

Newtonian Causality – The Natural Law of Cause and Effect

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By Ed Dellian, Berlin.

Abstract:

Newtonian causality, the law of cause and effect, is brought to light as a part of the metaphysics of Newton's theory of motion by scrutinizing Newton's definitions and laws of motion with respect to the true meaning of "force" as "cause". The law of cause and effect is identified in the metaphysical framework of absolute space and absolute time, which framework provides the system of reference and measurement for the causal generation of changes of true motion, or momentum. Moreover Newton's natural law of cause and effect is demonstrated mathematically to be also the most basic principle of modern physics. Thus another metaphysical dimension of true Newtonianism and of modern physics as well is revealed: namely their timeless true correspondence with natural experience, and their intrinsic "re-ligio" as a *conditio sine qua non*. This condition means the connection of empirical material entities like "momentum" to their transcendent generating causes (forces). As can be shown, it is established both in Newton's theory of motion and in modern physics through a quaternate geometric proportion that demonstrates in a spacetime frame of reference and measurement the relation of generated material effects to their proportional generating non-material causes. Geometric proportion theory consequently proves a true key to nature of overwhelming explanatory power – a key that was already known in antiquity under the name of "tetraktys".

I

Newton's natural philosophy is based on a theory of absolute motion of material bodies in non-resisting void space (i.e. in an absolute vacuum). He presents it in his famous Latin "Philosophiae naturalis principia mathematica" of 1687, the so-called "Principia" (1). Newton opens his book with eight "Definitiones" and three "Axiomata sive Leges Motus". The first definition ("Quantitas materiae est mensura ejusdem orta ex illius densitate et magnitudine conjunctim") (2) refers to the quantity of the subject of motion, i.e. the material body, which to call "body", or "mass", Newton announces in his explanation to the definition by the words "Hanc autem quantitatem sub nomine corporis, vel massae, in sequentibus passim intelligo". (3). The second definition ("Quantitas motus est mensura ejusdem orta ex velocitate et quantitate materiae conjunctim") (4) refers to the quantity of motion itself which is given through the product of the body's mass and its velocity. In the following I shall symbolize "mass" (as in ordinary physics) by the letter "m", and velocity by the letter "v" as well. So I obtain for Newton's "quantity of motion" the definition $p = mv$, the letter "p" to designate what physics today defines through the product of mass, m, and velocity, v, as well, calling it "momentum".

The subject of Newton's third definition is what he calls "materiae vis insita", or "vis inertiae". This term should correctly be rendered into "the force implanted in matter", since Newton conceives it not as a property of matter, but as an independent natural entity of its own that is "planted" in matter like a tree is planted in the ground (5). Newton defines the "materiae vis insita" as that thing which makes a body always persevere in its proper state of rest or uniform rectilinear motion. So this "vis", or "force", is the cause of a material body's perseverance in its state. Accordingly persevering uniform rectilinear motion then must be understood as the "effect" of that force.

The fourth definition deserves special attention: "Vis impressa est actio in corpus exercita, ad mutandum ejus statum vel quiescendi vel movendi uniformiter in directum." (6). As the body perseveres in its state of rest or uniform rectilinear motion caused (i.e. maintained) by the "vis insita", so the body changes its proper state only through an outside action on it, which action Newton again calls by the general name of "force", specifying it as "vis impressa", the force that is "impressed" on a body from outside, whatever its origin may be (says Newton in the explanation to this definition: "Est autem vis impressa diversarum originum, ut ex ictu, ex pressione, ex vi centripeta." (7)). Since the impressed force makes a body change its state of rest or uniform rectilinear motion, it represents the cause of that change. Having symbolized uniform rectilinear "motion" by the product $mv = p$, every "change" of this motion then could be symbolized by Δp to mean the quantity of difference (Δ) between a former and a latter state of uniform rectilinear motion. In the following, however, I simplify the case by using the general symbolic notation $p = mv$ as "effect", since p measures correctly the difference Δp between a state of rest, $p = 0$, and a state of uniform rectilinear motion, p , i.e. the "change of motion" from zero to p .

Newton as an atomist (in the old sense) held that all natural phenomena (observables on principle) could be motions, or changes of motions, of the small particles (the "atoms" of the Ancients) that should constitute the mass of all macroscopic material bodies. Says he in the "Auctoris praefatio ad lectorem" to the first edition of his "Principia", dated Cambridge, May 8, 1686: "Omnes enim Philosophiae difficultas in eo versari videtur, ut a phaenomenis motuum investigemus vires Naturae, deinde ab his viribus demonstramus phaenomena reliqua." And five sentences later: "Nam multa me movent, ut nonnihil suspicer ea omnia ex viribus quibusdam pendere posse, quibus corporum particulae, per causas nondum cognitae, vel in se mutuo impelluntur et secundam figuras regulares cohaerent, vel ab invicem fugantur et rece-

dunt: quibus viribus ignotis, Philosophi hactenus Naturam frustra tentarunt.” (8). The causes of that (changes of) motions are the so far unknown “forces” the discovery of which was Newton’s aim in the “Principia”. Newton’s law of cause and effect, so far as the “effect” p is understood as “change” of motion, and with the letter F to symbolize the “impressed force”, then must show a relation between F and p , and it should be a *mathematical* relation anyhow, according to the title of Newton’s book.

Let us now turn to the “Axiomata sive leges motus”, Newton’s three laws of motion. The first two of them, the author of which (according to Newton) was not Newton himself but Galileo (9), will suffice for the following investigation of Newton’s true mathematical law of cause and effect.

The first law “Corpus omne perseverare in statu suo quiescendi vel movendi uniformiter in directum, nisi quatenus illud a viribus impressis cogitur statum suum mutare” (10) repeats what we have learned from the definitions: Material bodies are passive. They cannot change their state of rest or uniform rectilinear motion by themselves. Only active “impressed forces” coming from outside (and from different origins) can urge them to do so.

The second law finally introduces the *mathematical relation* between “impressed force”, or “cause”, and “change of motion” as the effect of that cause: “Mutationem motus proportionalem esse vi motrici impressae, et fieri secundum lineam rectam qua vis illa imprimatur.” (11) The effected “change of motion” p is proportional to the force F which has produced the said effect as its cause.

I omit the second clause of Newton’s law (and consequently the vector notation in the following equations) for the sake of concentrating on the heart of the law: Newton’s law states a *geometric proportionality* of cause and effect to read in symbols

$$F \propto p. \quad (1)$$

Now it is generally known that mathematical terms which are proportional, when related to each other always produce a “constant of proportionality”. I symbolize this constant by c , and so I obtain, as an equivalent of the law $F \propto p$, the equation

$$F : p = c \quad (2)$$

to symbolize the general “law of cause and effect” which – according to Newton – should indeed explain all phenomena of “change” that we observe in nature, understanding them as “changes of motion of (the small particles of) bodies”, and explaining them causally as the effects of generating “forces”.

What does Newton know of these causes, the “forces”? They are certain “potencies” (so says the third definition of the “vis insita”), or active “actions” (so says the fourth definition of the “vis impressa”). But they are not potencies, actions, qualities, or properties, or capacities of matter, of the body, or of its “mass”. If the active “impressed force” were a quality or an action of matter, then matter would be active itself. In contradiction to the first law it would then be able to change the state of other matter, and also of itself, as a rolling billiard-ball seemingly may change the state of another such ball in a collision that would change also its own state. So the “force” to change the state of a material body must be something different from matter, i.e. an independent natural entity of its own sort, observable not in itself, but only through its material effects.

It is a well-known property of geometric proportions to show lawful relations between different entities. Newton’s explanation of his method in the “Scholium” to follow Lemma X of Section 1 (“De methodo rationum primarum et ultimarum, cujus ope sequentia demonstrantur”) (12) in the Principia’s First Book (“De motu corporum Liber Primus”) shows him using this very property. Here he says: “Si quantitates indeterminatae diversorum generum conferantur inter se ...” (13), adding a detailed explanation of direct and inverse proportions.

“Quantitates diversorum generum”, that is: quantities of a different sort, can form geometric proportions, and so impressed force as a non-observable active natural entity of its own, can form a geometric proportion with the ontologically different observable material entity “change of motion” or “momentum p”. And this geometric proportion enables us to determine by measurement of this quantity p alone the quantity of the unobservable “force” F that produces a certain quantity of an observable “effect”, namely the measured (change of) motion p.

Here we meet with a special power of the “synthetic” geometric proportion: It allows to exactly determine and measure the unknown on the basis of the known, the unobservable by the observable, and the non-material cause “force”, based on knowledge of its material effect.

II

Modern physics is full of geometric proportions, even though this fact is not realized in theoretical physics. Here is the proof:

1. Modern physics in a way began with the Faraday-Maxwell theory of electromagnetism in the middle of the 19th century. In 1884 John Henry Poynting derived from the Maxwell equations a formula that somewhat later was used, and is still used today, as an explanation of radiation pressure. It is written as a proportionality of momentum p to an entity E (“energy”):

$$E : p = c . \quad (3)$$

2. In the year 1900, Max Planck introduced his radiation law as a proportionality of radiation frequency f to energy E , whereby he obtained the constant of proportionality h (Planck’s constant) according to $E : f = h$. Since the momentum p of radiation however is not given by f but by h/λ (λ stands for “wavelength”), and since $f \times \lambda = c$, we can transform Planck’s equation into a proportionality of E and p according to $E : (c/\lambda) = h$; $E/c = h/\lambda$; $E/c = p$; and so finally we obtain again

$$E : p = c . \quad (4)$$

3. In 1905, Albert Einstein published his theory of special relativity to culminate in the equation $E = mc^2$. This equation, however, implies a proportionality of the momentum $p = mc$ of light, to energy E , so that it can be also written

$$E : p = c . \quad (5)$$

4. In 1926, Werner Heisenberg found the so-called indeterminacy relations which Niels Bohr was the first to introduce to the public in 1927 at the Solvay Congress in Como in the form

$$\Delta E \times \Delta t = \Delta p \times \Delta s (= h) . \quad (6a)$$

This equation of products can be transformed into an equivalent equation of ratios according to the pattern “ $A \times B = C \times D$ equals $A : C = D : B$ ”. The transformed eq. (6a) then reads

$$\Delta E : \Delta p = \Delta s : \Delta t \quad (6b)$$

so that Planck’s constant again vanishes (as in eq. (4)), and the constant of proportionality is given by the constant ratio $\Delta s : \Delta t$, the elements Δs (element of space) and Δt (element of time) of which must needs also be constants. And this is also the case with the elements of “space” and “time” that form the (dimension of) the constant c of eqs. (3) and (5) called “vacuum velocity of light”. So we can put $\Delta s : \Delta t = c$, and, by omitting the symbol “delta” (which is of no special use in our case, as has been shown above) we obtain once again, as an equivalent of Heisenberg’s equations, the formula

$$E : p = c \quad (6c)$$

III

Newton’s law of cause and effect, given through eq. (2), $F : p = c$, is equivalent to the eqs. (3) (Poynting), (4) (Planck), (5) (Einstein), and (6c) (Heisenberg) which are equivalent among themselves. It is Euclid’s axiom I (**14**) that justifies to include Newton’s second law here, which axiom allows to understand “Newton’s” ratio in the form $F : c (= p)$ as an equivalent of the ratio $E : c (= p)$, so that $F : c = E : c$. From an extension of this axiom, according to which whatsoever an undetermined entity is found to be geometrically proportional to another defined entity, p , be the undetermined entity symbolized by F or by E , we see that such entities F, E will always fulfil the same ratio to the defined entity, p . Consequently, so long as $F \propto p$ and $E \propto p$, the ratios $F : p$ and $E : p$ will always result in the same factor of proportionality, which is c in the equations presented above (**15**).

Having thus demonstrated the mathematical equivalence of Newton’s law of non-material and non-observable cause “force” (*vis impressa*) and its observable material effect on a body’s state of motion or rest with the most basic laws of modern physics, we can now for the first time understand the true meaning of these laws. Since they all mathematically coincide with Newton’s natural law of cause and effect, their true meaning must also coincide with the meaning of Newton’s law – that is with its general meaning to present the true law of causali-

ty as well as with the nature and meaning of its equivalent constituents. “Energy” E , then, insofar as it is part of the above introduced basic equations of modern physics, must be the same thing as Newton’s “impressed force” F : It is the true metaphysical, or transcendent (non-observable, that is) non-material “cause” that generates a material “effect” given through the quantity of proportional momentum. The constant c called “vacuum velocity of light” in physics can now be understood as a ratio of (the invariant element of absolute) “space” and (the invariant element of absolute) “time”. The law of cause and effect thus shows intimately intertwined with absolute space and absolute time (see eq. (6b), indicating that nothing will ever be generated or corrupted but in space and time.

Actually eqs. (6a) and (6b) are much more revealing than the formula $E \propto p$, or $E : p = c$, as they each represent a quaternate proportion, or “tetraktys”, which geometric pattern meant a sort of “key to nature” in Platonic and Neo-Platonic philosophy. Note that the tetraktys is present in Raffael’s picture “The School of Athens” where on the left (the “Platonic”) side a young man shows it on a tablet in his left hand to sitting old Pythagoras. Never before has it been understood let alone demonstrated that this quaternate geometric proportion of cause and effect, of absolute space and absolute time, lies behind the enigmatic mathematical formulae of modern physics – and that it is a constituent of the true Newtonian theory of motion as well.

What else can be summarized as a result of scrutinizing Newton’s “Principia”?

1. It has been shown that Newton’s theory of motion (which was meant by Newton as a “theory of everything”) implies a “dualist” law of causality, representing a rational, measurable mind-body” interaction of non-material and non-observable active causes, the (impressed) “forces of nature”, with passive material bodies, their changes of motion being the material “effects” generated by the said non-material causes. Thus we meet with a “Newtonian world view” very different from the one that has been taught so far – a world view that implies a non-material or spiritual transcendent “Platonic” reality in contrast to the dominating monist-materialist scientific world view of our times.

2. It has been shown that Newton’s law also provides the general basis of a rational understanding of natural processes of change, of generation of the new in space and time, from Newton to modern science, thus revealing a “red threat” of timeless truth which was interrupt-

ed only for a while when Newton's theory of motion had been misrepresented in the so-called "classical mechanics" (16). In classical mechanics invariant (absolute) space and invariant (absolute) time were not present. There was no true transcendent "spacetime frame of reference of motion" at hand, so that the relativist dogma of the "equivalence of all reference systems" (introduced at will) could be propagated, which dogma moreover implied a materialist preoccupation as it mistook material bodies for reference systems. The finding that non-material absolute space and non-material absolute time provide the absolute system of reference of motion in modern physics, and in Newton's authentic theory as well, means to restore against the presently dominating relativist view the presence and the power of the absolute, i.e. of truth, in science.

3. It has been shown that Galileo was true when he, in his "Saggiatore" of 1624, wrote that all philosophy (not only "natural" philosophy!) must be read in the "book of nature" ("questo grandissimo libro che continuamente ci sta aperto innanzi a gli occhi - io dico l'universo") which is written "in lingua matematica", i. e. in geometric language, the characters of which "son triangoli, cerchi ed altre figure geometriche", without which means it is impossible to understand the least of it. Galileo's view coincides with that of Newton who in the 1670ies, in one of his "Lectiones opticae" held at Cambridge University, used the following most interesting phrase: "Verum ut Geometris philosophantibus et Philosophis geometriam exercentibus, pro conjecturis et probabilibus, quae venditantur ubique, scientiam Naturae summis tandem evidentiis firmatam nanciscamur." (16). That is: *We must do philosophy as geometers and geometry as philosophers if we, instead of producing the omnipresent conjectures and probabilities, want to gain an exactly established and most evident science of nature.*

4. It has been shown that neither the Galileian-Newtonian theory of motion, nor any of the modern scientific developments from Faraday and Maxwell to Planck, Einstein and Heisenberg is based on, or supports a materialist world view. Rather by the true meaning of "force" and "energy" we have found and restored a "Platonic" dualist view which implies and unites active spiritual entities (Newton's active "forces of nature" as well as the concept of "energy" of modern physics) with passive matter. The world, then, consists of "spirit" and matter in interaction, and as its material phenomena become recognized again as effects of non-material powers, or forces, this means to restore a "religious" understanding of scientific knowledge – religious here means an understanding of material phenomena that rebinds, refers and con-

nects them mathematically to the transcendent reality of absolute space and absolute time, of true active generating causes, and so to truth itself.

5. One should note that there exist no “material causes” in this world, so long as Newton and modern physics are right to teach a law of causality that shows active causes being non-material entities throughout, and matter being always passive and unable to change its state of uniform rectilinear motion or rest by itself. At closer inspection one will always find them who aim for material causes to confuse effects with causes, i.e. to mistake material effects for their generating causes (17), as e.g. when a body’s falling to the ground is taken for an effect of the body’s weight (which weight actually is itself an effect of the active non-material force impressed on the body by gravity). Matter then will also be unable to “organize” and to “evolve” by itself – which result effectively disproves the Aristotelian-Scholastic principle of entelechy, i.e. the becoming actual “by itself” of what was potential present in matter, as well as the biological theory of evolution based on it (18). If Newton was right, and if modern science is also right in attributing material phenomena as effects to non-material generating causes, then Darwin, for instance, was wrong.

Footnotes.

(1) I want to introduce to the reader my selected “Principia” edition “Isaac Newton, Mathematische Grundlagen der Naturphilosophie”, Felix Meiner, Hamburg, 1988. It presents the first reliable German translation of Newton’s principles in 300 years. A new (third) edition of it has just been published (Academia Verlag, Sankt Augustin, 2011). I refer to it in the following whenever I translate Newton’s phrases into German.

(2) This is in German: *Die Menge der Materie ist der Messwert derselben, der sich aus dem Produkt ihrer Dichte und ihres Volumens ergibt.*

(3) In German: *Die Materiemenge aber, von der hier die Rede ist, verstehe ich im Folgenden jeweils unter den Begriffen Körper oder Masse.* – Newton’s „mass“ accordingly is a *discrete quantity* of matter, i.e. a discrete multitude of elementary particles or „atoms“ in the old sense. Here we see that the physics of the textbooks, which treats „mass“ as a *property* of matter, is far away from Newton.

(4) In German: *Die Menge der Bewegung ist der Messwert derselben, der sich aus dem Produkt der Geschwindigkeit und der Menge der Materie ergibt.*

(5) Here Newton already introduces a „dualist“ concept of “matter” and “force”. This concept was at will reduced in classical mechanics to a “monist” view, when Newton’s “vis insita” (which he also called “vis inertiae”) became transformed into a quality of matter only. It was Immanuel Kant who in his most influential “Metaphysische Anfangsgründe der Naturwissenschaft” of 1786 effectively argued that Newton’s concept of „vis inertiae“ *should be removed from natural science notwithstanding the famous name of its author* (“... muss also unerachtet des berühmten Namens ihres Urhebers aus der Naturwissenschaft gänzlich weggeschafft werden”; *ibid.* Drittes Hauptstück Mechanik, Lehrsatz 4 Zusatz 2 Anmerkung 2).

(6) In German: *Die eingedrückte Kraft ist eine Einwirkung auf einen Körper, die auf eine Veränderung seines Zustands der Ruhe oder der gleichförmig-geradlinigen Bewegung gerichtet ist.*

(7) In German: *Die eingedrückte Kraft hat im übrigen verschiedene Ursprünge, sie stammt z.B. aus Stoß, Druck, oder aus der Zentripetalkraft.*

(8) In German: *Alle Schwierigkeit der Philosophie besteht wohl darin, dass wir aus den Bewegungserscheinungen die Kräfte der Natur erschließen und alsdann von diesen Kräften ausgehend die übrigen Erscheinungen genau bestimmen... Ich habe nämlich viele Gründe dafür jedenfalls zu vermuten, dass alles von bestimmten Kräften abhängen könnte, durch die die Theilchen der Körper aus noch nicht bekannten Ursachen entweder wechselseitig gegeneinander stoßen und in regelmäßigen Strukturen zusammenhängen, oder sich wechselseitig fliehen und voreinander zurückweichen. Da diese Kräfte bisher unbekannt sind, haben die Philosophen die Natur bislang insoweit vergebens untersucht.*

(9) See Newton’s „Principia“, Leges motus, Coroll. VI, Scholium: *Bis hierher habe ich die Grundlagen dargestellt, die von den Mathematikern erfasst und durch vielfältige Erfahrung bestätigt sind. Mit Hilfe der beiden ersten Gesetze und der beiden ersten Corollarien fand Galilei heraus, dass der Fall schwerer Körper nach dem Quadrat der Zeit geschieht ... “.*

(10) In German: *Jeder Körper verharrt in seinem Zustand der Ruhe oder der gleichförmig-geradlinigen Bewegung, sofern er nicht durch eingedrückte Kräfte zur Änderung seines Zustands gezwungen wird.*

(11) In German: *Die Bewegungsänderung ist der eingedrückten Bewegungskraft proportional und geschieht in der Richtung der geraden Linie, in der jene Kraft eindrückt.*

(12) In German: *Über die Methode der ersten und letzten Verhältnisse, mit deren Hilfe das Nachfolgende bewiesen wird.*

(13) In German: *Werden unbestimmte artverschiedene Mengen zueinander ins Verhältnis gesetzt ...*

(14) Euclid's axiom I reads: *Things that equal the same thing also equal one another.*

(15) The geometric identification of the meaning of this factor of proportionality is given through its "dimension" which is "space s over time t ". It can be found in Newton's Principia in various ways that he indeed respects this constant and knows its geometric "dimensions" (see e.g. Ed Dellian, Die Newtonische Konstante, Philos. Nat. 22 nr. 3 (1985) p. 400).

(16) See Isaac Newton, Opera quae exstant omnia, Samuel Horsley ed., vol. III, London 1782, p. 354.

(17) Basically this misrepresentation consisted in replacing the geometric *proportionality* of force, or cause, and its effect on a body's motion, through an arithmetic-algebraic *identity* of cause and effect, according to the principle "causa aequat effectum" introduced by G. W. Leibniz into mechanics. This principle led to the mistaken version of Newton's law to read "force equals mass-acceleration", which today is generally, but erroneously understood as the most basic equation of Newtonian mechanics. Evidently this principle suppresses the above-revealed most important factor of proportionality c which represents the absolute spacetime system of reference. So it destroys the "dualist" Newtonian law of causality and reduces the theory of motion to a mere description of phenomena, which makes only a semantic use of the concept of "force" (as it then is synonymous with "accelerated motion"), and only seemingly but not truly "explains" phenomena through "causes". At closer view one can see that this

Leibnizian idea “*causa aequat effectum*” also led to a *materialisation* of “forces” which accordingly were no longer understood as non-material entities of their own, but as *qualities of matter*. For this I refer again to Immanuel Kant, *Metaphysische Anfangsgründe der Naturwissenschaft*, 2. Hauptstück „Dynamik“, Erklärung 2: „Anziehungskraft ist diejenige bewegende Kraft, wodurch eine Materie die Ursache der Annäherung anderer zu ihr sein kann... Zurückstoßungskraft ist diejenige, wodurch eine Materie Ursache sein kann, andere von sich zu entfernen...“. Here we learn about „matter“ apparently being a „cause“, i.e. being active, and able to change the state of motion of other matter – in open contradiction to Newton’s theory, and to the truth of nature as well.

(18) See. e.g. Christian Kummer, *Der Fall Darwin, Evolutionstheorie contra Schöpfungsglaube*, Pattloch Verl. München, 2009, p. 168 f. This author clearly refers to Aristotle’s concepts of *dynamis*”, “energy” and “entelechy” in order to establish the theory of evolution on a principle which he calls „die Dynamik des sich selbst erstellenden Naturdings“ (i.e. in English: *The dynamic power of a natural entity to create itself*).

Ed Dellian

Bogenstr. 5

14169 Berlin

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