and occasioning motion to all sorts of mill-work by the impelling force of fire." The apparatus employed is shown in the illustration on page 43, and the following is the description which Savery furnished in a work entitled the "Miner's Friend":—"*A a* are the furnaces which contains the boilers; *b* 1, *b* 2, the two fire-places; *c*, the funnel or chimney, which is common to both furnaces. In these two furnaces are placed two vessels of copper, which I call boilers; the one large, as *l*, the other small, as *d*. *d*, the small boiler contained in the furnace which is heated by the fire at *b* 2; *e*, the pipe and cock to admit cold water into the small boiler to fill it; *f*, the screw that covers and confines the cock *e* to the top of the small boiler; *g*, a small gauge-cock at the top of a pipe going within eight inches of the bottom of the small boiler; *h*, a larger pipe, which goes the same depth into the small boiler; *i*, a clack or valve at the top of the pipe *h* (opening upwards); *k*, a pipe going from the box above the said clack or valve in the great boiler, and passing about an inch into it. *l l*, the great boiler contained in the other furnace, which is heated by the fire at *b* 1; *m*, the screw with the regulator which is moved by the handle *z*, and opens or shuts the apertures at which the steam passes out of the great boiler into the steam-pipes *o o*; *n*, a small guage-cock at the top of a pipe which goes half way down into the great boiler; *o o*, steam-pipes, one end of each screwed to the regulator, the other ends to the receivers *p* 1, *p* 2, to convey the steam from the great boiler into these receivers; *p* 1, *p* 2, copper vessels called receivers, which are to receive the water which is to be raised; *q*, screw joints by which the branches of the water-pipes are connected with the lower parts of the receivers; *r* 1, *r* 2, *r* 3, *r* 4, valves or clacks of brass in the water-pipes, two above the branches *o*, and two below them; they allow the water to pass upwards through the pipes, but prevent its descent; there are screw-plugs to take out on occasion, to get at the valves *r*; *s*, the forcing pipe, which conveys the water upwards to its place of delivery, when it is forced out from the receivers by the impellent steam; *t*, the sucking pipe, which conveys the water up

from the bottom of the pit, to fill the receivers by suction; a square frame of wood, or a box with holes round its bottom in the water, encloses the lower end of the sucking pipe, to keep away dirt and obstructions; *x*, a cistern with a buoy-cock coming from the force-pipe, so as it shall always be kept filled with cold water; *y*, a cock and pipe coming from the bottom of the said cistern, with a spout to let the cold water run down on the outside of either of the receivers, *p* 1, *p* 2; *z*, the handle of the regulator, to move it by, either open or shut, so as to let the steam out of the great boiler into either of the receivers."

The next person who interested himself in steam motive power was Thomas Newcomen. He invented an engine which differed from Savery's in the following particulars:—In Savery's engine water was raised partly by force of steam, and partly by the pressure of the atmosphere; in Newcomen's engine water was raised entirely by the pressure of the atmosphere, steam being only employed alternately, to create a vacuum. Newcomen's was, in fact, a pneumatic engine.

At the time therefore, at which Watt directed his attention to the subject, but little was really understood of steam power. There were several engines employed for draining mines, and other purposes of the same stationary nature, but they were totally unlike the modern steam engine. The idea which Hero of Alexandria had thrown out was still to be elaborated; others had diverted it, and made engines useful in their way no doubt, but very different from those which Watt was born to invent. Lounging on his workship roof, he is thinking of these things, shading his eyes with his hands, for the sun is troublesomely bright. But there is work for him to do to-day and work that must be done, so by-and-by he descends from his elevation and begins to look at the article which requires his attention. The professor of Natural Philosophy has been there and wants a model of Newcomen's engine repaired; the professor is going to lecture to the students, and there is no time to lose.

It is just one hundred years ago since Watt stood by his work-bench and examined the model. He went about

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