Introduction: Flawed Genius

"*Nature, and nature's laws lay hid in night. God said, Let Newton be! and all was light*"

Alexander Pope

The name of Isaac Newton appears on virtually every survey of the public's choice for the most important persons of the second millennium. A poll published in the 12 September 1999 issue of the London *Sunday Times Magazine* ranked him first, even above Shakespeare, Leonardo da Vinci, Charles Darwin, and similar canonized figures. Among his crowning achievements was the research starting around 1670 on light and color, but he is best known for his enunciation of the laws of motion and of gravitation and their application to celestial mechanics as summarized in one of the greatest tomes in science, the *Philosophiae naturalis principia mathematica*, usually shortened to *Principia*—the first version of which was published in 1687.

Putting physics on a firm experimental and mathematical foundation—an approach known as Newtonism—earned Newton the ultimate accolade as father of modern scientific thought. A revisionist historical analysis, based in part on the discovery by the economist John Maynard Keynes of a huge trove of unpublished papers and documents, has led some scholars to consider Newton the last great mystic rather than first modern scientist. While his work in physics and mathematics set in motion the Age of Enlightenment, revisionist historians point out that neither as a person nor an intellect did he belong to it. As debunking of some of the hagiography surrounding Newton commenced in the latter part of the twentieth century, it became evident that Newton spent much more time on alchemy and mystical theology than on "science"—composing over one million words on each of these two endeavors,

—much more than all his writings on physics combined. His alchemical library was huge and his alchemical experiments, though kept secret from all but a few intimates and servants, consumed many of his waking hours for decades. The scientific genius whom Alexander Pope credited with shedding light on Nature was also a man of disturbing darkness.

The term "darkness" can be applied to much of Newton's personality. A deeply complex man, he was also morally flawed. Adjectives that have been used to describe facets of his personality are remote, lonely, secretive, introverted, melancholic, humorless, puritanical, cruel, vindictive, and, perhaps worst of all, unforgiving. Some readers have even discerned malice in the most famous apothegm attributed to Newton, "If I have seen further it is by standing on ye sholders [sic] of Giants." Often cited as a sign of his modesty, it has also been interpreted as the ultimate poisonous lacing in a disingenuously polite letter addressed to one of his bitterest scientific foes, Robert Hooke, of pronounced dwarfish stature. (It is worth noting that the origin of the aphorism long antedates Newton since it can be traced to at least John of Salisbury in the twelfth century.) But irrespective of its source, it can—in the words of Robert Merton, the master sociologist of science and author of *On the Shoulders of Giants: A Shandean Postscript*—be taken in two ways: extolling the dwarfs, who are raised high on the giants' shoulders, or the giants without whom there would be no eminence from which the little men could see far and wide.

The onset of Newton's "darkness"—so intimately related to his obsession with alchemy and his religious convictions—can be dated to Christmas Day 1642 (the year of Galileo's death) when Newton was born prematurely. Newton's father had died at the early age of thirty-six, two months before his son's birth. To make matters worse, very soon after Newton's birth, his mother married the rector of North Witham, Barnabas Smith, and left her infant son to be brought up by his grandparents. His mother only returned to the family home when Newton was a pre-pubescent eleven year-old. Newton never forgave his mother for this perceived abandonment and henceforward never trusted any woman. He loathed his stepfather; so much so, that in his *Fitzwilliam Notebook* (now in the Fitzwilliam Museum) Newton wrote, "Threatening my father and mother Smith to burne them and the house over them."

As a result, the young Newton became intensely introverted and arrogantly Puritanical. So convinced was he of his supernatural powers that he once constructed a virtual anagram of his name *(Isaacus Neutonus)* in terms of "God's holy one" *(Jeova sanctus unus)*. His own secret religious beliefs even caused turmoil during his tenure as Lucasian Professor of Mathematics at Cambridge University's Trinity College. As holder of that chair, Newton was supposed to be ordained into the Anglican Church, but as a closet Aryan regarding Trinitarianism as heresy he continually sidestepped the issue. Like the Alexandrian priest, Arius, at the Council of Nicea in 325, Newton believed that God and Christ were separate entities and that the Bishop of Alexandria, Athanasius (later beatified by the Catholic Church), was "a vile blasphemer" because Athanasius insisted that the Early Church accept the notion of Homoousion—the doctrine stating that God and Christ are of the same substance. At Athanasius's insistence, the Catholic Church—regarded by the Puritan Newton as the work of the Devil—adopted the doctrine of the Holy Trinity, as did the Anglican Church. So Newton spent several years of his life researching the history of the Church. He felt the day approaching when he might have to prove to Trinity College that the Holy Trinity (Father, Son and Holy Ghost, one and indivisible, three in one, one in three) was not only blasphemous but also mathematical nonsense. As Newton was preparing to publicly defend his heretical beliefs to the authorities, his friends at Charles II's court persuaded the king to convert the Lucasian Chair into a purely secular position and thus saved him from professional hara-kiri.

Newton's subsequent elevation to the important government rank of Master of the Mint and conferment of a knighthood by Queen Anne should have required open adherence to the Anglican Church. Yet Newton avoided confrontation with the Church throughout his adult life, and was only openly defiant on his deathbed in 1727 at age eighty-five, when he refused the last rites. Even that noncompliance did not prevent a state burial in Westminster Abbey nor the unveiling there in 1731 of a monument in just recognition of his towering contributions to science and of his services to England.

Newton's obsession with alchemy almost antedated his immersion in religious studies. In his teens, he boarded above an apothecary's shop. It

was because of the apothecary, Clark, that Newton first discovered his passion for chemistry and alchemy, and displayed the beginnings of his life-long hypochondria. He could not resist concocting bizarre remedies that he used both on himself and his acquaintances. As he wrote, "My Lactellus Balsam is composed of turpentine, rose-water, beeswax, olive oil, sack and red sandal wood, and is good for consumption"—which he falsely believed he was suffering from—"and is equally efficacious when applied externally to cure green wounds and the bite of a mad dog." Apothecary Clark's stepdaughter, Catherine Storer, fell in love with him, but the teenager was so consumed by his studies and his boyhood experiments that he soon forgot his childhood sweetheart—an early sign of life-long bachelorhood.

When Newton achieved a place at Cambridge University, he continued experimenting on himself. He went almost blind looking for extended periods directly into the sun while observing colored rings and spots before his eyes. As he wrote, "I took a bodkin, and put it between my eye and the bone as near to the backside of my eye as I could; & pressing my eye with the end of it (so as to make the curvature in my eye) there appeared several white, dark and colored circles." Thus he nearly ended his scientific career before it had begun.

In the latter part of 1669, when Newton was only twenty-six, he was appointed as the second Lucasian Professor of Mathematics at Trinity College (a chair now held by Stephen Hawking). His first lecture was on optics—eventually the subject of his groundbreaking book, *Opticks*. But not a single student turned up for his lecture the following week. For the next seventeen years Newton found himself mostly alone in the class room "and for want of hearers, he read to the walls."

During his early college days at Trinity, the twenty year-old Newton, who found it very hard to mix with his fellow students, profited from his peers by becoming a moneylender. Ironically Newton's fervent interest in money did not reach its apotheosis until many years later, when he was appointed Warden (1696) and subsequently (1699) Master of the Royal Mint. (As a wayward Puritan student, Newton criticized himself in his Fitzwilliam *Notebook*, "Setting my heart on money more than God," but that did not keep Newton at age seventy-eight from speculating and losing heavily in the South Sea Bubble financial debacle.)

Then, in 1663, John Wickins—the first of two men featuring in Newton's repressed homosexual life—came to room with him. Wickins, the son of the Master of Manchester Grammar School, lived and worked with Newton for the next twenty years. They turned their rooms into an alchemist's laboratory filled with the fumes of sulfur and quicksilver. It was Wickins who observed of Newton, "endless nights he did not sleep or eat because of his desire for the Philosopher's Stone." Newton told Wickins that he attributed the prematurely gray color of his hair to so much experimentation with quicksilver that "*I took so soon the colour*." Newton, the genius who would one day write the unrivalled *Principia*, knew only too well how he would be judged by his peers if they ever discovered that he was spending infinitely more of his time on alchemy than on science (or natural philosophy as it was then called). Hence alchemy, like religion, became a part of his obsessively secret life.

Newton felt more than friendship for Wickins, yet it is almost certain that his Puritan beliefs prevented him from indulging in physical intimacy with his friend. But Newton's vindictive nature showed itself when Wickins deserted him by marrying and becoming a clergyman. Wickins still wanted to continue their friendship, but when he asked Newton for a donation of Bibles for his flock, Newton sent him the Bibles but refused to communicate with him ever again.

The character trait most relevant to the present book is Newton's obsessively competitive nature. Frank E. Manuel wrote in 1968 in one of the great Newton biographies that "the violence, acerbity, and uncontrolled passion of Newton's attacks, albeit directed into socially approved channels, are almost always out of proportion with the warranted facts and character of the situations." This statement applies in spades to three of Newton's best-known bitter conflicts: with the physicist Robert Hooke, the astronomer royal, John Flamsteed, and a German contemporary of almost equal intellectual prowess, Gottfried Wilhelm Leibniz—the last fight eventually turning into an England vs. Continental Europe competition. It is two of these three relentless drawn-out battles that we intend to illuminate in the form of historically grounded drama. Below is presented a brief summary of the historical evidence, starting with the Newton-Hooke struggle (Chapter 2) conducted *mano a mano*, to be followed by historical background on the

Newton-Leibniz confrontation (Chapter 3), which was fought largely through surrogates.

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Newton had not been exposed to any form of censure by his peers until he published his "Theory of Light and Colours" in the Royal Society's *Transactions* in 1672 at the age of thirty. A few weeks after Newton had been accepted into the Royal Society, his paper on optics was dismissed in a letter by the Society's Curator of Experiments, Robert Hooke (seven years Newton's senior), "as to Mr. Newton's hypothesis of solving the phenomenon of colours, I confess I cannot yet see any undeniable argument to convince me of the certainty thereof." Newton was apoplectic. So the battle began between two of England's greatest natural philosophers. It lasted for over thirty years, until Hooke's death in 1703.

But Hooke, whose childhood was as traumatic as Newton's, was an entirely different creature to the Puritan, over-secretive, and paranoid Cambridge recluse. Hooke's father was an unbalanced clergyman who hanged himself when Hooke was in his teens, but the youth responded to his emotional loss by utilizing his considerable talent as an artist. After receiving a small inheritance of £100, Hooke was sent off to London to be taught by the famous portrait painter, Sir Peter Lely. Not long after his arrival in London, Richard Busby, a master at Westminster, realizing that Hooke possessed a fine analytical mind, helped him secure a place at Christ Church College, Oxford, where he received an M.A. in 1663. But whereas Newton was over-sensitive and introverted, Hooke was carefree and gregarious, soon becoming involved with the Invisible College where he associated freely with the influential thinkers who eventually created the Royal Society.

In 1662, Hooke was appointed The Royal Society's Curator of Experiments, an office he filled innovatively in spite of much pressure on his time. Like Newton, he produced theories on mechanics, gravity and optics. But unlike Newton, Hooke did not concentrate on a single problem for decades until it was solved. Rather, his frenetic energy caused him to flit from one theory to another. He developed hypotheses in geology, botany, cartography and telescopes. His major work,

Micrographia, was a treatise on the microscope that also contained some original theories on the nature of light, thus crossing Newton's path. In addition, Hooke was an architect who was admired by Sir Christopher Wren. Because of his Renaissance-like genius, Hooke was known as "the Leonardo of London," but to Newton he was simply a profligate dilettante. By contrast, Hooke—a bon vivant and great frequenter of inns and coffee houses with his many friends, including Wren and Halley—despised Newton's sedentary and apparently chaste life. The latter stood in marked contrast to Hooke's numerous affairs with women, including a prolonged incestuous relationship with his young niece, Grace Hooke, who also served as his housekeeper for several years. Hooke went so far as to describe in his extensive diaries his various sexual exploits and the quality and the quantity of his orgasms, along with his bowel movements.

Newton's response to Hooke's dismissive letter of 1672 was swift: "I doubt not but that upon severer examinations, my theory on light and colours will be found as certain a truth as I have asserted it." Newton threatened to leave the Royal Society and refused to have any of his own work published for the next twenty years until the appearance of his *Principia*. This was the beginning of many feuds between Newton and Hooke, including one where Hooke accused Newton of using passages of his *Micrographia* to demonstrate Newton's opposing theory of light.

The vituperative conflict between them (to be illustrated more fully in Chapter 2 in "*Newton's Hooke*") continued over the years, finally coming to a head when Hooke confronted Newton on the subject of gravity. Hooke realized that any theory on gravity, in relation to the planets, had to be predicated on elliptical motion, but Hooke did not have the mathematical sophistication to prove it. So, in January 1680 he challenged Newton, "I doubt not but that with your excellent method, you will easily find out what that curve [the ellipse] must be, and its properties, and suggest a physical reason for this proportion [the inverse square law]." Hooke believed that Newton would fail, but Newton not only took up his challenge, it irrevocably led Newton to his proven theory of universal gravitation.

Two years after the publication of the *Principia* (1687), Newton met Nicolas Fatio du Duillier, who was soon to become the love of his life.

His frustrated relationship with Fatio, like that with Wickins, was also probably never consummated but was largely the cause of Newton's nervous breakdown in the autumn of 1693. Fatio, who came from a wealthy Swiss family, was a spoilt but charismatic youth of twenty-five when he met the forty-seven-year-old Newton at the Royal Society. Although Fatio had a great talent for mathematics and natural philosophy, he had an even greater talent for flattery and self-promotion. From Newton's letters it is obvious that the older man was besotted by the younger, with whom he was soon conducting alchemical experiments. Fatio was a spendthrift, and he encouraged Newton to provide him with money. Indeed there was very little that Newton would not do for the young protégé, which caused Newton's numerous enemies to soon dub Fatio as "Newton's ape." Despite this, Newton continually tried to persuade Fatio to move into his rooms at Trinity, but his protégé always demurred. Then Fatio became careless and began to send Newton alchemical secrets by post. The paranoid Newton, terrified that his enemies, specifically Hooke, would discover his obsession with alchemy and his unacceptable religious beliefs, broke with Fatio, whose religious beliefs were even more extreme.

Within weeks of their relationship ending, Newton's chained emotions snapped into temporary insanity. In September 1693 Newton wrote a deranged letter to Samuel Pepys; shortly thereafter, he accused his friend, the philosopher Locke, of "having endeavoured to embroil me with women." But Locke, realizing that his friend was mentally unstable, forgave Newton for his libelous accusations. Locke also knew that Newton had enjoyed serving briefly as the member of parliament for Cambridge, and that he was now desperate to acquire an eminent civil position. With the powerful assistance of another of Newton's friends, the Chancellor of the Exchequer Charles Montagu, Locke helped Newton in the early spring of 1696 to become Warden and three years later Master of the Royal Mint.

With that appointment and move from Cambridge to London, Newton left forever the world of science and alchemy and set about the recoinage of England. If Newton had failed in his new post, it could well have broken the English economy and set off a social upheaval equivalent to that of the Civil War. He applied his ruthlessness and

mathematical genius to the task. Within three years he had successfully re-coined six and a half million pounds—an Olympian achievement considering that barely half that amount had been produced in the previous thirty years. To ensure the continuing success of the re-coinage, Newton personally supervised the interrogation, the trials and the executions of every apprehended counterfeiter and coin-clipper, commenting brusquely, "Criminals, like dogs, always return to their vomit."

As Master of the Mint, the academic recluse Newton turned into a figure in London society, with his niece Catherine Barton, a great beauty and erstwhile mistress of Jonathan Swift, becoming Newton's confidante and housekeeper. Unlike Hooke's incestuous relationship with his niece, Newton's affection for Catherine was purely platonic. But Newton's friend and enabler, Chancellor of the Exchequer Charles Montagu, had a passionate relationship with Catherine until Montagu's death in 1715. Hypocritically, Newton, the rigorous Puritan, turned a blind eye to their twelve-year affair even though the lovers often cohabited under Newton's own roof—because Newton never forgot that it was Montagu who had made him Warden of the Mint, the initial source of his power and growing wealth.

Newton rarely attended the meetings of the Royal Society at Gresham College because of the omnipresence of his life-long adversary, the society's secretary, Robert Hooke. Then in March 1703 the overworked and decrepit Hooke died. In November of the same year Newton, by now one of the most famous scientists in the world, was made the Society's president. Instantly he took his revenge on his dead enemy, though not openly. Instead, Newton first approved the Royal Society's acquisition of new premises in Crane Court, Fleet Street, and then arranged for the mysterious loss of the only existing portrait of Hooke, along with many instruments created by Hooke, none ever to be seen again. Now at last Newton felt free to publish his second work of genius, *Opticks*, in four volumes. It was only because of Hooke's critique of Newton's "Theory of Light and Colours" that Newton had remained silent on the subject for over thirty years. Yet even in his final years, he was often heard to mutter, "Damn Hooke, damn him."

Although Newton's wealth and prestige continued to grow apace, culminating with his being knighted by Queen Anne in 1705, even in his twilight years his appetite for vengeance remained as rabid as ever. When "Le Grand Newton"—as he was known on the Continent—was not destroying the reputations of fellow scientists, as late as three years before his death at age eighty-five he was still sending counterfeiters to the gallows without a hint of mercy. Or, bizarrely, trying to re-create the proportions of Solomon's Temple in his library because he regarded Solomon as the greatest alchemical magus of them all.

Newton's vengeful vindictiveness might be equally well illustrated by his drawn-out fights with the Astronomer Royal John Flamsteed and his protégé Stephen Gray, but the decades' long priority struggle with the German Gottfried Wilhelm Leibniz concerning the invention of the calculus differed in an important respect: it transcended personal priority claims to become one between nations that was largely conducted through surrogates rather than the principals themselves. As with Hooke, Newton pursued the vendetta beyond Leibniz's death by removing any mention of his competitor in the final revision of his *Principia*—a fate posthumously also experienced by Flamsteed.

In addition to his monumental contributions to physics summarized in his *Principia*, Newton was also an inventor of the calculus (which he first called the "method of fluxions"). Up in Parnassus or down in his grave, he would immediately interject: "An inventor? Was I not the creator of the calculus—a bedrock of modern mathematics since it first revealed the relationship between speed and area?" Why would such a genius even ask such a question? Because as we have already amply demonstrated, Newton was also a fallible human being for whom priority—and especially priority about the calculus—counted above all else.

Priority can only be assigned after a definition of the term has been agreed upon. To this day, no such unambiguous definition has been produced in science, where multiple independent discoveries occur all too frequently. In many instances, the question must be asked whether

priority should be assigned to the first discoverer, to the person who published first, or to the one who first understood the nature of the discovery. In the case of the calculus, both inventors fully comprehended the nature of their invention. Furthermore, it is now clear that Newton was first in terms of conception, whereas Leibniz long predated the secretive Newton in terms of publication. But since in Newton's mind and words "second inventors have no right," resolution of that priority dispute required for him a fight to the death, like a gladiator in a Roman circus. Unlike the gladiators, Newton was a consummate master of using surrogates and continued the struggle even after Leibniz's burial in Hanover in 1716.

The calculus priority struggle—with each protagonist ultimately charging the other with piracy—has, in the words of William Broad, "been fought for the most part by the throng of little squires that surrounded the two great knights." It is through the story of some of Newton's "little squires" that Chapter 3 (in the play *Calculus*) tries to examine one of Newton's greatest ethical lapses.

The stage was set by the aforementioned Nicolas Fatio de Duillier, who became Newton's most fawning disciple. This "Ape of Newton" shot the first brutal salvo openly accusing Leibniz of plagiarism. Like Newton, Fatio never married; like Newton he indulged in alchemical experiments and religious fanaticism; but unlike his mentor he went way beyond him in that regard by openly associating with the Cevennes Prophets, who spoke in tongues and became possessed during religious ecstasies. Fatio's accusation of Leibniz was not pursued—partly because of the former's religious excesses as well as Newton's fear that their joint alchemical experiments would be exposed in the process—but in 1708, another loyal follower of Newton, John Keill (secretary of the Royal Society as well as "a war-horse, whose ardor was so intense that Newton sometimes had to pull in the reins"), formally repeated the charge of Leibniz's plagiarism—an accusation published in the *Philosophical Transactions* of the Royal Society in 1710. And when Leibniz, as a long-time foreign member of the Royal Society, demanded an official retraction, Newton in his capacity as president created a commission of eleven Fellows of the Royal Society ("a Numerous Committee of Gentlemen of Several Nations") to adjudicate the conflict. At a Royal

Society meeting on 24 April 1712, a 51-page long report—partly in Latin and replete with references to private as well as published letters and documents primarily in the possession of Newton's correspondent John Collins—was read openly (and subsequently published by the Royal Society) under the title *commercium epistolicum collinii & aliorum* ("exchange of letters from Collins and others") in which Keill's accusation was totally supported.

Such a blatantly biased procedure, though clearly to be condemned, was nevertheless to be expected, considering that Newton as president of the Royal Society had indirectly appointed the committee. But further scrutiny reveals much blacker details.

The composition of the committee that never openly signed the document did not become acknowledged for over 100 years. Not only do we now know the identity of the eleven fellows, but even more importantly their dates of appointment. The famous astronomer Edmond Halley, the physician and well-regarded literary figure John Arbuthnot, and the little-known William Burnet, Abraham Hill, John Machin, and William Jones were all appointed on 6 March 1712. Francis Robartes (Earl of Radnor) was added on 20 March, Louis Frederick Bonet (the King of Prussia's resident in London) on 27 March, and three more members, Francis Aston and the mathematicians Brook Taylor and Abraham de Moivre, on 17 April.

Why should these dates be significant? Because it is patently impossible that at least the last three members, appointed on April 17, could have had anything to do with a lengthy and complicated report *officially* presented seven days later! In point of fact, none of the eleven fellows was authorially responsible, because Newton himself had written the report! And in spite of the claim that the committee consisted of "Gentlemen of Several Nations," only two out of the eleven—Bonet and de Moivre—could be categorized as foreigners. In the case of Bonet, so little is known of him that even the Sackler Archive Resource of Fellows of the Royal Society does not contain his date and place of birth, although German and Swiss archives do shed some light on him. The question can rightfully be raised why such a diverse group of Royal Society Fellows, some of them of major distinction, should have allowed themselves to be so blatantly manipulated by Sir Isaac Newton—

ostensibly to be chosen as watchdogs and then so quickly transformed into barkless showdogs.

Calculus (in Chapter 3)—in the form of a play-within-a-play—provides some speculative insight into this scientific scandal through the personalities of John Arbuthnot, Louis Frederick Bonet, and Abraham de Moivre, with most of the biographical references firmly rooted in historical records, as is the case with *Newton's Hooke* (Chapter 2). And while the particular meeting of the playwrights Colley Cibber and Sir John Vanbrugh in *Calculus* is invented, both are historical characters whose respective plays *Love's Last Shift* and *The Relapse: Or Virtue in Danger* and their final collaboration, *The Provok'd Husband,* are part of the proud canon of British Restoration drama.

This brings us to a final comment: Why did we choose the form of two theatre plays—*Newton's Hooke* and *Calculus*—for an exploration of some of the darker aspects of Newton's highly complex personality? "What purpose is served by showing that England's greatest natural philosopher is flawed… like other mortals?" asks one of the characters in *Calculus*. "We need unsullied heroes!"

But what if the hero is sullied? At stake is an issue that is as germane today as it was 300 years ago: a scientist's ethics must not be divorced from scientific accomplishments. There is probably no other scientist of whom so many biographies and other historical analyses have been published as Isaac Newton. To this date, new biographies or books about him are published almost annually—all of them in the standard format of academic or documentary prose because of their didactic purpose to transmit or interpret historical information. But since we chose to concentrate on the *human* aspects of Newton's persona, we felt that his personality also merited illumination through the most human form of discourse, namely dialog.* Most modern plays are "played" rather than read. It is our hope that *Newton's Darkness: Two Dramatic Views* will enjoy a double role by finding a home on the stage as well as in the hands of engaged readers.

*An additional example of this approach has recently appeared in French: *la Guerre des science aura-t-elle lieu?* by Isabelle Stengers (Le Seuil, Paris, 2001), dealing with the Newton-Leibniz controversy.