take place at the equator at 6 A. M., or a few hours after, of course modified by the tide wave due to the moon's attraction.

What is the case, however? The solar tide wave takes place under the equator two or three hours after midday, proving that it is due solely to the solar attraction, which shifts the center of gravity of our earth directly toward the sun, as the lunar attraction shifts it constantly toward the moon; and the combination of these two attractions, in the different relative positions of the sun and moon, produce the difference in hight of the tides, spring tides, etc. Observations continued for centuries over almost the whole earth in the interest of navigation, have settled the subject of these tides in such a rigorous manner, that we know positively the non-existence of a tide wave, due to the shifting of the earth's center of gravity, toward that half which in its daily rotation is falling toward the sun.

In the same manner as the attraction of the sun brings the center of gravitation of our earth toward that luminary, so the attraction of our earth tends to bring, in all terrestrial bodies, rotating or at rest, the centers of their own gravitation or mutual attraction nearer to the earth; only this mutual attraction of terrestrial bodies is so infinitely small, when compared with the earth's attraction, that it cannot be perceived except with very delicate contrivances, like the torsion balance of Coulomb, who already, seventy years ago, demonstrated this mutual attraction of all bodies on the surface of our earth.

It appears to me that the chief cause of error in those who defend the notion that the center of gravity of a vertical revolving wheel shifts toward the descending portion, or toward the ascending portion (there are some persons who also defend the last idea) is, that they overlook the fact that gravitation acts on all the particles of bodies either in rest or in motion, ascending or descending, with the most perfectly equal force, and that a body is not lighter when ascending nor heavier when descending, or that the attraction of gravitation will not diminish as soon as the body obeys this attraction by falling, nor that the attraction will increase when the body moves against gravitation. The adherents to the last notion maintain, of course, that the center of gravity of the wheel shifts toward the ascending portion. Every one of these notions is erroneous, and beside they would not explain the gyroscope, even if true.

Another cause of error is that the centrifugal force is confounded with the tangential force. They are not the same. The first is the amount of pull to the string when whirling a stone around, and is simply due to the tendency of all bodies to move in a straight line; the last, the tangential motion, is obtained when occasion is given to the body to move in that straight line, and the velocity of this tangential motion will be exactly equal to the motion of the body in the curve in which it moved previously, only continued in a straight line.

I close in expressing my surprise that Mr. McCarroll, the reputed discoverer of the notion, on page 243, in place of admitting that I was right in my statement (page 195) that this thing was not new, and more than ten years ago, mooted in connection with the gyroscope, "informs" me about these facts. He desires that my observations might be more intelligible. I believe that unprejudiced persons by careful reading will easily understand my short description of the apparatus which disproves totally his theory. With mere words, without figures, it could not be made more clear; and I trust that very few readers of the SCIENTIFIC AMERICAN, will need to be further enlightened on this subject. If so, I am willing to give figure and description.

P. H. VANDER WEYDE, M. D.

### An Aerolite.

The Anglo-Brazilian *Times* of the 7th August contains a communication from Dr. Franklin Massena, giving an account of an aerolite which he observed at the Observatory of Itataya upon the 30th July, near daybreak. He says:

"Suddenly, toward the east, at almost 30° of the meridian, I saw an immense and beautiful aerolite crossing to the southwest. I called Messrs. Arsenio and Veija, and together we watched the disappearance of the luminous body, and its form and motion. Its form was that of a globe, having an apparent diameter of about 43', and a tail of 9°, in an elliptical curve extending into space with an inclination of about 30°. The tail was an oval form and very divergent toward the part away from the nucleus. The motion was made by the nucleus, the tail following its track. Both the tail and the nucleus were as brilliant as electrical light, and emitted some luminous drop or tear-like particles, which threw out silvery sparkles with incredible rapidity. Six minutes after its meridian passage the body exploded toward the southwest. Such was the rapidity with which it moved that in 17 seconds it traversed a celestial area of 77° 41', losing itself behind a hill at 5 hrs. 55' 50", or 17 hrs. 55' 50" of true solar time.

"This aerolite so disturbed the magnetic instruments that the declinometer turned its pole from the north toward the west and stuck itself in the box where it found resistance; the horizontal magnometer turned toward the west eight divisions of the scale; the vertical magnometer fell in its center of gravity, and finally, the compass oscillated 15° from north to west. I showed Sr. Arsenio the disturbed state of the declinometer. It is, therefore, demonstrated for physics that an aerolite has an intense action upon the north pole of magnets, powerfully attracting them.

"The following are some mathematical elements of the orbit of this body: Meridian passage, 5h. 55' 33", on July 30, 1868; declination, 65° south; vertical distance, 42° 32'; setting, 50° 15' W. by S.

"With these data the orbit of the aerolite is found to have 17° 40' of inclination upon the line of the earth's rotation, with its movement contrary to that of the earth.

"At 6 o'clock, at the moment of detonation, the state of the atmosphere, to be taken into account for the calculation of tance, was, Bar. 584·3; Ther. C. 8° 3; Hyg. of relative humidity 76·5. Sky clear and cold; wind N. W., weak. The motion of the aerolite was followed by a noise like that of silk dragged over the ground. The aerolite must has passed between Itajuba and Guarantingueta, and it remains now to find out where it fell in order to ascertain its size."

### JOHNSON & FROGGOTT'S PATENT HORSE SHOE.

The principal wear on horses' shoes is on the calks, particularly on hard roads or paved streets. It is evident if these calks could be readily removed when worn, and replaced by others, the cost of shoeing would be materially reduced and many inconveniences avoided. Screws for attaching calks to shoes have been used, but the liability to loosen, turn, and eventually to come off, seems to be objectionable.

The device, herewith illustrated, is intended to provide a means of preventing these difficulties. The shoe is in the usual form, but without protuberances. The toe calk, A,—a separate piece—and the heel calks, B, also separate, are attached to the shoe by a screw secured in their upper surface,

Fig. 1

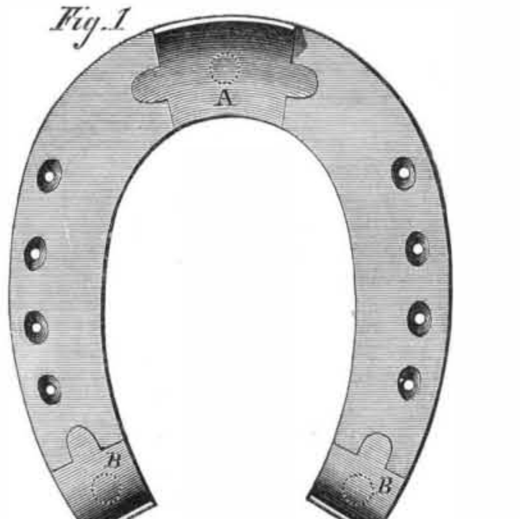
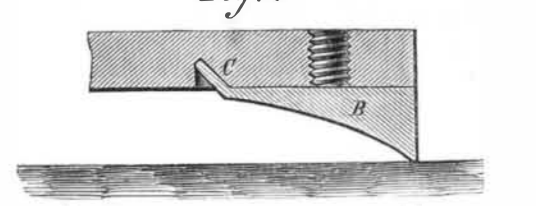



Fig. 2




which fits a correspondingly threaded hole in the shoe, shown in Fig. 2. The toe calk is provided with two projecting pointed arms and the heel calks with one each, which after the calks are screwed in place, are bent down and seated in depressions in the under side of the shoe. See C, Fig. 2. These arms prevent the calks from casually unscrewing or turning, and tend to assist in their support, and the calks may be easily detached and replaced by others.

Patented through the Scientific American Patent Agency, Sept. 29, 1868. Address, for further information, P. C. Johnson, Central City, Colorado.

### The Semaphore Steering Apparatus.

A Liverpool paper gives an account of a new steering apparatus, recently invented by an officer in the English Coast Guard Service:

"The difficulty hitherto experienced of knowing and indicating exactly, when vessels meet each other on the high seas or in narrower waters, the course which each vessel intends to take, Mr. Read's invention is intended to obviate. Mr. Read's plan is to connect by a self-acting apparatus the helm of the ship with the starboard and port lights during the night, and with a flag or ball signal during the day, so that any movement which is given to the helm is at once correspondingly indicated to any approaching vessel. A rope or chain is rove through a block, or cheek, at the masthead, from thence to a block hooked on the ship's side and laid along the rail or water-ways through a tube to a block abreast of the wheel or tiller, the turns are passed under and over the barrel of the wheel and to the end of the tiller if the rope or chain is placed on the barrel of the wheel. The port and starboard lights are then placed in connection with this apparatus, and the result is that the turn of the wheel to the right tightens the line attached to the starboard light, raises it from the box in which it has been concealed, and places it fully in the veiw of any vessel approaching. A similar movement of the wheel to the left raises the port light, and starboard light descends and disappears from sight. The lights are placed in metal tubes open at the front, so as to show the light clearly to approaching vessels, and with holes at the back, so that not only may the steersman see that the light is working properly, but vessels approaching from behind may know the exact course which is being taken by the vessel in front of them. If the helm is put the wrong way, as is often the case, the officer in charge of the ship will be able to check the helmsman in an instant, or a ship approaching will detect the mistake and act accordingly. The apparatus is so simple that any cabin boy can rig and repair it when it is out of order. By the use of the apparatus all speculation as to which side a vessel will pass another is at an end, and should a collision take place between ships with the apparatus on board, the party upon whom the blame rests is at once indicated. The lamp signals are of course for use by night; for day signals, the same apparatus puts in motion a yardarm at the masthead, with green or red flags or balls which are seen to port or starboard in accordance with the motion of the helm. The invention has its useful application also in naval tactics; for when the hulls of ships are enveloped in smoke, the rudder can be indicated by the signals made at the fore, main, or mizzen royal truck; and thus, tacking in succession, ships would be able to follow each other accurately either by day or night. Captain Mends, R. N., and other officers, upon whose judgment and experience reliance can be placed, have warmly encouraged Mr. Read's plans; Captain Mends being of opinion that, whether the invention is adopted by the Board of Trade for the high seas or not, it will assuredly be of service in narrow waters."

The Liverpool correspondent of the *New York Mercantile Journal*, gives the history of the invention as follows:

Some time ago Mr. George Read, a chief officer in the Coast Guard Service, stationed in the South of England, dreamt that he could distinguish at a great distance the course a vessel was steering by seeing the movements of her rudder. At first he thought nothing of his dream, and discarded it as a meaningless phantasy. A few nights after, however, he dreamt the same thing, and the peculiarity of the occurrence caused him to ponder over the subject of his sleeping thoughts, and to consider whether the course of a vessel could not be indicated by some means different to what had been in use. Reflection led to the conclusion that there was "something in it," aud the result of this wonderful dream, worked out by the skill of the dreamer, was the invention referred to in this letter, which Mr. Read has perfected and brought into practical use, viz: the "Semaphore steering apparatus."

### A New Way of Estimating the Motion of the Stars.

A remarkable paper has lately been sent to the Royal Society in England by Mr. Huggins, one of the Fellows. It announces the application of a new and most promising method of inquiry to the determination of the stars' motions. Mr. Huggins tested this method by the motions of the star Sirius. The spectrum of this star is crossed by a multitude of dark lines, and among others by one known to correspond to a bright line seen in the spectrum of burning hydrogen. The two spectra were brought side by side, and due care having been taken to magnify as much as possible any discrepancy which might exist, it was fonnd that the dark line in the spectrum of Sirius was not exactly opposite the bright line in the spectrum of hydrogen, but was slightly shifted towards the red end of the spectrum. It followed from the amount of the displacement that at the observation Sirius was receding from the earth at the rate of about forty miles per second. When due account is taken of the earth's orbital motion at the time of observation, it results that Sirius is receding from the sun at the rate of about twenty-eight miles per second, or upwards of nine hundred millions of miles per annum.

The new method of examining the stellar motions (says an English paper) is a most promising one. It will doubtless soon be extended to other stars. In fact, nothing but time and patience are required to enable astronomers to extend this method to all the visible stars, and even to many telescopic ones. For the latter purpose, however, an instrument of enormous light-gathering power will be required, and Mr. Browning, F. R. A. S., the optician, is engaged in constructing a spectroscope to be used with the great six-feet mirror of the Parsontown reflector.

### Rapid Telegraphic Communication.

The *Telegrapher* says: "It may be mentioned, by way of showing the important aid rendered to modern commerce by the wonderful operation of the magnetic telegraph, that a mercantile house in this city on Tuesday received a dispatch dated Calcutta, September 21, which had been less than twenty-four hours on its way, and which conveyed the fact that their ship was ready on that date to sail for Boston. We believe this is the quickest time yet employed in communicating between these two commercial cities—so wide apart and yet so near together."

We noticed in the *Tribune* of October 2d, the following announcement:

"An attempt was made, yesterday, to assassinate the Viceroy of Egypt while he was attending a celebration in Cairo."

So much has been said and written upon the wonders of telegraphic communication, that the subject has become a trite one; yet we confess our wonder at the developments of the art of telegraphy grows rather than diminishes. Think of it. Less than one day from Egypt! Only one day from Calcutta, and the end is not yet. No further apart than Albany and New York were twenty-five years ago. Newspapers have a good time. If no catastrophe occurs in America, somebody is sure to be struck by lightning in China or somewhere, it don't matter where; it all seems to belong to us, and we are beginning to feel an intense interest in the little family matters of our next door neighbors in Japan. No dearth of news now. Our eight page dailies come literally gorged with items from everywhere, borne silently and swift as light by the wonderful electric current. Old superstitions, effete systems, heathen darkness, get up and move; your date is out.

IT stated that a cement impermeable by air and steam, which is said to be superior to any in use for steam and for gas pipes, can be made as follows: Six parts of finely powdered graphite, three parts of slaked lime, and eight parts of sulphate, are mixed with seven parts of boiled oil. The mass must be well kneaded until the mixture is perfect.

**Improved Direct-Acting Steam Hammer.**

Simplicity being, next to efficiency, the most important point to be aimed at in the design of steam hammers, the form illustrated in the annexed engravings should commend itself to all who have occasion to use this class of tools. There being, with the exception of the regulating valve, but one moving part in this hammer, there seems to be nothing left to be attained on the score of simplicity. Fig. 1 is a perspective view of the hammer, and Figs. 2 and 3 vertical sections showing two positions of the hammer.

The ram being down, as in Fig. 2, steam is admitted to the annular channel, A, and from thence in the direction of the arrow, through the vertical passage, B, to the under side of the piston, C, the passage, D, communicating through the piston with the portion of the cylinder above the piston, being open to the exhaust as seen, whatever steam there may be above the piston escaping in the direction shown by the arrows through the passage, E, to the exhaust. The steam admitted at A, and passing up the passage, B, lifts the piston until the passage, D, connecting above the piston, opens to the steam inlet admitting steam over the piston. Notwithstanding this, the momentum of the ram continues the upward stroke until the passage, B, opens to the upper exhaust, when the parts are in the position seen in Fig. 3, to which we will now direct our attention, similar letters denoting the same parts.

The pressure of steam above the piston combines with the weight of the ram to carry it down with great force, until the passage, B, is uncovered to the steam inlet, A, and the passage, D, is open to the lower exhaust port, when the motion is reversed, the piston cushioning on the steam admitted through B.

The admission of steam and consequent speed of the hammer is regulated and governed by the foot of the forger, as plainly shown in Fig. 1. A hand gate also may be placed on the steam pipe if desired. Thus a slow and light blow, or a rapid and heavy one can be obtained at pleasure. For work requiring rapid and uniform blows, such as drawing small steel, making cutlery or edge tools, planishing saws, etc., this is a very efficient hammer. We witnessed its operation at the works of the American Tool Steel Company, corner Kent avenue and Keap street, Brooklyn, E. D., N. Y., with great satisfaction. This hammer is the invention of David Joy, of England, and has been patented in this country by Merrick & Sons, 430 Washington avenue, Philadelphia, Pa. For terms and prices address as above, or Geo. Birkbeck, Jr., the agent, at their office, 62 Broadway, New York city.

Fig. 1

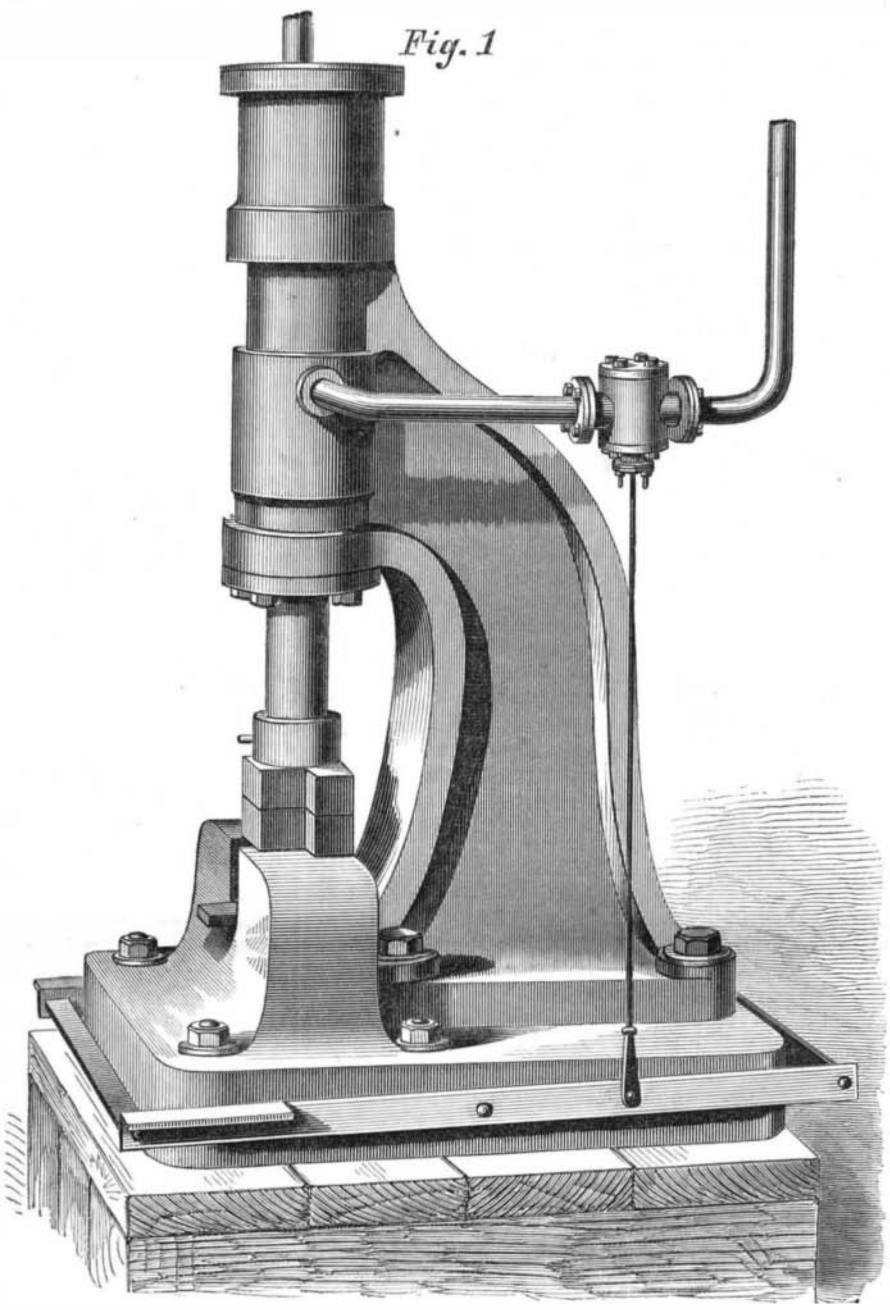


Fig. 3.

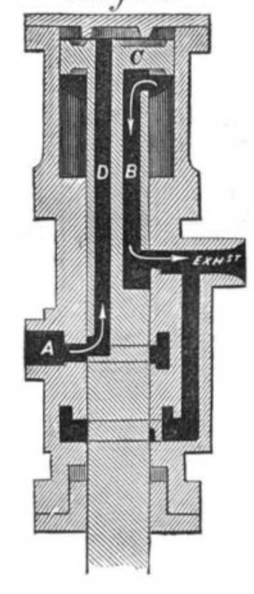
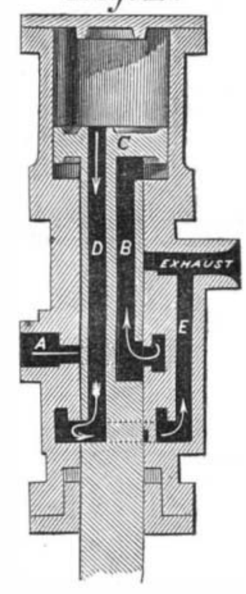



Fig. 2.




**THE JOY PATENT STEAM HAMMER.**

**CAN WATER BE SOLIDIFIED BY PRESSURE?**

In No. 19 of the current volume of the SCIENTIFIC AMERICAN, a correspondent asks the question, "Is there any depth in the ocean to which an iron weight or bar would not sink?" We answered no. An exchange has taken up this subject. It says "it is the popular theory, that lead, at great depths, remains suspended in the water and refuses to sink further. The theory stated is not correct. The fact may be as alleged, namely, that the lead refuses to sink, on reaching a certain depth below the surface of the ocean; but this is not because it is equally balanced by the water, nor is it in a state of equilibrium. We presume it will not be denied that a solid will float on the surface of a liquid, as iron on quicksilver, only when the the specific gravity of the latter exceeds that of the former; also, that a solid remains suspended, or equally balanced, in a liquid, only when the specific gravity of the latter is exactly equal to that of the former. Now a cubic inch of lead weighs more than eleven times as much as a cubic inch of water; hence, in order that the lead may become suspended in the water, the latter must be so compressed that eleven and forty-five hundredths cubic inches shall occupy the space usually occupied by one cubic inch. Such a degree of compression can scarcely be conceived of as possible. A pressure of some hundreds of tuns to the square inch is required to reduce the volumn of a column of water five per cent, or one-twentieth of its bulk; while the pressure on a square inch at a depth of nine miles (the estimated depth of the ocean, in its deepest part), would be less than eleven tuns. But we are told that the lead does refuse to sink at a depth of about three miles, where the pressure does not exceed three-and-a-half tuns to the square inch; and, consequently, the specific gravity of the water can not be sensibly greater than at the surface.

"We come now to the perplexing question: 'Why, then, does the lead refuse to sink at great depths?'

"Of course, we take for granted, that the fact stated by seamen, who alone have had opportunity to state the same, is real—that the lead does actually refuse to sink, when it has reached a certain depth, though it has not yet reached the bottom. We have just seen that this fact can not be accounted for, by supposing that the water, at that depth, has become, specifically, as heavy as lead; for this supposition is contrary to what we know of the effect of pressure on water. Nor do we know of any well-established principle, by which this result can be accounted for.

"It can do no harm to offer a conjecture, which may help in solving this difficult question, even if it be not the correct answer.

"We conjecture, then, that pressure has somewhat the same effect on water that it is known to have on some of the gases; namely, that it reduces it to a solid form. We know that a reduction of temperature has this effect; and that water, in the solid form of ice, is not even so heavy, specifically, as in the liquid form. Now, pressure may, possibly, reduce it to the form of a solid, without any perceptible increase of specific gravity, and three or four tuns to the square inch may be the amount of pressure required to accomplish this result. It is also possible, that the solidifying process may be more or less gradual, which would prevent any sudden jarring of the lead on reaching the solid stratum of water."

We should have been loth to concede that the belief in the theory, that a weight of greater specific gravity than water would fail to sink to any depth which can be found in the ocean, prevailed to any great extent but for this singular hypothesis. It is fair to suppose that the public is not wiser than its teachers, and we therefore suppose this belief is one of those popular errors which still remain uncorrected. With a view of correcting it we shall first analyze the theory itself, and show that it is neither sustained by fact or reason; second, show the absurdity of the hypothesis framed to account for it; and third, as a matter of general interest, make some remarks upon the difficulties in deep sea sounding which undoubtedly gave rise to the error.

The theory is not based upon fact. Lieutenant Berryman, of the steamer Arctic, in 1857, in sounding the depths of the Gulf Stream, reached bottom at 4,480 fathoms, more than five miles, and in one case 6,600 fathoms, a depth of seven and one-half miles, were reached without touching the bottom. Some deductions are to be allowed for possible errors in perpendicularity, but they must be small in proportion to the general result.

Admitting that these facts do not prove that at still greater depths a point might not be reached where a body heavier than its own bulk of water would cease to sink, the consideration of the nature of that fluid itself forbids the supposition. The most elaborate experiments have been instituted to determine the compressibility of liquids, and it is even yet doubted by some whether the amount of compressibility which has been apparently determined, is not due to defects in the method of experimenting. Be that as it may, it is probably true that no solid is so little compressible as water It follows, therefore, that even if water were capable of being condensed so as to become of the density of lead under ordinary conditions, that a solid immersed in it and receiving the same pressure would also be condensed, and its specific gravity increased proportionally. Thus a body, if it begins to sink at all in water, must continue to sink until it reaches the bottom, unless the hypothesis that water solidifies under pressure be correct.

We have no reason to believe that this hypothesis is correct. On the contrary we have many reasons to disbelieve it. All experiment teaches us that when any gaseous or liquid body is rendered solid, it does not instantaneously resume the gaseous or liquid form. It must absorb the amount of heat which it lost when it became solid, it being a law that bodies when they become denser impart heat, and when they become less dense absorb it. It takes time in all cases to accomplish this, and the larger the mass operated upon the longer time it will take. In former ages the bottoms of oceans have been upheaved. In every case where upheaval has occurred we find a fossil deposit which has been proved to be organic in its origin. How would this be possible if the water at the bottom were in a solid state? If that were so, large masses of this solidified water would have been upheaved, having all this deposit upon its upper surface, the gradual change to a liquid state would have generated rivers, whose force would have broken up and carried along the fossil deposit, and distributed and arranged it in forms strikingly different from that in which it is always found. Moreover, it is impossible if this solid state exists anywhere in the sea, and especially if it is solid at the depth of three miles, that such depths could have been reached as we have stated were reached by Lieutenant Berryman. In all the experiments to which water has been subjected, there has never been the least indication that it could be solidified by pressure, and it is most improbable that if it were possible such indications should have totally escaped notice. But as we have shown that there was no need for this supposition, as the supposed fact for which it was intended to account does not exist, we will pass to what was probably the origin of the error.

The difficulties in sounding great depths are very great. Formerly the twine used was so light that when a certain depth was reached its buoyancy was sufficient to float the lead. It became on this account necessary to improve its quality and density so that its specific gravity should not vary greatly from that of sea water, while at the same time it should have enough strength to sustain the weight used in making the cast. Twine was thus perfected until it was able to sustain a strain of sixty pounds without breaking, six hundred feet weighing only one pound. With this twine having a 32-pound shot attached, very much greater depths than had been previously possible were reached. Small wire has been used in lieu of twine, and we believe the line used by Lieutenant Berryman in the soundings above alluded to was partially composed of wire. The second difficulty was the determining the precise moment at which the weight reached the bottom. It was found that when the ball had reached the bottom the line would continue to run out, being acted upon by the force of deep sea currents. The shock could not be felt at great depths, and thus it was necessary to devise some method by which this important detail should be made determinate. If a line be made fast to one side of a river, carried across and allowed to trail in the water, it will run out rapidly from the side where it is not fastened. In sounding when the ball reaches the bottom, the same thing occurs. The ball becomes immovable while the under currents acting upon the line carry it rapidly out. So long as this difficulty remained nothing certain could be ascertained. And still another difficulty was discovered. The counter currents made bights in the line, so that the length of line run out was not a correct indication of the depth reached. These difficulties were overcome by the inventions of Brooke and of Massey. The former invented a self-detaching apparatus by which the weight