Reflections

Remembering Newton

This is the story of Isaac Newton, the scientist and the man. Life and work of Newton reveals how thought processes are determined by the cultural-philosophical bias of the times.

Most of us first become familiar with Newton when during our early years we are told the tale of the falling apple: sitting under presumably an apple tree, the young Newton, looked at a falling apple and pondered why apple falls ‘down’ only. Thus came the revelation and Newton discovered gravity. We are also told another anecdote in the same spirit about Archimedes who was asked to find out the purity of gold in emperor Heiron’s crown. Suddenly one day, observing the water spilling out of bath-tub as he floated, Archimedes jumped out and ran naked on the streets of Syracuse shouting ‘Eureka, eureka!’ Such stories often mask the complex nature of scientific discoveries and introduce a super-natural element into it. History could then be conveniently reduced into Alexander Pope’s lines:

Nature and Nature’s laws lay hid in night
God said, let Newton be! And all was light

Nothing of the sort happened. The lightning flash that suddenly cleared the vision is a metaphorical description of the terminal point in a continuous process of scientific cognition that went on for several years and resulted in a comprehensive and integrated world view consonant with the then known experimental facts. Newton described the most important phase of this scientific enterprise in the following words: “In the beginning of the year 1665, I found the method for approximating series and the rule for reducing any dignity [power] of any binomial to such a series [i.e., the binomial theorem]. The same year in May I found the method of tangents of Gregory and Slusius, and in November the direct method of Fluxions [differential calculus], and next year in January had the Theory of Colours, and May following I had entrance into the inverse method of Fluxion [integral calculus], and in the same year I began to think of gravity extending to the orb of the Moon…and having thereby compared the force requisite to keep Moon in her orb with the force of gravity at the surface of the earth, and found them to answer pretty nearly…”
His ‘Theory of Colours’, that white light consists of seven dominant colours was his first major discovery reported to the Royal Society in 1872. It brought a new insight to the understanding of the nature of colours. However, the theory did not win approval of many including his renowned scientific colleagues Christians Huygens and Robert Hooke. This controversy made him bitter and believed to be the major reason why he did not talk about his epoch making work on mechanics the next two decades. There seems to be another reason equally decisive. It had to do with the contradiction between his materialistic scientific world view and his religious convictions. Being a theist and also realizing the social-political climate of the then England, Newton probably did not make haste in declaring his scientific findings as the exact and faithful description of what happens in nature. The inquisition of Galileo was not a thing of distant past for him. Even within theological domain, he believed in free use of reason in religion, in the doctrine of One God and passionately opposed ascribing divinity to Church. The fact that two of his protégés, Fatio de Duillier and William Whiston were punished for holding proscribed religious views speak for itself why during his life time Newton never approved publication of any of his non-scientific writings on theology, etc.

Fall of Apple

Newton was born on the Christmas day, 1642, in a farmer’s family. A premature child, so frail and tiny, that no one expected him to survive. His father died three months before he was born, his mother remarried leaving her three year old child to the care of his old grand mother. He had his primary education in the common village school. When he was 15, his mother returned, her second husband having died, and decided to let Newton help her managing the farm at Woolsthorpe, his home. Newton detested farming and luckily for him, upon persuasion of his maternal uncle, his mother allowed him to prepare for Cambridge University. Newton entered Trinity College at the age of 18, in the year 1660. There he met Lucsian Professor Isaac Barrow, an able mathematician and theologian who did not fail to recognize the genius of his pupil. When Barrow resigned from his prestigious post, the young Newton, at the age of 26, acquired that distinction.

After his graduation in 1664, Newton returned to his home at Woolsthorpe. He spent nearly 18 months there as the University was closed due to the Great (Bubonic) Plague of 1664-65. It was during this forced sojourn, Newton knit the fabric of his mechanics. In the countryside there, Newton must have witnessed many apples falling from trees. How he discovered gravity out of it was narrated by the great mathematician Gauss as following: “A stupid, officious man asked Newton how he discovered the law of gravitation. Seeing that he had to deal with a child in intellect, and wanting to get rid of the bore, Newton said that an apple fell and hit him on the nose. The man went away fully satisfied and completely enlightened.” From this moment
onwards Newton steadily worked out his theory of gravitation, checked the results with astronomical data, perfected it, and finally compiled them in his famous *Principia*. “Newton was the first to succeed in finding a clearly formulated basis from which he could deduce a wide field of phenomena by means of mathematical thinking, logically, quantitatively and in harmony with experience”, wrote Einstein who portrayed Newton as proof of the power of reason. Newton constructed this basis by first clearly articulating the notions of space, time, matter and causality. It was no easy task. This implied stepping into the realm of philosophy and contending with the then dominantly prevailing Aristotelian viewpoint. It was a dangerous proposition because by the thirteenth century, Christian scholars, especially St. Thomas Aquinas, had reconciled Aristotle with Christian doctrines. Aristotelian God had become the God of Christianity and Aristotelian conception of universe, part of Christian drama of salvation. An attack on Aristotle therefore meant an attack on Church itself (see Box 1).

Newton was born the year Galileo died. Galileo already had disagreed with Aristotle so far as the motion of falling apple (or stone) was concerned. Aristotle maintained that a stone falling freely picked up velocity (impetus) because it had an immanent desire to reach its goal (i.e., earth, being the natural place of rest for it) and nearer the goal more the desire. That means that its velocity at any point on way depended not on the distance it had already traveled from the starting point but the distance remaining towards its goal. Galileo successfully demonstrated the contrary. He succeeded in deriving correct quantitative relations between velocity, distance and time of travel for uniformly accelerated motions and verified them experimentally for motion under gravity. What was more ominous was his observation that all objects, irrespective of their mass, travel equal distance in equal time. This cut at the root of the entire hierarchical structure based on theology. Aristotle had written, “The downward movement of a mass of gold or lead, or of any other body endowed with weight, is quicker in proportion to its size…” However, Galileo never addressed himself to the cause of motion. With a sense of modesty, he said “other minds more acute than mine will explore its remote corners.” It was Newton who introduced the notion of force as the cause of motion and systematically reproduced the results of Galileo in a complete and mathematically precise language of calculus. Thus the Aristotelian myth of potency and entelechy, that is, the “programme” of change inherent in body and its ability to execute it was replaced by a universal law of gravitational force.

The Rational Scientist

Newton developed a systematic picture of universe that, as it was, stood purely on materialistic foundations. Accordingly, there is matter and independent of matter, objective space and time. Regarding the structure of matter and universe, he took the position with ancient atomists, Democritus and Leucippus. Democritus maintained that reality consists only of atoms and the
Aristotle, the Greek philosopher and founder of natural science, is regarded as the greatest thinker of antiquity. He was born at Stagira in Thrace in the year 384BC and was educated at Athens under the tutelage of Plato. After Plato’s death, he moved around for some time and eventually returned to Athens where he founded his own academy known as Lyceum.

Aristotle contemplated almost every subject under the sun, from natural science to logic, politics, ethics, and metaphysics. His views on physics and cosmology are a set of statements, without the benefit of observations or computations. Rejecting Pythagoras, he regarded earth as the center of the universe and opined that light bodies like fire move upward while heavy bodies move downward to the center of the universe if there is no interference. He maintained that bodies fall with speeds proportional to their weights and thus rejected the idea of void only because in void all things would fall at the same rate.

Aristotle was more interested in the question “why (than how) bodies move?” He thus propounded that everything in nature has two ingredients—matter and form (or idea). Form lies within matter and is the cause of motion. Not only form, as force, moves matter but matter strives to become or realize the form. In this context, he introduced two fundamental concepts—that of potentiality and entelechy. Matter being a passive principle is conceived to possess potentiality or possibility of ‘becoming’. Entelechy is the active principle which drives the possibility into reality. For example, clay is potentially brick, brick is potentially house; house and brick are forms inherent in clay, the matter. Entelechy is the above forms realized. Entelechy may exist in the mind of artist or inherently in natural objects, as for example, when embryo grows into child and child grows into adult.

At the end, all objects strive to realize the pure ‘form’, without matter, who is the cause of all motion. He is the prime cause, the ultimate source of all motion. He is the eternal ‘unmoved mover’. Aristotelian God is perfect, passionless and changeless. He moves the world ‘as a beloved object moves the lover’.

Christianity from early days was influenced by Greek thoughts. Thomas Aquinas (thirteenth century), being greatly inspired by Aristotle, tried to reconcile Christian theology and Aristotelian philosophy. Everything that moves must have a mover, argued Aquinas. Ultimate source of movement in universe must therefore be the unmoved mover of Aristotle. God for Aquinas was pure form, first and final cause who created everything out of nothing. Aquinas set the pattern which is followed by Catholics even now.
Newton, “Absolute, true, and mathematical time of itself, and from its own nature flows equably without relation to anything external…” These notions were not only against Aristotelian viewpoint but also met a powerful opposition from the contemporary Cartesian school of Descartes on the continent. Both Aristotle and Descartes regarded space as material (or Cartesian) extension, an attribute of things. Similarly, while Aristotle regarded time as an attribute of motion, Descartes upheld a subjective view of time, as something pertaining to material objects and would not exist if there were no such objects. It turned out to be a long drawn battle. Nearly two centuries later, Ernest Mach was still arguing that, “No one is competent to predicate things about absolute space and absolute motion; they are pure things of thought, pure mental constructs, that cannot be produced in experience.”

Not surprisingly the abstract idea of absolute and objective space and time led Bishop Berkeley, the idealist philosopher, to launch a vigorous attack on Newton. However, Berkeley raised a relevant point that “absolute motion, exclusive of all external relation, is incomprehensible.” He argued that there cannot be “any motion other than relative”, i.e., other than with respect to some reference body. A motion in relation to absolute space is an unperceivable reality. Newton did realize this difficulty, both for rectilinear and circular motions. It is interesting to find that he resolved the problem theologically. Jeremy Bernstein, a leading American physicist, in his biography of Einstein, comments that, “… it was enough [for Newton] that rest and motion were distinguishable, in consciousness of God. God, in other words, provides the absolute frame of reference in Newtonian mechanics.” Newton never pronounced that explicitly. However, his ecclesiastical friend and spokesman, Samuel Clarke, said, “Space and duration are not hors de Dieu, but are caused by, and are immediate and necessary consequences of His existence.”

The idea of void space was much more vulnerable. Although Newton rejected the identification of space with matter, it in no way necessitated the existence of an actual vacuum. Newton argued against the space being full of matter on simple scientific basis that if it were so, nothing would descend in it due to specific density. However, one could always consider an extremely rarefied ‘plena’ or ‘ether’ filling the space. “And if the quantity of matter in a given space can, by any rarefaction, be diminished, what should hinder a diminution to infinity?” commented Newton, thus throwing the ball in theologians court who maintained that to say that God did not create matter everywhere was to limit the power of God’s creation.

In this absolute void space, as time flows, things stay at rest or move uniformly in straight lines, unless an external force acts and change their motion, propounded Newton expounding the law of inertia. Given the force he could predict the change precisely. Looking at the findings of Galileo on the motion of bodies on earth, and of Kepler on the motion of planets, he deciphered the universal law of gravitational attraction. It was the genius of Newton to see unity in
diversity, the correlation between the domains of man and God. The force of gravity, following a well-defined law, controlled the motion of heavens as well as of the falling feather from the tower of Pisa.

“We are to admit no more causes of natural things than such as are both true and sufficient to explain their appearances.” Newton firmly believed that nothing happened without a reason and that nature was simple enough not to admit a complex of causes. “Therefore to the same natural effects we must, as far as possible, assign the same causes.” This notion of mechanistic causality and consequently rigid determination became the cornerstone of Newtonian world view. Laying down ‘Rules of Reasoning in Philosophy’ in *Principia*, Newton said, “For since the qualities of bodies are only known to us by experiments, we are to hold for universal all such as universally agree with experiments, and such as are not liable to diminution can never be quite taken away. We are certainly not to relinquish the evidence of experiments for the sake of dreams and vain fictions of our own devising; nor are we to recede from the analogy of Nature, which is wont to be simple and always consonant to itself.” And, therefore, since it appeared from both terrestrial and astronomical observations that different bodies gravitate towards each other ‘in proportion to the [product of] quantity of matter’, he was ready “to allow that all bodies whatsoever are endowed with a principle of mutual gravitation.”

Whether it was movement of tides produced by the gravitational pull of the moon and the sun, the bulging of earth at the equator due to the rotation of the earth, the seeming motion of the earth’s axis, or the perturbation in planetary orbits, Newtonian mechanics could exactly describe each phenomena. Newton, the Lion, was known to his friends by his paw. The entire world was dazzled by the success of his mechanics. He almost eclipsed such great scientists of his times as Hooke and Huygens. Huygens’ fundamental contribution towards a wave theory of light was ignored under the influence of Newton who favoured atomistic view of light. Newtonian paradigm, firmly established by eighteenth century, was succinctly summarized by the great French mathematician Laplace: “We ought then to regard the present state of the universe as the effect of its antecedent state and the cause of the state that is to follow. An intelligence knowing, at any given instant of time, all forces acting in nature, as well as the momentary positions of all things of which the universe consists, would be able to comprehend the motions of the largest bodies of the world and those of the smallest atoms in one single formula, provided it were sufficiently powerful to subject all data to analysis; to it, nothing would be uncertain, both future and past would be present before its eyes.” Of course, this picture of a causal, deterministic, and universal world view emerged much later in the eighteenth century.

Newtonian void and gravitational attraction between distant planets created an insuperable
problem. “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 fall into it”, wrote Newton in a letter to Richard Bentley, the future Bishop of Worcester and Master of Trinity College. Despite all the experimental evidences to the contrary, Newtonian rationality could not reconcile to the concept of action-at-a-distance. In the same letter to Bentley, he further said: “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.” But that was a bad escape. Hence, later in his famous ‘Queries' in *Opticks*, he wrote, “it is the Business of experimental Philosophy to find them [Agents] out.”

**The Metaphysicist**

Newton was primarily a scientist. To that extent he had no choice but to conceive reality within materialist framework and in conformity with experimental facts. But beyond concrete horizon of scientific rationality, the vision seems certainly shrouded by idealistic dogmas. Being a believer, a devout Christian, he inherited an undercurrent of theological doctrines. While his scientific enterprise took a great leap forward and enlarged the horizon, the inherent faith struck back time and again. One can witness this conflict in the following remark of Alexander Koyre’ that “Good, empirical, and experimental natural philosophy does not exclude from the fabric of the world and the furniture of heaven, immaterial or transmaterial forces. It only renounces the discussion of their nature, and dealing with them simply as causes of the observable effects, treats them as mathematical causes.....”

“And to us it is enough that gravity does really exist, and act according to the laws which we have explained, and abundantly serves to account for the motions of the celestial bodies, and of our sea.” This was the approach of a scientific rationalist who would speak so far as he conceived reality and no further. As to the cause of gravity and how gravitational force transmits through void, to the extent that they can’t be deduced (or verified) experimentally, he would not make any hypothesis. *Hypothesis non fingo*. “I feign no hypothesis”, said Newton, because “hypothesis, whether metaphysical or physical, whether of occult qualities or mechanical, have no place in experimental philosophy.” Not making hypothesis did not mean that one would confine only to sense-perception excluding the category of cognition based on pure reason. The notion of gravity as a universal force was such a cognitive act. But to entertain fictitious or fanciful notion of gravity as an ‘occult’ phenomenon, as Leibnitz would argue, was simple hypothetical nonsense, and Newton was not going to do that.
Nevertheless the cultural bias was too strong for him not to feign hypothesis. It was the natural scientist in him, living in the age of Baconian rationalism, which saved him from ascribing occult qualities to gravity. But his religious dogmatism was an obstacle that deterred him from looking at the causes of natural phenomena in nature itself. “This beautiful system of the sun, planets, and comets, could only proceed from the counsel and dominion of an intelligent and powerful Being.” Newton would not accept that “the world exists by necessity and by the same necessity follows the laws proposed”, but would rather allow, “that the supreme God exists necessarily; and by the same necessity he exists always and everywhere.” He had nothing to do with those who said, “all philosophy ought to be founded in atheism.” Unlike the Unmoved Mover of Aristotle (see Box 1.) as the First Cause or the God of Descartes who gave the first push and then let the world machine run forever, Newton visualized a God who is “omnipresent not virtually only, but also substantially; for virtue cannot subsist without substance.”

“Sir Isaac Newton was firmly persuaded by the Existence of a God; by which he understood not only an infinite, omnipotent, and creating being, but moreover a Master who has made a relation between himself and his creatures”, wrote Voltaire. Newton felt the need of God not only as Primary cause without whose counsel how could the world initially proceed on its course but also as vigilant guardian who sustained it and saved it from time to time from natural calamities. In a private memo to David Gregory in 1694, he suspected, “…a continual miracle is needed to prevent the sun and fixed stars from rushing together through gravity; that the great eccentricity in comets in directions both different from and contrary to the planets indicates a divine hand…”

It is important for us to note that Newton openly published his epistemological and metaphysical views in natural sciences towards the later part of his life. General Scholism was appended to Principia in its second edition while Queries were inserted in Opticks in its Latin edition (1706). It is possible that the works of Berkeley, Leibnitz, or George Cheney induced Newton to express overtly on these matters. But the theological undercurrent, as we have seen above, was always present. Slowly but surely he was getting more and more embroiled with the problems of theology and allied matters. In a very curious letter to Hooke in 1679, he wrote, “…I had for some years past been endeavoring to bend myself from philosophy [Natural philosophy] to other studies in so much that I have long grudged the time spent in that study unless it be perhaps at idle hours sometimes for a diversion….” The same melody was recorded a few years earlier, in 1674, in another letter to Oldenburg, “…I have long since determined to concern myself no further about the promotion of philosophy.”

…with his prism and silent face,
…a mind forever,
Voyaging through strange seas of thought, alone
wrote, William Wordsworth about Newton. He took up this voyage into such strange seas as of economics, alchemy, theology and chronology. Voluminous manuscripts, which he left on these subjects, have not been thoroughly studied. In 1936, during Sotheby sale of Portsmouth collection of Newton’s non-scientific writings, a lot amounting close to 200,000 words was described as related directly to chronology apart from theological writings running over a million words. In addition to Portsmouth collection, there is about a thousand folios, chiefly on chronology and theology now preserved at New College, Oxford. The sheer bulk of these writings and the passion with which he carried out his arguments clearly show that he spent vast amount of time on it and pursued the study with all sincerity. Though history and chronology became the chief preoccupation for him only towards the final period of his life, “general geography amended” by him, published in 1672, set the scene right in the beginning of his voyage. His experiments in alchemy conducted in the Cambridge laboratory to lay bare the ultimate unity of chemical elements must have nurtured the germs of mysticism. He undertook an important mission in theology, that is, to tackle the problem of Trinity (see Box 2) and is found discussing Prophetic Books with Henry More in 1680; his major correspondence with Locke during 1690’s revolved around the meaning of sacred texts and early Church history.

**The Master of Mint**

By 1696, Newton had almost abandoned active pursuit in natural science. Strangely, he accepted the position of Warden of the Mint in 1696. He took up his job of reforming the coinage seriously and was promoted, in 1699, to the dignity of Master. His job in Mint meant a greater involvement in the affairs of the State. He now spent most of the spare time in history, thus revising, perfecting, and reformulating ideas that had been generated years before. In his chronological studies he attempted a radical revision of ancient chronology on the basis of astronomical proof, interpreted mythology and Egyptian hieroglyphs. Here again, his attempt at astronomical dating of events thorough computations of the equinoxial precession shows an act of sheer genius.

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**Box 2.**

According to Encyclopedia Britannica, “Holy Trinity [is] the Christian doctrine [of] the unity of the Father, Son, and Holy Spirit as one God in three persons…. It is a doctrine formulated in the early church to interpret the way God revealed himself, first to Israel, then in Jesus as Saviour, and finally as Holy Spirit, preserver of the church.” As Christianity developed during the first centuries, the pure, holy and perfect God of bible took other intermediate forms, the Logos to account for the creation of the universe, and the Holy Spirit to be the power of divine origin permeating all universe. Later theologians argued that Jesus Christ was the Logos in the form of man. The discussion on concept of Trinity prolonged for centuries; ultimately Christian doctrine settled down with the God of Thomas Aquinas.
It is evident that his researches in theology and history ran parallel with his studies of natural science all through his life, from his student days at Cambridge till death. He was motivated to study the sacred texts in order to demonstrate the existence of God and His relation with His creatures. Religious truth was to be established by the accuracy of prophetic pronouncements and narration of true events would provide the real evidence of Christianity. Newton had discovered the orderliness in this “most beautiful Frame of the World” as proof of the Biblical God; he was now rummaging for the evidence in the pages of history. Baffled, Lord Keynes, who for the first time bought and collated the Portsmouth papers at Sotheby sales, called Newton a magician: “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 who looked out on the visible and intellectual world with the same eyes as those who began to build our intellectual inheritance rather less than ten thousand years ago.”

The interesting aspect is that Newton pursued his researches in interpreting mythology and sacred texts by employing the methodology of a natural scientist. “The new scientific spirit pervaded Newton’s most recondite antiquarian investigations. He was diligent, he read prodigiously, and he employed a comparative method of analyzing disparate texts. Quotations from authority were almost always accurate, and he insisted upon multiple proofs for a new proposition”, says Frank Manuel, a scholar on theological-historical writings of Newton. Being interested in chronology, he equated historical evolution to the time development of a physical system, described social movements in terms of statistical averages, increase or decrease of geographical dimensions in time sequences. Commenting on his studies on the origin of monarchies, Manuel says: “In his law of the growth of great kingdoms Newton was performing for political history a function similar, mutatis mutandis, to his discovery of the laws of motion (it was universal and it was simple).”

These historical writings reveal another facet of his personality, the psychological. It is well known that Newton quarreled with Leibnitz over priority in the discovery of calculus and lost patience with Robert Hooke when Hooke laid claim to inverse square law. Moreover, Bernstein says that “Newton, a fanatical puritanical man, who seems to have died [20 March, 1727] a virgin and probably had suppressed homosexual tendencies, could be vicious and petty, given to violent rages.” His puritanical ego was evident in his role as Master of mint where he managed agents and informers to find men involved in counterfeiting royal currency and prosecuted them ruthlessly. His vengeance knew no bounds when after taking charge of Royal Society he not only purged all the memories of Robert Hooke but also confiscated all astronomical data of Flamsteed, the Royal Astronomer. According to Manuel, his historical writings show that “everything human is alien to him.” His history has no conscious subject; aesthetic and sensuous aspect seems to be completely missing in his analysis. “When
confronted by the more complex manifestations of mankind – polytheist, idolatry, luxury and lies, the poetical, the cabalistic, the emotive, the fabulous, the philosophical conceit, the cruel and the lustful – he either pushed them away with repugnance or dropped them into the eighteenth century catch-alls known as errors and deception. At best he drew upon stock explanations from stereotyped psychology: men acted out of variety and a desire for power.” His psychological make-up could be a result of his lonely and unhappy childhood, deprived of parental love and affection. But it is plausible that doctrine of mechanistic psychology of his contemporary Thomas Hobbes that men act always from a single motive, that is, there own self interest, too had its impact on him.

Posthumously, when his theological views slowly started coming out, most were taken by surprise. His ecclesiastical friends were immediately on the toes eager to get them published in order to reveal to the world what devout Christian he was. Scientific community was, however, shocked and preferred to put them into oblivion in the interest of scientific cause. It is an interesting piece of history that Laplace and Biot, in a desperate attempt to protect the reputation of Newton, spread the rumour that these writings were not the creation of real Newton but the aberrations of a sick man who had suffered a complete breakdown in the end of 1693. (The breakdown referred to was general trouble of acute insomnia and amnesia with which he suffered for a brief period following 1693.)

To suggest that Newton “envisaged the whole of his scientific work from a religious viewpoint” is as far from truth as to claim that he was a conscious materialist. Formulating mechanics with scientific rationalism and simultaneously dabbling in alchemy, myths and hieroglyphs exhibits the real contradiction of him and his age. I. Prigogine, in his book *Order Out of Chaos*, quotes Joseph Needham as saying that western thought has always oscillated between the world as an automaton and a theology in which God governs the world. Prigogine then remarks that in fact the two visions are interconnected: “An automaton needs an external God.” Newtonian world for Newton, was not an automaton; it was created by God, designed and then perpetually sustained. It turned into an automaton only after the work of Laplace. When Napoleon asked Laplace how he wrote *Celestial Mechanics* without once mentioning the author of the universe, Laplace is said to have replied that he had no need of that hypothesis.

*Newton completed the revolution that began with Copernicus.* A dialogue with Aristotle had started; Copernicus, realizing the relativity of motion that “every apparent change in place occurs on account of the movement either of the thing seen or of the spectator”, put the Sun at the “center of the world” leaving the Earth to wander among other ‘Stars’. However it remained a finite world enclosed by celestial sphere. Kepler then dug out the laws of planetary motion and found that the planets move in elliptical orbits around the Sun. Galileo, overlooking
Kepler’s work, conceptualized inertia in natural circular motion of the planets and empirically found out how things move on the earth. Descartes discovered rectilinear inertial motion, despised the piece-meal approach of Galileo, and laid emphasis on a complete, logically deduced world-view. Nevertheless the basic question of the Aristotelians “Why does a body move?” was obviated by all of them (except Descartes). Newton synthesized the entire information, integrated pure and practical reason, and converged mathematics and experiments into one whole. He transformed the above question into “What is force?” and passed it on to posterity as the interrogative component of cognition. The dialogue was ended by formulating a dynamic picture of the world, an infinite world as system of motions in contradistinction to geocentric, finite, and static world of Aristotle. That precisely is the heritage of Isaac Newton.

The theological solution to the problems that who put the planets in their respective positions (i.e., how the universe evolved?) and how gravity acts at a distance (i.e., what is force?) implies that Newtonian system had no causal explanation for the entire nature. His hesitation and wavering reveals that those questions were addressed to future and their rational explanation required fundamentally new conception of reality. (It took two hundred years before Einstein gave a rational explanation of gravity.) Newton was a scientist in the sense of a natural philosopher and as such viewed scientific propositions within the context of the whole system of knowledge. Science was not divorced from philosophy for him. Scientific community during Renaissance indulged constantly in deep philosophical debates and fought life and death battle with Church. The positive aspect of all this was that science could never be an activity in abstraction, alienated from human life and its values. The spirit of science consequently inspired and animated the entire Age of Reason and Enlightenment.

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