from that of machinery, for, as it is in the abstract incapable of change or alteration in its nature, we are enabled to adopt just that arrangement of wood, iron, &c., in separate parts which we find most convenient, well knowing that so long as a few laws are attended to which will prevent the waste of force, its nature, character, or existence can be in no way imperilled. And we thus find that the dimensions of a machine really bear no relation whatever to the amount of power which it may render available, other than those which are impressed by certain properties of the materials of which it is composed, such as their tensile or transverse strength, their liability to wear by friction, and the nature of the modes by which the developed forces are subsequently transmitted. In practice, we meet with instances of the truth of this proposition continually. The ponderous Cornish engine, with all its arrangements of colossal beam, huge cylinder, and vast boilers, developes less power, perhaps, than the little locomotive which hauls a train of coal waggons laden with material for the supply of its furnaces. It is needless to multiply examples with which all our readers must be sufficiently familiar.

Power is force in motion, and therefore the question of relative velocity is a matter of great importance in the construction of all machines, but more especially of those which are intended to concentrate a great capacity for work in a very small compass. Most of the forces at our disposal will operate, under certain conditions, at any speed deemed most desirable. These conditions are in general easily secured, and, therefore, we find that nothing but considerations, totally apart from the development of power *per se*, prevent us from resorting to the use of even minute mechanism whenever its employment becomes desirable from the exigencies of situation, &c. Practically speaking, the great obstacle to the concentration of power is found in friction. A given strain being placed at our disposal, the amount of mechanical effect, or, more exactly, power, which that force or strain can give out, will be measured directly by the space which it passes over in a given time. Consequently, small machines intended to do much work must run at a high speed. A resistance of 1 lb. overcome at a speed of 33,000 ft. per minute, is a horse power just as much as 33,000 lb. overcome at the velocity of 1 ft; but at high speeds all the trouble ever given by friction becomes magnified, and special arrangements for lubrication, and particular forms and dimensions for the rubbing parts or surfaces must be adopted, or the machine will altogether fail in the performance of its duties. When the friction problem is solved no difficulty whatever is met with in the concentration of power, provided the conditions under which that power is produced in the first instance, by some one or other of the natural forces, are complied with. Thus, a cannon ball, at the moment it leaves the muzzle in its flight, is the very impersonation of concentrated power due to high velocity. This, perhaps, is scarcely an instance strictly analogous to anything found in machinery. Turbines, however, now and then furnish fine examples of the production of immense power within a very small space. At St. Blazier, in the Black Forest, a Fourneyron turbine, only 20 in. diameter, under a fall of 172 ft., gives 56 horse power, although its entire weight is but 105 lbs. Another turbine at the same place, of but 13 in. in diameter, under a head of 354 ft., makes 2,200 revolutions per minute, using 1 cubic foot of water per second, and driving 8,000 spindles, besides looms, &c., in the mill to which it is attached. In cotton mills, spindles are frequently driven at 11,000 revolutions per minute. Now, if one of these spindles is fitted with a disc 12 in. in diameter, its periphery will attain the enormous velocity of 33,000 ft. per minute, and therefore it will require just 1 lb. of resistance at this periphery to render a horse power necessary to overcome it; and *vice versa*, were the force impressed on the disc sufficient to overcome this resistance, it would give out a horse power. The late Mr. Richard Roberts has driven spindles for the experiment, at 60,000 revolutions per minute; a greater speed, perhaps, than was ever before attempted in any machine. High speed lathes, circular saws, and some other machines supply us with examples, where an immense amount of power is concentrated within a very small space. These are, however, strictly speaking, negative examples illustrating the expenditure, rather than the development of force.

As the power of steam is the most universally applicable of all the forces used for driving machinery, its concentration becomes a matter invested with considerable importance. A great deal has been done in the production of small high speed engines of late years, but a great deal more remains to be done before the principle can be regarded as approaching those limits, beyond which it may be neither safe nor prudent to carry it. The "Great Britain" locomotive has frequently given out 1,000 horse power for many minutes together, with a pair of 18-in. cylinders 24-in. stroke, the weight of the engine in working order being little over 35 tons, or, with the tender, 50 tons. This may, perhaps, be considered as a maximum effort which it would not be advisable to attempt to maintain. Taking the work done, then, at but half this, or 500 horse power, we have still over 14 horse power per ton; or, if we neglect the weight of the wheels as in no way necessary to the development of this power, we have at least 15 horse power per ton of machinery. One of the steam fire engines, tried last year at Sydenham, developed nearly 30 horse power, the weight being under 50 cwt. This estimate of power does not pretend to strict accuracy, as the indicator was not used, and the power was calculated merely at an assumed pressure, some 20 or 30 lbs. less than that in the boiler. Still if we disregard the weight of the wheels, driving seats, &c., we find that the amount of power developed very nearly equals that of a first-class locomotive, weight for weight. Modern express engines give out 350 horse power as a matter of daily occurrence, and even goods' engines sometimes a great deal more. It is needless to say that in all these cases the power is obtained by an extremely high velocity of piston. In stationary engines, seldom confined in space, the march of improvement goes slowly, but, nevertheless, steadily on; and we trust ere long to see the clumsy beam and its appendages banished for ever in favour of high speed horizontal engines, working expansively. The "Allen" engine, exhibited in 1862, inaugurated a change of practice, which is