issue so great a number of plates within the period required for permanent photographs." From a lithographic plate only about 500 good impressions can be taken, but here they can be made by thousands. It will also be of great advantage in copying plates from monographs, or valuable pictures of any kind which are out of print or otherwise inaccessible.

## IMPROVEMENTS AT THE MOUTH OF THE MISSISSIPPI.

The long discussion relative to the most practicable method of improving the mouth of the Mississippi, so as to render the same passable to vessels of deep draft and thus to open the river ports to direct ocean traffic, was virtually terminated by the granting of an appropriation by the last Congress, for the construction of a system of jetties at one of the passes through which the stream enters the Gulf. The plans involving canals, which have been strenuously advocated by many eminent engineers, are therefore for the time at least set aside, and to Captain J. L. Eads, an engineer now widely celebrated for his successful construction of the St. Louis bridge, has been entrusted the task of causing the mighty current of the Father of Waters literally to undo its own work and to break down the barrier which itself has created.

The Delta of the Mississippi is formed of narrow strips of land, mostly low lying banks, through which the river winds until it makes its exit to the Gulf by a number of narrow passes. In some of these channels, previous attempts have been made to deepen them by dredging, with but partial success, however, as a single flood has been known to carry down sufficient sediment to fill them to their original depth; and the current besides, emptying into the open water at the mouths, speedily left at that point bars of blue clay, surmountable only by light draft ships. The gist of Captain Eads' plan will now be readily apprehended when it is regarded as shifting the point of deposit of these barriers from the shoal water at the entrance of one pass, out into the deep water where filling up by natural causes is impossible. By this means the river current is to be made to cut out and scour its own channel across the present bar. To do this, it is obvious that the banks of the pass must be extended, so as to lead the stream far enough out; another section of conduit, as it were must, be added, and this is now to be formed of the submarine dykes or jetties.

The materials of which these structures are to be composed are willow twigs bound in bundles, termed by engineers "fascines," eight or ten feet in length and about as many inches in diameter. A large number of fascines at a time will be lashed together to form rafts, the first of which will be from seventy-five to two thousand feet in width, the largest rafts being sunk in the deepest water. The rafts will next be towed to the proper point, there loaded with stones, and submerged, and thus the work will continue, one raft being sunk above another until the surface is reached. Each line of rafts will be narrower than the one below it until the upper course will not be more than ten feet wide. The two walls which will thus be constructed will be prolongations of the banks, and between them will form a channel with sloping sides. In the course of time, the interstices of twigs and stones will fill with sand and mud, so that eventually two solid submarine levees will be produced. Very little pile work, it is said, will be required except perhaps at the head of South Pass, which is the outlet at which the jetties are to be built, in order to provide for the proper regulation of the volume of water in the new channel at various stages of the river.

Captain Eads has already begun his surveys, in which work, together with the making of the necessary contracts for materials, labor, etc., the summer will be consumed. The first raft, it is expected, will be sunk by the beginning of October next.

## MOTION ON A MOVING BODY.

For the last few months we have been receiving queries from all sections of the country, something like the following: "If a train is moving at the rate of sixty miles an hour, and a cannon on the train is fired, giving the shot a velocity of sixty miles an hour, will it leave the train, or just drop down at the mouth of the gun?" We have once or twice attempted to explain the matter in our correspondence columns, but our remarks seem either to have been overlooked or misunderstood, and we must try once more to stop this stream of inquiries by satisfying the inquirers. Our remarks may also be useful in giving some of our readers more correct ideas about rest and motion than they possess at present.

The dwellers on the surface of the earth are carried through space so smoothly that many of them doubtless forget that the earth is revolving on its axis with a velocity, at the surface, of more than 1,000 miles an hour, and moving in its orbit at the enormous speed of about 68,000 miles an hour. They know, however, that they can set up a target on the surface of the earth, and pierce it with a shot that has much less than the velocity of the earth, whether the shot be fired in the direction in which the earth is moving or the contrary. It is easy to see, then, that if a ship or train is put in uniform motion, and the same experiment is tried, it will give a similar result. The reason, too, must be obvious after a moment's reflection. Everything on the ship or train being carried along with it, an additional velocity will evidently move it away from the position that it formerly occupied, to some other position on the moving body.

This disposes of the first part of the question, and now we will consider what is necessary, in order to make a body leave the ship or train. Probably some of our readers have seen Mr. Hale's entertaining story of the "Brick Moon," which was projected into space with such velocity that it never returned to the earth. Many more of our readers, no doubt, have experienced some of the difficulties of leaving a moving body, as, for instance, a car: because, as we explained some time ago, the car had put them in motion, and so there was a liability of their being dashed back again violently if they attemped to jump directly from the rear of a train moving at high speed. Now of course the train is not going to be more considerate of the shot in a cannon than it is of a human passenger, so that, unless the powder drives it back faster than the train is moving forward, it will not leave the gun. It is scarcely necessary for us to say that the case supposed by our correspondents is a purely imaginary one, since a train or a ship does not move with perfectly uniform velocity, and neither does a shot from a cannon. Considered in this light, the subject is of no practical importance, and our only reason for referring to it in this prominent manner is to call attention to the principles involved, which are both interesting and useful. We do not propose to discuss this question of the cannon and the train any further, and beg that our readers will send us no more communications on the subject, as we have not room even for all the valuable and instructive letters that we are constantly receiving.

## WHAT IS THE CAUSE OF TIDES?

There are occasional fallacies which, in some mysterious way, gain credence in the minds of men till they finally become accepted as unquestioned facts. Among these may be mentioned the oft-repeated proverb: "It is always darkest just before day," and the commonly accepted explanation of the rising of light bodies in a denser medium. It is not true that smoke, heated air, balloons, etc., rise because of their lightness, and then the air rushes in to take their place; but the air, being heavier, seeks by gravity the lowest place, and in so doing crowds up the lighter bodies. Water is said to contract down to a few degrees of the freezing point, and then to expand in changing to ice; but it is probable that the molecules are drawing closer to one another all the time, and that the apparent expansion is because the crystals of ice do not fit together exactly, and hence leave between them interstices filled with air, and thus occupy more space.

And it is quite possible, if not probable, that the common explanation of tides furnishes still another illustration. With sufficient credulity, the explained cause of the tide on the moon's side of the earth may be accepted as somewhat satisfactory: but there is room for reasonable doubt as regards that of the tide opposite the moon. This luminary is said, in the first case, to draw the water away from the earth, and in the second, to draw the earth away from the water. This is considered possible because the nearer object will be influenced more by the moon's attraction than the more distant object, and this difference of attractive force, as exerted on the stable earth and the unstable water, is said to produce the tides as we observe them. Attraction varies inversely as the square of the distance. If we represent the force with which the moon draws the earth by ten, the force with which it attracts the water on the opposite side of the earth will be about nine and two thirds. This latter force is not diminished by the intervening earth, and tends to draw the water toward the moon. The earth, by its attraction, holds the water to its surface, and its influence is not lessened when the moon acts upon it. As both these forces tend to draw the water opposite the moon toward that luminary, we would reasonably expect a low, rather than a high, tide at that point. It is said that the water remains behind by its inertia. But as the moon acts constantly upon the earth, and gradually upon anyone point of its surface, the inertia of the water would be overcome at least as soon as that of the solid earth, and probably sooner, as the water is more free to yield to the influence of attraction.

Again, the theory rests on the supposition that the attraction of the moon gives the earth a daily motion toward itself; but this cannot be strictly true, for, if so, the earth and moon would be continually approaching each other, and we would live in constant fear of a collision, whereas they maintain a uniform mean distance between them. In opposition to this, it is argued that the deviations from the tangential motion of the earth in its orbit are precisely those which the earth would move through if falling toward the attracting body unaffected by any other impulse. Whether this is satisfactory, each must decide for himself.

The sun also exerts upon the earth an influence tending to produce tides, which is about two fifths as great as that exerted by the moon. The sun's real attraction, of course, is much greater than the moon's, but, on account of its greater distance, the difference between its influence on the earth and on its aqueous envelope is less. From the sun's influence, we would expect a tide to follow the sun, as one is said to follow the moon, and differ from it only in being smaller; and when the sun and moon are in quadrature, we should expect, according to theory, that there would be four tides in a day: two caused by the moon and two by the sun, whose major axes would be at right angles to each other. When the sun and moon are in conjunction, we have the highest tides, because both act together and in the same direction. When they are in opposition, we should expect the lowest tides because they act in opposite directions and each tends to counteract the effect of the other. But in fact this combination also appears to produce spring tides.

If the tidal wave is caused by the moon, and follows her as she apparently makes a complete circuit of the earth in about 25 hours, it must travel at the rate of one thousand miles per hour, and this is hardly reconcilable with its mildness and harmlessness in dashing upon the shore, nor with Mr. Airy's law for the velocity of tidal waves, which makes it the "same as that which a free body would acquire by falling from rest, under the action of gravity, through a space equal to one half the depth of the water." The Pacific Ocean is estimated to average 440 fathoms in depth, and according to this rule the velocity would be less than 200 miles per hour; or, by a slight change in its application, the rule would make the average depth of water over the whole surface of the earth more than twelve miles. The tidal theory supposes the anomalous condition of an interrupted ocean enveloping the whole globe. Again, if the moon or sun causes the tide, we would expect an observable uniformity in the direction and velocity of the tidal wave from the eastern borders of the Atlantic and Pacific Oceans to their western borders; but on the contrary, it is acknowledged by orthodox believers in the lunar and solar cause of tides that we have little or no clue to the course or rate of travel of the ocean tide. Even for the North Atlantic, which is constantly alive with commerce, no connection has yet been discovered between tides of the opposite coasts.

The tide on either side of the earth does not rise on the vertical between the earth and the attracting body, but, under favorable circumstances, about three hours behind it; and when these are not favorable, the retardation may be almost indefinitely prolonged. The reason of this is said to be that the inertia and friction of the water, and other causes, prevent its rapid change of form; and although the elevating force is greatest under the vertical, it still continues to act in the same direction, and with but little diminution of force, for some hours after the passage of the moon. But, strange to say, when the influences of the sun and moon are combined to overcome this friction and inertia, the interval between the meridian passages of these luminaries and the spring tide is longest of all. The retardation so varies with the depth of the sea, form of the basin, interruption of the land, etc., that confessedly no regular progressive movement of the tide wave can take place except in the unfrequented Southern Ocean. This, together with the acknowledged want of observed connection between the tides on the opposite coasts of the North Atlantic—though here subject to constant inspection—leads to the conclusion that the belief, respecting the movement of the tidal wave around the earth from east to west, is based on conjecture rather than positive demonstration. On the other hand, there are some reasons for the supposition that this wave moves in the opposite direction Mr. John Wise, who suggests some of the objections mentioned above, claims that it moves from west to east, and is due to the action of the earth's centrifugal force, just as water is thrown forward on the surface of a rapidly revolving grindstone. In substantiation of this, he says: "The first authenticated records we have of this centrifugal wave rolling round the earth, from west to east, are given in the log of the clipper ship Sovereign of the Seas, in her remarkably short passage of eighty-three days from the Sandwich Islands to New York, in 1853, in accordance with Maury's chart furnished by our government. This ship made 16½ knots an hour in her easting for four consecutive days while riding this great centrifugal wave in her doubling of Cape Horn. And in the same year, by the same directions, the sailing ship Flying Scud made equally good castings, and made as much as 449 miles in one day, taking advantage of this fact of the great tidal wave." These statements would seem to necessitate the progressive movement of the water as well as the wave, for their explanation. But it is generally held that the water itself has little or no real forward motion.

Mr. Wise also claims that there are not two distinct daily tides in the Southern Ocean, nor at all intertropical points; and that where two appear, they are due to gurgitation and regurgitation of the water, occasioned by its forcible contact with the shores between which it oscillates, and may be influenced by the fact that the equator of the earth is an ellipse and not a perfect circle. He assigns, as the cause of their regularity, what Herbert Spencer calls the rhythm of motion, and says: "They have their elucidation in, and are manifestly referable to, that harmonious pulsation of Nature which exhibits itself in the throbbing of the heart, in the motion of the blood, the vibration of sound, the 'nodding' of the poles of the earth, in all mechanical movements, and in the measured cadence of the waterfall as it rises and falls in its musical rhythms."

That most of the objections cited herein have their stereotyped answers is not denied. But it will doubtless be conceded that there is some reasonable doubt as to their correctness, and that strict science, which rests on facts and not on theories, would not be injured by a careful revision of this whole question. With this end in view, we close our remarks as we began, with the honest query: What is the cause of tides?

Cambridge, Mass. S. H. TROWBRIDGE.

### Coughing.

The best method of easing a cough is to resist it with all the force of will possible, until the accumulation of phlegm becomes greater; then there is something to cough against, and it comes up very much easier and with half the coughing. A great deal of hacking, and hemming, and coughing in invalids is purely nervous, or the result of mere habit, as is shown by the frequency with which it occurs while the patient is thinking about it, and its comparative rarity when he is so much engaged that there is no time to think, or when the attention is impelled in another direction.

A GELATINOUS substance frequently forms in sponges after prolonged use in water. A weak solution of permanganate of potassa will remove it. The brown stain caused by the chemical can be got rid of by soaking in very dilute muriatic acid.