lantic, that on entering upon soundings in the English Channel, he has found an increase of temperature in the water of 2° Fahrenheit. Those who differ from our views in regard to these currents, ought, therefore, to propose some hypothesis which will account for the extraordinarily low temperature of the waters which lave the Atlantic coast of the United States. Were these waters derived as an eddy current from the Gulf Stream, it is probable that they would no longer serve for the myriads of codfish which now frequent our shores, and which appear to inhabit the coldest waters.

Many experiments upon the drift of currents have been made with bottles containing memoranda of the date and locality in which they were committed to the sea. These experiments are not without their value, although it is obvious that a circuitous course is liable to be construed into a direct one, and that violent winds may greatly affect the course of such objects upon the surface of the ocean, while an important diversion may also result from a superficial cross current, as we have already noticed in the case of the Gulf Stream. Perhaps the suspension of some suitable weight to these floating messengers, with a line from five to twenty fathoms in length, would afford results of a more satisfactory character; although the duration of such pendulous fixtures can hardly be relied on. If fitted in this manner, the fact should be noted upon the memorandum inclosed, which should specify also the length of line which may be attached.

A full knowledge of the general system of currents in every ocean is obviously of great value to the nautical profession, and is important, also in its relations to physical science. It is hoped, therefore, that these considerations will prove sufficient to stimulate our navigators to make and record the necessary observations, and to promulgate the same through the proper channels of information.

Art. XX.—*On the use of the Dynamic Multiplier,* with a new accompanying apparatus;* by C. G. Page, M. D.

The multiplier used in these investigations is composed of three hundred and twenty feet of copper ribbon, one inch wide, wound

* As the instrument in its generalized form as described in a previous No. of this Journal, has become a very useful piece of apparatus, it is proper it should have a name. As the phenomena exhibited by this instrument belong to the class called Electro-dynamic, by Ampere, I have selected the term Dynamic Multiplier.

into a flat spiral with a single strip of varnished cotton to insulate the coils. It has ten mercury cups soldered at various distances from the center. It must be premised, that in using large batteries with this coil, the maximum results by the induced current, are obtained by including only a portion of the coil in the direct circuit. With small pairs of plates the whole coil should be used.

A small pair of plates connected with this multiplier, deflects a delicate needle at ten feet distance.

Twelve pairs of plates arranged as an alternating series produce far more powerful results, than the same elements arranged as a calorimotor. The direct current is slightly augmented by passing through the coil. When the circuit is broken with a blunt pencil of zinc or lead, the spark appears of the size of a large pea, with a very loud snap. When both the connexions with the coil are broken simultaneously, two equally bright sparks are produced, while a third spark occurs in the induced circuit. Fifty pairs of plates give no brighter spark than twelve, and three hundred not so bright. Charcoal points, in the induced circuit, give a vivid spark, provided they do not quite touch. If directly in contact, the action of the coil is nearly lost as the current passes directly through the charcoal. This shows the reason why the induced current is stronger, when half or more of the coil is included in the direct circuit, than when the whole is used; in the latter case the lateral circuit is so short, that the battery is partly discharged through it.

It is not impossible that the arch of light may be produced in the induced circuit, if the rupture of the direct circuit could be made commensurate with the velocity of the current.

To effect decomposition, it is desirable that the circuit should be broken with great rapidity. To attain this I have tried a variety of means and succeeded in the contrivance of several beautiful pieces of apparatus.

Barlow's spur wheel answers very well where large batteries are used, but not for small. A stellated wheel, connected by a band with a multiplying wheel, answers exceedingly well; but as independence of action is a great beauty and convenience in experiments, it must give place to the following self regulating instruments.

Ritchie's revolving voltaic-magnet, which has recently come to us in connection with Daniell's and Mullen's constant batteries, makes a good interruptor. Fitted with a glass cell for the mercury, made by sections of tubes, it becomes a pleasing and useful apparatus. Placed upon the box containing the multiplier, it turns rapidly without the magnets, merely by the action of the coil. The pieces of wood separating the mercury floods, or poles of the battery, should be arranged in the direction of the radius of the coil, as that is the position of equilibrium for the magnet. The opposite poles of a magnet, conspiring with the action of the coil, make the revolution extremely rapid. The interruption occurs twice in each revolution, but it may be made more frequent if the number of partitions in the cells be increased, and the magnetic poles in like manner. This instrument is liable to one objection. The mercury is often dragged across the partitions and the revolution ceases. This may in part be obviated by pouring a little water upon its surface.

Fig. 1, is a representation of a vibrating interruptor of my own invention. A piece of soft iron wire one eighth of an inch in diameter, and three inches long, is covered with copper wire, and made to vibrate rapidly between the poles of a horse shoe magnet. It should be carefully suspended and well balanced. Its motion is increased if the poles just touch the wires, to give the bar a spring. The cups for mercury (*p* and *n*) are sections of glass tubes; *r* is a thumb screw for regulating the vibrations of the bar. If the four ends of the wires be carefully adjusted near the surface of the mercury, by bringing down the screw upon the bar, the vibrations may be rendered inconceivably rapid.

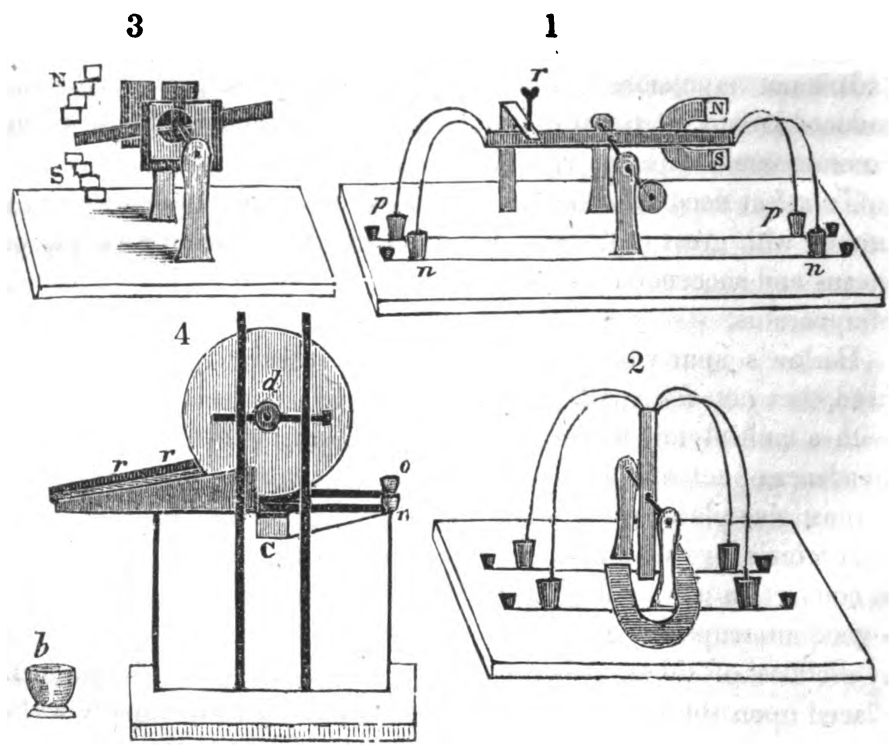

Fig. 2, is an oscillating interruptor differing from the last only in the mode of suspension.

There are two ways of arranging the wires, so as to produce motion by changing the direction of the current. A single wire may be used having two extra ends, which are to be carried to the other extremity of the bar and crossed before reaching the cups. In the oscillating interruptor the extra ends are soldered to the ends of the wire, at the same extremity of the bar, viz. the top. The other method is to cover the bar with two wires running in different directions.

Fig. 3, is a side view of a revolving interruptor, which is to be preferred to all other forms.

The bar may be of larger size and have a brass rim attached to it, to make its motions more regular; two bars at right angles may be used to increase its speed, but one will be found sufficient. The extremities of the wires are brought down upon the axis, and soldered to upper and lower pieces of copper, which are segments of circles, for dipping into the glass cells for mercury. Single wires will answer. There are three methods of changing the direction of the current. First, by using two coils of wire running in different directions; 2d, by using a single coil and having four mercury cells, two positive and two negative, and lastly, by having a single coil and two cells; the extra ends are attached, and crossed on the axis. I have tried all these methods, and prefer the last. A single horse shoe magnet held any where near the extremity of the bar, will keep it in rapid revolution. The most proper disposition of the magnets would be in a circle, having all the poles of one kind in the upper, and all of the opposite kind in the lower half. The revolution is so rapid as to scatter the mercury, if the cells are not sufficiently deep: they are made each of four strips of window glass, having sufficient space between them at the center to allow the axis to pass. The tops of the cells are then covered, and the spaces between the glass strips closed, except where the axis passes. (The mercury is rapidly oxidized, but the oxide may be saved (as it should be in all cases) and dissolved in nitric acid, for use in small batteries. The nitrate of mercury is far superior, as a motor of electricity, to acids or the cupreous salts. A single pair of plates, the size of a cent, each separated by a strip of gold beater's skin, immersed in the nitrate of mercury, give results by the dynamic multiplier, equivalent to a battery of four square feet of common construction. If the zinc plate be entirely protected by gold beater's skin, the whole of the mercury may be recovered by precipitation on the copper plate in its metallic form. Pairs of plates of copper and iron, copper and lead, lead and zinc, or iron and zinc may be used, but copper and zinc are preferable.) As a still further improvement in the revolving interruptor, I have attached a short shaft to its axis, which carries two wheels, one entire and one stellated. A small battery is used to move the interruptor, while the circuit of the battery used with the coil is broken by the star wheel of the attached shaft; the entire wheel turning in mercury preserves the connexion. The velocity of this interruptor is very great, and when viewed in the night by its own light, the whole apparatus appears to be at rest. When decompositions are performed with the multiplier and interruptors, the acidulated water is put in a glass tube, with platinum wires passing in at the ends and running parallel to each other for an inch or two, and about one fourth of an inch apart. A fine tube passes through one of the corks to allow the water to escape. Fine wires answer better than large.

On the thermo-electric spark and shock.—The six outer circles of the dynamic multiplier, connected with a single thermo-electric pair, give a bright spark, when the circuit is broken with a clean pencil of zinc or lead. The snap is very audible, and the shock distinct, by acupuncture.

Ignition of anthracite coal by the deflagrator.—Anthracite becomes a good conductor when heated, and becomes intensely ignited between the poles of the deflagrator, if the following method be adopted. Pencils of the coal being attached to the poles, the ends of a piece of copper wire bent in the form of the letter U are placed on either side just where the coal is in contact with the poles; the wires are then slowly approximated on the coal points, which soon glow with a brilliant white light, and afford a short arch.

On the use of the metals as substitutes for copper in batteries excited by the cupreous salts.—As the copper plate serves only for a conductor of the electricity put in motion, any metal having the same electrical relation to zinc as copper, must be an equivalent, provided its conducting power be as good; but where plates of metal of no great length are used, this difference must be inappreciable. The activity of such batteries is commensurate with the decomposition of the metallic salt; and as iron or lead precipitates metallic copper from its solutions, the decomposition in the batteries might be facilitated by the introduction of these metals. As the results of a number of experiments, I conclude, that iron when clean and freshly immersed in sulphate or nitrate of copper with zinc, is as good as copper. But its liability to oxidation is an objection to its use. Lead answers very well. I have batteries which were made of lead and zinc plates nearly two months since, and have used them often. Their power seems to improve by use. The lead plate becomes covered with metallic copper on the side towards the zinc. Lead plates excited by sulphate of copper, will answer for compound batteries. Mercury answers as well as copper. Bismuth and antimony, also make a good series with zinc. Brass is nearly equivalent to copper. Zinc with zinc makes a tolerable battery, provided one of the plates much exceeds the other in surface. The plate answering for a conductor, should be cut so as to leave narrow parallel strips. Other metals have not been tried. A very active arrangement is made by the nitrate of mercury and suphate of copper, separated in a cell by a strip of membrane; the connexion is made by two strips of copper immersed in each cell.

In copper or lead batteries, where the salts of copper are used, the zinc plate should be movable, in order to clear it from the copious deposit. To effect such an arrangement, and to give the battery at all times the benefit of fresh immersion, I have contrived a revolving plate battery.

Fig. 4, represents a side view of the revolving plate battery. The zinc plate is raised from the box lined with lead or copper holding the solution of the sulphate. The plate is of thick cast zinc, a foot in diameter: *d*, is a copper disc attached to the axis of the zinc plate, and when the plate is lowered, turns in a narrow mercury cell, C, fixed to the side of the box, and connected by a strip of metal with the mercury thimble, *n*: *r*, *r*, are two deeply grooved, inclined rubbers on each side, to strip and lead off into the bowl *b*, the deposit from the zinc plate. That side of the rubber which presses against the zinc plate, is covered with leather, and the pressure is regulated by springs. After the zinc wheel has been immersed a minute or two, it is turned over by its crank, which is on the side opposite the copper disc, *d*. This battery combines the following advantages, viz. the zinc plate and exciting liquid are kept clean, both surfaces are opposed to the copper or lead plate, the conducting plate exceeds the other in surface, the zinc plate will last a great length of time, if properly turned, as only half of it is immersed at once, and above all, if the zinc wheel turn accurately, it may come very near the conducting plate; whereas in batteries where the zinc plates are permanent, considerable distance must be preserved, on account of the filling up of the intervening space by deposit. A vast amount of electricity is lost, by this necessary defect in common batteries. The battery I have, has a lead cell, and can be depended upon at all times, for a regular and powerful current. Any number of parallel plates may be mounted upon the same axis, and be used as a simple or compound battery.

When the battery is not in use, the zinc wheel is raised and supported between the upright pillars, by two cross bars.

Salem, Mass. April 19th, 1837.

P. S. In my communication a few days since, I omitted to mention the form of constant or protected battery, of which I sent you a model. The truth is, it does not answer my expectations. When first used, it was active and serviceable from its economy, but time has proved it to be inferior to that of Mullen. As however I have tried a great variety of forms, with a view of determining the best, a few remarks may prove acceptable.

On the use of protected batteries.—That which is known as Mullen's, where the copper cylinder is surrounded with membrane, containing sulphate of copper, and the zinc plate outside, immersed in some alkaline salt, appears to be the most active form of protected batteries. But this battery is somewhat simplified, if the zinc plate be protected in the same manner as the copper plate, and the copper be made a tight cylinder, holding the sulphate. A considerable saving is made, if the surface of the zinc plate not opposed to the copper, be varnished or painted. The most active arrangement yet tried, is made by using the nitrate of mercury as a substitute for the salts of copper. The power of such a battery is so great, that the size may be very much diminished for common experiments. Cylinders of copper, two inches high, and an inch and a half in diameter, are sufficiently large. The arrangement is the same as in Mullen's battery, with a few exceptions; the outer surface of the zinc cylinder is varnished or painted, and likewise the inner surface of the copper cylinder; this last condition it is very necessary to observe. A little battery of this description has been immersed without being replenished seventy two hours, without any perceptible diminution of action. The solutions used, are nitrate of mercury in the copper cylinder, and nitrate of potash for the zinc. The great superiority of this battery over the sulphate of copper batteries, is due to the co-operation of an independent chemical or electrical action, viz. the decomposition of the metallic salt by the copper plate itself.

Salem, April 24th, 1837.