ciation Committee, constructed a number of standard "ohms," of different alloys, and marked upon them the temperatures at which they were correct, but, after the lapse of twenty years, it appears that the resistances of these standards have somewhat changed, and they are not all consistent with one another. In addition to this, it has been found that the original determination of the absolute unit is considerably in error, and the International Committee have recommended that that the standard ohm should be the resistance of a column of pure mercury, one square millimetre in section, and of a length to be determined in accordance with the electro-magnetic principles above referred to. This length will be between 104 and 105 centimetres.

Boxes containing sets of resistance coils are constructed, and by means of such resistance boxes, as they are called, any desired resistance can be introduced into a circuit. These coils are made to represent multiples (or fractions) of an ohm, and are generally arranged on the same principle as a set of weights. Thus, it is usual to construct resistance boxes capable of furnishing any multiple of an ohm, from 1 ohm to 10,000 ohms. Such boxes usually contain sixteen coils, which, expressed in ohms, are as follows:—1, 2, 2, 5, 10, 10, 20, 50, 100, 100, 200, 500, 1,000, 1,000, 2,000, 5,000. It will be seen that, from this set, any number of ohms, from 1 to 10,000, can be obtained. The coils are so connected that any coil can be introduced into the circuit by removing a brass plug.

If one end of the wire is connected to the positive terminal of a battery and maintained at potential V while the other end is connected to the negative terminal and also to the earth, and so kept at potential zero, the potential of the wire will diminish uniformly from one end of the wire to the other as the current flows along it; that is to say, there will be the same fall of potential between any two points on the wire, the resistance between which is the same. In order to raise the wire to this potential the surface of the wire must receive from the battery a statical charge corresponding at every point to the potential to which it is raised. In the case of a submarine cable we have a copper conductor surrounded by an insulator, and this again surrounded by iron sheathing, or by sea water. Such an arrangement possesses all the characteristics of a condenser, and possesses a very great capacity. Hence, a large quantity of electricity must be provided by the battery in order to charge the surface of the wire before a "steady current" can be maintained in the circuit. This behaviour of the cable, (ressembling that of a Leyden jar) limits the "speed of signalling," which can be obtained through long sub-marine cables. The charge taken up by the cable when employed in transmitting a current with its far end to earth is one half that which would enter the cable if the remote end were insulated and the whole cable raised to the same potential. V, as the end formerly connected with the battery. The reason of this is that when one end of the cable is "put to earth" the average potential to which the cable is raised is only $\frac{1}{2}$ V.

There are great many different method of measuring the resistance of the wire. For example, the wire may be introduced into a battery circuit along with a galvanometer, and the deflection of the galvanometer, which measures the strength of the current, noticed. The wire may then be removed, and replaced by resistance coils until the galvanometer shews the same deflection. The resistance of the coils will then be equal to that of the wire, provided that the battery has experienced no change.

But, both the electromotive force, and the resistance of a battery, are liable to undergo considerable change, when the current flowing through the battery is altered even for a short time. Hence it is desirable that a comparison of the wire and coils should be made by a current flowing through both at the same instant, and not by two observations made in succession. The best arrangement for this purpose, is known as "Wheatstone's Bridge." The method depends upon the fact, that the potential diminishes uniformly per unit resistance along a wire in which a current is flowing.

Suppose two canals to be cut from a mountain lake to the sea, and, for the sake of illustration, we may suppose one canal to be long and winding, and the other short and straight. Since the difference of level between the extremities is the same, it follows that the slope of the first canal will be gentle, and that of the other steep; for simplicity, suppose that the slope of each is the same throughout its whole length. Now, let a cross canal be cut, so as to join one point on one canal, and one point on the other. There will be a flow of water in this canal, unless it is horizontal, in which case the water in the cross canal will remain stationary. The condition that the cross canal may be horizontal is that the points selected on the two canals may be distant from the top of each canal, by the same fraction of the length of the canal, since the level falls uniformly along each canal. Thus, if the point selected on the long canal is one third the way down, the point on the short canal must be also one third the way down. The existence or non-existence of a current in the cross canal will determine whether this condition is fulfilled or not.

Now suppose two conductors, *a* and *b*, to be joined end to end, so as to form one conductor, and let the extremities of this conductor be connected with the terminals of a battery. Suppose two other conductors, *c* and *d*, to be similarly connected together and to the battery, so that the battery current divides itself between the two compound conductors $a \div b$ and $c \div d$. Now let the terminals of the galvanometer be connected with points of junction of *a* with *b* and of *c* with *d*. Then no current will flow in this conductor, when, and only when, these points of junction are at the same potential. But the potential falls uniformly per unit of resistance along each conductor, from the positive pole to the negative pole of the battery. Hence, the condition that the points should be at the same potential, is analagous to the condition that the ends of the cross canal may be at the same level, and it may be expressed, thus:—

Resistance of *a* : Resistance of *b* : : Resistance of *c* : Resistance of *d*. Hence, denoting these resistances by P, Q, R, and S respectively, if there is no current in the galvanometer, we know that

$$P : Q :: R : S.$$

if *a*, *b*, and *c* consist of coils of known resistance, the resistance of *c* being changed until there is no current in the galvanometer, then P, Q, and R are known, and the unknown resistance, S, of the conductor *d* can be found from the above proportion. *(To be Continued.)*