000 ergs. Now, one horse-power is equivalent to 550 foot-ponnds, or, about 7,458,000,000 ergs per second. Hence, if an electromotive force of one Volt be employed to send a current of one Ampère round a circuit, work will be done at the rate of $\frac{1}{745 \cdot 8}$, or nearly $\frac{1}{746}$ horse-power.

If an electromotive force, E, be employed to send a current C. the horse-power exerted will be $\frac{1}{746}$ EC.

Similarly, if a current of C Ampères is made to pass through a conductor, whose resistance is R ohms, the horse-power required to sustain it will be $\frac{1}{746}$ C_2R.

For example, if a 20-candle lamp requires an electromotive force of 110 Volts between its terminals, and allows a current of ·6 Ampère to pass, the horse-power actually required to light the lamp will be

$$\frac{110 \times \cdot 6}{746} = \cdot 0885, \text{ nearly.}$$

Again, suppose the current for 20,000 lamps, each requiring ·6 Ampère, is transmitted along a cable having a resistance of ·1 ohm, the horse-power wasted in sending the current through the cable will be

$$\frac{12000_2 \times \cdot 1}{746} = 19303, \text{ nearly.}$$

Hence conductors of very much less resistance must be employed in conveying the current for so large a number of lamps, and hence the lamps should be very near to the dynamos, or else conductors of very great sectional area must be employed.

When a current is made to flow through certain chemical compounds, such as dilute acids, saline solutions, &c., these compounds are decomposed into their elements, or into more simple substances. The operation is called *electrolysis*, the compound which is decomposed is the *electrolyte*, and the substances formed by the decomposition are *ions*. The conductor by which the current enters the electrolyte is called the *anode*, that by which it leaves it is the *cathode*. The *ion*, which appears at the anode, is sometimes called the *anion*, and that which appears at the *kathion*. This nomenclature was established by Faraday.

When the electrolyte is a simple binary compound, as, for example, silver chloride, the passage of a current separates it into its elementary constituents. It was by the electrolysis of the caustic alkalies that Sir Humphrey Davy prepared the metals of the alkalies (potassium and sodium). When the electrolyte is of more complex constitution, the passage of the current is frequently accompanied by uhe separation of the electrolyte into two compounds.

When the electrolyte consists of more than one compound it often happens that the ions into which one of the compounds (the true electrolyte) is separated, react upon and decompose the other, so that it seems as if two-sets of ions had been produced by the same current. This is called secondary action, and it frequently accompanies the electrolysis of a metallic salt in aqueous solution. For example, suppose we are electrolysing a solution of sodic sulphate, $Na_2 SO_4$. We may suppose that the true electrolysis consists in the separation of this compound into metallic sodium, which appears at the negative pole, or kathode, and sulphiod (SO_4), which appears at the positive pole, or anode. Now, the metallic sodium will decompose the water forming caustic soda and liberating hydrogen, thus,

$$Na_2 + 2H_2O = 2HaHO + H_2.$$

while the sulphion will also combine with water forming sulphuric acid and liberating oxygen, thus,

$$SO_4 + H_2O = H_2SO_4 + O.$$

Hence as the result of the passage of the current, we find caustic soda and hydrogen liberated at the kathode, and sulphuric acid and oxygen at the anode, but the current is not to be held responsible for both these actions. The true electrolysis is the separation of the sodic sulphate into sodium ann sulphion, and the decomposition of the water is a secondary and purely chemical action.

The great law of electrolysis, that of electro-chemical equivalents, was discovered by Faraday. This law may be briefly stated thus :—

If the same current be made to pass though several different electrolytes the amount of chemical action produced in each will be the same, and if the current be made to vary the amount of chemical action per second will be proportional to the current.

In more definite language, the law may be expressed as follows :—

If the same current be made to pass through several different electrolytes, the quantity of each ion produced will be proportional to its *combining weight* divided by its *valency*, and if the current vary the quantity of each ion liberated per second will be proportional to the current.

Thus, if the electrolyte consist of fused potassic chloride, fused silver chloride. copper sulphate, and dilute sulphuric acid, the electrodes in each case being platinum plates, for each gramme of hydrogen liberated in the sulphurie acid cell there will be 8 grammes of oxygen liberated from the sulphuric acid, 39 grammes of potassium and 35.5 of chlorine from the potassic chloride, 108 grammes of silver and 35.5 of chlorine from the silver chloride, and $\frac{1}{2}$·83·5 or 31·75 grammes of copper and 49 of sulphuric acid from the copper sulphate. while 8 grammes of oxygen will escape from the copper sulphate solution, as the result of secondary action.

An *apparent* exception to Faraday's law occurs when secondary actions takes place, when it seems as if the same current decomposed two electrolytes and did double duty in the same cell, but this has already been explained.

The amount of hydrogen liberated in one second by a current of one ampére is about ·000105 grammes, which may be taken as the electro-chemical equivalent of hydrogen. From this the amount of any other ion liberated by any given current in any time can be determined by Faraday's law.

All electrolytes must be in the liquid condition. Metallic salts must either be fused or in solution.

If a battery is employed to decompose dilute sulphuric acid with the evolution of oxygen and hydrogen, or to separate any other compound into its constituents, a definite amount of work must be done in decomposing the compound for every unit of electricity which passes through the electrolyte ; for the passage of each unit of electricity corresponds to the decomposition of a definite quantity (one electro-chemical equivalent) of the compound.