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Chapter 24

Animals

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Descartes notoriously proposed that (non-human) animals are mere machines, devoid of sensation or feeling. This proposal, which in itself seems ludicrous, becomes intelligible when seen within Descartes's larger philosophical scheme. In this scheme, sensation and feeling can arise only in a mind: an immaterial substance, distinct from matter. For various reasons, Descartes denied minds to animals, and, on that basis, he denied them feeling.

In the body of ancient, medieval, and Renaissance philosophy and theology that informed Descartes's philosophy, most thinkers considered the divide between non-human and human animals to be large and significant. Most philosophers held that only the human animal is rational, self-reflective, and free to deliberate and choose. They viewed non-human animals as possessing sentience and some simple cognitive abilities, but as unable to entertain universal notions (such as the concept of *animal*, which applies to all animals) or to represent cognitively anything except concrete, particular bodies. Theologically, most held that, while the human soul is immortal, other animals either lack a soul or have a soul that perishes with the body. Descartes reinforced the metaphysical divide between humans and other animals. He upheld the immortality of the human soul, and he argued that, if other animals had souls, they too would be immortal – a theologically heterodox consequence that he rejected, therefore denying souls to animals.

Nonetheless, animals are like human beings in that they are alive, they eat and drink to maintain their bodies, they have sense organs, and they move. Many earlier thinkers explained such commonalities by attributing a lower form of soul, an *animal soul*, to both human and non-human animals. Plato held that this common animal soul explains sentience in humans and animals alike, and that humans additionally have an intellectual soul. Aristotle and his medieval followers held that human and animal souls share the *vegetative* (or vital) powers of nutrition, growth, and reproduction and the *sensitive* powers of sensation and movement, but that only the human soul has the power of *reason* or *intellect*.

Given that Descartes denied any sort of soul to animals, his other philosophical commitments entailed that he must explain the vital and sensitive powers of non-human animals through purely material causes. Indeed, he welcomed this task, for he was engaged in the larger project of providing purely mechanistic explanations for all

natural phenomena of the material world. Animal bodies form functional unities that are adapted to environmental circumstances and that maintain themselves by eating and drinking when they need to. Earlier thinkers invoked animal souls to explain such functional unity and goal-seeking behavior. In his new physics, Descartes sought to discover or hypothesize material mechanisms that would explain the physiological and behavioral capacities of animals, including how they maintain themselves by seeking food and drink, reproduce themselves, and modify their behavior to fit current circumstances. Metaphysically, his new perspective raised the problem of accounting for the functional unity of the animal body considered as a purely material construction, devoid of an active, organizing power such as the sensitive soul.

Descartes's project becomes even more challenging if we ask whence come such mechanisms that are capable of performing the functions of living things. Officially, Descartes endorsed the accepted theological orthodoxy, that God designed and created the bodily mechanisms of humans and animals. However, in his natural philosophy he set himself the task of explaining the origin of animals as part of the natural development of the universe out of an original chaotic soup of material particles. Within this naturalistic perspective, he must explain how, through purely material processes, the functionally organized bodies of living things (plants and animals) could be produced from non-living matter. Without a designing creator, how do animal bodies arise that are capable of digesting food, growing, reproducing, and performing the behaviors needed to preserve life and health?

This chapter considers philosophical problems concerning non-human (and sometimes human) animals, including their metaphysical, physical, and moral status, their origin, what makes them alive, their functional organization, and the basis of their sensitive and cognitive capacities. I proceed by assuming what most of Descartes's followers and interpreters have held: that Descartes proposed that animals lack sentience, feeling, and genuinely cognitive representations of things. However, some scholars interpret Descartes differently, denying that he excluded sentience, feeling, and representation from animals, and I will consider the evidence for these interpretations as well. Finally, hereafter, when I use the word "animal" without further qualification, it means non-human animal.

Status of Animals

Among ancient Greek philosophers, Plato accorded a modicum of reason to animals, and Aristotle denied them reason. Thomas Aquinas, the single most important philosopher among medieval Christian theologians, codified this denial. He drew the implication – which Augustine of Hippo, the most important Christian theologian of late antiquity, had only suggested – that only the human animal has an immortal soul (Sorabji 1993). Aquinas thereby placed humankind on the frontier between worldly and divine. Human beings are linked to the animal world through their bodily capacities, but they are similar to angels and analogous to God through their immaterial, hence immortal, souls.

Aquinas's philosophical argument for the special status of humankind drew upon the Aristotelian account of the vital and cognitive faculties of plants, animals, and

human beings, which attributed differing kinds of souls to each: vegetative souls to plants; sensitive souls to animals; but rational souls to human beings alone. Just as the sensitive soul of animals also incorporates the vegetative powers (nutrition, growth, and reproduction), the human rational soul incorporates both these and the sensitive (sensory and motor) powers as well. The higher, rational, powers unique to humans include intellection and voluntary action, or free will (Thomas Aquinas 1964–81: I.76.4, 79.1). Following a hint in Aristotle, Aquinas argued that the vegetative and sensitive souls are intrinsically united to corporeal organs in their operation and that they therefore perish with the body of the plant or animal (Sorabji 1993: 201). By contrast, the rational power of the human soul operates independently of any bodily organ (even if, for the human soul to think during this life, it must use the faculty of imagination, which does require a corporeal organ, in the brain) (Hatfield 1998: 954–61). Accordingly, the rational soul is deemed to be immaterial and immortal. This generalized Aristotelian account of animal and human souls and their powers and status was widely held in Descartes's time (e.g., Dupleix 1990: 521–652; Eustachius a Sancto Paulo 1998: 83–92).

Augustine and Aquinas held a further thesis about the relation between humans and animals: that animals are created for the use of humankind, and so may be killed and eaten (Sorabji 1993: 198). The metaphysical divide between rational and non-rational, together with this view about God's providential aims, rendered animals as means toward human ends.

There were dissenters regarding the cognitive and moral divide between humans and animals. The ancient atomists, Epicurus and Lucretius, argued that all minds are purely material, formed from subtle matter, that is, from very fine material atoms in the bodies of human and non-human animals (Lucretius 1994: 71–2). These atoms possess only the qualities of shape, size, motion, and weight (pp. 45–6). Sensation arises when groups of atoms – shaped as images, in the case of vision – enter the sense organs and brain. Thought occurs when images interact with the subtle matter of the mind (pp. 113–16).

In the seventeenth century, Thomas Hobbes developed a similar position. He agreed that sensation involves nothing other than bare interactions between the matter inside and outside sentient bodies, and he also restricted the content of thought to images. Accordingly, he recognized no intrinsic, metaphysical distinction between human and animal cognition: human thought is a function of the faculty of imagination – a faculty that theorists generally, Aquinas included, agreed is common to humans and animals. Hobbes explained the human capacity for reasoning as arising through the acquisition of language. By providing a range of distinguishable symbols, language increases the power of the imagination for thinking (Hatfield 1998: 972–5).

In the century prior to Descartes and Hobbes, Michel de Montaigne (1965) argued that humans are not different in kind from animals, either morally or cognitively. His arguments drew upon a range of literature, with frequent reference to Lucretius. In effect, he denied any metaphysical distinction between humans and animals, whether founded on supposed differences in rationality or in moral standing.

Descartes widened and reconceived the gap between animals and human beings. He viewed Aristotle's and Aquinas's theories as accounting for human souls by adding a new power – that of reason – to the animal soul (3:62; AT 1:415). By contrast,

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Descartes rejected the animal soul. Thus arose the task (which he coveted) of explaining the capacities of both human and animal bodies through configurations of deanimated matter: matter devoid of any properties except shape, size, position, and motion. He continued to place human beings on the border between the material world and the divine: they have bodies, but they also have immaterial minds. As he saw things, thought and feeling are functions of an unextended, immaterial, thinking substance. But, further, since he viewed feeling as a function of thought, if animals had souls that felt, they would exhibit signs of thought (1:140–1; AT 6:58–9; 3:374; AT 5:345).

In his *Discourse on the Method*, Descartes proposed two criteria to prove that animals show no signs of thought, and indeed "have no reason at all" (1:140; AT 6:58). He described animals as purely material bodies, which he labeled as "machines" due to their intricate organization. He then contended that, although such machines might exhibit all the behaviors characteristic of animals, two aspects of their behavior would reveal that they lack minds. First, "they could never use words, or put together other signs, as we do in order to declare our thoughts to others" (1:140; AT 6:56). Parrots and magpies can pronounce words that sound like human language, but they do not exhibit the behavior that indicates genuine speech: "they cannot show that they are thinking what they are saying" (1:140; AT 6:57). Second, although mindless machines might do some things better than can human beings (as bees do in building a honeycomb), they would fail at many other tasks. This shows that their skill derives from innate mechanisms rather than from reason, because "reason is a universal instrument which can be used in all kinds of situations" (1:140; AT 6:57). If animals possessed reason, they would show the same sort of general problem-solving abilities as do human beings.

Descartes claims that these arguments reveal the profound gap between animals and humans: "when we know how much the beasts differ from us, we understand much better the arguments which prove that our soul is of a nature entirely independent of the body, and consequently that it is not bound to die with it" (1:141; AT 6:59). As did Aquinas, he concluded that reason is an immaterial power, so that the possession of reason proves that the human soul is capable of surviving the body. Unlike Aquinas, Descartes refused to countenance a vegetative or sensory soul. In his *Treatise on Man*, which he composed in the early 1630s and described in the *Discourse* (of 1637), he asserts that his animal machines could perform vital and sensitive functions without "any vegetative or sensitive soul" (1:108; AT 11:202). This was, in effect, to deny that animals possess any sentience at all, on the assumption that matter by itself is incapable of feeling (3:98–100; AT 2:38–41).

A few years later, in a letter to his chief correspondent, Marin Mersenne, Descartes clarified the relation between sentience and the human (or "rational") soul. He conceded that animals might exhibit the kind of behavior that we exhibit when we feel pain, but he contended that they do not actually feel pain, because they have no minds:

> I do not explain the feeling of pain without reference to the soul. For in my view pain exists only in the understanding. What I do explain is all the external movements which accompany this feeling in us; in animals it is these movements alone which occur, and not pain in the strict sense. (June 11, 1640; 3:148; AT 3:85, 11)

Animals, we can infer, possess no faculty of "understanding" and so no soul or mind; hence, they feel no pain. (On Descartes's equation of the immaterial soul with mind, see 2:114, 246; AT 7:161, 356.)

By making sentience depend on the understanding, Descartes deviates from the Aristotelian position and leaves no room for an animal soul that lacks reason and understanding but still possesses sentience. In the *Meditations*, Descartes elaborated his theory of mind in a way that illuminates this connection between sentience and understanding. Matter is a spatially extended and unthinking substance, and mind is an unextended and thinking substance (2:54; AT 7:78). They share no properties: matter can't think, and thoughts (or the mind that thinks them) are not extended. Further, the one essential property of thinking substance is intellect or understanding. Sensory perception and consciousness depend on the intellectual attribute of thinking substance (2:54–5, 113, 382; AT 7:79, 160, 559). Thinking substance also has a faculty of volition, that is, of willing; willing is a sort of thought, or thought-activity (2:19; AT 7:28; 1:204; AT 8A:17).

Descartes's theory therefore marks two further differences between human beings and animals, beyond language use and general reasoning: human beings have sentience and consciousness, animals do not; human beings exercise will, animals do not. The denial of will to animals was commonplace. Aquinas spoke of animal "appetite" rather than will (1964–81: I.81.3); for him, such appetite involved sentience and feeling.

Finally, Descartes did not endorse the usual notion that animals were created for human use. He did not deny it outright, but he contended that we could never know it, because we are unable to discern God's ends. For the latter reason, he generally banished from natural philosophy the search for "final causes" (2:39; AT 7:55): "it would be the height of presumption if we were to imagine that all things were created by God for our benefit alone, or even to suppose that the power of our minds can grasp the ends which he set before himself in creating the universe" (1:248; AT 8A:81). He allowed that, ethically, it may be "an act of piety to assert that God made everything for our benefit"; but, to assume "in the study of physics" that "all things were in fact made for our benefit, in the sense that they have no other use," would be "utterly ridiculous and inept," since "many things exist, or once existed, though they are here no longer, which have never been seen or thought of by any man, and have never been of any use to anyone" (1:248–9; AT 8A:81).

Origins of Animals

Common medieval and early modern explanations of how living things (plants and animals) reproduce have them arising through the propagation of "seeds" or from the mixing of seminal fluids. In the Aristotelian scheme, male animals provide the "form" of the living thing (the animal soul), female animals the "matter." According to Aquinas and his followers, God infuses the rational soul in human animals when the embryo has reached an appropriate stage of development (Roger 1997: 49, 72).

Such a process might explain the origin of individual animals, but how did the first male and female parents arise? Augustine, Aquinas, and other Christian theologians

believed that God designed and created original pairs of plants and animals, from which subsequent living things have descended through the usual processes of reproduction. However, special creation and sexual reproduction were not the only going accounts of the origins of (at least some) plants and animals. Many thinkers, including Christian thinkers, held that, after creation, some plants and even some animals, such as insects or worms, arise through spontaneous generation (Roger 1997: 61). When conditions are right in rotting meat, mud, or dead wood, flies or worms may come forth. Indeed, Lucretius held that spontaneous generation could even explain the origin of the first plants and animals: they were born of the Earth in an earlier age when its crust was hotter and wetter.

Lucretius envisioned an account of the formation of the heavens, earth, plants, and animals from the chance conglomeration of atoms in the void. The atoms, which naturally fall downward (recall that these atoms have weight, in addition to shape, size, and motion), are diverted from their uniform falling when some of them, on some occasions, inexplicably "swerve" (1994: 43). The resulting collisions among particles led to the formation of the heavens and Earth. Over time, the atoms variously combine; indeed, they "have come together in every possible way and tested everything that could be formed by their combination" (p. 139). Among these combinations were living things. Once the Earth had formed, it spontaneously produced plants (p. 148). Subsequently, it brought forth all the animals, including human beings, through a process that still sometimes occurs:

> Even now multitudes of animals are formed out of the earth with the aid of showers and the sun's genial warmth. So it would not have been surprising if more and bigger ones had taken shape and developed in those days, when earth and ether were young. (p. 149)

Processes similar to those that (ostensibly) now cause spontaneous generation brought forth all the animal kinds in an earlier age. Birds were formed first; then, as there was "a great superfluit of heat and moisture in the soil," there formed "wombs, clinging to the earth by roots." These wombs brought forth mammals who were suckled by Earthly extrusions of "a juice resembling milk." Indeed, "here is further proof that the name of mother has rightly been bestowed on the earth, since it brought forth the human race and gave birth to every beast that runs wild among the high hills" (p. 149).

Descartes knew Lucretius' work well enough to attempt to quote it from memory (3:63; AT 1:417). In his post-student days in Holland (1618–19), he studied atomism (and mathematics) with Isaac Beeckman (AT 10:67–8). In 1619–20, he started a notebook entry named "Democritica," after the ancient atomist Democritus (AT 10:8). In this early period, he was enthralled by the atomist picture, and may, in atomist fashion, have considered the soul as subtle matter, like wind or fire (1:5; AT 10:218; 2:17; AT 7:26). He later rejected atomism in favor of corpuscularism (the view that matter is infinitely divisible, where atoms are indivisible), and he adopted a view that the soul or mind is immaterial. Nonetheless, for the material world he reinterpreted and developed the atomist cosmogony in corpuscular terms.

Descartes described the formation of the solar system and Earth in two major works, the *Principles of Philosophy* and the earlier *World, or Treatise on Light*. In both works, he nominally endorsed the "doctrine of Christian faith," that the Earth and its plants and

animals were created by God just as they are now (1:256; AT 8A:99–100; also 1:90, 99; AT 11:32, 120). Nonetheless, within natural philosophy he considered it more useful to develop ("hypothetically," he said) an account in which God's role is limited to creating the material soup of moving particles from which a world like ours arises. He wrote in the *Principles*:

> if we want to understand the nature of plants or of men, it is much better to consider how they can gradually grow from seeds than to consider how they were created by God at the very beginning of the world. Thus we may be able to think up certain very simple and easily known principles which can serve, as it were, as the seeds from which we can demonstrate that the stars, earth and indeed everything we observe in this visible world could have sprung. (1:256; AT 8A:100)

He begins with the hypothesis that God has created bare, extended matter that forms a plenum of particles of various sizes; he imparts to these particles a certain quantity of motion that he keeps constant as it is transferred among the particles in accordance with his three laws of motion (1:240–3; AT 8A:61–6). Descartes describes how, out of this soup, suns and planetary systems form, how continents and mountains form on the Earth, and how minerals form.

How plants and animals form should come next, yet Descartes does not cover this topic in either the *Principles* or the *World*. But he was working on it. In the *Discourse*, describing the as yet unpublished *World*, he encourages us to believe that, from matter in motion, "all purely material things could in the course of time have come to be just as we now see them" (1:133–4; AT 6:45). He then implies that he had already provided an account of the formation of plants in the *World*, but that animals and human beings had stymied him:

> From the description of inanimate bodies and plants I went on to describe animals, and in particular men. But I did not yet have sufficient knowledge to speak of them in the same manner as I did of the other things – that is, by demonstrating effects from causes and showing from what seeds and in what manner nature must produce them. (1:134; AT 6:45)

The part of the work in which he described the formation of plants has not survived (assuming he actually wrote it); he continued to develop, but never published, his account of the generation of animals.

In 1639, Descartes wrote to Mersenne that "the number and the orderly arrangement of the nerves, veins, bones and other parts of an animal do not show that nature is insufficient to form them, provided you suppose that in everything nature acts exactly in accordance with the laws of mechanics" (3:134; AT 2:525). Having previously excluded the generation of animals from his *World* because it would "take me too long" to explain (3:39; AT 1:254), he now boasts that he "can explain it all in detail, just as in my *Meteorology* I explained the origin of a grain of salt or a crystal of snow," saying that if he were starting his *World* over, he would include this explanation (3:134–5; AT 2:525). Ten years later, he expressed dissatisfaction with his explanation of the "formation" of animals, but, although discouraged, he believed that he could finish it *and* his entire physics, given the needed time and experiments (AT 5:261).

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If Descartes did not achieve a satisfactory account of how animals might arise naturally out of the chaos, it was not for want of trying. In some of his early recorded thoughts on generation (both spontaneous and through mating), he sketched the basic process as starting from the circular flowing of subtle matter (spirits and blood) that heat has enlivened; this flowing matter presses particles together to form tubular structures and closed sacs, eventually accruing an entire body (AT 11:505–6). The same process might form animals spontaneously in nature: "so little is required to make an animal, it is really not surprising that we see so many animals, so many worms, so many insects spontaneously forming in all putrefied matter" (AT 11:506). In January 1648, as he composed the portion of his *Description of the Human Body* on generation, he retained the basic conception: procreative generation results when the seminal fluids from male and female form a kind of intrauterine vortex, through which various organs and limbs are produced (1:321–4; AT 11:252–7). In his conversation with Burman at this time (3:349; AT 5:168–9), he also made clear that he considered the account of creation in Genesis to be metaphorical. We may therefore take Descartes to have believed that plants, animals, and human bodies really were formed naturally as the cosmos developed, just as animal bodies are now formed naturally through material interactions in procreation.

Life, Health, and Function

Plants, animals, and human beings exhibit the traditional marks of life: nutrition, growth, and reproduction. Further, animals have sense organs and motor apparatus that allow them to seek nutrients, avoid harms, and locate benefits. Descartes acknowledged that these phenomena are displayed by living things. He contended that all these phenomena could be explained mechanistically, by the "disposition" or "arrangement" of plant or animal organs, just as the behavior of a clock is explained by its "counterweights and wheels" or its "wheels and springs" (1:108; AT 11:202; 1:139–41; AT 6:55–9). Further, he held that the same mechanisms can explain how animals behave so as to approach what is beneficial and avoid what is harmful to their bodies (Descartes 1998: 163; AT 11:193, 519).

The dominant explanation of these phenomena in Descartes's time invoked Aristotelian teleology. A teleological explanation appeals to aims or ends or outcomes in explaining a process. Plants and animals incorporate nutrients *so that* their bodies will grow and sustain themselves, they mate *in order to* reproduce, they avoid harm and seek benefit *in order to* preserve their bodies. In Aristotelian terms, the development, maintenance, and reproduction of the plant or animal is the end or "final cause" of the plant's or animal's vegetative soul or power; and the preservation and reproduction of the animal is the final cause of the animal's sensitive soul (Aristotle 1984: 661). Christian theologians such as Aquinas adapted the notion that lower souls pursue ends or final causes to their conception of the world as created. Thus, on their view plants and animals seek to live and reproduce because God found it good to make things that have those ends (Thomas Aquinas 1964–81: I.44.4, 47.1, 77.3). Here, the notion of an end or final cause has both an external aspect (God as creator, who orders things

according to his goodness) and an internal aspect (God creates things which themselves have Aristotelian internal ends).

As noted above, Descartes sought to banish from natural philosophy any appeal to God's ends. He also banished vegetative and sensitive souls, and hence he precluded explaining the self-preserving behavior of plants and animals in terms of final causes that are embedded in such souls. In the material world, he permitted causation only through the impact of bodies (large or small) on other bodies. Unlike Aristotelian physics, there are no "forms" embodying final causes through which they order and direct the motions of even inanimate things.

Did Descartes, then, remove all final causes from the world? In fact, no. As many scholars have observed (e.g., Laporte 1928; Simmons 2001), Descartes himself appealed to teleology and final causes in the *Meditations*. He describes God's ends in setting up the mind-brain relation: God sought to align sensations with brain states so that the sensations would best contribute to "the preservation of the healthy man" (2:60; AT 7:87). God made the mental feeling of thirst a generally reliable indicator that we should drink, and he arranged that the sensations of the external senses generally lead us toward what is beneficial and away from what is harmful to the body (2:56; AT 7:81).

So far, Descartes has invoked teleology only in God's ends regarding the mind-brain relation. Descartes also used teleological talk in describing the parts of the body (Hatfield 1992: 361), when he spoke of the "functions" or "uses" of those parts. These include the generic functions usually associated with the vegetative soul (nutrition, growth, and reproduction), as well as more specific functions, such as alterations in the blood to make it suitable for nourishing the body or for producing the spirits in the brain (1:108; AT 11:202; 1:318; AT 11:244, trans. alt.). Are these functions a product of God's designing intentions and creative acts? Descartes affirms so in passages already cited. Some scholars (e.g., Garrett 1999) have therefore urged that he allowed final causes and teleology only in God's creative acts (as well as in the purposes of human agents). And yet Descartes also offers a cosmogony in which plants and animals arise out of the chaos, without special creation. In that case, what becomes of his talk of functions? Can the notion that an animal's parts cooperate to preserve the animal's health be explained in a natural cosmogony?

To answer these questions, we need to disentangle various notions of teleology, to see which Descartes did or could endorse. In doing so, we should keep in mind why Descartes would want to avoid final causes in nature. Apart from acknowledging that minds act for purposes, Descartes would find unintelligible any case in which something that hasn't happened yet (a future "end state"), or in which something that is not in contact with a body (a distant "end state"), is able to influence the motion of a body.

First, we should distinguish *external* from *internal* final causes. An external final cause would come from a designer or creator; it exhibits external teleology because the ends are fixed externally. If I build a mousetrap, I design it with a structure that will achieve a desired outcome. My desire to catch mice fixes the end and so determines the function of the trap. Similarly, if God thinks it good to adjust our sensations to our nervous systems, then his external intention fixes the function of those sensations (to preserve the body). In the traditional picture, according to which God designs animal

bodies, the functions of their parts would be fixed externally. Descartes offers a different picture, in which a world like ours arises without God directly fashioning its parts. In Descartes's naturalistic cosmogony, God institutes laws of motion that produce a "quite perfect world" (1:91; AT 11:35); these laws depend on God's will (1:92; AT 11:36; 2:294; AT 7:435–6), and in choosing the laws, God would also choose the type of world they would produce. However, that world and the things in it arise out of an initial soup of particles, which might have been totally chaotic (a random ordering: 1:257; AT 8A:101–3). Hence, God does not initially arrange the particles so that, through Laplacean determinism, they unfold in a fixed causal sequence that leads to our world. Rather, our world emerges through natural processes. This suggests that, even if God foresees the outcome, natural processes must create the organized entities in the world, from solar systems and mountains to plant and animal bodies. Let us see if these processes sustain a notion of internal final cause, or immanent teleology.

Internal final causes are immanent to the thing that acts. We can distinguish two sorts of immanent teleology: those in which the end-state directly causes the behavior ("end-state caused"), and those in which a previous tendency to produce a certain end-state causes a type of thing or a type of mechanism to exist now ("end-state selected"). In the end-state caused case, the end or goal causally influences the body. This sort of final causation is possible for minded beings: the end state of crossing the street, as represented in my mind, causes me to direct my legs in a certain manner. Aristotelians posited this type of causality even in unthinking matter, for they held that the motion of the element "earth" is directed toward the center of the universe. The element moves toward the center by its own power, without any intermediary such as a force of attraction – and in this way the round globe of Earth is formed. Descartes restricts this type of end-state caused finality to thinking beings, rejecting the Aristotelian version in unthinking matter (or incorrectly accusing the Aristotelians of positing little souls in matter that know where to go: 2:298; AT 7:442; 3:216; AT 3:648).

In the case of end-state selected finality, a type of thing or mechanism exists (or continues to exist) because it regularly achieves a certain outcome (Wright 1973). Cases of end-state selection can be divided into two classes. In the first class, a thing exists because its designer or creator foresaw (or perhaps merely believed) that it would achieve a certain effect. Here, we have both external and internal finality. The designer chooses the effect, but the thing has the function of bringing it about. I make the mousetrap, but it exists because of what it can do (or what I think it can do). Therefore, the mousetrap itself has the function (immanent end) of catching mice. In the second class, natural processes "select" a thing because of what it can do. Through the random operation of natural causes, a thing or mechanism arises that has a certain effect: for example, an animal that can run faster in avoiding predators than do others of its type. The faster animal continues in existence (reproduces itself), whereas the slower ones get caught and so don't reproduce. There is no external teleology, since the selection process occurs blindly, with no end; and yet this process produces things that serve an end. This sort of end-state selection occurs in Darwinian natural selection, according to which variants of a biological trait are selected because they contribute to the survival of a given type of animal. Hearts exist because they pump blood. Their immanent end is pumping, because they have been blindly selected for doing that.

The internal teleology of the functional operations of animals, including growth, reproduction, pursuit of benefits, and avoidance of harms, might be explained if Descartes held that God designed the mechanisms that promote these life-functions; here, external teleology would fix internal teleology. However, since Descartes wanted to formulate a cosmogony in which plants and animals arise naturally from the chaos, he needs a mechanism for ends-selection that can sustain his talk about function.

Although he did not describe such a mechanism, a description was available to him. Lucretius not only posited that the various species originally arose through spontaneous generation, but also speculated that many more types of animal were produced than exist today. Among the products of spontaneous generation would be "monstrous and misshapen births," such as "mouthless brutes," or animals "disabled by the adhesion of their limbs to the body, so that they could neither do anything nor go anywhere nor keep out of harm's way nor take what they needed." Nature "debarred" them from increase because they couldn't feed and perhaps couldn't couple in procreation (1994: 150). Other erstwhile species, although capable of feeding and procreation, would die out through competition:

> Every species that you now see drawing the breath of life has been protected and preserved from the beginning of the world either by cunning or by courage or by speed. In addition, there are many that survive under human protection because their usefulness has commended them to our care. (*Ibid.*)

The lion lives by courage, the fox by cunning, the stag by flight, the dog through human care. By contrast, other species have faced extinction:

> Those that were gifted with none of these natural assets, unable either to live on their own resources or to make any contribution to human welfare, in return for which we might let their race feed in safety under our guardianship – all these, trapped in the toils of their own destiny, were fair game and easy prey for others, till nature brought their race to extinction. (p. 151)

Here, then, is a mechanism of end-state selection that might explain the occurrence of organisms that exhibit immanent teleology. Lucretius, who rejected teleology of the sort I have called "external" (pp. 116–17), provided a mechanism by which types of organisms are selected, and their descendants exist, because of the functioning of their parts. Although he did not overtly describe the organs of the surviving species as possessing immanent teleology, he spoke (p. 116) of their "use" (a term connoting function), and he described a mechanism of selection that would support ascriptions of immanent teleology. (Although Lucretius' position is generically similar to Darwinian natural selection, he did not envision that later species evolve from earlier ones by selection on heritable variations; he has all species arise at once, with differences among them existing already, and some then die out through selection processes.)

Descartes's extant writings include passages that describe the formation of the solar system and Earth and also the spontaneous generation of animals. He promises, but does not deliver, an account of the original formation of plants and animals. Descartes

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repeats the Lucretian notion that over time the matter of the universe will combine "in every possible way" (Lucretius 1994: 133, 139), subject to his own laws of nature: "by the operation of these laws matter must successively assume all the forms of which it is capable; and, if we consider these forms in order, we will eventually be able to arrive at the form which characterizes the universe in its present state" (1:258; AT 8A:103). Thus, although there is no direct evidence that Descartes posited ends-selection, the mechanism fits his naturalistic cosmogony, as the above excerpts from Lucretius give witness. (Descartes also supposed that solar systems arise naturally, but he did not apply functional terminology to such systems – presumably because he accepted the traditional view that the parts of living things show a special unity and integrity of function, such that notions like health and disease apply to them, but not to solar systems.)

Let us grant that ends-selection could account for immanent teleology within Descartes's chaotic cosmogony, and let us assume that Descartes would want to treat his function statements as instances of immanent teleology. That would provide him with a basis for ascribing functions to plant and animal organs that have wholly natural origins. We must still face a further metaphysical challenge, which questions whether Descartes can accommodate the functional unity of the animal machine within his metaphysics. The idea of ends-selection tacitly assumes that types of organisms, with heritable structures, form recognizable natural kinds that possess organic integrity. Two considerations militate against this assumption in Descartes's natural philosophy.

First, as several scholars have noted (Laporte 1928: 389; Des Chene 2001: 135), in the *Meditations* Descartes appears to deny the reality of the notion of bodily well functioning as applied to the human body considered as a natural thing. Focusing on the bodily machine itself (apart from its relation to mind), he observes that a description of it as working improperly (when it is ill) is a mere "extraneous label" (2:59; AT 7:85). He compares this description to that of a broken clock, implying that the property of the clock's being broken is not metaphysically real, because the alleged defect obtains only in relation to the time-keeping purposes of makers and users of clocks (external teleology).

This first problem, that animal bodies should not be assigned functional integrity apart from external purposes, lacks a certain plausibility. On the assumption that God is the designer of the human body (which Descartes publicly affirmed), the notion that being ill and deviating from his intended design is "merely" extraneous seems odd: surely God's design could fix the internal ends of bodily mechanisms. But perhaps Descartes did not wish to put great weight on the design hypothesis (Descartes 2000: 65; AT 11:524). There is still a reason to doubt the cogency of his classifying a description of the body's *proper* functioning as a merely extraneous label, for he held that death is constituted by the fact that the body becomes disordered or broken (1:314–15, 329–30; AT 11:225, 330–1). To say that being broken has no genuine reality in this case would be to assign a tenuous status to death itself, even though, for Descartes, death has the metaphysical consequence that the mind quits the body. Presumably, the mind quits the body because it detects the fact that the body is broken. Since the mind does not itself direct (or even understand) the body's

functioning, there should be a brute natural fact of brokenness to which the mind responds at death. (A second response would treat well functioning as a physical, rather than metaphysical fact, per my discussion of the second problem.)

Second, scholars have objected that Descartes could not have a notion of immanent teleology because in his system animal bodies are not proper substances (Laporte 1928: 391–4) and do not form natural kinds (Des Chene 2001: 116). Apart from God, there are only two sorts of substance for Descartes: minds and body. Minds exist as separate individuals. The objection proceeds by supposing that Descartes held, or should have held (Grene 1985: 100–1), that all matter everywhere constitutes a single substance; what we call individual bodies are merely provisional collections of particles within the one material substance. If that is so, only substances have genuine metaphysical standing. Then animal bodies, like all individual bodies, are merely notional entities – that is, a mere product of the ways that humans divide up and classify the world for their own practical purposes.

For some *metaphysical* purposes, the functional organization of a body and its existence as an entity may be merely "extraneous" and notional. However, that need not prevent our construing animal bodies as properly unified entities for the purposes of Descartes's *physics* or *natural philosophy*. The objection that individual bodies and types of body have a tenuous metaphysical status would also apply to various kinds of things that Descartes places at the center of his natural philosophy, including his notion of a "particle" (a piece of the one material substance) and the three kinds of matter he describes in the *Principles* (defined by the size and shape of particles). It would also apply to the various kinds of material things he examines in his natural philosophy: vortexes, suns, planets, magnets, minerals, metals, and so on. Perhaps, strictly speaking, vortexes, magnets, and salt are not metaphysically real kinds in Descartes's metaphysics. But Descartes found that in natural philosophy, the properties of salt can be studied, outlined, and discussed, even if salt is a relatively late product of the processes through which the crust of the Earth and the oceans are formed (AT 8A:220–32).

Within his natural philosophy, Descartes believed that from his first principles – particles moving according to the laws of motion – he could deduce *a priori* (that is, from their causes) the basic constituents of the world: the basic kinds of particles, the formation of vortexes, stars, light, and planets; and even, in his ambitious moments, the formation of water, air, fire, and minerals (1:144; AT 6:64). Other, more particular things, including perhaps steel and magnets (AT 8A:281–7), cannot be derived *a priori*: we must collect their properties from natural history (through observation). Plants and animal bodies surely belong in this latter class. But that needn't diminish their claims to physical kindhood. For, if only matter itself has a substantial essence or nature, then no physical kinds, whether derivable *a priori* or not, are metaphysical kinds.

When Descartes assigned a single essence – extension – to the entire material world, he made a revolutionary departure from Aristotelian natural philosophy. Consequently, he needed to retheorize the notion of a natural kind within his own natural philosophy. Metaphysically, he described extension as the "nature and essence" of material substance (1:210; AT 8A:25), which is consistent with there being only one substantial natural kind in the material world (extended matter). But he also speaks of the "natures" of various kinds of bodies: air, water, the Earth's interior, quicksilver, magnets (1:271–6; AT 8A:231–79), plants, animals, and man (1:186; AT 9B:14). He thus employed a

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double usage of the term "nature." The second usage suggests that, in his physical scheme, magnets, plants, and animals are real *physical* kinds.

Metaphysically, these kinds lack a substantial nature that would be peculiar to each of them. They certainly do not have Aristotelian natures: substantial forms that govern their activity and that individuate them as kinds in Aristotle's physics. Descartes, however, proposes a counterpart to Aristotelian natures. Having observed that changes in the one extended matter arise only through motion, he updates the notion of a corporeal nature:

> any variation in matter or diversity in its many forms depends on motion. This seems to have been widely recognized by philosophers, since they have stated that nature is the principle of motion and rest. And what they meant by "nature" in this context is what causes all corporeal things to take on the characteristics of which we are aware in experience. (1:232–3; AT 8A:53)

Descartes suggests that a nature is a configuration of matter in motion that produces a standard set of effects, including the variety of corporeal things and their characteristics. A natural kind would then be such a configuration that exists in many instances. In Descartes's world, this means that a natural kind arises through regular processes out of the chaos or from the subsequent stable patterns that develop. Perhaps that is reality enough for physical kinds and for functionally organized bodies in Descartes's system.

Sense and Cognition

Animals engage in behaviors that are similar to those that humans engage in when we have sensory experience (3:99, 303, 365; AT 2:39, 4:574, 5:276). They respond differentially to light, sound, and other sensory stimulation: a dog may cry when struck or cringe at a loud noise. Animals can be trained to act differently than usual: to cringe at the sound of a violin (3:20; AT 1:134), or to remain still when partridges fly and not to flee at a gunshot, but instead to retrieve a dead partridge on command (1:348; AT 11:370). More generally, animals seek what is beneficial and avoid what is harmful (AT 11:519).

These animal abilities were granted by all, including Descartes. During the seventeenth century, there was an ongoing debate about how to explain them.

Prior to Descartes, philosophers who denied reason to animals usually did not deny them sentience and cognition, or (sometimes) knowledge. Although Aristotle had restricted animal cognition to sense perception, the Arabic commentator Ibn-Sina proposed that animals should be granted a special cognitive power, the "estimative faculty," to explain how animals grasp properties that are not proper to any one sense: as when the sheep perceives that the wolf is an enemy, even though being an enemy is not a specifically visual property. Aquinas accepted the estimative faculty, and it became common doctrine concerning the sensitive soul (Sorabji 1993: 64). Before Descartes's animal-machine hypothesis became known, seventeenth-century authors were agreed that animals possess cognitive powers. They debated whether to call these powers

"knowledge," and whether these powers constitute a limited form of rationality that did not require immateriality and so did not portend immortality (e.g., La Chambre 1989).

Descartes altered all such debates by applying his animal-machine hypothesis to the control and direction of behavior. He argued, on both metaphysical and scientific grounds, that although animals exhibit complex behaviors, they are unfeeling machines.

Metaphysically, his new system led him to regard sensation as intrinsically intellectual. The mind's properties all derive from the two chief forms of thought, intellection and will (1:204; AT 8A:17). Intellection includes sensation, imagination, and pure intellect (the ability to understand without contemplating images). The will includes desire, doubt, and affirming or denying. Sensation and memory, as well as earthly passions and desires, depend on the union and interaction of mind and body, but the mental effect in these sensations or emotions is a mode of intellection. Hence, if animals are denied intellect, they are denied sensation.

Descartes's new conception of matter as possessing only the geometrically describable properties of shape, size, position, and motion was even more radical in the seventeenth century than his new conception of mind, for it deanimated matter, debarring active principles, Aristotelian substantial forms, and Aristotelian real qualities from it (Henry 1997: 59–70). Aristotelians considered the souls of beasts to be substantial forms. If Descartes could find a reason to reject such forms, he would have an argument for denying Aristotelian sensitive souls to animals.

Descartes offered both metaphysical and natural philosophical arguments to support his denial of substantial forms (and animal souls). The metaphysical arguments purporting to establish that extension is the essence of matter are well known. He also offered natural philosophical (or physical) arguments for corpuscularism, based upon its intelligibility and parsimony (Hatfield 1985: 151–6). The arguments from intelligibility are found in the *World* (1:90–1; AT 11:33) and the *Discourse* (1:132; AT 6:42–3); those from parsimony, in the *Meteorology* (Descartes 1965: 268; AT 6:239) and letter to Morin (3:107; AT 2:200). Descartes did not claim that these arguments *refute* the doctrine of substantial forms; rather, they show that he can explain all natural phenomena *without appealing* to such notions.

That is just what Descartes claims to do in the *Treatise*: to explain all the functions of animals – including sense-guided behavior and the pursuit of beneficial and the avoidance of harmful objects – through mechanical causes alone. He would not require "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 a fire burning continuously in its heart – a fire which has the same nature as all the fires that occur in inanimate bodies" (1:108; AT 11:202). In effect, Descartes imagines a hydraulic machine in which innate structures ("instincts": Descartes 1998: 163; AT 11:192), sensory stimulation, and internal states of the organism (such as lack of food: Descartes 1998: 164; AT 11:194–5) direct the flow of animal spirits to the muscles so as to produce appropriate behavior.

Descartes here claims to be able to explain mechanistically the offices of the sensitive soul, including those that Aristotelians explained by invoking cognitive powers. He uses a combination of instinct and associative memory to account for the chief

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psychological capacities in animals: sensory and motor response, associative learning (which might explain training), and situationally appropriate behavior. If his explanations test out, he could then press the comparative intelligibility of his basic principles (arrangements and motions of particles possessing only shape and size) and the parsimony of his explanations (material corpuscles alone, as opposed to myriad substantial forms, one for each type of plant and animal).

He has admitted that his natural philosophical arguments do not *prove* that substantial forms are not real, and hence that animals lack sensitive souls. He merely claims to provide simpler and more intelligible explanations than those which invoke such entities. His metaphysical arguments were supposed to take up the slack. In the *Meditations* (2:44, 54; AT 7:63, 78) and *Principles* (1:210; AT 8A:25), he claimed to establish that matter has *only* the properties of shape, size, position, and motion. This finding was meant to exclude from purely material things all substantial forms (which are active principles), real qualities (including the Aristotelian primary qualities of hot, cold, wet, and dry, which Descartes must now explain solely through extended matter in motion), and thought, including sensation.

Descartes's metaphysical argument for excluding animal souls invokes these premises: if animals have sentience, they must have minds; hence, they must exhibit intellect and reason, but they don't. His argument is, of course, subject to challenge. First, one might ask why animals should be denied reason. I examined Descartes's arguments for this conclusion in an earlier section.

Second, one might ask why there couldn't be minds that are merely sentient. This challenge suggests that animals might be assigned a lesser form of soul or mind, capable of sentience and limited cognition but lacking the resources for language use and general intelligence. Metaphysically, Descartes's reason for excluding this as a possibility stems from his purported direct insight that intellection is the one essential property of mind, which means that all minds must always have it. He further claimed that, if animals were given diminished minds, these would still have to be immaterial and hence immortal, an outcome he rejected on metaphysical and theological grounds (2:287; AT 7:426; 3:304; AT 4:576; 3:366; AT 5:277). He also held that the faculty of will is essentially infinite (2:40; AT 7:58), which entails that, if animal minds had wills, those wills would of necessity be as free as the human will, which he and his audience would have found implausible.

The third challenge asks why matter can't produce sentience, or even thought. Descartes might respond by denying that matter, or material states, are capable of representation, an essential ingredient (he might plausibly claim) in sensory perception and thought. This response could also provide a deeper reason for his position on the second challenge.

In the Aristotelian psychology, the sensitive soul receives representations of things via "sensible species" that are transmitted through a medium. In vision, the quality of color (a "real quality") is transmitted to the eye as a sensible species. Scholastic Aristotelians described sensible species as "intentional," which meant, first, that they have *diminished being* (an explication of Aristotle's "forms without matter": 1984: 674), and, second, that they *represent* the quality in the object.

Descartes assigned the ability to represent to mind, not to matter. Indeed, on one interpretation of his philosophy, representing is the very essence of mind (Hatfield

2003a: 259). If he indeed equated intellection with representing, then in saying that intellection is the essence of mind, he would also be saying that representation is its essence. This view accounts for consciousness by suggesting that, as representing powers, minds essentially represent (and so are conscious of) their own states (2:382; AT 7:559). If we further assume that the power to represent is essentially general – so that any being that can represent would be endowed not only with sensory representation but also with the ability to form general concepts – then we have an argument for Descartes's much used premise that, if animals had souls, they would have reason or intellect.

This last assumption, concerning the generality of any representing power, may be too much to ask. One might well wonder why God couldn't create lesser minds (3:304; AT 4:576), possessing only restricted powers of representation, lacking pure intellection and will, and having only sentience and sensory appetite (Pardies 1972). Or perhaps he could create animals that reason about particulars, but lack general concepts and the ability to reflect (La Chambre 1989), and so do not exhibit the general problem-solving ability that Descartes set as a criterion of mindedness. Indeed, Descartes himself allowed that faculties of intellect admit of differing degrees of perfection (2:40; AT 7:57). If forced to concede the metaphysical possibility of lesser animal minds, Descartes would have to fall back on his natural philosophical argument, that his soulless account of animal behavior is preferable for its parsimony (Newman 2001) and intelligibility. The question of animal sentience would then become a natural philosophical problem, concerning whether Descartes's purely mechanistic explanations of animal behavior are adequate, or whether notions such as representation and feeling are in fact required in any plausible account of animal behavior.

Are Descartes's Animals Unfeeling Machines?

Although most of Descartes's followers (Rosenfield 1968: Appendix, B–D) and most scholars read Descartes as denying sentience to animals, a minority argues that he ascribes limited mental properties to them (Vartanian 1953: 210–12), making them sentient but not (reflectively) conscious (Cottingham 1998). These scholars appeal to textual evidence, and some additionally argue that Descartes needs to invoke intentionality in order to successfully explain the behavioral capacities of animals (Gaukroger 2002: 201, 203).

In a letter of 1649 to the English philosopher Henry More, Descartes refines his earlier, unequivocal stance (3:148; AT 3:85) that animals have no feeling. He now indicates that it is impossible to *prove* that animals either do or do not have feelings, "since the human mind does not reach into their hearts" (3:365; AT 5:277). Forgoing certainty, he regards the denial of sentience as the "most probable" conclusion, a position that is consistent with a retreat to natural philosophical (as opposed to metaphysical) arguments.

Scholars who say that Descartes actually granted feeling to animals point especially to two passages. The first is his letter of 1646 to the Marquess of Newcastle, in which he speaks of animals expressing "the hope of eating" and "their fear, their hope, or their joy" (3:303; AT 4:574). Here, Descartes has animals "expressing" their emotions or

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passions. This way of speaking is also found in the *Treatise*, in which Descartes mentions the "passions" of the animal body in the absence of mind. (In the *Treatise*, Descartes's descriptions apply to animal behavior as well as to human behavior that occurs without thought: 2:161, AT 7:229–30; 3:149; AT 3:122.) Indeed, in a letter from 1638, he had warned that people mistakenly infer that animals have "feelings and passions like ours" because animals behave similarly to how we behave when we have feelings. In his view, the correct view is that animals still are "automatons" without "any real feeling or emotion in them," but that their outward behavior nonetheless resembles ours (3:99–100; AT 2:39–41). This position lets us easily interpret the letter to the Marquess as attributing to animals only *corporeal counterparts* to the passions: internal states that explain animal behavior but that do not involve genuine feeling.

The second passage occurs in the letter to More, in which Descartes denies that animals have sensation and thought "like us" (3:365–6; AT 5:277). After giving various arguments to show that this conclusion is the most plausible on the evidence, Descartes continues:

> Please note that I am speaking of thought, and not of life or sensation. I do not deny life to animals, since I regard it as consisting simply in the heat of the heart; and I do not even deny sensation, insofar as it depends on a bodily organ. Thus my opinion is not so much cruel to animals as indulgent to human beings – at least to those who are not given to the superstitions of Pythagoras – since it absolves them from the suspicion of crime when they kill or eat animals. (3:366; AT 5:278–9)

Several points deserve attention. First, the Latin term here translated as "sensation" is *sensus*, which may mean simply the faculty of sense. Accordingly, the term need imply only that animals have sense organs that guide them when stimulated, leaving open how that function is carried out, whether by sentience or by unfeeling mechanisms. Second, the qualification "insofar as it depends on a bodily organ" suggests that Descartes here allows animals a faculty of sense in just this mechanistic manner. Third, it is difficult to understand Descartes's final sentence about killing and eating animals if we suppose that he allows them genuine sentience. It seems plausible that Descartes means to alleviate human concerns about killing and eating sentient beings by indicating that animals aren't really sentient after all. On the alternative reading, he would be saying that animals are sentient but not reflective, which doesn't provide much comfort to those concerned with animal pain. In the end, the passage can easily be assimilated to the other places in which Descartes describes purely material, unfeeling sensory processes in animal bodies as performing many of the guidance functions that conscious sensation performs in human beings (e.g., 2:161–2; AT 7:229–31; 3:148; AT 3:85).

The other strategy for arguing that Descartes assigned sentience to animals appeals to the explanatory resources that he may seem to need (according to present-day lights, at least) in order to explain the behavioral capacities of animals. Gaukroger contends that, since Descartes assigns discriminative sensory responses to animals (they respond appropriately to differing environmental stimuli), he must also attribute to them the ability to "process information," which means that they must "interpret stimuli" and form "representations" (Gaukroger 2002: 203). This reconstruction relies on intuitions

about what is needed "to explain animal cognition, not explain it away" (p. 200). It renders animals as "sentient but non-conscious automata" (p. 203). Animals are sentient in virtue of representing and interpreting stimuli; non-conscious because, lacking a mind, they lack human rational capacities for reflection; and they are automata because their sentient states are actualized in a mechanistically conceived material body that lacks an immaterial mind.

My alternative reading is that Descartes restricts genuine representation and cognition to human beings, in virtue of their exclusive possession of minds. Descartes explains the apparent phenomena of animal cognition by appeal to non-intentional, mechanistic processes. On this view, he interprets the processes in animal sensory systems as complex material causes. The retinal image and the counterpart brain images (which Gaukroger sees as representations) are material patterns that enter into the blind associative processes of material memory (Descartes 1998: 150–2; AT 11:177–9). Descartes "explains away" the Aristotelian's attribution of genuine cognitive states to animals, but he still aims to *explain* the behavioral capacities of animals in non-cognitive fashion. I recommend this interpretation as the one most consistent with Descartes's firm distinction between mind and matter.

Descartes's Legacy

Descartes's philosophy left a dual legacy regarding psychology and the theory of mind. Through the doctrine of mind-body dualism and the attendant unification of mental phenomena as those within conscious awareness, his philosophy encouraged the notion of phenomenal access as a defining feature of the mental. Through the doctrine of the animal machine, it almost diametrically led to a materialistic conception of animal and then human psychology and was an ancestor of early twentieth-century behaviorism. Let us consider this second aspect first.

Descartes's doctrine of the animal machine was part of his larger naturalist cosmogony. Although the idea that the world developed out of particulate matter in motion had been broached by the ancient atomists, Descartes gave it real flesh, in his *World* and in Parts Three and Four of the *Principles*. The natural development of the solar system and of the Earth's geological features became an immediate object of debate and further research (Roger 1982). The natural development of living things out of the Earth was taken up and developed in the eighteenth century (Vartanian 1953: 273–88). Hume, citing the Epicurean (hence Lucretian) cosmogony, contended that a process equivalent to ends-selection could explain the "uses of the parts" of plants and animals and the apparent "adjustment of means to ends" of those parts (Hume 1977: 184–5). Whether or not Descartes was aware of (or would have chosen) ends-selection as an explanation for the functional unity of organisms, later authors were (and did). Eventually, Darwin argued convincingly that natural selection can explain the adaptedness of organisms. Even so, the proper interpretation of immanent teleology in contemporary descriptions of organic functions remains under discussion (Ariew, Cummins, and Perlman 2002).

Descartes's conception of the animal machine was an important precursor to La Mettrie's *Man a Machine* (1994), and to the materialism of Diderot and other French

philosophes (Vartanian 1953: 221–46). Thomas Willis (1971) prepared the way by asserting that purely material animals possessing a soul of fine matter could exhibit sentience, thereby rendering the animal machine sentient. La Mettrie and Diderot proposed that human beings might be wholly material entities that are conscious and rational. The materialistic claim that mental states can be reduced to (or perhaps identified with) material states has subsequently gained adherents, although the topic remains under investigation. Substance dualism is now in demise, but the reason is not that materialists have shown how to explain consciousness and mental representation on their terms. Indeed, there is no currently accepted physical or material explanation of conscious sensation, mental representation, or conceptual thought. Whether there can and will be such an explanation is under dispute, and will remain so until such a time (if ever) that the mind-brain problem is solved.

Descartes's dualism started yet another thread in the history of psychology. Many eighteenth-century investigators of sensory perception adopted a kind of "empirical dualism" of mental and physical phenomena, leaving the metaphysics of mental substance aside (Hatfield 1995). They were inspired by Descartes's example that the psychological processes of depth perception might be explained by taking both physiology and mentalistic psychology into account. His conception that the mind-body union is explanatorily relevant to sensory perception encouraged investigators to search for empirically based descriptions of mind-brain relations (Hatfield 2000).

The merging of these two streams in the nineteenth and twentieth centuries led to further questions about the definition of the mental and the adequacy of nonmentalistic psychology. The behaviorists J. B. Watson and B. F. Skinner sought nonmental explanations of all animal and human behavior. E. C. Tolman challenged this project from within, as did Gestalt psychology and subsequent perceptual and cognitive psychology from without (O'Neil 1982: ch. 9). At the same time, physiological psychologists were referring to Descartes's animal machine and concluding that consciousness is not a necessary concomitant of all psychological capacities, including habit formation and the sensory processes that precede conscious sensory experience (Huxley 1884). One model treated the underlying processes as reflexive and mechanistic, echoing Descartes's animal machine. Another view suggested that non-conscious processes might nonetheless be mental, that is, they might include representational content that was combined according to innate or learned psychological mechanisms (Hatfield 2003b). Representation is here divorced from consciousness.

Morally, we can ask whether Descartes's animal-machine hypothesis left a legacy of cruelty toward animals. His follower Malebranche is said to have been indifferent to the squeals of animal pain that he induced by kicking a pregnant dog while remarking that animals are insentient machines (Rosenfield 1968: 70). Some Cartesians used Augustine's theological finding that an innocent newborn is undeserving of pain and suffering to support the animal-machine hypothesis. Owing to the Fall of humankind, human infants are not innocent and so their pain is just. Since other animals are born innocent, they do not deserve to suffer, hence they are insentient and don't suffer (Rosenfield 1968: 47).

Descartes himself had a dog (AT 5:133), but this fact provides no grounds for suggesting that he didn't really believe that dogs lack feeling. In the decades following Descartes's death, the most compelling argument for the sentience of animals was one

he raised and rejected (2:162; AT 7:231; 3:99; AT 2:39): their organs are analogous to ours, and we are sentient (Pardies 1972).

If we accept that Descartes's animal-machine hypothesis is understandable given his other philosophical commitments, we can nonetheless find implausible his view that animals lack feeling and basic cognition. That finding is consistent with the conclusion that the hypothesis was part of an intellectual program that spurred further growth in philosophy and psychology. Even as the tenets of that program have been progressively abandoned, the questions and problems that it raised remain in play.

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