haps a better measure of the resistances opposed by dif­ferent kinds of work, because their power is very distinctly known. We have been informed by one of the most emi­nent engineers, that a ton and a half of water per minute falling one foot will grind and dress one bushel of wheat per hour. This is equivalent to nine tons falling ten feet.

If an overshot wheel opposed no resistance, and only one bucket were filled, the wheel would acquire the velo­city due to a fall through the whole height. But when it is in this state of accelerated motion, if another bucket of water is delivered into it, its motion must be checked at the first, by the necessity of dragging forward this water. If the buckets fill in succession as they pass the spout, the velocity acquired by an unresisting wheel is but half of that which one bucket would give. In all cases, there­fore, the velocity is diminished by the inertia of the enter­ing water when it is simply laid into the upper buckets. The performance will therefore be improved by delivering the water on the wheel with that velocity with which the wheel is really moving. And as we cannot give the direc­tion of a tangent to the wheel, the velocity with which it is delivered on the wheel must be so much greater than the intended velocity of the rim, that it shall be precisely equal to it when it is estimated in the direction of the tan­gent. Three or four inches of fall are sufficient for this purpose ; and it should never be neglected, for it has a very sensible influence on the performance. But it is high­ly improper to give it more than this, with the view of im­pelling the wheel by its stroke ; for even although it were proper to employ part of the fall in this way (which we shall presently see to be very improper), we cannot pro­cure this impulse ; because the water falls among other water, or it strikes the boards of the wheel with such ob­liquity that it cannot produce any such effect.

It is a much debated question among mill-wrights, whether the diameter of the wheel should be such that the water will be delivered at the top of the wheel; or larger, so that the water is received at some distance from the top, where it will act more perpendicularly to the arm. We apprehend that the observations formerly made will de­cide in favour of the first practice. The space below, where the water is discharged from the wheel, being pro­portional to the diameter of the wheel, there is an undoubt­ed loss of fall attending a large wheel ; and this is not com­pensated by delivering the water at a greater distance from the perpendicular. We should therefore recommend the use of the whole descending side, and make the diameter of the wheel no greater than the fall, till it is so much re­duced that the centrifugal force begins to produce a sen­sible effect. Since the rim can hardly have a smaller ve­locity than three feet per second, it is evident that a small wheel must revolve more rapidly. This made it proper to insert the determination that we have given of the loss of power produced by the centrifugal force. But even with this in view, we should employ much smaller wheels than are generally done on small falls. Indeed the loss of water at the bottom may be diminished, by nicely fitting the arch which surrounds the wheel, so as not to allow the water to escape by the sides or bottom. While this improvement remains in good order, and the wheel entire, it produces a very sensible effect ; but the passage widens continually by the wearing of the wheel. A piece of wood or stone fall­ing in about the wheel tears off’ part of the shrouding or bucket, and frosty weather frequently binds all fast. It therefore seldom answers expectations. We have nothing to add on this case to what we have already extracted from Mr Smeaton’s Dissertation on the subject of Breast or Half Overshot Wheels.

There is another form of wheel by which water is made to act on a machine by its weight, which merits consider­ation. It is known in this country by the name of *Bar­ker's mill,* and has been described by Desaguliers, vol. ii. p. 460. It consists of an upright pipe or trunk AB (fig. 11), communicating with two horizontal branches BC, B*c*, which have a hole C*c* near their ends, opening in opposite directions, at right angles to their lengths. Suppose water to be poured in at the top from the spout F, it will run out by the holes C and *c* with the velocity corresponding to the depth of these holes under the surface. The consequence of this must be, that the arms will be pressed backwards ; for there is no solid surface at the hole C, on which the late­ral pressure of the water can be exerted, while it acts with its full force on the opposite side of the arm. This unba­lanced pressure is equal to the weight of a column having the orifice for its base, and twice the depth under the sur­face of the water in the trunk for its height. This measure of the height may seem odd, because if the orifice were shut, the pressure on it is the weight of a column reaching from the surface. But when it is open, the water issues with nearly the velocity acquired by falling from the sur­face, and the quantity of motion produced is that of a co­lumn of twice this length, moving with this velocity. This is actually produced by the pressure of the fluid, and must therefore be accompanied by an equal re-action.

Now suppose this apparatus set on the pivot E, and to have a spindle AD above the trunk, furnished with a cy­lindrical bobbin D, having a rope wound round it, and passing over a pulley G. A weight W may be suspended there, which may balance this backward pressure. If the weight be too small for this purpose, the retrograde motion of the arms will wind up the cord, and raise the weight ; and thus we obtain an acting machine, employing the pres­sure of the water, and applicable to any purpose. A run­ner millstone may be put on the top of the spindle ; and we should then produce a flour-mill of the greatest simplicity, having neither wheel nor pinion, and subject to hardly any wear. It is somewhat surprising, that although this was invented at the beginning of last century, and appears to have such advantage in point of simplicity, it has not come into use. So little has Dr Desaguliers’s account been at­tended to (although it is mentioned by him as an excel­lent machine, and as highly instructive to the hydraulist), that the same invention was again brought forward by a German professor (Segner) as his own, and has been ho­noured by a series of elaborate disquisitions concerning its theory and performance by Euler and by John Ber­noulli. Euler’s Dissertations arc to be found in the Me­moirs of the Academy of Berlin, 1751, &c. and in the *Nov. Comment. Petropol.* tom. vi. Bernoulli’s are at the end of his Hydraulics. Both these authors agree in saying that this machine excels all other methods of employing the force of water. Simple as it appears, its true theory, and the best form of construction, are most abstruse and deli­cate subjects ; and it is not easy to give such an account of its principles as will be understood by an ordinary reader.

We see in general that the machine must press back­wards ; and little investigation suffices for understanding the intensity of this pressure when the machine is at rest. But when it is allowed to run backwards, withdrawing it­self from the pressure, the intensity of it is diminished; and if no other circumstances intervened, it might not be dif­ficult to say what particular pressure corresponded to any rate of motion. Accordingly, Desaguliers, presuming on the simplicity of the machine, affirms the pressure to be the weight of a column which would produce a velocity of efflux equal to the difference of the velocity of the fluid and of the machine ; and hence he deduces that its performance will be the greatest possible when its retrograde velocity