structed ; the one commonly called high-pressure steam engines, and the other low-pressure steam-engines.

In a high-pressure steam-engine, the principal source of motion is the *elastic force* of steam, formed by water, raised to a high temperature in confined vessels, and tending to escape from them with such force, as to im part motion and movement to solids or fluids, ingeniously arranged to receive from it velocity or direction required for the accomplishment of some end.

In a low-pressure steam-engine, the principal source of power is derived from using steam merely for the purpose of forming a vacuum. For this purpose steam is admirably calculated. It is only necessary to allow the steam of a liquid to enter any vessel filled with air ; and if there be left an aperture of escape, the steam, entering in abun dance, will push the air out before it. When the air has wholly escaped, it only remains necessary to close all the openings of the vessel, and allow it gradually to cool down, when the steam will be condensed, will shrivel up in the form of water into the 1728th part of its bulk, leaving the other 1727 parts vacuous. The mechanical force of a vacuum on the earth’s surface is well known : it will raise water to a height of more than 30 feet, and support 1.5 lbs. on every square inch of surface exposed to it. What ever, therefore, the formation of a vacuum on the earth’s surface can effect, of that is the force of steam capable at low pressure, scarcely exceeding the temperature of 212°. Hence the low-pressure engine is sometimes called the condensing engine, because it acts principally by condensation of steam to form a vacuum. The high pressure of

steam, and its vacuumforming power, are frequently used in combination.

22. There are other properties of steam, besides its mechanical force, that render its use of great practical value. Its great capacity for heat enables it to take up, at one time, and in one place, a large quantity of heat, which it may be employed as a vehicle to transfer, at a subsequent period and at a distant point, to some other substance. It is thus rendered an economizer and distri­buter, a reservoir of heat derived from the combustion of fuel. In this view it has great value as an agent in distributing the heat used for warming buildings, heating baths, evaporating solutions, distilling, brewing, drying, dyeing, and even for domestic cookery, and the means of extracting wholesome and nutritious food from most un promising and unpalateable materials.

In order, however, to its successful application as a mechanical power, and its profitable use in each of the various functions which it is capable of performing, it is necessary to study its various phenomena in greater de tail ; to obtain an intimate acquaintance with its proper ties ; to determine its laws in the various relations of space, time, and quantity ; how much heat it requires, what fuel it consumes, what force it exerts, how fast it will move, how it will condense, expand, and contract, and what relation it bears to the different fluids from which it may be derived. Each of these enquiries, and the manner in which each of these objects may be most satisfac­torily attained, is the subject of one or other of the following sections of this article.

SECT. II.—EXPERIMENTAL RESEARCHES CONCERNING THE ELASTIC FORCE OP STEAM AT DIFFERENT TEMPERATURES.

23. The earliest researches we have met with into the phenomena of steam, under taken with the philosophical purpose of obtaining experimental data for the scientific investigation of its properties and relations, are to be met with in a scarce work, printed at Basle in 1769, and entitled,

*“ Specimen physico-chernicurn de Digestore Papini; pri­mitias experimentorum no­vorum circa fuidοrum a calo­re rarefactionem et vapoream elasticitatem exhibens, &·c.*

*Auctore Jo. Henrico Zieg­ler.”* His experimental boiler consisted of a copper vessel (fig. 7) AA, silvered internally, and belted externally with massive iron hoops BB. A strong framework of iron, attached to the upper hoop, gives support to the circular cover B, (fig. 8,) in which there are an opening P for admitting water, an other D into which an elaterometer is inserted, consisting of a bottle G, containing mercury, and a glass tube c c cased in iron, open at both ends, and immersed in the mercury at the bottom ; the third or central aperture E being occupied by a copper tube F, closed below, and containing oil or other viscid liquid, to act as a bath for the bulb of the thermometer F and its protector from the pressure of the vapour. The method of using this apparatus was as follows. The digester being partly filled with water, closed and placed on the fire, the generation of the steam would raise the oil or mercury in the bath