a hook, is carried round the wheel *t*, and fastened by its hook to the piston rod PQ, and the other end of the rope has other ropes attached to it, to be grasped by the men, as in the figure.

"Now, if the stopcock X be closed, the piston being nearly at the bottom, the joint efforts of fifty or more men will not be able to raise it more than about half way up the cylinder.

“ If, now, in the *fifth* place, the large glass receiver, formerly mentioned, which has been previously made perfectly vacuous, (by an air-pump,) be applied to the stopcock X, and then when the men are exerting their utmost force, the stopcocks at X of the vacuous receiver and the cylinder be opened, so as to make a free communication from the one into the other; the piston PQR. will be suddenly forced down to the bottom of the cylinders in spite of the greatest efforts of the men to keep it up.

“ The whole cause of this matter is to be attributed to the gravity of the air, which, when the vacuum is formed below, instantly presses down the piston into it with a force which, according to our former calculation, amounts in that size of cylinder to 2686 pounds' weight.”

The next of the Magdeburg experiments still more closely resembles the atmospheric steam-engine in its mode of application, and still further illustrates it.

“ By the above-mentioned invention, a child of twelve or fifteen years old can raise an enormous weight. Every

thing being left as formerly, only the piston being nearly at the top of the cylinder *a*, you are to pass the rope round a second pulley, hung from a staple ; and by a hook to suspend from the rope the scale of a large ba­lance, which you are to load with a weight of 2686 pounds. If a small syringe be applied by a little boy to the stopcock X to pump out the air. it will follow that, as the air is pumped out from below the piston, the atmosphere above will press it down and raise the weight.”

The transition from this to the engine of Newcomen is immediate. To the last-described apparatus of Guericke let there be added a small copper globe or boiler, Z, Fig. 22, to be placed over a fire till the water which it contains boils into steam. This steam, entering below the piston, will occupy the whole space of the cylinder ; but if now the stop cock X be suddenly closed, and especially if cold water be sprinkled on the outside of it to cool it, the steam will be condensed back

into its original bulk of water, and leave the space it formerly occupied in the cylinder a vacuum, into which the atmosphere will press down the piston PQ R, just as in the former instance, raising up the weights at the other end of the rope. This is just the atmo­spheric engine of Newcomen.

It is the atmosphere which does the work ; the steam acts indirectly as the medium through which a vacuum is effected ; and it is only the efficient agency of the atmosphere which is thus rendered useful in giving motion to a weight.

We hope that nothing which we have here said concerning thé discoveries of Guericke will be misunderstood, as intended in any way to depreciate the value set upon the inventions of Mr Savary or Mr Newcomen ; they are only introduced as illustrations by which we are most easily conducted to a thorough comprehension of the principles on which they act, and of the state of knowledge of atmospheric pressure which existed at that date. The experimental apparatus of Guericke was in no respect a steam-engine ; and although his speculations were divulged before the inventions of Savary and Newcomen, the agency of steam still remained to be introduced, before a machine useful to the arts and industry of man was pro duced.

*Newcomen's FireEngine.—*Switzer, in his Hydrostatics, (1729) has the following passage :—“ To finish this long account of the surprising engine for the raising of water by fire, I produce this last improvement of it by Mr Thomas Newcomen, which makes it undoubtedly the beautifullest and most useful engine that any age or country ever yet produced, as the best and most useful inventions and improvements which have been discovered either in art or nature, have, in process of time, been liable to improvement, so this, of the fire-engine, has been subject to the same, for this ingenious gentleman to whom we owe this late invention, has, with a great deal of modesty, but as much judgment, given the finishing