On the Impenetrability as the fourth General Property of Bodies and of their Essence.

35. Every material body must occupy in space a particular location, and it is impossible for two bodies to be at the same location at the same time.

Our concept of bodies includes their impenetrability of such necessity, that nobody would regard a thing, that does not have that property, as a material body. Thus images produced by means of mirrors, although they have extent and mobility, are not considered bodies, because they can freely interpenetrate each other. It is therefore an important and general property of all bodies, that none can be at the same location that is in reality taken up by another. The presence of a body at a certain location excludes from this location all other bodies as long as the first body remains there, and no other body can occupy the location without expelling the first body from it. In this consists an essential difference between mere space and a body, space being readily penetrable by bodies, but a body not being able to reach a location already occupied by an other body. It is thus quite impossible for two bodies to occupy the same location. It follows that each body must occupy a particular location, inaccessible to any other body, as long as the former is not ejected from it. Just as this body can not be simultaneously at more than one location, can two bodies be at the same location. This property is without exception accepted by all who have written about the nature of bodies, and although Descartes considered the essence of bodies to be in their mere extent, he nevertheless considered impenetrability to be connected with extent.

36. The fact that a body can pass fairly freely though air, water and other liquid matter is in no conflict with the impenetrability of the body itself or of the liquid matter.

If air were not a body, the impenetrability of a body would not be affected by the fact that it can be moved through air quite freely; but since air, like other liquid matter, is a body, no body can pass through air without all the time displacing those parts of the air from the location to which it is moving. Experience manifestly shows this, since no body can move through air without setting the latter in motion; and from this stems the resistance experienced by a body moving through air or any other liquid medium, continuously slowing its movement, as is usually discussed in the theory of motion. Air is continuously displaced from all locations occupied in succession by the body, so that air and body can never simultaneously be at the same location. But as soon as the body vacates a location, there is nothing to prevent the location to be occupied at once by air or by another body. The same applies to water and other liquid media, since the impossibility of two bodies occupying the same location simultaneously becomes the more manifest, the coarser the liquid medium is. In that case the resistance becomes that much greater, a clear indication of impenetrability. Although we

have not yet investigated the nature of liquid bodies, there can be no objection against the general property that is here discussed.

37. If at times it appears that a body completely enters an other body, there is even then no penetration; instead the pores in one body accept particles of the other, after the ejection of any matter that might previously have occupied the pores.

If a piece of sugar is moistened with water, the water enters the sugar in such a way, that it appears as if the location previously occupied by the sugar alone, is now also occupied by water. But if one examines the matter more closely, one finds that the whole of the location had not been occupied solely by sugar, but that there were in the sugar a large number of holes, called pores, filled with air or some other invisible matter. The water enters these pores in such a way that the matter previously contained in them is ejected. If one does not take this into account, it does indeed appear as if sugar and water were present at the same location at the same time. The same can be said of all mixing processes, where two bodies are dissolved into very small particles, that are mixed together, and it can never happen that two such particles should be at the same location. Returning to the previously discussed case of sugar, we may remember that all known bodies contain a large number of pores, filled with air or some other invisible matter. This foreign matter must be distinguished from the proper matter of the body. Since it can frequently happen that these pores are filled with some other visible matter, after the former has been displaced, all doubt regarding the impenetrability of bodies is removed.

38. The impenetrability implies the extent and the mobility, and in consequence also the persistence. Therefore if one ascribes to bodies impenetrability, one must also ascribe to them the other properties.

If there is no extent, the concept of impenetrability does not apply, for a thing that has no extent, can also not occupy a location, and consequently the question cannot arise whether or not another thing could simultaneously occupy the same location. An impenetrable thing has therefore of necessity extent, and it must have this in all three directions, for one cannot say of a mere line or surface that it is impenetrable. One can also not imagine a thing that is impenetrable as other than mobile, for even if it were attached to one location such that it could not be torn off by any force, then this would be an external force, for in the thing itself one can find nothing that would prevent it from being moved from this position. Here we are discussing the mere possibility of changing the location, and consequently mobility must also be ascribed to an impenetrable thing. But persistence is immediately connected with mobility, for when a thing is mobile, it must also have persistence, since otherwise any change could occur without sufficient

reason. Therefore impenetrability contains all previously discussed properties, namely extent, mobility and persistence.

39. Whatever is impenetrable belongs to the category of bodies, and therefore the essence of bodies is their impenetrability, on which therefore all their other properties must be founded.

The essence of material bodies is a property that is not only shared by all bodies, but which is also such that it is not applicable to anything else. Because of this, extent cannot be regarded as the essence of bodies, because space also has extent, and to whoever is unwilling to accept space, we can mention shadows, and images projected by mirrors and lenses, whose extent and mobility one cannot dispute; but in spite of that nobody will regard them as bodies. From this follows that mobility, although connected with extent, cannot constitute the essence of bodies. The same applies to persistence, since it is a necessary consequence of mobility. But nobody will doubt that the imagined pictures, if they were endowed with impenetrability, should belong to the category of bodies. But since every impenetrable thing is rightly regarded as a body, it is obvious that impenetrability is the essence of bodies. Whoever wanted to deny this, would have to maintain that things that are impenetrable, but nevertheless could not be regarded as bodies, actually exist or should be possible. Since we have now discovered the essence of bodies, it is clear, as shown above, that all properties of bodies must stem from their impenetrability, and that bodies have no properties that are not of necessity connected with their impenetrability.

40. Since bodies through their essence are impenetrable, no force, however large, is able to compress two bodies such that, even in their smallest parts, a real interpenetration can occur.

If a force could compress two bodies into each other at the same location, one could not say that they were impenetrable, but only perhaps that a very large force were required to achieve the interpenetration. But since the essence of bodies is their impenetrability, such an interpenetration is simply impossible, even if the greatest force rammed two bodies together. One knows from experience that many bodies can, with sufficient force, be compressed into a much smaller space; however what happens here is nothing but that the constituent particles of the bodies are forced closer together and the pores between them are made smaller, after air or other invisible matter, with which they were filled, has been driven out, as can be made clear by the example of a sponge. Air in particular is such a body that can be compressed into a much smaller space. However there is no doubt that it contains within it many small spaces that are either empty, or are filled with a more subtle substance. But in the case of water, experience has shown that no force is able to compress it into a smaller space; the impenetrability is therefore strong enough to resist the greatest force and to prevent all real interpenetration. [Unfortunately, paragraphs 41 to 48, i.e. the last paragraphs of

the present, and the first of the following Chapter 6 are missing in the manuscript, where the relevant pages are lost.]

49. If no spirits are involved, all changes in the world of material bodies are brought about by the forces of impenetrability of the bodies, and therefore there are in bodies no forces other than these forces.

Here we exclude explicitly the changes that are brought about by God or by a spirit. Accordingly, when we consider in the world nothing but bodies, then it is clear that each body must remain in its state so long as no external cause arises that is capable of causing a change. As long as there is a distance between the bodies, none of them will prevent the others from remaining in their respective states; in fact if the bodies could freely interpenetrate each other, the state of none would be disturbed by the others. From this it follows that the state of bodies is only changed because they cannot remain in a state without interpenetrating each other; from this source originate all changes in the state of bodies. But since no change can take place without a force, all forces that produce changes in the world have their origin in the impenetrability of bodies, and therefore we meet in the world of material bodies no forces other than those that derive from the impenetrability of bodies. Here we have therefore the true cause of all change in the universe; since the relation of bodies with each other is such that nearly none can remain in its state for only a moment without disturbing others in their state, we see why there is continual change in the world. We now also see that these changes are a necessary consequence of the impenetrability and persistence of the bodies, a view distinct from that of some scholars, who concluded from the incessant changes in the world that bodies must be equipped with forces enabling them to change their state, notwithstanding the fact that persistence is in clear contradiction to such forces.

50. The whole of Natural Science therefore consists in explaining, for every change that takes place, in what state the bodies had initially been, and why because of the bodies' impenetrability just those changes occurred, that actually took place.

Whoever can in this manner explain the changes that take place in Nature, has achieved the aims of Natural Science, by deriving the true causes from its basic and indisputable principles. Since no change in the state of bodies is possible, i.e. since none can change its state without disturbing the others in their state, all changes arise from the forces of impenetrability, through which the actual interpenetration is prevented. Therefore in Natural Science the aim is in each case to show that the bodies could not possibly have remained in their state without penetrating each other, and that, in order to prevent actual penetration, the forces of impenetrability had to produce just those changes that actually did occur. But since this requires a precise knowledge of all bodies, together with their special characteristics, one will only rarely achieve such a complete explanation. Frequently one has to be content with assuming certain occurrences to be understood, and to explain others in terms of these, and as arising from the same principles. But to determine in each case what changes are produced by the forces of impenetrability, it is

necessary before all else to deal with the Science of Forces, which forms the foundation of all complete explanation. From this one will be in a position to point to many changes, which are not influenced by the particular characteristics of the body. However when it is necessary to take these particular characteristics also into account, one usually meets the greatest difficulties.