The transatlantic cable, if the machinery is multiplied, and sixteen machines are employed, could, we have little doubt, complete the cable in six or seven months.

The third difficulty is, "a ship big enough." This can be no difficulty, for if one would not do, surely twenty would. What is the objection to sending it by trips or in pieces? Could it not be attached, as it was laid down, to a buoy? A vessel of 1000 tons could surely carry 400 tons of coil, for our cable would not exceed 12,000 tons.

Another important matter to be determined is, to what extent a galvanic current can be sent on an insulated wire. This has also been determined, for in favourable states of the atmosphere, lines in this country have been so insulated as to work in one circuit from 800 to 1000 miles.

In my work on the Telegraph, p. 152, I there state that the greatest distance that any of the lines had worked in one circuit, was from Boston to Montreal, *via* New York, Buffalo, and Toronto, a distance of about 1500 miles. This was done when the earth was frozen, and the lines insulated by frost.

The entire length of the telegraph line from New York to New Orleans, *via* Charleston, Savannah, and Mobile, is 1966 miles, and even this distance has been worked as one circuit by the aid of an instrument termed a connector, the effect of which is to cause one circuit to work the other through the entire series, thus producing a result similar to working through the entire line in one circuit.

As late as December 3, 1853, despatches were written direct through from New Orleans to Philadelphia and New York, on the National Telegraph line, the weather being cold and the earth frozen. In doing so, the only connector or repeater used was an insulated screw on the back of the register, invented by a distinguished telegraphic engineer, W. C. McRea, of this city, which is now the simplest mode employed; but this distance would require at least 30 Grove's cups, of a pint each, for every 100 miles, making about 480 cups, or 240 each side. I think this number of the battery of Mr. C. T. Chester would be amply sufficient. If a copper and zinc battery were employed, the number would have to be increased to about 30 to 40 cups every 100 miles, but even with this large battery, the expenses would be less than with the Grove's battery. In preparing the batteries, it is even possible to determine mathematically beforehand the amount of resistance and the force necessary to overcome it; and thus to proportion the number and size of the plates to the distance to which the wires extend. Large wires are better conductors than small ones. Copper is a much better conductor than iron; and as a thinner wire answers the purpose of conduction, it may be much more easily insulated.

The several conditions may all be calculated from the beautiful formula of Ohm.

In some recent experiments of Professor Faraday, that distinguished philosopher, by some of the results he obtained, has thrown much light upon the action of voltaic electricity in the submerged wire of the electric telegraph.

He first determines by actual experiment, that when copper wire is perfectly covered with gutta percha, so high is the insulation that in 100 miles of such wire, when fully charged by an intensity battery of 350 pairs of plates and submerged in water, the deflexion of a delicate galvanometer was not more than 5 degrees. The great perfection in the covering of the wire may be judged of by this fact alone. The 100 miles of wire was 1-16th of an inch in diameter; the covered wire was 4-16ths; the gutta percha on the metal was 0·1 of an inch in thickness. There could not be a better proof than this, that gutta percha is one of the best insulating agents we have, which fact I have before stated in my work on the Telegraph. He experimented with the subterraneous wires which exist between London and Manchester, and when they were all connected together so as to make one series, they made almost the distance as determined by Lieutenants Berryman and Maury between the Irish coast and Newfoundland, being 1500 miles, and having introduced galvanometers at intervals of about 400 miles, he found that when the whole 1500 miles were included, it required *two seconds* for the electric stream to reach the last instrument, which was placed at the end. In this instance the insulation was not as perfect, still the result shows that it will require a little over two seconds to cross the Atlantic by telegraph, which is about the rate of 750 miles in a second, which result is far below those obtained by the London and Brussels telegraph, which is stated at only 2700 miles in a second, even with a copper wire, while it will be remembered that Wheatstone, in 1834, with copper wire, made the velocity of the electric current 288,000 miles per second—a considerable difference.

The whole of this difference, according to Professor Faraday, depends upon the lateral induction of the wire carrying the current. "The production of a polarized state of the particles of neighbouring matters by a excited body, constitutes *induction*, and this arises from its action upon the particles in immediate contact with it, which again act upon those contiguous to them, and thus the forces are transferred to a distance. If the induction remain undiminished, then perfect insulation is the consequence; and the higher the polarized condition which the particles can acquire or maintain, the higher is the intensity which may be given to the acting forces. In a word, insulators may be said to be bodies whose particles can retain the the polarized state; whilst conductors are those whose particles cannot be permanently polarized." And in regard to long circuits, such as those described, their conducting power cannot be understood, whilst no reference is made to their lateral static induction or to the conditions of intensity and quantity which then comes into play.

The conducting power of the air and water wires are alike for a constant current. This, according to Faraday, is in perfect accordance with the principles and with the definite character of the electric force, whether in the static, or current, or transition state. When a voltaic current of a certain intensity is sent into a long water wire, connected at the further extremity with the earth, part of the force is in the first instance occupied in raising a lateral induction round the wire, ultimately equal in intensity at the near end to the intensity of the battery stream, and decreasing gradually to the earth end.

In the report of Professor Faraday, which is given in the *London Philosophical Magazine* for March, he there, in conclusion, refers to the terms *intensity* and *quantity*. These terms, he remarks, or equivalents for them, cannot be dispensed with by those who study both the static and dynamic relations of electricity. Every current where there is resistance, has the static element and induction involved in it, whilst every case of insulation has more or less of the dynamic element and conduction; and we have seen that the same voltaic source, the same current in the same length of the same wire gives a different result, as the intensity is made to vary with variations of