CHAPTER VIII.

RATES OF REACTIONS.

A few simple experiments with zinc and sulphuric acid shew how the rate of evolution of hydrogen gas depends on the area of the zinc, the concentration of the acid, and the temperature. If a drop of copper sulphate solution be added the zinc turns black from deposition of copper and the rate is increased; if a little mercuric chloride solution be added it turns silvery and the rate is diminished.

In the hydrogen generator the heat liberated as the reaction proceeds raises the temperature and tends to increase the rate, while the fall in concentration of the acid, and the diminution of the area of the zinc tend to decrease it; the net result being that the rate at first increases, reaches a maximum, and then falls off to zero.

This reaction may be regarded, in a sense, as typical; for the area of the surface of solids, the concentrations of solutions, the temperature, and the presence of "catalysers" (see page 42) are the factors on which the rates of reactions in general depend. Light has an effect in certain cases, and so have electrical conditions when the reaction is accomplished by electrolysis.

Most of the reactions used in analysis are extremely rapid—indeed they are selected partly for that very reason—but even in the text-books of analysis a few cases can be found where "the mixture must be let stand for a few hours" to complete the reaction. Examples are: the precipitation of phosphates by magnesia mixture or molybdic acid, and the determination of potassium by platinum chloride.

One of the analytical reactions may be selected for a somewhat closer study.

Potassium permanganate and Oxalic acid. Three solutions are necessary:—*Pm* potassium permanganate 3.2 g, water to make 1 litre; *Ox* crystallized oxalic acid 3.2 g, water to 500cc; *Ac* sulphuric acid 100cc, water 900cc, this must be cooled to room temperature before using. Equal volumes of these solutions contain the permanganate and oxalic acid in the proportions required by the equation

$$2KMnO_4 + 5C_2H_2O_4 + 3H_2SO_4 = K_2SO_4 + 2MnSO_4 + 8H_2O + 10CO_2$$

but sixty times as much as sulphuric acid.

Comparison of the time required to decolourize the following solutions (mix in the order given, and count the time from adding the *Pm*)

(*i*) Water 5cc, Ox 50cc, Ac 100cc, Pm 5cc, (total volume 160cc)

(*ii*) Water 80cc, Ox 50cc, Ac 25cc, Pm 5cc, (total volume 160cc)