
Philosophical Perspectives on Behavior: From Animism to Materialism

I notice something and seek a reason for it: . . . I seek an intention in it, and above all someone who has intentions, a subject, a doer: every event a deed—formerly one saw intentions in all events, this is our oldest habit. Do animals also possess it?

—Friedrich Nietzsche (1901/1967)

As we observe the world around us, our attention is drawn to things that move and change. The sun makes its journey from east to west across the sky each day, and by night the moon, stars, planets, and occasional comets and meteors trace their luminous paths across the heavens. Drops of rain fall to the earth, collecting into rivulets and then streams that join together to form rivers that rush or leisurely meander to a sea that never seems to tire of sending waves crashing against the shore. Over many years, a fragile seedling grows into a towering oak and a helpless human infant somehow manages to transform itself into a musician, Olympic athlete, airline pilot, or neurosurgeon. Birds circle overhead while squirrels scamper among the branches of trees, and bees and butterflies busily collect nectar and pollen from flowers that open their brightly colored petals to the warm sun. In our cities we see a constant blur of movement as streams of people move along its sidewalks and vehicles clog its streets.

We humans are both affected by and constitute an important part of this movement and change as we go about our daily activities. So it is not surprising that we should be interested in the what, how, and why of the behavior of both nonliving objects and living organisms, including ourselves. In our attempts to understand, three major types of theories of motion and change have been developed. The first type appeals to immaterial, nonphysical explanations, including what may be called psychic,

animist, supernatural, spiritual, or mystical entities and forces. The second type rejects such nonphysical explanations and sees all motion and change—whether of objects, plants, animals, or humans—as the result of processes involving only matter, energy, and physical laws that govern them and their interactions. The third type takes a dualist middle ground, combining both physical and spiritual entities and processes to account for all forms of behavior.

In this chapter we examine these three types of theories from a philosophical perspective, saving a psychological perspective for the next chapter. But before doing so, I have to provide some definitions.

Although the words *behave* and *behavior* are often meant to refer to actions of living organisms, they are also commonly used to refer to changes and movements that nonliving objects undergo. This more inclusive meaning is consistent with the definition of *behaviour* provided by the *Oxford English Dictionary*: “The manner in which a thing acts under specified conditions or circumstances, or in relation to other things.” So though we speak of the behavior of a dog or child, we also consider how one chemical behaves in the presence of another and how the stock market behaved yesterday. Indeed, a better understanding of the differences underlying the behavior of inanimate objects on the one hand and living organisms on the other is a major goal of this book, and so I will use the unqualified term behavior and its derivatives to refer to either living or nonliving entities. When more specificity is required, the terms *inanimate behavior* and *animate behavior* will be used, recognizing that the discipline that refers to itself as *behavioral science* deals only with animate behavior (with physics usually restricting itself to the study of nonliving objects and systems; that is, inanimate behavior). To avoid the necessity of the adjective *nonhuman* when referring to animals other than *Homo sapiens*, the word *animal* is used, with its more usual meaning that excludes our own species (although, of course, our species is technically just another animal, if a rather special and peculiar one).

Mind Over Matter: Psychic Philosophies of Behavior

That humans possess self-awareness, consciousness, intentions, and desires that are not easily explained in terms of physical processes is a major

motivator for immaterial theories of behavior, theories that have been extended by some to include all animals and plants and even inanimate objects. To explain motion and change, these theories appeal to non-physical entities and forces that remain beyond the domain of physical sciences as we know them.

Such theories of behavior are often referred to as *psychic* or *animist*, *psyche* being the Greek word for “mind” or “soul” that also forms the root of our modern terms *psychology* and *psychiatry*; *anima* is its Latin equivalent. Those theories that go the entire distance in using psychic explanations to account for all behavior involving humans, animals, plants, and objects are referred to as *panpsychic*. Panpsychic theories do not necessarily deny the existence of a physical world and mechanical processes, but see materialist explanations as insufficient to explain any of the phenomena occurring in the universe.

Animism

It has been stated that animist explanations of behavior characterized humankind’s earliest attempts to make sense out of the world, a world containing other human beings, animals, and plants, as well as physical forces emanating from fire, wind, water, and the earth itself. At some point in the evolution of our species, our ancestors developed awareness of their own existence and desires as well as the strange and powerful force of life present in all living animals and humans, but obviously absent in the bodies of dead animals and humans. Therefore they developed belief in a soul or spirit that gave life to bodies and also accounted for human consciousness, thought, desires, and behavior. The phenomenon of dreams, in which one has experiences that seem detached from the physical location of one’s body, would also suggest a life-giving spirit that normally inhabits the body but can also leave it. Belief in an immaterial, life-giving soul is consistent with belief in a spiritual life after death of the physical body, a creed that is characteristic of religions throughout the world.

But human imagination is such that it has also developed a belief in souls residing in apparently nonliving objects. In his *Natural History of Religion*, Scottish philosopher David Hume (1711–1776) attempted to make sense of the belief in the souls of objects (1757; quoted in Tylor 1871/1958, p. 61):

There is an universal tendency among mankind to conceive all beings like themselves, and to transfer to every object those qualities with which they are familiarly acquainted, and of which they are intimately conscious. . . . Nor is it long before we ascribe to them thought and reason, and passion and sometimes even the limbs and figures of men, in order to bring them nearer to a resemblance with ourselves.

Such animistic interpretations of the behavior of objects and physical forces allowed (and still allow) prescientific peoples to make better sense of their surroundings. Ascribing motives and intentions to other people and animals is the first step in this process. If I eat when hungry, flee when fearful, fight when angry, perform nurturing acts when loving, hunt to eat, and find or make shelter to stay warm and dry, it would not require much imagination to suppose that other humans and animals perform similar acts for similar reasons and purposes. It is but one more step to reason that kindness of the air and sun results in favorable weather and good crops while anger and jealousy of the spirits of water, earth, and fire bring floods, droughts, volcanic eruptions, landslides, earthquakes, wildfires, and other natural disasters. The next step is to attempt to influence these natural physical events by acts of propitiation, that is, by attempting to appease and favorably influence the spirits of the physical world through prayer, sacrifice, atonement, and other rituals (Kelsen 1946).

Sir Edward Burnett Tylor (1832–1917), one of the founding fathers of anthropology, provided the first systematic survey and description of animism throughout the world, describing animistic belief as a necessary first stage in the emergence of more fully developed religious systems (Tylor 1871/1958). That such beliefs serve the purpose of understanding and attempting to control natural events is demonstrated by their relative rarity in societies with modern science and technology and their persistence in societies that have had little or no contact with science and technology. However, as we will soon see, ignorance of science is not required for belief in an animistic world.

Ancient Panpsychism

It is also not the case that psychic theories of behavior are limited to “primitive” illiterate peoples not possessing sophisticated, carefully examined philosophies. Serious panpsychic theorizing goes back at least as far

as the Greek pre-Socratic philosophers. Plato (428–348 B.C.) considered souls necessary to explain both the movements of heavenly bodies and the behavior of animals and humans. Concerning the former, Plato was struck by the orderly movements of stars, planets, sun, and moon and considered it evidence of a type of “world soul” provided by the Creator.

The primary cause of movement must be that which can move both itself and other things, and this he [Plato] identified as soul. Soul carries around the sun, moon, and stars but he leaves it doubtful whether this is because soul is present in the sun as it is in man or because soul pushes the sun from outside or because the sun is moved from outside by soul in some other way. (Kerferd 1967, p. 157)

Plato’s rationale for rejecting purely materialist, mechanistic explanations of human behavior is offered in his *Phaedo* dialogue in which Socrates is about to be put to death. Here, Socrates insists that materialist explanations simply cannot provide satisfactory answers to the why of human action, such as why he decided to stay in Athens and face death rather than flee and save his life.

Among ancient Greek thinkers it was Plato’s student Aristotle (384–322 B.C.) who provided the most ambitious account of motion and change in the universe, dealing explicitly with both inanimate objects and living organisms. Somewhat paradoxically, Aristotle’s panpsychism seems to have been motivated by a rather mechanical notion of movement. For him, all movement had to be caused by a mover, so that if object B moves, it was because object A had moved it. But then what had caused object A to move? To avoid an infinite regress, Aristotle posited the existence of an unmoved mover that was eternal and immaterial. Whereas he referred to this unmoved, transcendent mover as the “outermost heaven,” Christians later conceived of this prime mover as an all-powerful and personal God.

For Aristotle, even the actions of animals were ultimately due to outside causes. Although it might appear as if animals move themselves spontaneously, he explained that “many motions are produced in the body by its environment and some of these set in motion the intellect or the appetite, and this again then sets the whole animal in motion” (*Physics*, book VIII, chapter 2, p. 337).

Thus an animal is first at rest and afterwards walks, not having been set in motion apparently by anything from without. This, however, is false: for we observe that there is always some part of the animal’s organism in motion, and the cause of

the motion of this part is not the animal itself, but, it may be, its environment. (*Physics*, book VIII, chapter 2, p. 337)

Aristotle's cause-effect reasoning led to the notion of a *stimulus* that played such an important role in later psychological theory. But whereas Aristotle considered the environment ultimately responsible for the behavior of organisms, he also realized important distinctions between inanimate objects and living organisms and therefore attributed a soul to all forms of life, including plants, animals, and humans. His conception of soul was somewhat less mystical and spiritual than either Plato's or later Christian conceptualizations, and for this reason some scholars might well object to describing his philosophy as panpsychic. Nonetheless, it is clear that he saw the soul as that which gave life to living things.

Aristotle believed that plants had nutritive and reproductive souls that caused them to take in nourishment from the sun, air, and ground, and allowed their growth and reproduction. Animals had souls that were similarly nutritive and reproductive, but in addition allowed them to sense the world around them, move, and have desires so that they would seek some things but avoid others. The souls of humans, in addition to possessing all the abilities of those of plants and animals, were intelligent, making humans capable of thought and rational action. Through their rationality, they could develop plans and rules to impose on their cruder animal desires. Aristotle saw the human soul as quite distinct in its rational powers from the souls of plants and other animals, but his placing plants, animals, and humans on the same continuum showed an appreciation of the relationship existing among all living organisms that was not seen again until the time of Charles Darwin some twenty-two centuries later.

Even a cursory treatment of Aristotle's view must mention its strong teleological flavor. *Telos* in Greek means "end" or "goal," and a teleological explanation is one that attempts to explain a phenomenon as directed by its ultimate outcome. To quote Aristotle, "Nature, like mind, always does whatever it does for the sake of something, which something is its end" (*On the Heavens*; quoted in Peters & Mace 1967, p. 3). That such a view considers nature an intelligent, purposeful agent with a grand plan for the universe is additional evidence of the essentially panpsychic nature of Aristotle's thought.

Modern Panpsychism

Anyone acquainted with the success of modern science might suspect that panpsychic theories of behavior have long since disappeared, together with other obsolete scientific theories, such as the earth-centered theory of the solar system, the ether theory of space, and the phlogiston theory of fire. But this is actually far from the case. Although the success of the physical sciences and technology (especially Newton's physics and the technology of the industrial revolution) did help materialist theories of behavior eventually win out over psychic ones, panpsychic views of nature have been entertained by many influential thinkers of the nineteenth and twentieth centuries. Among prominent post-Newtonian panpsychists we find psychologist G. T. Fechner; philosophers G. W. Leibniz, Arthur Schopenhauer, C. S. Peirce, and A. N. Whitehead; and biologists Pierre Teilhard de Chardin, C. H. Waddington, and Sewall Wright.

A set of passages that vividly illustrates one nineteenth-century panpsychic perspective comes from Schopenhauer (1788–1860) who commented on the “strong and unceasing impulse with which the waters hurry to the ocean, [the] persistency with which the magnet turns ever to the North Pole, [the] readiness with which iron flies to the magnet, [the] eagerness with which the electric poles seek to be reunited, and which, just like human desire, is increased by obstacles [as well as] the choice with which bodies repel and attract each other, combine and separate, when they are set free in a fluid state, and emancipated from the bonds of rigidity.” He noted that when we lift a heavy object we notice how it “hampers our body by its gravitation towards the earth” and that we “feel directly [how it] unceasingly presses and strains [us] in pursuit of its one tendency.” He further observed how the stars and planets “play with each other, betray mutual inclination, exchange as it were amorous glances, yet never allow themselves to come into rude contact” (1818, 1836; quoted in Edwards 1967, p. 25).

Schopenhauer's observations appear amusing because he invokes well-understood physical phenomena as evidence of nonphysical psyches. Gravity and magnetism are understood today (indeed, as they were in his day) as mindless physical forces, and although we may still not completely understand why they act as they do, scientists today feel no need to invoke spirits, souls, ghosts, or other supernatural entities to account for their effects.

More recent, and perhaps more reasonably proposed, was the panpsychism of English embryologist and geneticist C. H. Waddington (1909–1975). Waddington felt that the voluntary and purposeful nature of our actions was evidence of an immaterialist cause of human behavior, arguing that “the experiences to which we give the name of free-will cannot depend wholly on the particular type of nervous activity which, when it is expressed in action, appears as a purpose, but most essentially involve a phenomenon of self-awareness in addition to this” (1962, p. 118).

He also held that biological evolution, together with the fact that human beings have self-awareness, logically leads to the view that all other organisms as well as inanimate objects also have at least some degree of self-awareness. In addition, since humans are undoubtedly aware of themselves and evolved from simpler forms of life, these simpler forms—indeed all forms of life—must also have some degree of self-awareness. And since, according to the theory of evolution, life arose from previous non-living matter, all nonliving things must also have at least some degree of self-awareness.

So we see that panpsychic theories of behavior have a long history in philosophical attempts to make sense of the movements and changes of the world’s objects and organisms. Arguments vary, but common to all of them is the belief that actions appearing to be deliberate and goal directed cannot be explained by completely mindless physical processes.

Having One’s Ghost and Feeling It, Too: Dualist Philosophies of Behavior

In contrast to panpsychic philosophies, psychophysical dualism restricts an immaterial soul or mind to certain entities, typically not attributing a psyche to inanimate objects and perhaps also not to plants and animals. For dualists, certain behaviors can be explained as the results of purely physical processes and others are determined (or at least influenced by) a nonphysical soul or mind. Any theory that is not either panpsychic or purely materialistic must embrace psychophysical dualism to some degree.

Descartes: Putting the Ghost in the Machine

Influential French philosopher and mathematician René Descartes (1596–1650) is considered by many to be the father of modern philosophy.

Accordingly, his dualist philosophy had a great and continuing impact on Western thought.

Descartes's dualism has two major characteristics. The first concerns where he drew the line on the existence of souls. This line was very clear: only humans had souls; inanimate objects as well as plants and all animals were purely physical machines with no consciousness, desires, or purposes of any kind. It is reported that Descartes was amused at the howls, cries, and whimpers of live animals he dissected in his research, since he considered these to be but the hydraulically caused noises of unfeeling machines (Jaynes 1973, p. 170).

This may seem to be an absurd and downright inhumane attitude to take today, but it should be mentioned that during Descartes's time English physician William Harvey (1578–1657) showed that the heart, formerly thought by many to be the seat of the passions, was “only” a mechanical pump for the blood. Also, during that time hydraulically animated mechanical models of people and animals were popular fountain decorations. These developments likely encouraged Descartes's belief in the purely mechanical nature of animals.

The second defining characteristic of Descartes's dualism was his theory of the interaction between the physical machine of the living human body and the soul it somehow contained. It should be noted first that whereas he believed that all humans had a soul, he nonetheless considered the physical human body to be a machine in the same way that animals were machines. Accordingly, many human actions were purely physical phenomena that occurred without involving the soul, as when we reflexively pull our hand away from a hot object. This Descartes explained as the action of a mechanistic and automatic one-way cause-effect reflex from sensation to behavior. He believed erroneously that these automatic behaviors involved transmission of a fluid from sensory organs to brain to muscles. But his conceptualization of the reflex arc as a one-way physical connection between perceiving senses and acting muscles had a lasting effect on psychology's one-way cause-effect conception of animal and human behavior as consisting of responses to stimuli.

But actions involving human will involved the functioning of the soul. Descartes believed that the pineal gland at the base of the brain was the

site of interaction between the spirit of the soul and the machine of the body. He chose the pineal gland for this function because it appeared to him that it was the only part of the brain that did not exist in other animals (we now know that it does). So unlike stimulus-response reflexes that took place without involvement of the soul, willful action involved the soul receiving information from the senses and determining action by moving the pineal gland, which set in motion “animal spirits” ultimately resulting in muscle movements and overt human behaviors. Although he had the physiological details wrong, his belief that willful or deliberate action involves mediation of a mind acting between stimulus and response anticipated the basic structure of later psychological theorizing, including modern cognitive psychology.

Some rather serious problems plague Descartes’s dualism, and many post-Cartesian philosophers have based their careers on describing them. Even in his own day, many could not understand how a soul—which by Descartes’s account possessed no physical properties such as shape, volume, position, or mass—could manage to move a physical organ, even one as small as the pineal gland. (The same problem, often unrecognized by cartoon and movie makers, arises for ghosts who are able to pass unimpeded through walls and doors but still somehow manage to make things go bump in the night and have other effects on physical objects.) But it should be recognized that Descartes did pursue a materialist philosophy of behavior as far as it seemed to him prudent to go. All animal behavior was a mechanical reaction to the environment, as is the behavior of a machine. Similar were certain types of human behavior, such as automatic reflexes we make when we are startled by a loud noise or sneeze when dust enters our nose.

But Descartes recognized something quite different about the purposeful behavior that humans consciously want to perform and do so by the exercise of their will. He did not see how a purely mechanical account could be sufficient to explain such actions in which humans do not merely *react* to their environment but instead autonomously and willfully *act* on their environment. In this respect, he was convinced that a human being was fundamentally different from a machine, no matter how cleverly designed such a machine might be.

Vitalism

Descartes's philosophy is just one of the many forms that dualism has taken in the history of human thought. Another form, still very much with us in popular thought if not in science, is known as *vitalism*, which recognizes a fundamental difference between living and nonliving entities. Whereas both inanimate objects and living organisms are subject to the materialist laws of physics and chemistry, vitalism posits a nonphysical entity that gives an organism life and powers that no inanimate body can possess. So whereas panpsychists see all objects possessing a nonphysical soul, and Descartes reserved souls for humans only, vitalism makes what most of us today would likely find to be a more reasonable distinction between objects and organisms, with a nonphysical life force, or *élan vital*, possessed only by the latter.

One of the best-known vitalists of the twentieth century was German physiologist and philosopher Hans Driesch (1867–1941). He defined vitalism as “the theory of the autonomy of the processes of life” (quoted in Beckner 1967, p. 255). For him, the life of an organism depended on “an autonomous, mindlike, nonspatial entity that exercises control over the course of organic processes” (Beckner 1967, p. 255). Driesch admitted that laws of physics and chemistry applied to living organisms and their behavior, but he found such mechanistic principles insufficient to account for an organism's stages of development. The development of a fertilized egg into an embryo and then into a viable, independent organism could be explained after the fact by laws of physics and chemistry. However, such mechanistic laws by themselves could not determine this development, but only put limits on the range of possibilities. It was the special life-giving entity that Driesch referred to as “entelechy” that determined the actual course of development from egg to mature organism.

A description of Driesch's most famous experiment will provide a useful illustration. In the late nineteenth century it was generally believed that a fertilized egg cell contained within it a miniature likeness of the mature organism that it used as a plan for the developing embryo, a theory known as *preformationism*. But in 1891 Driesch separated the two cells of the first division of a sea urchin's egg and was surprised to find that each separate cell developed into a normal, whole sea urchin. For Driesch, this was proof that the egg was more than a machine governed by ordinary

laws of physics and chemistry, since no machine divided in half could still make what it had been designed to produce. He saw here evidence of a type of living agency—a regulatory, goal-based process that could not be explained mechanically.

Similarly, Driesch felt that a person's voluntary actions could not be accounted for mechanically, and here we see that he shares company with Descartes. As an example, take a moment to decide whether you want to raise your hand above your head and then act on your decision. If you did raise your hand, this behavior could be accounted for after the fact as the result of contracting muscles that had been stimulated by motor neurons carrying impulses from the brain. But Driesch thought that laws of physics and chemistry were inadequate to explain your *decision* to raise your hand or not.

Although Driesch's vitalism differs from Descartes's dualism concerning where the soul/no-soul line is drawn, they do share two important features. First, like Descartes's mind-body dualism, Driesch's vitalism runs into the problem of how an immaterial, vital entity could direct the physical processes of a living organism without being a physical entity itself. Second, both theories were inspired by the phenomenon of apparently purposeful, goal-driven life processes. Descartes saw such purpose only in the willful action of human beings; Driesch recognized it even in the development of a sea urchin egg that successfully overcame the disturbance of being divided into two parts by developing into two complete organisms. Neither man saw how such purposeful, goal-directed behavior could be accounted for mechanically and so had to reach outside the physical sciences to search for a spiritualist explanation.

Getting Extremely Physical: Materialist Philosophies of Behavior

Although dualist views of behavior are problematic on several counts, forms of dualism are surely the most widely held views of behavior today. Dualism is also an integral part of the world's major religions, which all make distinctions between body and soul, flesh and spirit. But many individuals throughout history, including most philosophers and scientists today, see no need to go beyond physics and chemistry to explain behavior. In contrast to both psychic and dualist theories, such materialist

theories attempt to explain the behavior of objects and organisms using only physical explanations based on matter, energy, and their interactions, rejecting all immaterial entities and forces. According to materialism, “there are no incorporeal souls or spirits, no spiritual principalities or powers, no angels or devils, no demiurges and no gods (if these are conceived as immaterial entities). Hence, nothing that happens can be attributed to the action of such beings” (K. Campbell 1967, p. 179).

Ancient Materialists

Although the doctrine of materialism is often associated with modern science, materialism has a long history and has been in competition with psychic and dualist theories since at least the time of ancient Greek philosophers. Among classical Greek thinkers, Leucippus (fifth century B.C.) and his student Democritus are best known for the development of materialism. They were the first to come up with the notion of atomism, the belief that the universe consisted of nothing but bits of tiny, indivisible matter and empty space between them—atoms and void. For Leucippus and Democritus, all that happened in the universe was the result of the mechanical action of these atoms as they collided with and exerted pressure on each other, with all movement and changes due to the combination and separation of atoms. As is consistent with our current theory of the conservation of matter and energy, these pioneering materialists asserted that nothing can arise out of nothing, and nothing can be destroyed. Thus they excluded from their system all teleology of the type embraced by Plato and Aristotle.

Three other early Western philosophers who developed materialistic theories should also be mentioned. Empedocles (fifth century B.C.) divided all matter into the four elements of earth, wind, water, and fire, a system that was also used by Aristotle. Epicurus (342–270 B.C.) saw all motion and objects as the result of an infinite number of atoms falling through infinite space during unlimited time, with resulting collisions leading eventually to every possible arrangement of atoms, including those in living organisms. Lucretius (c. 99–55 B.C.) was the only notable Roman to expound a materialist theory of behavior. These last two thinkers were similar in wanting to liberate people from religious anxieties and so argued with vigor against an immaterial soul and for the mortality of human existence.

Materialists of the Seventeenth Century and Later

Due to renewed popularity of Aristotle's philosophy and the power of the Roman Catholic Church, materialism did not form an important part of European thought until the Renaissance of the seventeenth century. One person who helped to bring about its revival was the well-known English philosopher Thomas Hobbes (1588–1679).

Influenced by the physics of Galileo (whom Hobbes met during a visit to Italy in 1636) and the notion of inertia, according to which objects in motion tend to stay in motion, Hobbes attempted to provide a purely materialist, mechanistic account of human sensation and behavior. Like other materialist theorists we have encountered, he understood all change in the universe as the result of physical bodies in motion and all movement as caused by contact of one moving body with another. He also considered the human body to be a complicated machine as did Descartes, although devoid of Descartes's immaterial soul.

But unlike classical materialists, Hobbes rejected the idea of empty space, believing instead that all space was filled with an intangible material substance. Accordingly, he rejected all notions of souls, angels, and a purely spiritual God, but instead saw God as making up the physical matter that filled what only appeared to be empty space.

A bit later on the European continent, French physician and philosopher Julien Offroy de La Mettrie (1709–1751) was promoting materialist ideas (and getting into trouble for doing so, such as being exiled in Holland). After a bout of serious illness during which La Mettrie experienced his mental powers declining along with his physical health, he became convinced that thought is nothing but the physical functioning of the brain and nervous system. His books *L'histoire naturelle de l'âme* (*The Natural History of the Mind*) and *L'homme machine* (*Man the Machine*) described humans as self-energized machines whose body parts functioned in purely mechanical ways. He also explained perception and learning as the results of changes in the brain, a concept that although wrong in its specific details is similar to the modern view of the essential relationship among brain, mind, and behavior. By showing that muscles and bodily organs could continue to function when removed from a living body, La Mettrie believed he had demonstrated that a soul was not necessary for

life. But in contrast to Descartes's passive, purely reactive view of the functioning of animal and human bodies, La Mettrie conceived of the living body "as a purposively self-moving and self-sufficient system, consisting of dynamically interrelated parts" (Popkin 1967, p. 381).

In the *Système de la nature* published in 1770 by German-born Frenchman Paul Heinrich Dietrich d'Holbach (1723–1789), we find a well-developed and thoroughly atheistic materialism. Holbach saw all events in the universe as the result of the redistribution of matter and its energy. Human behavior, which might appear spontaneous and uncaused by physical forces, was for him the result of motion already existing within the body. He also explained emotional feelings and personality as dependent on arrangements of internal states of matter and explained behavior that appeared to be based on free will as the result of spontaneous modifications of the brain.

Progress in science, notably in physics, chemistry, and biology from the seventeenth century to the present day, has done much to make materialism more appealing and respectable. The influence of Galileo on the materialism of Thomas Hobbes has been noted. But it was the remarkable breakthrough in physics achieved by Sir Isaac Newton that had the most significant and lasting effect on these theories. Newton's grand achievement was a precise, mathematical understanding of the motion of bodies through space.

Kepler had derived laws of motion for the planets, and Galileo had developed laws describing the motions of bodies on earth. Newton's system of three laws (described in chapter 1) was more general than either and applicable to all objects, terrestrial and celestial. In Newton's system, all physical objects are fundamentally inert and can only move or change as a reaction to outside forces such as gravity, or by coming into contact with another moving object. This is very unlike Aristotle's teleological system of physics in which, for example, a heavy object falls toward the center of the earth not because of the influence of an external force but rather because of the object's own goal to be as near the center of the earth as possible. By convincing scientists that the behavior of all physical bodies could be understood as quantifiable reactions to external forces, Newton had an enormous impact on science, philosophy, and even psychology.

But whereas the success of Newton's mechanics eliminated the full-time job that angels had of pushing the planets around the sun, Newton himself did not believe his laws of physics completely eliminated the need for God. Instead, God was still required to prevent the stars from collapsing into one giant heap of mass under the force of gravity and to maintain the regular motion of the planets that would otherwise be disrupted by gravitational attraction as they passed close to each other in their orbits around the sun. Thus he maintained a decidedly dualist philosophy of the universe.

The same could not be said for French astronomer and mathematician Pierre Simon de Laplace (1749–1827). One of the advantages Laplace had over Newton was the improved calculus developed by his colleagues, especially that of Italian-French mathematician Joseph Louis de Lagrange (1736–1813). With this tool in hand, Laplace went about polishing up Newton's system of mechanics, eliminating from it all known problems and anomalies, such as the varying speeds of Saturn and Jupiter. He was therefore convinced that no divine intervention was necessary to maintain the observed regular motion of the planets. His confidence in the adequacy of a purely mechanical and deterministic account of the motions of objects was such that when Napoleon questioned him about the absence of God from his theory, Laplace confidently replied that he had no need of that hypothesis!

To illustrate the power of his new and improved Newtonian mechanics, Laplace proposed a thought experiment involving superhuman intelligence that knew the position of every particle of matter in the universe and all the forces currently acting on each of them. To a being with this knowledge of initial conditions, together with the now-understood laws of motion, "nothing would be uncertain and the future as the past, would be present to its eyes" (Laplace 1814/1902, p. 4).

Laplace's materialist theory of the universe's behavior, based entirely on the idea of moving particles of matter interacting with each other, is clearly reminiscent of the classical materialist views of Leucippus, Democritus, Empedocles, Epicurus, and Lucretius. But one important difference is that he had mathematics and empirical results to back up his claim, at least with respect to the regular behavior of inanimate matter such as the motion of planets around the sun. And although it is less clear that even

improved Newtonian mechanics could do much to explain the more complex behavior of living organisms, we will see that the one-way cause-effect perspective was eventually to become—and remains—the principal model on which psychological theories of animal and human behavior are founded.

The world today is divided along many lines. One of the most obvious is the line dividing the wealthy, industrialized countries of Europe, North America, and Oceania from the poorer, less industrialized countries of much of the rest of the world. Perhaps less obvious, but just as striking, is the line separating materialist (physical, natural) methodologies and beliefs of science and scientists from overwhelmingly psychic (spiritual, supernatural) or dualist methodologies and beliefs of the rest of the world's human population. While science is now thoroughly materialistic in orientation and methodology, most individuals doubt that life, its origin, its meaning, and its experiences can be accounted for by physical properties of matter, energy, and their interaction, and hence believe in a God or gods, spirits, angels, paranormal happenings, and other supernatural entities and phenomena. In the next chapter we will see that there is good reason to doubt the adequacy of widely held materialist explanations of animate behavior.