

RENÉ DESCARTES

Discourse on Method  
*and Related Writings*

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than what I was, I thought I should try by every possible means to become worthy of the reputation I had acquired; and it is exactly eight years since this desire made me resolve to move away from all the places where I had acquaintances and to retire here<sup>14</sup> to a country where the long duration of the war has resulted in a situation in which the armies involved in it serve only to make the fruits of peace available with much greater security and where, among a great crowd of busy people, who are more concerned with their own business than inquisitive about that of others, I have been able to live as solitary and withdrawn a life as in the most remote deserts, without lacking any of the conveniences that are available in the busiest towns.

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I do not know if I should tell you about the first meditations that I did there, because they are so metaphysical and unusual that they may not be to everyone's taste.<sup>15</sup> However, I find that I am in some way forced to talk about them, so that readers may judge whether the foundations I adopted are solid enough. I had realized for a long time that it is sometimes necessary, in our conduct, to act on the basis of opinions that are known to be uncertain as if they were indubitable, as already mentioned above. But since, at that time, I wanted to focus exclusively on the search for truth, I thought it was necessary to do the exact opposite, and to reject as absolutely false everything in which I could imagine the slightest doubt and to see, as a result, if anything remained among my beliefs that was completely indubitable. Thus, because our senses sometimes deceive us, I decided to assume that nothing was the way the senses made us imagine it. And since there are some people who make mistakes in reasoning and commit logical fallacies, even in the simplest geometrical proofs, and since I thought that I was as subject to mistakes as anyone else, I rejected as false all the arguments that I had previously accepted as demonstrations. Finally, since I thought that we could have all the same thoughts, while asleep, as we have while we are awake, although none of them is true at that time, I decided to pretend that nothing that ever entered my mind was any

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more true than the illusions of my dreams. But I noticed, immediately afterwards, that while I thus wished to think that everything was false, it was necessarily the case that I, who was thinking this, was something. When I noticed that this truth 'I think, therefore I am' was so firm and certain that all the most extravagant assumptions of the sceptics were unable to shake it, I judged that I could accept it without scruple as the first principle of the philosophy for which I was searching.

Then, when I was examining what I was, I realized that I could pretend that I had no body, and that there was no world nor any place in which I was present, but I could not pretend in the same way that I did not exist. On the contrary, from the very fact that I was thinking of doubting the truth of other things, it followed very evidently and very certainly that I existed; whereas if I merely ceased to think, even if all the rest of what I had ever imagined were true, I would have no reason to believe that I existed. I knew from this that I was a substance, the whole essence or nature of which was to think and which, in order to exist, has no need of any place and does not depend on anything material. Thus this self – that is, the soul by which I am what I am – is completely distinct from the body and is even easier to know than it, and even if the body did not exist the soul would still be everything that it is.

After that, I thought about what a proposition generally needs in order to be true and certain because, since I had just found one that I knew was such, I thought I should also know what this certainty consists in. Having noticed that there is nothing at all in the proposition 'I think, therefore I am' which convinces me that I speak the truth, apart from the fact that I see very clearly that one has to exist in order to think, I judged that I could adopt as a general rule that those things that we conceive very clearly and distinctly are all true. The only outstanding difficulty is in recognizing which ones we conceive distinctly.

Then, by reflecting on the fact that I doubted and that, consequently, my being was not completely perfect – for I saw clearly that it was a greater perfection to know than to doubt – I decided to find out where I learned to think about something that was more perfect than myself, and I knew clearly that this had to be from some nature that was in

of many observable and bodily things; for even if I supposed that I was dreaming and that everything that I saw or imagined was false, I still could not deny that the ideas were truly in my thought. But because I already knew in myself very clearly that there is a distinction between intellectual and bodily natures, when I considered that every composition is an indication of dependence and that dependence is manifestly a defect, I concluded that it could not be a perfection in God to be composed of these two natures and that, consequently, he was not such. Instead, I concluded that if there were some bodies in the world, or some intellects or other natures, which were not completely perfect, their existence must therefore depend on his power in such a way that they could not subsist without him for a single moment.

I then tried to find other truths and, turning to the object studied by geometers — which I conceived of as a continuous body or space extended indefinitely in length, breadth and height or depth, divisible into different parts that could have various shapes and sizes and could be moved or transposed in every way, for geometers presuppose all that in the object of their study — I reviewed a sample of their simplest demonstrations. When I noticed that the great certainty that everyone attributes to these demonstrations is based only on the fact that they are conceived as evident, in accordance with the rule that I stated earlier, I also realized that there was nothing at all in them that would convince me of the existence of their object. For example, I saw clearly that, if we assume a triangle as given, its three angles would have to be equal to two right angles; however, for all that, I saw nothing that convinced me that there was any triangle in the world. In contrast, when I returned again to examine the idea I had of a perfect being, I found that existence was included in it in the same way as, or even more evidently than, the idea of a triangle includes its three angles being equal to two right angles or the idea of a sphere includes the equidistance from its centre of all its parts [on the surface] and that, consequently, it is at least as certain as any geometrical demonstration could ever be that God, who is this perfect being, is or exists.

But the reason why many people are convinced that there is some difficulty in knowing this, and even in knowing what their soul is, is that they never raise their minds above observable things, and they

fact more perfect. As regards the ideas I had of many other external things, such as the sky, the earth, light, heat and thousands of others, I did not have any comparable difficulty in knowing where they came from, because I did not notice anything in them that seemed to make them superior to me and therefore I was able to believe that, if they were true, they depended on my nature to the extent that they contained any perfection and, if they were not true, I got them from nothing, that is, they were present in me because of some deficiency in me. But the same would not apply to the idea of a being that was more perfect than me. To get such an idea from nothing was something manifestly impossible. And I could not have received it from myself either, because it was just as impossible for something that is more perfect to result from and depend on something less perfect as for something to proceed from nothing. Thus the only remaining option was that this idea was put in me by a nature that was really more perfect than I was, one that even had in itself all the perfections of which I could have some idea, that is — to express myself in a single word — by God.

I would add that, because I knew some perfections that I did not have myself, I was not the only being in existence (with your permission, I shall freely use scholastic terminology here), but that it necessarily had to be the case that there was some more perfect being on which I depended and from which I received everything that I had. For if I had been alone and independent of everything else, so that I myself was the source of the little perfection by which I participated in the perfect being, then by the same argument I would have been able to have, from myself, all the extra perfection that I knew I lacked, and thus I would myself be infinite, eternal, immutable, omniscient, omnipotent, and indeed have all the perfections that I was able to recognize in God. For according to the arguments I have just constructed, all I had to do in order to know the nature of God — in so far as my nature was capable of doing so — was to ask, about all the things of which I found some idea in myself, whether or not it is a perfection to possess them. I was convinced that none of them which involved some imperfection was in God, but that all the others were. Thus I saw that doubt, fickleness, sadness and similar things could not have been in him, since even I myself would have been very glad to be free from them. I also had ideas

are so used to not thinking about anything without imagining it — which is an appropriate way of thinking about material things — that anything that is not imaginable seems to them to be unintelligible. This is clear enough from the fact that even philosophers in the schools adopt the maxim that there is nothing in the intellect that was not previously in the senses, although it is certain that the ideas of God and of the soul have never been there. It seems to me that those who wish to use their imagination to understand these ideas are doing exactly the same as if they wished to use their eyes to hear sounds or to smell odours, except for this difference: the sense of sight is no less convincing about the truth of its objects than smell or hearing are, whereas neither the imagination nor our senses could ever convince us of anything if our understanding did not intervene in the process.

Finally, if there are still some people who are not sufficiently convinced of the existence of God and of their soul by the arguments that I have presented, I want them to know that all the other things of which they think they are more convinced — such as having a body, or the existence of an earth or of the stars, and similar things — are less certain. For although we are morally certain<sup>16</sup> about these things, so that to doubt them would seem to be extravagant, it is also true that, when it is a question of metaphysical certainty, it cannot reasonably be denied that there is a basis for not being completely convinced about them once we realize that, while asleep, one can imagine having a different body in exactly the same way, or that one can see other stars and another earth where there is none. For how do we know that the thoughts that arise in us while we are dreaming are more false than others, since they are often no less vivid and explicit? Let the best minds study this question as much as they wish; I do not think they can provide a reason that is enough to resolve this doubt if they do not presuppose the existence of God. For, firstly, the very thing that I had accepted as a rule above — viz. that the things we conceive clearly and distinctly are all true — is guaranteed only because God is or exists, that he is a perfect being, and that everything in us derives from him. It follows from this that our ideas or notions, which are real things and come from God, cannot but be true to the extent that they are clear and distinct. Thus if we frequently have ideas that contain some falsity,

that can arise only in the case of those that contain some confusion and obscurity because, to the extent that they do so, they participate in nothingness; in other words, they are present in us in this confused manner only because we are not completely perfect. It is evident that to claim that falsehood or imperfection as such result from God is no less contradictory than claiming that truth or perfection would result from nothingness. But if we did not know that any reality or truth in us comes from God, then no matter how clear and distinct our ideas might be, we would have no reason that would convince us that they had the perfection of being true.

But once knowledge of God and of the soul has thus made us certain of this rule, it is rather easy to know that the dreams we imagine while asleep should in no way make us doubt about the truth of the thoughts we have while awake. For if it happened, even while sleeping, that someone had a very distinct idea — for example, if a geometer discovered a new demonstration — the fact that they were asleep would not prevent it from being true. And as regards the most common mistake of our dreams, i.e. that they represent various objects to us in the same way as our external senses do, it is irrelevant that it provides an opportunity for us to doubt the truth of such ideas, because they can also mislead us rather frequently even when we are not asleep, as when those with jaundice see everything coloured yellow, or when stars and other very distant bodies appear much smaller to us than they really are. After all, whether we are awake or asleep, we should never allow ourselves to be convinced of anything except by the evidence of our reason; and it should be noted that I say 'our reason', and not 'our imagination' or 'our senses'. Although we see the sun very clearly, we should not for that reason judge that it is only as large as it seems; and we could easily imagine distinctively a lion's head attached to a goat's body without, for that reason, thinking that there is a chimera in the world, because reason does not tell us that what we see or imagine in this way is true. It tells us instead that all our ideas or notions must have some basis in truth, for otherwise it would be impossible for God, who is absolutely perfect and true, to put them in us. Since our reasoning is not as evident or complete while we are asleep as when we are awake, although what we imagine while asleep is sometimes as vivid and explicit, or even

more so, reason also tells us that our thoughts cannot all be true, since we are not absolutely perfect, and that whatever truth our ideas possess should infallibly be found in those we have while awake rather than in our dreams.

## [PART FIVE]

I would be very happy to continue and to reveal the whole chain of other truths that I deduced from these first ones. However, in order to do that, I would have to discuss here many questions that are disputed among the learned, and I do not wish to become entangled in those issues. I think it would be better, therefore, if I were to refrain from discussing them and if I simply identified them in a general way, so as to leave it to those who are wiser to judge whether it would be useful if the public were informed about them in more detail. I remain firmly committed to the decision I have made not to assume any other principle apart from the one I have just used to demonstrate the existence of God and of the soul, and not to accept anything as true that does not seem more clear and distinct to me than the proofs of geometers seemed to me in the past. Nevertheless, I dare to claim that not only have I found a way to satisfy myself in a relatively short time about all the principal difficulties that are usually discussed in philosophy, but I have also noticed certain laws which God has so established in nature and of which he has impressed such notions in our souls that, having reflected on them sufficiently, we could not doubt that they are observed exactly in everything that exists or that happens in the world. And in thinking about the consequences of these laws, I believe I have discovered more truths that are more useful and important than everything I had previously learned or had ever hoped to learn.

But since I tried to explain the principal truths among them in a treatise that I was prevented from publishing by a number of considerations, the best I can do to make them known is to provide a summary here of that treatise.<sup>17</sup> My plan was to include in it everything that I thought I knew, before I began writing it, about the nature of material

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things. But just as painters cannot represent equally well on a flat surface all the different sides of a solid body — by choosing one of the principal sides to face towards the daylight, they leave all the others in the shade and do not allow them to appear except in so far as one can see them by looking at the principal side — in the same way, I was afraid that I could not include in my discourse everything that I had thought about. Thus I undertook to explain in it reasonably fully only what I understood about light and, at the same time, to add something about the sun and the fixed stars, because most light results from them; about the skies, because they transmit the light; about the planets, comets and the earth, because they reflect it; and in particular about all the bodies that are on earth, because they are either coloured, transparent or luminous; and, finally, about human beings, because they are the perceivers of light. However, in order to camouflage all these things to some extent and to be able to say more freely what I thought about them without having either to accept or refute the views that are in vogue among the learned, I decided to leave this whole real world to their disputes and to speak only about what would happen in a new world if God were to create somewhere, in imaginary space, enough matter to compose such a world, and if he were to impart random and varying motions to the different parts of this matter so that it constituted a chaos as confused as poets could imagine and if, subsequently, he did nothing else except lend his ordinary cooperation to nature and allow it to act in accordance with the laws that he had established.<sup>18</sup>

Thus I first described this matter and tried to describe it in such a way that there is nothing in the world, it seems to me, which is more clear or more intelligible, apart from what was said earlier about God and the soul. I even assumed, explicitly, that it contained none of those forms or qualities about which they dispute in the schools nor, generally, anything which was not so naturally known to our souls that one could not even pretend to be ignorant of it. Moreover, I showed what the laws of nature are and, without basing my reasons on any other principle apart from the infinite perfections of God, I tried to demonstrate all the laws that may have seemed to be doubtful, and to show that they are such that, even if God had created many worlds, there could never

be one in which these laws failed to be observed. Then I showed how the largest part of the matter in this chaos should dispose and arrange itself, according to these laws, in a certain way which would make it similar to our skies; how, meanwhile, some parts of this matter should compose an earth, some should compose planets and comets, and others should compose a sun and fixed stars. Then, expanding on the subject of light, I explained at considerable length what kind of light should be found in the sun and the stars, and how it traversed, in an instant, the immense spaces of the heavens and how it would be reflected from the planets and comets towards the earth.

I also added many things about the substance, position, movements and all the various qualities of these heavens and stars, so that I thought I had said enough to show that there is nothing observed in those of this world which ought not to, or, at least, which could not, appear in exactly the same way in those of the world I was describing. Then I came to speak specifically about the earth – how, although I had explicitly assumed that God had not put any weight in the matter of which it is composed, all its parts would necessarily tend precisely towards its centre; how, since there is water and air on its surface, the disposition of the skies and the stars, especially of the moon, should cause an ebb and flow on its surface that would be similar in every respect to what is observed in our seas; how it should also cause a certain current – of water, as much as of air – from the east to the west, similar to what is also observed in the tropics; how mountains, seas, fountains and rivers could naturally be formed there, and how metals could be present in mines and how plants could grow in the fields and, generally, how all the bodies that are called mixed or composed could be engendered there. Among other things, since there was nothing in the world that I knew of, besides the stars, which produced light except fire, I applied myself to explain very clearly everything that pertains to the nature of fire, how it occurs and how it is fed, and how it sometimes has only heat without light and sometimes only light without heat, how it can introduce different colours in various bodies and many other qualities, how it melts some bodies and hardens others, how it can consume almost all bodies or change them into ashes and smoke, and finally how from these ashes it forms glass

simply by the force of its action. Since this transformation of ashes into glass seems to me to be as admirable as any other transformation that occurs in nature, I took special pleasure in describing it.

However, I did not wish to conclude from all these things that this earth was created in the way I had suggested, because it is much more probable that God made it, from the beginning, in the way it was to be.<sup>19</sup> But it is certain – a view that is widely accepted among theologians – that the action by which God conserves the world now is exactly the same as that by which he created it; so that even if, at the beginning, he had not given it any other form apart from that of a chaos, once he had established the laws of nature and had lent it his support to move as it usually does, one could believe, without denying the miracle of creation, that simply as a result of that, all things which are purely material would have been able, in time, to become as we observe them today. Their nature is also much easier to understand when one sees them developing gradually in this way than when one thinks of them only as being fully formed.

I moved on from the description of inanimate bodies and plants to that of animals and, in particular, to that of human beings. But since I did not yet have enough knowledge about this topic to speak in the same way as about the rest – i.e. by demonstrating effects by causes, and by showing from what seeds and in what way nature must produce human bodies – I was content to assume that God formed a human body entirely similar to one of ours, both in the external shape of its members and in the internal structure of its organs, without composing it of any other matter apart from what I have described above, and without putting into it, at the beginning, any rational soul or anything else that would function as a vegetative or sensitive soul. All he did was to stimulate in its heart one of those fires without light which I have already explained, and which I did not conceive as having any nature other than that which heats hay when it is harvested before it is dry or makes new wine bubble when it is left to ferment on the stems. In examining the functions that could occur in the body as a result of this heat, I found precisely all those that can occur in us without us thinking about them and, therefore, without our soul contributing to them – i.e. the part that is distinct from the body,

about which it was said above that its nature is only to think; these are all the same functions in which one could think that animals without reason resemble us. However, I could not find any of those functions which, since they depend on thought, are the only ones that belong to us as human beings, whereas I found all of them there subsequently once I had assumed that God created a rational soul and joined it to this body in a certain way that I described.

But to show how I dealt with this subject matter, I would like to provide here an explanation of the movement of the heart and arteries. Since this is the first and the most general motion that is observed in animals, one will judge easily from it what one should think about all the others. And to make it easier to understand what I shall say about it, I would like those who are not trained in anatomy to take the trouble before reading this to have cut open in front of them the heart of a large animal with lungs, because the heart in all of them is similar enough to the human heart, and to have shown to them the two chambers or cavities which are there. First, that which is on the right side, with which two very large tubes communicate, viz. the vena cava, which is the principal receptacle of the blood and is like the trunk of a tree, of which all the other veins of the body are branches, and the arterial vein (which was poorly named thus, because in fact it is an artery) which originates in the heart and, when it comes out of the heart, divides into many branches that spread out everywhere in the lungs. Then, the ventricle on the left side with which two tubes communicate in the same way, which are as large as, or are larger than, the former ones. These are the venous artery (also badly named, because it is merely a vein), which comes from the lungs, where it is divided into many branches that are intertwined with those of the arterial vein and those of the conduit called the windpipe, through which air enters when breathing; and the great artery which, coming out of the heart, sends its branches throughout the whole body.

I would also like them to be shown carefully the eleven small valves, which, like so many little doors, open and close the four openings in these two cavities. There are three of them at the opening of the vena cava, where they are arranged so that they cannot in any way impede the blood it contains from flowing into the right ventricle of the heart,

but they can prevent it completely from flowing out of it. There are three valves at the entrance to the arterial vein, which, since they are arranged in exactly the opposite way, easily allow the blood in this ventricle to pass into the lungs, but prevent the blood in the lungs from returning to the heart. There are also two more valves at the entrance to the venous artery that allow the blood to flow from the lungs towards the left cavity of the heart, but block its return; and there are three at the entrance of the large artery that allow blood to flow out of the heart but prevent its return. There is no need to look for any other explanation of the number of these valves apart from the fact that the opening of the venous artery is, because of its location, oval in shape and can easily be closed by two valves, whereas the others, which are round in shape, can be closed better by three of them. Moreover, I would like it if readers were asked to consider that the large artery and the two arterial veins are much harder and stronger in composition than the venous artery and the vena cava, and that the latter two become enlarged before entering the heart and are like two pouches there, called the auricles of the heart, which are composed of flesh similar to that of the heart. I would also like them to consider that there is more heat in the heart than in any other part of the body and, finally, that this heat can make a drop of blood which falls into its cavities expand and dilate suddenly, as all liquids usually do when they are made to fall, drop by drop, into a very hot vessel.

After that, I need say nothing else to explain the heart's motion except that, when its ventricles are not filled with blood, some blood flows necessarily from the vena cava into the right ventricle and from the venous artery into the left one, because these two vessels are filled with blood and their openings, which face towards the heart, cannot therefore be blocked. However, as soon as two drops of blood enter in this way, one into each ventricle, these drops — which must be very large, because the openings through which they enter are very large and the vessels from which they come are very full — are rarefied and expand because of the heat that they encounter there. In that way they cause the whole heart to expand, and push and close the five little doors that are at the entrances of the two vessels from which they came, thereby preventing any more blood from descending into the

heart. While they continue to rarefy more and more, they push and open the other six small doors that are at the entrances of the other two vessels through which they exit, thereby causing all the branches of the arterial vein and of the large artery to expand at almost the same time as the heart itself. Almost immediately afterwards, the heart contracts, and so do the arteries, because the blood that has entered them becomes cooled there and their six small doors are closed, while the five doors of the vena cava and venous artery reopen, and allow in two more drops of blood which immediately cause the heart and arteries to expand, in exactly the same way as the previous drops. Since the blood that enters the heart in this way passes through these two pouches which are called its auricles, it follows that their movement is the opposite to that of the heart, and that they contract when it expands.

Finally, in order that those who are not familiar with the force of mathematical demonstrations and are unaccustomed to distinguishing true reasons from probable ones, may not be tempted to reject this without examination, I wish to advise them that this movement that I have just explained follows just as necessarily from the disposition of the organs alone (which can be observed in the heart with the naked eye), from the heat (which one can feel there with one's fingers), and from the nature of the blood (that can be known by experience), as the motion of a clock follows from the force, arrangement and shape of its counterweights and wheels.

But if one asks how the blood in the veins is not exhausted by flowing continuously into the heart, and how the arteries are not filled by it too much because all the blood that flows through the heart goes into them, I need not say anything else in reply except what has already been written by an English physician,<sup>20</sup> who deserves to be praised for having broken the ice on this issue and for having been the first who taught that there are numerous small passages at the extremities of the arteries through which the blood that they receive from the heart enters into the small branches of the veins, from which it returns immediately to the heart, so that its motion is nothing but a constant circulation. He proves this very well from the common experience of surgeons who, when they ligate the arm moderately tightly above the

place where they open a vein, cause the blood to come out more abundantly than if they had not ligated it. The very opposite would happen if they ligated lower down, between the hand and the opening, or if they ligated very tightly above the opening. For it is clear that a moderately tight ligature can impede the blood that is already in the arm from returning to the heart through the veins; but it cannot thereby prevent new blood arriving from the arteries, because they are located below the veins and their walls are harder and are therefore less easy to press, and because the blood that comes from the heart tends to move with more force through them towards the hand than to return from there towards the heart through the veins. Since this blood comes out of the arm through the incision in one of the veins, there must necessarily be some passages below the ligature, i.e. towards the end of the arm, through which it can flow there through the arteries. He also proves equally well what he says about the way the blood flows through certain small membranes, that are so arranged at different places along the veins that they do not allow the blood to pass from the centre of the body towards its extremities, but only to return from the extremities towards the heart. He also proves it from the experience that shows that all the blood in the body can leave the body in a very short time through a single artery if it is cut, even if it had been very tightly ligated near the heart and if it were cut between the heart and the ligature, so that one has no reason to think that the blood which would emerge comes from anywhere else except the heart.

But there are many other things that show that the true cause of this motion of the blood is the one I indicated. For example, firstly, the difference that one can observe between the blood that comes from the veins and that which comes out of the arteries can result only from the fact that, when it is rarefied and as it were distilled in passing through the heart, it is thinner, livelier and warmer immediately after coming out – that is, when it is in the arteries – than it is a little while before it enters the heart, i.e. when it is in the veins. If one observes it, one will find that this difference appears clearly only near the heart, and does not appear as much in parts of the body that are far from it. Secondly, the hardness of the membranes, of which the arterial vein and the great artery are composed, is enough to show that the blood



strikes against them with greater force than against those of the veins. And why would the left cavity of the heart and the large artery be larger and wider than the right cavity and the arterial vein, if it were not that the blood from the venous artery — which, since it passed through the heart, has been only in the lungs — is thinner and becomes rarefied more easily and to a greater extent than that which comes directly from the vena cava? And what can physicians discover in feeling the pulse if they do not know that, as the blood changes its nature, it can be rarefied by the heat of the heart more or less strongly and more or less quickly than before? And if one examines how this heat is passed on to other parts of the body, must one not concede that it happens by means of the blood which, in passing through the heart, is reheated and spreads from there throughout the whole body?

It follows from this that, if one removes the blood from some part of the body, one thereby also removes the heat from it; and even if the heart were as hot as glowing iron, it would not be enough to reheat the hands or the feet as much as it actually does, if it did not continually send new blood there. This also shows that the true function of respiration is to bring enough fresh air into the lungs so that the blood, which comes to the lungs from the right cavity of the heart, where it was rarefied and, as it were, changed into vapours, thickens there and is immediately converted into blood before falling again into the left cavity, without which it would not be able to serve as nourishment for the fire that it encounters there. This is confirmed by observing that animals which have no lungs also have only one cavity in the heart, and that children who cannot use their lungs while they are enclosed in their mothers' wombs have an aperture through which blood from the vena cava flows into the left cavity of the heart, and a tube through which it comes from the arterial vein into the large artery without passing through the lung. Again, how would digestion take place in the stomach, if the heart did not send it some heat through the arteries and also some of the more fluid parts of the blood that assist in breaking down the foods that have been put there? Is it not easy to understand the action that converts the juice of these foods into blood, if one considers that it is distilled as it passes repeatedly through the heart, perhaps more than one or two hundred times per

day? And what more is required to explain nutrition, and the production of various humours that are found in the body, except to say that the force with which the blood passes from the heart to the extremities of the arteries when it is rarefied causes some of its parts to come to rest among those of the various members through which they flow, and they displace some of those that they expel; and, depending on the position, shape or small size of the pores they encounter, some of them go to some parts rather than to others in the same way that everyone may have seen that different sieves, with holes of varying sizes, are used to separate different grains from one another.

Finally, what is most noticeable in all this is the generation of animal spirits; they are like a very subtle wind or, rather, like a very pure and lively flame which, rising continually in great abundance from the heart to the brain, move from there through the nerves into the muscles and provide motion to all parts of the body. There is no need to imagine any other cause that makes the most penetrating and fast-moving parts of the blood the most suitable for constituting these spirits, and makes them move towards the brain rather than elsewhere, apart from the fact that the arteries, which carry them there, are those that come from the heart in a more direct line than any other arteries; according to the rules of mechanics — which are the same as the laws of nature — when many things tend together to move in a certain direction and there is not enough room for all of them, in the way in which particles of blood that exit from the left cavity of the heart tend towards the brain, the weaker and slower among them must be turned aside by the stronger particles which, in this way, travel there on their own.

I had explained all these things in sufficient detail in the treatise that I had planned to publish earlier.<sup>21</sup> Then I had shown, in the same place, what the structure of the nerves and muscles of the human body would have to be in order for the animal spirits in the body to have the power to move its members, as one sees when heads, soon after they have been cut off, still move and bite the ground even though they are no longer alive; what changes must be made in the brain to cause waking, sleep and dreams; how light, sounds, odours, tastes, warmth and all the other qualities of external objects can impress different ideas on it through the senses; how hunger, thirst, and the

other internal passions can also send their ideas there; what part of the brain should be taken as 'the common sense', where these ideas are received;<sup>22</sup> what should be taken as the memory, which stores the ideas, and as the imagination, which can vary them in different ways and compose new ones and, by the same means, distribute the animal spirits to the muscles and cause the limbs of the body to move in as many different ways as our own bodies can move without the will directing them, depending on the objects that are present to the senses and the internal passions in the body.

This will not seem strange to those who know how many different automata or moving machines can be devised by human ingenuity, by using only very few pieces in comparison with the larger number of bones, muscles and nerves, arteries, veins and all the other parts in the body of every animal. They will think of this body like a machine which, having been made by the hand of God, is incomparably better structured than any machine that could be invented by human beings, and contains many more admirable movements. I specifically paused to show that, if there were such machines with the organs and shape of a monkey or of some other non-rational animal, we would have no way of discovering that they are not the same as these animals. But if there were machines that resembled our bodies and if they imitated our actions as much as is morally possible, we would always have two very certain means for recognizing that, none the less, they are not genuinely human. The first is that they would never be able to use speech, or other signs composed by themselves, as we do to express our thoughts to others. For one could easily conceive of a machine that is made in such a way that it utters words, and even that it would utter some words in response to physical actions that cause a change in its organs — for example, if someone touched it in a particular place, it would ask what one wishes to say to it, or if it were touched somewhere else, it would cry out that it was being hurt, and so on. But it could not arrange words in different ways to reply to the meaning of everything that is said in its presence, as even the most unintelligent human beings can do. The second means is that, even if they did many things as well as or, possibly, better than any one of us, they would infallibly fail in others. Thus one would discover that they did not act

on the basis of knowledge, but merely as a result of the disposition of their organs. For whereas reason is a universal instrument that can be used in all kinds of situations, these organs need a specific disposition for every particular action. It follows that it is morally impossible for a machine to have enough different dispositions to make it act in every human situation in the same way as our reason makes us act.

Now one could also recognize the difference between human beings and beasts by these same two means. For it is very noticeable that there are no human beings so unintelligent and stupid, including even mad people, who are incapable of arranging different words and composing from them an utterance by which they make their thoughts understood; whereas there is no other animal, no matter how perfectly and favourably born it may be, which acts similarly. This does not result from the fact that they lack organs, for one sees that magpies and parrots can utter words as we do, but they still cannot speak as we do, that is, by showing that they think what they say; whereas human beings who are born deaf and dumb, and are thus deprived, as much as or even more than beasts, of the organs that are used by other people to speak, are accustomed to inventing some signs themselves by which they make themselves understood to those who are usually in their company and have the time to learn their language. And this shows not only that beasts have less reason than human beings, but that they have none at all. For it is clear that, to know how to speak, very little reason is required. And since one notices that there is as much inequality between animals of the same species as there is among human beings, and since some of them are easier to train than others, it is not credible that the most perfect representatives of the monkey or the parrot species would not be equal to one of the most stupid children or, at least, a child with a defective brain, if the nature of their soul were not completely different from ours.

One should not confuse words with the natural movements that express passions and that can be imitated both by machines and by animals; nor should one think, as some of the ancients did, that beasts speak although we do not understand their language. For if that were true, since they have many organs that correspond to ours, they would be able to make themselves understood by us as much as by other

animals. It is also something very remarkable that, although there are many animals that show more skill than us in some of their actions, one still notices that the same animals do not show any skill at all in many others. Thus whatever they do better than us does not prove that they have a mind because, on this assumption, they would have more intelligence than any of us and would be better at everything. It proves, rather, that they have no intelligence at all, and that it is nature which acts in them in accordance with the disposition of their organs, just as we see that a clock, which is made only of wheels and springs, can count the hours and measure time more accurately than we can with all our efforts.

After that, I had described the rational soul and had shown that it could not in any way be drawn from the potentiality of matter<sup>23</sup> as could the other things that I spoke about, but that it has to be specially created. I also showed how it is not enough if, with the possible exception of moving its limbs, it is lodged in the human body as a pilot in their ship, but that it has to be joined and united more closely with the body in order to have, in addition, sensations and appetites like ours and thus constitute a real human being. Finally, I discussed the soul at some length here because it is among the most important subjects; for, apart from the error of those who deny God — which I think I have adequately refuted above — there is none that more readily leads weak minds away from the straight path of virtue than to imagine that the soul of beasts has the same nature as ours and, consequently, that we have nothing to fear or hope for, after this life, any more than flies or ants. However, when we know how much these souls differ, we understand much better the reasons that prove that our soul is of such a nature that it is completely independent of the body, and therefore that it does not have to die with it. And since one can see no other causes that destroy the soul, one is naturally led to judge that it is immortal.

It is now three years since I reached the end of the treatise that contains all these things and began to revise it for submission to a publisher, when I noticed that some people whom I respect, and whose authority over my actions can hardly be less than that of my own reason over my thoughts, had censured a physical theory which had been published a little earlier by someone else.<sup>24</sup> I am not saying that I shared this view; but I would not have noticed anything about it, prior to their censure, that I could have imagined as prejudicial either to religion or the state or, consequently, that would have prevented me from writing the same if I had been convinced of it by reason. This made me fear that I might have been mistaken about one of my own views, despite the great care I had always taken not to accept any new beliefs unless I had very certain demonstrations for them, and not to write anything about them that could turn out to be detrimental to anyone. That was enough to make me change my earlier decision to publish them. For even though the reasons why I had made that decision previously were very convincing, my natural inclination — which had always made me hate the work of writing books — caused me to find immediately other reasons that were enough to excuse me from publishing. These reasons, both for and against, are such that it is not only in my own interest to state them here, but the public may also have an interest in knowing them.

I have never attributed great significance to what came from my own mind, and, as long as I gathered no other results from the method I used apart from the fact that I solved a number of problems that belong to the speculative sciences, or that I tried to regulate my own conduct by the reasons that I learned from it, I did not believe that I should write anything about it. For, as far as conduct is concerned, everyone trusts their own sense so much that one could find as many reformers as there are heads, if others were allowed to assume responsibility for changing conduct, apart from those whom God has established as sovereigns over their peoples, or to whom he has given enough grace and zeal to be prophets. And even though I was very satisfied with my