These men will be composed, as we are, of a soul and a body. First I must describe the body on its own; then the soul, again on its own; and finally I must show how these two natures would have to be joined and united in order to constitute men who resemble us.

I suppose the body to be nothing but a statue or machine made of earth, which God forms with the explicit intention of making it as much as possible like us. Thus God not only gives it externally the colours and shapes of all the parts of our bodies, but also places inside it all the parts required to make it walk, eat, breathe, and indeed to imitate all those of our functions which can be imagined to proceed from matter and to depend solely on the disposition of our organs.

We see clocks, artificial fountains, mills, and other such machines which, although only man-made, have the power to move of their own accord in many different ways. But I am supposing this machine to be made by the hands of God, and so I think you may reasonably think it capable of a greater variety of movements than I could possibly imagine in it, and of exhibiting more artistry than I could possibly ascribe to it.

Now I shall not pause to describe the bones, nerves, muscles, veins, arteries, stomach, liver, spleen, heart, brain, or any of the various other parts from which this machine must be composed. For I am supposing that they are entirely like the parts of our own bodies which have the same names, and I assume that if you do not already have sufficient first-hand knowledge of them, you can get a learned anatomist to show them to you — at any rate, those which are large enough to be seen with the naked eye. As for the parts which are too small to be seen, I can inform you about them more easily and clearly by speaking of the movements which depend on them. Thus I need only give an orderly

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1 By 'these men', Descartes means the fictional men he introduced in an earlier (lost) part of the work. Their description is intended to cast light on the nature of real men in the same way that the description of a 'new world' in The World, ch. 6, is intended to cast light on the real world. See also Discourse, part 5, pp. 132ff below.

2 By 'earth' Descartes means the third 'element', which he had discussed in The World, ch. 5 (cf. p. 89 above).
account of these movements in order to tell you which of our functions they represent ...  

129  The parts of the blood which penetrate as far as the brain serve not only to nourish and sustain its substance, but also and primarily to produce in it a certain very fine\(^2\) wind, or rather a very lively and pure flame, which is called the \textit{animal spirits}. For it must be noted that the arteries which carry blood to the brain from the heart, after dividing into countless tiny branches which make up the minute tissues that are stretched like tapestries at the bottom of the cavities of the brain, come together again around a certain little \textit{gland}\(^3\) situated near the middle of the substance of the brain, right at the entrance to its cavities. The arteries in this region have a great many little holes through which the finer parts of the blood can flow into this gland ... These parts of the blood, without any preparation or alteration except for their separation from the coarser parts and their retention of the extreme rapidity which the heat of the heart has given them, cease to have the form of blood, and are called the ‘animal spirits’.

Now in the same proportion as the animal spirits enter the cavities of the brain, they pass from there into the pores of its substance, and from these pores into the nerves. And depending on the varying amounts which enter (or merely tend to enter) some nerves more than others, the spirits have the power to change the shape of the muscles in which the nerves are embedded, and by this means to move all the limbs. Similarly you may have observed in the grottos and fountains in the royal gardens that the mere force with which the water is driven as it emerges from its source is sufficient to move various machines, and even to make them play certain instruments or utter certain words depending on the various arrangements of the pipes through which the water is conducted.

131  Indeed, one may compare the nerves of the machine I am describing with the pipes in the works of these fountains, its muscles and tendons with the various devices and springs which serve to set them in motion, its animal spirits with the water which drives them, the heart with the source of the water, and the cavities of the brain with the storage tanks. Moreover, breathing and other such activities which are normal and

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2 Fr. \textit{subtil}, by which Descartes means ‘composed of very small, fast-moving particles’.

3 The pineal gland, which Descartes later identifies as the seat of the imagination and the ‘common’ sense (p. 106 below). See also \textit{Passions} (pp. 340ff, below), where the gland is identified as the seat of the soul.
natural to this machine, and which depend on the flow of the spirits, are like the movements of a clock or mill, which the normal flow of water can render continuous. External objects, which by their mere presence stimulate its sense organs and thereby cause them to move in many different ways depending on how the parts of its brain are disposed, are like visitors who enter the grottos of these fountains and unwittingly cause the movements which take place before their eyes. For they cannot enter without stepping on certain tiles which are so arranged that if, for example, they approach a Diana who is bathing they will cause her to hide in the reeds, and if they move forward to pursue her they will cause a Neptune to advance and threaten them with his trident; or if they go in another direction they will cause a sea-monster to emerge and spew water onto their faces; or other such things according to the whim of the engineers who made the fountains. And finally, when a rational soul is present in this machine it will have its principal seat in the brain, and reside there like the fountain-keeper who must be stationed at the tanks to which the fountain's pipes return if he wants to produce, or prevent, or change their movements in some way . . .

Next, to understand how the external objects which strike the sense organs can prompt this machine to move its limbs in numerous different ways, you should consider that the tiny fibres (which, as I have already told you, come from the innermost region of its brain and compose the marrow of the nerves) are so arranged in each part of the machine that serves as the organ of some sense that they can easily be moved by the objects of that sense. And when they are moved, with however little force, they simultaneously pull the parts of the brain from which they come, and thereby open the entrances to certain pores in the internal surface of the brain. Through these pores the animal spirits in the cavities of the brain immediately begin to make their way into the nerves and so to the muscles which serve to cause movements in the machine quite similar to those we are naturally prompted to make when our senses are affected in the same way.

Thus, for example [in Fig. 1], if fire A is close to foot B, the tiny parts of this fire (which, as you know, move about very rapidly) have the power also to move the area of skin which they touch. In this way they pull the tiny fibre cc which you see attached to it, and simultaneously open the entrance to the pore de, located opposite the point where this fibre terminates—just as when you pull one end of a string, you cause a bell hanging at the other end to ring at the same time.

When the entrance to the pore or small tube de is opened in this way,

1 There follows a description of the way in which the animal spirits bring about muscular movements, breathing, swallowing, etc. See Passions, Part 1, pp. 334ff below.
the animal spirits from cavity \( F \) enter and are carried through it – some to muscles which serve to pull the foot away from the fire, some to muscles which turn the eyes and head to look at it, and some to muscles which make the hands move and the whole body turn in order to protect it . . .

Now I maintain that when God unites a rational soul to this machine (in a way that I intend to explain later) he will place its principal seat in the brain, and will make its nature such that the soul will have different sensations corresponding to the different ways in which the entrances to the pores in the internal surface of the brain are opened by means of the nerves.

Suppose, firstly, that the tiny fibres which make up the marrow of the nerves are pulled with such force that they are broken and separated from the part of the body to which they are joined, with the result that the structure of the whole machine becomes somehow less perfect. Being
pulled in this way, the fibres cause a movement in the brain which gives occasion for the soul (whose place of residence must remain constant) to have the sensation of pain.

Now suppose the fibres are pulled with a force almost as great as the one just mentioned, but without their being broken or separated from the parts to which they are attached. Then they will cause a movement in the brain which, testifying to the good condition of the other parts of the body, will give the soul occasion to feel a certain bodily pleasure which we call ‘titillation’. This, as you see, is very close to pain in respect of its cause but quite opposite in its effect.

Again, if many of these tiny fibres are pulled equally and all together, they will make the soul perceive that the surface of the body touching the limb where they terminate is smooth; and if the fibres are pulled unequally they will make the soul feel the surface to be uneven and rough.

And if the fibres are disturbed only slightly and separately from one another, as they constantly are by the heat which the heart transmits to the other parts of the body, the soul will have no more sensation of this than of any other normal function of the body. But if this stimulation is increased or decreased by some unusual cause, its increase will make the soul have a sensation of heat, and its decrease a sensation of cold. Finally, according to the various other ways in which they are stimulated, the fibres will cause the soul to perceive all the other qualities belonging to touch in general, such as moisture, dryness, weight and the like.

It must be observed, however, that despite the extreme thinness and mobility of these fibres, they are not thin and mobile enough to transmit to the brain all the more subtle motions that take place in nature. In fact the slightest motions they transmit are ones involving the coarser parts of terrestrial bodies. And even among these bodies there may be some whose parts, although rather coarse, can slide against the fibres so gently that they compress them or cut right through them without their action passing to the brain. In just the same way there are certain drugs which have the power to numb or even destroy the parts of the body to which they are applied without causing us to have any sensation of them at all...

It is time for me to begin to explain how the animal spirits make their way through the cavities and pores of the brain of this machine, and which of the machine’s functions depend on these spirits.

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1 There follows an account of the other external senses (taste, smell, hearing and sight) and of internal sensations (hunger, thirst, joy and sadness). For Descartes’ theory of vision, see Optics (pp. 167ff below), for the other external senses, see Principles, Part 4, art. 192–4 (pp. 282ff below) and for the internal sensations, see Passions, passim.
If you have ever had the curiosity to examine the organs in our churches, you know how the bellows push the air into certain receptacles (which are called, presumably for this reason, wind-chests). And you know how the air passes from there into one or other of the pipes, depending on the different ways in which the organist moves his fingers on the keyboard. You can think of our machine’s heart and arteries, which push the animal spirits into the cavities of its brain, as being like the bellows of an organ, which push air into the wind-chests; and you can think of external objects, which stimulate certain nerves and cause spirits contained in the cavities to pass into some of the pores, as being like the fingers of the organist, which press certain keys and cause the air to pass from the wind-chests into certain pipes. Now the harmony of an organ does not depend on the externally visible arrangement of the pipes or on the shape of the wind-chests or other parts. It depends solely on three factors: the air which comes from the bellows, the pipes which make the sound, and the distribution of the air in the pipes. In just the same way, I would point out, the functions we are concerned with here do not depend at all on the external shape of the visible parts which anatomists distinguish in the substance of the brain, or on the shape of the brain’s cavities, but solely on three factors: the spirits which come from the heart, the pores of the brain through which they pass, and the way in which the spirits are distributed in these pores. Thus my sole task here is to give an orderly account of the most important features of these three factors ... 

Now, the substance of the brain being soft and pliant, its cavities would be very narrow and almost all closed (as they appear in the brain of a corpse) if no spirits entered them. But the source which produces these spirits is usually so abundant that they enter these cavities in sufficient quantity to have the force to push out against the surrounding matter and make it expand, thus tightening all the tiny nerve-fibres which come from it (in the way that a moderate wind can inflate the sails of a ship and tighten all the ropes to which the sails are attached.) It follows that at such times the machine is disposed to respond to all the actions of the spirits, and hence it represents the body of a man who is awake. Or at least the spirits have enough force to push against some parts of the surrounding matter in this way, and so make it tight, while the other parts remain free and relaxed (as happens in parts of a sail when the wind is a little too weak to fill it). At such times the machine represents the body of a man who is asleep and who has various dreams as he sleeps ...

1 There follows a description of the animal spirits and how their state is affected by digestion, respiration, and other bodily functions; of the pores of the brain; and of the movement of the spirits through the pores.
But before I speak in greater detail about sleep and dreams, I must have you consider the most noteworthy events that take place in the brain during the time of waking: namely, how ideas of objects are formed in the place assigned to the imagination and to the 'common' sense, how the ideas are retained in the memory, and how they cause movement in all the parts of the body...

In order to see clearly how ideas are formed of the objects which strike the senses, observe in this diagram [Fig. 2] the tiny fibres 12, 34, 56, and the like, which make up the optic nerve and stretch from the back of the eye at 1, 3, 5 to the internal surface of the brain at 2, 4, 6. Now assume that these fibres are so arranged that if the rays coming, for example, from point A of the object happen to press upon the back of the eye at point 1, they pull the whole of fibre 12 and enlarge the opening of the tiny tube marked 2. In the same way, the rays which come from point B enlarge the opening of the tiny tube 4, and likewise for the others. We have already described how, depending on the different ways in which the points 1, 3, 5 are pressed by these rays, a figure is traced on the back of the eye corresponding to that of the object ABC. Similarly, it is obvious that, depending on the different ways in which the tiny tubes 2, 4, 6 are opened by the fibres 12, 34, 56, etc., a corresponding figure must also be traced on the internal surface of the brain.

Suppose next that the spirits which tend to enter each of the tiny tubes 2, 4, 6, and the like, do not come indifferently from all points on the surface of gland H, but only from certain of these points: those coming from point a on this surface, for example, tend to enter tube 2, those from points b and c tend to enter tubes 4 and 6, and likewise for the

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1 See footnote 1, p. 41 above.
others. As a result, at the same instant that the openings to these tubes expand, the spirits begin to leave the corresponding points on the gland more freely and more rapidly than they did previously. Thus, just as a figure corresponding to that of the object ABC is traced on the internal surface of the brain according to the different ways in which tubes 2, 4, 6 are opened, likewise that figure is traced on the surface of the gland according to the ways in which the spirits leave from points a, b, c.

And note that by ‘figures’ I mean not only things which somehow represent the position of the edges and surfaces of objects, but also anything which, as I said above, can give the soul occasion to perceive movement, size, distance, colours, sounds, smells and other such qualities. And I also include anything that can make the soul feel pleasure, pain, hunger, thirst, joy, sadness and other such passions. For it is easy to understand that tube 2, for example, may be opened in different ways – in one way by the action which I said causes sensory perception of the colour red, or of tickling, and in another way by the action which I said causes sensory perception of the colour white, or of pain; and the spirits which leave from point a will tend to move towards this tube in a different manner according to differences in its manner of opening, and likewise for the others.

Now among these figures, it is not those imprinted on the external sense organs, or on the internal surface of the brain, which should be taken to be ideas – but only those which are traced in the spirits on the surface of the gland H (where the seat of the imagination and the ‘common’ sense is located). That is to say, it is only the latter figures which should be taken to be the forms or images which the rational soul united to this machine will consider directly when it imagines some object or perceives it by the senses.

And note that I say ‘imagines or perceives by the senses’. For I wish to apply the term ‘idea’ generally to all the impressions which the spirits can receive as they leave gland H. These are to be attributed to the ‘common’ sense when they depend on the presence of objects; but they may also proceed from many other causes (as I shall explain later), and they should then be attributed to the imagination.

Here I could add something about how the traces of these ideas pass through the arteries to the heart, and thus radiate through all the blood; and about how certain actions of a mother may sometimes even cause such traces to be imprinted on the limbs of the child being formed in her womb. But I shall content myself with telling you more about how the traces are imprinted on the internal part of the brain [marked B on Fig. 2] which is the seat of the memory.

1 See note 3, p. 100 above.
To this end, suppose that after the spirits leaving gland \( H \) have received the impression of some idea, they pass through tubes 2, 4, 6, and the like, into the pores or gaps lying between the tiny fibres which make up part \( B \) of the brain. And suppose that the spirits are strong enough to enlarge these gaps somewhat, and to bend and arrange in various ways any fibres they encounter, according to the various ways in which the spirits are moving and the different openings of the tubes into which they pass. Thus they also trace figures in these gaps, which correspond to those of the objects. At first they do this less easily and perfectly than they do on gland \( H \), but gradually they do it better and better, as their action becomes stronger and lasts longer, or is repeated more often. That is why these figures are no longer so easily erased, and why they are preserved in such a way that the ideas which were previously on the gland can be formed again long afterwards without requiring the presence of the objects to which they correspond. And this is what memory consists in.

But before going on to describe the rational soul, I should like you once again to give a little thought to everything I have said about this machine. Consider, in the first place, that I have supposed in it only organs and mechanisms of such a type that you may well believe very similar ones to be present both in us and in many animals which lack reason as well. Regarding those which can be seen clearly with the naked eye, the anatomists have already observed them all. And as for what I have said about the way in which the arteries carry the spirits into the head, and about the difference between the internal surface of the brain and its central substance, the anatomists will, if they simply make closer observations, be able to see sufficient indications of this to allay any doubts about these matters too. Nor will they be able to have doubts about the tiny doors or valves which I have placed in the nerves where they enter each muscle, if they take care to note that nature generally has formed such valves at all the places in our bodies where some matter regularly goes in and may tend to come out, as at the entrances to the heart, gall-bladder, throat, and large intestine, and at the main divisions of all the veins. Again, regarding the brain, they will not be able to imagine anything more plausible than that it is composed of many tiny fibres variously interlaced; for, in view of the fact that every type of skin and flesh appears to be similarly composed of many fibres or threads, and that the same thing is observed in all plants, such fibrous composition is apparently a common property of all bodies that can grow and be

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1 There follows an account of the way in which the animal spirits form ideas on the surface of the pineal gland, and produce bodily movements like those of real men, despite the absence of any soul. See Passions, Part 1, art. 13–16, 21–4, pp. 333ff, 336f below.
nourished by the union and joining together of the minute parts of other bodies. Finally, as for the rest of the things I have assumed which cannot be perceived by any sense, they are all so simple and commonplace, and also so few in number, that if you compare them with the diverse composition and marvellous artistry which is evident in the structure of the visible organs, you will have more reason to think I have omitted many that are in us than to think I have introduced any that are not. And, knowing that nature always acts by the simplest and easiest means, you will perhaps conclude that it is possible to find some which are more similar to the ones she in fact uses than to those proposed here.

I should like you to consider, after this, all the functions I have ascribed to this machine—such as the digestion of food, the beating of the heart and arteries, the nourishment and growth of the limbs, respiration, waking and sleeping, the reception by the external sense organs of light, sounds, smells, tastes, heat and other such qualities, the imprinting of the ideas of these qualities in the organ of the ‘common’ sense and the imagination, the retention or stamping of these ideas in the memory, the internal movements of the appetites and passions, and finally the external movements of all the limbs (movements which are so appropriate not only to the actions of objects presented to the senses, but also to the passions and the impressions found in the memory, that they imitate perfectly the movements of a real man). I should like you to consider that these functions follow from the mere arrangement of the machine’s organs every bit as naturally as the movements of a clock or other automaton follow from the arrangement of its counter-weights and wheels. In order to explain these functions, then, it is not necessary to conceive of this machine as having any vegetative or sensitive soul or other principle of movement and life, apart from its blood and its spirits, which are agitated by the heat of the fire burning continuously in its heart—a fire which has the same nature as all the fires that occur in inanimate bodies.