terminals of an electric generator, possessing difference of potential as before. C is the connecting wire, *a* is the key or switch, and R the resistance. The E.M.F., due to the difference of

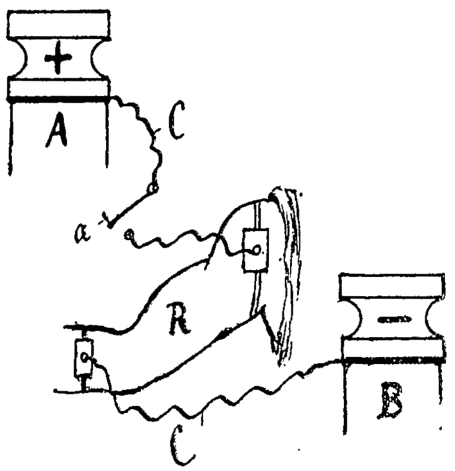

FIG. 17.

potential between A and B, remains as in the first case (Fig. 16), but owing to the resistance offered by the arm to the flow of current, only a small current-strength can pass from A to B. The presence of resistance R does not alter the E.M.F., but it does alter the current-strength.

Pressure in a water-pipe is the factor which overcomes obstruction and causes flow. In like manner electro-motive force in an electric circuit is the factor which overcomes resistance in that circuit, and similarly makes the current flow. The quantity flowing depends upon the amount of resistance in the circuit. Electro-motive force is generally written for shortness E.M.F., and we shall so write it during the remainder of these lessons. Current-strength is sometimes called current intensity, and is written for shortness sometimes C, sometimes I. We prefer the former, but as that is hardly explicit enough shall adopt the symbols C-S. Resistance is represented by the capital letter R.

E.M.F., C-S, and R. can all be measured, and their units of measurement are as follows :—

E.M.F. is measured in Volts.
C-S „ „ „ Ampères.
R „ „ „ Ohms.

The ampère is too large a unit for medical purposes, so its thousandth part has (on the suggestion of Dr. de Watteville) been adopted. This medical unit of C-S is called the milliampère, written shortly *m.a.*; but we must not forget that this is only the thousandth part of the proper unit (the ampère), which has to be used in all calculations.

OHM'S LAW.

The relation between E.M.F., C-S, and R is known as Ohm's law, and is expressed by the equation :—Current-strength in ampères equals electro-motive force in volts, divided by the total resistance in the circuit in ohms, or shortly—

$C = \frac{E}{R}$ where C stands for C-S in ampères, E for E.M.F. in volts, and R for R in ohms.

By means of this law, when the values of any two of the symbols are known, it is easy to find that of the third, for the equation is true in whatever way it may be written. If we know the values of E and R, but want to find C, we use the equation written above. If we know the values of E and C, but want to find R, we use the equation written as $R = \frac{E}{C}$ If we know the values of C and R, but want to find E, we use the equation written as $E = C \times R$. It will be advisable to illustrate the use of Ohm's law by a few numerical examples :—

(1) How much C-S will be passed through a patient whose R is one thousand five hundred ohms, if a battery having an E.M.F. of thirty volts be used?

Ans.: C-S $= \frac{E}{R}$ *i.e.*, C-S $= \frac{30}{1500} = 0{\cdot}020$, or 20 milliampères.

(2) What is the R of a patient through whom a C-S of eighteen milliampères is passed by a battery having an E.M.F. of twenty-five volts?

Ans.: $R = \frac{E}{Cs}$ *i.e.*, $R = \frac{25}{0018} = 1389$ ohms: therefore R of patient is 1389 ohms.

(3) If a C-S of fifteen milliampères has to be administered to a patient whose R is one thousand two hundred ohms, what amount of E.M.F. must the battery used possess?

Ans.: E = C-S × R, *i.e.*, $E = 0{\cdot}015 \times 1200 = 18$ volts: therefore E.M.F. of battery must be eighteen volts.

(4) If the cells of the battery used in the last example have each an E.M.F. of 1·28 volt, how many such cells must be employed?

Ans.: To find this we have only to divide the total E.M.F. required by the E.M.F. of each cell, *i.e.*, $\frac{18}{1{\cdot}28} = 14$ cells.

(To be continued.)

AN Irish editor says he sees no reason why women should not be allowed to become medical men.