many, and Hirn[1] in France, studied the most important of all machines then in use, the steam-engine, in the light of the new discoveries. It became possible to define clearly what was meant by the efficiency of an engine, and to distinguish between those losses of the energy of heat or temperature which were dependent on the use of steam as the working substance, and therefore inherent and unavoidable, and those losses which depended upon the mechanism and upon the carrying out of the process employed. The older teachings contained in treatises written before a knowledge, or even an idea, of the

largely based upon the scientific training afforded in the excellent chemical laboratories and polytechnic schools of Germany, it assisted in giving to German industrial enterprise that scientific character which was at first ridiculed and has latterly been extolled in unbounded measure, and which—combined with the organising ability inherited from English ancestry—seems to be one of the distinctive features of the great industrial progress of America. First among writers on the Continent Zeuner gave such a connected exposition of the principles developed by Clausius, Thomson, and Rankine as met the requirements of practical engineers; attached to them applications referring to the steam-engine; criticised the views adopted by Watt and later writers, notably de Pambour, with reference to the behaviour of saturated vapour in the steam-cylinder during expansion and compression; and largely prepared the way for the great improvements in steam, air, and refrigerating engines which have been brought out on the Continent by those trained in his school. Through Clausius, Zeuner, and others, Dingler's 'Polytechnic Journal' became the organ by which the many discussions on the new mechanical theory, and notably the second law of thermo-dynamics, gradually forced themselves upon the attention of practical men.

[1] Equally important were the labours of Adolph Hirn (1815-90). He was a self-made man who had grown up in the midst of the important textile industry of Alsace. With a naturally inquiring disposition he combined the scientific and artistic accomplishments for the manifestation of which the chemical and mechanical products of that country have long been renowned. He approached some of the great theoretical problems connected with practical engineering, such as those of heat, steam, lubrication, and superheating, by a long series of carefully planned experiments. A very interesting account by several authors is given in a publication by Faudel and Schwoerer ('G. A. Hirn, sa Vie, sa Famille, ses Travaux,' Paris, 1893). Hirn, like Rankine, was not only an engineer, but also an artist and a philosopher.