merely as a mechanical achievement, took by surprise some of the most celebrated engineers of the day, who had not concealed their opinion, that the Atlantic Telegraph Company had undertaken an impossible problem. As a mechanical achievement it was completely successful; and the electric failure, after several hundred messages (comprising upwards of 4,359 words) had been transmitted between Valentia and Newfoundland, was owing to electric faults existing in the cable before it went to sea. Such faults cannot escape detection, in the course of the manufacture, under the improved electric testing since brought into practice, and the causes which led to the failure of the first Atlantic cable no longer exist as dangers in submarine telegraphic enterprise. But the possibility of damage being done to the insulation of the electric conductor before it leaves the ship (illustrated by the occurrences which led to the temporary loss of the 1865 cable), implies a danger which can only be thoroughly guarded against by being ready at any moment to back the ship and check the egress of the cable, and to hold on for some time, or to haul back some length according to the results of electric testing.

The forces concerned in these operations, and the mechanical arrangements by which they are applied and directed, constitute one chief part of the present address; the remainder is devoted to explanations as to the problem of lifting the west end of the 1,200 miles of cable laid last summer, from Valentia westwards, and now lying in perfect electric condition (in the very safest place in which a submarine cable can be kept), and ready to do its work, as soon as it is connected with Newfoundland, by the 600 miles required to complete the line.

## Forces concerned in the Submergence of a Cable.

In a paper published in the "Engineer" Journal in 1857, the speaker had given the differential equations of the catenary formed by a submarine cable between the ship and the bottom, during the submergence, under the influence of gravity and fluid friction and pressure; and he had pointed out that the curve becomes a straight line in the case of no tension at the bottom. As this is always the case in deep sea cable laying, he made no further reference to the general problem in the present address.

When a cable is laid at uniform speed, on a level bottom, quite straight, but without tension, it forms an inclined straight line, from the point where it enters the water, to the bottom, and each point of it clearly moves uniformly in a straight line towards the position on the bottom that it ultimately occupies.\* That is to say, each particle of the cable moves uniformly along the base of an isosceles triangle, of which the two equal sides are the inclined portion of the

\* Precisely the movement of a battalion in line changing front.