

CONDITIONED INERTIA IN THE PHYSICS OF SPINOZA AND HIS FOLLOWERS

(with excursus on the correction of a misleading comma in Spinoza's text)*

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Modern physics considers and accepts the principle of inertia as an indisputable presupposition and foundation stone of its theories. The Nobel prize laureate Richard Feynman may serve here as a witness for all workers in the field.

The discovery of the laws of dynamics, or the laws of motion, was a dramatic moment in the history of science. Before Newton's time, the motions of things like the planets were a mystery, but after Newton there was complete understanding. [...] Galileo made a great advance in the understanding of motion when he discovered the *principle of inertia*: if an object is left alone, is not disturbed, it continues to move with a constant velocity in a straight line if it was originally moving, or it continues to stand still if it was just standing still. Of course this never appears to be the case in nature, for if we slide a block across a table it stops, but that is because it is *not* left to itself – it is rubbing against the table [...] Newton wrote down three laws. The First Law was a mere restatement of the Galilean principle of inertia just described.¹

In recent times the classical theory about inertia was challenged by Barnhard Haisch, Alfonso Rueda and H.E. Puthof in their article "Inertia as a zero-point-field Lorentz force".²

Inertia as formulated by Galileo (ca.1638) was simply the property of a material object to either remain at rest or in uniform motion in the absence of external forces. Newton (ca. 1697) merely restated the Galilean proposition [...] Since the time of Newton there has been only one noteworthy attempt to associate an underlying origin of inertia of an object with something external to that object: Mach's principle. Since motion would appear to be devoid of meaning in the absence of surrounding matter, it was argued by Mach (ca. 1883) that the local property of inertia must somehow asymptotically be a function of the cosmic distribution of all other matter. Mach's principle has remained, however, a philosophical statement rather than a testable scientific proposition.³

The authors conclude their criticism of the traditional concept of inertia by declaring that it is their intention to specify the causal basis of what was until then only a 'postulate', "thus developing a scientific version of Mach's principle [...] thereby offering a deeper insight into what has been thought to be a fundamental nonderivable property of matter, i.e.inertia".

In both quotes above the historical role of Galileo is overestimated and the role of Descartes is forgotten. Galileo surmised the thing that was later called inertia but certainly did not yet make it a formal principle.⁴ That was first done by Descartes in his *Principia*

*This article is a shortened version of the long (120 pp) elaboration of the subject in *The Sphinx. Spinoza reconsidered in three essays* (Vrijs tad 2000, private publication still available from the author).

¹ R.Feynman, R.Leighton and Matthew Sands, *The Feynman Lectures on Physics* (Addison-Wesley Publishing Company 1963). Vo.,I, 9/1. Italics in the source.

² *Physical Review A* 49 (1994) 668-694.

³ O.c.p.678-679. Cf. E. Mach, *The Science of Mechanics* (Open Court Edition 1960) p. 286 "When, accordingly, we say that a body preserves unchanged its direction and velocity in space, our assertion is nothing more or less than an abbreviated reference to the entire universe". The expression 'Mach's principle' was coined by Einstein.

⁴ See A.Koyré, *Metaphysics and Measurement* (London 1968). Koyré writes that this fundamental law of physics "implicitly pervades Galilean physics and quite explicitly that of Descartes and Newton" (19). See also

Philosophiae (Amsterdam: Elsevier 1644) where he circumscribes the “first law of nature” (*prima lex naturae*) as:

Everything, which is simple and undivided, remains, as far as it is on itself, always in the same state and never changes except by external causes (*Unamquamque rem, quatenus est simplex & indivisa, manere, quantum in se est, in eodem semper statu, nec umquam mutari nisi a causis externis*).⁵

Apart from the question whether this principle is consistent with various other ‘principles’ of Descartes, it will be clear that it is plagiarized by Newton in his *Philosophiae naturalis principia mathematica* (1687). He did not judge it necessary to mention his source. His formula shows only a minor adaptation.

Every body continues in its state of rest or of uniform motion in a right line unless it is compelled to change that state by forces impressed on it (*corpus omne perseverare in statu suo quiescendi vel movendi uniformiter in directum, nisi quatenus a viribus impressis cogitur statum illum mutare*).

The ‘not being forced by external causes to change its state’ was, of course, implied by Descartes in his formula ‘*quantum in se est*’. But Newton is nonetheless dangerously close to the old fashioned theory of an ‘*impetus*’ in projectiles when he writes:

This innate force (*vis insita*)⁶ of matter is a power of resisting by which every body, as much as in it lies, continues in its present state, whether it be of rest or of moving uniformly forward in a right line [...] This ‘innate force’ may, by a most significant name, be called a force of inactivity (*vis inertiae*). But a body only exerts this force when another force, impressed upon it, endeavors to change its condition.⁷

His interpretation of inertia as a force in resting or propelled bodies makes Newton to be the strongest possible representative of the defenders of the principle of inertia.⁸ That Descartes may *not* be reckoned to this group of extreme ‘inertialists’ can be made clear by quoting another axiom of his physics, which he somehow had to reconcile with his first law. This axiom, as such not contained in his *Principia Philosophiae*, sounds:

No weaker cause is required to keep a thing in its state than to bring it therein (*non minor causa requiritur ad rem conservandam, quam ad ipsam primum producendam*).⁹

E.J. Dijksterhuis, *De mechanisering van het wereldbeeld* (Amsterdam 1950) p.383 and Stillman Drake’s introduction to his translation of Galileo’s *Dialogue concerning the two chief World Systems* (Berkeley 1967), who comments: “Galileo did not fully recognize the law of inertia and its fundamental significance” (p.xi).

⁵ Part two, art. 37.

⁶ ‘*Insita*’, which is not classical Latin, is considered synonymous with ‘*nativa*’.

⁷ Quoted from *Newton’s Philosophy of Nature. Selection from his writings*. Ed. By H.S. Thayer (New York 1974), p.25.

⁸ Without giving any textual evidence Alan Gabbey unduly attributes the Newtonian concept of ‘*vis inertiae*’ (and what he called ‘forces of motion or of rest’) to Descartes, writing that “it is clear from a considered reading of the Cartesian *corpus* (including the correspondence) that the force is a real feature of the mechanical world which Descartes presents to us”. See his “Force and Inertia in Seventeenth-Century Dynamics” in *Studies in History and Philosophy of Science* 2 (1971) 1-67 (quote p. 7-8). But, I think, this author was apriori misled by his aversion of what he called “the extremism of [...] a mechanistic programme”.

⁹ Zie *Réponses aux secondes objections* in Descartes, *Œuvres philosophiques*. Ed. F. Alquié (Paris 1967). Tome I, p.592.

Descartes left the problem unsolved. It was Spinoza who “cured the Cartesians from an error”.¹⁰ This brings me to the objective of this article on Spinoza’s ‘deconstruction’¹¹ of a holy truth of modern (from Newton onwards) and contemporary physics.

- Spinoza started his public philosophical¹² career with a critical exposition of Descartes’ physics in his *Renati des Cartes Principia Philosophiae more geometrico demonstrata* (1663).¹³ This work, mostly neglected by Spinoza scholars and admirers, is fundamental for our subject. It is here already that he stresses and exploits the just mentioned Cartesian axiom about the continuous creation of whatever thing in whatever condition to the disadvantage of the so-called inertial bias of things, which is nonetheless correctly mentioned as a Cartesian principle.¹⁴ The overall tendency of this devilish¹⁵ work is to demonstrate for the attentive reader the incompatibility of the axiom and the first law, more generally the contradictory character of Descartes’ physics. Immediately after his mentioning of the Cartesian axiom Spinoza applies it to the continuation in existence of whatever thing. By a subtle remark the reader is implicitly invited to think of inertia in rest or motion.

From the fact that at this moment we are thinking, it does not necessarily follow that we shall hereafter be thinking [...] In order to persevere in existing it stands in need of the same force that it needs to begin existing. And what we here say about thought must be said about every thing (*de omni re*) whose essence does not involve necessary existence.¹⁶

This, of course, is relevant for the question of inertia. No state of things, neither rest nor motion, guarantees its subsequent being. Everything enduring in time has to be produced anew from moment to moment. It must be permanently re-created by a range of external causes. “The parts of duration don’t have any connection with each other”¹⁷. On itself a thing or a state of affairs has no influence on its continuation. “I have no power at all to conserve myself.”¹⁸ The case of man’s body is not exceptional in nature.

At a first sight Spinoza seems to keep himself in his main work, the *Ethica*, to the formula of Descartes’ principle of inertia’ since he concludes “that a body in motion moves until it is determined by another body to rest, and that a body at rest also remains at rest until it is determined to motion by another”. However, the semblance deceives. This assertion is a deduction (it was preceded by the words *hinc sequitur*) from a presupposition (‘lemma 3’) which runs as follows: “A body which moves or is at rest must have been determined to motion or rest by another body, which has also been determined to motion or rest by another, and that again by another, and so on, to infinity”. And this lemma, on its turn, is argued for by a reference to the famous 28th proposition in part I, which implies the strongest possible rejection of any kind of inertia in the sense of ‘existing by itself if not obstructed by anything else’.

Every singular thing, or anything which is finite and has a determinate existence, can neither exist nor be determined to produce an effect unless it is determined to exist and produce an

¹⁰ “Il les désabusa d’une erreur”, aldus J.M. Lucas in zijn *La vie de Monsieur Benoit de Spinoza*, written shortly after Spinoza’s death but first published in 1719. Republished by J. Freudenthal in *De Lebensgeschichte Spinoza’s in Quellenschriften* (Leipzig 1899).

¹¹ To use a term of Jacques Derrida.

¹² In the seventeenth century the word *philosophia* is not opposed to but included all kinds of physical sciences.

¹³ Amsterdam by Rieuwertsz. Added to the work are *Cogitata Metaphysica*. The titles are here shortened to the initials PPC and CM.

¹⁴ See PPC II/14.

¹⁵ Devilish and pseudo-defensive. He entered the world of science disguised in Cartesian clothes.

¹⁶ See Spinoza. *Principles of Cartesian Philosophy with Metaphysical Thoughts. Translated. By S. Shirley. Introduction and notes by St. Barbone and Lee Rice* (Indianapolis 1988) p.23.

¹⁷ *Cogitata Metaphysica* II/11/2 : *Denique quum partes durationis nullam habeant inter se connexionem...*

¹⁸ PPC demonstration of prop.7: *Ego nullam vim habeo me conservandi.*

effect by another cause, which is also finite and has a determinate existence, and again, this cause also can neither exist nor be determined to produce an effect unless it is determined to exist and produce an effect by another, which is also finite and has a determinate existence, and so on, to infinity.¹⁹

Spinoza's position against Descartes' first law must by now be clear. Inertia, in motion and in rest, is always an effect. In a recently found copy of Spinoza's *Opera Posthuma*, owned at present by the Leiden University Library, one finds many marginal annotations, made by one of Spinoza's intimates.²⁰ To Spinoza's corollary, in which he repeats Descartes' formula, we find the remark: "for during that time a moving cause and a cause that constitutes the rest are thought to be active and to produce now the effect" (*tamdiu enim causa movens & causa quietem constituens agere sive nunc producere effectum considerantur*). A better understanding of Spinoza's position is impossible.

Spinoza is also far away from Newton's 'innate force', that resting or uniformly moving bodies would possess and by which they would be able to resist opposing forces. Right early, in his first writing which remained unfinished and was published posthumously, he used himself the word 'innate force' (*vis nativa*) but explained it in a way which excludes all kinds of misunderstanding. "By innate force I understand what is caused in us by external causes. We shall explain this later in our forthcoming philosophy".²¹ This, indeed, is the core tenet of his general physics, as presented in the first and second parts of the *Ethics*. His natural science tolerates no exemption from the fully-fledged determinism, neither in inanimate things nor in man. In the case of Newton, however, the acceptance of an innate force seems to be detractive from his mechanistic science.

But there seems to be a serious difficulty. In October 1674 Spinoza writes a letter to G.H. Schuller, but in fact destined for Ehrenfried Walther von Tschirnhaus, in which he defends his system against the latter's objections to his deterministic position. For the sake of our argument we have now to quote from the first publication of this letter in the *Opera Posthuma*, since the autograph is not saved from the teeth of time. The purpose of our quoting a rather long passus of this letter is a) to find a correct translation of the sentence in which Spinoza describes the example of what happens when one throws a stone, and b) its interpretation in the immediate context exemplified by it. Since we broach a philological question about the original Latin, the text has first to be presented in this language.

Sed ad res creatas descendamus, quae omnes a causis externis determinantur ad existendum, & operandum certa, ac determinate ratione. Quod ut clare intelligatur, rem simplicissimam concipiamus. Ex.gr. Lapis a causa externa, ipsum impellente, certam motus quantitatem accipit, qua postea, cessante causae externae impulsu, moveri necessario perget. Haec igitur lapidis in motu permanentia coacta est, non quia necessaria; sed quia impulsu causae externae definiri debet; & quod hic de lapide, id de quacumque re singulari, quantumvis illa composita, & ad plurima apta esse concipiatur, intelligendum est, quod scilicet unaquaeque res necessario a causa externa aliqua determinatur ad existendum, & operandum certa, ac determinata ratione. Porro, concipe jam, si placet, lapidem, dum moveri pergit, cogitare, & scire, se, quantum potest, conari, ut moveri pergat. Hic sane lapis, quandoquidem sui tantummodo conatus est conscius, & minime indifferens, se liberrimum esse, & nulla alia de causa in

¹⁹ Translations from the *Ethica* are mine. For a more concrete idea of the 'usque in infinitum', i.e. the exclusion of a *primum movens*, see CM II/11/2 where Spinoza explains the process of permanent procreation by saying "that all things that exist in nature are reciprocally determined by each other to their activity" (*quod omnia vicissim, quae in natura sunt a se invicem ad aliquid operandum determinantur*).

²⁰ See "Nieuwe tekstfragmenten van en over Spinoza" in *NRC Handelsblad* 19.10.1995.

²¹ *Tractatus de intellectus emendatione* § 31, note: *per vim nativam intelligo illud, quod in nobis a causis externis causatur, quodque postea in mea philosophia explicabimus*. In the Heidelberg academic edition of Spinoza's *Opera* Carl Gebhardt, the editor, has mistakenly introduced a negation in this note, as a consequence of which it sounds "what is *not* caused by external causes".

*motu perseverare credet, quam quia vult. Atque haec humana illa libertas est, quam omnes habere jactant, & quae in hoc solo consistit, quod homines sui appetitus sint conscii, & causarum a quibus determinantur, ignari.*²²

Let me first remark that Shirley's translation, given in a footnote, is qua meaning the same as I find, without any exception, in a dozen of other respectable and scholarly translations. I mention here only F. Akkerman,²³ C.Gebhardt / M. Walther,²⁴ A. Dominguez²⁵ and R.Caillois / M. Francès / R. Misrahi.²⁶

Apart from the question whether Spinoza's physical description of the flight of a thrown stone is not in conflict with his theory about conditioned inertia, as explained in PPC and *Ethica*, the attentive reader of his letter must, to my opinion, find himself confronted with a problem concerning the coherence of the text. Whereas the flight of the stone through the air is described as an effect of the impelling hand, the human behavior, which had to be clarified by the example, is not in the same way interpreted as an effect of an earlier conditioning, but as an effect of actually operating causes. Spinoza is undoubtedly focused on the '*in motu permanentia*' of which he says that it is not a free but a constraint process, in the stone as well as in the 'humanized' stone, who is thinking that he is moving by himself and endeavoring to go on by himself. The stone's motion *after* being thrown has to be defined by the impact of an external cause, just as man's growth and activity after his being thrown into the world, his '*in motu perseverare*', has to be defined by the *contemporary* forces which determine it. No autonomy nor indeterminacy characterizes the ongoing motion.

But what does Spinoza's description of the stone's flight imply? Indeed, that it is caused, determined and so defined by the no longer existing driving-hand, which implication is in flagrant contradiction with the context. The reader must feel embarrassed. And so was I when I, long ago, read the letter in a translation. The first Latin text, however, which I consulted, was the edition of Spinoza's *Opera quae supersunt* by C.H.Bruder, published in 1843.²⁷ And in this edition, putatively 'superseded' by newer editions like the already mentioned one and the edition of Van Vloten and Land,²⁸ the comma's after the words '*postea*' and '*impulsu*' were to my surprise absent! In his introduction Bruder had declared his intention to present a text according to the *editio princeps*, but "without its vices" (*sublati*s

²² "However, let us move down to created things, which are all determined by external causes to exist and to act in a fixed and determinate way. To understand this clearly, let us take a very simple example. A stone receives from the impulsion of an external cause a fixed quantity of motion whereby it will necessarily continue to move when the impulsion of the external cause has ceased. The stone's continuance in motion is constrained, not because it is necessary, but because it must be defined by the impulsion received from the external cause. What here applies to the stone must be understood of every individual thing, however complex its structure and various its functions. For every single thing is necessarily determined by an external cause to exist and to act in a fixed and determinate way. Furthermore, conceive, if you please, that while continuing in motion the stone thinks, and knows that it is endeavouring, as far as in it lies, to continue in motion. Now this stone, since it is conscious only of its endeavour and is not at all indifferent, will surely think it is completely free, and that it continues in motion for no other reason than that it so wishes. This, then, is that human freedom which all men boast of possessing, and which consists solely in this, that men are conscious of their desire and unaware of the causes by which they are determined." Translation of Samuel Shirley in Spinoza, *The Letters* (Indianapolis 1995) p.284. The Latin text can be controlled in the *critical* edition of C. Gebhardt, *Opera* (o.c.), Vol.4, p. 266.

²³ *Briefwisseling* (Amsterdam 1992) p.340.

²⁴ *Briefwechsel* (Hamburg 1986) p.236.

²⁵ *Correspondencia* (Madrid 1988) p.336.

²⁶ *Oeuvres complètes* (Paris 1954) p.1252.

²⁷ Leipzig, Teubner, in three volumes.

²⁸ *Opera quotquot reperta sunt, recognoverunt J. van Vloten and J.P.N.Land* (The Hague 1914), 4 volumes.

vitiis): “mistakes are discovered and removed” (*errores detecti et remoti sunt*).²⁹ Bruder’s text correction was, so it seems, never noticed by the modern editors and translators.

Or the correction was observed but considered inappropriate or improbable.³⁰ I will argue here, that only one conclusion is possible: the text of the *Opera Posthuma* is corrupt. The punctuation marks, the above mentioned comma’s, betray the popular or prejudicial interpretation of the phenomenon which cannot have been Spinoza’s scientific view, as explained and demonstrated in the *PPC* and *Ethica*. The type-setter must have introduced them into the text during the printing process, thinking that this would clarify its meaning.³¹

Canceling the comma’s has the following advantages. First: it transforms the sentence into another one, which is grammatically possible. Second: this new translation makes sense in the context and is presupposed by the context. This point was already argued for. Third: the new reading of the text is most strongly confirmed by the reception of Spinoza’s physics by his intimates, who later published about it.

Ad primum: the improvement of the text is realized by (mentally) transposing the first of the two comma’s to the place between ‘*cessante*’ and ‘*causae*’ and deleting the second one. The sentence, then, becomes: : “*e.gr. lapis a causa externa ipsum impellente certam motus quantitatem accipit, qua postea cessante [,] causae externae impulsu moveri necessario perget*’. An acceptable translation would become the following one: “A stone for instance receives from an external cause impelling it a certain degree of motion. After the cessation of this impulsion the stone will necessarily continue its course by the impact of an external cause”. This new translation is grammatically possible and even irreproachable. ‘*Qua postea cessante*’ is a normal ablativus absolutus, already used by Spinoza in his *PPC*.³²

Ad tertium: a reception and an elaboration of Spinoza’s physics as a critique of Descartes’ inertial ‘fundamentalism’, which also strikes Newton’s position, is retrievable in at least five learned authors, of which three were known as his friends. Two were post-Newtonian professors in mathematics and physics. The first work to be mentioned is *Pantosophae Principia*³³ of Abraham Cuffeler, a lawyer in the Court of Holland in the Hague. A mathematician, Dr. Petrus van Gent, called him Spinoza’s ‘*summus amicus*’.³⁴ He was a great admirer of Spinoza.³⁵ In his defense of Spinoza’s physics he fully subscribes to

²⁹ Vol.I, p.V. I happened to trace another important improvement of Spinoza’s text by Bruder. See Klever, “Spinoza’s Concept of |Christian Piety: Defense of a Text Correction by Bruder in the TTP” in *NASS Monograph 9* (Baltimore 2000) 17-28.

³⁰ However, scholarly commentaries in the secondary literature never discuss Bruder’s proposal.

³¹ It is remarkable and, moreover, a minor point against my argument, that the mistaken comma’s are also visible in the Dutch translation of the *Opera Posthuma*, namely the *Nagelate Schriften* (Amsterdam: Rieuwertsz 1677): “Tot een voorbeelt, een steen ontfangt van zekere uiterlijke oorzaak, die hem drijft, zekere hoegrootheid van beweging, door de welke hy daar na, schoon d’aandrift van d’uiterlijke oorzaak ophoud, nootzakelijk voortgaat in bewogen te worden”. *De Nagelate Schriften*, being a translation by Spinoza’s friends of the *Opera Posthuma*, are often helpful for a better understanding but are never fully reliable as a kind of standard or norm for the Latin original. Cf. F. Akkerman, *Studies in the Posthumous Works of Spinoza. On Style, earliest Translation and Reception, earliest and modern Edition of some Text* (Meppel 1980)..

³² See e.g. the demonstration of the 16th proposition in the second part. There we read, fully in line with Descartes’ second law: “*Corpus, quod circulariter movetur, continuo a vi externa impeditur, ne secundum lineam rectam pergat moveri, qua cessante corpus ex se perget secundum lineam rectam moveri*”. ‘*Qua cessante*’ simply refers back to ‘*vi externa*’ in the first part of the sentence.

³³ Published anonymously (and with the same false *impressum* as the *Opera Posthuma*) in Amsterdam by Rieuwertsz in 1684. The full title is: *Specimen artis ratiocinandi naturalis & artificialis ad Pantosophae Principia manuducens*.

³⁴ See WimKlever, “La clé d’un nom: Petrus van Gent à partir d’une correspondance”, in *Cahiers Spinoza*, vol.6 (Paris 1991) 109-203.

³⁵ Spinoza is praised as “a certain philosopher of a great name, whose immature, how terrible!, decease from the literary world can never be enough deplored, as is testified by his very learned writings, which circulate in the

our interpretation of the stone-passage. “Well, to gather up the thread of thought we had left, I claim that from that inborn truth that everything moving is moved by something else and nothing by itself, we can infer that every moving body must be moved by another body *contiguous to it* and moving, and this body in its turn must be moved by another contiguous and moving body etcetera, and so on.”³⁶ Elsewhere³⁷ he asserts “that the mind is determined to its operation [...] by a certain external cause, in the same way as a stone is determined by *vicinal* moving bodies to start *and to continue* its motion in this or that direction”. The Cartesian ‘first law of nature’ is characterized as a ‘fiction’. Descartes himself is said to ‘hallucinate’ when he tries to explain the motion of projectiles by the inertia of matter.³⁸ The vicinal bodies responsible for their motion are other bodies than the causes which launched them. One has to think here of the forward pressure in the air particles brought to circulation by the disturbing hand.

Heidenricius Overkamp had become a ‘*doctor medicinae*’ at the university of Leiden in 1677. Some months later his name was canceled from the ‘*catalogus promotorum*’ and his certificate combusted, probably on account of his trespassing the official Cartesian doctrine.³⁹ He is ascertained to sympathize with Spinoza because he was a member of an Amsterdam Spinoza circle, which discussed the *Ethica*.⁴⁰ In 1683 he published *Nader Onderzoek over het Tweede Deel van de Beginzelen der Wysbegeerte van Renatus Des-Cartes* (A further screening of the second part of Descartes’ *Principia Philosophiae*). Nowhere in this running commentary of PC part 2, does he mention Spinoza’s name or quote him. His own critique, however, is the same as Spinoza’s. He teaches that whenever something moves through water or air, it is constantly ‘*transported*’. And that every transport presupposes a transporter. “It is an eternal truth that no body can be moving alone [...] When I throw a ball into the air, the ball cannot go further unless another body being in the air itself is also in motion: the ball must be driven forwards by means of the air, pushing it from behind and itself having been pushed backwards by the ball”.⁴¹ “No body has any power to remain in the state in which it is, so that it is not true [...] that a body which is at rest has any power whatever to remain at rest”.⁴² “The words ‘rest’, ‘force’, ‘power’, ‘conatus’ etc. clear up nothing”.⁴³ When the millstone remains on its place, this does not originate from the millstone itself, but from the universal pressure [‘aanpers’) of the bodies around it.⁴⁴ Its eventual resistance against an influence, is not its own force but the force of a heavier pressure from the opposite side.

Also Tschirnhaus, the addressee of the letter 58 which we have corrected, became, after ample hesitation, convinced of the truth of Spinoza’s radical determinism. In his *Medicina mentis*⁴⁵ he sharply criticizes Descartes by stressing that a definition always needs to mention the generating cause, which can never be something else than motion. “Whatever is conceived, is conceived by motion and without motion nothing”.⁴⁶ “Had he demonstrated this efficient cause, he would without any doubt never have asserted, that a body thrown by the hand and separated from it would persevere in its motion, if only no bodies would prevent

hands of nearly all people, although they are understood by very few”. The *Ethica* was called a golden book which would never perish.

³⁶ Part 1, p.68.

³⁷ Ib. p.162.

³⁸ III, p.13.

³⁹ Zie L. Thijssen-Schoute, *Nederlands Cartesianisme* (reprint Utrecht 1989), p.286.

⁴⁰ Zie o.c. *La clé d’un nom*, p.189.

⁴¹ O.c.p.134.

⁴² O.c.p.147.

⁴³ O.c.p.192.

⁴⁴ O.c.p.145.

⁴⁵ Published at Amsterdam by Rieuwertsz jr in 1687.. A second and a third edition were published in Leipzig in 1695 and 1733.

⁴⁶ O.c.p.89.

it".⁴⁷ In a letter to Christian Huygens he elucidates his theory: "This motion [of the stone in its flight] does not come from the hand, but from other bodies, who propel this body after it is away from the hand".⁴⁸ In an early writing, *De motu corporum ex percussione*,⁴⁹ Huygens' startingpoint had been Descartes' principle of inertia.⁵⁰

Most interesting is De Volder's defense of the relativity of inertia against Leibniz at the end of the century.. Burchard De Volder (1643-1709), a rather famous professor of mathematics and physics in Leiden, positioned himself in the line of Spinoza, whose friend he had been.⁵¹ He was well versed in Newton's *Principia Mathematica*, which complicated treatise he even explained to Christian Huygens. But he could not follow Newton's mechanics insofar it allows an '*actio in distans*'. This twin-theory of the *inertia naturalis* is ruthlessly knocked down in long correspondence with Leibniz, together with his idea of a primitive activity in matter. "It is only by an external cause that each body has a conatus to persevere in its state or will be disturbed from it. Likewise it is an external cause which gives eventually the conatus to motion."⁵² And elsewhere, after many long letters of protest by Leibniz, De Volder summarizes again:

Because they [the Cartesians] do not consider motion as a permanent cause from which the translation follows, but as the translation itself consisting in nothing but the alteration of place, there must according to the same rule, which they apply for the solution of this problem, be given on every singular moment a new cause of this changing of place, just like they rightly require for every moment of the curvilinear motion a new cause changing the direction. Just as this body will loose its curvilinear course when the permanently determining cause is taken away, so also will that body no longer change its place when the moving cause fails.⁵³

The last echo of Spinoza's quite original physical theory, shared only by a handful learned friends, is heard in a letter of the German professor of physics, Georg Christoph Lichtenberg, to his friend J.D. Ramler on 3-7-1786. According to him Spinoza, "ein ganz außerordentlicher Kopf", taught us that the idea of inert matter originates from a false concept of nature. "We imputed to the powers of nature an inert mistress and called her matter, whereas we evidently knew nothing else about matter than these powers. This inert Mistress is only a chimera" (*diese träge Basin sei bloß Hirngespinnst*).⁵⁴

Spinoza lost the battle and is forgotten in the history of physics. Descartes and Newton were the winners for centuries. For some people, however, the twentieth century, with its general theory of relativity, meant a turning point. Its author at least, Albert Einstein, thought that after all Spinoza was right. In a famous letter to D. Runes (6-10-1932) he confessed:

⁴⁷ O.c.p.69-70.

⁴⁸ See Huygens, *Oeuvres Complètes* (Den Haag), vol. ix, p.149 (Letter 2457 d.d.12-5-1687).

⁴⁹ Published posthumously in Amsterdam 1717 in *Christiani Hugenii Opera Reliqua*.

⁵⁰ His first hypothesis sounds: "*Corpus quodlibet semel motum si nihil obstat, pergere moveri eadem perpetuo celeritate & secundum lineam rectam*". O.c.p.75. For the the partly congenial but partly antagonistic relation between Spinoza en Huygens, see Klever, "Spinoza en Huygens. Een geschakeerde relatie tussen twee fysici", in *GEWINA* 20 (1997) 14-31.

⁵¹ See Klever, "Burchard de Volder, a crypto-spinozist on a Leiden cathedra" in *LIAS* xv (1988) 191-241.

⁵² See *Die philosophischen Schriften von G. W. Leibniz, herausgegeben durch C.J. Gebhardt* (Berlin 1880, repr. Olms 1978), vol. Iv, p.188.

⁵³ O.c.p.242.

⁵⁴ See G.C.Lichtenberg, *Schriften und Briefe. Hrsg. Von F.H. Mautner* (5 Bde Frankfurt 1983) vol.4, p.488.

All that I think of that extraordinary man, I can express as follows. Spinoza was the first to apply with true consistency to human thought, feeling and action, the idea of the DETERMINISTIC CONSTRAINT OF ALL THAT OCCURS.⁵⁵

Inertia (of bodies or systems) is part of 'all that occurs'. The 'deterministic constraint' is exercised by all things however existing on each other, "for all bodies are enclosed by other bodies and are *reciprocally determined* to their existence and to their way of working so and so" (*omnia enim corpora ab aliis circumcinguntur et ab invicem determinantur ad existendum et operandum certa ac determinate ratione*).⁵⁶ Inertia is conditional.

⁵⁵ Capitals are mine. For the sake of completeness: in Buddhism there were many forerunners of Spinoza's radical determinism like Nagarjuna, Hui-Neng, Linchi, Dogenshi. See 'pratytya samutpada' (conditioned arising) in *The Shambala Dictionary of Buddhism and Zen* (Boston 1991).

⁵⁶ Letter 32.