, and, according to the depth of the descent, so would be the nature of the evil to come. In the present instance, the lights gradually disappeared, like the snuff of a candle, and the weather continued clear and fine for several subsequent days.

[*Boston Journal.*]

An Account of the Passage of Water through an Aqueduct being totally obstructed by collections of Air; and on the Equilibrium of different fluids in bent tubes. By D. TREADWELL.

A LEAD pipe, having a bore an inch and a half in diameter, was laid from a well in Roxbury, to the mills at the water works on the Boston mill-dam, for the purpose of supplying the workmen, who carry on the various manufactories erected on the mill-dam, and their families, with fresh water. The surface of the water in the well was found, by a survey, to be somewhat higher than any of the ground through which the aqueduct passed. The whole length of the aqueduct was about 6000 feet, and its general course was through a salt marsh; in its way, however, it passed under the bed of two creeks, which may be taken at 12 feet deep, each, and near its termination, it descended from the marsh to the bed of the bay on which the mill-dam is built. It was laid about three feet beneath the surface of the marsh, and opened into a reservoir at the city mills, four feet below the level of the surface of the water in the fountain well.

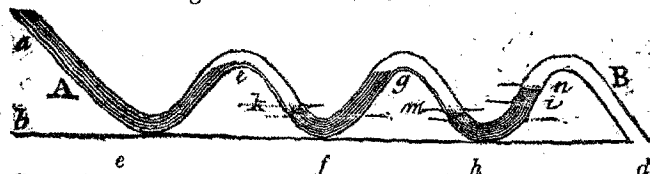
After completing the aqueduct and opening it into the well, it was found that not a drop of water would run through it. As it was known that there were no mechanical obstructions in the pipe, it was thought not a little anomalous that the water should not pass through it.

In this state of things I was requested, by those interested in the aqueduct, to consider the circumstances, and endeavour to procure a passage of the water. When the exact condition of the aqueduct was taken into consideration, I perceived that the water let into it might have made such an arrangement, in relation to the air with which the pipe was previously filled, as wholly to obstruct its passage. For let us suppose in the annexed figure, A B to represent a pipe open throughout its length, but its sides being perfectly tight, and having the several vertical flexures here represented, and let it be

required to pass water, or any heavy fluid, through it in the direction from A to B, the end A being elevated the distance ab above B, $c d$ being a horizontal line. It is evident, that the water being let into the end at a , will pass and fill the pipe to e , displacing all the air with which the pipe, being open to the atmosphere, was previously full. Flowing over the curvature e , in a stream or column less than the bore of the pipe, it fills the curvature at f , without displacing the air previously contained in the descending section from e to f . This air is thus shut up, and cannot pass from the pipe in any direction, without passing under the water, which, from its inferior specific gravity, is impossible. The water, continuing to flow over the flexure e , rises from f to g , and flowing over this flexure, the same thing is repeated, as to the air from g to h , which took place at the flexures e and f . Rising from h until it attains some point, i for example, at which the sum of the perpendicular heights of the ascending columns $c e, f g$, &c. is equal to the height of the column ab . That is, if we suppose the air to be un-elastic and void of weight, but as this is not true in fact, the air will be condensed in a greater or less degree, according to its volume and the height of the columns of water opposed to it. In consequence of this condensation, the water will rise, as shown in the figure, to k and m , for example, and the weight of these columns being added to the effective force of the column ab , produces a rise of the water to some point, n , in the flexure $h n$. There is then a perfect equilibrium in the opposing forces, and the water can flow no farther. This equilibrium may be expressed, generally, by

$$ab + cd = be$$

in which a is the perpendicular height of the water in all the descending flexures; b its density; c the perpendicular height of all the enclosed air; d its mean density; and e the perpendicular height of all the ascending columns of water.



Several writers on Hydrodynamics, have noticed the obstruction which air often presents to the passage of water in bent tubes; but in the works that I have had an opportunity of consulting, the authors appear to regard the air as collecting in the high parts of the tube, and partially closing its bore, thus diminishing, without totally obstructing, the discharge. This is quite different from the effect of the arrangement which I have attempted to explain. Those, however, who are acquainted with this subject, will recollect the Zurich machine for raising water, invented many years since, as owing its efficacy to an arrangement which the air and water take in a spiral tube, very similar to that stated in the preceding part of this paper.

As the aqueduct at the mill-dam was more or less bent through

its whole course, the flexures being considerable at the creeks under which it passed, it appeared to me certain that it was partly filled with air, and that this alone interrupted the flow of water. On opening small holes into it in several places, air rushed out in great quantity; still, however, the water did not flow at the reservoir, and as it was impossible to get at the bendings in every part of the pipe, without the labour of uncovering it wholly, the design of freeing it from air by piercing it with small holes, was suspended. A forcing pump was then coupled to the upper end of the pipe, and water, which had been heated in the worm tube of a distil house, in the vicinity, was forced into it. The pump was furnished with a valve loaded with a weight equal to a column of water 80 feet high, and a very small opening made from the aqueduct into the reservoir at the mills, so that the water passing slowly through the whole length of the aqueduct, was there discharged. The object of this apparatus, was, to produce an absorption of the air, by bringing it in contact, under heavy pressure, with water which had parted with some of its air, by being heated; as these conditions are known to be favourable to the absorption of air by water. The pumping was continued about ten days, and the quantity of water used may be taken at 20 hogshheads; when the pump was taken off, and the aqueduct opened into the fountain. The water was then found to flow at the reservoir, discharging as much as was due to the head. This discharge has continued uninterruptedly to the present time, about five months. There can be no doubt but much air was absorbed, its presence in the aqueduct being indicated, when the pumping was commenced, by its throwing a stream of water out of the pipe, on which the loaded valve was placed, whenever the weight was removed from the valve. The quantity of water thus thrown back was much too great to have been produced from the elasticity of the water, or the lead pipe, and it diminished daily, having almost ceased before the pump was taken off. [16.]

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS GRANTED IN NOVEMBER, 1828.

With Remarks and Explanations by the Editor.

1. For a mode of *Applying Steam for Extracting Tannin*, and other ingredients, from the bark, and other substances used in tanning; William Coburn, Gardiner, Maine, November 1.
(See the specification.)

2. For an improved *Plough, for Ploughing Hill-sides*, denominated the 'Hill-side Plough;' Norman Staples, Penn's Store, Patrick county, Virginia, November 1.

The object to be attained by the use of this plough, is the turning of the sward down hill, in horizontal ploughing, in both directions.