CHAPTER IV

THE IMPOSSIBILITY OF PERPETUAL MOTION

It is easier to resolve the question of perpetual motion in dynamics than in statics. However, for Leonardo da Vinci and for Cardan as well as for Aristotle, there are no insurmountable barriers between these two sciences. On the other hand, Galileo and Stevin accepted the impossibility of perpetual motion as an axiom capable of providing a basis for certain demonstrations in statics. And both of them had read Cardan, where they probably found support for their confidence in this axiom. But Cardan himself, in writing against perpetual motion, had done nothing more than summarize the scattered notes of Leonardo da Vinci. Thus we cannot gain a clear and complete picture of the origins of statics without reviewing the objections raised by Leonardo da Vinci and Cardan to the perpetuum mobile.

The search for perpetual motion is a general term expressing two distinct utopian goals: the search for the perpetual motor and the search for the perpetually moving body.

The cruder of these two utopian goals is the search for the perpetual motor. Such is the illusion of the miller who has a given volume of water in reservoir ready to be released from a given height. The miller dreams of combining marvellous gears which would enable him to mill as much grain as he wants without raising his reservoir by an inch or adding a pint to the existing volume of water.

We have seen with what precision Leonardo da Vinci, the great master of hydraulics, brings our miller's ambitions back to earth. Let him connect one hundred millstones to his waterwheel instead of one. Each one of them will then mill for him one hundred times less grain. A given weight which falls from a given height represents a given driving power. One can divide up this power or change its use infinitely, but one cannot increase it.

This truth dashes the hopes of anyone looking for a perpetual motor. However, it still gives free reign to the dreams of those seeking to realize the perpetually moving body.

Without requiring an engine to produce any external mechanical work and without exerting on it any action, could we not have an
engine which, once put into motion, would move indefinitely? Could we not construct, for instance, a wheel so perfect that, once in motion, it would turn on its axis without ever stopping? Could we not construct a clock in such a way that its two equal weights would precisely counterbalance one another and that one weight descending from its highest point would lift the second weight, which, in turn, had lifted the first weight so that this perpetual clock would rewind itself?

It is absurd to expect perpetual motion from an initial impulse because the motive power of this impulse — Leonardo calls it its "forza" or its "impeto," Leibnitz will call it its living force — is constantly being expended. It is equally absurd to expect from any arrangement of weights a perpetually moving body because gravity always tends towards equilibrium and any motion produced by it has as its goal a state of rest:

No thing without life, says Leonardo da Vinci, is capable of pushing or pulling without accompanying the body being moved. These motors can only be "forza" or falling weight. If falling weight pushes or pulls, it can only produce this displacement of the body because the body seeks a state of rest and, since no moving body which is descending is capable of returning to its initial position, motion stops.

And if one body which moves another body is the "forza," this potential capacity, in its turn, accompanies the body being moved by it. It moves it in such a way that it expends itself. And once it is expended, no body, having been moved by it, is capable of reproducing it. Thus no moving body can move for a long time because in the absence of causes there will no longer be any effect.

Leonardo da Vinci's contemporaries readily agreed with him that the motor power of an impulse transmitted to a group of bodies will dissipate. Indeed, all the Peripatetics accepted as axiomatic that violent motion always finishes by expending itself. As they were in the habit of saying: "Nullum violentum potest esse perpetuum." When Leonardo describes this continuous loss of the living force within a system in motion, he uses glowing poetic expressions:

I maintain that the "forza" is a spiritual virtue, an invisible power which, through an external accidental violence, is caused by motion, and which is introduced and infused into the bodies, which are, in turn, being pulled and diverted from their natural condition. This spiritual force imparts to them an active life of marvelous power and forces all things created to change their form and place. It runs furiously to its desired death under ever changing forms according to its causes. Slowness renders it vigorous and swiftness makes it feeble. Born of violence, it dies of liberty. The more vigorous it is, the faster it expends itself. It hunts with a fury whatever opposes its destruction; it