advanced to the construction of his machine. He made experiments of a conclusive nature on the boundless force of steam. He found that the only impediment to its use was the want of sufficiently strong boilers ; and his having found a way to make his vessels so as to be strengthened by the force within them, merely shows that he overcame the difficulty of making steam-tight joints by using internal flanges, which should become tightened by the pressure of steam within them. There is also internal evidence of the genuineness of his description in the statement of the quantity of water converted into steam for the effect of raising the water,—“ one vessel rarefied by fire driveth up forty of cold water,” is a mea sure of the power of steam far within the compass of its capability. Even under most unfavourable circumstances, an unprincipled exaggerator would not have contented himself with this moderate statement of its actual power.

But we have not yet concluded the marquis’s description of the nature of his stupendous prime-mover ; for his mind, in dwelling upon its principles, applications, and powers, gradually became assured that his engine was to become the most important and powerful agent in the whole world, and appears, even at that remote era, to have obtained a glimpse of the multifarious avocations and powers of the modern steam-engine. He proceeds to describe “ an engine so contrived, that working the *pri­mum mobile* forward and backward, upward or downward, circularly or cornerwise, to and fro, straight upright or downright, yet the intended operation continueth and advanceth, none of the motions above mentioned hindering, much less stopping the other, but unanimously and with harmony agreeing, they all augment and contribute strength unto the intended work and operation ; and therefore I call this a semi-omnipotent engine, and do intend that a model thereof he buried with me.”

“ How to make one pound weight to raise an hundred as high as one pound falleth, and yet the hundred pound descending doth what nothing less than one hundred pounds can effect.’’

“ Upon so potent a help as these two last mentioned inventions, a water-work is, by many years’ experience and labour, so advantageously by me contrived, that a child's force bringeth up, an hundred foot high, an incredible quantity of water, even two foot diameter, so naturally, that the work will not be heard into the next room ; and with so great ease and geometrical symme­try, though it work day and night from one end of the year to the other, it will not require forty shillings' reparation to the whole engine, nor hinder one day’s work ; and I may boldly call it the most stupendous work in the whole world ; and not only with little charge to drain all sorts of mines, and furnish cities with water, though never so high seated, as well as to keep them sweet, running through several streets, and so performing the work of scavengers, as well as furnishing the inhabitants with sufficient water for their private occasions, but like wise supply rivers with sufficient to maintaine and make them portable from towne to towne, and for the bettering of lands all the way it runs, with many more advantageous and yet greater effects of profits, admiration, and consequence ; so that, deservedly, I deem this invention to crown my labours, to reward my expenses, and make my thoughts acquiesce in the way of further inventions.’’

To any one who is familiar with the advantages which such cities as London derive at this moment from having the water raised up by fire and distributed through the highest houses for private use ; who has witnessed the in credible quantity of water brought up by a Cornwall, or Newcastle, or Staffordshire steam-engine from enormous depths, by the descent of a piston not one thousandth

part of the weight which' it raises through an equal height ; who has observed the elastic force of steam as a *primum mobile* in a cylinder performing in any and every position its multifarious duties, and that a child's force is sufficient to control and guide the operation of that stupendous power, it must be most obvious that we have only carried to perfection that engine which the Marquis of Worcester first conceived and made.

Some points in the statement of the marquis, which had not formerly been noticed, have received considerable elucidation, by a manuscript account of his inventions, discovered a few years ago by Mr Robert Stuart, and by another document, of no small importance in this question, which was brought to light by the zeal and in dιιstry of the same writer, viz. a Diary of Cosmo de’ Me dici, Grand Duke of Tuscany, who visited England about the year 1656, in which he gives an account of the engine invented by the Marquis of Worcester, which he had an opportunity of witnessing in operation at Vauxhall.

*The Condensing steam-engine of Captain Savary.*

About thirty years after the marquis’s death, which happened in 1667, the condensing steam-engine was in vented by an Englishman, Captain Thomas Savary, and was by him introduced for draining mines, raising water for buildings and gardens, and generating a revolving me­chanical power. He exhibited a model of it to the Royal Society of London in 1699. *(Phil. Trans,* vol. xxi. p. 228 ) We have seen that the marquis's model appears to have been placed on or below the level of the water to be raised, and that his vessels being filled, their contents were raised by the elastic force only of the steam. Mr Savary, on the other hand, erected his engine at a height of nearly thirty feet above the level of the water. A large close vessel was filled with steam ; this steam was recon verted, by cooling the outside of the vessel, into water, leaving the large space it had formerly occupied vacuous ; into this vacuum water was raised, as into the vacuum of a common sucking pump, by atmospheric pressure, and so within the limit of atmospheric pressure, raised twenty eight or thirty feet. After this was accomplished, the water was further raised through any remaining height by the elastic force of the steam, just as in the engine of the Marquis of Worcester. But the improvement was great. The same force of steam, strength of vessels, and consumption of fuel which was sufficient on the marquis's plan to raise water thirty feet high, would be capable first of drawing up the water thirty feet, and then raising it thirty feet more ; or doing double the work, or sixty feet of height on Savary’s plan. This was certainly a notable improvement.

There has been considerable discussion among the historians of mechanics regarding the merits of Worcester and of Savary. Those who have thought proper to praise the inventive talent of the one, have thought it essential to their purpose to depreciate the merit of the other. We think their claims rest on independent grounds. The Marquis of Worcester expressly disclaims the use of a vacuum, which, on the other hand, is the distinguishing feature of Captain Savary’s, when he says, “ not by drawing or sucking it upward, for that must be as the philosopher calleth it, *infra sphæram activitatis,* which is hut at such a distance ; but this way (by high-pressure) hath no bounder, if the vessels be strong enough.” It appears, therefore, to us, that the inventions were quite independent and different ; and we have no hesitation in admitting it as exceedingly probable, that when Captain Savary added the principle of high-pressure to his own principle of a vacuum from condensation, he was not unacquaint­ed with the marquis's works, and even with his engine for raising water by fire, for which he had obtained a pa­