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Isaac Newton

ANTHONY STORR

Isaac Newton is generally acknowledged to have been one of the greatest creative men of genius who ever existed. It also happens that he showed many striking abnormalities of personality, and at one time was considered mad by his contemporaries. His early history, moreover, is such that, to my mind, it is not surprising that he grew up to be eccentric. I want to examine two questions that may or may not be related. Firstly, how far were his adult peculiarities the consequences of his childhood circumstances, and, secondly, were his scientific achievements in any way connected with his personality?

There are those, even among psychiatrists, who deny that the experiences of early childhood play any important part in the formation of adult character, believing this to be the consequence of inheritance, hardly modified by circumstance. I do not find myself among their number, although I recognise that heredity must not only influence a child's response to adverse circumstance but may also determine which experiences he perceives as harmful. Newton's early childhood, however, was, as we shall see, so classically traumatic that I find it impossible to believe that it did not play a major part in shaping his personality.

The relation between his personality and his achievement is more dubious. Some like to believe that scientific discovery is entirely the result of intelligence combined with application. When I ventured to suggest that the structure of Newton's character and his discoveries might be related Sir Karl Popper, who was at the meeting at which I spoke, said: "I do not believe in the currently fashionable psychopathological interpretation of Newton. I think that Newton's theory is a clear answer to a definite problem situation. The problem situation was set by the work of Galileo and Kepler, and subsequent to their work various people attempted to solve the problem that Newton eventually solved. Newton was certainly one of the greatest geniuses of all time, and he exhibited talents of a very special order; but to explain his work as the result of, say, an obsession with unity seems to me empty talk, and to represent a very dangerous kind of psychologistic approach."[1]

I should, I suppose, have been abashed by being put in my place by one who has been described as the greatest living philosopher of science. Despite Karl Popper's strictures, however, I find it difficult to believe that intellectual achievement can take place in isolation from other features of personality. Although the mind of a scientist may seem, at times, to act like an impersonal calculator, there are, it seems to me, traits of character and circumstances that render this possible that are not shared by all of us. Even the most detached intellectual operations are motivated, I believe, by forces that are emotional in origin rather than purely rational, a conclusion supported by the philosopher Hume, who wrote: "Reason is, and ought only to be, the slave of the passions, and can never pretend to any other office than to serve and obey them."[2] This is not to say that I subscribe to the kind of interpretations that the more fundamentalist psychoanalysts are only too ready to advance. I do not believe that the wish to make sense out of the universe is a sublimation of sexual or aggressive drives in any direct or simple sense, but I do consider it likely that those who, like Newton and Einstein, prove capable of creating new models of the universe are unusual in ways besides the obvious one of being unusually intelligent.

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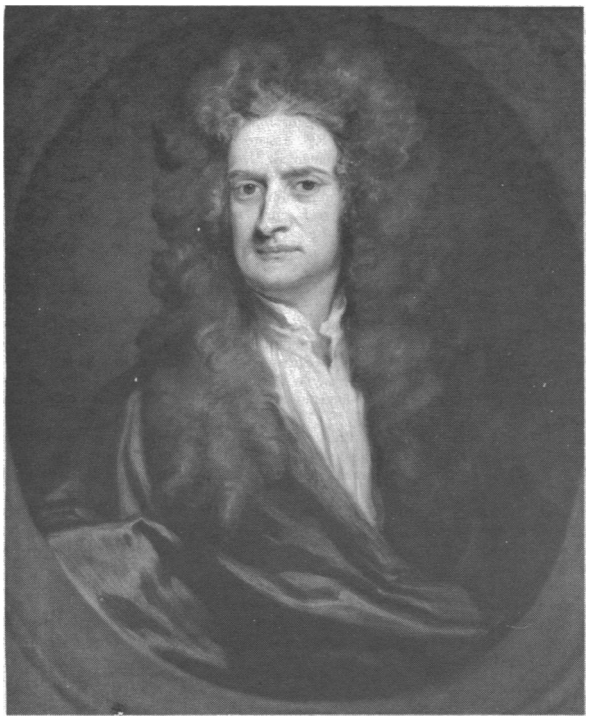
Formative years

Isaac Newton was born prematurely on Christmas day 1642. He was so tiny that his mother often remarked that at birth he was small enough to fit into a quart pot. His father, a yeoman without education, unable even to sign his name, had died three months



Portrait of Sir Isaac Newton by Godfrey Kneller. Reproduced by permission of the National Portrait Gallery.

before Newton was born. For his first three years Newton enjoyed the undivided attention of his mother without suffering competition from any rival. Indeed, as premature children often require special care he may have had even more of her attention than was customary. Then on 27 January 1646, when Newton was just past his third birthday, his mother remarried. She not only presented Newton with an unwanted stepfather but added insult to injury by abandoning him, leaving him to be reared by his maternal grandmother under the legal guardianship of a maternal uncle. Although his mother, with her new husband, moved to a house that was only a short distance away, we know that Newton passionately resented what he felt to be a betrayal. When Newton was about 11 his stepfather died and his mother returned, bringing with her two little girls and a boy, the offspring of her second marriage. According to contemporary accounts Newton's mother was a remarkable woman of strong personality. Although his feelings towards her were ambivalent, Newton remained attached to her and looked after her during her last illness in 1679, when he was 36; but Westfall records that he paid her few visits during his time at Cambridge despite living quite close to home.

As a child Newton is reported as spending more time making ingenious mechanical models than playing with his fellows. A contemporary reported that "he was always a sober, silent thinking lad, and was never known scarce to play with the boys abroad, at their silly amusements."[3] If this was really his attitude towards boyish games it is not surprising that his schoolfellows are reported as being "not very affectionate toward him. He was commonly too cunning for them in everything. They were sensible he had more ingenuity than they, and 'tis an old observation, that in all Societys, even of men, he who has most understanding, is least regarded."[4] There is a story, which Newton himself repeated, that on one occasion when he did deign to compete he beat the other boys at jumping by first noting the direction and then taking advantage of the gusts of a strong wind that was blowing on that day. Westfall, who has examined what is known of his aggressiveness and disobedience in boyhood, writes that he must have been insufferable.

Evidence suggests that as a boy Newton was often so abstracted as not to be aware of either his school books or what was going on about him. His ability was recognised by his schoolmasters, but examination of the curriculum offered at Grantham Grammar School, to which Newton went when he was 12, showed how little mathematics was taught. Yet Newton invented the calculus four years after leaving school. His mother's servants are said to have been glad to part with him, declaring that he was "fit for nothing but the 'Versity.'"[5]

Accomplishments at Cambridge

In June 1661, when he was 18, Newton was sent to Trinity College, Cambridge. In February 1664 he was elected scholar and took his BA in 1665. In 1667 he became a minor fellow, in 1668 an MA and major fellow. In 1669, when still only 27, he became Lucasian professor of mathematics. Charles II provided, by letter patent, a special dispensation, which allowed Newton to take this chair without at the same time taking holy orders, a step that was normally demanded of all fellows.

What was Newton like as a young man? According to a contemporary account, he was a recluse; the archetype of the absent minded, solitary scholar.

> I never knew him to take any recreation or pastime either in riding out to take the air, walking, bowling, or any other exercise whatever, thinking all hours lost that was not spent in his studies, to which he kept so close that he seldom left his chamber unless at term time, when he read in the schools as being Lucasianus Professor, where so few went to hear him, and fewer understood him, that ofttimes he did in a manner, for want of hearers, read to the walls . . . . So intent, so serious upon his studies that he ate very sparingly, nay, ofttimes he has forgot to eat at all, so that, going into his chamber, I have found his mess untouched, of which, when I have reminded him, he would reply—"Have I!" and then making to the table, would eat a bite or two standing, for I cannot say I ever saw him sit at table by himself . . . . He very rarely went to bed till two or three of the clock, sometimes not until five or six . . . .[6]

Newton in youth was predominantly solitary, seldom receiving visitors or calling upon others. In old age he told a relative that he had never "violated Chastity," and it seems probable that he died a virgin. There are hints that he had some obsessional traits. "He was very curious in his garden, which was never out of order, in which he would at some seldom times take a short walk or two, not enduring to see a weed in it."[7]

Newton must have been physically robust as he not only survived the hazards of prematurity but lived until he was nearly 85. Despite this he was notably hypochondriacal, dosing himself with home-made remedies and recommending medicine to others, and he was often preoccupied with death.

Religious beliefs

Newton's religious beliefs were unorthodox. He was an Arian, a secret Unitarian, which is not only peculiar in a fellow of a college named after the Trinity but at that time was regarded as dangerously heretical. He believed that worshipping Christ as God was idolatry, and that Athanasius, whose fourth century rout of Arius in that famous controversy between Homoouisians and Homoiousians that so amused Gibbon, had corruptly distorted the early texts of the Christian Fathers. Despite this Newton remained a member of the Church of England, professed orthodoxy when he needed to, and was a determined adversary of Roman Catholicism. When James II ordered that a Benedictine monk be admitted to the degree of MA without taking an oath of loyalty to the established church Newton was one member of the University who bitterly opposed what he saw as an attempt to infiltrate Cambridge with papists. Indeed, he put himself at risk by appearing as one of the delegates from the university before the high commission, chaired by the notorious Judge Jeffreys who had presided over the so called Bloody Assizes, which had been appointed to inquire as to why the university had not instantly obeyed the King's command.

Newton's religious beliefs were puritanical. Notebooks exist showing that at the time of his entry to Trinity he was obsessed with sin. In 1662 he wrote a confession in which he catalogued no less than 58 sins of which he found himself to have been guilty. Most of

these were concerned with his failures in religious observance or in his love for and obedience to God. Thus he records that as a child he had been guilty of "eating an apple at Thy house"; "making a mousetrap on Thy day"; "twisting a cord on Sunday morning"; and "squirting water on Thy day." He also records trivial instances of stealing food, gluttony, and "having uncleane thoughts words and actions and dreames." He also recorded his aggressive thoughts towards his mother and stepfather. "Threatning my father and mother Smith to burne them and the house over them." There are many depressive ideas about his own lack of worth, dread of punishment, and fear of future disaster. As one biographer notes: "The word love never appears, and expressions of gladness and desire are rare. A liking for roast meat is the only strong sensuous passion. Almost all the statements are negations, admonitions, prohibitions. The climate of life is hostile and punitive. Competitiveness, orderliness, self control, gravity,—these are Puritan values that became part of his being."[8]

At this date, therefore, the picture is that of a predominantly depressive character, self punitive, anxious, and insecure, with poor interpersonal relationships and little capacity for enjoyment. Whiston, his successor in the Lucasian chair, said that Newton was "of the most fearful, cautious, and suspicious temper that I ever knew."[9]

Attitude to others

A lasting distrust of others, which I think it reasonable to derive from his sudden maternal deprivation, led to fear that critics would harm him and that his discoveries would be stolen. Brodetsky, one of his biographers, writes:

> He was always somewhat unwilling to face publicity and criticism, and had on more than one occasion declined to have his name associated with published accounts of some of his work. He did not value public esteem as desirable in itself, and feared that publicity would lead to his being harrassed by personal relationships—whereas he wished to be free of such entanglements.... Apparently Newton hardly ever published a discovery without being urged to by others: even when he had arrived at the solution of the greatest problem that astronomy has ever had to face he said nothing about it to anybody.[10]

One of Newton's most famous and lengthy quarrels originated from his reluctance to publish. This was with the philosopher and mathematician Leibniz. Both men independently invented the calculus, but Newton did not publish his discovery until 1687, although it is clear from his papers that he invented the method in the years 1664-6, when most of his major discoveries were made. Leibniz invented his variety of calculus in 1675-6 and published it in 1684. It was natural that he should claim priority The dispute was vituperative on both sides, but Newton's violence and vengefulness seem to have been out of all proportion. In one set of memoirs Newton is recorded as saying "pleasantly" that "he had broke Leibnitz's heart with his reply to him."[11]

Newton was notably reluctant to acknowledge his indebtedness to others, and this seems to have been the occasion of another quarrel, with Flamsteed, the astronomer royal. For Flamsteed had provided Newton with astronomical observations and felt that his contribution to the Newtonian synthesis had not been sufficiently recognised.

Another running battle was with Robert Hooke, a secretary of the Royal Society and a distinguished scientist. But Hooke not only had the temerity to criticise Newton's theory of light, which led to Newton's threatening to resign from the Royal Society, but also claimed priority in discovering the inverse square law. In one sense this was probably true, but, as Newton claimed, Hooke had been unable to prove the law, while he, Newton, had demonstrated it mathematically.

These are far from being the only disputes in which Newton was involved, but enough has been said to show that along with the depressive traits in his character was a strongly paranoid streak. Newton was no more able to cope with the hostility of others than he was with his own and was apt to see slights when none were intended and to exaggerate any that were. Even his friend, the philosopher Locke, said of him: "a nice man to deal with [meaning touchy and hypersensitive] and a little too apt to raise in himself suspicions where there is no ground."[12]

In line with Newton's isolation and suspiciousness was his lack of trust in the senses, a characteristic familiar to psychiatrists who treat schizoid persons for they are commonly "out of touch" with physical experience. In one passage Newton wrote: "The nature of things is more securely and naturally deduced from their operations one upon another than upon our senses."[13] In this connection it is worth noting that Newton's style of writing, even when he is not dealing with mathematics or physical phenomena, is devoid of metaphor and nearly bare of adjectives. He was suspicious of the poetic and the imaginative, and his arid style reflects this.

Science and spiritualism

In his Freud memorial lecture "The nature of genius,"[14] Ernest Jones points out that one feature of Freud's psychology was a peculiar scepticism, a refusal to acquiesce in the generally accepted conclusions of others. He goes on to say that in a more limited subject, Freud was also distinguished by an unexpected credulity, which at times bordered on superstition. Jones goes on to suppose that this combination of opposites in one person is characteristic of genius and quotes Newton as one of several examples. In his scientific work Newton took nothing on trust and was rigorous in demanding that his hypotheses be supported by mathematical proof. But there was another side to his character. Until he left Cambridge for London in 1696 he was deeply preoccupied with alchemy. This preoccupation was not merely scientific interest in what was partly the precursor of chemistry but a reflection of his belief that the secrets of nature had been revealed to the ancients and that the alchemists possessed esoteric knowledge concealed in hieroglyphs that required decipherment. As Sherwood Taylor writes in his book on alchemy, "Alchemy... was essentially religious. Its philosophy aimed at the unification of all nature in a single scheme, the author of which was avowed to be God."[15] This was also Newton's aim, and he left a vast pile of manuscripts concerned with alchemy, which has always disconcerted scientists who like to imagine him as possessing a rational intellect unclouded by superstition.

Newton was credulous also in that he was euhemeristic, a term derived from the name of Euhemerus of Messina (300 BC), who believed the classical gods to have been actual people deified. Newton believed that myths represented real events in human history, albeit requiring interpretation in many instances. He spent much time and effort in constructing a system of chronology on the supposition that if the position of the sun relative to the fixed stars could be determined past events could be dated with certainty. But the key date on which he based his revision of the traditional system was that of the expedition of the Argonauts led by Jason to recover the golden fleece, which Newton found to have taken place in 936 BC, which cut about four hundred years off the accepted record of Greek history. French historians attacked Newton's chronology with vigour, much to his chagrin.

Newton was passionately anti-pagan as well as anti-Catholic, and it seems that many of his historical studies were designed to prove that the Israelites, rather than the heathens, had introduced humanity into the ancient world. He seems to have believed that originally all mankind worshipped one God and acknowledged one universal law. Both his major works, the *Principia* and the *Opticks*, have religious endings.

I am not asserting that a scientist cannot be both devoutly religious and rigorously objective in experiment, but Newton's religious beliefs seem to have been peculiar, even for his age, and certainly misled him in his historical studies. Lord Keynes suggests that he thought that God had left clues that could be deciphered, and that he regarded the riddle of the universe in theological terms. "He looked on the whole universe and all that is in it *as a riddle*, as a secret which could be read by applying pure thought to certain evidence, certain mystic clues which God had laid about the world

to allow a sort of philosopher's treasure hunt to the esoteric brotherhood."[16]

Keynes gained possession of most of a collection of secret papers that Newton assembled on leaving Cambridge for London in 1696. These papers consisted of nearly a million words on church history, alchemy, prophecy, and other biblical writings, besides disclosing the Unitarianism that he had sought to conceal. These writings led Keynes to remark:

> In the eighteenth century and since, Newton came to be thought of as the first and greatest of the modern age of scientists, a rationalist, one who taught us to think on the lines of cold and untinctured reason. I do not see him in this light. I do not think that anyone who has pored over the contents of that box which he packed up when he finally left Cambridge in 1696 and which, though partially dispersed, have come down to us, can see him like that. Newton was not the first of the age of reason. He was the last of the magicians, the last of the Babylonians and Sumerians, the last great mind which looked out on the visible and intellectual world with the same eyes as those who began to build our intellectual inheritance rather less than 10 000 years ago.[17]

Newton's religious and historical studies were so extensive that J W N Sullivan calculates that he cannot have given to physics and mathematics more than about a third of his time. Sullivan ends his biography by saying that Newton "was a genius of the first order at something he did not consider to be of the first importance."[18]

Deterioration of genius

Newton became mentally ill in 1693, when he was just over 50. "He broke with his friends, crawled into a corner, accused his intimates of plotting against him, and reported conversations that never took place." In September of that year he wrote to the diarist Pepys, abruptly terminating their relationship. It is significant that in this letter Newton admits that his psychotic episode, like so many others, was preceded by anorexia and insomnia. He also retains some insight: "I am extremely troubled at the embroilment I am in, and have neither ate nor slept well this twelve month, nor have my former consistency of mind." It has been suggested that Newton, who performed chemical experiments in his rooms, was suffering from poisoning by mercury; but, although insomnia, loss of memory, and delusions do occur in this condition, there is no mention of the characteristic features of tremor and loss of teeth, and the symptoms subsided too quickly for the diagnosis to be likely.

Newton alleged that a fellow of Magdalene called Millington had importuned him with messages from Pepys and made him promise that he would visit Pepys in London, but this allegation is thought to have been delusional. Newton continues: "I never designed to get anything by your interest, not by King James's favour. . . . I am now sensible that I must withdraw from your acquaintance, and see neither you nor the rest of my friends any more, if I may leave them quietly."

A letter to the philosopher Locke, evidently written when his disturbance was beginning to subside, runs:

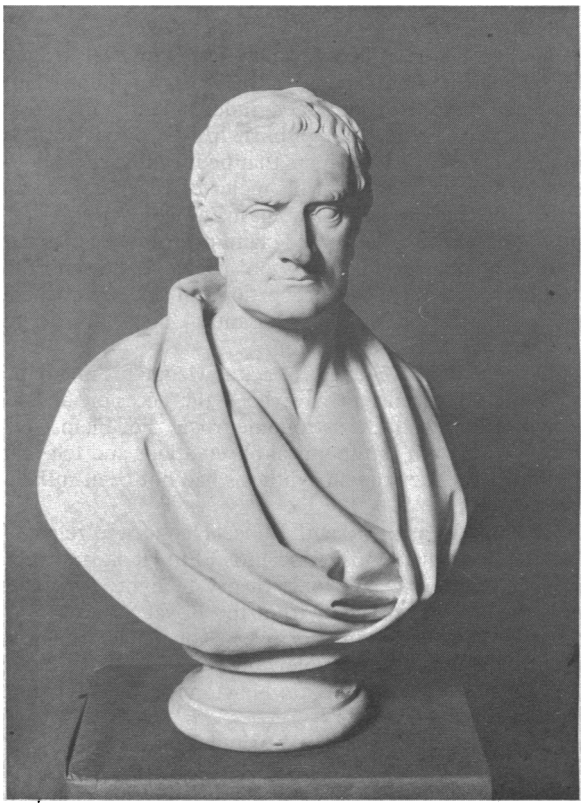
> Being of opinion that you endeavoured to embroil me with women and by other means I was so much affected with it as that when one told me you were sickly & would not live I answered twere better if you were dead. I desire you to forgive me this uncharitableness. For I am now satisfied that what you have done is just & I beg your pardon for my having hard thoughts of you for it & for representing that you struck at the root of morality in a principle you laid down in your book of Ideas & designed to pursue in another book & that I took you for a Hobbist. I beg your pardon also for saying or thinking that there was a designe to sell me an office or embroile me.[19]

Both Pepys and Locke realised that Newton was ill and were solicitous in offering help. The period at which Newton was accusing his friends was succeeded by depression, as may be deduced from the letter from which I have just quoted; and it seems probable that the paranoid ideas that Newton exhibited were in fact secondary to depression, just as in youth his diaries show more of self accusation than of accusation of others. But Newton possessed a mixture of traits that were manifested in exaggerated form during his illness.

Personal and general criticism

The faults of which he accused others were clearly his own. His preoccupation with place seeking, soon to be rewarded, may be traced to his ambition: his fear of being embroiled with women to his almost total suppression of sexuality. His calling Locke a Hobbist, which meant atheist, may have been related to his own doubts about the nature of God. Three years earlier Newton had written a vehemently anti-Trinitarian tract but had withdrawn it from publication. Professor Manuel lays great emphasis on Newton's affection for a much younger man, a Swiss scientist named Fatio de Duillier, and supposes that his breakdown may have been precipitated by his recognition that this affection contained homosexual elements. Newton certainly wrote to the young man in terms more intimate than those he usually employed. "Yours most affectionately to serve you," he ends one letter. In another he offers him money to pay doctors when he is ill. Freud would certainly have agreed with Professor Manuel in supposing that Newton's breakdown was the result of homosexual impulses that he found intolerable breaking the chains of repression, but firm evidence seems to me to be lacking. I find it at least as convincing to suppose that Newton's illness was primarily a mid-life depression in which he had to come to terms with the fact that his great days of inventiveness were over. As Manuel points out, he had published the *Principia—Philosophiae Naturalis Principia Mathematica* to give it its full title—only in 1687, and he may well have felt that this marked the zenith of his creativity. After his illness he did little fresh work, though Dr Whiteside, who is editing Newton's mathematical papers, informs me that he was still capable of original work. His creativeness declined, but his appetite for power found ample fulfilment.

Although Newton's illness was short lived, rumours that he was



Bust of Sir Isaac Newton by H Bailey after Roubiliac. Reproduced by permission of the National Portrait Gallery.

mad spread far and wide, fuelled no doubt by envy and the delight that lesser mortals often experience when great men run into trouble. Newton made a good recovery in most respects, however, and became an able administrator. In 1696 he became warden of the Mint, then master of the Mint, and in 1703 president of the Royal Society. He was also knighted. As master of the Mint one of his duties was to prosecute forgers and coiners. He did this with efficiency and relish and seems personally to have conducted the interrogation of such criminals in the Tower. In my essay on Winston Churchill I drew attention to the fact that those who carry within themselves aggressive impulses that they find difficulty in discharging find relief in acquiring a legitimate enemy. For Newton the coiners served the same function as did Hitler for Churchill.

Newton died in March 1727 in his eighty fifth year. No other scientist, until the appearance of Einstein, has won such universal acclaim. As we have seen, his personality was unusual. I think it legitimate to attribute many of his pathological traits to the circumstances of his early life, his prematurity, his lack of a father, and his abandonment by his mother. I turn now to the much more difficult and controversial question of whether his personality and his discoveries can in any way be related to one another.

Inventive times

Newton's main discoveries were made in 1664-6, between the ages of 21 and 23. It is characteristic of physicists and mathematicians to make their major contributions early in life, which is unlike creative people working in the arts, who may not come to maturity until much later. During those two years Newton formulated his basic laws of mechanics, his optical observations on the nature of light, the calculus, and the law of universal gravitation. This latter discovery is generally supposed to have been made in his mother's garden in Lincolnshire, for Newton twice left Cambridge (from June 1665 to March 1666 and from June 1666 to April 1667) to avoid the great plague, which closed the university. He himself recalled: "All this was in the two plague years of 1665 and 1666 for in those days I was in the prime of my age for invention, and minded Mathematicks and Philosophy more than at any time since."[20]

The Newtonian synthesis was based on the discoveries of Kepler, who had been able to describe the motions of the planets round the sun, combined with those of Galileo, who had described the laws of motion of objects upon the earth. Until Newton these two sets of laws seemed to be quite separate. But when Newton made the leap of imagination that led him to suppose that gravity was a universal that acted at enormous distances, he combined the discoveries of Kepler and Galileo in such a way that the motions of bodies in the heavens and bodies on earth could be seen to obey the same universal laws. The law of gravitation, which states that "every body attracts every other with a force directly proportional to the square of the distance between them," has been described as the greatest generalisation achieved by the human mind. To prove his law Newton had to show that the path of the moon round the earth could be accounted for by the interaction of the gravitational force on it, which he supposed the earth to be exerting, together with the centrifugal force of the moon, the formula for which had already been discovered by Huygens. His mathematical gift enabled him to accomplish this. He then computed the sun's attraction on the planets and showed that their orbits, which Kepler had described but for which he could not account, complied with the same laws. Newton left a diagram that anticipates the possibility of artificial satellites by showing that increasing the velocity of a projectile will eventually result in its circling the earth at the same velocity for ever.

But action at a distance worried Newton just as much as it has worried later scientists. In a letter to Richard Bentley, the master of Trinity, he wrote:

> It is inconceivable that inanimate brute matter should, without the mediation of something else, which is not material, operate upon, and affect other matter without mutual contact: as it must do, if gravitation, in the sense of Epicurus, be essential and inherent in it. And this is one reason, why I desired you would not attribute innate gravity to me. That gravity should be innate, inherent, and essential to matter, so that one body may act upon another at a distance through a vacuum, without the mediation of anything else, by and through which their action and force may be conveyed from one to another, is to me so great an absurdity, that I believe no man who has in philosophical matters a competent faculty of thinking can ever fall into it. Gravity must be caused by an agent acting constantly according to certain laws; but whether this agent be material or immaterial, I have left to the consideration of my readers.[21]

The material agent to which Newton refers was the hypothetical interstellar "ether," in which Newton himself probably no longer believed. The immaterial agent is God, and Sullivan thinks that Newton came to regard gravitational phenomena as due to the direct intervention of the deity. It is, therefore, interesting to note that Newton's religious beliefs may have prevented him from travelling further along the path towards relativity. I do not pretend to understand relativity in its entirety but can comprehend that in considering the motions of bodies it is impossible to define absolute rest or absolute uniform motion. The only physically detectable states of uniform motion are the relative motions of one observer with respect to another. According to Jeremy Bernstein in his book on Einstein: "Newton himself was aware of the difficulty of specifying states of absolute motion." But, "Newton resolved the problem theologically. For him, a devout Christian mystic, it was enough that rest and motion were distinguishable in the consciousness of God. God, in other words, provides the absolute frame of reference in Newtonian mechanics."[22]

Psychological explanations

As we have seen, Newton's adult character presented both depressive and schizoid traits; and these, in part, may justifiably be related to the sudden severance, at an age before it could have been reasonably understood by him, of an unusually close tie with his mother. Being suddenly left by one's only parent can, I believe, make self esteem difficult to achieve. For self esteem seems primarily dependent on the sense of value derived from being loved, and the withdrawal of love is likely to result in a child doubting his own worth. Newton, in youth, wondered whether he would be fit for anything, as he himself recorded. I think that the part of his achievement that can be attributed to ambition (and what great achievement does not owe something to this source?) took origin from his need to obtain self-esteem in ways other than by gaining the affection of his fellows. We cannot assume that even a man as intelligent as Newton necessarily achieved as much as he did without some compulsive force fuelling that intelligence.

Although Newton guarded his work jealously, and might have gained public recognition earlier than he did if he had not been reluctant to publish, it seems certain that his self esteem was almost entirely bound up with his work, and that this is why he was so touchy about questions of priority and anxious always to be in the right in any dispute. Like other people of similar temperament, Newton may have felt that, though he himself might be of little worth, the amount and quality of his work would bring him fame, as indeed it did. Fame often serves as a partially effective substitute for love in those who are uncertain of obtaining love; and work is often substituted for the self as a focus of self esteem in those in whom a tendency toward depressive self denigration is manifest. In later life, when his creative days were past, Newton found an alternative in that he sought and obtained power, as in Wagner's opera *Das Rheingold* the dwarf, Alberich, spurned in his pursuit of love by the Rhinemaidens, foreswears love in exchange for the power conferred by Rhinegold, which he steals from his mockers.

There are other aspects of his achievement that may, not unreasonably, be related to his early experience. To an infant the world must seem arbitrary and unpredictable, as the fulfilment of his needs, indeed, his very existence, depends on the whim of those on whom he is dependent. If his needs are met he develops what Erik Erikson has aptly called a sense of basic trust. If, on the contrary, his needs are not met or he is suddenly deprived by his

mother's death or disappearance he is likely to develop a sense of basic distrust with regard to people and an exaggerated anxiety about the arbitrary and unpredictable nature of the world. The writer Kafka, better than anyone else I know, described in his novels and short stories what it is like to feel oneself helplessly at the mercy of people who are not only powerful but also remote, inaccessible, and entirely arbitrary in their actions.

It seems likely that an exaggerated sense of helplessness in the face of the unpredictable in infancy may lead some gifted people to strive especially hard to master and control as many facets of existence as possible. Could Newton's basic mistrust have been one motive force that spurred him to solve some of the most difficult problems with which science has been confronted? Manuel has no doubt of it, and I am inclined to agree with him. As he puts it: "To force everything in the heavens and on earth into one rigid, tight frame from which the most minuscule detail would not be allowed to escape free and random was an underlying need of this anxiety-ridden man."[23]

An absence of intimacy with other persons often goes hand in hand with being cut off from one's own emotions; out of touch with bodily experience, which, more than thought, seems to be the common basis of our closest relationships with others, as the phrase "out of touch" indicates. In some instances failure to achieve later intimacy seems to follow as a consequence of an interruption of the physical relation of the child with its mother, leading to distrust of the senses. Such distrust may, in gifted people, enhance certain capacities even if it deprives them of the chance of closeness with others.

Abstraction and creative achievement

One human capacity that is enormously important in certain kinds of creative achievement is that of abstraction; the ability to divorce thinking from feeling and to be more concerned with the relation between concepts than with the objects from which the concepts originated. Both Newton and Einstein distrusted the senses. The latter believed that understanding the world depended on concepts of objects becoming to a high degree independent of the sense impressions that originally gave rise to them. Einstein said himself that his supreme aim was to perceive the world by thought alone, leaving out everything subjective.

Most human beings are, to some extent, capable of abstraction in the sense in which I am using the word. Indeed, in my book, *The Dynamics of Creation*, I attribute man's inventiveness, and hence his supremacy, in part to this capacity. But most of us do not find it easy to escape from the subjective for long periods, from the demands of the body or our need for interpersonal relationships. Those men of genius who are responsible for the greatest achievements of abstract thought seem particularly often to have formed no close personal ties and to have been largely indifferent to, or else repelled by, bodily needs and functions. Newton shared his absence of close personal ties with Descartes, Locke, Hobbes, Hume, Pascal, Spinoza, Kant, Leibniz, Schopenhauer, Nietzsche, Kierkegaard, Wittgenstein—in short, with many of the world's greatest thinkers. This is also true of two of the greatest historians: Gibbon and Macaulay. Some of these men of genius were celibate or homosexual, others had transient affairs with women. Descartes fathered a daughter on a servant girl; Schopenhauer, in spite of his notorious misogyny, had a number of short lived involvements with women. Nietzsche fell in love with Lou Andreas Salomé, who later became a psychoanalyst and intimate friend of Freud. He had himself and another admirer of Lou, Paul Ree, photographed with Lou brandishing a whip, apparently driving a cart to which both men were roped. Within a few months the relationship broke up and Nietzsche coined his famous phrase: "You go to women? Don't forget the whip." Whatever passing relationships these men had, none of them married, and most of them lived alone for the greater part of their lives. The point I want to make is amply shown. Although, especially in youth, sexual preoccupations and the need for personal relations may distract a man from his work, emotional isolation, with or without celibacy, goes hand in hand with supreme abstract mental achievement.

There is, of course, a simpler, more obvious relation between solitude and thinking. Lord Keynes, in the essay on Newton from which I have already quoted, wrote: "I believe that the clue to his mind is to be found in his unusual powers of continuous concentrated introspection. . . . His peculiar gift was the power of holding continuously in his mind a purely mental problem until he had seen straight through it. . . . I believe that Newton could hold a problem in his mind for hours and days and weeks until it surrendered to him its secret. Then being a supreme mathematical technician he could dress it up, how you will, for purposes of exposition, but it was his intuition which was pre-eminently extraordinary. . . ."[24]

This kind of prolonged concentration requires solitude. Without going into any elaborate speculations about the sublimation of the sexual drive let me make the simple point that if intense periods of concentration over long periods are required to attain fundamental insights the family man is at a disadvantage. In answer to a question as to how he came to make his discoveries, Newton himself said: "I keep the subject constantly before me, and wait till the first dawnings open slowly by little and little into the full and clear light."[25] If Newton had been subject to the demands of a wife for companionship or interrupted by the patter of tiny feet it would certainly have been less easy for him to concentrate so intensely over long periods of time.

The field of pathography has been so muddied by Freudian overstatement that it is small wonder that Popper and other critics entirely dismiss psychopathological interpretations of historical figures. In this paper I have tried to limit myself to discussing psychological matters that though they may provoke disagreement, are accessible to common sense. In a subject in which so much is controversial it behoves both the psychiatrist and the historian to be modest in their claims to psychological understanding.

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