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Isaac Newton *On the Origin of Species* (1713)

Abstract

Isaac Newton's "Philosophiae naturalis principia mathematica" of 1687 teaches the origination of "mutations" *of motion* by active "forces of nature". In the second edition (1713) of the "Principia" Newton's editor Roger Cotes (in an "editor's preface") and Newton himself (in a "Scholium generale") embedded the theory in the much broader context of *creation of the new*, ultimately referring to the Creator. Newton's natural "forces" or "causes" relate to this "First cause", and they are always and only *active immaterial principles to activate passive matter*. These invisible generating principles can be known by their observable material effects according to "analogy", that is *the Euclidean geometric proportion theory* which Newton prefers as a mathematical device in the "Principia". Newton's *dualist theory of origination of motion* is at variance with the evolutionists belief in the activity and omnipotency *of matter* as a corner-stone of their hypothetical-deductive *theory of the origin of species*. In short: If Newton was right, Darwin was wrong.

Introduction

Isaac Newton (1642-1727), about 150 years before Charles Darwin, published a particular theory on the origin of species. This fact should be known not only to Newton scholars, but also to theologians and biologists, at least since Christoph Cardinal Schönborn's 2006 Castel Gandolfo talk "*Fides, Ratio, Scientia*: The Debate about Evolution" **(1)**. The Cardinal began by recalling the 1713 publication of Newton's *Scholium generale* to the second edition of his famous *Philosophiae naturalis principia mathematica* of 1687. Quoting extensively from Newton, he showed that, according to the opus quoted, "out of the blind play of chance and necessity the diversity of natural things cannot arise" and the Cardinal added correctly: "The theory of evolution that is current today says precisely the opposite" **(2)**. Actually, Newton's reasoning results in understanding the really existing God as the "First cause", the Creator and Governor of everything, including *all changes of states of everything* as effects of secondary causes depending on the God above all, whose existence *always and everywhere* Newton calls an *inescapable fact* **(3).**

Even though he did not literally anticipate Darwin's 1859 title "On the Origin of Species" in his 1713 *Scholium generale*, Isaac Newton wrote on the very same subject as Darwin - *the origin of variety and variation in nature.* But while Darwin tried to explain the phenomena by empirically identifiable mechanisms, Newton stated that "all that diversity of natural things

which we find suited to different times and places could arise from nothing but the ideas and will of a Being necessarily existing" **(4).** Newton argued on the basis of a throughout *scientific* (i.e. *mathematical*) general theory of "mutatio", i.e. of the change of phenomena from a state A to a different state B. The germ of this theory of course concerns the "origin", that is the *how* and *why* of the forthcoming of something really "new" at its very beginning, of something (some new phenomenon, some new state of being of something) that had never existed before. Cardinal Schönborn in his 2006 talk did not enter into this problem, but generally referred to my relevant book "Die Rehabilitierung des Galileo Galilei oder Wie die Wahrheit zu messen ist" **(5).** Thoughtlessly he insinuated that Newton might perhaps have deduced his theistic statements from a hypothetically presupposed "belief in the Creator (that) makes him see things in this light". This idea, however, contradicts Newton's scientific method "hypotheses *non* fingo" (for this cf. Roger Cotes's and Newton's methodological statements in the following paragraph 3). Newton did not introduce "God" as a *scientific hypothesis* from which to deduce some insight into the order of the world. Quite the contrary, his empirical method leads from a first understanding of the "phaenomena" and their true immaterial causes through a chain of such causes *ultimately* to truth, i.e. to God as the "first cause" **(6)**. In the following I will show some of the considerations that were basic for Newton's *theistic* view of the "origin" – not only of species, but of everything: a view that encouraged Newton's amanuensis Samuel Clarke already in 1704 to praise the new natural philosophy from the pulpit of St. Paul's in London as the only philosophy that harmonises with the truth of Christianity.

1. Newton's paradigm of "origin": The origination of a new state of a body's motion.

It was a common belief in Newton's time that the theory of motion provided the "key of nature" (Colin Maclaurin) **(7)**. In some way, motion, its generation, and its change from one state to another, seemed to lie at the bottom of all natural phenomena, so that its understanding, and especially the understanding of the natural generating causes thereof, should yield a most basic and true causal explanation of the phenomena themselves. Accordingly in his preface to the "Principia" of 1687 Newton argued that it should be the main task of natural philosophy to deduce the generating "forces" from the phenomena of motion and then to explain other phenomena by these forces. The "Principia" reflects this view already through its composition in three books, the first two dedicated to "the motion of bodies", and the third to "the system of the world", which system Newton explained on the basis of the first two books, i.e. by means of the principles that form the backbone of his "theory of motion", as he developed it in these two books.

1.1. Which are these principles? In short they are: 1) Motion of material bodies is a change of place in space and time that basically proceeds *harmonically* (i.e. according to the *geometric proportionality of space and time*) in a uniform, straightlined manner. 2) By a careful investigation into the conditions of its very beginning ("ipso motus initio") **(8)**, this real spatio-temporal motion, though not directly observable, can be mathematically determined, and can be distinguished from rest as well as from only apparent motion, according to certain reasonable principles, or "laws of motion". 3) The main contents of these laws consists in understanding *by analogy* (i.e. by means of Euclid's *geometric proportion* theory) the invisbile generating active "causes" of motion, the so-called *forces of nature*. 4) Causal generation of motion is always a generation of uniform straightlined motion, not continually, but *step by step*, i.e. as "change" of an existing state of motion or rest into another such state *in geometric proportion to its generating cause*, that is to the invisible "force" impressed on the body, no matter if this non-material force "is impressed all at once or successively by degrees" **(9)**. (5) "Accelerated" or "decelerated" motion, i.e. a motion the velocity of which increases or decreases in the course of time, is accordingly also *not generated continuously*, but rather it changes *step by step*, in proportion to its generating active cause, i.e. the immaterial or spiritual "force" impressed on the moving body.

1.2. It is evident that these principles are not those of "*classical* or *Newtonian mechanics*" of the textbooks all around the world. As a matter of fact, the non-geometric classical mechanics of the schools cannot correctly be ascribed to Newton. It is well known, at least to historians of science, that Newton's theory, like Galileo's based on the geometric theory of proportions, on the "analogy of nature" **(10)**, and on a *dualism* (i.e. a spirit-matter interaction) of non material, unobservable generating active "forces of nature", and generated observable ("material") motion, underwent a radical change during the 18th century. This change is sometimes called a "positivistic interpretation" (Paolo Casini) **(11)**. Actually it removed the philosophical feature of this geometric-synthetic theory and made it an arithmetical and analytical technical tool. This transformation, however, meant a most fundamental change of paradigms: from Newton's *synthesis* to Leibnizian *analysis*, from Newton's *geometry* to Descartes' and Leibniz's *arithmetic* and *algebra*, from Newton's *analogy of nature* to Leibnizian *equivalence* of cause and effect, from a neo-platonic Christian *dualism* of "spirit" (force) and "matter" (motion of bodies) to materialistic-atheistic *monism*. This change began in 1637 with Descartes' work on the reduction of geometry to algebra. Somewhat later, the German philosopher G.W.

Leibniz, in order to advance Descartes' mathematical work, explicitly reduced geometric proportions to arithmetic-algebraic equations that no longer represented an *equivalence of relations* between *different things*, but rather *an equivalence of things themselves*, even of things like "cause" and "effect" that had been considered different entities so far. The result of this operation was based not on Newton's principles, but on his philosophical antipode's Leibniz "first axiom of mechanics" – the *identification* of cause and effect ("causa aequat effectum"), which made causes indistinguishable from their allegedly "equal" effects. Thus began the decline of Newton's research program: To detect the transcendent forces of nature through investigation of the phenomena of motion, and then, by means of these forces, to causally explain other phenomena as effects thereof **(12)**. As a result of the general acceptance of Leibniz's and Kant's reductionist program, however, Charles Darwin and others mistook material *effects* for originating "causes". Today's evolutionists cannot but imagine "natural causes" as *material*, observable phenomena, so that e.g. "mutation" (i.e. the effective appearing of something new), and "selection" (the effective elimination of the "unfit") are understood as *material causes* or "mechanisms" of evolution. Any research that would not *a priori deny* the existence of immaterial or *transcendent* causes (such as e.g. the will of living beings, not to speak of the will of God) is now spurned as a *non-scientific*, irrational venture into "supernatural" regions. Consequently, today's natural science appears not only in a materialistic-atheistic garb, but is *based* on the philosophy of materialism (often glossed over as "naturalism"), and even intrinsically *identical with it*. From Newton's point of view evolutionists, so long as they persevere in the restricted realm of material effects and dogmatically refuse to accept *even the possibility* of non-material entities, will *never* successfully identify a true *originating cause* of anything, because of the absolute immateriality and transcendence of any causes.

1.3. The above-mentioned principles of Newton's theory of motion and natural philosophy show what one learns by concentrating not on secondary literature, but on the works of Isaac Newton himself, mainly on his "Philosophiae naturalis principia mathematica" of 1687, 2nd edition 1713. I learned those principles when in the 1980ies translating Newton's *opus magnum* from his Latin into German. My aim was to make available for the first time a reliable German edition of the "Principia" which among German scholars (mathematicians, physicists, philosophers) was as well known as the Holy Bible – that is, only by name, not in its contents.

What I consider a most important result is the fact that Newton teaches "generation", or should we say "creation" of motion, *not as a continuous process* that, even though initially

perhaps “created” by some cause, from then on should emerge, so to speak, “by itself”, that is, *continually in time*, without any further intervention of a generating principle. Rather he insists on a *stepwise* creation which, for every single step, requires a new activity to create it, i.e. a new generating “force”. This “discrete” paradigm of generation of motion can clearly be understood in Newton’s explanation of the “free fall” of bodies: “*Corpus cadente, gravitas uniformis, singulis temporis particulis aequalibus aequaliter agendo, imprimit vires aequales in corpus illud, et velocitates aequales generat. Et tempore toto vim totam imprimit, et velocitatem totam generat tempori proportionalem.*” English, according to I. Bernard Cohen and Anne Whitman: “*When a body falls, uniform gravity, by acting equally in individual equal particles of time, impresses equal forces upon that body and generates equal velocities, and in the total time it impresses a total force and generates a total velocity proportional to the time*” **(13).** Evidently, the process of “free fall” according to Newton is a *discrete* or *quantised* process, the result of which, at any time, must be understood as a *sum of discretely generated finite parts of velocity, every discrete step newly generated in every single* “*equal particle of time*” – which, by the way, shows the *quantisation of time* **(14).**

1.4. Newton’s message then is: There exists no continuously “accelerating force” in nature to produce “accelerated motion”. *There is no continuous emergence of motion in nature* **(15)**. And generally spoken (since “generation of motion” means only an example of the generation of everything, i.e. of “generation itself”, or of “creation”): *Nothing in nature emerges continuously* (“*by itself*”). *Every* individual new “state” of something, which state *differs by novelty* from a former state of that something, must individually be generated, or created, as an *effect* of an individual *cause*, or *generating* “*force*”. This cause is not an *equivalent* of its effect, rather causes and effects are *basically different entities*: the effect being an observable phenomenon, the cause being an unobservable, transcendent principle which, however, *always obeys a rational geometric proportion* to its generated effect. Consequently this cause represents a *measurable* entity of its own, namely a truly *creative* force that is able to *generate* in space and time as its effect something new, something that never had existed before. Of course this concept of generation of the “new” is one of a *creatio continua*, and also a concept of *creatio ex nihilo*. The transition from a state A of “something” to a different state B means that there must exist a difference, that is, something real must exist in the state B that *did not exist* in the previous state A. So the process of generation of a new state B (new with respect to the former state A) in time describes in fact the origin of “something” out of “nothing” – but only,

of course, if the generating transcendent and immaterial principle "force", as it is nothing *material*, were considered to be "nothing" *at all*.

2. From Newton's paradigm of origin *of motion* to the origin *of species*.

Isaac Newton introduced with his "Philosophiae naturalis principia mathematica" of 1687 a theory which was not restricted to *motion* only, but according to the title of his book he aimed very generally at a new "philosophy of nature". This philosophy he meant as a counterpoint to René Descartes' "Principia philosophiae" of 1644, which Newton understood as a false doctrine that misled to materialism and atheism. If one contrasts this doctrine with Newton's philosophy, the main error of Descartes concerns his absolute separation of *res cogitans* and *res extensa*, an idea that denies any *interaction* of spirit, soul, free will, mind etc. with the material world of extended matter only; consequently it excludes non-material entities from this world, and thus surrenders the world to sheer materialism. If Newton was right with his suspicions concerning materialism and atheism, we can clearly see today.

The general philosophical aim of Newton's teaching can be seen not only in book III of the "Principia", where he – on the basis of his theory of motions presented in the first two books – explains "the system of the world". Rather it is deeply rooted already in the very first principles of the theory of motion. The first law of motion, for instance, as it states that every material body remains in its state of rest or uniform straightlined motion until its respective state is changed by the action of an external "force", teaches very generally that *every* change in the state of the material world requires a cause *which is not iself matter*, or *a property of matter* itself, but something "external" to material bodies. *Matter itself is absolutely passive* **(16)**. It changes its states *only* according to the actions of active external causes which *cannot themselves* be material, since matter is throughout passive. So Newton's very first law of motion already implies the message that the generating active causes of every "change of state" in the material world must themselves necessarily be non-material or *immaterial entities* in their own right, i.e. active *spiritual* "forces of nature". The "generation" of change in general, then, is described *as a spirit-matter interaction*, which was in Newton's time a well-known principle in neo-Platonic circles such as the "Cambridge Platonists" (e.g. Ralph Cudworth, Henry More, and Isaac Barrow, Newton's academic teacher and predecessor to the Lucasian chair of mathematics at Cambridge University).

It is quite obvious that this principle must imply the origin of "species". This comes to light e.g. in Newton's *Scholium* after *Lemma* X in the "Principia" Book I Section 1, which *Scholium* refers to the application of geometric proportion theory in order to determine the respective quantities of "*diversorum generum*", that is of *different species, or of different "kinds"*. According to I. Bernard Cohen and Anne Whitman: "If indeterminate quantities of different kinds are compared with one another …" **(17)**.

This reference starts the question how *exactly* the generation of a new species according to a spirit-matter interaction should work, or how we could mathematically describe it, if at all. We find Newton's answer in his second law of motion, the central message of which reads as follows: "Mutationem motus proportionalem esse vi motrici impressae" **(18)**. That is, generally spoken: *Every observable change in natural material things happens in proportion to its generating immaterial cause.* Be the "change", i.e. the "effect" of the said interaction an infinitely small "mutation" in the biological sense, or be it an "offspring" of a whole new "species", that effect being symbolised by Δp, and be its generating cause, or force, or energy, symbolised by ΔE, then we obtain the *natural law of creation* according to $\Delta E : \Delta p = C$, with C symbolizing the required *constant of proportionality*.

Evidently here begins a *dualist* natural philosophy of active spirit and passive matter to form *together* (by interaction) the variety and the variations of the empirical world. Says Newton, in the *Scholium generale* of 1713: "No variation in things arises from blind metaphysical necessity, which must be the same always and everywhere. All the diversity of created things, each in its place and time, could only have arisen from the ideas and the will of a necessarily existing being" **(19)**.

All that has been said above is not only a matter of historical reminiscense, but a result of research work with far-reaching consequences (not only) for the present theory of evolution. Contrary to the general belief of evolutionists in *material* "mechanisms" such as mutation, selection etc., Newton shows that generally "the new", and especially *new species always and only* come into being as the effects of generating *immaterial causes.* Cardinal Schönborn has been right when he stated in 2006: Newton's philosophy of nature says about 'evolution' precisely the opposite of what scientists believe today. And Newton has also been right! The most striking proof of this finding, however, yields the absolutely startling correspondence of Newton's *authentic* principles of the theory of motion with reliable basic principles of modern

physics, e.g. with Einstein's equation $E = mc^2$, and with Heisenberg's indeterminacy relations, as I have demonstrated and published elsewhere **(20)**.

3. Newton, the truth, and the discourse about God

Ten years ago, after having studied Pope John Paul's II enzyclic "Fides et Ratio" of 1998, I wrote a longer German comment, which was published in the leading German Catholic journal "Münchener theologische Zeitschrift" **(21).** This paper "Newton, die Wahrheit und die Rede von Gott" I sent in the year 2000 to Cardinal Joseph Ratzinger, now Pope Benedict XVI. He answered with great kindness, expressing his interest in my "enlightening reflexions" concerning the relation of Galileo's and Newton's philosophy to the above-mentioned encyclic, stressing his hope that my "remarkable considerations" would become a subject of "due philosophical discussion" leading to a "reformation of metaphysics" **(22)**. It must be said, however, that theologians and philosophers in Germany have only shown the same indifference for Ratzinger's express hope as for most his learned writings, and especially for his criticism of Kantian reason in the famous "prophetic" (Georg Gänswein) "Regensburg lecture" of September 2006 **(23)**.

What I have shown in the above-mentioned article is the little-known aspect of Galileo's and Newton's work as an *absolutely new beginning* not only of science, but *of philosophy in its very sense*: a *theocentric* venture to prove the existence of God by analogy, i.e. by transduction from the knowledge of his reasonable creation – a scientific venture *within the frame of reference of absolute truth.* Already as a student, Isaac Newton had adopted the slogan "Amicus Plato amicus Aristoteles, magis amica veritas" to show that he wanted to study not in order to join this or that philosophic school, but as a *cooperator veritatis*, a servant of truth, i.e. of God **(24)**.

3.1. To the 1713 second edition of the "Principia" Newton added the *Scholium generale* in order to reveal again his general aim for a really true, i.e. realistic description, not only of a new "theory of motion" as presented in books I and II, or a description of "the system of the world" (book III), based on books I and II, but also of the necessary and reasonable connection of that system and its principles to the "first cause", the creator of all things. To this end, Roger Cotes (1682-1716), at that time Plumian professor of astronomy at Cambridge, whom Newton had chosen as editor, contributed a most interesting and elucidating "editor's preface" to the edition.

Cotes begins strongly emphasizing Newton's anti-scholastic (anti-nominalistic) philosophy, and his empirical method, by means of a methodological criticism of "those who take the foundation of their speculations from hypotheses". Cotes continues: "Even if they then proceed most rigorously according to mechanical laws, (they) are merely putting together a romance, elegant perhaps and charming, but nevertheless a romance". After that, he explains Newton's "twofold method, analytic and synthetic", i.e. from certain selected phenomena to "deduce by analysis the forces of nature and the simpler laws of those forces", from which then to "give the constitution of the rest of the phenomena by synthesis". As an example, Cotes uses the theory of gravity which he explains in full detail, and defends it against the conflicting "doctrines of Descartes", adding in favour of Newton that "it is the province of true philosophy to derive the natures of things from causes that truly exist, and to seek those laws by which the supreme artificer willed to establish this most beautiful order of the world, not those laws by which he could have, had it so pleased him". Near the end of his preface, Cotes strikes a last blow at the Cartesian theory, arguing that its adherents "finally will say that (the constitution of the universe) has not arisen from the will of God but from some necessity of nature. And so at last they must sink to the lowest depths of degradation, where they have the fantasy that all things are governed by fate and not by providence, that matter has existed always and everywhere of its own necessity and is infinite and eternal…. Surely, this world – so beautifully diversified in its forms and motions – could not have arisen except from the perfectly free will of God, who provides and governs all things. From this source, then, have all the laws that are called laws of nature come, in which many traces of the highest wisdom and counsel certainly appear, but no traces of necessity…. All sound and true philosophy is based on phenomena, which may lead us – however unwilling and reluctant – to principles in which the best counsel and highest dominion of an all-wise and all-powerful being are most clearly discerned; these principles will not be rejected because certain men may perhaps not like them. These men … (may be) willing to confess at last that philosophy should be based on atheism. Philosophy must not be overthrown for their sake, since the order of things refuses to be changed".

After high praise of Newton for having "unlocked the gates", having "opened our way to the most beautiful mysteries of nature", and having "revealed a most elegant structure of the system of the world for our further scrutinity", Cotes concludes:

"And hence it is now possible to have a closer view of the majesty of nature, to enjoy the sweetest contemplation, and to worship and venerate more zealously the maker and lord of all; and this is by far the greatest fruit of philosophy. He must be blind who does not at once see, from the best and wisest structures of things, the infinite wisdom and goodness of their almighty creator; and he must be mad who refuses to acknowledge them. Therefore Newton's excellent treatise will stand as a mighty fortress against the attacks of atheists; nowhere else will you find more effective ammunition against that impious crowd" **(25)**.

3.2. Newton's *Scholium generale* which he added to the third book of the "Principia" in 1713 is certainly the best source of his own ideas.

He begins with a short abstract of his theory of heavenly bodies in motion "according to the laws set forth above. They will indeed persevere in their orbits by the law of gravity, but they certainly could not originally have acquired the regular position of the orbits by these laws….. This most elegant system of the sun, planets, and comets could not have arisen without the design and dominion of an intelligent and powerful being. And if the fixed stars are the centers of similar systems, they will all be constructed according to a similar design and subject to the dominion of *One*… And so that the systems of the fixed stars will not fall upon one another as a result of their gravity, he has placed them at immense distances from one another. He rules all things, not as the world soul but as the lord of all. And because of his dominion he is called Lord God *Pantokrator*. For "god" is a relative word and has reference to servants, and godhood is the lordship of God, not over his own body as is supposed by those for whom God is the world soul, but over servants. The supreme God is an eternal, infinite, and absolutely perfect being; but a being, however perfect, without dominion is not the Lord God….And from true lordship it follows that the true God is living, intelligent, and powerful; from the other perfections, that he is supreme, or supremely perfect. He is eternal and infinite, omnipotent and omniscient, that is, he endures from eternity to eternity, and he is present from infinity to infinity; he rules all things, and he knows all things that happen or can happen. He is not eternity and infinity, but eternal and infinite; he is not duration and space, but he endures and is present. He endures always and is present everywhere, and by existing always and everywhere he constitutes duration and space. Since each and every particle of space is *always*, and each and every indivisible moment of duration is *everywhere*, certainly the maker and lord of all things will not be *never* or *nowhere*.

Every sentient soul, at different times and in different organs of senses and motions, is the same indivisible person. There are parts that are successive in duration and coexistent in space, but neither of these exist in the person of man or in his thinking principle, and much less in the thinking substance of God. Every man, insofar as he is a thing that has senses, is one and the same man throughout his lifetime in each and every organ of his senses. God is one and the same God always and everywhere. He is omnipresent not only *virtually* but also *substantially*; for active powers cannot subsist without substance. In him all things are contained and move, but he does not act on them nor they on him. God experiences nothing from the motions of bodies; the bodies feel no resistance from God's omnipresence.

It is agreed that the supreme God necessarily exists, and by the same necessity he is *always* and *everywhere.* It follows that all of him is like himself: he is all eye, all ear, all brain, all arm, all force of sensing, of understanding, and of acting, but in a way not at all human, in a way not at all corporeal, in a way utterly unknown to us. As a blind man has no idea of colors, so we have no idea of the ways in which the most wise God senses and understands all things. He totally lacks any body and corporeal shape, and so he cannot be seen or heard or touched, nor ought he to be worshiped in the form of something corporeal. We have no ideas of his attributes, but we certainly do not know what is the substance of any thing. We see only the shapes and colors of bodies, we hear only their sounds, we touch only their external surfaces, we smell only their odors, and we taste their flavors. But there is no direct sense and there are no indirect reflected actions by which we know innermost substances; much less do we have an idea of the substance of God. We know him only by his properties and attributes and by the wisest and best construction of things and their final causes, and we admire him because of his perfections; but we venerate and worship him because of his dominion. For we worship him as servants, and a god without dominion, providence, and final causes is nothing other than fate and nature. No variation in things arises from blind metaphysical necessity, which must be the same always and everywhere. All the diversity of created things, each in its place and time, could only have arisen from the ideas and the will of a necessarily existing being. But God is said allegorically to see, hear, speak, laugh, love, hate, desire, give, receive, rejoice, be angry, fight, build, form, construct. For all discourse about God is derived through a certain similitude from things human, which while not perfect is nevertheless a similitude of some kind. This concludes the discussion of God, and to treat of God from phenomena is certainly a part of natural philosophy…." **(26)**.

There exists another revealing passage on natural philosophy to be found in Newton's "Opticks", at the end of "Query 31", after some methodological considerations. Here Newton shows his philosophy, if correctly understood as a *theocentric research of truth*, to provide the generating source of a progress of human ethics, or "moral philosophy". The passage reads as follows:

"… And if Natural Philosophy in all its parts, by pursuing this method, shall at length be perfected, the bounds of Moral Philosophy will also be enlarged. For so far as we can know by Natural philosophy what is the First cause, what power he has over us, and what benefits we receive from him, so far our duty towards him, as well as that towards one another, will appear to us by the light of Nature" **(27)**.

Footnotes

(1) See Creation and Evolution, A Conference with Pope Benedict XVI. in Castel Gandolfo, Ignatius Press San Francisco 2008, p. 84-106; German edition: Schöpfung und Evolution, Eine Tagung mit Papst Benedikt XVI. in Castel Gandolfo, Augsburg 2007, S. 79-98.

(2) Cf. Schönborn's footnote 1. However, in his – German! - Castel Gandolfo talk the Cardinal did not quote from the English Motte-Cajori edition of Newton's *Principia*, as he asserts here, but rather he quoted from *my* selected German edition (Isaac Newton, Mathematische Grundlagen der Naturphilosophie, Ed Dellian ed., Hamburg 1988 – the first and only reliable and qualified German "Principia" to appear 300 years after Newton's first (1687) edition. For this cf. the German edition of Schönborn's talk, as cited in footnote 1) above. Meanwhile, a second edition of my selected *Principia* translation has been published by Academia Verlag Sankt Augustin, 2007.

(3) "Deum summum necessario existere in confesso est". I. Bernard Cohen and Anne Whitman have translated this phrase as follows: "It is agreed that the supreme God necessarily exists". See Isaac Newton, the *Principia*, Mathematical Principles of Natural Philosophy, A New Translation by I. Bernard Cohen and Anne Whitman, Preceded by *A Guide to Newton's* Principia, by I. Bernard Cohen, Berkeley-Los Angeles-London, 1999, p. 942.

(4) Isaac Newton, Principia, 2nd ed. 1713, Book III, *Scholium generale.* I quote this English version from Cardinal Schönborn.

(5) See Creation and Evolution as quoted in fn. 1 above, p. 89 fn. 5. Meanwhile my book has been published in an extended version: Ed Dellian, "Die Rehabilitierung des Galileo Galilei oder Kritik der Kantischen Vernunft" (The 'Rehabilitation of Galileo Galilei or a Criticism of Kantian Reason'), Sankt Augustin 2007.

(6) In the *Scholium generale* Newton writes: "Et haec de Deo, de quo utique ex Phaenomenis disserere ad Philosophiam Naturalem pertinet." That is: "To treat of God from phenomena is certainly a part of 'natural' philosophy" (Cohen-Whitman p. 943).

(7) See e.g. Colin Maclaurin, An Account of Sir Isaac Newton's Philosophical Discoveries, London 1748, p. 55.

(8) See Cohen-Whitman p. 437/8, where Newton's Lemma X concerning the generation of motion reads: "The spaces which a body describes when urged by any finite force,… are at the very beginning of the motion in the squared ratio of the times."

(9) Newton's words in the explanation to his second law of motion are: "Si vis aliqua motum quemvis generet, dupla duplum, tripla triplum generabit, sive simul et semel, sive gradatim et successive impressa fuerit." According to Cohen-Whitman: "If some force generates any motion, twice the force will generate twice the motion, and three times the force will generate three times the motion, whether the force is impressed all at once or successively by degrees" (p. 416).

(10) Newton opens the "Third Book" of the Principia with three "regulae philosophandi" (Cohen-Whitman: "Rules for the study of natural philosophy"). There he writes: "Certe contra experimentorum tenorem somnia temere confingenda non sunt, nec a Naturae analogia recedendum est, cum ea simplex esse soleat et sibi semper consona." According to Cohen-Whitman: "Certainly idle fancies ought not to be fabricated recklessly against the evidence of experiments, nor should we depart from the analogy of nature, since nature is always simple and ever consonant with itself" (p. 795).

(11) Paolo Casini, Newton's Principia and the philosophers of the Enlightenment, in: Newon's Principia and its Legacy, D.G. King-Hele and A.R. Hall eds., London (The Royal Society) 1988, p. 48.

(12) In Newton's 1686 preface to the Principia one reads – in Cohen-Whitman's English: "The basic problem [*lit. Omnis enim difficultas*, i.e. *the whole difficulty*] of philosophy seems to be to discover the forces of nature from the phenomena of motions and then to demonstrate the other phenomena from these forces" (p. 382).

(13) Cohen-Whitman p. 424.

(14) Already in Galileo's "Discorsi" of 1638 the increasing velocity of free fall is described as a *successive step-by-step augmentation* of generated *discrete* units of velocity to the already established sum of such units. Contrary to this view, classical mechanics, following not Galileo and Newton but Descartes and Leibniz, teaches a *continuous* augmentation of velocity. The *authentic* Galileian-Newtonian theory then appears as a *quantum theory of motion*, with far-reaching consequences not only for the history of science, but also for the understanding of "modern physics". For this see Ed Dellian, "Die Rehabilitierung des Galileo Galilei oder Kritik der Kantischen Vernunft", as quoted in footnote 5 above, and the introduction to my *Principia*-edition of 2007, as quoted in footnote 2 above.

(15) Of course it contradicts classical mechanics absolutely to state that there should not exist a continuously accelerating force. Is not such a force the generally accepted cause of gravitational motion? Nevertheless, if one reads Newton carefully, one sees that the *continuous* (and consequently *infinite*) force of gravity is *not* the *immediate cause* of motion. Rather Newton describes it as kind of a *source* of *finite forces*, or *quantities*, or *quanta* of forces, the "vires impressae", which produce *proportional finite quantities of motion* stepwise. Cf. *Principia*, Newton's explanation to Def. 4 (Cohen-Whitman p. 405). Referring to circular motion around

a centre, Newton demonstrates this fact even to the eye, in *Principia*, Book I Section 2 Proposition 1 Theorem 1 (see Cohen-Whitman p. 444).

(16) That matter was passive, and could only be forced to change its state by external immaterial causes or "forces", was common knowledge of neo-platonic Renaissance scholars (Galileo, Torricelli, Boyle etc.). Newton is very clear about this in his "Opticks", Query 31.

(17) Cohen-Whitman p. 438.

(18) According to Cohen-Whitman: "A change in motion is proportional to the motive force impressed …" (p. 416).

(19) Cohen-Whitman p. 942.

(20) Cf. e.g. my published papers as follows: 1) Die Newtonische Konstante, Philos. Nat. vol. 22 no. 3 (1985) p. 400; 2) Experimental philosophy reappraised, Spec.Sci.Techn. vol. 9 no. 2 (1986) p. 135; 3) Inertia, the Innate Force of Matter, a Legacy from Newton to Modern Physics, in: P.B. Scheurer and G. Debrock (eds.), Newton's Scientific and Philosophical Legacy, Arch. Internat. Hist. Idées no. 23 (1988), Dordrecht (Kluwer), p. 227; 4) On Cause and Effect in Quantum Physics, Spec. Sci. Techn. vol. 12 no. 1 (1989) p. 45; 5) Newton, die Trägheitskraft und die absolute Bewegung, Philos. Nat. vol. 26 no. 2 (1989) p. 34; 6) Does Quantum Mechanics Imply the Concept of Impetus? Physics Essays vol. 3 no. 4 (1990) p. 365; 7) Neues über die Erkenntnistheorie Isaac Newtons, Zeitschr. f. philos. Forschung 1992 no. 1 p. 89; 8) Newton, die Wahrheit und die Rede von Gott, Zur Enzyklika „Fides et Ratio" Papst Johannes Paul II., Münchener theolog. Zeitschr. vol. 51 (2000) no. 2 p. 171; 9) Newton on Mass and Force, Physics Essays vol. 16 (2003) no. 2. – Some more articles can be found on my website www.neutonus-reformatus.de .

21) See footnote (20), no. 8).

22) Joseph Cardinal Ratzinger, private letter to the author, Oct. 25, 2000.

23) Cf. Christoph Dohmen (ed.), Die 'Regensburger Vorlesung' Papst Benedikts XVI. im Dialog der Wissenschaften, Regensburg 2007. On p. 112 Gereon Piller states that the Pope as an intellectual, insofar as he derives his zeitgeist criticism from the vanishing worship of God, is fighting *all over Europe utterly alone* ("europaweit allein auf weiter Flur").

24) For the slogan "Amicus Plato …" see Richard S. Westfall, Never at Rest, A Biography of Isaac Newton, Cambridge 1980, p. 89.

25) All quotations of Cotes from I. Bernard Cohen's and Anne Whitman's Principia edition, pp. 385-398.

26) I. Bernard Cohen and Anne Whitman, pp. 939-943.

27) Isaac Newton, Opera quae exstant omnia, Samuel Horsley ed., London 1779-1785, vol. 4 p. 264.

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