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Natural Inertia and Leibniz's Reappropriation of Kepler: A German Precursor Against the Newtonian Front[1]

Leibniz first explicitly introduced the notion of *inertia naturalis* (or *inertia materiae*, *inertia corporum*) in the early 1680s, in the context of his studies on collision[2]. He used this term to designate the resistance of bodies to motion in proportion to their quantity of matter. This principle remained central to his theory of matter, and from the mid-1680s he came to ground it in what he termed "passive force", paired with active force as cause of motion. It is only by the mid-1690s, however, that Leibniz began to acknowledge the Keplerian origin of this concept. It was indeed Johannes Kepler who had first articulated the notion of natural inertia, offering its fullest account in the *Epitome astronomiae copernicanae* (1618-21). Yet before the mid-1690s Leibniz never made this reference explicit. From that point on, by contrast, Kepler became a regular presence in his discussions of natural inertia, both in private and in public texts. In my view, this shift was anything but incidental. The purpose of this paper is to account for the reasons behind it. To do so, I first turn to an unpublished manuscript in which Leibniz recorded extensive annotations and comments on Kepler's *Epitome*. These notes make it clear that Leibniz was actively constructing Kepler as a precursor with respect to the concept of natural inertia. Second, I will clarify why Leibniz at times invoked Descartes alongside Kepler when discussing natural inertia. I will examine texts from the 1680s and 1690s in which Leibniz traced aspects of Descartes's physics and geometry back to earlier authors, thereby relativizing Cartesian originality. I will also situate Leibniz's account of natural inertia in relation to the Cartesian version through his polemical exchanges with Burchard De Volder and Denis Papin. Finally, I argue that Leibniz's "reappropriation" of Kepler should be understood as part of a broader anti-Newtonian strategy – namely, the effort to emphasize a German scientific lineage within the context of the escalating calculus dispute.

1. Leibniz's Comments on Kepler's *Epitome*: Constructing a Precursor

[1] This paper revises and expands on material previously published in Hraoui and Ottaviani, "Force, Inertia and the Constitution of Bodies", sections 1 and 3.
[2] *Principia mechanica ex metaphysicis dependere* (A VI 4 1980).

After Christiaan Huygens's death in 1695, Leibniz bought several books from his library, amongst which was Kepler's *Epitome astronomiae copernicanae*[3]. This provided Leibniz with the opportunity to undertake a thorough reading of this work, as attested both by marginal notes in Huygens's former copy[4] and by a series of excerpts and comments preserved in an unpublished manuscript[5]. Contained in this manuscript (LH 35, 15, 6, Bl. 28-29, two folios in quarto), in addition to the notes on Kepler, is a set of excerpts from works by Richard Bentley, Edward Stillingfleet, and John Locke[6]. These other excerpts appear to be part of a set of reading notes for the composition of a text that Leibniz appended to his letter to Thomas Burnett of Kemnay dated 2 February 1700, intended for John Locke, and which was subsequently sent to Locke with Burnett's letter dated 13 April 1700[7]. Taken together with the dates of the works excerpted, this evidence suggests that the manuscript can be dated to 1699-1700[8].

Unlike other sets of notes on Keplerian texts composed during the preparation of *Tentamen de motuum coelestium causis*, the excerpts and comments contained in this manuscript do not deal directly with astronomical problems in their technicalities[9]. Instead, Leibniz engages here with Kepler's ideas about the nature of bodies, as he states at the outset of the first sheet: "There are many passages in Kepler which are consistent with my philosophy about the constitution of bodies.

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[3] See Hess, "Bücher aus dem Besitz von Christiaan Huygens in der Niedersächsischen Landesbibliothek Hannover".

[4] Cf. Leibniz Marg. 97. The volume contains several underlinings corresponding to passages cited and/or commented on in the manuscript. In the margin of page 454, Leibniz drew a table noting the distances from the Sun and the periods of revolution of Saturn, Jupiter, Mars, Earth, Venus, and Mercury, most likely intended to illustrate Kepler's third law. On the inside of the back cover, Leibniz pasted a sheet on which he copied the constellations, divided into groups and set out 'in verse' to aid memorization, as presented by Kepler on p. 344 (with some small variations and a few explanatory notes). On the verso of this sheet, partially detached, one can read fragments of personal notes in German (I thank Siegmund Probst for his help in deciphering these). The notes seem to refer to recently published books to be obtained and to future engagements; one reads, for instance, "mit Mons. Scheiz" and "wegen pourtraits". Andreas Scheits is the author of a well-known portrait of Leibniz, dated 1703. It may therefore be a record of a meeting related to that painting, whose date is not far removed from the period in which Leibniz was carefully studying the *Epitome*.

[5] In his book on Leibniz's theory of planetary motions, Bussotti acknowledges that Leibniz knew the *Epitome* and referred to it many times, but he adds: "Nevertheless, it is significant that he never mentioned passages of the *Epitome*, but always general conceptions" (Bussotti, *The Complex Itinerary of Leibniz's Planetary Theory*, pp. 125-126), concluding that "there is no evidence: (1) to claim that he had a profound knowledge of the *Epitome*; (2) to detect what parts he knew better" (p. 130). The text of this manuscript, however, proves that both these statements must be reconsidered.

[6] The works are as follows: Richard Bentley's *Stultitia et irrationabilitas atheismi* (1696), the first edition of Locke's *An Essay Concerning Human Understanding* (1690), Stillingfleet's *Answer to Mr Locke's Second Letter* (1698), and Locke's counter-reply to Stillingfleet (1699). This has also been noted by Bertoloni Meli (*Equivalence and Priority*, p. 37n35), although he does not mention the last text and the connection with the document addressed to John Locke, which establishes the dating of the manuscript.

[7] The text has been edited with the title *Réflexions sur la seconde réplique de Locke* (1699-1700, A VI 6 29-33); Cf. Locke, *Correspondence*, VII, pp. 57-58, and the remarks in A VI 6 XXI.

[8] The dating has been established in Hraoui and Ottaviani, "Force, Inertia and the Constitution of Bodies", which also provides transcriptions and translations of the passages cited. A provisional transcription of the manuscript is now also available in A VI 5 ve N. 3400.

[9] See, for instance, Leibniz's excerpts from *Astronomia nova* (LH 35, 9, 2 Bl. 80, ca. 1688) and *Harmonice Mundi* (LH 35, 10, 1, Bl. 9, ca. 1688-89). These excerpts are mentioned in Bertoloni Meli, *Equivalence and Priority*, p. 308.

I would like to excerpt only some of them from his *Epitome Astronomiae*"[10]. Indeed, almost all of the passages pertain to the concept of natural or material inertia, and to the causes of the motion of celestial bodies discussed by Kepler.

After a few excerpts concerning circular motion and centrifugal force[11], Leibniz quotes a passage from the end of Book I, Part 4: "p. 102. Indeed, the Earth is inert to motion, *and to some extent resists motion imposed from elsewhere*, but such are all bodies *as far as they are bodies*"[12]. From what is a broader anti-geocentric statement in Kepler's text, Leibniz extracts the assertion of the resistance of all bodies to motion[13]. His emphasis suggests that Leibniz found in this passage a definition of Keplerian inertia, leading to the series of excerpts outlined below centering on this same concept. These excerpts are all taken from Book I Part 5, 'On the Diurnal Motion of the Earth' (*De motu Terrae diurno*), and from Book IV Part 2, 'On the Motion of the Bodies of the World' (*De motu corporum mundanorum*)[14].

In the excerpts from the section dedicated to the Earth's diurnal motion, Leibniz recognizes some of the fundamental concepts of his own physics. Here, Kepler is justifying how the Earth's axis maintains its direction during the Earth's rotational motion. He explains this constancy by referring to the material configuration of the terrestrial globe: as also shown in the illustration (Fig. 25, below) accompanying this question, it is the rectilinear fibers parallel to the axis of rotation that prevent the axis from deviating.

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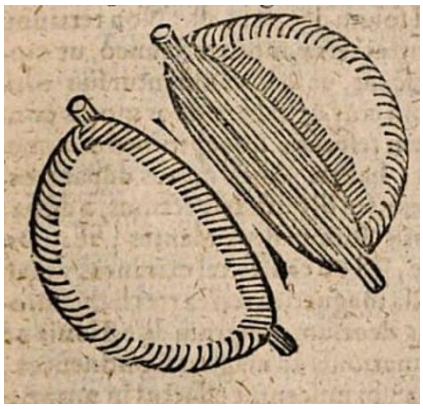
[10] "Kepleri loca sunt multa meae de corporis constitutione philosophiae consentanea. Tantum quaedam ex *Epitome Astronomiae* excerpere placet" (LH 35, 15, 6, Bl. 28r).

[11] "Lib.1. part. 4. pag. 95-96 tractat de impetu concepto, quomodo ejus opere corpora circulariter mota excutiantur in linea recta. p. 95. In motu circulari violento, si qua petunt medium totius rei mobilis, illa oportet esse leviora re ipsa mota, ut in vorticibus ligna et paleae sunt leviora, quam est ipsa aqua rotata in gyrum: ibi namque major a rotatione fit impressio in corpus aquae, quod gravius est, ut impetu ruat, et rectitudinem affectans extima circuli petat, centrumque veluti exhauriat, quo facto, leviora innatantia, cum propter minorem impressionem motus in ipsa, tardioremque motum, destituuntur, tum etiam propter declivitatem centri, in medium naturaliter influunt. p. 96. Ex diverso solet motus violentus horizonti parallelus, cum gravia corripit, incitare illa, si soluta a rota fuerint, et in lineam rectam a circumferentia circuli excutere [in figura recta est tangens]" (Ibid).

[12] "p. 102. Iners quidem est terra ad motum, *eidemque aliunde illato quadamtenus resistit*, at talia sunt omnia corpora *quatenus corpora*" (Ibid).

[13] The passage comes from the question that concludes the Fourth Part of the First Book of the *Epitome*, entitled 'On the Place of the Earth in the World, and its Proportion to the World' (*De loco Telluris in Mundo, ejusque proportione ad Mundum*). Here, Kepler argues against the Earth being at the center of the cosmos due to its heaviness and inertia to motion: this is not a characteristic property of the Earth, but of every body as far as it is a body.

[14] For more background on Kepler's *Epitome*, see Stephenson, *Kepler's Physical Astronomy*, pp. 138-201 and Boner, *Kepler's Cosmological Synthesis*, pp. 139-158.

 [Fig. 25, from *Epitome* 117]

Leibniz is interested in Kepler's use of the expression *forma corporea* and comments on the following passage:

> p. 117. Since it is evident that the globe of the earth is informed by a corporeal form … it will not be absurd to attribute this constancy of the direction of the axis in the same tract to the same form (+ which means, it must be attributed to the active intrinsic force, or to the already acquired impetus +)[15].

Leibniz consciously excludes the adjective "rectilinear" (*rectilinea*) that characterizes the corporeal form in the sense of the configuration of the globe's fibers. Instead, referring only to "corporeal form", he relates it to his own account of form and to the role it plays in his own physics, that is, the role of *vis activa insita*, identifying in Kepler's theory his own doctrine of active forces.

In a more extensive passage, Leibniz once again detects in Kepler's text the idea of an intrinsic active force, as well as that of natural inertia. He comments as follows upon a passage concerning the question of whether the Earth's rotational motion is a violent or a natural motion:

> p. 119. I would certainly not deny that this material inertia of the Earth's body towards motion, and its density (+ that is, the quantity of matter [+]) are the seat into which the *impetus* of rotation is impressed, in the same way as it happens in a violently revolving whirlwind, in which the heavier the matter (+ that is, the greater the quantity of matter in the same volume [+]), the longer the motion impressed upon it lasts; certainly, feathers and similar bodies that have no (+ that is, a little +) resistance do not easily receive motion, nor are they suitable for slings or scorpions … The motion which the form of matter, the faculty or soul imparts to its own body is not usually considered violent (+ that is, in my understanding, [the motion] which follows from the force already existing within +) since nothing is more natural to matter than its own form, to a body than its own faculty or soul … thus, the movement of animals … is not considered violent[16].

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[15] "p. 117. Cum manifestum sit globum telluris informatum esse forma corporea … non absurd[e] eidem formae tribuitur etiam haec constantia directionis axis in plagam semper eandem (+ nempe vi activae insitae, sive impetui jam concepto id tribuendum +)" (LH 35, 15, 6, Bl. 28r).

[16] "p. 119. Haud negaverim inertiam hanc materialem corporis telluris ad motum, et densitatem ejusdem (+ id est quantitatem materiae [+]) esse sedem in quam imprimitur impetus rotationis eodem modo quo id fit in turbine violenter

Although the Earth resists rotational motion, explains Kepler, this motion is not a violent one, but is caused instead by a motive soul that acts upon the body of the Earth. Being material and thus inert, the Earth resists this motive soul as much as possible. The motion is a natural one, however; the motive soul is proper to the Earth, so that like every form to its matter, or soul to its body, it exerts a natural action upon it. Kepler's idea is that celestial bodies, like the Earth, possess a soul that acts upon the fibers of their bodies, much as happens with the fibers in animals' bodies: the Earth's rotational motion is as natural as the leaps of a cat and the darting of a snake[17].

Having likely been drawn in by Kepler's use of the hylomorphic jargon of form and matter, Leibniz takes Kepler's view, as described in the passage quoted above, to reflect his own account of force[18]. Although Leibniz qualifies his position by reiterating that immaterial forces cannot act upon bodies – a cornerstone of his physics – he nonetheless insists on the affinity between Kepler's notion of a motive soul acting on a body and his own conception of intrinsic active forces.

Regarding natural inertia, the passage quoted above clearly shows how Leibniz seeks to refine Kepler's assertions through a terminology that he deems more rigorous. In particular, he asserts the proportionality of a body's material inertia to its quantity of matter. This proportionality is not entirely absent in Kepler, who connects his *inertia* to concepts such as *copia materiae* and *densitas*[19]. Leibniz, however, is keen to establish this proportionality through the concepts of

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circumacto, cujus quo ponderosior est materia (+ id est quo major in pari volumine materiae quantitas [+]) hoc diutius durat ab illa impressus motus; plumae vero et similia corpora quae nullam habent (+ id est exiguam+) resistentiam motum non facile concipiunt, nec scorpionibus aut fundis sunt apta … Motum quem infert forma materiae, facultas vel anima suo corpori non solemus violentum reputare (+ id est meo sensu qui sequitur ex vi jam semel inexistente +) cum nihil sit magis naturale materiae quam sua forma, corpori quam sua facultas vel anima …sic cursus animalium …pro violentis non habentur" (LH 35, 15, 6, Bl. 28r).

[17] The complete passage, which Leibniz does not quote in its entirety, reads as follows: "Sic cursus animalium impetu corpora sua librantium in aere, saltusque felium, aut jaculationes serpentum pro violentis non habentur" (*Epitome* 119). A very clear overview of these Keplerian ideas is given by Gassendi in a passage of his *Syntagma philosophicum*: "adnoto dumtaxat Keplerum ita Sidera fecisse animata; ac ut instrumenta Motus in Animalibus sunt fibrae digestae per musculos; sic censuisse illum esse & in Terra, & in Planetis caeteris ingenteis fibras aliquas pro ratione molis cuiusque, per quas Anima vim suam motricem excerceat" (OOG, I, 635a). There's a chance that Leibniz himself was familiar with this passage from the chapter "*De Motibus Siderum*" of the *Syntagma*. A series of notes and comments from 1672-1673, which largely focus on astronomical matters, attest to Leibniz's familiarity with Gassendi's *Opera omnia* (Cf. A VIII 2, 3-8). On Gassendi's reading of this Keplerian idea of a motive soul, see Sakamoto, "The German Hercules's Heir".

[18] Although Kepler uses the *form-matter* lexicon, he seems, elsewhere in this same question (in a passage not excerpted by Leibniz), to mean by form the configuration of the fibers, which here explains the magnetic action of a body: "Magnes natura materiae tendit deorsum, at natura corporeae formae specialis, ascendit ad magnetem alium" (*Epitome* 119).

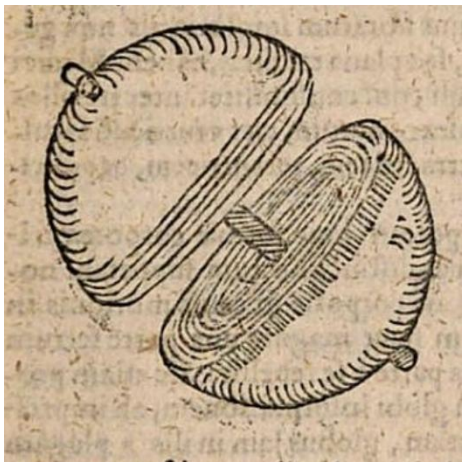
[19] "Terra tota, quatenus tota, et respectu suae materiae, motum plane nullum habet naturaliter: materiae enim, qua plurima Terra constat, propria est inertia, repugnans motui, eaque tanto fortior, quanto major est copia materiae in angustum coacta spacium" (*Epitome* 118).

quantitas materiae, *volumen* (or *extensio materiae*), and *densitas* (or *intensio materiae*), which he extensively systematized in his 1690 *Dynamica*[20].

Leibniz not only recognizes his concepts of inertia and active force in Kepler's writing. He goes further, reading in the *Epitome* something similar to his own distinction between primitive and derivative active forces:

> p. 122. Even if this corporeal form of the fibers were established as the only cause of motion, what moves and what is moved would nonetheless not be the same. The same globe will rest and resist to motion by reason of the [straight] fibers, will be moved by reason of the circular fibers and receive an *impetus* because of their material inertia to motion, and finally it will move by reason of the form extended through these circular fibers. (+ Here he excellently distinguishes the primitive force or form, the secondary force or *impetus*; and matter or inertia. But he ignored that all intrinsic force, excluding only the laws of motion (which arise from higher principles), can be mechanically explained; nor, therefore, is there a need to invoke form here +)[21].

In this passage, Kepler illustrates the cause of the Earth's rotational motion. He distinguishes three factors involved in this motion of the globe: first, the straight fibers – which stabilize the axis, as we have seen – cause the globe to resist motion; secondly, the circular fibers facilitate circular motion and receive an *impetus* to move; and finally, the form – conceived as a motive faculty (*facultas motrix*) – moves the globe (Fig. 26, below).



[Fig. 26, from *Epitome* 121]

[20] These are the three definitions of the second chapter "*De quantitate materiae seu volumine et densitate*" (CFP II-1 34-36). The relation between these three concepts is expressed as follows in the first definition of the *Conspectus Phorometricus*: "MOLES SEU QUANTITAS MATERIAE *est factum ex ductu voluminis seu extensionis materiae in densitatem seu materiae intensionem*" (CFP II-1 336).

[21] "p. 122. Etiamsi haec forma corporea fibrarum solitaria motus causa statueretur, non esset tamen idem quod movet et movetur. Globus idem ratione [rectarum] fibrarum quiescet et motui substabit, ratione circularium fibrarum movebitur, earumque materiali ad motum inertia concipiet impetum denique ratione formae per has circulares fibras porrectae movebit. (+Hic optime distinguit vim primitivam seu formam, vim secundariam seu impetum; et materiam seu inertiam. Sed nescivit omnem vim intrinsecam presuppositis tantum legibus motus, (quae ex altioribus principiis oriuntur) mechanice explicari posse; neque adeo hic formam esse advocandam +)" (LH 35, 15, 6, Bl. 28v).

According to Kepler, the globe's rotation is initially caused by an original impression from God, which imprints a circular configuration on the Earth's fibers, ensuring the continuation of this rotational motion. These fibers are not the cause of motion, but an instrument of a motive soul: if God provides the original impulse, the motion is then continued by the Earth's soul[22]. In the globe's fibers – in its material component, in other words – Leibniz identifies his own concept of 'inertia or matter' (*inertia seu materia*). In the *impetus* that these fibers receive, he reads his own secondary (or derivative) active forces, which he often denotes using the same terminology[23]. Finally, he associates the form or motive faculty with his own primitive active force.

Thus, Leibniz reads in Kepler the basic concepts of dynamics. Kepler's limitation lies in not having recognized the true distinction between primitive and derivative forces, namely that once the "higher principles" (i.e., primitive forces) are established, "whenever we treat the more accessible and particular efficient causes of natural things we find no place for these souls or entelechies, any more than for superfluous faculties and inexplicable sympathies"[24]. Thus, Leibniz subjects Kepler to the same critique he applies to other proponents of non-mechanical principles of activity in nature (e.g., the hylarchic principle, plastic natures)[25]: while it is coherent to acknowledge the existence of such active principles, these do not play an actual role in explaining natural phenomena, which consist solely of the mechanical interactions of bodies[26]. These inherent forces explain only what occurs "*in monade seu substantia*", namely, the succession of internal states that proceed in parallel to the successive states of bodies.

The foregoing analysis of the manuscript's key passages shows that Leibniz engages with Kepler's text in a particularly distinctive way. As already noted, this is not a critical discussion of Kepler's actual positions. Rather, it is an attempt to uncover in the *Epitome* elements that resonate with Leibniz's own theory of forces and of the "constitution of bodies". While Leibniz does not shy away from pointing out the problematic aspects of certain Keplerian assumptions, it is clear that his

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[22] See Boner, *Kepler's Cosmological Synthesis*, pp. 139-158.

[23] Of course, the concept of *impetus* is employed by Kepler in a very different sense from that of Leibniz, who understands it as "the product of the mass of the body [*moles*] and its velocity" (*Specimen Dynamicum*, GM VI 237 / JANP 179).

[24] Ibid. 242-243 / 186.

[25] See, for example, *De ipsa natura* §2: "Itaque et calidum omniscium Hippocratis, et Cholcodeam animarum datricem Avicennae, et illam sapientissimam Scaligeri aliorumque virtutem plasticam, et principium hylarchicum Henrici Mori, partim impossibilia, partim superflua puto; satisque habeo, machinam rerum tanta sapientia esse conditam, ut ipso ejus progressu admiranda illa contingant, organicis praesertim (ut arbitror) ex praedelineatione quadam sese evolventibus. Itaque quod Vir Cl. naturae cujusdam creatae, sapientis, corporum machinas formantis gubernantisque figmentum rejicit, probo. Sed nec consequi inde nec rationi consentaneum puto, ut omnem vim creatam actricem insitam rebus denegemus" (GP IV 505).

[26] An emblematic passage in this sense is the remark on Kepler in the 1689 *Tentamen*, where Leibniz writes: "Sed tantarum tamque constantium veritatum causas dare nondum potuit, tum quod Intelligentiis, aut sympathiarum radiationibus inexplicatis haberet præpeditam mentem, tum quod nondum illius tempore Geometria interior, et scientia motuum eo quo nunc, profecissent" (CFP II-2 578).

primary aim is to construct a precursor. This concerns not only natural inertia, whose Keplerian lineage is explicitly acknowledged by Leibniz in many other writings, both private and public, but also his theory of active forces, which he here traces back to Kepler's concept of motive souls. In my view, this private document is revealing of what Leibniz sought to achieve when, from the mid-1690s onwards, he mentioned Kepler whenever introducing the notion of natural inertia. Before advancing a hypothesis regarding the reasons for this operation, it is necessary to examine another point: the relationship between this Keplerian notion of inertia and Descartes, whom Leibniz sometimes mentions alongside Kepler. To this end, several polemical exchanges from this period are particularly revealing, and an examination of these exchanges will help to clarify how Leibniz's concept of natural inertia relates to what we would now call the principle of inertia.

2. Natural Inertia and the Kepler-Descartes Connection

From the mid-1690s onwards, Leibniz regularly mentioned Kepler when discussing natural inertia. In some of the very same passages, he also mentions Descartes among those who acknowledged this idea. In a letter to De Volder written in the same years as the manuscript, for example, Leibniz writes as follows: "I have noted that, following the example of Kepler, in his letters Descartes also recognized inertia in matter"[27]. He repeats this observation in later writings, most notably in the *Essais de Théodicée* (1710)[28]. The meaning of this Cartesian reference is not immediately obvious. It is precisely against Cartesianism that Leibniz framed his account of natural inertia in the early 1690s[29]. There are two key considerations, however, that can help us to clarify what Leibniz is aiming to accomplish with this allusion to Descartes.

First, it should be noted that when Leibniz cites Descartes as a proponent of natural inertia, his purpose is to claim that Descartes adopted an idea that was already present in Kepler. This reflects a broader tendency in Leibniz to trace innovations commonly attributed to Descartes back to earlier authors, so as to call into question Descartes's originality. In a text from 1689, for example, Leibniz attributes certain Cartesian ideas to figures such as Thomas Harriot, Isaac Vossius, Willebrord

[27] "Inertiam in materia alicubi, exemplo Kepleri, et Cartesium in Epistolis agnovisse notavi" (G. W. Leibniz to B. De Volder, 24 March 1699, A II 3 546 / LDV 73).
[28] In 1702 he writes: "Itaque duo insunt Resistentiae sive Massae, primum Antitypia ut vocant seu impenetrabilitas; deinde restitantia seu quod Keplerus vocat corporum inertiam naturalem, quam et Cartesius in *Epistolis* alicubi ex eo agnovit, ut scilicet novum motum non nisi per vim recipiant corpora adeoque imprimenti resistant et vim ejus infringant" (*Principia mechanismi ex altiore fonte*, A VI 5 ve N. 2642); see also the *Essais de Théodicée*: "Le celebre Kepler et apres luy M. des Cartes (dans ses Lettres) ont parlé de *l'inertie naturelle des corps*" (GP VI 119).
[29] See, for example, *Excerpt from a Letter on the Question Whether the Essence of Body Consists in Extension* (A VI 5 ve N. 2130), published in the *Journal des sçavans* of 18 June 1691.

Snell, and, significantly, Kepler[30]. Particularly telling is his attribution to Kepler of the idea of the "rejection by the tangent" of a body in circular motion (what Huygens would later call centrifugal force) as expressed in the second law set down in Descartes's *Principia*[31]. The same genealogy appears in the contemporary *Phoranomus* and explains why Leibniz copied extracts on circular motion into the manuscript analyzed above, before devoting most of it to the theory of forces[32]. Even in the mid-1680s, Leibniz was pursuing a similar strategy. For instance, he regarded Cartesian vortices as nothing more than a translation of the ideas of "Leucippus, Giordano Bruno, Copernicus, Gilbert, and Kepler" from the "language of qualities" into "the language of small bodies"[33]. This claim is famously reiterated at the opening of the *Tentamen de motuum caelestium causis*, where the reference to Kepler and his *Epitome* is even more explicit[34].

It is therefore natural to read the references to natural inertia in this light, and a brief unpublished text provides further confirmation. Leibniz opens this fragment as follows: "Kepler provided the principle and the occasion for many discoveries by others; from him Descartes learned the inertia of matter and rejection along the tangent, topics treated in the *Epitome*"[35]. He then proceeds to list other insights originally due to Kepler that were subsequently developed by Descartes himself, Cassini, and others. The document refers to marginal notes made by Huygens in his own copy of Kepler's *Somnium*. This indicates that it was written after 1695, the year, as we have seen, in which Leibniz gained access to these works of Huygens. It is thus reasonable to infer a close chronological connection between this text, the manuscript of notes on the *Epitome*, and the 1699 letter to De Volder. The reference to Descartes should therefore be understood as Leibniz's attempt to underscore Descartes's debt to Keplerian ideas as retrieved and emphasized by Leibniz himself.

The second consideration arises from a detail that characterizes these mentions of Kepler and Descartes – namely, the fact that Leibniz refers specifically to Descartes's letters. It is only in some letters, indeed, that Descartes speaks about natural inertia. These are the letters to Mersenne on 6

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[30] *Notata quaedam G. G. L. circa vitam et doctrinam Cartesii* (A VI 4 2057-2065).
[31] Ibid. 2059.
[32] "Est vis centrifuga quod ei nomen imposuit Hugenius, rem autem primus quod sciam Keplerus consideravit! […] Quod Keplero primum in mentem venit, postea uberius explicuit Cartesius" (*Dialoghi* 750-751). See subsection §5.2.1, footnote 78 for the excerpts.
[33] "Les tourbillons sont bien pensés, cependant joignant les pensées de Leucippus, de Jordanus Brunus, de Copernic, de Gilbert et de Kepler, il ne pouvoit manquer d'y venir, en traduisant quelques fois les expressions de certains bons auteurs, qui parloient encor le langage des qualités en la langue des petits corps, sans faire grand changement dans les pensées" (*De la philosophie cartesienne*, 1683-1684/85, A VI 4 1486).
[34] CFP II-2 576-580.
[35] "Keplerus plurimis aliorum inventis, principium et occasionem dedit; ab eo didicit Cartesius inertiam materiae, et rejectionem per tangentem, de quibus in *Epitoma*" (LH 35, 8, 30, Bl. 69).

December 1638 and 25 December 1639, and to Florimond Debeaune on 30 April 1639[36]. Here, Descartes rejects the notion of natural inertia as an intrinsic resistance to motion. Using the example of larger and smaller ships pushed by the same wind, he admits, nonetheless, that larger bodies, propelled by the same force, move more slowly. Descartes justifies this stance on the basis of his law of conservation of the quantity of motion (mv): if the product of mass (m) and velocity (v) is constant, an increase in mass will result in a decrease in velocity[37]. In this qualified sense, Descartes can thus claim that "the more matter a body contains, the more *Natural Inertia* it has"[38]. Here Descartes adopts the terminology introduced by Debeaune, while explaining the phenomenon it describes within the framework of his own physics: larger bodies are moved more slowly by the same force, but matter itself does not possess any intrinsic resistance to motion.

It is thus a fundamental ambiguity that allows us to better understand Leibniz's reference to Descartes. The term natural inertia, in fact, is used by Leibniz to indicate both the natural phenomenon by which larger bodies resist motion more *and* the property of matter that accounts for this behavior[39]. Descartes accepts the first meaning of natural inertia but explicitly rejects the second: contrary to Kepler and the mature Leibniz, he does not believe that matter is intrinsically resistant to motion, but he accepts and explains the phenomenon of natural inertia using the tools of his physics (his theory of matter as extension, his laws of nature). For Leibniz, however, it is impossible to account for this behavior of bodies without acknowledging this additional *quality* within them, a passive force of resistance[40].

This contrast is evident in Leibniz's exchange with Burchard De Volder. In his letters from 1698 and 1699, Leibniz presents to De Volder his own account of natural inertia, referring both to Kepler and to the Cartesian letters I mentioned. On this question, De Volder takes a thoroughly Cartesian stance. In response to Leibniz, he states that this material inertia does not "denote anything distinct

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[36] R. Descartes to M. Mersenne, 5 December 1638, AT II 466-467; R. Descartes to F. Debeaune, 30 April 1639, AT II, 543-544; R. Descartes to M. Mersenne, 25 December 1639, AT II 627.

[37] Cf. Gabbey, "Force and Inertia in Seventeenth-Century Dynamics", pp. 287-289 and Garber, *Descartes' Metaphysical Physics*, pp. 253-254.

[38] "Et pour ce que, si deux cors inégaux reçoiuent autant de mouuement l'un que l'autre, cette pareille quantité de mouuement ne donne pas tant de vitefle au plus grand qu'au plus petit, on peut dire, en ce sens, que plus un cors contient de matière, plus il a d'Inertie Naturelle" (R. Descartes to F. Debeaune, 30 April 1639, AT II, 543).

[39] For the first sense, see, for instance, a passage from the *Phoranomus* (1689): "Ex his aliisque argumentis multiplicibus collegi tandem, materiae naturam nobis nondum satis cognitam esse, nec inertiae corporum, aut potentiae rationem reddi posse nisi aliquid aliud quam extensio et impenetrabilitas in corporibus statuatur" (*Dialoghi* 798). The second meaning of the term is clearly expressed in a passage from *Journal des sçavans* (18 June 1691; A VI 5 ve N. 2130): "Nous remarquons dans la matiere une qualité que quelques uns ont appellée l'*inertie naturelle*, par laquelle le corps resiste en quelque façon au mouvement".

[40] Ultimately, therefore, I agree with Bertoloni Meli in claiming that "Despite important differences of metaphysical beliefs and conservation laws, both Leibniz and Descartes consciously reinterpreted Keplerian inertia within their views on motion and impact physics" (Bertoloni Meli, "Inertia", p. 512).

from extension"[41]. He asserts that everything has a 'force' to persevere in its state, which does not differ from the nature of the thing: in the case of Leibniz's material inertia, it is not something additional to extension, but it derives from it and can be explained without admitting any additional property of matter. For Leibniz, this cannot be the case: by considering matter solely as extended or as what fills space, and motion as merely a change of place, we end up with purely geometrical descriptions of the interactions of bodies indifferent to motion and rest[42]. Bodies so conceived, he explains, can retain a state until something changes it, but such a body cannot be said "to have a force and, as it were, an inclination to retain its state, and so to resist changing"[43]. De Volder's approach is twofold and sheds light on the contrast between these Leibnizian ideas and the Cartesian framework. First, he identifies natural inertia with the first Cartesian law of nature, according to which "each thing, by its own nature, always perseveres as far as possible in the same state"[44]. Secondly, to account for this perseverance, he claims that nothing is needed in matter beyond extension. It is this identification that lies at the heart of the disagreement between Leibniz and De Volder: inertia, in the Keplerian-Leibnizian sense, is something quite distinct from the first Cartesian law, which articulates what in a post-Newtonian lexicon could be referred to as a 'principle of inertia'[45].

A similar divergence occurs, in the same years, in Leibniz's correspondence with Denis Papin[46]. In these letters, however, Leibniz is even more explicit in clarifying his stance regarding these two different concepts and their relation. In one of his letters Papin had stated that "mass is absolutely indifferent to motion and rest"[47], referring to the example of a globe rotating around its axis. According to Papin, there is no mass that continuously resists force, but only the body's perseverance in the same state of being (*maniere d'être*). In 1699, Leibniz counters as follows:

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[41] B. De Volder to G. W. Leibniz, 18 February 1699 (A II 3 530/LDV 61).

[42] This is the same argument that Leibniz had already employed as early as 1678-1680/81 (Cf. A VI 4 1980) and continued to use in his later writings, including the text published in the *Journal des sçavans* of 18 June 1691.

[43] "Fateor unumquodque manere in statu suo, donec ratio sit mutationis, quod est metaphysicae necessitatis principium, sed aliud est statum retinere donec sit quod mutet, quod etiam facit per se indifferens ad utrumque, aliud est multoque plus continet rem non esse indifferentem sed vim habere et velut inclinationem ad statum retinendum atque adeo resistere mutanti" (G. W. Leibniz to B. De Volder, 24 March 1699, A II 3 546-47/LDV 73-5).

[44] "unaquaeque res, quantum in se est, semper in eodem statu perseveret" (Descartes, *Principia Philosophiae*, AT VIII 62).

[45] Howard R. Bernstein seems to conflate these two senses. In his translation of a passage from Leibniz's *Animadversiones* to *Principia Philosophiae*, where Leibniz discusses Descartes's first law, he renders the text using the term 'inertia,' which is absent from the original and complicates the interpretation (See Bernstein, *Passivity and Inertia in Leibniz's Dynamics*, p. 109). On the anachronism of labelling these Cartesian ideas as 'inertia', see Cohen, "*Quantum in Se Est*", and Gabbey, "Force and Inertia in Seventeenth-Century Dynamics", esp. 288-291; for a more general perspective, see Roux, "Découvrir le principe d'inertie".

[46] For a thorough overview of the exchange, see Ranea, "The *a priori* Method and the *actio* Concept Revised".

[47] "Je suis tres persuadé que la masse est absolument indifferente au mouvement et au repos et qu'elle resiste simplement à ce qui tend à changer sa maniere d'être" (D. Papin to G. W. Leibniz, 13 February 1699, A III 8 59).

> We agree on the fact that a body at rest resists motion, and that a body in motion resists rest. Now, according to me rest is nothing but a simple privation; it follows that it is the mass itself that resists motion, and this is what I call, along with Kepler, inertia. But when the body is in motion and resists rest, then I maintain that it has a force or entelechy, which makes it tend to continue the motion. Hence it follows that the mass continuously resists the entelechy, and thus there is action and reaction within the body itself[48].

Leibniz had long acknowledged the Cartesian perseverance endorsed by Papin[49]. The inclination to maintain rest and the inclination to maintain motion, however, require a positive reason, some principles within bodies: these, respectively, are natural inertia and entelechy[50]. Leibnizian inertia, therefore, does not correspond to the perseverance of bodies expressed by Descartes's first law, but only to the bodies' inclination towards rest. To account for the behavior of bodies described by this law, one needs, in fact, both an active and a passive principle, that is the action and reaction of entelechy and inertia intrinsic to every body.

The example chosen by Papin, therefore, helps to highlight the differences between the Cartesian position endorsed by himself and De Volder, and those of Leibniz and Kepler. The problem of the Earth's rotational motion (or, more simply, the motion of a globe rotating around its axis) is central to many of the aforementioned passages of the *Epitome* that attracted Leibniz's commentary. Kepler's explanation refers to the natural action of the Earth's motive soul upon its body. As we have seen, Leibniz recognizes here his own idea of intrinsic forces in bodies, but he adjusts the Keplerian approach with the distinction between derivative and primitive forces. In this sense, one should understand the intrinsic action and reaction mentioned in the last passage quoted above, which illuminates Leibniz's own use of Keplerian inertia. Bodies possess an intrinsic resistance to motion (natural inertia), but are at the same time continuously acted upon by an intrinsic impulse to motion (entelechy). Leibniz thus grounds metaphysically the mechanical behavior of bodies resisting motion and rest; rejecting such dynamical principles, Papin explains such resistance by

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[48] "Nous sommes d'accord dans le fait, que le corps en repos resiste au mouvement, et que le corps en mouvement resiste au repos. Or selon moy le repos n'estant autre chose qu'une simple privation; il s'ensuit que c'est donc la masse en elle même qui resiste au mouvement, et c'est ce que j'appelle avec Kepler, inertie. Mais quand le corps est en mouvement, et resiste au repos, alors je tiens qu'il a une force ou entelechie, qui le fait tendre à continuer le mouvement. D'où il s'ensuit que la masse resiste continuellement à l'entelechie, et ainsi qu'il y a action et reaction dans le corps même" (G. W. Leibniz to D. Papin, 28 February 1699, A III 8 69).

[49] Leibniz already endorses a similar principle in his 1669 *De rationibus motus* (A VI 2 160-161). This version of the principle, however, is closer to the one expressed in Hobbes's *De corpore*, as Leibniz explains to Oldenburg a couple years later: "Prima vera est, *princip*. part. 2. n. 37. sed a Cartesio non demonstrata. Demonstravit eam primus Hobbius, quod semel moveatur, semper, quantum in se est, moveri" (G. W. Leibniz to H. Oldeburg, 15 October 1671, A II 1 272).

[50] "Et l'inclination d'un corps en repos à garder ce repos appartient justement à ce que j'appelle inertie; et l'inclination d'un corps en mouvement à garder ce mouvement appartient aussi à ce que j'appelle entelechie qui en effect ne signifie que cette inclination" (G. W. Leibniz to D. Papin, April 1699, A III 8 96-97).

appealing to the bodies' indifference to any state, and relies instead on Descartes's first law of nature.

3. A German Precursor in Opposition to the Newtonian Front

We have seen that Leibniz's reference to Keplerian inertia is best understood as an attempt to position Kepler as a precursor. Nowhere else than in the manuscript examined above does Leibniz again draw the connection between Kepler's motive souls and his own notion of active force; elsewhere, he prefers instead the more established and immediately intelligible terminology of entelechy or substantial form. His references to Kepler in connection with natural inertia, however, remain consistent, a vestige of a broader, if only partially realized, effort to cast Kepler as an intellectual forerunner. His occasional invocations of Descartes also become more easily understood in this light, since Descartes himself is presented as ultimately indebted to the author of the *Epitome*. The question then becomes why does Leibniz, having already elaborated and referred to this concept for over a decade, now start to insist on its Keplerian provenance? In my view, the most compelling hypothesis is that this tendency should be read against the backdrop of Leibniz's engagement with what was arguably, for him, the most influential text in the late 1680s, namely, Isaac Newton's *Philosophiae Naturalis Principia Mathematica*.

From the standpoint of Newton and his follower Samuel Clarke, the opposition between the *vis inertiae* of the *Principia* and Leibniz's notion of natural inertia was explicit. In his polemical exchange with Leibniz, Clarke contrasts the Newtonian definition of *vis inertiae* as the passive force by which matter "*equally resists* Any change *from the State it is in, either of* Rest *or* Motion" with Leibniz's account of inertia as mere resistance to motion, dismissing the latter as an inadequate remnant derived from Kepler's by-then outdated physics[51]. Newton himself likely reached similar conclusions upon reading about Keplerian inertia in the *Essais de Théodicée*. Indeed, as I. Bernard Cohen famously demonstrated, Newton underlined the passages on inertia in his copy of the *Théodicée* and, in a brief 1713 note, explicitly contrasted his own understanding of inertia with that of Kepler, writing: "Non intelligo vim inertiae ~~Kepleri~~ aliquorum qua corpora ad quietem tendunt

[51] Cf. Clarke's *Fifth Writing*, §99, footnote (Brown 787). Clarke also refers to section 7 of his appendix (of his edition of the correspondence), where he assembled many quotations by Leibniz in support of Keplerian inertia (see Brown, pp. 826-829).

sed vim manendi in eodem seu quiescendi seu movendi statu"[52]. From a Newtonian perspective, Leibniz's conception of inertia is deficient because it accounts only for matter's resistance to motion, without encompassing resistance to any change of state. Newton's intrinsic *vis inertiae*, by contrast, explains both aspects of a body's persistence in its state, while it is an extrinsic *vis impressa* that produces a change of state[53]. As I have shown through the 1698-1699 correspondence with De Volder and Papin, however, Leibniz does acknowledge this persistence of bodies, grounding it not on inertia alone but on the combined interplay of entelechy (active force) and natural inertia (passive force). For Leibniz, both principles are intrinsic to bodies, thereby excluding any appeal to extrinsic impressed forces[54].

The way in which Newton and Clarke opposed Leibniz's Keplerian inertia is thus clear. The documents available to us, however, also allow us to understand Leibniz's own attitude towards Newtonian inertia. Already in 1688, Definition 3 of the *Principia* had attracted Leibniz's attention, prompting one of his most extensive marginal comments from his first reading of the work. In that note, Leibniz equated Newton's *vis inertiae* with his own *inertia materiae*, by which he clearly meant the "private resistance" he attributed to bodies as an effect of passive force. In the comments on Kepler's *Epitome*, by contrast, Newton is not explicitly mentioned. Yet the second part of the manuscript is entirely focused on the Newtonian notion of attraction, particularly its use to explain the cohesion of bodies, which is the very explanation criticized in Leibniz's note on Definition 3. Here Newton is named directly. More importantly, Leibniz draws clear connections between the authors he cites by tracing their shared debt to Newton's idea. Bentley, for example, invokes Newtonian attraction to account for how atoms scattered in the void combine to form compound bodies and, more broadly, the world as we know it[55]. Bentley also treats this attraction, impressed by God into bodies, as proof of God's existence[56]. Similarly, Locke, in his reply to Stillingfleet,

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[52] The same note, without the substitution of "Kepleri" with "aliquorum", also appears in the margin of Definition 3 in Newton's copy of his *Principia*; see Cohen, "Newton and Keplerian Inertia" and Cohen, "Newton's Copy of Leibniz's Theodicée".

[53] "*Vis impressa est actio in corpus exercita, ad mutandum ejus statum vel quiescendi vel movendi uniformiter in directum*" (Newton, *Principia*, p. 2).

[54] For a comparative analysis of Leibniz's and Newton's "Force", see Garber, *Leibniz: Body, Substance, Monad*, pp. 172-179.

[55] Excerpting from Bentley's *Stultitia et irrationabilitas atheismi*, Leibniz writes: "p. 350. per attractionem … eam materiae vim et qualitatem volumus, cujus ope universae materiae particulae mutuo attrahantur sive mutuo ad alias quascunque tendant, ita, ut ex. gr. duae in vacuo ab invicem segregatae Atomi sponte sua nullo externo corpore impellente sint coiturae… prorsus concipi nequit quo pacto materia bruta ac inanimata nullo intercedente Ente immateriali in materiam aliam operari eamque afficere possit absque contactu mutuo; Corporave ab invicem distantia in se mutuo per vacuum agere interveniente nihilo cujus ope actio ab uno corpore ad aliud transferri queat" (LH 35, 15, 6, 29r).

[56] Again, from Bentley: "p. 354 quod si [eas vis materiae] non sit essentialis manifeste consequitur nunquam eidem superventuram fuisse, nisi incorporea et divina potentia ei impressam atque infusam. p. 355 si firma ratione demonstretur ejusmodi vim gravitatis revera existere atque in praesentis systematis constitutione perpetuo sese exerere ea res utique novum et invictum pro afferenda numinis existentia argumentum nobis suppeditabit" (LH 35, 15, 6, 29v).

accepts the notion of an attraction imprinted by God in bodies, stating that he adopted it after reading Newton and intended to incorporate it into the new edition of the *Essay*[57]. In a marginal note, likely added when he had completed his reading, Leibniz writes unequivocally: "Matter, according to Newton, Locke, Bentley, acts at a distance"[58].

It is therefore clear that Leibniz regarded these British authors as constituting a kind of "Newtonian front", united by their acceptance of Newton's controversial admission of action at a distance and their theological and metaphysical elaboration thereof. My claim is that it is precisely against this "front" that we should read Leibniz's reappropriation of Kepler. From the anti-Cartesian polemics of the early 1690s to the period of the Keplerian manuscript, we can see a gradual shift in Leibniz's focus. Around the mid-1690s, he read Locke's *Essay*; between this first reading and 1704 (the year of the composition of the *Nouveaux essais* and of Locke's death), Leibniz repeatedly sought to open an exchange with Locke, as attested by his correspondence with Burnett and Damaris Masham[59]. In 1692, Nicolas Fatio de Duillier meanwhile wrote to Huygens accusing Leibniz of plagiarizing Newton's new mathematical method. In 1693, excerpts from Newton's famous 1676 letters were published by John Wallis in the second volume of his *Opera mathematica*, with Wallis claiming in his preface that Newton had disclosed his method to Leibniz in this exchange[60]. By 1699, likely the year of composition of the *Epitome* manuscript, Wallis published in the third volume of the *Opera* both Newton's *Epistola prior* and *Epistola posterior*, alongside the full set of letters exchanged between Leibniz, Newton, Oldenburg, and Wallis himself. At the same time, in his *Lineae brevissimi descensus investigatio geometrica duplex*, Fatio publicly accused Leibniz of plagiarism, prompting Leibniz's reply in the May 1700 issue of the *Acta Eruditorum*[61].

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[57] Excerpting from *Mr. Locke's Reply to the Right Reverend the Lord Bishop of Worcester's Answer to His Second Letter* (1699): "p. 408. T'is true I say (*Essay* Book 2. Ch. 8. §. 11) that Bodies operate by impulse and nothing else; and so I tought when I writ it, and yet can conceive no other way of their operation. But I am since convinced by the judicious Mr. Newton's incomparable Book, that is too bold a presum[p]tion to limit God's power in this point, by my narrow conceptions. The gravitation of matter towards matter by ways unconceivable to me is not only a demonstration that God can if he pleases put into bodies powers and ways of operation, above what can be derived from our idea of body, or can be explained by what we know of matter, but also an unquestionable and every where visible instance that he has done so. Additque se proxima libri sui editione haec mutaturum" (ibid.).

[58] "Materia sec[undum] Newtonum, Lockium, Bentlejum agit in distans; quod si tanto vigore ageret, quanto ex vicino, oriretur id ipsum quod nos praesentiam appellamus substantialem sed non dimensionalem[,] posito eodem prorsus modo agere, quo si vicinum esset, et in omnibus[:] nam si solum ageret uno aliquo modo ut attractionis, non esset nisi virtualis praesentia, sed si omni virtute, seu per omnia eodem modo[,] tota substantia esset praesens" (*ibid.*). In this note, Leibniz contrasts the "substantial but non-dimensional" presence that characterizes the action of his primitive force with the merely "virtual" presence of Newtonian action at a distance. This same distinction, though without reference to Newton, also appears in his discussion of real presence in the Eucharist with Pellisson (Cf. G. W. Leibniz to P. Pellisson-Fountanier, 8 January 1692, A II 2 484-488).

[59] Cf. Antognazza, *Leibinz: An Intellectual Bibliography*, pp. 406-418.

[60] Ibid. 355-357.

[61] "Newtonum tamen primum, ac pluribus Annis vetustissimum, hujus Calculi Inventorem, ipsa rerum evidentia coactus, agnosco: a quo utrum quiequam mutuatus sit Leibnitius, secundus ejus Inventor, malo eorum, quam meum, sit

It is therefore reasonable to suppose that Leibniz's interest in anti-Cartesian polemic was sidelined, during these years, in favor of a more pressing anti-British agenda. This also explains why he could list Descartes, until then a polemical target of his theory of matter, among the precursors of his own concept of natural inertia. As for Kepler, the principal precursor, Leibniz's insistence on reclaiming him may also be understood in light of what Mattia Brancato has described as "the invention of a German tradition in the sciences"[62]. Leibniz's effort to highlight German contributions to science was not new to this period: he had long underscored the importance of figures such as his teacher Erhard Weigel and the mathematician and philosopher Joachim Jungius, whom he described as "the only man of his time, after Kepler, whom one could set against Galileo and Descartes"[63]. With the intensification of the calculus dispute, this strategy would become increasingly explicit, as documented by the unpublished *Antiplagiarius* (1713), a short history of science written by Leibniz that aimed, as its full title suggests, to vindicate German achievements[64]; amongst these were included Zacharias Janssen and Jacob Metius in the invention of the telescope, Boyle's debt to Johann Rudolph Glauber's chemistry, Kepler's priority over Descartes, and, of course, Leibniz's own priority in the invention of the calculus over Newton[65].

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From the mid-1690s onwards, Leibniz presents his concept of natural inertia accompanied by references to Kepler (and occasionally to Descartes). These references, at times made in such a way as to epitomize his entire dynamics, reflect a deliberate presentational strategy. The manuscript containing his notes on the *Epitome astronomiae copernicanae* reveals an operation of clearly

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Judicium, quibus visae fuerint Newtoni Litterae, aliique ejusdem Manuscripti Codices. Neque modestioris Newtoni Silentium, aut prona Leibnitii Sedulitas, Inventionem hujus Calculi sibi passim tribuentis, ullis imponet, qui ea pertractarint, quae ipse evolvi, Instrumenta" (Fatio de Duillier, *Lineae brevissimi descensus investigatio geometrica duplex*, p. 18). For a comprehensive overview of these events, see the classic study Hall, *Philosophers at War*, pp. 110-128.

[62] Brancato, "Christoph Pfautz as a Reviewer for the *Acta Eruditorum*: the Invention of a German Tradition in the Sciences".

[63] "Inter omnes qui veram Apodicticen restituere sunt aggressi hactenus, nullum novi, qui totam rem inspexerit profundius Joachimo Jungio Lubecensi, quem eo minus praeterire debeo, quod non pro merito nosci animadverto. Et tamen hunc fere unum post Keplerum habuit tunc Germania, quem Galilaeo et Cartesio opponere posset" (*Elementa rationis*, 1686, A VI 4 726). On Leibniz relation to Weigel, see Brancato, "Erhard Weigel and His Influence on Leibniz's Philosophy of Mathematics".

[64] The full title reads as "*Antiplagiarius seu vindiciae verorum inventorum, praesertim Germanicorum, contra usurpatores et obrectatores*" (LH 35, 7, 16). Attention to this manuscript was first drawn by Osvaldo Ottaviani. I am grateful to Ottaviani for having provided me with his transcription, of which I make use in this work.

[65] Note that Leibniz regarded the Dutch Janssen and Metius as "Germanic" in an ethno-linguistic sense, viewing the Flemish-Dutch region as part of the broader German cultural and linguistic sphere ("Tandem artifex quidam inferioris Germaniae sive Belgii Germanici, sive is fuerit Zacharias Johannides Middelburgensis, sive … Metius Jacobi celebris Mathematici frater Alcmarianus, concavum vitrum cum convexo conjungens, nobis Telescopium donavit, quo manere primus pulcherrime usus est magnus Galilaeus" LH 35, 7, 16, 2r-2v). Similar remarks relating to Robert Boyle are found in a letter to Christian Wolff, where Leibniz also adds that Otto von Guericke had not been duly credited with the invention of the *Machina vacui* (GLW 159). Finally, it should be noted that the sections on Descartes's debt to Kepler closely parallel those in the aforementioned manuscript LH 35, 8, 30, Bl. 69, although inertia is not alluded to there.

strategic character: the reappropriation of Kepler as a precursor. By invoking the great German scientist during a period marked by an intensifying polemic with the British over the priority of the invention of the calculus, Leibniz sought to lay claim to a German scientific tradition in opposition to the Newtonian front.