

SALV.: That the Pythagoreans held the science of numbers in high esteem, and that Plato himself admired the human understanding and believed it to partake of divinity simply because it understood the nature of numbers, I know very well; nor am I far from being of the same opinion. But that these mysteries which caused Pythagoras and his sect to have such veneration for the science of numbers are the follies that abound in the sayings and writings of the vulgar, I do not believe at all. Rather I know that, in order to prevent the things they admired from being exposed to the slander and scorn of the common people, the Pythagoreans condemned as sacrilegious the publication of the most hidden properties of numbers or of the incommensurable and irrational quantities which they investigated. They taught that anyone who had revealed them was tormented in the other world. Therefore I believe that some one of

them, just to satisfy the common sort and free himself from their inquisitiveness, gave it out that the mysteries of numbers were those trifles which later spread among the vulgar. Such astuteness and prudence remind one of the wise young man who, in order to stop the importunity of his mother or his inquisitive wife—I forget which—who pressed him to impart the secrets of the Senate, made up some story which afterwards caused her and many other women to be the laughing-stock of that same Senate.

SIMP.: I do not want to join the number of those who are too curious about the Pythagorean mysteries. But as to the point in hand, I reply that the reasons produced by Aristotle to prove that there are not and cannot be more than three dimensions seem to me conclusive; and I believe that if a more cogent demonstration had existed, Aristotle would not have omitted it.

FRANCIS BACON

Selection from *Essays*

Sir Francis Bacon (1561–1626), the son of a high-ranking official under England's Queen Elizabeth I, seemed destined for a career as a courtier. He did indeed spend much of his life serving Elizabeth and her successor, James I, but he also found time to write extensively about the implications of the Scientific Revolution, which during the 1600s was destroying the medieval world picture and establishing the scientific method as the basic way to understand the natural world. Inspired by the Renaissance, and in revolt against Aristotle and scholastic logic, Bacon proposed an inductive method of discovering truth; founded upon empirical observation, he proposed analysis of observed data resulting in hypotheses and verification of hypotheses through continued observation and experiment. The purpose of the Baconian method was to enable humanity to gain mastery over nature for humanity's own benefit.

Although Bacon had no laboratory and made no discoveries, he became the period's most persuasive champion of the "new learning." With his encouragement, science became a movement as he gave it a sense of direction, wrote endlessly about its usefulness, and predicted that it would improve life. Both his enthusiasm for a better tomorrow built on the scientific method and his abiding faith in the capacity of humans to advance themselves inspired later generations to believe that they could make the world better. The zenith of Bacon's influence was in the eighteenth-century Enlightenment when Voltaire (see *Candide*), the age's leading thinker, called him "the Secretary of Nature."

Bacon's scientific works included *The Advancement of Learning* and the *New Organon*, or "New Method" (1620). He also wrote a history of King Henry VII of England, legal works, and treatises on religious matters. Probably his most lasting impact was on English letters, as he made the essay genre a standard prose form. Borrowed from Montaigne (see *Essays*), the essay, in Bacon's hands, became a short composition: Terse, moralistic, and aloof in style, it seldom exceeded a few hundred words.

Despite outstanding achievements as a writer, he ended his political career in scandal. Made Lord Chancellor, the highest position a commoner could hold in the English government under James I, Bacon quickly fell from power. Charged with receiving bribes, to which he confessed, he died five years later in disgrace, his political reputation ruined.

Reading the Selection

Much like Montaigne's, Bacon's essays embrace a miscellany of subjects, reflecting his restless intellect. Many appeal to the highest ideals, such as love, friendship, and truth; others are incisive, sometimes cynical, observations on greed and riches, or on ambition and the struggle for power. As a rule, he omits his own experiences and instead distills what he has witnessed into political guidelines, advice, and aphorisms (pithy sayings).

"Of Studies," taken from Bacon's first group of *Essays* (1597), offers sound advice about learning, then and now. He claims that all knowledge is useful and defines three goals of study: studying for private pleasure, for public discourse, and for practical application. He recommends three paths to learning: reading, discussing, and writing. He also thinks that studying many different subjects, such as history, mathematics, poetry, and natural philosophy (science), makes humans more versatile.



Of Studies

Studies serve for delight, for ornament, and for ability. Their chief use for delight is in privateness and retiring; for ornament, is in discourse; and for ability, is in the judgment and disposition of business. For expert men can execute, and perhaps judge of particulars, one by one; but the general counsels, and the plots and marshaling of affairs, come best from those that are learned. To spend too much time in studies is sloth; to use them too much for ornament is affectation; to make judgment wholly by their rules is the humor of a scholar. They perfect nature, and are perfected by experience; for natural abilities are like natural plants, that need pruning by study; and studies themselves do give forth directions too much at large, except they be bounded in by experience. Crafty men condemn studies, simple men admire them, and wise men use them, for they teach not their own use; but that is a wisdom without them, and above them, won by observation. Read not to contradict and confute, nor to believe and take for granted, nor to find talk and discourse, but to weigh and consider. Some books are to be tasted, others to be swallowed, and some few to be chewed and digested; that is, some books are to be read only in parts; others to be read, but not curiously; and some few to be read wholly, and with diligence and attention. Some books also may be read by deputy and extracts made of them by others, but that would be only in the less important arguments and the meaner sort of books; else distilled books are like com-

mon distilled waters, flashy things. Reading maketh a full man, conference a ready man, and writing an exact man. And therefore, if a man write little, he had need have a great memory; if he confer little, he had need have a present wit; and if he read little, he had need have much cunning, to seem to know that he doth not. Histories make men wise; poets, witty; the mathematics, subtle; natural philosophy, deep; moral, grave; logic and rhetoric, able to contend. *Abeunt studia in mores*.¹ Nay, there is no ston'd [obstacle] or impediment in the wit but may be wrought out by fit studies, like as diseases of the body may have appropriate exercises. Bowling is good for the stone and reins [kidneys], shooting for the lungs and breast, gentle walking for the stomach, riding for the head, and the like. So if a man's wit be wandering, let him study the mathematics; for in demonstrations, if his wit be called away never so little, he must begin again. If his wit be not apt to distinguish or find differences, let him study the schoolmen, for they are *cumini sectores*.² If he be not apt to beat over matters and to call up one thing to prove and illustrate another, let him study the lawyer's cases. So every defect of the mind may have a special receipt.

¹ *Abeunt studia in mores*. Latin, "Studies pass into and influence manners." Attributed to Ovid (43 B.C.–A.D. 17), the Roman poet.

² *cumini sectores*. Latin, "splitters of hairs."

RENÉ DESCARTES

Selections from *Discourse on Method*

The French thinker and mathematician René Descartes (1596–1650) is one of the intellectual founders of the modern world. He lived during the age of the Scientific Revolution, 1550–1700, when the earth-centered model of the universe was slowly giving way to the sun-centered model, when medieval modes of reasoning were being replaced by mathematics and induction. He made important contributions to the new science, such as helping to establish the final form of the law of inertia and developing analytic geometry; however, it is for his rational (deductive) method that he is best remembered today.

Descartes's reasoning method first appeared in an introductory essay called *Discourse of the Method of Rightly Conducting the Reason and Seeking Truth in the Field of Science* (1637), which was attached to a treatise setting forth his discoveries in optics, meteorology, and geometry. The treatise is seldom read today, but the *Discourse on Method* (the essay's short title) has become a classic text of modern thought. Proposing a rational, deductive approach to all problems, Descartes's method had a double-edged effect: helping to end the reign of Aristotle and scholastic logic, while ensuring that deduction would play a major role in the new science. Cartesian deduction, with its mathematical emphasis, and Baconian (see "Of Studies") induction, with its stress on experimentation, became the twin pillars of modern science. And Cartesian skepticism, as shown in the *Discourse*, became the starting point of modern philosophy.

Ironically, Descartes, the advocate of rationalism, became a philosopher because of a mystical experience. After completing his schooling in 1612 at the Jesuit school at La Flèche, France, he spent the next nine years in travel and military service. Even though he profited from La Flèche, he was disillusioned by traditional studies, with their crumbling worldview. Especially troubling was that in the sciences no new absolute criterion of truth seemed available to replace the old. While on military duty in 1619, he had a series of dreams, which according to his later accounts, pointed the way to certainty in the sciences, using mathematics. After 1621, he devoted the remainder of his life to study and writing, in fulfillment of this mystical mission.

Reading the Selections

These two excerpts from Descartes's *Discourse on Method* contain the heart of the argument justifying his method. Part II lays out his four-step method, of which step one is the most famous. Step one declares that he will accept as true only those ideas that register on his reason as clear, distinct, and free from internal contradiction—his standard of certainty in philosophy, which he thought would give results equivalent to those reached in science using geometry. These are the remaining steps of his method: Divide each problem into manageable parts; solve each part in an orderly fashion, moving from the simplest to the most complex; and finally, check the results.

Part IV shows Descartes doubting everything as a necessary stage to clear the slate of philosophic confusion and to define the truths that can "clearly and distinctly" be affirmed without question. At the end of this process, he is left with the undeniable idea, "I think, therefore I am," meaning that he can doubt everything, except that *he himself is doubting*. From this first principle of self-awareness, Descartes deduces the existence of the physical world and, finally, God.

Part II

... Thus it is by custom and example that we are persuaded, much more than by any certain knowledge; at the same time, a majority of votes is worthless as a proof, in regard to truths that are even a little difficult of discovery; for it is much more likely that one man should have hit upon them for himself than that a whole nation should. Accordingly I could choose nobody whose opinions I thought preferable to other men's; and I was as it were forced to become my own guide.

But, like a man walking alone in the dark, I resolved to go so slowly, and use so much circumspection in all matters, as to be secured against falling, even if I made very little progress. In fact, I would not begin rejecting out of hand any of the opinions that might have previously crept into my belief without being introduced by reason, until I had first taken enough time to plan the work I was undertaking, and to look for the true method of attaining knowledge of everything that my mind could grasp.

The subjects I had studied a little when I was younger included, among the branches of philosophy, logic, and in mathematics, geometrical analysis and algebra. These three arts or sciences, it appeared, ought to make some contribution towards my design. But on examination I found that so far as logic is concerned, syllogisms and most of the other techniques serve for explaining to others what one knows; or even, like the art of Lully,¹ for talking without judgment about matters one is ignorant of; rather than for learning anything. And although logic comprises many correct and excellent rules, there are mixed up with these so many others that are harmful or superfluous, that sorting them out is almost as difficult as extracting a Diana or Minerva² from a block of rough marble. As for the analysis of the ancients, and the algebra of our time,

¹ Lully Ramon Llull or Raymond Lully, thirteenth-century Catalan (Spain) mystic, philosopher, poet, and missionary. Devoted his life to Christian theological and Neo-platonic philosophical questions and traveled in Asia Minor, trying to convert Muslims to Christianity.

² Diana or Minerva Diana, the Roman nature goddess (closely associated with the Greek goddess Artemis), and Minerva, the Roman goddess of war and wisdom (the Roman equivalent to Athena, the Greek goddess) were known for their beauty and thus were subjects for sculptors.

besides their covering only a highly abstract and apparently useless range of subjects, the former is always so restricted to the consideration of figures, that it cannot exercise the understanding without greatly wearying the imagination; and in the latter, there is such a complete slavery to certain rules and symbols that there results a confused and obscure art that embarrasses the mind, instead of a science that develops it. That was why I thought I must seek for some other method, which would comprise the advantages of these three and be exempt from their defects. And as a multitude of laws often gives occasion for vices, so that a State is much better ruled when it has only a very few laws which are very strictly observed; in the same way, instead of the great number of rules that make up logic, I thought (the following four) would be enough, provided that I made a firm and constant resolution not to fail even once in the observance of them.

The first was never to accept anything as true if I had not evident knowledge of its being so; that is, carefully to avoid precipitancy and prejudice, and to embrace in my judgment only what presented itself to my mind so clearly and distinctly that I had no occasion to doubt it.

The second, to divide each problem I examined into as many parts as was feasible, and as was requisite for its better solution.

The third, to direct my thoughts in an orderly way; beginning with the simplest objects, those most apt to be known, and ascending little by little, in steps as it were, to the knowledge of the most complex; and establishing an order in thought even when the objects had no natural priority one to another.

And the last, to make throughout such complete enumerations and such general surveys that I might be sure of leaving nothing out.

Those long chains of perfectly simple and easy reasonings by means of which geometers are accustomed to carry out their most difficult demonstrations had led me to fancy that everything that can fall under human knowledge form a similar sequence; and that so long as we avoid accepting as true what is not so, and always preserve the right order for deduction of one thing from another, there can be nothing too remote to be reached in the end, or too well hidden to be discovered. . . .

Part IV

... I had noticed long before, as I said just now, that in conduct one sometimes has to follow opinions that one knows to be most uncertain just as if they were indubitable; but since my present aim was to give myself up to

the pursuit of truth alone, I thought I must do the very opposite, and reject as if absolutely false anything as to which I could imagine the least doubt, in order to see if I should not be left at the end believing something that was

*Message of
delusion*

absolutely indubitable. So, because our senses sometimes deceive us, I chose to suppose that nothing was such as they lead us to imagine. Because there are men who make mistakes in reasoning even as regards the simplest points of geometry and perpetrate fallacies, and seeing that I was as liable to error as anyone else, I rejected as false all the arguments I had so far taken for demonstrations. Finally, considering that the very same experiences (*pensées*) as we have in waking life may occur also while we sleep, without there being at that time any truth in them, I decided to

feign that everything that had entered my mind hitherto was no more true than the illusions of dreams. But immediately upon this I noticed that while I was trying to think everything false, it must needs be that I, who was thinking this (*qui le pensais*), was something. And observing that this truth 'I am thinking (*je pense*), therefore I exist' was so solid and secure that the most extravagant suppositions of the sceptics could not overthrow it, I judged that I need not scruple to accept it as the first principle of philosophy that I was seeking. . . .

THOMAS HOBBS

Selection from *Leviathan*

The English philosopher Thomas Hobbes (1588–1679) was probably the most radical thinker to be spawned by the Scientific Revolution of the 1600s. He was a scandalous figure to his contemporaries, for he was thought to be an atheist, and possibly was, though he denied it. Well-placed friends, including King Charles II, who forgave Hobbes's religious doubts and welcomed his defense of monarchy, intervened to save him from prison or burning at the stake. Hobbes developed a philosophy of mechanistic materialism that was characterized by lack of free will and identification of mind as a "motion in the head." It owed its method to the geometric reasoning of Descartes (see *Discourse on Method*), its empiricism to Bacon ("Of Studies"), and its atomistic structure of nature to the ancient Atomists (see Epicurus's "Letter to Menoeceus") and their modern followers, such as Galileo Galilei (1564–1642). Galileo, whom Hobbes met in Italy, especially impressed him with the idea that human matter is in constant motion, guided by natural laws—the notion that Hobbes later made the guiding principle in *Leviathan*, his pioneering work in modern political theory. It is for his political writings that he is known today, his scientific works having passed into oblivion.

Hobbes's *Leviathan* (1651), in which he advocated absolute monarchy, reflected his disgust at the English Civil War, 1642–1647, which resulted in the abolition of England's kingship and the setting up of a republic. Having sat out the war in France, where he sought sanctuary, 1640–1651, he became convinced that only an absolute king could restore social order and maintain national unity. He found the word *Leviathan* in the Book of Job (chapter 41), where God used it as a term for a sea monster "king" who rules "over all the children of pride"—an image of divine power. In Hobbes's book, "Leviathan" refers to an all-encompassing state, or commonwealth, that absorbs and directs all human actions.

Hobbes's method in *Leviathan* was to try to found a science of politics based on the idea that the world is a machine of matter, moving according to law. Like Descartes, he wanted to establish an undeniable truth from which to deduce the rest of his philosophy. He located his truth in his gloomy view of human nature: Left to their own devices, human beings would fight with each other all the time. This is his notion of the "war of every man against every man" that he thought existed in a "state of nature," that is, in periods when rule by law had broken down or else had never been established. It is to escape this anarchy that humanity gives up all its rights and its claims to self-government to a powerful state—Leviathan—that will protect them from themselves.