water-pipes, in such a manner that when the one is being filled the other is being emptied, and when the latter is again being charged with water from below, the other is discharging its contents in the receiver above.

In this double form a model of the engine was exhibited to the Royal Society in June 1699, and approved of. The following figure and description are those given in the *Philosophical Transactions,* vol. xxi :—

*“ A* the furnace, B the boiler, **CC** two cocks which convey the steam alternately to the vessels DD, which receive the water from the bottom in order to discharge it again at the top. EE EE, valves opening only upwards; FF cocks which keep up the water while the valves on occa sion are cleansed ; G the force-pipe, II the sucking-pipe, I the water.” The action of this double engine is mani fest. One of the vessels (D) is first filled with water from below, by the effect of the vacuum formed in it, and is then discharged into the reservoir above. The steam is then shut off, and the vacuum again begins to form, and this first receiver to refill with water ; in the mean time the steam would be unemployed, and therefore it is now admitted into the second receiver D 2, where it forms a vacuum, or if the receiver be filled with water, forces it up to the top, and having emptied it, is again shut off and forms a vacuum to refill this second receiver with water. But in the mean time, this second receiver being now vacuous, and in the process of being refilled with water from below, the steam being unemployed upon it may be admitted to the first receiver D, which has in the interval been charged with water from below, and the steam acting upon it will continue the stream into the reservoir at the top, until the other receiver, D 2, being again filled, is again ready to be discharged in the same direction, and so on as long as the cocks are turned.

But this working model of the Royal Society was by no means a perfect machine for performing work on a large scale. We have, therefore, extracted the following description of the machine of Savary, in the form which he gave it when introduced for the purpose of draining

mines. The description and figure are taken from an old work in the Advocates’ Library, entitled, “ The Miner's Friend ; or, a Description of an Engine for Raising Water by Fire, with an Answer to the Objections against it. By Thomas Savary, Gent.” London, 1702.

Fig. 16 represents the engine of Savory as applied to the purpose of drawing water from the bottom of deep mines. The furnaces, boilers, and receivers are placed under ground, on a platform raised sixteen or twenty feet above the level of the water at the bottom of the mine. From this platform the chimney ascends to the surface along the shaft of the mine, and a pipe through which water is forced to the surface accompanies it.

*A Description of the Engine.*

A the furnaces ; B1 B2 the two fireplaces ; **C** the funnel or chimney ; D the small boiler ; E the pipe and cock of it ; F the screw that covers and confines the force ; G a small cock going to a pipe within eight inches of its bottom ; H a large pipe going the same depth ; I a clack on the top of the said pipe opening upwards ; K a pipe going from the box of the said clack or va!ve into the great boiler about an inch into it; *L* the great boiler ; M the screw with the regulator; N a small cock and pipe going half way down the great boiler ; O1 O2 steam pipes, one end of each is screwed to the regulator, and the other end to the receivers ; P P2 the vessels called receivers ; Q the screws which bring on the pipes and clacks into the front of the engine; RRRR Nos. 1. 2. 3. 4. valves or clacks of brass, with screws to open and come at them upon occasion ; S the force-pipe ; T the sucking-pipe, having a square frame of wood, with holes round its bottom in the water ; X a cistern, with a buoy-cock coming from the bottom of the said cistern ; Z the handle of the regulator.

“ The manner of working this engine is first : there is a good double furnace so contrived that the flame of the fire may circulate round and encompass the two boilers to the best advantage, as you do coppers for brewing. Before you make any fire, unscrew G and N, being the two small gauge-pipes and cocks belonging to the two boiIers, and at the holes fill L, the great boiler, two thirds full of water, and D, the small boiler, quite full;