1

THE PRACTICAL PHILOSOPHERS

SPOKESMAN FOR AN AGE, the brilliant and caustic Voltaire is brought strikingly to life in this statue by the great French sculptor Jean-Antoine Houdon, who clothed his subject in the long robes of a classical philosopher.

In 1784, at the height of the Age of Enlightenment, the German philosopher Immanuel Kant wrote an article for a popular audience explaining the meaning of the word that gave the age its name. "Enlightenment," Kant began, "is man's emergence from his nonage." This nonage, or immaturity, he continued, was caused not by lack of intelligence, but lack of determination and courage to use that intelligence without another's guidance. "*Sapere aude!* Dare to know! Have the courage to use your own intelligence!"

Kant's words summed up the most cherished convictions and ambitious designs of radical 18th Century scholars and intellectuals. His words implied that man was mature enough to find his own way without paternal authority; they urged man to understand his own nature and the natural world by the methods of science. In short, they were a declaration of freedom. Kant and his fellow thinkers wanted men to shake off the hand of authority in politics and religion, and think for themselves.

Kant was called a *philosophe*, a French word that did not apply to Frenchmen alone. From Scotland to Naples an impressive clan of radical intellectuals had become passionate and outspoken partisans of the new philosophy of John Locke and the new science of Isaac Newton. They were hostile to organized Christianity, and said so; they openly deplored cruel legal procedures and arbitrary government; they believed in freedom of speech and the press, and in personal liberty. They were erudite, but they were not above popularizing their views. Kant's article had been preceded by a vigorous campaign conducted by the *philosophes* in country after country, designed to expose the evils of religion and extol the virtues of their own enlightened philosophy.

And yet, while the *philosophes* were a clan, they were not a coherent movement. Although they knew one another and corresponded, they did not always think alike. The only thing they had in common was a critical attitude toward any sort of orthodoxy, and especially toward orthodox religion. They did not believe in miracles, and, if they believed in God at all, thought of Him as the mechanic of the universe—a sort of cosmic watchmaker; He had built a superb machine, given it laws to run by and then withdrawn. From such a view it followed that the only reliable road to knowledge of God's plans was through science, not religion, through observation and experiment, not dogma and revelation.

Fortunately for the *philosophes'* purpose, their ideas were launched in a cultural atmosphere that was generally favorable to them. Thousands of educated men and women who were good Christians and thoroughly loyal to existing political institutions—men and women, in fact, who had nothing but dislike, and even contempt, for the *philosophes* —nevertheless shared at least some of their attitudes. They were humanitarians, or tepid about religious observances, or critical of government policies. The *philosophes* had many allies who did not know they were allies, people whose cast of mind was compatible with the ultimate goals of the Enlightenment.

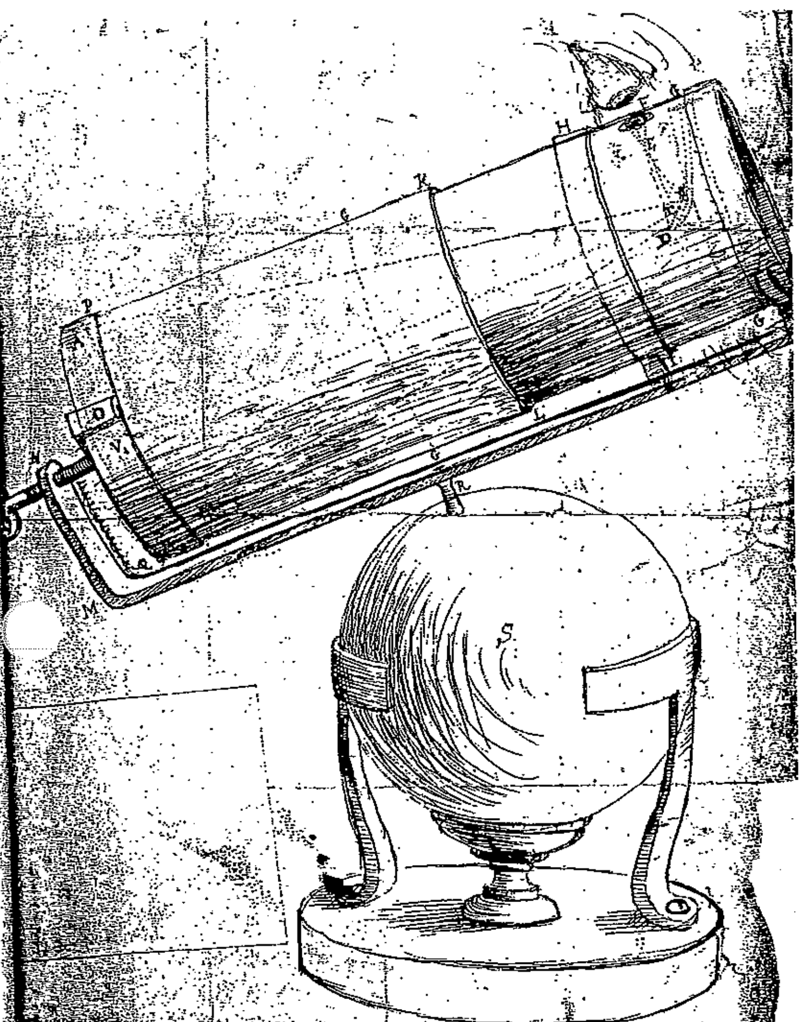
Clearly, an age that takes its name from an intellectual atmosphere cannot be fixed within rigid chronological limits. In one sense the Enlightenment began as far back as the Renaissance, with men's renewed interest in Greek and Latin texts, their critical approach to medieval Christian philosophy and their general sense of curiosity about this world as opposed to the next. Even the Protestant Reformation, despite its call for a return to the beliefs of early Christianity, helped to prepare the way for the Enlightenment by disrupting the unity of Western Christendom and weakening the authority of the Church.

During the 17th Century philosophers tried to weld the consequences of these intellectual developments into a new kind of philosophy, distinct from the Christian world-view of medieval theologians. It was this century, too, that elaborated the new science—and without science and reason the Enlightenment would have been unthinkable. In fact, if a single point in time must be assigned as the start of the Enlightenment, no date could be more logical and fitting than the year of Newton's publication of his widely admired—but intellectually demanding—masterpiece, the *Philosophiae naturalis principia mathematica* (*Mathematical Principles of Natural Philosophy*). That year was 1687.

In 1687, what was Europe like? France, the most powerful country in Europe, was in the middle of the long reign of Louis XIV, the Sun King, a man of considerable ability and vast aspirations. Louis built himself impressive palaces, reigned over a glittering court at Versailles, and encouraged the arts and literature with notable success. All across the Continent, rulers powerful and petty imitated him by posing as gentlemen of refinement and benefactors of culture.

But Louis was a menace, as well as a model. He strengthened the powers of the central government and silenced domestic criticism. He revoked the century-old Edict of Nantes, which had granted tolerance to French Huguenots, driving them out of France by the thousands to settle in England, Prussia, the Netherlands and America. He built himself an imposing army and in a ruthless series of military actions expanded French power to the north and east.

In 1687, the year that Newton published his *Principia*, Louis was acquisitively eyeing the Rhineland and was even casting glances toward once-powerful Spain, now rapidly declining under its sickly monarch Charles II (of whom it was said, rather cruelly, that he was perpetually dying). Thus France was technically at peace but the rest of Europe, knowing it to be but a lull, was preparing for war. The League of Augsburg, a coalition of European powers, was readying itself to face a French monarch who, for all his passion for culture and all his devotion to reason in administrative affairs, was much closer to being a despot than an enlightened ruler.



NEWTON'S REFLECTING TELESCOPE, *built from his own sketch (above), was only six inches long, but it could magnify objects as powerfully with mirrors as an ordinary six-foot telescope of the day could with its primitive, light-scattering lenses. Like many modern telescopes, its curved mirror (A, at upper left) focused images onto a smaller flat mirror (D, at upper right) which aimed them into the eyepiece (F, at top). The screw (N, at left) was used to adjust the telescope's focal length. A large ball joint (S) supported the device.*

In 1687 England, soon to be France's greatest enemy, was its abject dependent. Its Roman Catholic King, James II, hampered by a closefisted Parliament, was forced to depend on France for subsidies and support. James was unable to confine himself to the private practice of a faith that most of his countrymen feared and despised. He tried to bring England back into the Roman fold by purging anti-Catholic masters from the colleges and introducing Catholics into the government and the army. In 1688 James had an heir, and Englishmen, unable to abide the thought of being governed by a Catholic house, expelled both James and his heir and installed Protestant monarchs, William III and Mary. In the new atmosphere English science and philosophy flourished, making England the first home of the Enlightenment and a model for intellectuals on the Continent.

Meanwhile, a large segment of that continent, the Holy Roman Empire, lay sunk in torpor. It was more a memory or a joke than a political reality, a crazy quilt of more than 300 separate states —most of them minute—governed more or less autonomously by vest-pocket dukes, autocratic ecclesiastics or narrow-minded burghers. Few of these states could have afforded a theater, even if they had wanted one. Few could, or would, support the work of writers or scholars. In 1687 while other states were beginning to move toward the age of the Great Powers, the Holy Roman Empire remained a haphazard collection of small powers connected more by a name than any orderly political structure.

The Empire did include, however, some of the lands of two large family domains: the empire of the Habsburgs, ruled by Leopold I, and the Brandenburg-Prussian empire of the Hohenzollerns, ruled by Frederick William, the Great Elector. Leopold controlled not only Austria and Bohemia, but had recently reconquered Hungary from the Turks. Both he and his successors were too busy with gov-

GOSSIP AND FELLOWSHIP *flourished in London's 17th and 18th Century coffeehouses, augmenting the Enlightenment's communications explosion. Here writers, businessmen, scientists and politicians would come to find out what was going on.*

ernment affairs, however, to interest themselves in the new ideas circulating to the west. And although Brandenburg-Prussia, nearing the end of Frederick William's long reign, was clearly on the way to challenging its neighbors, Berlin was still an insignificant town. Not until a later Hohenzollern, Frederick William's great-grandson Frederick the Great, ascended the throne in 1740 was Prussia to be hospitable to the Enlightenment.

A perceptive observer, looking about him in 1687, would probably have predicted that if there was to be an enlightenment, it would begin in the then-fertile intellectual climate of England, would move from there to the ready soil of France, and would then spread throughout Europe and even to the European colonies in America. That is what a perceptive observer would have said, and he would have been right.

Isaac Newton of England did not, however, step upon an empty stage. The Scientific Revolution, like most revolutions in man's way of looking at the world, was rooted deep in the past; Newton had many ancestors. The critical impulse upon which science depends was first liberated by the ancient Greek philosophers, who passed it on to their disciples, the Romans. Not even the Middle Ages' preference for theology over philosophy wholly stifled it. For the sake of better harvests, for the sake of trade and navigation, medieval men studied the properties of natural materials and the geography of the earth.

Besides, there were good religious reasons for studying science. Just as the Bible and Church dogma gave men a knowledge of God's word, so the study of the natural world gave them a knowledge of His works. As early as the 13th Century, Roger Bacon, a Franciscan friar, evolved an elaborate plan for the conduct of research which was essentially the scientific method: investigate, experiment. Bacon justified his plan by asserting that since the

creation of the world was God's handiwork, studying that world could be considered a form of piety.

But the accumulated discoveries and theories that are justly called the Scientific Revolution had to await later, more favorable conditions. They came, these new and better times, in the closing days of the Renaissance, and chiefly in Italy. Humanist scholars, avid to restore the classical texts of ancient Greece and Rome, revived not only their literary masterpieces but also their treatises on the natural world. The rediscovered works of such men as the Second Century Roman physician Galen awakened a keen new interest in nature. And in looking at nature more frankly and directly than their medieval predecessors had done, the Renaissance humanists opened the way to a more precise observation of the world. The masterly anatomical drawings of Leonardo da Vinci, compared with the misshapen sketches of men and animals by the French architect Villard de Honnecourt, 300 years before, reflect the dawn of a world more hospitable to science.

Finally, and perhaps most significantly, the humanists, with their critical intellects, began to topple the authoritarian structure of medieval thought that had governed, and crippled, scientific investigation. For centuries things had been held to be true in science because Aristotle had said they were true. Sometimes the humanists were very little more adventurous; at first they simply substituted Galen's authority for Aristotle's. But at least, in pitting one authority against another, they opened a door to freedom. More and more, as the 16th Century progressed, men began to think, if not to say, that things were true in science because their own experience told them so—through observation and experiment.

This initial cautiousness about investigating nature did not stem from fear, but from philosophers' training in traditional lore and traditional methods. For all their boldness, the two most revolution[...] works in 16th Century science looked both forw[...] and backward: Nicholas Copernicus' *Concerning [...] Revolutions of the Heavenly Bodies* and Andr[...] Vesalius' *Concerning the Fabric of the Hum[...] Body* were, curiously enough, published in the sa[...] year, 1543. Copernicus substituted a stationary s[...] for a stationary earth in his system of the univer[...] and thus became the father of modern astronom[...] But his rotating planets still retained their tim[...] honored circular orbits because the circle was t[...] perfect geometrical figure—and it was difficult [...] think of natural law as other than perfect. Simila[...]ly, Vesalius' superb descriptions of the hum[...] body, drawn directly from his own medical expe[...]ence, surpassed those of all previous anatomists [...] accuracy of detail and daring of method. Yet V[...]salius worshiped Galen, and at first thought th[...] when his observations did not coincide with G[...]len's it was because he had made a mistake: h[...] observations, not Galen's, were in error.

It was only in the 17th Century that scien[...] finally broke loose from the moorings of traditio[...] For all the mystical beauty of the circle, and in spi[...] of his predilection for mysticism, the German as[...]tronomer Johannes Kepler calculated the orbits [...] the planets to be ellipses. Kepler's brave step fo[...]ward was matched by others—Galileo's remarkab[...] theories about the behavior of moving bodies, Wi[...]liam Harvey's discovery of the circulation of th[...] blood—and by the construction of various philo[...]sophical systems to explain and justify the ne[...] scientific procedures.

This coalition of science and philosophy was o[...] decisive importance to the Scientific Revolution[...] it led the best minds of the age into scientific in[...]quiry and gave science the sanction of reason. I[...] made the work of Galileo, Robert Boyle and New[...]ton not a series of accidental discoveries, but step[...] in a cumulative process. And it provided the un-

ALSO MADE $ USING HIS TELESCOPES TO OBSERVE INCOMING SHIPS AND SET PRICES.

derlying principle for the whole Enlightenment. The greatest of these 17th Century scientific philosophers were René Descartes, Galileo Galilei and Francis Bacon. Descartes was French, a brilliant mathematician and an imaginative theorizer about the nature of man and the universe. He made notable contributions to the sciences of optics, physics, physiology and psychology, and he is considered the father of modern analytical geometry. But none of these contributions is as important as the contribution of his intellectual method, which today is known as Cartesian thought.

Descartes' search for a new method grew out of a desire to resolve the endless disputes of philosophers over every conceivable issue. He wanted to build a view of the world that all rational men would accept. In the course of his search he developed certain revolutionary rules of reasoning which he claimed could be used for solving any complex problem. The student of nature, he argued, must discard all questionable preconceptions and begin his intellectual constructions from "clear and distinct" ideas. Then he can move, step by cautious step, from these ideas to others, and thus build up a logical universe. Descartes himself began this construction with the famous *cogito, ergo sum*—I think, therefore I am.

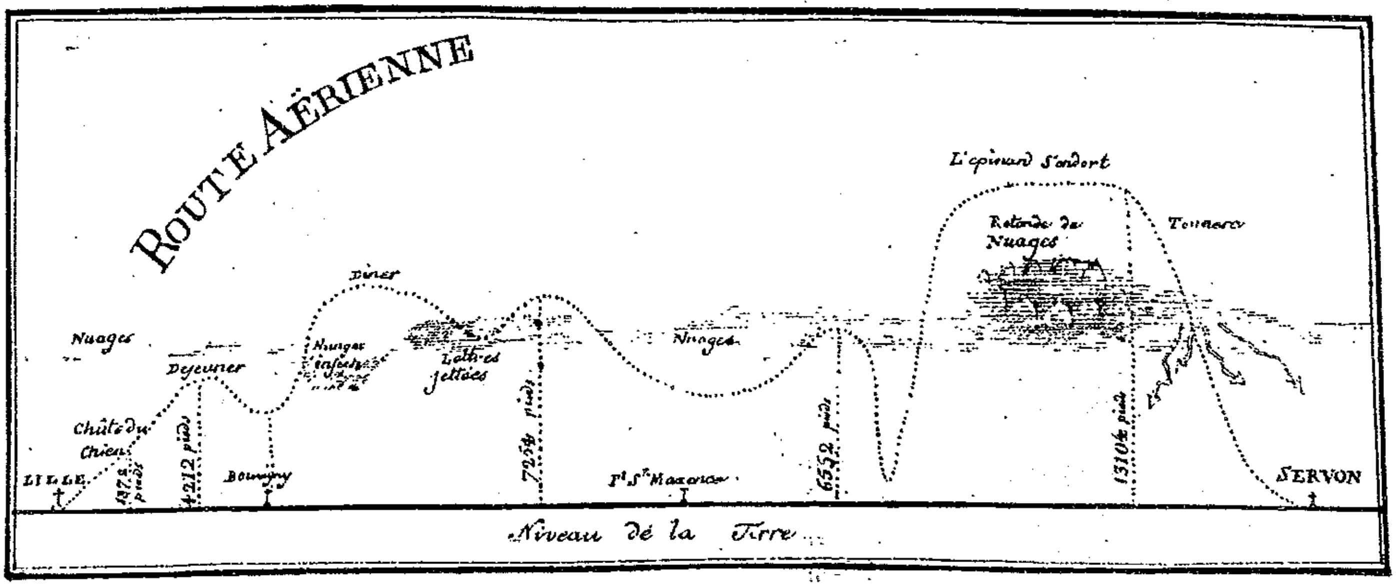
But this was not all. Descartes did not disdain empirical research; in fact he enjoyed making observations and experiments. But his emphasis was on the abstract character of science. He argued that mathematics was the one language capable of expressing scientific ideas with complete clarity. Partly through his assiduous propaganda for it, and partly through his own successes with it, he convinced other philosophers. It became customary to think of scientific inquiries as mathematical in nature, and of scientific laws as mathematical in form.

Galileo, his Italian contemporary, emphasized observation: he preferred looking to abstract speculation. In Galileo's day most professors of natural science still believed and taught Aristotle's theories about matter and motion, theories that were then 2,000 years old. Galileo urged the professors to look through his perfected telescope and see for themselves: the universe was not to be understood from theories but from observing the thing itself. Scientific speculation, pleaded Galileo, should be directed by facts. But he wisely added that men should not trust sense impressions alone; the laws of the universe must also be sought through mathematical models—formulas and equations.

Besides being a persuasive propagandist, Galileo was also an impressive practicing scientist. He discovered four of the satellites of Jupiter, the irregularity of the surface of the moon, and the fact that the Milky Way was made up of numberless stars. He discovered the phases of Venus and, in company with other astronomers, the spots on the sun. His experiments and theories in the field of mechanics were even more important, culminating in his theory of inertia. Mathematician, experimenter, instrument-maker, polemicist and dreamer, Galileo left a legacy of ideas that changed men's notions about the universe once and for all.

Compared to him, Francis Bacon seems curiously one-sided. Bacon was a moralist and prophet; his scientific writings are studded with aphorisms and he was mainly concerned with guiding men in the right scientific procedures. But it is wrong to view him, as critics sometimes do, simply as a fact-finder, or to imagine that the goal of his scientific energies was simply human comfort. Bacon said that for centuries philosophers had acted like ants, diligently but stupidly gathering little, useless bits of knowledge, or like spiders, spinning out intricate, unsubstantial theories from their own insides. The true philosopher, he said, must be like a bee; he must go to nature for his raw materials and absorb nature's lessons, and then, through exacting

A BALLOONIST'S ODYSSEY, *Jean-Pierre Blanchard's 250-mile jaunt from Lille to Servon in 1785 was one of several early voyages that opened men's eyes to the possibilities of flight. This chart of Blanchard's journey notes altitudes and events en route. At left, a dog leaves the gondola ("chute du chien"); this is followed by lunch below the clouds, some letters airmailed over the side, an unexplained dip close to the ground, then an exquisite leap above the clouds—during which Blanchard's companion, De L'Epinard, took a nap (until thunder and lightning presumably woke him). Europeans were soon talking of balloons as weapons to end wars.*



labor, transform these lessons into sound theories.

Although Bacon considered knowledge in itself to be a virtue, his great hope was that men would use the new knowledge to achieve power over nature and thus lead happier, healthier, longer lives. "The true and lawful goal of the sciences," he wrote, "is none other than this: that human life be endowed with new discoveries and power." It was a glorious dream and an enormously influential one. All through the 17th and 18th Centuries radical intellectuals all over Europe proudly allied themselves with him: Denis Diderot's famed *Encyclopédie,* published in installments between 1751 and 1772, practically made Bacon its patron saint.

Of Bacon's many fertile suggestions for the improvement of science, probably the most fruitful one was his proposal that scientific research be made a collaborative venture. In *The New Atlantis,* his blueprint for a utopian society, he includes an academy of scientists, liberally provided with brains and funds. A few such academies already existed when Bacon wrote, but after *Atlantis* they sprang up everywhere. All of them were endowed with vigor and good will, but not all of them were adequately financed. The most important of them was the English society which, after passing through several preliminary phases, was finally chartered in 1662 as the Royal Society of London for the Improvement of Natural Knowledge.

The Royal Society lived up to its name. It held meetings to encourage scientific inquiry, engaged in correspondence in aid of the "new philosophy" and reported on experiments, discoveries and inventions in its famous publication, *Philosophical Transactions.* Every prominent natural philosopher in England belonged to it, and so did many distinguished scientists on the Continent. So, too, did gifted amateurs like the diarist Samuel Pepys, the American clergyman Cotton Mather and the American statesman-scientist Benjamin Franklin. The list of its Fellows is a list of the leaders of the Scientific Revolution, but the greatest name on the list was that of Isaac Newton.

When Newton stepped upon the scene, the stage was set and his role prepared. His work is the culmination of a century's efforts—of Bacon's method, Galileo's mechanics, Descartes' mathematics, and the scientific endeavors of his Fellows in the Royal Society. But for all he owed to others, Newton's own achievement was tremendous and his contemporaries knew it: they first admired him, then idolized him. Alexander Pope's celebrated couplet sums up his impact on his age:

Nature and Nature's Laws lay hid in Night;
God said, "Let Newton be!" and all was Light.

Newton was born in 1642, the year Galileo died. Even as a youth he was a precocious mathematician, but no one thought of him as a genius. At Cambridge, where he attended college, he was considered to be intelligent, but rather absent-minded. Then in 1665, when he was 22, he went home to Lincolnshire to escape the Great Plague raging through London and threatening Cambridge. There, in isolation, he mused about the universe and made his greatest discoveries. "I was in the prime of my age for invention," he later recalled, "and minded mathematics and philosophy more than at any time since."

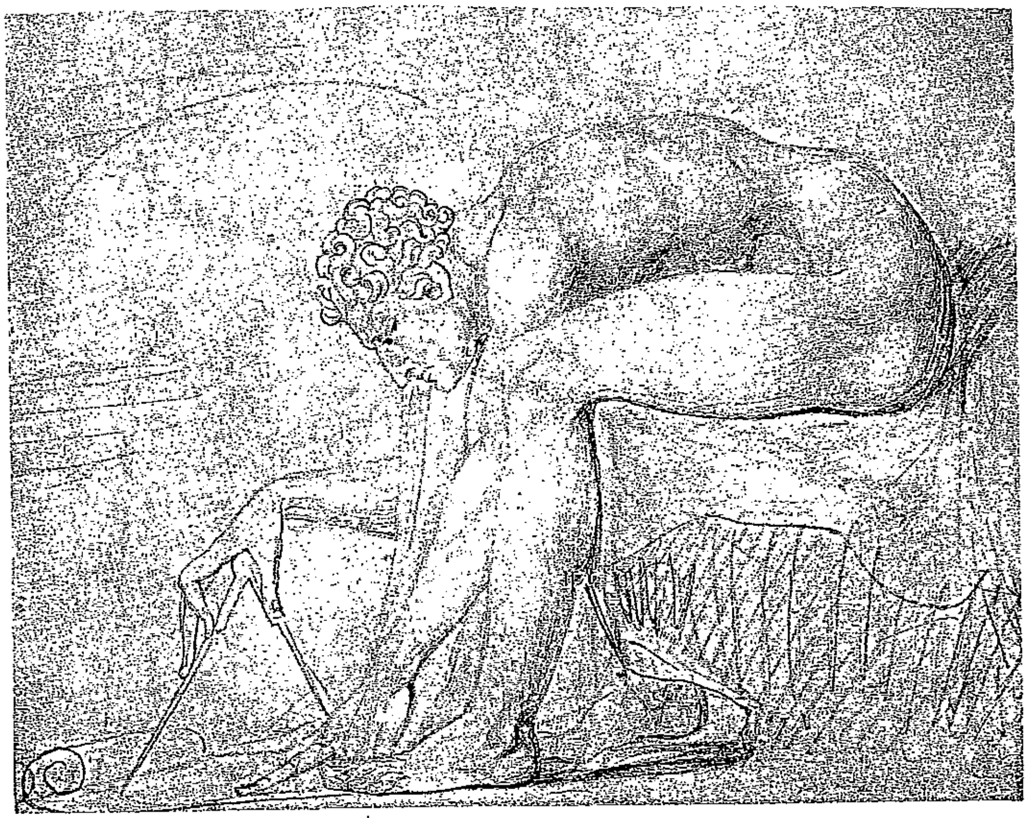
In a year and a half, between 1665 and 1667, Newton worked out the essentials of the branch of mathematics called calculus, hit upon the crucially important optical law that white light is a mixture of colors, and, most significant of all, grasped the principle of the law of gravitation by observing, so the story goes, a falling apple in a garden.

But Newton was more interested in research than in fame, and for years he published none of these findings. His invitation to join the Royal Society was based on his improvements in the telescope. It was not until 1687, at the urging of his friend, the astronomer Edmund Halley, that he published his *Principia mathematica*. The *Principia*, which in Newton's own words accounts for all "the motions of the planets, the comets, the moon and the sea," is probably the greatest scientific work ever written. It completed the revolution begun by Copernicus in the 16th Century, and dominated scientific thought for more than 200 years.

After its publication Newton paid the frequent price of fame: he became embroiled in bitter quarrels over precedence of discoveries. Then, in the 1690s, he suffered an alarming mental breakdown characterized by delusions of persecution. Yet he recovered enough to become president of the Royal Society, and to publish, in 1704, his *Opticks*, a work filled with pioneering insights into the physical characteristics of light. *Opticks* concludes with a series of provocative questions, "in order," as Newton put it, to "farther search to be made by others." Among them is the perceptive suggestion that light can behave like particles of matter. When he died in 1727, Newton was buried at Westminster Abbey in a funeral whose pallbearers included two dukes, three earls and the Lord Chancellor—like a king, as Voltaire put it, who had been good to his subjects.

Almost a century later, inspired by Newton's statue in Cambridge, the poet William Wordsworth wrote of "his prism and silent face" and of his voyaging "through strange seas of thought, alone." This is not strictly true: like other great innovators, Newton had both ancestors and companions—scientists whom he read and scientists with whom he talked. And yet, in a sense, Wordsworth was right. Newton alone grasped what dozens of brilliant searchers before him had glimpsed only in part: that heaven and earth were a single system governed by the same laws. If the word "genius" had been coined to describe a single man, that man might well have been Newton.

Newton also acted like a genius in another way: like many brilliant men, he was eccentric. He hated publicity and loathed controversy—so much so that



A HEROIC NEWTON, *encumbered only by a drawing compass and a scroll, strikes a romantic "scientist's" pose in this sketch by the mystical, antiscientific poet and painter William Blake. Sitting on a rock in a sea of time and space, he intently defines with his mathematical instruments the facts of the material world. Blake recognized Newton's genius but cried: "God is not a mathematical diagram!"*

he frequently got his friends to publish his papers and conduct his arguments for him. He was also odd in his religious views and intensely interested in alchemy. He spent untold hours reading Egyptian and Hebrew history, trying to fix the dates of Biblical events right back to the Creation. And some of the notes in his private papers suggest that he seriously believed in the elixir of life and the existence of a philosophers' stone.

These oddities in Newton's character caused some gossip, but everyone agreed, nevertheless, that his discoveries made him one of the great scientists of history. And yet curiously, Newton's lasting renown rests less on his discoveries than on his method. Newton himself, in fact, took pains to publicize his method whenever he could. In a letter addressed to the secretary of the Royal Society in 1672, he wrote that "The best and safest method of philosophizing seems to be, first, to inquire diligently into the properties of things and to establish those properties by experiments, and to proceed later to hypotheses for the explanation of things themselves. For hypotheses ought to be applied only in the explanation of the properties of things, and not made use of in determining them."

Newton's own slogan, *hypotheses non fingo*—"I do not invent hypotheses"—became the slogan of several generations of philosophers and scientists. But to Newton, and to his 18th Century followers, the word "hypothesis" had a special meaning. It was not just a tentative statement suggesting a course of inquiry, but a wholly imaginary thought construction—in Newton's words, "a proposition as is not a phenomenon nor deduced from any phenomenon, but assumed or supposed—without any experimental proof." It was, in short, a kind of metaphysical make-believe, and Newton was cautioning men not to use such imaginary systems of thought as the foundation upon which to base further inquiries.

Unfortunately, Newton's own theory of gravitation, with its suggestion that bodies were drawn to each other by some sort of mutual attraction, smacked of the very metaphysics he deplored. His critics accused him of smuggling "occult qualities" into science—a harsh accusation, for "occult qualities" was a term of derision normally used by the new scientists to put down the "essences" and "quiddities" that sprinkled the writings of medieval scholars. Newton defended himself by pointing out that the effects of gravitation could be seen, and therefore could not be called occult. Furthermore, he said that while he did not pretend to understand the nature of gravitation, he could—on the basis of his observations and experiments—justifiably generalize about its behavior.

Today this attitude is a commonplace among scientists, but in Newton's day it was a novelty, and it made an enormous and lasting impression on philosophers in two ways. It led them to prize the "scientific method"—the method of observation, generalization, experimentation—above all other methods of inquiry. And it led them to proclaim what they called, a little misleadingly, their "philosophical modesty": the world, they said, was full of mysteries and unanswered questions, and sensible men did not try to explain their causes, but instead, paid attention to their effects. Newton, wrote Voltaire, taught men to "examine, weigh, calculate and measure, but never to conjecture." He saw and made people see, but he didn't put his fancies in place of truth.

These two consequences of Newton's work—confidence in the scientific method and modesty about man's capacity to know—appear at first to be contradictory. But they do come together, and it is precisely where they join that the energy for the Enlightenment arose. Newtonian thought meant, first of all, that only patient and skeptical inquiry could produce reliable results. The vaulting philosophical systems of 17th Century metaphysicians, and the improbable tales of saints and miracle-workers, were equally suspect and equally useless. Second, Newtonian thought meant that the scientific method could, with care, be applied to nonscientific disciplines—to theology, history, morals, politics. Third, Newtonian thought meant that men did not have to concern themselves with airy fantasies about first causes, but could instead concentrate their intellectual energies on practical problems on improving man's lot in this world. This is how the *philosophes* understood Bacon: thinking, they said, must bear useful fruit; talk must be to some practical purpose.

Newton would have been deeply shocked by some of the conclusions the *philosophes* reached using his scientific method. He would have despised the deists, who turned God into a master mechanic, and would have been outraged by the atheists, who denied Him altogether. But then, not all the *philosophes* were wholly comfortable with Newton either. They found the language of mathematics too obscure and disliked the rigor of Newtonian thought. For every devout Newtonian, like Voltaire or Kant or Locke, there were many who gave him no more than pious lip service.

Between the two extremes there were others, like Diderot, who were devoted to Newton more from a general sympathy with the direction of his thought than from a detailed mastery of its parts. Admiring the immense prestige that science had acquired, they took the scientific attitude for their own. With science as a license they proceeded to examine all men's assertions in all fields of knowledge with critical freedom. They also took it as a philosophical position wholly incompatible with divine revelation. On this point all the men of the Enlightenment agreed, however much they knew of Newton and wherever they lived. David Hume in Scotland, Immanuel Kant in Prussia, Denis Diderot in Paris, Cesare Beccaria in Milan—all of them believed that when science advanced, religion had to retreat. Thus the uneasy peace between reason and revelation became war, and the Scientific Revolution was turned into an open rebellion against the faith that had governed Europe for more than a thousand years.