(1) When the zone is gaseous an are is formed, extreme temperature being attained, and this are is the agent by which the electric energy is converted into heat, obtaining the temperatures which are necessary to dissociate combinations of elements as found in nature, and obtain pure metals thereby, or to cause new combinations of elements reacting in new and useful compounds, and in other cases to cause the union of elements which may be associated but not combined tas in the case of nitrogen and oxygen in the air). It should be noted that the are transformation and application of the electric energy is mainly thermal in its action.

(2) When this zone of reduction contains substances liquitying and boiling at a high temperature, direct current being used, electrolysis usually results, and the liquid condition of the mass assists the electrolytic separation, the metal being deposited on the cathode or oegative pole of the furnace or cell used. Here the high temperature of the are is not required.

(3) When material such as carbon, graphite, carbonaceous mixtures, as well as metals having a high melting point form the zone of reduction, the incandescent or resistant effect is wholly or partly produced. The point of most importance in the incandescent application, although practically the same as the arc in its action in producing a thermal effect also, is that the heat can be regulated much more easily, making it possible to get some results that would not be obtained in the arc, especially in a commercial way. Therefore, in view of these observations, it is advisable to take up the description of electro-metallurgical processes (by which some 20 or more metals and compounds are produced) under the divisions as indicated by those of the electric furnace, and a more detailed description of some of these processes under each head will be dealt with later. It is, however, not intended that these divisions should be adhered to too rigidly, for in almost every application of the electric current to smelting and reduction processes, the effective phenomena are usually not confined to those exhibited in any one of the three types just outlined, but phenomena peculiar to two or even all three types may be invoked.

Now that we may start with a thorough knowledge of the practical operation of one of the simplest of these processes, as far as mechanical apparatus is concerned, a description in detail