the pressures, but also on the size of the lateral pipe, and its distance from the reservoir. When it is large, it greatly alters the train of the main, under the same head, by alter­ing the discharge at its extremity, and the velocity in it be­yond the branch ; and if it be near the reservoir, it greatly alters the train, because the diminished velocity takes place through a greater extent, and there is a greater diminution of the resistances.

When the branch is taken off at a considerable distance from the reservoir, the problem becomes more complicated, and the head *x* is resolved into two parts, one of which ba­lances the resistance in the first part of the main, and the other balances the resistances beyond the lateral pipe, with a velocity diminished by the discharge from the branch. A branch at the end of the main produces very little change in the train of the pipe.

When the lateral discharge is great, the train may be so altered, that the remaining part of the main will not run full, and then the branch will not yield the same quantity. The velocity in a very long horizontal tube may be so small (by a small head of water and great obstructions in a very long tube) that it will just run full. An orifice made in its upper side will yield nothing, and yet a small tube inserted into it will carry a column almost as high as the reservoir ; so that we cannot judge in all cases of the pressures by the discharges, and *vice versa.*

If there be an inclined tube, having a head greater than what is competent to the velocity, we may bring it into train by an opening on its upper side near the reservoir. This will yield some water, and the velocity will diminish in the tube till it is in train. If we should now enlarge the hole, it will yield no more water than before.

And thus we have pointed out the chief circumstances which affect these lateral discharges. The discharges are afterwards modified by the conduits in which they are con­veyed to their places of destination. These, for the sake of economy, being generally of small dimensions, the velocity is much diminished. But, at the same time, it approaches nearer to that which the same conduit would bring directly from the reservoir, because its small velocity will produce a less change in the train of the main conduit.

We should now treat of jets of water, which still make an ornament in the magnificent pleasure-grounds of the wealthy. Some of these are indeed grand objects, such as the two at Peterhoff in Russia, which spout about sixty feet high a column of nine inches diameter, that falls again, and shakes the ground with its blow. Even a spout of an inch or two inches diameter, lancing to the height of 150 feet, is a gay object, and greatly enlivens a pleasure-ground, especially when the changes of a gentle breeze bend the jet to one side. But we have no room left for treating this subject, which is of some nicety ; and must con­clude this article with a very short account of the manage­ment of water as an active power for impelling machinery.

CLASS II.

*Of Machinery driven by Water.*

This is a very comprehensive article, including almost every possible species of mill. It is no less important, and it is therefore matter of regret that we cannot enter into the detail which it deserves. The mere description of the immense variety of mills which are in general use would fill volumes, and a scientific description of their principles and maxims of construction would almost form a complete body of mechanical science. But this is far beyond the limits of a work like ours. Many of these machines have been already described under their proper names, or under the articles which give an account of their manufactures ; and for others we must refer our readers to the original works, where they are described in minute detail. The great academical collection *Des Arts et Metiers,* published in Paris in many folio volumes, contains a description of the peculiar machinery of many mills ; and the volumes of the *Encyclopédie Méthodique,* which particularly relate to the mechanical arts, contain many more. All that we can do in this place is, to consider the chief circum­stances that are common to all water-mills, and from which all must derive their efficacy. These circumstances are to be found in the manner of employing water as an acting power, and most of them are comprehended in the con­struction of water-wheels. When we have explained the principles and the maxims of construction of a water-wheel, every reader conversant in mechanics knows that the axis of this wheel may be employed to transmit the force im­pressed on it to any species of machinery. Therefore no­thing subsequent to this can with propriety be considered as *water-works.*

Water-wheels are of two kinds, distinguished by the manner in which water is made an impelling power, viz. by its weight, or by its impulse. This requires a very differ­ent form and manner of adaptation ; and this forms an os­tensible distinction, sufficiently obvious to give a name to each class. When water is made to act by its weight, it is delivered from the spout as high on the wheel as pos­sible, that it may continue long to press it down ; but when it is made to strike the wheel, it is delivered as low as pos­sible, that it may have previously acquired a great velocity. And thus the wheels are said to be overshot or undershot.

*Of Overshot Wheels.*

This is nothing but a frame of open buckets, so disposed round the rim of a wheel as to receive the water delivered from a spout ; so that one side of the wheel is loaded with water, while the other is empty. The consequence must be, that the loaded side must descend. By this motion the water runs out of the lower buckets, while the empty buckets of the rising side of the wheel come under the spout in their turn, and are filled with water.

If it were possible to construct the buckets in such a manner as to remain completely filled with water till they come to the very bottom of the wheel, the pressure with which the water urges the wheel round its axis would be the same as if the extremity of the horizontal radius were continually loaded with a quantity of water sufficient to fill a square pipe whose section is equal to that of the bucket, and whose length is the diameter of the wheel. For let the buckets BD and EF, fig. 5, be compared to­gether, the arches DB and EF are equal. The me­chanical energy of the water contained in the bucket BD, or the pressure with which its weight urges the wheel, is the same as if all this water were hung on that point T of the horizontal arm CF, where it is cut by the vertical or plumb-line BT. This is plain from the most elementary principles of mechanics. Therefore the effect of the bucket BD is to that of the bucket EF as CT to CF or CB. Draw the horizontal lines PB *b b,* QD *d d.* It is plain, that if BD is taken very small, so that it may be considered as a straight line, BD : BO=CB : BP, and EF : *bd =* CF : CT, and EF×CT = *b* *d*×CF. Therefore, if the prism of water whose vertical section is *b b d d,* were hung on at F, its force to urge the