motion of the returning ſtroke is therefore ſo much de­ranged by this foreign and inappreciated circumſtance, that it would have been quite uſeleſs to engage in the intricate exponential inveſtigation, and we muſt sit down contented with a leſs perfect adjuſtment of the counter weight and weight of water. — Any perſon who attends to the motion of a ſteam-engine will perceive that the deſcent of the pump-rods is ſo far from being accelerated, that it is nearly uniform, and frequently it is ſenſibly retarded towards the end. We learn by the way, that it is of the utmoſt importance not only to have a quick production of ſteam, but alſo a very capacious dome, or empty ſpace above the water in the boiler. In engines where this ſpace was but four or five times the capacity of the cylinder, we have always obſerved a very ſenſible check given to the deſcent of the pump rods after having made half their stroke. This obliges us to employ a greater counter weight, which diminiſhes the column of water, or retards the working ſtroke ; it alſo obliges us to employ a ſtronger ſteam, at the riſk of burſting the boiler, and increaſes the expence of fuel.

It would be a moſt deſirable thing to get an exact knowledge of the elaſticity of the ſteam in the cylinder; and this is by no means difficult. Take a long glaſs tube exactly calibered, and cloſe at the farther end. Put a ſmall drop of ſome coloured fluid into it, so as to ſtand at the middle nearly.—Let it be placed in a long box filled with water to keep it of a constant temperature. Let the open end communicate with the cylinder, with a cock between. The moment the ſteam-cock is open­ed, open the cock of this infiniment. The drop will be puſhed towards the cloſe end. of the tube, while the steam in the cylinder is more elaſtic than the air, and it will be drawn the other way while it is leſs elaſtic, and, by a ſeale properly adapted to it, the elaſticity of the fleam correſponding to every poſition of the piſton may be diſcovered. The ſame thing may be done more ac­curately by a barometer properly conſtructed, ſo as to prevent the oſcillations of the mercury.

It is equally neceſſary to know the ſtate of the cylin­der during the deſcent of the ſteam-piſton. We have hitherto ſuppoſed P to be the full preſſure of the atmosphere on the area of the piſton, ſuppoſing the vacuum below it to be complete. But the inſpection of our table of elaſticity ſhows that this can never be the caſe, becauſe the cylinder is always of a temperature far above 32⁰. We have made many attempts to diſcover its tem­perature. We have employed a thermometer in cloſe con­tact with the side of the cylinder, which ſoon acquired a ſteady temperature : this was never leſs than 145⁰. We have kept a thermometer in the water which lies on the piſton: this never ſunk below 135⁰. It is probable that the cylinder within may be cooled somewhat lower; but for this opinion we cannot give any very satisfactory reaſon. Suppoſe it cooled down to 120⁰; this will leave an elaſ­ticity which would support three inches of mercury. We cannot think therefore that the unbalanced preſſure of the atmoſphere exceeds that of 27 inches of mercury, which is about 134d pounds on a ſquare inch, or 101/2 on a circular inch. And this is the value which we ſhould employ in the equation P — L+y This queſtion may be decided in the ſame way as the other, by a barometer connected with the inſide of the cylinder.

And thus we ſhall learn the ſtate of the moving forces in every moment of the performance, and the machine will then be as open to our examination as any water or horſe mill ; and till this be done, or ſomething equiva­lent, we can only gueſs at what the machine is actually performing, and we cannot tell in what particulars we can lend it a helping hand. We are informed that Meſſrs Watt and Boulton have made this addition to ſome of their engines ; and we are perſuaded that, from the information which they have derived from it, they have been enabled to make the curious improvements from which they have acquired ſo much reputation and profit.

There is a circumſtance of which we have as yet ta­ken no notice, viz. the quantity of cold water injected. Here we confeſs ourſelves unable to give any preciſe inſtructions. It is clear at first fight that no more than is absolutely neceſſary ſhould be injected. It muſt ge­nerally be ſupplied by the engine, and this expends part of its power. An exceſs is much more hurtful by cool­ing the cylinder and piſton too much, and therefore wasting steam during the next riſe of the piſton. But the determination of the proper quantity requires a knowledge, which we have not yet acquired, of the quantity of heat contained in the ſteam in a latent form. As much water muſt be injected as will abſorb all this without riling near to the boiling temperature. But it is of much more importance to know how far we may cool the cylinder with advantage ; that is, when will the loſs of ſteam, during the next riſe of the piſton, compenſate for the diminution of its elaſticity during its preſent deſcent ? Our table of elaſticities ſhows us, that by cooling the cylinder to 120⁰, we ſtill leave an elaſticity equal to 1/10th of the whole power of the engine; if we cool it only to 140, we leave an elaſticity of 8/5th ; if we cool it to a blood-heat, we leave an elaſticity of 1/20th. It is extremely difficult to chooſe among theſe varieties. Experience, however, in­forms us, that the beſt engines are thoſe which uſe the ſmalleſt quantities of injection water. We know an exceedingly good engine having a cylinder of 30 inch­es and a six-foot ſtroke, which works with ſomething leſs than 1/5th of a cubic foot of water at each injection ; and we imagine that the quantity ſhould be nearly in the proportion of the capacity of the cylinder. Deaguliers obſerved, that a very good engine, with a cy­linder of 32 inches, worked with 300 inches of wa­ter at each injection, which does not much exceed 1/6th of a cubic foot. Mr Watt’s obſervations, by means of the barometer, muſt have given him much valuable in­formation in this particular, and we hope that he will not always withhold them from the public.

We have gone thus far in the examination, in order ſeemingly to aſcertain the motion of the engine when loaded and balanced in any known manner, and in or­der to diſcover that proportion between the moving power and the load which will produce the greateſt quantity of work. The reſult has been very unſatisfactory, becauſe the computation of the returning ſtroke is acknowledged to be beyond our abilities. But it has given us the opportunity of directing the reader’s atten­tion to the leading circumſtances in this inquiry. By knowing the internal ſtate of the cylinder in machines of very different goodneſs, we learn the connection be­tween the ſtate of the steam and the performance of the machine ; and it is very poſſible that the result of a full examination may be, that in ſituations where fuel is expensive, it may be proper to employ a weak ſteam which will expend leſs fuel, although leſs work is per­