Hooke, Newton, and Voltaire

1. Robert Hooke (1635-1703), *Micrographia.*[1] *This book primarily addresses Hooke's investigations with the microscope, but it includes a few pages on the telescope as well.*

[By means of a glass in October of 1664, I studied the surface of the moon.] On it I perceived several kinds of pits, which are shaped almost like a dish, some bigger, some less, some shallower, some deeper, each a hollow Hemisphere, encompassed with a round rising bank, as if the substance in the middle had been dug up, and thrown on either side. These seem to me to have been the effects of some motions within the body of the Moon, analogous to our Earthquakes, by the eruption of which, as it has thrown up a ridge higher than the Ambient surface of the Moon, so has it left a depression in the middle, proportionally lower. I have observed similar places here in England, on the tops of some hills, which might have been caused by some Earthquake in the younger days of the world. But what most inclines me to this belief is first, the generality and diversity of the magnitude of these pits all over the body of the moon, and next, the two experimental ways, by which I have made a representation of them.

First, I prepared a very soft and well-tempered mixture of tobacco-pipe clay and water, into which I let fall any heavy body, as a bullet; it would then throw up the mixture round the place, which for a while would make a representation, like these of the moon. (Considering the state and condition of the moon, [though,] (a) it would be difficult to imagine whence those bodies should come, and next (b) how the substance of the moon should be so soft.) If a bubble be blown under the surface of it, and suffered to rise, and break, or if a bullet, or other body, sunk into it, be pulled out from it, these departing bodies leave an impression on the surface of the mixture, exactly like these of the moon, save that these also quickly subside and vanish. Second, I observed in a pot of boiling Alabaster. That powder by eruption of vapors is reduced to a kind of fluid consistency; if, while it boils, it be gently removed from the fire, the alabaster presently ceases to boil, and the whole surface, especially that were some of the last bubbles have risen, will appear all over covered with small pits, exactly shaped like these of the moon. By holding a lighted candle in a large dark room, in different positions to this surface, you may exactly represent all the phenomena of these pits in the moon, according as they are more or less enlightened by the sun.

This analogy will seem the more probable if we suppose the moon like our Earth, for the earthquakes here seem to proceed from some such cause as the boiling of the pot of alabaster. For they seem to be generated in the earth, from some subterranean fires or heat…. and they raise a small brim round the place out of which they break…

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[1] Robert Hooke (1635-1703), English polymath, Curator of Experiments at the Royal Society, and author of the internationally famous *Micrographia*, which described his many investigations with a microscopic lens. *Micrographia* was originally published in 1665, and so its writing closely resembles Boyle's in spelling and construction; this selection has been considerably updated. Robert Hooke, *Micrographia* (New York, Dover Phoenix Editions: 2003), 243ff.

2. Isaac Newton (1642-1727),[2] multiple selections from two texts.
2a. *Principia Mathematica*, 1687

I. SCHOLIUM FOLLOWING DEFINITIONS

Hitherto I have laid down the definitions of such words as are less known, and explained the sense in which I would have them to be understood in the following discourse. I do not define time, space, place and motion, as being well known to all. Only I must observe, that the vulgar conceive those quantities under no other notions but from the relation they bear to sensible objects. And thence arise certain prejudices, for the removing of which, it will be convenient to distinguish them into absolute and relative, true and apparent, mathematical and common.

I. Absolute, true, and mathematical time, of itself, and from its own nature flows equably without regard to anything external, and by another name is called duration. Relative, apparent, and common time is some sensible and external (whether accurate or unequable) measure of duration by the means of motion, which is commonly used instead of true time, such as an hour, a day, a month, a year.

II. Absolute space, in its own nature, without regard to anything external, remains always similar and immovable. Relative space is some movable dimension or measure of the absolute spaces, which our senses determine by its position to bodies, and which is vulgarly taken for immovable space. Such is the dimension of a subterraneous, an æreal, or celestial space, determined by its position in respect of the earth. Absolute and relative space, are the same in figure and magnitude; but they do not remain always numerically the same…

III. Place is a part of space which a body takes up, and is according to the space, either absolute or relative. I say, a part of space, not the situation nor the external surface of the body. For the places of equal solids are always equal, but their superfices, by reason of their dissimilar figures, are often unequal. Positions properly have no quantity, nor are they so much the places themselves, as the properties of places. The motion of the whole is the same thing with the sum of the motions of the parts; that is, the translation of the whole, out of its place, is the same thing with the sum of the translations of the parts out of their places; and therefore the place of the whole is the same thing with the sum of the places of the parts, and for that reason, it is internal, and in the whole body.

IV. Absolute motion is the translation of a body from one absolute place into another; relative motion is the translation from one relative place into another. Thus in a ship under sail, the relative place of a body is that part of the ship which the body possesses, or that part of its cavity which the body fills, and which therefore moves together with the ship. Relative rest is the continuance of the body in the same part of the ship, or of its cavity. But real, absolute, rest is the continuance of the body in the same part of that immovable space in which the ship itself, its cavity, and all that it contains, is moved. Wherefore if the earth is really at rest, the body, which relatively rests in the ship, will really and absolutely move with the same velocity which the ship has on the earth. But if the earth also moves, the true and absolute motion of the body will arise partly

[2] *Isaac Newton* (1642-1727) invented integral calculus, proposed his three laws of motion, and developed the theory of universal gravitation. As President of England's premiere intellectual institution, the Royal Society, he had a vast influence on scientific research in his day. See http://members.tripod.com/~gravitee/. Punctuation has been modernized in this selection.

from the true motion of the earth in immovable space, partly from the relative motion of the ship on the earth. And if the body moves also relatively in the ship, its true motion will arise partly from the true motion of the earth, in immovable space, and partly from the relative motions as well of the ship on the earth, as of the body in the ship, and from these relative motions will arise the relative motion of the body on the earth…

Absolute time, in astronomy, is distinguished from relative, by the equation or correlation of the vulgar time. For the natural days are truly unequal, though they are commonly considered as equal and used for a measure of time; astronomers correct this inequality for their more accurate deducing of the celestial motions. It may be that there is no such thing as an equable motion, whereby time may be accurately measured. All motions may be accelerated and retarded, but the true, or equable, progress of absolute time is liable to no change. The duration or perseverance of the existence of things remains the same, whether the motions are swift or slow, or none at all. Therefore, it ought to be distinguished from what are only sensible measures thereof, and out of which we collect it, by means of the astronomical equation. The necessity of which equation, for determining the times of a phenomenon, is evinced as well from the experiments of the pendulum clock as by eclipses of the satellites of *Jupiter.*

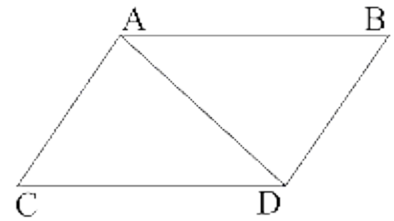
…But how we are to collect the true motions from their causes, effects, and apparent differences, and, *vice versa*, how from the motions, either true or apparent, we may come to the knowledge of their causes and effects, shall be explained more at large in the following tract. For to this end it was that I composed it.

II. LAWS OF MOTION

LAW I. Every body perseveres in its state of rest, or of uniform motion in a right line, unless it is compelled to change that state by forces impressed thereon. Projectiles persevere in their motions, so far as they are not retarded by the resistance of the air, or impelled downwards by the force of gravity. A top, whose parts by their cohesion are perpetually drawn aside from rectilinear motions, does not cease its rotation, otherwise than as it is retarded by the air. The greater bodies of the planets and comets, meeting with less resistance in more free spaces, preserve their motions both progressive and circular for a much longer time.

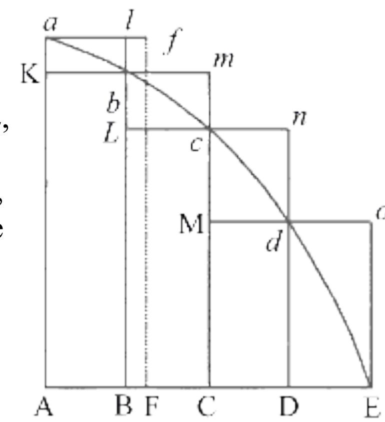
LAW II. The alteration of motion is ever proportional to the motive force impressed; and is made in the direction of the right line in which that force is impressed. If any force generates a motion, a double force will generate double the motion, a triple force triple the motion, whether that force be impressed altogether and at once, or gradually and successively…

LAW III. To every action there is always opposed an equal reaction; or the mutual actions of two bodies upon each other are always equal, and directed to contrary parts. Whatever draws or presses another is as much drawn or pressed by that other. If you press a stone with your finger, the finger is also pressed by the stone. If a horse draws a stone tied to a rope, the horse (if I may so say) will be equally drawn back towards the stone: for the distended rope, by the same endeavour to relax or unbend itself, will draw the horse as much towards the stone as it does the stone towards the horse, and will obstruct the progress of the one as much as it advances that of the other…



COROLLARY I. A body by two forces conjoined will describe the diagonal of a parallelogram, in the same time that it would describe the sides, by those forces apart. If a body in a given time, by the force M impressed apart in the place A, should with an uniform motion be carried from A to B, and if by the force N impressed apart in the same place, it should be carried from A to C, then (completing the parallelogram ABCD), by both forces acting together, it will in the same time be carried in the diagonal from A to D. For since the force N acts in the direction of the line AC, parallel to BD, this force (by the second law) will not at all alter the velocity generated by the other force M, by which the body is carried towards the line BD. The body therefore will arrive at the line BD in the same time, whether the force N be impressed or not; and therefore at the end of that time it will be found somewhere in the line BD. By the same argument, at the end of the same time it will be found somewhere in the line CD. Therefore it will be found in the point D, where both lines meet. But it will move in a right line from A to D, by Law I.

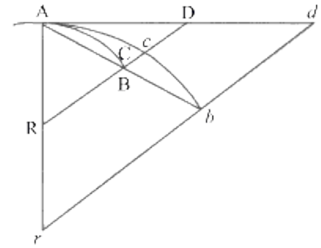
LEMMA I. Quantities, and the ratios of quantities, which in any finite time converge continually to equality, and before the end of that time approach nearer the one to the other than by any given difference, become ultimately equal. If you deny it, suppose them to be ultimately unequal, and let D be their ultimate difference. Therefore they cannot approach nearer to equality than by that given difference D— which is against the supposition.



LEMMA II. If in any[curvilinear] figure AacE, terminated by the right lines Aa, AE, and the curve acE, there be inscribed any number of parallelograms Ab, Bc, Cd, &c., comprehended under equal bases AB, BC, CD, &c., and the sides, Bb, Cc, Dd, &c., parallel to one side Aa of the figure; and the parallelograms aKbl, bLcm, cMdn, &c., are completed. Then, if the breadth of those parallelograms be supposed to be diminished, and their number to be augmented in infinitum, I say that the ultimate ratios that these figures (the inscribed figure AkbLcMdD, the circumscribed figure AalbmcndoE, and curvilinear figure abased) will have to one another are ratios of equality. For the difference of the inscribed and circumscribed figures is the sum of the parallelograms *Kl*, *Lm*, *Mn*, *Do*, that is (from the equality of all their bases), the rectangle under one of their bases, *Kb* and the sum of their altitudes Aa, that is, the rectangle *ABla*. But this rectangle, because its breadth AB is supposed diminished *in infinitum,* becomes less than any given space. And therefore (by Lem. I) the figures inscribed and circumscribed become ultimately equal one to the other; and much more will the intermediate figure be ultimately equal to either. Q.E.D.[3]

[3] *QED: Quod erat demonstrandum*, that which was to be proved.

LEMMA VI. *If any arc* ACB*, given in position is subtended by its chord* AB*, and in any point* A*, in the middle of the continued curvature, is touched by a right line* AD*, produced both ways; then if the points* A *and* B *approach one another and meet, I say, the angle* BAD*, contained between the chord and the tangent, will be diminished in infinitum, and ultimately will vanish.*



For if that angle does not vanish, the arc ACB will contain with the tangent AD an angle equal to a rectilinear angle; and therefore the curvature at the point A will not be continued, which is against the supposition.

III. GENERAL SCHOLIUM

This most beautiful system of the sun, planets, and comets, could only proceed from the deliberate purpose and dominion of an intelligent and powerful Being. He hath placed the systems of the fixed stars at immense distances from one another, lest they should, by their gravity,[4] fall on each other.

This Being governs all things, not as the soul of the world, but as Lord over all. On account of his dominion he is often called *Lord God*, or *Universal Ruler*. *God* is a relative word, and has reference to servants. The Supreme God is a Being eternal, infinite, and absolutely perfect. Still, a being without dominion, however perfect he may be, cannot be said to be Lord God. It is the dominion of a spiritual being that makes up a God: a true, supreme, or imaginary dominion makes a true, supreme, or imaginary God.

And from his true dominion it follows that the true God is a living, intelligent, and powerful Being. From his other perfections, it follows that he is supreme, or most perfect. He is eternal and infinite, omnipotent and omniscient. That is, his duration reaches from eternity to eternity; his presence from infinity to infinity; he governs all things and knows all things that are or can be done. He is not eternity and infinity, but eternal and infinite; he is not duration or space, but he endures and is present. He endures forever, and is everywhere present. By existing always and everywhere, he constitutes duration and space. Since every particle of space is *always*, and every indivisible moment of duration is *everywhere*, certainly the Maker and Lord of all things cannot be *never* and *nowhere*. God is the same God, always and everywhere. He is omnipresent. In him are all things contained and moved; yet neither affects the other: God experiences no change from the motion of bodies; bodies find no resistance from the omnipresence of God.

It is granted by all that the Supreme God exists necessarily; by the same necessity, he exists *always* and *everywhere.* Whence also he is all similar, all eye, all ear, all brain, and all arm; all power to perceive, to understand, and to act—but in a manner not at all human, in a manner not at all corporeal, in a manner utterly unknown to us. As a blind man has no idea of colors, so have we no idea of the manner by which the all-wise God perceives and understands all things.

He is utterly lacking all body and bodily shape, and can therefore neither be seen, nor heard, nor touched; nor ought he to be worshipped under the representation of any bodily thing. We have ideas of his attributes, but what the real substance of anything is we know not. In bodies, we see only their figures and colors, we hear only the sounds, we

[4] Before Newton, *gravity* meant mere heaviness. Newton demonstrated mathematically that the same force accounts both for bodies falling to the surface of the Earth and also for bodies orbiting in space.

touch only their outward surfaces, we smell only the smells, and taste the flavors. The inward substances of bodies, however, are not to be known, either by our senses or by any introspection. Much less, then, have we any idea of the substance of God. It is only by way of allegory that God is said to see, to speak, to laugh, to love, to hate, to desire, to give, to receive, to rejoice, to be angry, to fight, to frame, to work, and to build.

We know him only by his most wise and excellent contrivances[5] of things, and final causes.[6] We admire him for his perfections, but we revere and adore him on account of his dominion: for we adore him as his servants; and a god without dominion, providence, and final causes, is nothing else but Fate and Nature. Blind metaphysical necessity,[7] which is certainly the same always and everywhere, could produce no variety of things. All that diversity of natural things which we find suited to different times and places could arise from nothing but the ideas and will of a Being necessarily existing.

2b. *Opticks*, 1703[8]

[I. ATOMIC THEORY]

… it seems probable to me that God in the beginning formed Matter in solid, massy, hard, impenetrable, moveable particles, of such sizes and figures, and with such other properties, and in such proportion to space, as most conduced to the end for which He formed them; and that these primitive particles, being solids, are incomparably harder than any porous bodies compounded of them—even so very hard, as never to wear or break in pieces, no ordinary power being able to divide what God himself made one in the first creation. While the particles continue entire, they may compose bodies of one and the same nature and texture in all ages: but should they wear away, or break in pieces, the nature of things depending on them would be changed. Water and earth, composed of old worn particles and fragments of particles, would not be of the same nature and texture now, with water and earth composed of entire particles in the beginning. And therefore, in order that nature may be lasting, the changes of corporeal things are to be placed only in the various separations and new associations and motions of these permanent particles—compound bodies being apt to break, not in the midst of solid particles, but where those particles are laid together, and only touch in a few points.

It seems to me farther, that those particles have not only a force of inertia accompanied with such passive laws of motion as naturally result from that force, but also that they are moved by certain active principles, such as is that of gravity, and that which causes fermentation, and the cohesion of bodies. These principles I consider, not as occult qualities, supposed to result from the specific forms of things, but as general laws of nature, by which the things themselves are formed; their truth appearing to us by phenomena, though their causes be not yet discovered. For these are manifest qualities, and their causes only are occult. And the Aristotelians gave the name of occult qualities, not to manifest qualities, but to such qualities only as they supposed to lie hid in bodies,

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[5] *Contrivances*: arrangements, mechanisms, devices.
[6] *Final causes*: as in Aristotelian philosophy, purposes or goals towards which processes tend.
[7] *Blind metaphysical necessity*: Newton seems to mean an impersonal Fate.
[8] Isaac Newton, *Optics, or, a Treatise of the Reflections, Refractions, Inflections and Colors of Light*, 4th ed. (London, 1730). [Capitalization and spelling modernized.] halsall@murray.fordham.edu Internet Modern History Sourcebook. (c) Paul Halsall, Aug 1997.

and to be the unknown causes of manifest effects. Such would be the causes of gravity, and of magnetic and electric attractions, and of fermentations, if we should suppose that these forces or actions arose from qualities unknown to us, and incapable of being discovered and made manifest. Such occult qualities put a stop to the improvement of natural philosophy, and therefore of late years have been rejected.

To tell us that every species of things is endowed with an occult specific quality by which it acts and produces manifest effects, is to tell us nothing, but to derive two or three general principles of motion from phenomena, and afterwards to tell us how the properties and actions of all corporeal things follow from those manifest principles, would be a very great step in philosophy, though the causes of those principles were not yet discovered. And therefore I do not hesitate to propose the principles of motion above-mentioned, they being of very general extent, and to leave their causes to be found out.

Now by the help of these principles, all material things seem to have been composed of the hard and solid particles abovementioned, variously associated in the first creation by the counsel of an intelligent agent. For it became Him who created them to set them in order. And if He did so, it is unphilosophical to seek for any other origin of the world, or to pretend that it might arise out of a chaos by the mere laws of nature—although being once formed, it may continue by those laws for many ages. For while comets move in very eccentric orbs in all manner of positions, blind fate could never make all the planets move one and the same way in orbs concentric, some inconsiderable irregularities excepted, which may have risen from the mutual actions of comets and planets upon one another, and which will be apt to increase, till this System wants a reformation. Such a wonderful uniformity in the planetary system must be allowed the effect of choice.

And so much the uniformity in the bodies of animals, they having generally a right and a left side shaped alike, and on either side of their bodies two legs behind, and either two arms, or two legs, or two wings before their shoulders, a neck running down into a backbone, and a head upon it; and in the head two ears, two eyes, a nose, a mouth, and a tongue, alike situated. Also the first contrivance of those very artificial parts of animals, the eyes, ears, brain, muscles, heart, lungs, midriff, glands, larynx, hands, wings, other organs of sense and motion; and the instinct of brutes and insects, can be the effect of nothing else than the wisdom and skill of a powerful ever-living agent, who being in all places, is more able by His will to move the bodies within His boundless uniform sensorium, and thereby to form and reform the parts of the universe, than we are by our will to move the parts of our bodies. And yet we are not to consider the world as the body of God, or the several parts thereof, as the parts of God. He is a uniform being, void of organs, members or parts, and they are His creatures subordinate to him, and subservient to His will; and He is no more the soul of them, than the soul of man is the soul of the species of things carried through the organs of sense into the place of its sensation, where it perceives them by means of its immediate presence, without the intervention of any third thing. The organs of sense are not for enabling the soul to perceive the species of things in its sensorium, but only for conveying them thither; and God has no need of such organs, He being everywhere present to the things themselves. And since space is divisible *in infinitum* and matter is not necessarily in all places, it may be also allowed that God is able to create particles of matter of several sizes and figures, and in several proportions to space, and perhaps of different densities and forces, and thereby to vary the laws of nature, and make worlds of several sorts in several parts of the universe. At least, I see no contradiction in all this.

[II. INDUCTION]

As in mathematics, so in natural philosophy, the investigation of difficult things by the method of analysis ought ever to precede the method of composition. This analysis consists in making experiments and observations, and in drawing general conclusions from them by induction, and in admitting of no objections against the conclusions, but such as are taken from experiments, or other certain truths. For hypotheses are not to be regarded in experimental philosophy. And although the arguing from experiments and observations by induction be no demonstration of general conclusions; yet it is the best way of arguing which the nature of things admits of, and may be looked upon as so much the stronger, by how much the induction is more general. And if no exception should occur from phenomena, the conclusion may be pronounced generally. But if at any time afterwards any exception shall occur from experiments, it may then begin to be pronounced with such exceptions as occur. By this way of analysis we may proceed from compounds to ingredients, and from motions to the forces producing them; and in general, from effects to their causes, and from particular causes to more general ones, till the argument ends in the most general. This is the method of analysis. And the synthesis consists in assuming the causes discovered, and established as principles, and by them explaining the phenomena proceeding from them, and proving the explanations.

3. Voltaire (1694-1778), *Philosophical Letters*[9]
Letter XIV: On Descartes and Sir Isaac Newton

A Frenchman who arrives in London will find philosophy, like everything else, very much changed there. He had left the world a plenum, and he now finds it a vacuum. At Paris the universe is seen composed of vortices of subtle matter; but nothing like it is seen in London. In France, it is the pressure of the moon that causes the tides; but in England it is the sea that gravitates towards the moon; so that when you think that the moon should make it flood with us, those gentlemen fancy it should be ebb, which very unluckily cannot be proved. For to be able to do this, it is necessary the moon and the tides should have been inquired into at the very instant of the creation.

…According to your Cartesians, everything is performed by an impulsion, of which we have very little notion; and according to Sir Isaac Newton, it is by an attraction, the cause of which is as much unknown to us... A Cartesian declares that light exists in the air; but a Newtonian asserts that it comes from the sun in six minutes and a half… Descartes asserts farther, that extension alone constitutes matter, but Sir Isaac adds solidity to it. How furiously contradictory are these opinions…!

This famous Newton, this destroyer of the Cartesian system, died in March, anno 1727. His countrymen honored him in his lifetime, and interred him as though he had been a king who had made his people happy…

Nature had indulged Descartes with a shining and strong imagination, whence he became a very singular person both in private life and in his manner of reasoning. This imagination could not conceal itself even in his philosophical works, which are everywhere adorned with very shining, ingenious metaphors and figures. Nature had

[9] *Voltaire* (1694-1778) was the pen-name of Francois-Marie Arouet, French essayist and philosopher.

almost made him a poet… He embraced a military life for some time, and afterwards becoming a complete philosopher, he did not think the passion of love derogatory to his character. He had by his mistress a daughter called Francine, who died young, and was very much regretted by him. Thus he experienced every passion incident to mankind.

He was a long time of opinion that it would be necessary for him to fly from the society of his fellow creatures, and especially from his native country, in order to enjoy the happiness of cultivating his philosophical studies in full liberty… He left France purely to go in search of truth, which was then persecuted by the wretched philosophy of the schools.[10] However, he found that reason was as much disguised and depraved in the universities of Holland, into which he withdrew, as in his own country. For at the time that the French condemned the only propositions of his philosophy which were true, he was persecuted by the pretended philosophers of Holland, who understood him no better… Descartes was injuriously accused of being an atheist, the last refuge of religious scandal: and he who had employed all the sagacity and penetration of his genius, in searching for new proofs of the existence of a God, was suspected to believe there was no such Being.

Such a persecution from all sides, must necessarily suppose a most exalted merit as well as a very distinguished reputation, and indeed he possessed both. Reason at that time darted a ray upon the world through the gloom of the schools, and the prejudices of popular superstition. At last his name spread so universally, that the French were desirous of bringing him back into his native country by rewards… [but] he returned to his solitude in North Holland, where he again pursued the study of philosophy, whilst the great Galileo, fourscore years of age, was groaning in the prisons of the Inquisition, only for having demonstrated the earth's motion. At last Descartes was snatched from the world in the flower of his age at Stockholm...

The progress of Sir Isaac Newton's life was quite different. He lived happy, and very much honored in his native country, to the age of fourscore and five years. It was his peculiar felicity, not only to be born in a country of liberty, but in an age when all scholastic impertinences were banished from the world. Reason alone was cultivated, and mankind could only be his pupil, not his enemy.

One very singular difference in the lives of these two great men is, that Sir Isaac, during the long course of years he enjoyed, was never sensible to any passion, was not subject to the common frailties of mankind, nor ever had any commerce with women—a circumstance which was assured me by the physician and surgeon who attended him in his last moments.

We may admire Sir Isaac Newton on this occasion, but then we must not censure Descartes. The opinion that generally prevails in England is that the latter was a dreamer, and the former a sage. Very few people in England read Descartes, whose works indeed are now useless. On the other side, but a small number peruse those of Sir Isaac, because to do this the student must be deeply skilled in the mathematics, otherwise those works will be unintelligible to him. But notwithstanding this, these great men are the subject of everyone's discourse. Sir Isaac Newton is allowed every advantage, whilst Descartes is not indulged a single one. According to some, it is to the former that we owe the discovery of a vacuum, that the air is a heavy body, and the invention of telescopes. In a

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[10] *Wretched philosophy of the schools*: i.e., scholasticism, the manner of disputation developed in the medieval universities.

word, Sir Isaac Newton is here as the Hercules of fabulous story, to whom the ignorant ascribed all the feats of ancient heroes.

[…Some have asserted] that Descartes was not a great geometrician. Those who make such a declaration may justly be reproached with flying in their master's face. Descartes extended the limits of geometry as far beyond the place where he found them, as Sir Isaac did after him. The former first taught the method of expressing curves by equations. This geometry which, thanks to him for it, is now grown common, was so abstruse in his time, that not so much as one professor would undertake to explain it…

And if he was mistaken in some things, the reason of that is, a man who discovers a new tract of land cannot at once know all the properties of the soil. Those who come after him, and make these lands fruitful, are at least obliged to him for the discovery.

Geometry was a guide he himself had in some measure fashioned, which would have conducted him safely through the several paths of natural philosophy. Nevertheless, he at last abandoned this guide, and gave entirely into the humor of forming hypotheses; and then philosophy was no more than an ingenious romance, fit only to amuse the ignorant. He was mistaken in the nature of the soul, in the proofs of the existence of a God, in matter, in the laws of motion, and in the nature of light. He admitted innate ideas, he invented new elements, he created a world; he made man according to his own fancy; and it is justly said, that the man of Descartes is, in fact, that of Descartes only, very different from the real one. He pushed his metaphysical errors so far, as to declare that two and two make four for no other reason by because God would have it so. However, it will not be making him too great a compliment if we affirm that he was valuable even in his mistakes. He deceived himself, but then it was at least in a methodical way. He destroyed all the absurd chimeras with which youth had been infatuated for two thousand years. He taught his contemporaries how to reason, and enabled them to employ his own weapons against himself.

I indeed believe that very few will presume to compare his philosophy in any respect with that of Sir Isaac Newton. The former is an essay, the latter a masterpiece. But then the man who first brought us to the path of truth was perhaps as great a genius as he who afterwards conducted us through it…