

Attachment 1 - Brain Report
Executive Summary of Rene Descartes, French Mathematician,
Scientist and Philosopher
Dr. Frank J. Collazo Beauchamp
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Chronology of Rene Descartes

Descartes, René (March 31, 1596 - February 11, 1650), French mathematician, scientist, and philosopher. Descartes was one of the first to abandon scholastic Aristotelianism, because he formulated the first modern version of mind-body dualism, from which stems the mind-body problem. Because he promoted the development of a new science grounded in observation and experiment, he has been called the father of modern philosophy. Descartes had been a puny child with a weak chest and was not expected to live. He therefore watched his health carefully, becoming a virtual vegetarian.

March 31, 1596: Descartes, René was born in La Haye, Touraine,

France 16th-17th Centuries: For knowledge advances through the discovery and advocacy of new philosophical methods, and, because the diverse methods advocated depend for their validity upon the acceptance of different philosophical criteria of truth, meaning, and importance, the crucial philosophical quarrels of the 16th and 17th centuries were at bottom quarrels in the advocacy of methods. It is this issue rather than any disagreement over subject matter or areas of attention that separated the greatest Renaissance philosophers—such as Francis Bacon, René Descartes, and Thomas Hobbes.

17th Century: The modern problem of the relationship of mind to body stems from the thought of René Descartes, a 17th-century French philosopher and mathematician, who gave dualism its classical formulation. Beginning from his famous Cogito, ergo sum (Latin: “I think, therefore I am”), Descartes developed a theory of mind as an immaterial, non-extended substance that engages in various activities such as rational thought, imagining, feeling, and willing.

Although monads do not causally interact with each other, a “pre-established harmony” between them, created and maintained by God, ensures that the appearance of interaction is maintained at the level of material objects.

The other great figure of late 17th-century rationalism, Gottfried Wilhelm Leibniz, also gave a parallelistic answer to the problem of mind-body interaction. Each monad reflects, or perceives, the entire universe from its own point of view. Leibniz, saw mind and body as two perfectly correlated series, synchronized like two clocks at their origin by God in a pre-established harmony.

The Irish radical empiricist and Bishop George Berkeley (1685–1753) developed another monistic metaphysical system. Berkeley managed to avoid the problem of mind-body interaction by taking the extreme step of denying the existence of matter. Bodies, according to him, are only collections of sensible ideas that are presented to the human mind in lawful order

by God. Because there is no material world, there is also no skeptical problem about whether ideas truly represent physical reality. Instead, all ideas are known directly.

By contrast, the English materialist philosopher Thomas Hobbes (1588–1679) did away with mind as a mental substance by asserting that only matter exists. For Hobbes, the mind is the same as the brain, and thoughts or ideas consist of nothing more than motions of brain matter.

Because the mind is material, it is capable of causing bodily motions in response to sensory stimuli; and because ideas are material, they can resemble, and thus represent, material bodies.

Cordemoy, Géraud de (1620-1684), born in Paris, France. French historian and philosopher, who showed considerable originality in his development of the general principles of physical theory. He introduced a new atomism into the mechanistic system of René Descartes by linking unity and substantiality; matter is homogeneous but contains a multiplicity of bodies each of which is an individual substance.

Fermat, Pierre de (August 17, 1601- January 12, 1665) Beaumont-de-Lomagne, France; French mathematician who is often called the founder of the modern theory of numbers. Together with René Descartes, Fermat was one of the two leading mathematicians of the first half of the 17th century.

Independently of Descartes, Fermat discovered the fundamental principle of analytic geometry. His methods for finding tangents to curves and their maximum and minimum points led him to be regarded as the inventor of the differential calculus. Through his correspondence with Blaise Pascal he was a co-founder of the theory of probability.

Pascal trembled when he looked into the infinite universe and perceived the puniness and misery of man. Descartes exulted in the power of human reason to understand the cosmos and to promote happiness, and he rejected the view that human beings are essentially miserable and sinful.

René Descartes concluded that the pineal was the seat of the soul. A corollary notion was that calcification of the pineal caused psychiatric disease, a concept that provided support for those who considered psychotic behavior to be rampant; modern examination techniques have revealed that all pineal glands become more or less calcified.

Gottfried Wilhelm Leibniz, a 17th-century German rationalist and mathematician, saw mind and body as two perfectly correlated series, synchronized like two clocks at their origin by God in a pre-established harmony.

The other great figure of late 17th-century rationalism, Leibniz, also gave a parallelistic answer to the problem of mind-body interaction. Each monad reflects, or perceives, the entire universe from its own point of view.

1606: Descartes was sent to the Jesuit College at La Flèche, established in 1604 by Henry IV (reigned 1589–1610). Aristotle was taught from scholastic commentaries—they studied acting, music, poetry, dancing, riding, and fencing.

1605: The English philosopher Francis Bacon (1561–1626), in *Advancement of Learning* (1605), had earlier proposed a new science of observation and experiment to replace the traditional Aristotelian science, as Descartes himself did later.

1610: Descartes participated in an imposing ceremony in which the heart of Henry IV, whose assassination that year had destroyed the hope of religious tolerance in France and Germany, was placed in the cathedral at La Flèche.

1611: The Cardinal Pierre de Bérulle (1575–1629)—who had founded the Oratorian teaching congregation in 1611 as a rival to the Jesuits—was present at the talk. Many commentators speculate that Bérulle urged Descartes to write a metaphysics based on the philosophy of St. Augustine as a replacement for Jesuit teaching.

1614: Descartes went to Poitiers, where he took a law degree in 1616. At this time, Huguenot Poitiers was in virtual revolt against the young King Louis XIII (reigned 1610–43).

1615: In France, by contrast, religious intolerance was mounting. The Jews were expelled in 1615, and the last Protestant stronghold, La Rochelle, was crushed—with Bérulle's participation—only weeks before Descartes' departure.

1618: Descartes was encouraged in his studies of science and mathematics by the physicist Isaac Beckman (1588–1637), for whom he wrote the *Compendium of Music* (written 1618, published 1650), his first surviving work. He went to Breda in the Netherlands, where he spent 15 months as an informal student of mathematics and military architecture in the peacetime army of the Protestant stad-holder, Prince Maurice (ruled 1585–1625).

The *Compendium of Music* was written but it was not published until 1650. The *Musicae Compendium* was written in 1618, but published in 1650.

1619: While in Bohemia in 1619, he invented analytic geometry, a method of solving geometric problems algebraically and algebraic problems geometrically. He also devised a universal method of deductive reasoning, based on Mathematics that is applicable to all the sciences.

1619-28: Descartes spent the period 1619 to 1628 traveling in northern and southern Europe, where, as he later explained, he studied “the book of the world.” Descartes moved to Paris. There he gambled, rode, fenced, and went to the court, concerts, and the theatre. Descartes' friend, Théophile de Viau (1590–1626), was burned in effigy and imprisoned in 1623 for writing verses mocking religious themes.

The French Parliament passed a decree forbidding criticism of Aristotle on pain of death. Although Mersenne and the philosopher Pierre Gassendi (1592–1655) did publish attacks on

Aristotle without suffering persecution (they were, after all, Catholic priests), those judged to be heretics continued to be burned, and laymen lacked church protection.

1628: Descartes denied the alchemist Chandoux's claim that probabilities are as good as certainties in science and demonstrated his own method for attaining certainty. Descartes returned to Poitou regularly. The Rules for the Direction of the Mind was not published until 1701, consists of four rules: (1) accept nothing as true that is not self-evident, (2) divide problems into their simplest parts, (3) solve problems by proceeding from simple to complex, and (4) recheck the reasoning..

At a talk in 1628, Descartes denied the alchemist Chandoux's claim that probabilities are as good as certainties in science and demonstrated his own method for attaining certainty.

The *Regulae and Directionem Ingenii* was written in 1628, but published in 1701.

1628-1637: This method, which he later formulated in *Discourse on Method* (1637) and *Rules for the Direction of the Mind* consists of four rules:

- (1) Accept nothing as true that is not self-evident.
- (2) Divide problems into their simplest parts.
- (3) Recheck the reasoning.
- (4) Solve problems by proceeding from simple to complex.

These rules are a direct application of mathematical procedures. In addition, Descartes insisted that all key notions and the limits of each problem must be clearly defined.

Descartes went to the university at Franeker, where he stayed with a Catholic family and wrote the first draft of his *Meditations*. He matriculated at the University of Leiden. Descartes visited Denmark with the physician and alchemist Étienne de Villebressieu, who invented siege engines, a portable bridge, and a two-wheeled stretcher. Although Descartes feared the church, he also hoped that his physics would one day replace that of Aristotle in church doctrine and be taught in Catholic schools.

1633: Just as he was about to publish *The World* (1664), Descartes learned that the Italian astronomer Galileo Galilei (1564–1642) had been condemned in Rome for publishing the view that the Earth revolves around the Sun. Because this Copernican position is central to his cosmology and physics, Descartes suppressed *The World*, hoping that eventually the church would retract its condemnation. Although Descartes feared the church, he also hoped that: “his physics would one day replace that of Aristotle in church doctrine and be taught in Catholic schools.”

Le Monde de Mr. Descartes; ou, le traité de la lumière was written in 1633, published in 1664.

1635: Descartes' daughter Francine was born to Helena Jans and was baptized in the Reformed Church in Deventer. Although Francine is typically referred to by commentators as Descartes' “illegitimate” daughter, her baptism is recorded in a register for legitimate births. Her death of

scarlet fever at the age of five was the greatest sorrow of Descartes' life. Referring to her death, Descartes said that he did not believe that: "one must refrain from tears to prove oneself a man."

1637: "Descartes' Discourse on Method" is one of the first important modern philosophical works not written in Latin. Descartes said that: "he wrote in French so that all who had good sense, including women, could read his work and learn to think for themselves."

1639: He bragged that he had not been sick for 19 years and that he expected to live to 100. He told Princess Elizabeth to think of life as a comedy; bad thoughts cause bad dreams and bodily disorders. Because there is always more good than evil in life, he said, one can always be content, no matter how bad things seem.

The physician Henri Regius (1598–1679), who taught Descartes' views at the University of Utrecht in 1639, involved Descartes in a fierce controversy with the Calvinist theologian Gisbertus Voetius (1589–1676) that continued for the rest of Descartes' life.

1641: Descartes published the "Meditations on First Philosophy," in Which Is Proved the Existence of God and the Immortality of the Soul. Written in Latin and dedicated to the Jesuit professors at the Sorbonne in Paris, the work includes critical responses by several eminent thinkers—collected by Mersenne from the Jansenist philosopher and theologian Antoine Arnauld (1612–94), the English philosopher Thomas Hobbes (1588–1679), and the Epicurean atomist Pierre Gassendi (1592–1655)—as well as Descartes' replies.

Meditationes de Prima Philosophia was written in 1641; and its 2nd ed., with *Objectiones Septimae*, published in 1642. The *Meditations* is characterized by Descartes' use of methodic doubt, a systematic procedure of rejecting as though false all types of belief in which one has ever been, or could ever be, deceived.

Descartes' apparent knowledge based on authority is set aside, because even experts are sometimes wrong. His beliefs from sensory experience are declared untrustworthy, because such experience is sometimes misleading, as when a square tower appears round from a distance.

1642-1648: The second edition includes a response by the Jesuit priest Pierre Bourdin (1595–1653), who Descartes said was a fool. These objections and replies constitute a landmark of cooperative discussion in philosophy and science at a time when dogmatism was the rule. Descartes published *Principles of Philosophy*, a compilation of his physics and metaphysics. He dedicated this work to Princess Elizabeth (1618–79), daughter of Elizabeth Stuart, titular queen of Bohemia, in correspondence with which he developed his moral philosophy.

After 16 years in the Netherlands, Descartes returned to France for brief visits on financial business and to oversee the translation into French of the *Principles*, the *Meditations*, and the *Objections and Replies*. *Six Metaphysical Meditations; Wherein It Is Proved That There Is a God*, (1680) and *Principia Philosophiae* were written in 1644.

He also met with Gassendi and Hobbes, and he suggested to Pascal the famous experiment of taking a barometer up Mount Puy-de-Dome to determine the influence of the weight of the air.

Picot returned with Descartes to the Netherlands for the winter of 1647–48. During Descartes' final stay in Paris in 1648, the French nobility revolted against the crown in a series of wars known as the Fronde.

He wrote a Letter to Voetius in 1648 and made a plea for religious tolerance and the rights of man. Claiming to write not only for Christians but also for Turks—meaning Muslims, libertines, infidels, deists, and atheists—he argued that: “because Protestants and Catholics worship the same God, both can hope for heaven.”

August 17, 1648: Descartes left precipitously only days before the death of his old friend Mersenne. Descartes went reluctantly, arriving early in October 1649. He may have gone because he needed patronage; the Fronde seemed to have destroyed his chances in Paris, and the Calvinist theologians were harassing him in the Netherlands.

1649-50: This insight is the basis of Descartes' defense of free will and of the mind's ability to control the body. Despite such arguments, in his *Passions of the Soul* (1649), which he dedicated to Queen Christina of Sweden (reigned 1644–54), Descartes holds that most bodily actions are determined by external material causes.

A Discourse of a Method for the Well Guiding of Reason, and the Discovery of Truth in Sciences were written in 1649. *Les Passions de l'âme* was written in 1649, and *The Passions of the Soule* was written in 1650.

Early 17th Century: Fermat, Pierre de, and Descartes were the two outstanding mathematicians during this period.

17th-18th Centuries: The contrast between Rationalism and Empiricism, it was to dominate the philosophical controversies during these centuries, and to present a dilemma hardly to be resolved before the advent of Immanuel Kant.

1650: Descartes wrote the statutes for a Swedish Academy of Arts and Sciences. While delivering these statutes to the queen at 5:00 am, he caught a chill, and he soon developed pneumonia. He died in Stockholm on February 11. Many pious last words have been attributed to him, but the most trustworthy report is that of his German valet, who said that Descartes was in a coma and died without saying anything at all.

In his later years, Descartes said that: “he had once hoped to learn to prolong life to a century or more, but he then saw that, to achieve that goal, the work of many generations would be required;” he himself had not even learned to prevent a fever. Thus, he said: “instead of continuing to hope for long life, he had found an easier way, namely to love life and not to fear death.” It is easy, he claimed: “for a true philosopher to die tranquilly.”

1653: Renatus Des-Cartes *Excellent Compendium of Musick* was published.

1664: He also described the circulation of the blood but came to the erroneous conclusion that heat in the heart expands the blood, causing its expulsion into the veins. The *Man* and a *Treatise on the Formation of the Fetus* was published.

1667: The Roman Catholic Church made its own decision by putting Descartes' works on the "Prohibited Books" on the very day his bones were ceremoniously placed in Sainte-Geneviève-du-Mont in Paris.

1677: The rationalist metaphysics of the Dutch-Jewish philosopher Benedict de Spinoza derives from Descartes. Spinoza wrote his *Ethics* (1677) in mathematico-deductive form, with definitions, axioms, and derived theorems. His metaphysics, which is simultaneously monistic, pantheistic, and deistic, holds that there is only one substance, and that this one substance is God, and that God is the same as the world. The one substance has an infinite number of attributes, each of which expresses the totality of the world (or God), though the only attributes known to human beings are mind and matter.

All attributes are parallel in every respect. That is, for every idea expressed in the mental attribute, there is a parallel body in the material attribute, and vice versa. Thus, though mind and matter do not interact, for Spinoza as for Malebranche they appear to do so.

1691: This cosmetic work culminated in 1691 in the massive biography by Father Adrien Baillet, who was at work on a 17-volume *Lives of the Saints*. Even during Descartes' lifetime there were questions about whether he was a Catholic apologist, primarily concerned with supporting Christian doctrine, or an atheist, concerned only with protecting himself with pious sentiments while establishing a deterministic, mechanistic, and materialistic physics.

18th Century: Another response, also heroic, is that of the Scottish philosopher David Hume (1711–76), who accepted skeptical conclusions and contented himself with attempting to explain the psychological origins of our unjustifiable belief in an external world, in the continuity of past and future, and in an enduring "self" that is the unchanging subject of mental experience.

18th-19th Centuries: The idea also was central to the developmental idealism of the German philosopher G.W.F. Hegel (1770–1831), who conceived human history as the gradual coming to consciousness of a World Soul.

19th Century: Various mathematicians substituted alternatives to Euclid's parallel postulate, which, in its modern form, reads, "Given a line and a point not on the line, it is possible to draw exactly one line through the given point parallel to the line." They hoped to show that the alternatives were logically impossible. Instead, they discovered that consistent non-Euclidean geometries exist.

19th-20th Centuries: The German philosopher Edmund Husserl (1859–1939) attempted to establish a science of sensible ideas, which he called phenomenology.

Early 20th century, the British philosopher Bertrand Russell (1872–1970) and his student the Austrian-born Ludwig Wittgenstein (1889–1951), as well as the German founders of logical

positivism Moritz Schlick (1882–1936) and Rudolf Carnap (1891–1970), construed aspects of the physical world as “logical constructions” of sensible ideas, which they called “sense data.”

Russell, following the American pragmatist philosopher and psychologist William James (1842–1910), suggested that both mind and matter could be constructed out of what he called “neutral monads.” All of these systems can be considered steps along the Cartesian way of ideas.

20th Century: The metaphysics of Martin Heidegger (1889–1976), with its focus on the being of self, or Dasein, strongly influenced the existentialism of the French philosopher Jean-Paul Sartre (1905–1980), who argued that each individual chooses his own nature. Sartre also upheld the Cartesian position that the self is essentially conscious by rejecting the theory of the unconscious proposed by the Austrian psychoanalyst Sigmund Freud (1856–1939).

The Nobel Prize-winning Australian physiologist John C. Eccles (1903–97) and the British primatologist Wilfred E. Le Gross Clark (1895–1971) developed theories of the mind as a nonmaterial entity. Similarly, Eccles and the Austrian-born British philosopher Karl Popper (1902–94) advocated a species of mind-matter dualism, though their tripartite division of reality into matter, mind, and ideas is perhaps more Platonic than Cartesian.

One of the strongest contemporary attacks on traditional Cartesian dualism is that of the British philosopher Gilbert Ryle (1900–76). In *The Concept of Mind* (1949), Ryle dismisses the Cartesian view as the fallacy of “the ghost in the machine,” arguing that the mind—the ghost—is really just the intelligent behavior of the body.

A different criticism has been advanced by the American pragmatist Richard Rorty, who claims (in *Philosophy and the Mirror of Nature* [1979] and other works) that the Cartesian demand for certain knowledge of an objectively existing world through representative ideas is a holdover from the mistaken quest for God. That is, whereas certain knowledge of God's existence may be necessary for salvation, to seek certainty in science and in the ordinary affairs of life is both hopeless and unnecessary. Philosophy in the Cartesian tradition, Rorty contends, is the 20th century's substitute for theology and should, like the concept of God, be gently laid to rest. Late 20th century, however, numerous commentators had come to believe that Descartes was a Catholic in the same way he was a Frenchman and a royalist—that is, by birth and by convention.

End 20th Century: Descartes' skeptical, mathematical method underpins modern science. His conception of rationality informed modern Western ideas of what it means to be a human being until nearly the end of the 20th century, and his intense desire to control nature in the service of humanity has been the ultimate secular goal of modern science since the time of the Enlightenment.

In 1930, a majority of scholars, many of whom were religious, believed that Descartes' major concerns were metaphysical and religious.

20th century accomplishments by other philosophers, the history of the original works, and their early translations into English are as follows:

The British philosopher Bertrand Russell (1872–1970) and his student the Austrian-born Ludwig Wittgenstein (1889–1951), as well as the German founders of logical positivism Moritz Schlick (1882–1936) and Rudolf Carnap (1891–1970), construed aspects of the physical world as “logical constructions” of sensible ideas, which they called “sense data.”

Later, in the century, Russell, following the American pragmatist philosopher and psychologist William James (1842–1910), suggested that both mind and matter could be constructed out of what he called “neutral monads.” All of these systems can be considered steps along the Cartesian way of ideas.

The German philosopher Edmund Husserl (1859–1939) attempted to establish a science of sensible ideas, which he called phenomenology.

The idea also was central to the developmental idealism of the German philosopher G.W.F. Hegel (1770–1831), who conceived of human history as the gradual coming to consciousness of a World Soul. The metaphysics of Martin Heidegger (1889–1976), with its focus on the being of the self, or *Dasein*, strongly influenced the existentialism of the French philosopher Jean-Paul Sartre (1905–1980), who argued that each individual chooses his own nature. Sartre also upheld the Cartesian position that the self is essentially conscious by rejecting the theory of the unconscious proposed by the Austrian psychoanalyst Sigmund Freud (1856–1939). Some aspects of Cartesian metaphysics and epistemology were still strongly defended in the 20th century.

He once told a German protégée, Anna Maria van Schurman (1607–78), who was known as a painter and a poet, that she was wasting her intellect studying Hebrew and theology. He also was perfectly aware of—though he tried to conceal—the atheistic potential of his materialist physics and physiology.

The American linguist Noam Chomsky, for example, has argued that human beings are born with an innate knowledge of the underlying structures of all learnable languages, even of languages that have never been spoken.

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20TH-21ST Centuries: The nature of consciousness became a topic of particular interest to philosophers and neuroscientists. The problems faced by these researchers were essentially the same as those encountered by all philosophers since Descartes who have attempted to understand the nature of the mind. Although the seat of consciousness is universally accepted to be the central nervous system, and in particular the brain, it seems impossible that a material object like the brain could give rise to the mental experiences that human beings have when they are said to be conscious.

In other words, it seems impossible to give an account of these experiences that, on the one hand, captures what they are really like for human beings and, on the other, is consistent with the strictly physical vocabulary of the scientific theories in terms of which the brain is understood. Some philosophers have responded to this problem in a manner reminiscent of Descartes, who argued that, although mind-body interaction seems to be impossible, human beings experience it, and God can make it happen.

The British philosopher Colin McGinn, for example, is among a group of thinkers, known as “mysterians,” who claim that, although we know that the conscious mind is nothing more than the brain, it is simply beyond the conceptual apparatus of human beings to understand how this can be the case. Other philosophers, such as Daniel Dennett and Paul Churchland, have made valiant attempts to develop strictly materialist accounts of consciousness, but their efforts so far have not been widely accepted.

A third line of response is represented by the American philosopher John Searle, who argues that the root of the problem is the dichotomy between the old Cartesian concepts of mind and matter, which he claims are both inherently incompatible and outmoded, given modern physics. Searle believes that consciousness, like digestion, is a biological phenomenon (albeit a very complex one) that can in principle be fully explained in scientific terms.

Accomplishments

Descartes formulated the first modern version of mind-body dualism, from which stems the mind-body problem, and because he promoted the development of a new science grounded in observation and experiment, he has been called the father of modern philosophy.

Applying an original system of methodical doubt, he dismissed apparent knowledge derived from authority, the senses, and reason and erected new epistemic foundations on the basis of the intuition that, when he is thinking, he exists; this he expressed in the dictum “I think, therefore I am” (best known in its Latin formulation, “Cogito, ergo sum,” though originally written in French, “Je peens, donc je suis”).

Formulated in *Discourse on Method* (1637) and *Rules for the Direction of the Mind* (written by 1628 but not published until 1701), consists of four rules:

- (1) Accept nothing as true that is not self-evident.
- (2) Divide problems into their simplest parts.

(3) Solve problems by proceeding from simple to complex.

(4) Recheck the reasoning. These rules are a direct application of mathematical procedures. In addition, Descartes insisted that all key notions and the limits of each problem must be clearly defined. Descartes also investigated reports of esoteric knowledge, such as the claims of the practitioners of theosophy to be able to command nature. He developed a metaphysical dualism that distinguishes radically between mind, the essence of which is thinking, and matter, the essence of which is extension in three dimensions.

Descartes' metaphysics is rationalist, based on the postulation of innate ideas of mind, matter, and God, but his physics and physiology, based on sensory experience, are mechanistic and empiricist. Descartes was one of the first to abandon scholastic Aristotelianism, because he formulated the first modern version of mind-body dualism, from which stems the mind-body problem. And, because he promoted the development of a new science grounded in observation and experiment, he has been called the father of modern philosophy.

Two important themes in the history of modern philosophy can be traced to Descartes. The first, called "the way of ideas," represents the attempt in epistemology to provide a foundation for our knowledge of the external world (as well as our knowledge of the past and of other minds) in the mental experiences of the individual.

The Cartesian theory of knowledge through representative ideas is rooted in Galileo's distinction between real, or primary, properties of material bodies—such as size, shape, position, and motion or rest—which were thought to exist in bodies themselves, and sensible, or secondary, properties—such as colors, tactile feelings, sounds, odors, and tastes—which were thought to exist only in the mind.

Descartes assumes in his theory of light and as Locke later argued, secondary properties of bodies do not exist in bodies themselves but are the result of the interaction of distinctive arrangements of primary properties with the human sense organs.

According to Locke, however, our sensible ideas of the size, shape, position, and motion or rest of particular bodies resemble their corresponding primary properties and so can be a source of knowledge about them. Nevertheless, against this claim it is still possible to raise the skeptical objection that, because mental and material substances are radically distinct, and because all ideas are mental, no idea, not even an idea of a primary property can resemble a material object.

As noted above, Berkeley's phenomenalism is one heroic solution to this skeptical problem: Bodies are known directly simply because bodies are nothing more than bundles of sensible ideas.

Philosophy

Philosophy in the modern world is a self-conscious discipline. It has managed to define itself narrowly, so as to differentiate itself on the one hand from religion and on the other from exact

science. But this narrowing of focus came about very late in its history—certainly not before the 18th century.

Descartes' influence on Western philosophy is so pervasive that all Western philosophers, even those who reject Cartesianism, can be said to be Cartesians, just as they can be said to be Greeks: their positions are essentially responses to problems posed by Descartes.

The earliest philosophers of Greece were theorists of the physical world; Pythagoras and Plato were at once philosophers and mathematicians. In Aristotle, no clear distinction between philosophy and natural science can be maintained. The Renaissance continued this breadth of conception characteristic of the Greeks. Galileo and Descartes were mathematicians, physicists, and philosophers at once, and physics retained the name of “natural philosophy” at least until the death of Sir Isaac Newton in 1727.

Had the Renaissance been painstakingly self-aware in the matter of definition (which it was not), it might have defined philosophy on the basis of its actual practice, as “the rational, methodical, and systematic consideration of man, civil society, and the natural world.” The areas of its interests would in no case have been in doubt. But exactly what constitutes “rational, methodical, and systematic consideration” would have been extremely controversial.

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The *Discourse* and other works illustrate Descartes' conception of knowledge as being like a tree in its interconnectedness and in the grounding provided to higher forms of knowledge by lower or more fundamental ones. Thus, for Descartes, metaphysics corresponds to the roots of the tree, physics to the trunk, and medicine, mechanics, and morals to the branches. In the *Discourse* he also provided a provisional moral code (later presented as final) for use while seeking truth:

- (1) Obey local customs and laws.
- (2) Make decisions on the best evidence and then stick to them firmly as though they were certain.
- (3) Change desires rather than the world.
- (4) Always seek truth. This code exhibits Descartes' prudential conservatism, decisiveness, stoicism, and dedication.

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because even experts are sometimes wrong. His beliefs from sensory experience are declared untrustworthy, because such experience is sometimes misleading, as when a square tower appears round from a distance.

Finally, his apparent knowledge of simple and general truths of reasoning that do not depend on sense experience—such as “ $2 + 3 = 5$ ” or “a square has four sides”—is also unreliable, because God could have made him in such a way that, for example, he goes wrong every time he counts. As a way of summarizing the universal doubt into which he has fallen, Descartes supposes that an “evil genius of the utmost power and cunning has employed all his energies in order to deceive me.”

Parallelism also rejects causal interaction but without constant divine intervention.

Even his beliefs about the objects in his immediate vicinity may be mistaken, because, as he notes, he often has dreams about objects that do not exist, and he has no way of knowing with certainty whether he is dreaming or awake.

“Cogito, sum”

The second theme to derive from Descartes is an emphasis on the nature of the self, or ego. The roots of this idea extend back to the Neoplatonic philosophy of St. Augustine (354–430), who argued that when one is thinking, one necessarily exists. Nevertheless, it justifies accepting as certain only the existence of the person who thinks it. If all one ever knew for certain was that one exists, and if one adhered to Descartes' method of doubting all that is uncertain, then one would be reduced to solipsism, the view that nothing exists but one's self and thoughts.

The cogito is a logically self-evident truth that also gives intuitively certain knowledge of a particular thing's existence—that is, one's self. Although at this stage there is seemingly no belief about which he cannot entertain doubt, Descartes finds certainty in the intuition that, when he is thinking—even if he is being deceived—he must exist.

On the basis of clear and distinct innate ideas, Descartes then establishes that each mind is a mental substance and each body a part of one material substance. The mind or soul is immortal, because it is un-extended and cannot be broken into parts, as can extended body. Descartes' general goal was to help human beings master and possess nature. He spent the rest of his life working on the branches of mechanics, medicine, and morals. Mechanics is the basis of his physiology and medicine, which in turn is the basis of his moral psychology.

Descartes believed that all material bodies, including the human body are machines that operate by mechanical principles. In his physiological studies, he dissected animal bodies to show how their parts move. He argued that, because animals have no souls, they do not think or feel; thus, vivisection, which Descartes practiced, is permitted.

Dualism

Plato was a dualist; he believed in the existence of both material entities and immaterial ones. The most explicit statement of dualism, however, is found in the writing of René Descartes, who argued that mind and matter are two separate and distinct sorts of substances, absolutely opposed in their natures, each capable of existing entirely independently of the other.

The dualist is faced with the question of how, if at all, mind and matter are related to each other. Most dualists would agree that in rocks, tables, and other material things, matter exists alone and unrelated to mind; and that at what is called death (since for Descartes the soul is immortal), immaterial minds exist unrelated to matter.

In the case of a living human being, however, there are two substances: a mind and a body. Thus, the question arises of how the relation between them is to be conceived. Any dualistic theory would have to account for certain obvious facts about human beings. When people's bodies are affected in certain ways—when subjected, for example, to bright lights, loud noises, rises in temperature—people often experience colors, sounds, or sensations of warmth or of pain. Again, when people experience certain things, their bodies undergo certain changes—they shut their eyes.

Descartes View on Mind-Body Dualism

In philosophy, any theories that mind and body are distinct kinds of substances or natures. This position implies that mind and body not only differ in meaning but refer to different kinds of entities. Thus, a dualist would oppose any theory that identifies mind with the brain, conceived as a physical mechanism.

The modern problem of the relationship of mind to body stems from the thought of Descartes who gave dualism its classical formulation. Beginning from his famous *Cogito, ergo sum* (Latin: “I think, therefore I am”), Descartes developed a theory of mind as an immaterial, non-extended substance that engages in various activities such as rational thought, imagining, feeling, and willing.

Matter, or extended substance, conforms to the laws of physics in mechanistic fashion, with the important exception of the human body, which Descartes believed is causally affected by the human mind and which causally produces certain mental events. For example, willing the arm to be raised causes it to be raised, whereas being hit by a hammer on the finger causes the mind to feel pain. This part of Descartes' dualistic theory, known as interactionism, raises one of the chief problems faced by Descartes: the question how this causal interaction is possible.

This problem gave rise to other varieties of dualism, such as occasionalism and some forms of parallelism that do not require direct causal interaction. Occasionalism maintains that apparent links between mental and physical events are the result of God's constant causal action.

Among the difficulties of dualism is the inherent obscurity in conceiving of what sort of thing a mental substance—an immaterial, thinking “stuff”—might be. Such criticisms have led some thinkers to abandon dualism in favor of various monistic theories. On the basis of clear and

distinct innate ideas, Descartes then establishes that: each mind is a mental substance and each body a part of one material substance. The mind or soul is immortal, because it is unextended and cannot be broken into parts, as can extended bodies.

Epiphenomenalism

Another dualistic theory is epiphenomenalism, which agrees with other theories in holding that mental events and physical events are different. The epiphenomenalism holds, however, that the only true causes are physical events, with mind as a by-product. Mental events seem causally efficacious because certain mental events occur just before certain physical events and because humans are ignorant of the events in the brain that truly cause them.

Solipsism

Nevertheless, it justifies accepting as certain only the existence of the person who thinks it. If all one ever knew for certain was that one exists, and if one adhered to Descartes' method of doubting all that is uncertain, then one would be reduced to solipsism, the view that nothing exists but one's self and thoughts. To escape solipsism, Descartes argues that all ideas that are as "clear and distinct" as the cogito must be true, for, if they were not, the cogito also, as a member of the class of clear and distinct ideas, could be doubted. Since "I think, I am" cannot be doubted, all clear and distinct ideas must be true.

Epistemology

Both the rise of modern science and the rediscovery of Skepticism were important influences on René Descartes. While he believed that humans were capable of knowledge and certainty and that modern science was developing the superstructure of knowledge, he thought that Skepticism presented a legitimate challenge that needed an answer, one that only he could provide.

The challenge of Skepticism, as Descartes saw it, is vividly portrayed in his *Meditations*. He considered the supposition that all of one's beliefs are false, being the delusions of an evil genius who has the power to impose beliefs on people unbeknownst to them. But Descartes claimed that it is not possible for all of one's beliefs to be false, for anyone who has false beliefs is thinking and knows that he is thinking, and if the person is thinking, then that person exists. Nonexistent things cannot think. This line of argument is summarized in Descartes' formula, "Cogito, ergo sum" ("I think; therefore, I am").

Descartes distinguished two sources of knowledge: intuition and deduction. Intuition is an unmediated mental seeing or direct apprehension of something experienced.

The truth of the proposition "I think" is guaranteed by the intuition one has of one's own experience of thinking. One might think that the proposition "I am" is guaranteed by deduction, as is suggested by the "ergo." In *Objections and Replies* (1642), however, Descartes explicitly says that the certainty of "I am" is also based upon intuition.

If one could know only that one thinks and exists, human knowledge would be depressingly narrow. So Descartes proceeded to broaden the limits of human knowledge. After showing that all human knowledge depended upon thought or reason, not sensation or imagination, he then proceeded to prove to his own satisfaction that God exists, that the criterion for knowledge is clearness and distinctness that mind is more easily known than body, that the essence of matter is extension, and that most of his former beliefs are true.

Few of these proofs convinced many people in the form in which Descartes presented them. One major problem is what has come to be known as the Cartesian circle. In order to escape from the possibility that an evil genius is deluding him about everything he believes, Descartes proves that God exists. He then argues that clearness and distinctness is the criterion for all knowledge because God does not deceive man. But, since this criterion is arrived at only after the existence of God has been proven, he cannot appeal to this criterion when he presents his proof for the existence of God; hence he cannot know that his proof is cogent.

Empiricism/Rationalism

The scientific contrast between Vesalius' rigorous observational techniques and Galileo's reliance upon mathematical theory received further expression in the contrast between the respective philosophies of Francis Bacon and René Descartes. And, indeed, in its more abstract formulation as the contrast between Rationalism and Empiricism, it was to dominate the philosophical controversies of the 17th and 18th centuries and to present a dilemma hardly to be resolved before the advent of Immanuel Kant.

Physics, Physiology, and Morals

Descartes' general goal was to help human beings master and possess nature. He provided understanding of the trunk of the tree of knowledge in *The World, Dioptrics, Meteorology, and Geometry*, and he established its metaphysical roots in the *Meditations*. He then spent the rest of his life working on the branches of mechanics, medicine, and morals. Mechanics is the basis of his physiology and medicine, which in turn is the basis of his moral psychology.

Descartes believed that all material bodies, including the human body, are machines that operate by mechanical principles. He believed that everyone could tell true from false by the natural light of reason. In three essays accompanying the *Discourse*, he illustrated his method for utilizing reason in the search for truth in the sciences:

Descartes in *Dioptrics* derived the law of refraction.

Meteorology: He explained the rainbow.

Thus, for Descartes, metaphysics corresponds: "to the roots of the tree, physics to the trunk, and medicine, mechanics, and morals to the branches."

Although Descartes wrote no political philosophy, he approved of the admonition of Seneca (c. 4 BC–AD 65) to acquiesce in the common order of things.

He rejected the recommendation of Niccolò Machiavelli (1469–1527) to lie to one's friends, because friendship is sacred and life's greatest joy. Human beings cannot exist alone but must be parts of social groups, such as nations and families, and it is better to do good for the group than for oneself.

In his later years Descartes said that he had once hoped to learn to prolong life to a century or more, but he then saw that, to achieve that goal, the work of many generations would be required; he himself had not even learned to prevent a fever. Thus, he said, instead of continuing to hope for long life, he had found an easier way, namely to love life and not to fear death. It is easy, he claimed, for a true philosopher to die tranquilly.

In Sweden where, Descartes said, in winter men's thoughts freeze like the water.

Religious Beliefs

Descartes advocated religious tolerance and championed the use of reason. Descartes also advances a proof for the existence of God. He begins with the proposition that he has an innate idea of God as a perfect being and then concludes that God necessarily exists, because, if he did not, he would not be perfect. During his lifetime, Protestant ministers in the Netherlands called Descartes a Jesuit and a papist—which is to say an atheist. He retorted that they were intolerant, ignorant bigots. Descartes himself said that good sense is destroyed when one thinks too much of God.

Although Descartes feared the church, he also hoped that: “his physics would one day replace that of Aristotle in church doctrine and be taught in Catholic schools.” Descartes seemed indifferent to the emotional depths of religion. Whereas Pascal trembled when he looked into the infinite universe and perceived the puniness and misery of man, Descartes exulted in the power of human reason to understand the cosmos and to promote happiness, and he rejected the view that human beings are essentially miserable and sinful.

He held that: “it is impertinent to pray to God to change things. Instead, when we cannot change the world, we must change ourselves.” Descartes also advances a proof for the existence of God. He begins with the proposition that he has an innate idea of God as a perfect being and then concludes that God necessarily exists, because, if he did not, he would not be perfect.

This ontological argument for God's existence, originally due to the English logician St. Anselm of Canterbury (1033/34–1109), is at the heart of Descartes' rationalism, for it establishes certain knowledge about an existing thing solely on the basis of reasoning from innate ideas, with no help from sensory experience.

Descartes then argues that, because God is perfect, he does not deceive human beings; and therefore, because God leads us to believe that the material world exists, it does exist. In this way Descartes claims to establish metaphysical foundations for the existence of his own mind, of God, and of the material world.

The inherent circularity of Descartes' reasoning was exposed by Arnauld, whose objection has come to be known as the Cartesian Circle. According to Descartes, God's existence is established by the fact that Descartes has a clear and distinct idea of God; but the truth of Descartes' clear and distinct ideas are guaranteed by the fact that God exists and is not a deceiver. Thus, in order to show that God exists, Descartes must assume that God exists.

Free will, according to Descartes, is the sign of God in human nature, and human beings can be praised or blamed according to their use of it. People are good, he believed, only to the extent that they act freely for the good of others; such generosity is the highest virtue. Descartes also held that, unless people believe in God and immortality, they will see no reason to be moral.

Descartes seemed indifferent to the emotional depths of religion. He was correctly accused of holding the view of Jacobus Arminius (1560–1609), an anti-Calvinist Dutch theologian, that salvation depends on free will and good works rather than on grace.

Rosicrucian Affiliation

Descartes shared a number of Rosicrucian goals and habits. Like the Rosicrucian's, he lived alone and in seclusion, changed his residence often (during his 22 years in the Netherlands, he lived in 18 different places), practiced medicine without charge, attempted to increase human longevity, and took an optimistic view of the capacity of science to improve the human condition. Descartes rejected the Rosicrucian's magical and mystical beliefs. For him, this period was a time of hope for a revolution in science.

At the end of his life, he left a chest of personal papers (none of which has survived) with a Rosicrucian physician—his close friend Corneille van Hogelande, who handled his affairs in the Netherlands.

Descartes' background and beliefs: He came from a Huguenot province, he was not a Catholic enthusiast, he had been accused of being a Rosicrucian, and he advocated religious tolerance and championed the use of reason.

Jansenism

Descartes' morality is anti-Jansenist and anti-Calvinist in that he maintains that the grace that is necessary for salvation can be earned and that human beings are virtuous and able to achieve salvation when they do their best to find and act upon the truth.

His optimism about the ability of human reason and will to find truth and reach salvation contrasts starkly with the pessimism of the Jansenist apologist and mathematician Blaise Pascal (1623–62), who believed that salvation comes only as a gift of God's grace.

Epicurean

Descartes was Epicurean in his assertion that human passions are good in themselves. He was an extreme moral optimist in his belief that understanding of the good is automatically followed by

a desire to do the good. Moreover, because passions are “willing” according to Descartes, to want something is the same as to will it.

Stoicism

Descartes was also stoic, however, in his admonition that, rather than change the world, human beings should control their passions.

Pineal Gland

According to Descartes, a human being is a union of mind and body, two radically dissimilar substances that interact in the pineal gland. He reasoned that the pineal gland must be the uniting point because it is the only non-double organ in the brain, and double reports, as from two eyes, must have one place to merge. He argued that each action on a person's sense organs causes subtle matter to move through tubular nerves to the pineal gland, causing it to vibrate distinctively. These vibrations give rise to emotions and passions and also cause the body to act.

Bodily action is thus the final outcome of a reflex arc that begins with external stimuli—as, for example, when a soldier sees the enemy, feels fear, and flees. The mind cannot change bodily reactions directly—for example, it cannot will the body to fight—but by altering mental attitudes, it can change the pineal vibrations from those that cause fear and fleeing to those that cause courage and fighting.

Cross Eyed Women

Descartes argued further that human beings can be conditioned by experience to have specific emotional responses. Descartes himself, for example, had been conditioned to be attracted to cross-eyed women because he had loved a cross-eyed playmate as a child. When he remembered this fact, however, he was able to rid himself of his passion.

This insight is the basis of Descartes' defense of free will and of the mind's ability to control the body. Despite such arguments, in his *Passions of the Soul* (1649), which he dedicated to Queen Christina of Sweden (reigned 1644–54), Descartes holds that most bodily actions are determined by external material causes.

Mathematics

Descartes also stands at the beginning of modern mathematics through his contribution to the development of the infinitesimal calculus by Newton and Leibniz.

Geometry: he gave an exposition of his analytic geometry.

He also perfected the system invented by François Viète for representing known numerical quantities with a, b, c, \dots , unknowns with x, y, z, \dots , and squares, cubes, and other powers with numerical superscripts, as in x^2, x^3, \dots , which made algebraic calculations much easier than they had been before.

Analytic Geometry

Analytic geometry was initiated by Descartes, who introduced rectangular coordinates to locate points and to enable lines and curves to be represented with algebraic equations. Algebraic geometry is a modern extension of the subject to multidimensional and non-Euclidean spaces.

Projective Geometry

Projective geometry originated with the French mathematician Girard Desargues (1591–1661) to deal with those properties of geometric figures that are not altered by projecting their image, or “shadow,” onto another surface.

Differential Geometry

The German mathematician Carl Friedrich Gauss (1777–1855), in connection with practical problems of surveying and geodesy, initiated the field of differential geometry. Using differential calculus, he characterized the intrinsic properties of curves and surfaces. For instance, he showed that the intrinsic curvature of a cylinder is the same as that of a plane, as can be seen by cutting a cylinder along its axis and flattening, but not the same as that of a sphere, which cannot be flattened without distortion.

Non-Euclidean Geometries

Contemporary Influences

Some aspects of Cartesian metaphysics and epistemology were still strongly defended in the 20th century. Although Descartes wrote no political philosophy, he approved of the admonition of Seneca (c. 4 BC–AD 65) to acquiesce in the common order of things.

Descartes rejected the recommendation of Niccolò Machiavelli (1469–1527) to lie to one's friends, because friendship is sacred and life's greatest joy. Human beings cannot exist alone but must be parts of social groups, such as nations and families, and it is better to do good for the group than for oneself.

He once told a German protégée, Anna Maria van Schurman (1607–78), who was known as a painter and a poet, that she was wasting her intellect studying Hebrew and theology. He also was perfectly aware of—though he tried to conceal—the atheistic potential of his materialist physics and physiology.

Descartes may have felt jeopardized by his friendship with intellectual libertines such as Father Claude Picot (d. 1668), a bon vivant known as “the Atheist Priest,” with whom he entrusted his financial affairs in France.

The American linguist Noam Chomsky, for example, has argued that human beings are born with an innate knowledge of the underlying structures of all learnable languages, even of languages that have never been spoken.

The Nobel Prize-winning Australian physiologist John C. Eccles (1903–97) and the British primatologist Wilfred E. Le Gross Clark (1895–1971) developed theories of the mind as a nonmaterial entity.

Similarly, Eccles and the Austrian-born British philosopher Karl Popper (1902–94) advocated a species of mind-matter dualism, though their tripartite division of reality into matter, mind, and ideas is perhaps more Platonic than Cartesian.

One of the strongest contemporary attacks on traditional Cartesian dualism is that of the British philosopher Gilbert Ryle (1900–76). In *The Concept of Mind* (1949), Ryle dismisses the Cartesian view as the fallacy of “the ghost in the machine,” arguing that the mind—the ghost—is really just the intelligent behavior of the body.

A different criticism has been advanced by the American pragmatist Richard Rorty, who claims (in *Philosophy and the Mirror of Nature* [1979] and other works) that the Cartesian demand for certain knowledge of an objectively existing world through representative ideas is a holdover from the mistaken quest for God. That is, whereas certain knowledge of God's existence may be necessary for salvation, to seek certainty in science and in the ordinary affairs of life is both hopeless and unnecessary.

Philosophy in the Cartesian tradition, Rorty contends, is the 20th century's substitute for theology and should, like the concept of God, be gently laid to rest. In the late 20th and early 21st centuries, the nature of consciousness became a topic of particular interest to philosophers and neuroscientists. The problems faced by these researchers were essentially the same as those encountered by all philosophers since Descartes who have attempted to understand the nature of the mind.

Although the seat of consciousness is universally accepted to be the central nervous system, and in particular the brain, it seems impossible that a material object like the brain could give rise to the mental experiences that human beings have when they are said to be conscious. In other words, it seems impossible to give an account of these experiences that, on the one hand, captures what they are really like for human beings and, on the other, is consistent with the strictly physical vocabulary of the scientific theories in terms of which the brain is understood. Some philosophers have responded to this problem in a manner reminiscent of Descartes, who argued that, although mind-body interaction seems to be impossible, human beings experience it, and God can make it happen.

The British philosopher Colin McGinn, for example, is among a group of thinkers, known as “mysterious,” who claim that, although we know that the conscious mind is nothing more than the brain, it is simply beyond the conceptual apparatus of human beings to understand how this can be the case. Other philosophers, such as Daniel Dennett and Paul Churchland, have made valiant attempts to develop strictly materialist accounts of consciousness, but their efforts so far have not been widely accepted.

A third line of response is represented by the American philosopher John Searle, who argues that the root of the problem is the dichotomy between the old Cartesian concepts of mind and matter,

which he claims are both inherently incompatible and outmoded, given modern physics. Searle believes that consciousness, like digestion, is a biological phenomenon (albeit a very complex one) that can in principle be fully explained in scientific terms.

Assessment

Descartes' influence on Western philosophy is so pervasive that all Western philosophers, even those who reject Cartesianism, can be said to be Cartesians, just as they can be said to be Greeks: their positions are essentially responses to problems posed by Descartes.

Descartes also stands at the beginning of modern mathematics through his contribution to the development of the infinitesimal calculus by Newton and Leibniz. Descartes' skeptical, mathematical method underpins modern science; his conception of rationality informed modern Western ideas of what it means to be a human being until nearly the end of the 20th century. His intense desire to control nature in the service of humanity has been the ultimate secular goal of modern science since the time of the Enlightenment.

Descartes Museum

The 16th-century Maison des Sybilles, where the French philosopher René Descartes spent his childhood, houses a museum devoted to him. There is also a museum of the automobile. Cutlery has been manufactured at Châtellerauld since the 14th century. Its main industry is the manufacture of armaments.

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