head, it should be allowed to escape along the tail race freely and without much waste of power. The most usual way of accomplishing this is by providing a sudden drop at the end of the breast into the tail race, the wheel being then not in contact with the tail water. It cannot be denied that this arrangement is one of the simplest for effecting the free discharge of the water, but at the same time it is a disadvantageous one with respect to the performance of the wheel, as the whole height due to this sudden drop is lost. In order to get over this difficulty, the tail race is sometimes made to join the breast tangentially, and in order to prevent the tail water from acting objectionably as back water upon the buckets of the wheel, its velocity is made equal to the circumferential velocity of the wheel. In order to prevent the water from being lifted by the ascending buckets, the latter should be of such a shape that the tangent to the curve of the bucket assumes a vertical direction at the point in which this curve cuts the surface of the tail water. This condition is fulfilled if the shape of the bucket, as far as it is immersed in the water, is the evolute of the circle, the centre of which is the centre of the wheel, and the periphery of which touches the surface of the tail water. In a wheel constructed in this manner, it is obvious that every part of the bucket is moving in a vertical direction when cutting the surface of the water in the tail race, whence disregarding the friction between the water and wheel, no loss of head occurs whilst the water is being discharged.

In his wheels exhibited at Vienna Mr Straub endeavoured to improve the construction as much as possible, and he bestowed special care on the design of the curve of the buckets, whence he got a larger circumferential velocity. However, the manner in which the deepening of the tail race of the breast wheel is effected as shown in the vertical section of that wheel in our illustration on page 351, does not appear to be one capable of being readily justified, and does not even effect the object which leads to the adoption of the sudden drop so frequently used, the water surface not being lowered. Besides, the mode of deepening adopted by Mr. Straub has a detrimental influence, as it causes the tail water to move with a less velocity than the wheel, whence the buckets have to overcome a resistance which increases with the square of the difference between the surface velocity of the wheel and the speed of the water moving through the suddenly enlarged area of the tail race.

The breast wheel exhibited at Vienna, and illustrated in our engraving, was of a type suitable for a height of fall of from 0 3 to 4 metres (say 1 ft to 13 ft), and for a quantity of water per second of from 0 3 to 6 cubic metres (10.6 to 212 cubic feet). Mr. Straub states that the real effect of these wheels is between 65 and 75 per cent. The wheel exhibited at Vienna, was, with the exception of the buckets and the two bosses, made entirely of wrought iron, the object being to make the wheel less heavy, and to reduce as much as possible the loss of power through friction between gudgeons and bearings. The principal dimensions of the wheels are as follows: Diameter over all, 16 ft 8¾ in; width, 5 ft. 10⅞ in., diameter inside buckets, 9 ft 7⅝ in. The curves of the buckets are struck with a radius of 3 ft 3 in, the centres being situated on a circle touching the outer edges of the floats. The shaft is 8 in. in diameter through one of the bosses, and 6⅞ in. through the other; while the bearings are 7½ in. diameter by 9½ in long, and 6½ in diameter by 7⅝ in. long respectively. The shaft carries at one end a spur wheel 11 ft. 0½ in. diameter, and having 160 teeth, this wheel gearing into another 3 ft. 0⅝ in. diameter, and having 44 teeth. The two other wheels, which transmit the motion to the shafting, are 6 ft. 10⅝ in. and 2 ft. 10¼ in. diameter, and have 140 and 58 teeth respectively. All the details of this wheel, as will be seen from our illustration, are worked out exceedingly well. The regulating sluice delivers the water above its upper edge, which is rounded off in order to avoid contraction and irregularities in the motion of the jet. In our illustrations the sluice is shown full open.

The second water-wheel exhibited by Mr. Straub at Vienna, and illustrated on pages 350 and 351, represents the system known by the name of Millot's, and is characterised by the internal admission of the water. This system illustrates another endeavour to get over the difficulty of the relation existing between the delivery of the water to and its discharge from a wheel of ordinary construction, a difficulty which is especially felt when the level in the tail race is very variable. In this wheel of Mr Straub, however, this dependency of the inlet upon the discharge or *vice versâ* is entirely eliminated, and one part of the bucket may be formed in accordance with the conditions for a correct admission, whilst the other part may be shaped according to the rules for a proper discharge of the water. It cannot be denied that the first cost of such an arrangement is greater than that of a wheel of the ordinary construction, but it is urged that the final results obtained with such a wheel are also much in excess of what is generally expected. Mr. Straub claims for a wheel of this kind, and for a height of fall of 3 metres (9 ft. 10 in.) and a quantity of water of from 0.1 to 0.7 cubic metre (3.5 to 24 7 cubic feet) per second, a useful effect of as much as 88 per cent. We cannot, however, help regarding this performance as much over-estimated. As regards the design of this wheel, we may finally state that both Mr. Straub and Mr. Millot claim to be the inventors, but it appears to be difficult to decide to who a this right belongs. The wheel shown at Vienna had 54 buckets, and its internal and external diameters were 13 ft. 10⅛ in. and 18 ft. 5⅛ in. respectively. Its width was 6 ft. 11 in., and it was worked at a speed of five revolutions per minute, the head being 9 ft. 7¾ inches and the water supply 15¼ cubic feet per second. The shaft was 7⅛ in diameter through the wheel bosses, and the bearings were 5⅛ in diameter by 9⅜ in. long, and 5⅜ in. diameter by 8¼ in. long respectively, the bearing next the spur wheel being, of course, the larger of the two. The spur wheel fixed on the main shaft was 11 ft. 0¼ in. diameter with 160 teeth, and drove another wheel 3 ft. diameter.—*Engineering.*

PERPETUAL MOTION

It is strange, in these more modern days of scientific enlightenment, to hear again revived the old search after the unattainable in mechanics. One would as soon think of hearing it seriously announced that the old alchemists' exploded notion of the transmutation of metals had become sober fact. We have, however, been considerably amused by the self-delusion of an inventor who has gone so far as to spend years of his life and much money upon a machine which he claims will utilise gravity as a continuous motive power, and thus, by a proper arrangement of parts, produce perpetual motion. But this is not all. In self-deluded inventors in this direction, there has, at all times, been sufficient precedent and plenty of companionship. This inventor has, however, got so far as to read a paper explanatory of his machine before the society of civil and mechanical engineers, and has not been yet, as far as we know, disabused of his erroneous notions. In addition, when our inspection and opinion were boldly invited, many names, both of scientific and mechanical men, were adduced by way of bias to ourselves, as not having at any rate spoken unfavourably upon the model and the theory.

This but serves to show, in our opinion, how rarely practical mechanical knowledge is as yet combined with sound theory, or mere theory with really practical knowledge. We must say that we have never seen a machine more ingeniously devised to mislead both the inventor and the public if possible. It is for that reason that we give special notice to the disabusing, to the best of our power, both of the present inventor and of others who may at any time be so foolishly inclined as to wish to risk their time and money on such an *ignis fatuus*. The special deceptions of the invention are these:—To the practical man the motion of the rising and falling beam are so complicated that he is simply confused thereby. And to the merely theoretical man, the introduction of an entirely new complicated and ingenious mechanical motion prevents him from comprehending clearly the simple theoretical action of the machine. The inventor, too, most carefully refrains from saying much or anything about "perpetual motion," which would doubtless decide the point against him off-hand with any scientific mind. He merely prominently claims to increase the power of any small auxiliary force by the action of gravity on a weighted beam. The machine is primarily this:—A heavy beam is supported through a smooth slot upon two-geared cranks, which are so geared that they rotate one within the other, so to speak. This is a very novel and eccentric mechanical motion, and a very praiseworthy part of the invention. The action of