from anxiety when no less has been incurred. The pupa can be forced into the fly state in a hot bed any time in winter or spring.—*North British Agriculturist.*

ON WATER AS THE MOTIVE POWER OF AGRICULTURAL MACHINES.

WATER, wherever it can be obtained, has great advantages over other motive powers. Steam is too expensive and too hazardous for common use. Wind is too uncertain. The Lisbon windmills, however, appear to have some advantage over both the common and horizontal English ones. These mills have a long axle and eight arms, four some distance in advance. Instead of four sails as the English, four large ship sai s are so fixed each to a hind and fore arm, by ropes, that they may be tightened or slackened at pleasure, and have what inclination the miller pleases according to the force and direction of the wind. The advantage of these mills is the greater ease in shifting the sails, and the far greater surface for the wind to act on them. W..er-weeels are, however, by far the cheapest power; in these the gravity and momentum of water are made use of—gravity or weight alone in the balanced wheel, where the water is received in buckets on the same level as the axis of the wheel—gravity and momentum in the overshot wheel where the water falls above the level of the axis, and momentum only in the undershot wheel. In the breast wheel, that is, when the wheel is placed in a channel or "race," formed by masonry, shaped so as almost exactly to fit the lower quadrant of the wheel, the water acts both by momentum and gravity. There is one point in undershot wheels rarely attended to, and that is that the floats ought to be set, not perpendicularly to the centre of the axis of the wheel, as is common, but so that they should be perpendicular to the surface of the water when they emerge from it.

But the most powerful and economical application of water is the Turbine wheel. This is a French name for an American adaptation of an English invention, for it is merely an adaption of Barker's mill. The water is brought down in pipes into a circular chest, with apertures all turning in the same direction through which the water flows in streamlets; and it is the height of the pipe (the water in which acts in the same manner as in the hydrostatic paradox and Bramah's press) which gives the power, and not the size of the chest, for one about two feet diameter may have the power of 8 or 10 horses. These mills are used in a few places in Scotland and Ireland, but could not be employed in a level country unless an hydraulic ram were constantly used to lift up the water to a highly elevated reservoir, to work the Turbine when necessary.

In the first class wheels, as overshot, pitchback, and Turbine, both gravity and momentum being employed, only one-third or one-fourth of the whole power of the water is lost.

In second class wheels, as ballast wheels and breast wheels, and all which receive the water below the axis, about one-half is lost.

And in third class wheels, as the undershot tub wheels, and flatter wheel, more than two thirds of power is lost, as these act by momentum only.

When there is less than 4 feet of water, an undershot wheel is cheapest; from 4 to 10 feet, a breast wheel: and above 10 feet, an overshot or first class wheel; and in this last the water should flow upon the wheel or about 52¾ degrees below the top. For further information on this subject the works of Penslow, Morren, and Hocksley, should be consulted.

Horizontal watermills were in use in the Isle of Man about a century back. An author of that date says, "Many of the rivers, or rather rivulets, not having water sufficient to drive a mill the greater part of the year, necessity has put them upon an invention of a cheap sort of mill, which, as it costs very little, is no great loss, though it stands idle six months in the year The waterwheel, about 6 feet in diameter, lies horizontal, consisting of a great many hollow ladles, against which the water brought down in a trough strikes forcibly and gives motion to the upper stone, which by a beam and iron is joined to the centre of the waterwheel." This cheap mill would be worth erecting, when water was precarious, for minor purposes; it probably would not be powerful enough for thrashing. In Young's *Annals of Agriculture*, 1792, page 364, there is a description of a thrashing machine turned by water, which appears even now very superior. A Mr. Mordaunt, of Halsall, thus describes his machine for preparing corn for the mills to grind or make bread, &c., "so contrived as first with its beaters, fixed in the cylinders, to completely separate the straw and grain at 300 rotations per minute; secondly, to shake by means of a new invented sieve, the grain from the longer straws, which sieve delivers the grain with its short straws into a hopper or cone, which cone delivers it with its short straw into a large winnowing machine, which machine delivers it to the floor; from the floor it is put into another winnowing machine which completes the dressing, working all at one, and the same time at the rate of 300 bushels per day on an average. The main obstacle is getting away the straw; this often stops the work for several hours, and I cannot prevail on the farmers to join teams and mutually assist one another. I take only one-twentieth of the grain; my men or children feed the engine; the farmers find all the men, &c., on the floor. If I remember right, a large room of 70 by 27 feet, and 9 feet high, is cleared in