to have it almoſt full loaded, and to work it only during a few hours each day, and allow the pit water to ac­cumulate during its repoſe. This increaſes the first cost, and waſtes fuel during the inaction of the engine.

But this new engine can at all times be exactly fitted (at leaſt during the working ſtroke) to the load of work that then happens to be on it. We have only to adminiſter ſteam of a proper elaſticity. At the first erection the engine may be equal to twice its taſk, if the ſteam admitted above the cylinder be equal to that of common boiling water ; but when once the ebullition is fairly commenced, and the whole air expelled from all parts of the apparatus, it is evident, that by damping the fire, ſteam of half this elaſticity may be continually ſupplied, and the water will continue boiling although its temperature does not exceed 185⁰ of Fahrenheit’s thermometer. This appears by inſpecting our table of vaporous elaſticity, and affords another argument for rendering that table more accurate by new experiments. We hope that Mr Watt will not withhold from the public the knowledge which he has acquired on this ſubject. It may very poſſibly reſult from an accurate inveſtigation, that it would be advisable to work our ſteam-engines with weak ſteams, and that the diminution of work may be more than compenſated by the diminution of fuel. It is more probable indeed, and it is Mr Watt’s opinion, that the contrary is the caſe, and that it is much more economical to employ great heats. At any rate, the deciſion of this queſtion is of great im­portance for improving the engine ; and we ſee, in the mean time, that the engine can at all times be fitted ſo as to perform its taſk with a moderate and manageable motion, and that as the taſk increaſes we can increaſe the power of the engine.

But the method now proposed has a great inconve­nience. While the ſteam is weaker than the atmoſphere, there is an external force tending to ſqueeze in the ſides and bottom of the boiler. This could not be reſiſted when the difference is conſiderable, and common air would ruſh in through every crevice of the boiler and ſoon choke the engine : it muſt therefore be given up.

But the ſame effect will be produced by drminiſhing the paſſage for the ſteam into the cylinder. For this purpoſe, the puppet valve by which the ſteam enters the cylinder was made in the form of a long taper ſpigot, and it was lodged in a cone of the ſame ſhape ; conſequently the paſſage could be enlarged or contracted at pleaſure by the diſtance to which the inner cone was drawn up.

In this way ſeveral engines were conſtructed, and the general purpoſe of suiting the power of the engine to its taſk was completely answered ; but ( as the mathematical reader will readily perceive) it was extremely diffi­cult to make this adjuſtment preciſe and confiant. In a great machine like this, going by jerks, it was hardly poſſible that every ſucceſſive motion of the valve ſhould be preciſely the same. This occaſioned very ſenſible ir­regularities in the motion of the engine, which increaſed and became hazardous when the joints worked looſe by long uſe.

Mr Watt’s genius, always fertile in reſources, found out a complete remedy for all theſe inconveniences. Making the valve of the ordinary form of a puppet clack, he adjuſted the button oſ its ſtalk or tail io that it ſhould always open full to the ſame height. He then regulated the pins of the plug-frame, in ſuch a manner that the valve ſhould ſhut the moment that the piſton had deſcended a certain proportion (ſuppoſe one-fourth, one-third, one-half, &c. ) of the cylinder. So far the cylinder was occupied by ſteam as elaſtic as common air. In preſſing the piſton farther down, it behoved the ſteam to expand, and its elaſticity to diminiſh. It is plain that this could be done in any degree we pleaſe, and that the adjuſtment can be varied in a minute, ac­cording to the exigency of the caſe, by moving the plug pins.

In the mean time, it muſt be obſerved, that the preſ­ſure on the piſton is continually changing, and consequently the accelerating force. The motion therefore will no longer be uniformly accelerated : it will ap­proach much faſter to uniformity ; nay, it may be re­tarded, becauſe although the preſſure on the piſton at the beginning of the ſtroke may exceed the reſiſtance of the load, yet when the piſton is near the bottom the resiſtance may exceed the preſſure. Whatever may be the law by which the preſſure on the piſton varies, an ingenious mechanic may contrive the connecting ma­chinery in ſuch a way that the chains or rods at the outer end of the beam ſhall continually exert the ſame preſsure, or ſhall vary their preſſure according to any law he finds moſt convenient. It is in this manner that the watchmaker, by the form of the fuzee, produces an equal preſſure on the wheel-work by means of a very unequal action of the main-ſpring. In like manner, by making the outer arch heads portions of a proper ſpiral inſtead of a circle, we can regulate the force of the beam at pleaſure.

Thus we ſee how much more manageable an en­gine is in this form than Newcomen’s was, and alſo more eaſily inveſtigated in reſpect of its power in its va­rious poſitions. The knowledge of this laſt circumſtance was of mighty conſequence, and without it no notion could be formed of what it could perform. This ſuggeſted to Mr Watt the uſe of the barometer com­municating with the cylinder ; and by the knowledge acquired by theſe means has the machine been ſo much improved by its ingenious inventor.

We muſt not omit in this place one deduction made by Mr Watt from his obſervations, which may be call­ed a diſcovery of great importance in the theory of the engine.

Let ABCD (fig. 10.) repreſent a ſection of the cy­linder of a ſteam-engine, and EF the ſurface of its pi­ſton. Let us ſuppoſe that the ſteam was admitted while EF was in contact with AB, and that as ſoon as it had preſſed it down to the ſituation EF the ſteam cock is ſhut. The ſteam will continue to press it down, and as the ſteam expands its preſſure diminiſhes, We may expreſs its pressure (exerted all the while the pi­ſton moves from the ſituation AB to the ſituation EF) by the line EF. If we ſuppoſe the elaſticity of the ſteam proportional to its denſity, as is nearly the caſe with air, we may express the preſſure on the pi­ſton in any other poſition, ſuch as KL or DC, by K7 and D *c,* the ordinates of a rectangular hyperbola F l *c,* of which AE, A B are the aſsymptotes, and A the centre. The accumulated preſſure during the motion of the piſton from EF to DC will be expreſſed by the area EF *c* DE, and the preſſure during the whole motion by the area ABF *c* DA,