EPICUREAN ASTRONOMY?

ATOMISTIC AND CORPUSCULAR STARS IN KEPLER'S CENTURY[1]

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Introduction

At the threshold of modernity, novae and comets increasingly attracted the attention of European cosmologists. In fact, the parallax determination of their distances and cosmic trajectories undermined well established vistas on worldly order.[2] They challenged the scholastic image of nature, as their superlunary location cast doubt on the double physics of the Aristotelians separating the realm of generation and corruption below the Moon from the ethereal perfection of the superlunary heavens, subject only to local motion and by no means to material change. Debates on new stars and comets paralleled the rise of novel planetary theories, which aimed to answer the crisis of the Ptolemaic and Aristotelian cosmos. In this context, Tycho Brahe issued his *De mundi aetherei recentioribus phaenomenis* (1588), which stands out as a clear instance of the convergence of the two tendencies: 1. to recast post-Copernican planetary theory into a geocentric framework and 2. to revise celestial physics in the light of comets' measurements and the dissolution of the celestial spheres or orbs. Such dissolution went hand in hand with the acceptance of the paradoxical-sounding expression

[1] This publication is part of a project that received funding from the European Research Council: the ERC CoG *EarlyModernCosmology* (Horizon 2020, GA 725883).

[2] The literature on the subject is extensive but, for the purposes of the present discussion on the philosophical impact of celestial novelties, it should be sufficient to mention the following sources: Miguel Ángel Granada, ed., *Novas y cometas entre 1572 y 1618: Revolución cosmológica y renovación política y religiosa* (Barcelona: Universitat de Barcelona, 2012); Dario Tessicini and Patrick Boner, eds., *Celestial Novelties on the Eve of the Scientific Revolution, 1540–1630* (Florence: Olschki, 2013). Also, see Granada, *Sfere solide e cielo fluido: Momenti del dibattito cosmologico nella seconda metà del Cinquecento* (Milan: Guerini, 2002).

'celestial novelties,' no longer a contradiction in termini but rather a measurable reality.[3] The transformation of the conception of the heavens made the ideation of an alternative physics urgent. A new natural philosophy should account especially for the motion of planets through a fluid ether in the absence of material transporters.[4] The cosmological shift also opened up a theoretical space for the development of physico-mathematics; this is the task that Johannes Kepler took upon himself in paradigmatic works such as the *Astronomia nova* (1609). Arguably, planetary debates directly inspired the celestial physics of Kepler, Descartes and their likes, though controversies on comets were a secondary but no less important path towards a new mathematical science of nature. Eventually, the planetary and cometary themes converged in the work of Halley and Newton.[5]

Recent scholarship has pointed to the link between Kepler's theory (bringing together heliocentrism with novel laws and geometries of planetary motion) and the discussion of celestial novelties (first, his edition of Brahe's posthumous work on the nova of 1572, and secondly the discussion of the nova of 1604).[6] The theoretical challenge for Kepler – just as for Brahe one generation earlier – was to account for celestial novelties without renouncing the geometrical harmony of the heavens. In the concluding sections of *De stella nova in pede Serpentarii* (1606), Kepler cautioned astronomers against neo-Epicurean interpretations of the nova as a testimony that nature is ruled by chance:

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[3] In this respect, the exchanges between Christoph Rothmann and Tycho Brahe on comets and celestial fluidity are of the utmost relevance. See, among others, Miguel A. Granada, Adam Mosley and Nicholas Jardine, *Christoph Rothmann's Discourse on the Comet of 1585: An Edition and Translation with Accompanying Essays* (Leiden-Boston: Brill, 2014).

[4] Cf. Granada, "'A quo moventur planetae? Kepler et la question de l'agent du mouvement planétaire après la disparition des orbes solides," *Galilaeana*, 2010, 7: 111–141. Also, see William H. Donahue, *The Dissolution of the Celestial Spheres, 1595–1650* (New York: Arno Press, 1981) and Mary S. Kelly, *Celestial Motors: 1543–1632* (Ph.D. Dissertation, University of Oklahoma, 1964).

[5] This is Édouard Mehl's point in his article, "Théorie physique et optique des comètes de Kepler a Descartes," in *Novas y cometas* (ref. 1), pp. 254–274.

[6] In particular, see Patrick J. Boner, "Kepler's Copernican Campaign and the New Star of 1604," in *Change and Continuity in Early Modern Cosmology*, ed. Patrick J. Boner (Dordrecht: Springer, 2011), pp. 93–114.

> Only those philosophers to whom confusion is pleasing rather than order, who have debased the most beautiful world with intolerable atoms, deserve this, [namely] that neither are they moved by the beauty and congruence of that which they call chance nor do they allow others to take pleasure [in them].[7]

As Kepler explained, his words should not be read as an implicit acknowledgment of the beauty of chance (*pulchritudo casus*) but, on the contrary, as an attack on chance itself. For him, *casus* is opposed to natural causality and goes together with impiety:

> For what is chance? To be sure, it is a very detestable idol, and nothing but an offence to the highest and almighty God and to the most complete [*absolutissimi*] world He created. A blind and brash motion is ascribed to it as its soul and an infinite chaos as its body. Hence, the eternity, the omnipotence and the creation of the world, which belong to God, are impiously transferred [to nature].[8]

Kepler's "opposition to unnamed Epicureans," as Patrick Boner has stressed,[9] raises the question of the contemporary dissemination of theses linked to the Epicurean legacy. Certainly, Kepler picked up polemical themes that were widespread among the followers of Philipp Melanchthon at Protestant universities.[10] However, the question remains: Who were the dangerous Epicureans of Kepler's time, what theories did they put forward and what accounts of the celestial novelties did they advance?

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[7] Cf. *De stella nova*, *JKGW*, 1 285.40–286.3: "Soli hi philosophi, quibus pro ordine placet confusio, qui mundum pulcherrimum inter inamoenas atomos abiecerunt, hoc sunt meriti, ut pulchritudine et congruentia huius, quem dicunt, casus, nec ipsi moveantur, nec alios delectari patiantur." English translation by Patrick J. Boner from *idem*, "Kepler v. the Epicureans: Causality, Coincidence and the Origins of the New Star of 1604," *Journal for the History of Astronomy*, 2007, 38: 207–221, on p. 211.

[8] *De stella nova*, *JKGW*, 1, 284.18–23: "Casus vero quid est? Nimirum idolum est detestabilissimum, et nihil aliud nisi contumelia summi et omnipotentis Dei, et quem ille condidit, Mundi absolutissimi: Cui motus caecus et temerarius est pro anima, chaos infinitum pro corpore. Huic et aeternitas, et omnipotentia et Mundi creatio, Dei propria, transcribuntur nefarie."

[9] Boner (ref. 5), p. 216.

[10] The anti-Epicurean polemic is recurring in Philipp Melanchthon and Paul Eber's *Initia doctrinae physicae*, first published in 1549. The criticism begins in the dedicatory letter. Cf. *Initia doctrinae physicae* (Wittenberg: Johannes Lufft, 1549), f. A5r: "Non enim a Democrito aut Epicuro, aut aliis, qui doctrinam corrumpunt, ars petenda est."

My present purpose is to discuss the natural-philosophical dimension of the problematic evidenced by Kepler's concerns, but I would also like to go beyond Kepler and trace some general lines underscoring the presence of Epicurean themes in the comet controversies of the sixteenth and seventeenth centuries. I will specifically consider atomistic and corpuscular motifs connecting the debates on new stars and comets before and after Kepler. Atomism and the corruptibility of the heavens – theses that were reinforced by observations of celestial novelties – were at odds with the harmonic vision of the world that Kepler had embraced from the outset of his astronomical enterprise, as is clearly evidenced by the theological speculations of *Mysterium cosmographicum* (1596).[11] In turn, atomistic theories rehabilitated infinitism and cosmological homogeneity, while undermining faith in divine providence and the harmony of Creation. Among the atomists of Kepler's time, one might mention mathematicians and scholars in mechanics such as Giovanni Battista Benedetti and Galileo Galilei, both of whom were persuaded that the existence of a physical void (and atoms) was necessary for motion.[12] That Galileo's atomism could be accused of heresy is well known and should not be discussed in further detail.[13] Here, I will focus on atomistic and corpuscular *philosophers* who contributed to the astronomical debate and the understanding of comets.[14]

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[11] See among other publications Peter Barker and Bernard R. Goldstein, "Theological Foundations of Kepler's Astronomy," *Osiris*, 2001, 16: 88–113; Charlotte Methuen, *Kepler's Tübingen: Stimulus to a Theological Mathematics* (Brookfield: Aldershot, 1998). Also see my essay, "La contingente geometria del cosmo nella Dotta ignoranza cusaniana: Cusano e Keplero a confronto," in *Filosofia Arte Scienza in Cusano e Leibniz*, ed. Antonio Dall'Igna and Damiano Roberi (Milano: Mimesis, 2014), pp. 215–226.

[12] On Galileo, see Paolo Galluzzi, *Tra atomi e indivisibili: La materia ambigua di Galileo* (Florence: Olschki, 2011). On Benedetti, see Pietro Daniel Omodeo and Jürgen Renn, *Science in Court Society: Giovanni Battista Benedetti's* Diversarum speculationum mathematicarum et physicarum liber *(Turin, 1585)* (Berlin: Edition Open Access, in press).

[13] Pietro Redondi, *Galileo Heretic* (Princeton: Princeton University Press, 1989).

[14] Note that Stillman Drake interprets Galileo's atomism as an anti-metaphysical stance, differently than most of the authors I discuss here. Cf. his "Introduction" to *The Controversy on the Comets of 1618*, transl. by Drake and C.D. O'Malley (Philadelphia: University of Pennsylvania Press, 1960): pp. vii–xxv.

Among the atomistic tendencies that might have worried Kepler, one should refer to the Lucretian revival induced by Giordano Bruno, whose philosophy was held in high esteem by many in Kepler's Prague.[15] I will briefly examine Bruno's cometary theory and its reception by the lesser known English philosopher Nicholas Hill, author of the Epicurean and Brunian booklet *Philosophia Epicuraea Democritana Theophrastica proposta simpliciter non edocta* (Paris, 1601, and Geneva, 1619).

As a second phase of the atomistic discussion of celestial novelties in the seventeenth century, I would like to turn to the cometary theory of Pierre Gassendi in his *Syntagma philosophiae Epicuri* (1649), as well as to René Descartes' corpuscular physics, one generation after Kepler. These philosophers' views bear witness to a cultural tendency directed towards the physicalisation of comets at once continuing and opposing the Keplerian line of inquiry. Most importantly, Descartes connected the causal explanation of the origin and dissolution of novae, cometary theory and planetary theory on the basis of a corpuscular matter theory.

As a further development of the atomistic and corpuscular debates surrounding celestial novelties, I will deal with the interpretation of celestial novelties in the context of Cartesian astrology as developed by Johannes Placentinus, a lesser known professor of mathematics at Frankfurt (Oder) and court mathematician of Brandenburg. Placentinus's theories bear witness to a hybrid reception of Copernican and Keplerian astronomy and astrology as well as Cartesian philosophy in the second half of the seventeenth century.[16]

[15] I discuss this context in the conclusion of my article, "Astronomia, filosofia e teologia nel tardo Rinascimento tedesco: Heinrich Julius di Braunschweig e il soggiorno di Giordano Bruno in Germania," *Giornale Critico della Filosofia Italiana*, 2011, 90: 307–326.

[16] For an introduction to the life and thought of this lesser known middle-European Copernico-Cartesian, see my essay, "Central European Polemics over Descartes: Johannes Placentinus and His Academic Opponents at Frankfurt on Oder (1653–1656)," in *History of Universities*, 2016, 29: 29–64. On Dutch Copernico-Cartesianism, see Rienk Vermij, *The Calvinist Copernicans: The Reception of the New Astronomy in the Dutch Republic, 1575–1750* (Amsterdam: Koninklijke Nederlandse Akad. van Wetenschappen, 2002), esp. pp. 142–148.

1. *Epicurean Comets by Giordano Bruno and Nicholas Hill*

Bruno's eclectic natural philosophy picked up key elements from the Epicurean conception, most importantly the atomic constitution of matter. Yet, his atomism, widely known and debated in Kepler's Middle Europe, was also marked by elements that are absent from (if not radically at odds with) the doctrines of the ancient atomists. The most important difference between Bruno's version of atomism and the classic tradition is the rejection of chance. In his vision of the world, chance is substituted by the universal vicissitude of all things. The infinite variety of beings coming to being and passing away is the apt expression of God's omnipotence.[17] Rather than chance, it is based on a 'principle of plenitude' according to which the Scholastic distinction between God's *potentia absoluta* and his *potentia ordinata* (the latter serving as the source of the Creation) should be wiped away in the name of an actual infinity of nature.[18] Furthermore, Bruno embedded his speculations on the atom in a wider treatment of threefold minima: metaphysical, physical and gnosiological. The material atom of the natural philosopher shares one and the same essence with the mathematical point and the metaphysical unity – which is minimum and maximum at the same time in accordance with the basic principle, of Cusanian derivation, that the opposites coincide in the absolute.[19] Bruno believed in the infinity and eternity of nature and thereby consciously transgressed the limitations that most Scholastics ascribed to nature. "Hence," as Kepler would say, "the eternity, the omnipotence and the Creation of the world, which belong to God, are impiously transferred [to nature]."[20] Alongside atomism and Cusanian metaphysics, the Copernican element famously plays a central role in Bruno's grand philosophical vision.

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[17] Michele Ciliberto, *La ruota del tempo* (Rome: Editori Riuniti, 1986).

[18] Arthur Oncken Lovejoy, *The Great Chain of Being: A Study of the History of an Idea* (Cambridge, MA: Harvard University Press, 1936); Miguel A. Granada, "Il rifiuto della distinzione tra *potentia absoluta* e *potentia ordinata* di Dio e l'affermazione dell'universo infinito in Giordano Bruno," *Rivista di Storia della Filosofia*, 1994, 49: 495–532.

[19] For further details, see my essay, "Minimum und Atom: Eine Begriffserweiterung in Brunos Rezeption des Cusanus," in *Die "Modernitäten" des Nicolaus Cusanus: Debatten und Rezeptionen*, ed. Tom Müller and Matthias Vollet (Bielefeld: Transcript, 2013), pp. 285–304.

[20] *De stella nova* (ref. 7).

All stars, plunged in an infinite space, acquire the status of countless suns dispersed across the universe, each one encircled by the trajectories of its own animal-like planets.

Bruno conceives of comets as massive celestial bodies similar to the Earth and the planets circling around any other stellar system. However, they move independently of the trajectories of the other planets. In the fourth dialogue of *De l'infinito universo e mondi* (1584), Bruno refers to comets in order to criticize the Aristotelian theory of natural places.[21] In fact, Aristotle considered comets to be composed of terrestrial matter, which "is dragged upwards as an exhalation by the force of the first mobile to the inflamed realm of fire" (*in forma di exalazione è montata in alto sino all'incentiva [incendiata] regione del foco come rapita dal vigor del primo mobile*) and is forced to turn around the Earth. Bruno questions that such a body, depicted as "heavy, thick and dense" (*grave, spesso e denso*), could remain suspended in the air and not descend according to the theory of natural places. He specifically refers to the comet of 1577, on which he possibly wrote the lost treatise *De' segni de' tempi*.[22] What explains the motion of comets in the Aristotelian framework? Aristotle would argue that comets are dragged (*rapite*) by the circular motion of the air, but Bruno is not satisfied with this answer. He objects that all planets should be dragged (*rapiti*) in the same manner. Observations show that comets possess their proper motion independently of the daily rotation and motion of other planets. Moreover, the element around the Earth is "such a liquid air and subtle body" (*sì liquido aere e sottil corpo*), so it is not apt to hold and transport the huge body of a comet. According to Bruno, "the truth concerning the nature of comets" (*la verità della natura delle comete*) is that they are a "kind of celestial body" (*specie di astro*). They are heavenly bodies that draw closer and move away from us. Through their motion,

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[21] Giordano Bruno, *De l'infinito*, in *Dialoghi filosofici italiani*, ed. Michele Ciliberto (Milan: Mondadori, 2000), pp. 414–416. For a detailed discussion of Bruno's cometary theory, see Dario Tessicini, *I dintorni dell'infinito: Giordano Bruno e l'astronomia del Cinquecento* (Pisa-Rome: Serra, 2007), Chap. 4, "Le comete." Also see *idem*, "cometa," in *Enciclopedia Bruniana e Campanelliana*, ed. Eugenio Canone and Germana Ernst (Pisa-Rome: Serra, 2010), pp. 34–43.

[22] Bruno (ref. 20): "[. . .] come per quarantacinque giorni continui a tempi nostri n'è vista una."

they appear to increase in size and become inflamed when they move toward us and diminish in size and extinguish their fire when they leave our proximity.[23]

Bruno resumed and deepened his cometary theory in the 'Frankfurt poem' *De immenso et innumerabilibus* (1591). In Book 4, Chapter 13, he expounded the thesis that "there are more planets than appear [to us]" (*quod plures sint planetae quot apparent*).[24] Comets are indeed planets. Bruno contends that they sometimes appear without a tail, as was the case with the nova of 1572; and he refers to Helisaeus Roeslin's hypothesis that the comet of 1577 was the same celestial body.[25] According to Bruno, the tail does not mark a difference between planets and comets, as we read in *De immenso* [6, 20]:

> One should not deem them to have a different substance than the other planets simply because they have a tail. In fact, as I have already argued from observations made in our time and in the past, comets sometimes display a larger tail, sometimes a smaller one, sometimes a tiny one, and sometimes none at all. This can occur either along the whole arc of their circuit in which they are visible to us or in some part of it; in fact, they are found to differ from planets for no other reason than their rare appearance. [...] For planets appear tailed from some regions but their tail, as one may understand, can diminish or even disappear completely.[26]

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[23] *Ibid.*: "[. . .] et essere tale astro che col proprio moto avvicinandosi et allontanandosi verso e da questo astro, per raggione di accesso e recesso [avvicinamento ed allontanamento], prima par che cresca come si accendesse, et poi manca [decresce] come s'estinguesse [. . .]."

[24] Giordano Bruno, *Opera latine conscripta*, ed. Francesco Fiorentino (Naples: Morano, 1884), vol. I 2, p. 65.

[25] *Ibid.*, p. 70. Cf. Jürgen Hamel, "Die Vorstellung von den Kometen seit der Antike bis ins 17. Jahrhundert: Tradition und Innovation," in *Georg Samuel Dörffel (1643–1688): Theologe und Astronom*, ed. Johannes Richter (Plauen: Vogtland, 1994), pp. 97–122, on pp. 113–116 ("Die Kometentheorie von Helisäus Röslin").

[26] Bruno (ref. 23), p. 226: "Propter eam ergo, quam habent caudam, non sunt credendi alius substantiae, quam planetae reliqui: quandoquidem, ut in superioribus notavimus ex observatis nostro et alio tempore, et cometae interdum apparent maiore, interdum minore, interdum minima, interdum nulla cauda. Et hoc vel toto circuitus sui arcu, quo nobis sunt conspicui, vel parte; et quaedam non alia ratione differre comperiuntur a planetis, praeterquam quia non sunt ordinariae apparentiae. [. . .] Planetae enim ex aliqua regione caudati videbuntur, quorum cauda sicut intendi potest, et remitti, ita et omnino tolli."

Comets' motions are as perfect as those of the planets; for instance, the trajectories of Venus and Mercury (4, 13):

> Hence, it is proved that the comet is a heavenly body [. . .], in the seventh place, from the perfection of its motion, superior to the perfection of the lunar motion and comparable with that of Venus and Mercury, with whose motion it had a strong similarity.[27]

However, the fact that the 'poles' of the comet's motions are different than those of the planets running along the ecliptic make the former invisible to us for long periods of time. Comets, in conclusion, are Earth-like bodies (6, 20):

> The appearance of a comet is the solar light reflected by the celestial body's watery surface, which is opposite our eyes and with which our line of vision [*radius noster visualis*] forms an angle with the solar ray [*radius*]. As an entity [*subjectum*], a comet is a planet that circles around the Sun just like the Earth. Its matter [*substantia*] is composite. The only difference with the famous planets, in fact, is relational: they [the comets] are rarely visible for the sole reason that their circular path does not bring them to such an opposition between our sight and the Sun that it reflects its light in a mirror-like [frontal] manner.[28]

Among Bruno's readers and followers, the English philosopher Nicholas Hill deserves particular mention. This "philosopher-physician of the Elizabethan age"[29] belonged together

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[27] *Ibid.*, pp. 74–75: "Colligitur ergo cometam illum, astrum esse. [. . .] Septimo a motus perfectione, super perfectionem motus lunae et cum perfectione motus Veneris et Mercurii conparabili, cum quorum etiam motibus analogiam habebat."

[28] *Ibid.*, p. 225: "Cometae apparentia est lux Solis reflexa in aqueam, ad oculosque nostros oppositam, astri superficiem, in qua scilicet radius noster visualis cum solari radio angulum efficient. Subiectum cometae est planeta, Solem circumscurans non minus, atque aliter, quam Tellus, substantia quaedam composita est; ab istis vero famosis planetis sola relatione differens: quoniam ea de caussa raro apparent, quia eorum circulus non venit ad eam oculorum nostrorum et Solis oppositionem, ut specularem reddat lucem."

[29] According to Sandra Plastina's expression. See her "Introduzione" to Nicholas Hill, *Philosophia Epicuraea Democritana Theophrastica proposta simpliciter non edocta* (Pisa-Rome: Serra, 2007), pp. 11–75. I will quote from this edition.

with Thomas Harriot to the so-called 'Northumberland circle' of scholars who coupled an empirical and mathematical approach to nature with anti-Aristotelian views and the adherence to the Copernican system.[30] Harriot derived from Bruno his infinitist atomism that brought together speculations about natural *maxima* and *minima*.[31] Hill was even more keen on Bruno's philosophy than Harriot, as is evidenced by his ethical-philosophical tract, *Philosophia Epicuraea Democritana Theophrastica*, first printed in Paris in 1601.[32] The tract aimed at revitalizing the Epicurean and Brunian legacy. Hill defended a Christianized atomism connecting Democritean physics and divine providence. He presented it as a philosophy that was neither new nor old, "philosophia nec nova nec vetus."[33] Specifically, he dealt with comets in theses 379 and 380, in two paragraphs that closely follow in the footsteps of Bruno's text:

> 379. The appearance of a comet is the solar light reflected by the celestial body's watery surface, which is opposite our eyes and with which our line of vision [*radius noster visualis*] forms an angle with the solar ray [*radius*]. As an entity [*subjectum*], a comet is a planet that circles around the Sun just like the Earth. Its matter [*substantia*] is composite. The only difference with the famous planets is its ὀλιγοφανεία, that is, the rarity or faintness of its appearance, as its circular path seldom comes to such an opposition of our sight to the Sun as to reflect its light in a mirror-like [frontal] manner. [. . .]

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[30] Cf. Robert H. Kargon, *Atomism in England from Harriot to Newton* (Oxford: Clarendon, 1966).

[31] See Robert Fox, ed., *Thomas Harriot: An Elizabethan Man of Science* (Aldershot: Ashgate, 2000). Also, see John Henry, "Thomas Harriot and Atomism: A Reappraisal," *History of Science*, 1982, 20: 267–303.

[32] Among the studies on Hill, see especially Sandra Plastina, "Nicholas Hill: 'The English Campanella?'," *Bruniana & Campanelliana*, 1998, 4: 207–212, and "'Philosophia lucis proles verissima est.' Nicholas Hill lettore di Francesco Patrizi," *Bruniana & Campanelliana*, 2004, 10: 175–182. I deal with Hill's Brunian cosmology in *Copernicus in the Cultural Debates of the Renaissance: Reception, Legacy, Transformation* (Leiden: Brill, 2014), pp. 372–377.

[33] Hill (ref. 28), p. 80.

> 380. The comet's tail is a vaporous substance, which does not belong to the solid part of the celestial body; it reflects the light of the Sun in a hair-like form; its quantity, density and rarity elongates, reduces, extends and diminishes the tail.[34]

This is, in fact, a summary of Bruno's position. After Paris, the booklet was reprinted in Geneva in 1619 and can be seen as a witness of the European circulation of Bruno's ideas as well as a certain revival of eclectic Epicureanism. As for the Keplerian polemics against the philosophers of chance, it should be remarked that, although Bruno's ideas spread atomism and an image of the world in which plenitude takes the place of order, neither Bruno nor his followers embraced a vision of the world ruled purely by chance. Rather, they believed that divine providence is better secured by the assumption of infinitism than by geometrical proportion. As a matter of fact, Hill explicitly insisted on the importance of providence.[35] These views are certainly far from Kepler's but cannot be reduced to the Epicurean legacy tout court.

2. *Post-Keplerian Atomistic and Corpuscular Celestial Novelties: Pierre Gassendi and René Descartes*

The champion of Epicureanism one generation after Bruno and Hill, Pierre Gassendi founded his natural philosophy on ground far different from that of his predecessors. His views on comets were correspondingly distant from theirs.

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[34] *Ibid.*, pp. 152–153: "379. Cometae apparentia est lux solis reflexa in aqueam, et oculis nostris oppositam astri superficiem, in qua radius visualis cum solari radio angulum efficit. Subiectum cometae est, planeta solem circumcursans, a famosis planetis differens ὀλιγοφανείᾳ, i. exiguitate seu tenuitate apparitionis, illius circulo raro ad eam solis et oculorum oppositionem deveniente, ut specularem reddat lucem. [...] 380. Cauda cometae est substantia vaporosa ad astri partem solidam non spectans, reflexam solis lucem refrangens, et in crinitam formam ducens, cuius copia, densitas, et raritas caudam intendit, remittit, extendit, et minorat."

[35] Cf. Pietro D. Omodeo, "Perfection of the World and Mathematics in Late Sixteenth-Century Copernican Cosmologies," in *The Invention of Discovery, 1500–1700*, ed. James Douglas Fleming (Farnham-Burlington: Ashgate, 2011), 93–108.

However, before I deal with Gassendi's distinct Epicurean views on comets, I would like to stress the complexity and ambivalence of his link to Kepler's astronomy.[36] One could mention that, following Kepler's instructions in the *Admonitio ad astronomos* found in his final ephemerides (1630), Gassendi observed Mercury's solar transit in 1631 and thus established his renown among European astronomers. Still, Gassendi embedded the proof of Mercury's heliocentric path together with his disquisitions on comets and new stars in a neo-Epicurean vision of the world, as expressed in the *Syntagma philosophiae Epicuri* (1649), in particular the chapter *De cometis et novis sideribus* (*pars secunda, sectio secunda, liber V*).

Gassendi's lengthy discussion of comets, rather than pronouncing a clear-cut position on the debates, is a doxographic overview of ancient and modern opinions about their origin, nature, motion and effects. Gassendi remarks that the nature of comets seems to hover between that of heavenly bodies and that of sublunary ones.[37] Depending on the different theories brought forward by natural philosophers and astronomers, they might possess a fiery nature and originate in the uppermost cloudy sphere, originate and move in the ethereal region in orbs such as those of Mercury and Venus, or travel freely through the immense heavens. The variety of opinions is so vast that Gassendi declares himself incapable of identifying the right one. Rather, he deems it expedient to follow Epicurus's decision not to decide:

> Do you think that you can easily solve this issue if Epicurus did not want to determine which one of the two opinions was true? Indeed, the matter is very obscure. Whatever opinion you choose, no matter how you argue, so many difficulties will arise that it is expedient to suspend one's own judgment on this issue more than on anything else.[38]

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[36] For an insightful discussion, see Kuni Sakamoto, "The German Hercules's Heir: Pierre Gassendi's Reception of Keplerian Ideas," in *Journal of the History of Ideas*, 2009, 70: 69–91.

[37] Pierre Gassendi, *Opera omnia* [Lyon, 1658] (Stuttgart-Bad Cannstatt: Frommann, 1964), vol. 1, p. 700a.

[38] *Ibid.*, 701b: "An putas vero, nisi Epicurus determinare voluit utra sententiarum vera esset prae alia, res determinari facilius iam potest? Res sane perobscura est, et utramcumque delegeris, quomodocumque eam exposueris, tot occurrunt difficultates, ut non videatur usquam magis, quam heic continendus assensus."

Evidently, Gassendi's path to Epicureanism implies a sort of agnosticism on scientific matters that remain mysteries. Epicurus's teaching induces him to moderation and to suspend his own judgment on the nature of comets. Gassendi prefers to limit himself to observational reports rather than speculating on whether comets are fiery bodies arising from the terrestrial realm or produced in the ethereal region, whether their tails are an inflammation or an optical effect, as Cardano believed, and so on and so forth.

> Thus, since we see difficulties arise everywhere, it will be better not to embrace any definition and be satisfied to recount the facts [*historia*] about the comet that recently came to light when it first appeared to us. By solely dealing with that which can be drawn together by means of comparison with other [comets], we shall determine the most likely opinion.[39]

The lack of clarity in Gassendi's position on the nature of comets stands in stark contrast with the atomistic theories of those eclectic revivers of Epicurus preceding him. This is all the more striking, since Gassendi proves so knowledgeable about the scholarly literature on the subject, including neo-atomistic views à la Bruno and Hill. Although neither of the two predecessors is explicitly mentioned, their theses are reported in the doxography. Gassendi traces their opinions back to ancient schools different than the Epicureans. For instance, the planetary nature of comets is ascribed to the Pythagoreans, a notion derived from Aristotle. Gassendi additionally reports that some thinkers refused to consider comets to be *planetae* similar to those of our system; instead, they treated them as wandering stars travelling across the ether like *stellae*. Such a view, Gassendi remarks, is based on an analogy between comets and fish that are visible only when they rise to the surface but disappear as soon as they

[39] *Ibid*., p. 704b: "Cum videamus ergo ubique difficultates occurrere; planius est, ut nihil definiamus contentique simus heic animi gratia narrare historiam Cometae illius, qui ut nuperus exstitit, sic visus nobis primus fuit, et, coniiciendo solum, attexere, quid ex collatione ipsius cum caeteris, dicere quis quadam cum specie verisimilitudinis possit. Is Cometa sub finem anni MDCXVIII. et sequentis initium universae Terrae apparuit."

plunge to the depths again. In one passage where Gassendi explains the cometary theory of Kepler, Gassendi mentions him among the moderns who rely on this well known analogy:

> There are others, among whom Kepler is the most prominent, who believe that the ether [*aura aetheria*] condenses in some places producing orbicular masses. Comets originate from these conglomerates, once they are set in motion and imbued with light. They move through the immensity of the ether just like fish in the vastness of the sea. While we are on shore, we only see the fish that do not pass far from us. In the same manner, we can only see from the Earth those comets whose paths are not distant. Those visible to us receive their light from the Sun. Their tail and its direction, opposite the Sun, can be explained considering that it [the tail] is nothing but an effluvium from the head, produced by the force of the light that traverses it, until the comet is extinguished, due to the continuous outflow.[40]

All natural explanations of comets possess some shortcoming in Gassendi's eyes. The thesis of their ethereal origin is dubious in his view because it is not evident that something can be generated from the very subtles matter of the heavens and, even if this were admissible, it would be hard to explain why the cometary conglomerate should be set in motion. Gassendi mentions Kepler's theory of comets' linear motion as well as the circular theory held by others. The Galileo-Grassi controversy over whether the trajectory of comets is linear or circular looms large over this issue.[41] Gassendi limits himself to noting that the circular theory

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[40] *Ibid.*, p. 704a: "Sunt alii, quos inter Keplerus praecipuus, qui velint auram aetheriam variis in locis concrescere in moleis quasdam orbiculareis, et hasce moleis seu concretiones motione accepta, luceque imbibita, Cometas evadere; neque ferri minus frequenteis per immensitatem aetheris, quam pisceis per vastitatem maris; tametsi, ut eos solum pisceis qui dum stamus in littore, non procul praetereunt, videmus; ita ex Cometis ii soli apparent, qui a nobis in Terra degentibus non procul semitam instituunt: Istos qui a nobis videntur, accipere a Sole lucem, et caudam idcirco gestare, ipsamque a Sole aversam, quod ipsa nihil aliud sit, quam effluvium ex capite vi lucis traiicientis factum; adeo ut Cometa effluxu continuo demum exsolvatur."

[41] Drake and O'Malley (ref. 13).

is not supported by empirical evidence, since “no comet is recalled to have come to us twice.”[42]

In the section “De effectibus Cometarum in hisce inferioribus” (“On the effects of comets in this lower realm”), Gassendi rejects astrological interpretations of comets as harbingers of war, plague and famine. These are pernicious *fabulae* for Gassendi and should be rejected as superstitions just as Epicurus banned the myths of ancient religions.[43] The meteorological phenomena that accompany the appearance of comets, especially winds, should not be explained by astrological means but simply through the action of light, as is the case with other celestial bodies.[44] The lasting influence of Pico’s criticism of astrology is clearly at hand.[45]

Concerning the interdependency of winds and comets, Gassendi discusses this ‘observational evidence’ in connection with explanations of the origin of comets from the inflammation of sublunary matter in the superior spheres of the air.[46] He also specifies that the concomitance of strong winds (*magna ventorum vis*) and comets is frequent but not always given. I shall soon return to a variation of the same meteorological topos in connection with Placentinus’s heterodox reception of Cartesian cometary theory.

One may find more affinity with Renaissance atomists such as Bruno and Hill in Descartes’s corpuscular cometary theory than in Gassendi’s Epicurean *Syntagma*. Descartes already drafted a natural explanation of comets and their motions in Chapter 9 of *Le Monde*, “De l’origine, et du cours de planetes et des cometes en general, et en particulier des cometes”

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[42] Gassendi (ref. 36), p. 704b. For Kepler’s theory of comets’ linear motion, see *ibid.*, p. 706b: “nullus Cometa ad nos bis accessisse memoratur.” Cf. J. A. Ruffner, “The Curved and the Straight: Cometary Theory from Kepler to Hevelius,” *Journal for the History of Astronomy*, 1971, 2: 178–194, on pp. 178–186.
[43] Gassendi (ref. 36), p. 712.
[44] *Ibid.*, p. 711b: “Certe seu Venti, seu aliae impressiones in aere ad Cometarum seu exortum, seu duratione consequantur, id tribuendum videtur seu luci, seu qualitati alii, ut in Astris caeteris fit.”
[45] On the developments of the astrological polemics involving comets during the sixteenth century see, among others, Cesare Vasoli, “Andreas Dudith-Sbardellati e la disputa sulle comete,” in *idem*, *I miti e gli astri* (Naples: Guida, 1977), pp. 351–387.
[46] Gassendi (ref. 36), p. 701b.

("On the origin and course of planets and comets in general, and of comets in particular").[47] Descartes saw comets as celestial bodies crossing different planetary systems in a multicentric in-*de*-finite universe that bore a resemblance to Bruno's infinite universe. Such a legacy is controversial, as Descartes never wished to be connected with the doctrines of the 'impious' Bruno. He explicitly refused cornerstones of his cosmology such as the existence of a physical void and spatial infinity, which he substituted, however, with ambiguous doctrines such as his theory of the three elements, including a most subtle ethereal one, and that of the indefinite dimensions of the world. In spite of these cautionary measures, Descartes's opponents did not fail to stress the intellectual liaison with compromising forerunners, and they compared his cosmology with that of Bruno.[48] Many among them, in particular his Jesuit opponents, perceived the ambiguity of his positions (including that of the "immobility" of the Earth "transported" by celestial streams around the Sun) as a dissimulation strategy aiming to disguise the fundamental theses at odds with orthodox views that should be upheld for philosophical and theological reasons.[49]

Descartes gave his most detailed treatment of novae and comets in the third book of the *Principia philosophiae* (1644). There, he developed a full-fledged theory that assumes a continuity between various celestial bodies and the reciprocal convertibility of stars, comets and planets. In particular, Descartes offers a corpuscular explanation of the sudden appearance of novae such as that of 1572. The analogy between the Sun and the other stars (reminiscent of Bruno) leads him to assume that the spots observed on the surface of the Sun are common to all stars. In his view, sunspots are impurities emerging on the surface of the starry body through the motion of its subtle celestial matter. In some cases, the entire disc of a

[47] René Descartes, *The World and Other Writings*, ed. Stephen Gaukroger (Cambridge: Cambridge University Press, 2004), pp. 37–41.
[48] Cf. Saverio Ricci, *La fortuna del pensiero di Giordano Bruno* (Florence: Le Lettere, 1990), esp. Chap. 3.
[49] Cf. Roger Ariew, "Censorship, Condemnations, and the Spread of Cartesianism," in *Cartesian Empiricism*, ed. Mihnea Dobre and Tammy Nyden (Dordrecht: Springer, 2013), pp. 25–46.

star can be obscured by a huge dark spot: “And consequently, it can happen that one and the same spot extends over the entire surface of a star and remains there for a long time before being destroyed.”[50] As a consequence, stars can appear and disappear:

> Indeed, it can even happen that the spots which cover some star become [with the passing of time] so dense as to entirely conceal it from our view: thus seven Pleiades could formerly be counted, though now we see only six. On the other hand, it can also happen that a star which we have not seen before unexpectedly shines forth with a great light in an extremely short time.[51]

The entire universe is subject to change and transformation according to a principle of cosmological homogeneity. The *tourbillions* of subtle matter deputed to substitute the Scholastic spheres and their function of transporting the planets around their centers, in this case suns, can be altered and dissolve into anything else. If a cosmic whirl dissolves, the star at its center enters another whirl and becomes either a comet or a planet.[52] If it traverses the whirl and moves beyond its boundaries to another system, it becomes a comet; if it begins circulating around the center of the whirl, it becomes a planet:

> [. . .] if this globe is so solid that, before descending to the point at which the parts of the vortex move the most slowly, it acquires a degree of agitation equal to that of those parts among which it is located; it descends no further, and will proceed into other vortices, and become a comet. On the other hand, if it is not sufficiently solid to acquire so much agitation, and therefore descends below that point [at which the parts

[50] Descartes, *Principia philosophiae*, 3, 102, transl. Valentine Rodger Miller and Reese P. Miller, *Principles of Philosophy* (Dordrecht-Boston-London: Kluwer Academic Publishers, 1982), p. 139. Cf. *Oeuvres de Descartes*, ed. Charles Adam and Paul Tannery, vol. 7 (Paris: Cerf, 1905), pp. 151–152: “Hincque potest contingere, ut aliquando una et eadem macula sopra totam superficiem alicuius sideris se extendat, ibique diu permaneat priusquam dissolvi possit.”

[51] Descartes (ref. 49), 3, 104; *Principles of Philosophy* (ref. 49), p. 140. Cf. *Oeuvres de Descartes* (ref. 49), p. 152: “Quinetiam fieri potest, ut aliquod sidus tot et tam densis maculis involvantur, ut visum nostrum prorsus effugiat: sicque olim Pleiades numeratae sunt septem, quae iam sex tantum conspiciuntur. Itemque fieri potest, ut aliquod sidus, nobis antea non visum, brevissimo tempore atque ex improviso, magna luce affulgeat.”

[52] Descartes (ref. 49), 3, 115.

> of the vortex move the most slowly], it will remain a certain distance from the star which occupies the center of this vortex; and will become a planet revolving around it.[53]

Stars, novae, comets and planets are not essentially different. They are similar celestial bodies made out of the same matter and subject to the same physical laws. What is more, they are interchangeable and can be transformed into one another. Thus, instead of Gassendi's Epicurean skepticism, Descartes embraces a 'solid' corpuscular vision of comets as celestial bodies traversing the heavens and in all respects akin to the other celestial bodies, *in primis* the planets of the solar system and the Earth itself. As a matter of fact, his cometary theories fall much closer to those of atomists of Kepler's time such as Bruno and his supporters. God's Providence is not banned from the Cartesian *monde* in the name of chance. Rather, it guarantees the existence of nature after its beginning and the laws underlying its dynamics. Still, such a mechanistic view is distant from that of Kepler, since it renounces harmonic proportion together with final causation. According to Descartes, cosmological order is the by-product of matter and its interactions according to the laws of nature rather than the expression of a divine design inspired by geometrical archetypes. Hence, it should be no wonder that his natural philosophy could raise the suspicion to surreptitiously revive materialist visions that were deemed to be irreconcilable with piety. The link between Brunian and Cartesian cosmology would become a commonplace of intellectual historiography. The German historian of philosophy Jakob Brucker, for instance, stressed this relationship by arguing, in the fifth volume of his *Historia critica philosophiae* (Leipzig, 1742–1744), that

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[53] *Ibid.*, 3, 119; *Principles of Philosophy* (ref. 49), pp. 150–151. Cf. *Oeuvres de Descartes* (ref. 49), p. 168: "[. . .] si globus in illo vortice descendens adeo sit solidus, ut priusquam pervenerit ad terminum in quo partes vorticis omnium tardissime moventur, acquirat agitationem aequalem agitationi earum partium, inter quas versatur, non ulterius descendit, sed ex illo vortice in alios transit, et est Cometa. Si vero minus habeat soliditatis, atque idcirco infra terminum illum descendat, ibi postea ad certam distantiam a sidere, quod illius vorticis centrum occupat, semper manens, circa ipsum rotatur, et est Planeta."

Bruno's "Epicuro-Pythagoreanism" (*systema physicum Epicuri Pythagoreismo incrustatum*) was the most important source of Descartes's cosmology.[54]

3. *Novae and Comets from the Viewpoint of Post-Cartesian Astrology: The Case of Johannes Placentinus*

After dealing with atomistic, Epicurean and corpuscular approaches to comets in the time of Kepler by two generations of scholars, I would like to consider later developments. As has been argued, Descartes's corpuscular explanation of novae and comets impacted the astrological and meteorological discourses of the sixteenth century. In the Netherlands, his mechanical philosophy was functional to the marginalization of astrology as it offered alternative and more powerful integrated explanations of celestial and terrestrial phenomena and their interconnection solely based on material and causal interactions.[55] In Germany, the reception of Descartes was complicated by the fact that its lively astrological tradition led some scholars to undertake a Cartesian reform of astrological doctrines, including those related to comets. The most striking case is the work of Johannes Placentinus, Cartesian professor of mathematics at Frankfurt (Oder). Here, I would like to examine Placentinus's "physical and astrological" report on the "frightening, unusual and damaging winds" that blew in December 1660 and January 1661, *Physicalischer und Astrologischer Bericht Von Denen erschrecklichen, ungewöhnlichen . . . und schädlichen Winden* (1661).[56] The title page made clear that the physical-astrological perspective consists, first, in the reliance on "philosophical truths" (*auß Philosophischer Warheit auffgesetzet*) and second, in the explanatory connection of meteorological and heavenly phenomena. The philosophical

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[54] Jakob Brucker, *Historia critica philosophiae* (Leipzig: Christoph Breitkopf, 1766), vol. 5, chap. 2, pp. 12–62, "De Iordano Bruno Nolano," on pp. 31–33 and p. 37.

[55] See Rienk Vermij, "The Marginalization of Astrology among Dutch Astronomers in the First Half of the 17th Century," in *History of Science*, 2014, 52: 153–177.

[56] I discuss Placentinus's Cartesian astrology in more detail in "The Mechanization of Astrology in the Context of German Cartesianism," in *Astrology and Anti-Astrology in the Renaissance*, ed. Ovanes Akopyan (in press).

Wahrheit mentioned in the title refers to the author's commitment to Cartesianism. The astrological interdependency of the heavens and earth is evinced by the thesis that the windstorms of 1660–1661 were caused, or at least strengthened, by a new comet and a nova (*neuer Fixstern*) recently observed in the constellation of the Whale.[57]

Placentinus dedicated his publication to the Electoral Prince Friedrich Wilhelm (*Meinem Gnädigsten Churfürsten und Herren*). The preface begins with classical references to Strabo and Pliny, who wrote about winds and the relative pagan god, Aeolus. Placentinus points out that, for Christians, it is the biblical God and eternal king of the world that should be held responsible for nature's providential unfolding. It is the challenge of the "lovers of natural and astrological arts" (*die Liebhaber der Natürlichen und* Astrologi*schen Künste*), he argues, to discover its regularities. Evidently, Placentinus embraces Melanchthon's conception of astrology as natural theology, although his scientific 'paradigm' has shifted from Aristotelian hylomorphism to Cartesian mechanism.[58]

Placentinus stresses the main scientific concern at the outset of his report. "Where did these unusual, dreadful, and damaging winds originate from?"[59] The answer to this question requires a preliminary clarification of a series of general propositions, or *Sätze*. The first proposition pertains to hydraulics or, more precisely, to the behavior of fluids (*ein fliessendes Ding*), which according to Placentinus comprise not only the watery element but air and fire as well. This proposition asserts that fluids flow more quickly through narrower passages. Just

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[57] On the variable star Mira Ceti (especially around 1660), see Robert A. Hatch, "Discovering Mira Ceti: Celestial Change and Cosmic Continuity," in *Change and Continuity* (ref. 5), pp. 153–176.

[58] Cf. Sachiko Kusukawa, *The Transformation of Natural Philosophy: The Case of Philip Melanchthon* (Cambridge: Cambridge University Press, 1995) and Dino Bellucci, *Science de la Nature et Réformation: La physique au service de la Réforme dans l'enseignement de Philippe Mélanchthon* (Rome: Ed. Vivere, 1998). On the shifts in approaches to astronomy in late-humanistic Protestant universities, see my essay, "Institutionalized Metaphysics of Astronomy at Early-Modern Melanchthonian Universities," in *Wissen in Bewegung. Institution - Iteration - Transfer*, ed. Eva Cancik-Kirschbaum and Anita Traninger (Wiesbaden: Harrassowitz, 2016), pp. 51–78.

[59] Johannes Placentinus, *Physicalischer und Astrologischer Bericht Von Denen erschrecklichen, ungewöhnlichen . . . und schädlichen Winden* (Frankfurt an der Oder: Salomon Eichorn, 1661), f. A3*v*: "Woher diese ungewöhnlich, erschreckliche, durchgehende, und schädliche Winde entstanden sind?"

as sea tides can be explained as a consequence of the pressure exerted on the ether by the Moon forcing terrestrial waters to flow more quickly as it revolves around the Earth, winds similarly blow more strongly in narrow alleys. The second proposition concerns the solar warming of the air surrounding the Earth. Placentinus claims the warming is caused by aerial motions through rarefaction and the production of vapors. The third and fourth propositions concern the fluids' natural tendency to expand and flow, and the production of fluids' flow by means of mechanical motions.

The fifth proposition is astronomical. It asserts that celestial bodies and stars can arise, move and experience annihilation. Among more recent instances, Placentinus mentions Brahe's nova of 1572 as well as that of 1604. Furthermore, Kepler is mentioned as the observer of a nova in the constellation of the Swan that disappeared in 1618, the same year in which a comet appeared in the sky:

> In 1604, a new star was seen in the foot of the Serpent Bearer [*in pede Serpentarii*] until it disappeared in February 1606, just as Johannes Kepler wrote in *De stella nova in pede Serpentarii*. Also, in 1606 a new star was observed in the breast of the Swan. It remained there for four years according to Kepler, but in 1618, according to Krüger, it disappeared with the appearance of a comet.[60]

Placentinus remarks that the dimensions of these disappearing bodies were huge, as they had been calculated by scholars such as the Copernican astronomer Philip Lansbergen. This observation is at the heart of Placentinus's theory that the annihilation of novae provokes great movements of celestial matter and this, in turn, affects the streaming of air around the Earth. In fact, he argues that the disappearance of a nova does not imply its destruction but

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[60] *Ibid.*, f. B2*r*: "*Anno* 1604 ist [. . .] ein neuer Stern in pede Serpentarii gesehen worden, biß anno 1606 in Februario derselbe verschwunden ist, als davon schreibet Johannes Kepplerus, *De nova Stella in pede Serpentarii*. *Item anno* 1606 ist in der Brust des Schwans ein neuer Stern, welcher vier Jahre gestanden, observiret worden, teste Keplero, welchen man aber anno 1618, da ein Comet erschienen nicht mehr gemercket hat, Crügerus."

rather its transformation into a comet; Placentinus takes this thesis from Descartes's *Principia* 3, 119.

Following his general propositions on the physics of fluids, Placentinus explains the natural formation of winds. This section is entitled "Von den natürlichen und gewöhnlichen Winden in gemein" ("On the Natural and Usual Winds in General"). They are thought to be an effect of solar heat or mechanical displacements and collisions of masses of vapors also known as clouds. Placentinus presents here his *Aeolipyla*, a machine devised to produce "artificial winds." It is a metallic sphere of brass or copper, which functions like a pressure cooker: some water is poured into the sphere through a tiny hole; then the instrument is heated with fire; the heat transforms the water into vapor, which comes shooting out of the hole with great force due to the narrowness of the passage. The generation of winds by solar heat is similar.

The next section of the booklet deals with the strong windstorms of 1660–1661: "Von unsern erschrecklichen Winden insonderheit" ("On Our Frightening Winds in Particular"). Placentinus argues for the anomaly of these winds. As he claims, they traversed Europe, reaching all the way to Turkey. Hence, their causes were not local but 'universal.' They must have been astronomical or, rather, physico-astrological, according to the following account:

> Hence, I should add another cause to those given to account for these great winds. I would like to briefly mention that a star disappeared from the sky in the East and was transferred to another place in the heavens (according to my fifth proposition), shortly before the winds enraged and rampaged [the land]. Assuming that this star is […] a *stella obscura* whose magnitude is only to be compared with that of the Earth, that star left behind a large space reckoned as massive as the Earth. This [large space] could not remain empty on account of the *fuga vacui* [i.e., nature's flight from void]; the air and mist around the Earth flowed from the West […] with great violence for several

hours until the space was filled. They must have produced those universal and continuous winds (according to my third proposition).[61]

In order to corroborate his views, Placentinus printed a letter from the world-renowned Gdańsk astronomer (*Weltberühmter Astronomus*), Johannes Hevelius, describing a comet and a nova that had been briefly visible in the constellation of the Whale.[62] Placentinus lamented the poor meteorological conditions in Brandenburg at the time of the comet. The clouds had prevented him from sighting the celestial novelties described by Hevelius. In addition to providing a witness account from an expert observer, Hevelius's report reinforced Placentinus's theses. The nova's disappearance coincided with the blowing of the great windstorms. Consequently, Placentinus had no doubt that a physico-astrological connection between the two phenomena could and should be established.

The strictly astrological treatment occupies the last part of the treatise on windstorms. For Placentinus, there is nothing mysterious about the action of celestial bodies on terrestrial phenomena. Cartesian physics offers a mechanistic explanation of astrological influence. In the concluding pages of the *Physicalischer und Astrologischer Bericht*, Placentinus turns to astrology to cast wind horoscopes and assess the consequences of celestial conditions not only on elementary phenomena on earth but also on human affairs. The final section, entitled

[61] *Ibid.*, ff. B4*r*–*v*: "Und darumb nebenst diesen angezogenen Ursachen, noch eine andere seyn muß, welche diese grosse Winde verursacht habe; Und solche wil ich alhier kürzlich setzen, und sprechen, daß vor derselben Zeit, ehe die Winde gewütet und getobet, ein Stern am Himmel im Orient [. . .] sey verschwunden, und in einem andern Orth des Himmels transferiret worden, nach dem fünfften Satz, Und gesetzt, dieser Stern sey [. . .] stella obscura welche der Erd-Kugel nach der grösse nur zu vergleichen sey: so wird dennoch derselbe Stern einen grossen Raum, welcher der Corpulentz der Erden gleich zu schätzen ist, gelassen haben, und derselbe hat nicht können leer seyn ob fugam vacui; sondern die Lufft und Dünste umb die Erden, haben von Westen [. . .] mit grosser Gewalt, und etliche Stunden lang, biß der Raum ist erfüllet worden, Fliessen, und solche Universal und durchgehende Winde verursachen müssen, vermöge des dritten Satzes."

[62] *Ibid.*, f. C2*v*, "Vom Cometen. Welcher den 3. Febr. Styl. N. erschienen, und vom Neuen Fix-Stern im *Balena* oder Wallfisch, der von dem Weltberühmten *Astronomo*, (tit.) Hr. Johan Hewelcken, etc. in Dantzig *observiret* worden." I discuss the correspondence between Placentinus and Hevelius elsewhere, in "Asymmetries of Symbolic Capital in 17th-Century Scientific Transactions: Placentinus's Cometary Correspondence with Hevelius and Lubieniecki," in the proceedings of the conference "Institutionalization of Science in Early Modern Europe," ed. Giulia Giannini (in press).

"Unser *Astrologi*scher Bericht," first investigates the "astrological causes" (*Astrologishe Ursachen*) and then interprets their "meaning" (*Bedeutung*) by means of special horoscopes.

At 6:00 AM on 16 November 1660, the Sun, Mars and Mercury, the "common signifiers of winds" (*communes ventorum significatores*), were in conjunction. Moreover, at the time of the strongest windstorms, at 6:00 AM and 12:00 PM, all of the planets were below the horizon. Just as these conditions suggested "something unusual and strange" (*etwas ungewöhnliches und seltzomes*) in nativities cast for the microcosm of man, they were said to anticipate some exceptional events in the macrocosm as well. These and further astrological considerations led Placentinus to assert the extraordinary nature of the recent windstorms.

Placentinus's interpretation (*Bedeutung*) follows in three steps. First, he explains that winds alter the air and purify it, just as purges cleanse the human body. Secondly, since windstorms are heralds (*Vorboten*) of comets according to his theory, they also announce the same negative effects, that is to say, war, plague and misery. Thirdly, exceptional winds also reveal that the *Jüngster Tag*, the end of the world and the Final Judgment, are coming. A physical explanation is not lacking, although it is intricate: sunspots are signs of the last day; in fact, at the end of the world the entire surface of the Sun will be obscured; according to Cartesian theory, when a star is completely obscured by dark spots, it can be transformed and transferred elsewhere in the form of a comet; the obscuration of the Sun will thus prelude its transformation into a comet and its consequent displacement; as a result of such metamorphosis, terrific winds will be generated, which are an apocalyptic sign according to the Scriptures. Ultimately, Placentinus's Cartesian astrology culminates in a bizarre Cartesian eschatology:

> Hence, these unheard-of winds are also harbingers of the Last Judgment. As I explained before, this [phenomenon] occurs when a star disappears from the heavens, if sunspots [*dergleichen maculis*] entirely cover and hide a heavenly light and the

latter is therefore transported to another place, as René Descartes explains in the third part of the *Principles*. Thus, when the great light of the Sun shall be completely obscured by those spots – together with other earthly and heavenly signs – frightening winds will also originate, and the forces of the heavens will set themselves in motion, as announced by the Holy Bible.[63]

Conclusion

The nova of 1604 rekindled the question of the corruptibility of the heavens already fueled by debates surrounding the celestial novelties of the 1570s and the invention of planetary systems, such as the Tychonian, which presupposed the fluidity of space. The appearance of unpredictable phenomena like the novae of 1572 and 1604 also acted to resuscitate materialistic views. In the eyes of Kepler, new and old followers of Epicurus revived ideas of cosmic disorder at odds with the belief that Divine wisdom underlies the Creation. Renaissance debates on novae and comets had paved the way for the acceptance of the principle of cosmological homogeneity and for novel conceptions of nature and physics. New theories would account for the possibility of change in the heavens, the very possibility of which had been banned from Scholastic philosophy in the wake of the Aristotelian doctrine of the two physics – in particular, the distinction between the sublunary realm of change and the superlunary one of incorruptible perfection.

In *De stella nova*, Kepler voiced his concern over the resurgence of Epicurean chance. He viewed such a philosophy as radically opposed to his own trust in the geometrical proportion and inner harmony of the heavens – a manifestation of God's providential design.

[63] *Ibid*., f. D4*v*: "Also seynd auch Vorboten des grossen Tages, solche unerhörte Winde, welche entstehen, wie oben dargethan, wann ein Stern im Himmel verschwindet, solches aber geschiet, wann ein himmlisches Liecht mit dergleichen *maculis* gäntzlich umbgeben, bedecket, und deßwegen in einem andern Ort versetzet wird: als dieses demonstrieret Renatus des Cartes, *in tertia parte Principiorum*. Wenn also das grosse Liecht der Sonnen, mit denen *maculis* gäntzlich wird tegieret werden, als werden nebenst andern irrdischen und himmlischen Zeichen, auch erschreckliche Wind entstahen, und werden der Himmel Kräffte sich bewegen, wie die heilige Schrift davon meldet."

In spite of his concern, I could not trace any relevant Renaissance follower of Epicurean atomism ready to renounce divine providence. Rather, they grasped the guidance of God elsewhere. Instead of mathematical perfection, Bruno and his followers – among whom Hill and possibly Prague courtiers with whom Kepler was familiar – assumed that spatial infinity and the existence of countless beings in the universe better suited the Almighty than order and finitude. In this sense, even though Kepler was wrong in assuming that the modern admirers of Epicurus might revive the rule of chance, he correctly stressed that celestial novelties might reinforce "those philosophers to whom confusion is pleasing rather than order," and "who have debased the most beautiful world with intolerable atoms."[64] Seen from a Keplerian outlook, Brunian atomism and later corpuscular visions found common ground in their criticism of harmonic finitude and geometrical *concinnitas*.

In this essay, I have considered significant Renaissance and early seventeenth-century instances of cometary theories that relied on atomist and corpuscular philosophies. Bruno and his followers treated comets as celestial bodies that are similar to the planets and the 'planetary' Earth. Descartes went as far as assuming the interchangeability of stars, planets, comets and novae, seen as the products of material transformation processes in the heavens. It is remarkable that his cosmology, as well as his planetary conception of comets, resembles the Brunian conception more closely than that of Gassendi. The latter, a renowned French Epicurean, rather expressed an agnostic attitude, based on a skeptical interpretation of Epicureanism. Finally, I considered the Cartesian astrologer Placentinus's attempt to bring together the legacies of Descartes and Kepler, that is, to connect mechanical explanations of nature with the Keplerian theory of astrological influences. Placentinus interpreted comets as eschatological signs, in spite of his mechanical explanation of these heavenly phenomena.

[64] Cf. *JKGW*, 1, 285.40–286.3: "Soli hi philosophi, quibus pro ordine placet confusio, qui mundum pulcherrimum inter inamoenas atomos abjecerunt, hoc sunt meriti, ut pulchritudine et congruentia hujus, quem dicunt, casus, nec ipsi moveantur, nec alios delectari patiantur." English translation by Patrick J. Boner from *idem* (ref. 6), p. 211.

From the viewpoint of the crisis of heavenly harmony, his syncretistic reading of comets as celestial harbingers of calamity is traditionally not disjointed from the move away from the archetypal understanding of cosmic beauty.

In the end, Kepler rightly sensed that phenomena such as the nova of 1604 were leading contemporary cosmologists towards a philosophy of contingency and disorder, abandoning the principle of harmony of classical astronomy.