the steam on the piston ? How is this inconsistency to be reconciled?” We think it right to give a direct answer to this question, because a considerable authority, Mr Tredgold, has committed a grievous error in reporting, and apparently demonstrating, that the rotatory and crank engines actually differ in theory in the proportion of 3 to 2 — the proportion being against the rotatory engine ; whereas, if they he not equal, our whole system of mechanics since the time of Galileo has been resting on a fallacy.

Let it be recollected, then, that at the two extremes of the line of centres the greatest loss is said to take place. Now, here the fact is, that it is impossible there can be loss of power, for there is no power at all exerted; there is no steam in action : it is forgotten that, at this point, the communication which supplies the steam from the boiler has been cut off. The steam on one side of the piston having done its work, only waits to he released from the chamber, and escapes on the instant of the opening of the eduction-valve, and at the same instant is in the act of being permitted to enter on the opposite side, for reversing the motion. At these points, therefore, all application of force has ceased, and arrangements are making for reversing the motion ; and, as no power is applied, none can be lost.

In regard to the remaining points of the circle, at which it is said that power is lost, it is easy to show that the velocity imparted to the crank is such as to be an exact equivalent to the force which is apparently lost. The following table presents the results of very accurate calculations of power and velocity, showing that the velocity at a given point in the circle is increased exactly in the same ratio as the force or pressure is diminished, so as at all times to present the same dynamical equivalent. The table extends from one neutral point to the other neutral point of the orbit of the crank, comprehending a semicircle divided into ten equal parts. The first column indicates the point in the semicircle at which the force and velocity are estimated; the next column shows the percentage of the direct force of the steam on the piston, which is given out in pressure upon the crank of the engine ; and the last column, the velocity given out at each point.

Place of the Per centage of Relative

crank. power given out in pressure. velocity.

0° 0.00 Infinite.

18° 30.90 3 236

36° 58.78 1.701

54° 80.90 1.236

72° 95.11 1.051

90° 100.00 1.000

108° 95.11 1.051

126° 80∙90 1.236

I44° 58.78 1.701

162° 30.90 3.236

180° 0.00 Infinite.

From this table it is evident that when we take note, as we must do in every correct estimate of power, both of force and velocity, the crank has at each point the equivalent in greater velocity for less force.

The numbers in the second column also represent the velocity of the piston in relation to the crank, so that when the velocity of the crank is uniform, the velocity of the piston, or the steam consumed, which is proportional to its velocity, is in the exact ratio of the pressure on the crank.

The last consideration which we shall submit upon this part of the subject is, that if the average of the pressures on the crank be taken for every point of its orbit, it will amount to about G3.3 per cent. for the whole circumference of the circle. Now, as the same circumference of the

orbit of the crank is greater than the stroke of the piston in the cylinder, the whole space described in a given time by the crank is greater than the whole space de­scribed by the piston, also in proportion of 3.1416 to 2 ; so that if we combine the greater length of the whole orbit with the force on it, we shall have an exact equivalent to the greater force on the piston moved through a smaller space.

The error of Mr Tredgold lies, not in his estimate of the effect of the crank, but in his estimate of the effect of the steam in the rotatory engine. By a strange oversight, he gives a statement of its power as much over the truth as that of the crank is generally stated under the truth. We admit that, in the first abstract view of the subject, the rotatory is theoretically a perfectly efficient propagator of power, and we have merely designed to show that in theory the crank has not the faults usually attributed to it, and is also a perfect machine. We shall by and by show what the considerations are by which the impracticability of the rotatory scheme is exposed.

It appears, therefore, that the power of steam is by no means disadvantageously applied through the medium of the crank in the ordinary way, because, 1. the velocity of the crank is in the inverse ratio of the pressure upon it; 2. because the mean pressure on the crank during the whole revolution is less than the pressure on the piston, only in the proportion in which the whole space moved over by the latter is less than the space described by the former, so that the whole effect is equal to the whole power; 3. because the steam is not at all ex pended at the neutral points, and because its expenditure is at every point exactly proportioned to the pressure which it gives out, the velocity of the piston being in that ratio. In theory, therefore, the ordinary crank possesses no inferiority to the rotatory machine, as an engine for applying the power of steam to revolving machinery.

II. In a practical point of view, it may be shown, that the rotatory steam-engine is greatly inferior to the com­mon reciprocating crank-engine in simplicity of parts, easy construction, cheapness, amount of friction, compactness, precision and uniformity of work, and durability and economy in use ; and that it does not possess any of the peculiar applicability that has been attributed to it, to the great purposes of inland navigation and railway transport.

1. Simplicity.—A little unfairness is sometimes in­advertently used by inventors of rotatory engines, in making comparisons with their machines and the common crank-engine ; they select the large beam-engine with all its conveniences and appendages, and compare it with the simplest form of the rotatory engine ; but in justice we may be allowed to take the simplest form of both. Now, there is a simple form of engine used both in America and in this country, of the oscillating species as it is called, and this species of reciprocating engine consists only of the following parts:—cylinder, piston, and cranked axle; there are no valves or further mechanism of any kind, so that where simplicity is the first great requisite, this kind may be used with advantage. The rotatory engine of the most simple species must have its drum, diaphragm, piston, and axle.

If we take those forms of the rotatory engine which require valvegear, air-pump, condenser, force-pumps, &c., such appendages will have no advantage of any kind, in either form ; but in working the pumps which are themselves reciprocating, the reciprocating engine will have the advantage of more direct, immediate, and simple action ; for in the rotatory engine additional mechan­ism is necessary to convert the revolving motion into one calculated for reciprocating pumps.