ATOMISM IN THE *NOVATORES* AND LATE SCHOLASTICS

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Abstract. Novelty was not considered a positive epistemic value in the 17th century, so that when people were referred to as innovators (*novatores*) they were being criticized as dangerous and as holding views contrary to the sentiments and the practice of the Church, that is, as heretics and new philosophers. You can find various lists of such "novelists" at the time; the members of the list do not have much in common, except that they were implicitly or explicitly anti-Aristotelians and often also atomists. I survey the wide variety of atomism prevalent in the works of the *novatores* and some of their close contemporaries. I focus on the alchemical atomism of Étienne de Clave, the *minima naturalia* theory of Daniel Sennert's early period, the Democritean atomism (without void) of Sébastien Basso, and the corpuscularianism of René Descartes (as seen through the criticism it received from scholastics). All of these "new philosophers" can be found on a list of *novatores* at one time or another during the 17th century.

Keywords: early modern philosophy; atomism; scholastics; Étienne de Clave; Daniel Sennert; Sebastian Basso; Descartes.

In the context of a nasty letter from Descartes to Beeckman about whether Mersenne had spoken ill of Beeckman to Descartes and whether Beeckman had gotten too familiar in his tone with him, treating himself as Descartes' teacher and Descartes as a mere schoolboy, Descartes reflects on what kind of things someone can teach another: "languages, history, experiences, and clear and certain demonstrations that convince the mind, like those of the geometers." But, Descartes says, the maxims and opinions of the philosophers cannot be taught: "simply to say them is not to teach them." At this point Descartes poses a now notorious rhetorical question, exclaiming: "Plato says one thing, Aristotle another, Epicurus another, Telesio, Campanella, Bruno, Basso, Vanini, and all the *novatores* all say something different from each other. Who of all these people really teaches, not me, but anyone who loves wisdom?"[1] Now, like

[1] *Descartes to Beeckman,* 17 October 1630, in *Oeuvres de Descartes,* vol. I, (ed. C. Adam and P. Tannery. 2nd. ed. Paris: Vrin, 1964–1974), p. 158.

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other aspects of his letter, the words Descartes used were not exactly pleasant and sincere. Clearly, Descartes wanted to suggest that his near predecessors and contemporaries – the *novatores* – held a great variety of philosophical opinions, but he also was referring to them with a generally derogatory term.

We might not think badly of innovators, but in the 17th century the Latin term *novator* and its cognates in other languages were terms of disapprobation[2]. You can find dozens of books in the first half of the century whose titles include the term, all of them *contra* or *adversus Novatores*[3]. This attitude is enshrined in the first edition of the *Dictionnaire de l'Académie française* (1694) which defines *novateur* as "Celuy qui introduit quelque nouveauté, quelque dogme contraire aux sentimens & à la pratique de l'Eglise." and gives as the sole example of the term: "*Les Novateurs sont dangereux*." The pejorative sense of "novateur" continues well into 6th edition of the *Dictionnaire* (1875). The term is also gradually given a broader domain, beyond designating someone "contrary to the sentiments and the practice of the Church," to include those who introduce some novelty into philosophy: "Depuis le comencement du siècle on a comencé à l'employer pour les matières profanes," and then, "Il se dit quelquefois De ceux qui veulent innover dans quelque matière que ce soit." More generally, *novateur* becomes "*Dérangé*, [il] signifie *désorienté*: suivant *les Novateurs*." The *Dictionnaire Littré* (1872–1877) cites some interesting historical uses of the term, including this from Malebranche: "Ils appellent indifféremment du nom odieux de novateur les hérétiques et les nouveaux philosophes"[4].

We can see such sentiments expressed by others in Descartes' circle in various lists of *novatores* similar to Descartes' list of Telesio, Campanella, Bruno, Basso, Vanini, et al. Although he does not call them so by name, Mersenne, in *L'impiété des Deistes*, after having discussed such "despicable" authors as Charron, Cardano, Machiavelli, Bruno, the "accursed" Vanini, "and similar rogues," talks about the work he is writing against them: "I do not want to spend much time on this subject, since I expect to refute everything these authors stated so inappropriately in the Encyclopedia I am preparing in the defense of all truths and against all sorts of lies, in which I will examine more diligently what has been advanced by Gorlaeus, Charpentier, Basso, Hill, Campanella, Bruno, Vanini, and a few others"[5]. Mersenne proceeds to gives examples of the

[2] I discuss the French term *novateur* below. In English, the cognate is *novelist*, which the OED defines as "An innovator (in thought or belief); someone who introduces something new or who favours novelty. Chiefly *derogatory. Obs."*

[3] A search through the Worldcat database for the years up to 1650 yields over Latin 90 titles, with another dozen in French.

[4] Émile Littré, "MALEBR., *Rech. vér. II, II, 3*." Also "BOSSUET, *2e instruct. past. sec. 111*: En général, tout novateur est artificieux."

[5] Marin Mersenne, *L'impiété des Déistes, Athées, et Libertins de ce temps, combattue, et renversée de point en point par raisons tirée de la Philosophie, et de la Théologie* (Paris, 1624), pp. 237–238. Mersenne had previously listed Campanella, Bruno, Telesio, Kepler, Galileo, Gilbert, Bacon, Fludd, Hill, and Basso as *novatores* in his *Commentary on Genesis* (Marin Mersenne, *Quaestiones celeberrimae in Genesim* (Paris, 1623), *Praefatio* p. 1, and column 1838).

"impertinence" of these authors. He complains specifically about the adherence of Charpentier and Gorlaeus to the principle that "all things are made and derived from nothing" and that of Gorlaeus and Hill to atomism, that is, to Hill's "Epicureanism" and to the doctrine "that inside bodies there are atoms which have quantity and shape." According to him, "ultimately, they are all heretics, which is why we should not be surprised that they agree, being all as thick as thieves." A year later, he gives a similar list in *La vérité des sciences* but this time they are just described as anti-Aristotelians:

> Franciscus Patrizi has tried to discredit Aristotle's philosophy, but he made no more progress than Basso, Gorlaeus, Bodin, Charpentier, Hill, Olive, and several others, who raise monuments to Aristotle's fame through their writing, since they are not able to strive high enough to bring down the flight and glory of the Peripatetic Philosopher, for he transcends everything of the senses and imagination, and they grovel on the ground like little worms: Aristotle is an eagle in philosophy and the others are like small chicks who wish to fly before they have wings[6].

The list of *novatores* changes over time to include even Descartes and Gassendi[7], and the earlier Italian *novatores* tend to drop out, but the sentiment is clear: These are dangerous people, heretics or near heretics[8], the heresy stemming from their attacks on Aristotelianism and hence, in general, against authority and, ultimately, against the faith. The question is, did the *novatores* share any other traits or are we obliged to think of them as a random group of "alchemists, atheists, atomists, kabbalists, deists, naturalists, occultists, even sceptics," as they have been described?[9] They are surely a motley crew, and not all of them can be fitted under a single umbrella, but we should note that the majority of them are atomists[10]. Although there are many varieties of atomism at the

[6] Marin Mersenne, *La verité des sciences* (Paris, 1625), pp. 109–110.

[7] For an interpretation of why Gassendi and his editor-translator François Bernier (and Walter Charleton) seem to have escaped official condemnation, see Roger Ariew, *Descartes Among the Scholastics* (Leiden: Brill Academic 2011), chap. 9.

[8] For a list of the lists of *novatores*, see Daniel Garber, "Why the Scientific Revolution wasn't a Scientific Revolution, and Why it Matters" in *The Mechanization of Natural Philosophy,* eds. D. Garber and S. Roux, (Dordrecht: Springer, 2013), Appendix. For an argument about the changes in the lists over time, see Sophie Roux, "An Empire Divided: French natural Philosophy (1670–1690)", in *The Mechanization of Natural Philosophy,* eds. D. Garber and S. Roux (Dordrecht: Springer 2013). See also Daniel Garber, "Novatores: Rejecting Aristotle and Forging a New Philosophy in the Seventeenth Century", in *Encyclopedia of Early Modern Philosophy and the Sciences*, eds. D. Jalobeanu, C. T. Wolfe (Dordrecht: Springer 2019).

[9] Brian Copenhaver, "Doubt and Innovation", in *Columbia History of Western Philosophy*, ed. R. Popkin (New York: Columbia University Press, 1999), p. 323. See also Daniel Garber, "Novatores: Rejecting Aristotle and Forging a New Philosophy in the Seventeenth Century", in *Encyclopedia of Early Modern Philosophy and the Sciences*, ed. cit., who adds a nice quote from a 17th century philosopher expressing this sentiment "Concerning the Patrizis, the Gorlaeuses, the Keplers, the Galileos, the Bassons, the Telesios, the Campanellas, the Boots, the Bacons, the Gilberts, the Berigards, and numerous other *novatores*, I won't add even a word, since this whole bunch never came together into a unity so as to make up a proper sect. ([Utrecht professor Gerard] de Vries 1683, § XIV)."

[10] Garber notes that "Telesio explained everything in terms of hot and cold; Gilbert explained everything in terms of magnetism. Others, like Basson, Gorlaeus, and Gassendi, were some variety or another of an atomist…. Though all the *novatores* from Telesio to Descartes and beyond agreed in rejecting Aristotle and Aristotelianism, they could hardly be said to form a uniform school of thought." (Daniel Garber,

beginning of the 17th century, most, though not all, atomists are anti-Aristotelians. There are also numerous reasons why philosophers might profess atomism; one of these originates in alchemical thought. Being an alchemist does not in itself automatically put one into the list of *novatores:* not all alchemists were anti-Aristotelians and not all of them got into difficulties with Church doctrine; still, many did. So, one can find thinkers who were driven to atomism because of their alchemical leanings. These often became anti-Aristotelians and often ran afoul of the Church.

Such was a case with some *novatores* who attempted to hold a public refutation of Aristotelian, Paracelsian, and Cabalist theses. Étienne de Clave, Jean Bitault, and Antoine Villon scheduled a disputation for August 24 and 25, 1624, posting a broadsheet containing fourteen such theses on the streets of Paris. The disputation did not take place. The President of the Parlement saw copies of the theses and prohibited the disputants from sustaining them. The Parlement then sent the theses to the Faculty of Theology of the University of Paris to be examined. A few days later, the Sorbonne replied with a censure of some of them as false, overly bold, near heresy, or erroneous in faith, and, through an *arrêt* of 4 September 1624, Parlement ordered de Clave, Villon, and Bitaud to leave Paris, never to teach again within their jurisdiction, on pain of corporal punishment[11]. Among the prohibited theses was one regarding matter, calling it fictitious. Another concerned form, referring to substantial forms (except rational souls) as absurd. Its official condemnation by the faculty of Theology was that "this proposition is overly bold, erroneous, and close to heresy." The Sorbonne seemed particularly incensed by the thesis against the Peripatetic view of change and a related one supporting the atomist view. These, they claimed, "in some way attacked the holy sacrament of the Eucharist"[12].

There are many extant reports about the event of 1624, including some by Descartes' correspondents Mersenne and the astrologer Jean-Baptiste Morin, as well as by others such as J.-C. Frey, Professor of Philosophy at Paris. The reports have little favourable to say about the theses of de Clave, Bitaud and Villon. Mersenne in *La vérité des sciences* defends Aristotle against their attacks and dismisses them as charlatans[13]. He goes through all fourteen posted theses, expressing general disapproval, and showing that their anti-Aristotelianism derives from their atomistic and alchemical bent. As Mersenne

"Novatores: Rejecting Aristotle and Forging a New Philosophy in the Seventeenth Century", in *Encyclopedia of Early Modern Philosophy and the Sciences*, ed. cit.). True. We cannot expect necessary and sufficient conditions for being a *novator* (or a Cartesian, or a Scholastic, etc.) and it is even difficult to claim the term as an actor's category. Like most derogatory terms (even Jansenist), it is used by opponents, not by the actors themselves. still, it may be useful to detail the varieties of atomism and anti-atomism in the period; there is a link between anti-atomism and Aristotelianism, though some Aristotelians were atomists as well. Moreover, not all *novatores* were explicitly anti-Aristotelian.

[11] See Daniel Garber, "Descartes, the Aristotelians and the Revolution that Did Not Happen in 1637." *The Monist*, 71, (1988): 471–86, and Daniel Garber, "Defending Aristotle/Defending Society in Early 17th C Paris", in *Wissensideale und Wissenskulturen in der frühen Neuzeit*, eds. C. Zittel and W. Detel (Berlin: Akademie-Verlag, 2002).

[12] Jean de Launoy, *De varia Aristotelis fortuna,* 2nd Ed. (Hages-Comitum, 1656), pp. 310–321.

[13] Marin Mersenne, *La verité des sciences* (Paris, 1625), pp. 100–101.

says: "It seems to me that they are opposed in particular to Aristotle's doctrine and that the first two theses reject matter and form. The third makes fun of privation. The fourth and fifth assert that every mixture is composed of five simple bodies, namely earth, water, salt, sulfur or oil, and mercury or some acidic spirit." Mersenne continues with his description of the theses as requiring the diversity in genus, species, and individuals to stem from the five alchemical principles as well as all motions and actions of sensible individuals to be caused only by them. He ends by asserting that the anti-Aristotelian theses make fun of the transmutation of elements and maintain that "earth can never be changed into water, nor water into earth, nor any of the other three principles into one another. As a result, they conclude that Aristotle was wrong to have mocked the two maxims of the ancients, namely, that all things are in everything and that all things are composed of atoms"[14].

Mersenne's main argument against the theses is that: "if there is no form and no matter, then man has neither body nor soul, something contrary to the belief of the Catholic faith; if there are no other genera and no other species, except for the various mixture of the five substances established by them, man is of the same species as stones, plants, and animals, which is most false"[15]. The others, Morin and Frey, issued similar criticism. Morin took as basic and beyond question the Aristotelian view that "matter … and form united are the essence of body as such." He then argued that without matter and form, there can be no bodies – there cannot even be a human body for a soul to inform, since the body without its own form is nothing[16]. In a similar vein, working on the lack of parallelism between humans and other animals (humans having rational souls, but animals lacking any substantial form), Frey asked rhetorically: if a donkey is a donkey without the substantial form for being a donkey, then why would a human not be human without the substantial form for humanity? And if a human is formally a human by its substantial form, why would a donkey not be a donkey by its own substantial form?[17]

Notwithstanding these attacks and his banishment, de Clave subsequently published a number of alchemical treatises consistent with his earlier anti-Aristotelian views. He continued to reject the Aristotelian doctrine of four elements, denying the element fire[18] and the doctrine that the elements were the product of permutations of the opposing qualities hot, cold, dry, and moist[19]. He held that a primary element can only be derived from a single form and that form could not itself be derived from

[14] *Ibid*., pp. 79–80.

[15] *Ibid*., pp. 81–82.

[16] Daniel Garber, "Defending Aristotle/Defending Society in Early 17th C Paris", in *Wissensideale und Wissenskulturen in der frühen Neuzeit*, eds. C. Zittel and W. Detel (Berlin: Akademie-Verlag, 2002).

[17] Jean-Cécile Frey, *Cribrum philosophorum qui Aristotelem superiore et hac aetate oppugnarunt* in *Opuscula varia nusquam edita, philosophis, medicis, et curiosis omnibus ultilissima*, ed. Antoine Morand (Paris, 1628), chap. 17 about Villon and de Claves, Garasse and Basso, though Basso is not mentioned in the text. Frey's "Preface" refers to his target: "Campanella, Patrizi, Bacon, Telesio, Chassinus, Peter Ramus, and recently the Vile Villon, as held by Parlement."

[18] Étienne de Clave, *Nouvelle lumiere philosophique* (Paris, 1641), chap. 1: "Du nombre des elemens Peripatetiques."

[19] *Ibid.,* chap. 13: "Des qualitez elementaires."

matter[20]. He denied substantial forms for things such as donkeys, preferring to think of them as composites of primary elements.

Mersenne was right in seeing the attack on Aristotle as coming in large part from a desire to accord with the principles of the alchemists – the Paracelcian *tria prima* of salt, sulphur, and mercury – the status of element or simple body and to dispute the traditional four Aristotelian elements. Thinking of bodies as combinations of the basic elements tends to lead to the denial of substantial forms and to some kind of atomism. However, some alchemists tried to accomplish this within the Aristotelian framework itself. It happens that Aristotle, who was as a rule strongly anti-atomist, also uttered the obscure statement that "neither flesh, bone, nor any such thing can be of indefinite size in the direction either of the greater or of the less"[21]. This comment took on a life of its own[22]. By the 17th century, the resulting doctrine entailed that there were intrinsic limits of greatness and smallness for every sort of living thing. For example, some argued that since every natural body has an actually determined substantial form, every natural body must have a determinate assortment of accidents and its quantity must be limited to some particular range. Moreover, they asserted limits even for the four basic elements (earth, air, fire, water), which have no determinate magnitude of themselves and intrinsically; the elements might be augmented indefinitely, if there were matter enough, and their division can be continued indefinitely. They do have an extrinsic limitation, however, with respect to prime matter: there may not be enough prime matter to sustain a form and the amount of prime matter is finite. In addition, elements cannot be condensed or rarefied, that is, they cannot have their quantity changed indefinitely, without being corrupted. For example, earth cannot be as rarefied as fire, and fire cannot be as condensed as earth; when air is condensed too much, it is turned into water, and water overly rarefied is turned into air[23]. (We can recall Mersenne's rejection of the proposition that earth can never be changed into water, nor water into earth, nor any of the other three principles into one another and de Claves denying that that the elements were the product of permutations of the opposing qualities hot, cold, dry, and moist.) For a late scholastic, rarefaction and condensation, that is, augmentation and diminution in quantity, can result in generation and corruption, under appropriate circumstances. There is, then, a natural minimum of any given element, which is to say that late scholasticism can countenance a kind of atomism. This doctrine of a natural minimum became a bridge between Aristotelian and alchemical theories of matter.

[20] *Ibid.*, p. 117.

[21] Aristotle, *Physica* 187b 18–21.

[22] For a history of *minima naturalia* from Averroes to Toletus, see Pierre Duhem, *Le Système du Monde*, (10 vols. Paris: Hermann, 1913–1959), vol. 7, pp. 42–54 and *Etudes sur Léonard de Vinci,* 3 vols. (Paris: Hermann, 1908–1913), vol. 2, pp. 11–15. There is also an account in Andrew G. van Melsen, *From Atomos to Atom* (New York: Harper 1960), I, chap. 2, pp. 58–81.

[23] See Franciscus Toletus, *Commentaria una cum quaestionibus in octo libros de Physica auscultatione* (Venice, 1589), I, cap. 4, quaest. 10–11; Daniel Sennert, *Thirteen books of natural philosophy* (London, 1659), I, chap. 5, pp. 27–29; Charles François d'Abra de Raconis, *Tertia pars Philosophiae, seu Physica*, Paris 1651, pp. 370–377.

Daniel Sennert, a Professor of Medicine at Wittenberg who does not normally figure in the list of the *novatores*[24], provides a good example of a corpuscularian alchemist working within a scholastic tradition of *minima naturalia*[25]. In his more mature work Sennert announced his aim as the correction of Aristotle by reason and experience: "For neither would I be of those number of rash innovators, whether Paracelsians or Chymists, or how ever otherwise called, who endeavor wholly to banish from the Schools the ancient philosophy, which is come to us chiefly from the Writings of Aristotle: nor yet would I be reckoned amongst them who are not ashamed in this Age of ours publickly to profess, that they had rather err with Aristotle and Galen, than speak the truth with any later author"[26]. The changes Sennert wished to make are particularly evident in the third discourse, "Of Atomes and Mixtures"; there Sennert develops the notion that the matter constituting bodies is composed of particles that can be divided again into their original minimal form. Like other chemists, he uses chemical operations to argue that there are atoms in nature.

> And although those Atomes be so exceedingly small; yet the essential forms of things remain in them entire, as was lately said, and experience it self does witness. For if Gold and Silver be melted together, the Atomes of the Gold and Silver are so mingled together, that no sense can discern the one from the other. Yet both of them do retain their forms entire. Which appears hereby in that if you put *Aqua fortis* upon the said Mass, the Silver melts and turns into the Liquor, but the Gold remains in the form of a Powder.[27]

Sennert's atoms are of two kinds. First are those from which all things are made, that is, the four Aristotelian elements each with its own form. They are the smallest things in nature. Sennert argues that the particles of fire are the smallest atoms, that they are more subtle than the atoms of earth, and "that they diffuse not themselves beyond their Natural bounds"[28]. The second atoms, which Sennert specifically

[24] Though Leibniz puts him in a list of those who should be criticized; as he said, "there are Patrizi, Telesio, Campanella, Bodin, Nizolius, Fracastoro, Cardano, Galileo, Bacon, Gassendi, Hobbes, Descartes, Basson, Digby, Sennert, Sperling, Deondon, Deusing, and many other names among whom the mantle of philosophy is torn apart". *Leibniz to Thomasius*, April 20/30, 1669, in G. W. Leibniz, *Philosophical Papers and Letters*, 2d ed. (Dordrecht: Reidel, 1989), ed. L. E. Loemker, p. 93.

[25] Sennert was a prolific author of works in natural philosophy, chemistry, and medicine. His books went through numerous editions, with several of them being translated into English (I cite the latter).

[26] Daniel Sennert, *Thirteen books of natural philosophy* (London, 1659), p. 413.

[27] *Ibid.,* pp. 453–54.

[28] *Ibid.*, p. 454. He constructs an argument on analogy with light, which he claims has a *minimum naturale*: "though there is not a smallest in quantity, yet Light hath a smallest in Nature, that is to say, so small a Light that it cannot be smaller without perishing. After which manner there are also the smallest among Natural Bodies; which if they be any more divided they lose their form and essence." (*Ibid.*, p. 454). Sennert even argues that this view is consistent with the division of the continuum to infinity by differentiating between mathematical and natural divisibility: "Now those disputes against Atomes concerning the infinite division of that which is continued of indivisible Lines, are disputed not from Natural but Mathematical Principles. For the question is not here … whether a thing continued be perpetually divisible Mathematically? but, whether or no Nature in her Generation and resolution of Bodies does not stop at some smallest Bodies, than which there are not, nor can be any smaller." (*Ibid.*, p. 454).

identifies with the principles of the chemists – such as quicksilver, vitiol, sulfur, and salt – are the first mixtures, or second-order corpuscles composed out of the atomic elements. These are rarely divided but other compound bodies normally resolve into them. "For there are (in the second place) Atomes of another kind besides the Elementary (which if any man wil term first mixt bodies, he may do so as he please) into which as similar parts other compounds are resolved."[29] Sennert's hierarchy of particles enables him to recover the alchemical tradition as a middle-level theory within a broadly Aristotelian framework of the four elements differentiated at the basic level by their natures.

Ultimately Sennert abandoned his unsteady compromise for full-blooded atomism[30]. Other scholastics did as well. The second half of the 17th century also saw the rise of "Peripatetic atomism," the title of a philosophy textbook by the Capuchin monk Casimir of Toulouse, who allied himself with Gassendi but whose works were ultimately placed on the Index[31]; it is also the attitude adopted by the Jesuit Honoré Fabri and others who introduced corpuscularian principles and explanations into scholastic philosophy and similarly got into some trouble with the Church[32]. But let us return to the atomism of the *novatores* mentioned by Mersenne and Descartes. Not all such atomism was motivated by alchemical leanings. Some of it was more like Gassendi's atomism, renovation instead of innovation, the attempt to modernize and Christianize some ancient doctrines. Such was the atomism of Hill and Basso[33].

Nicholas Hill published *Philosophia Epicurea, Democritiana, Theophrastica…*, a collection of aphorisms offering an alternative to Aristotle by attempting to resurrect the philosophy of the ancients. In it, Hill fiercely attacks certain scholastic uses of forms and develops a view of natural objects composed of conglomerations of solid, indivisible and variously shaped particles. Generation, qualitative alteration, corruption, and local motion are all explained in terms of changing atomic composition, not by an appeal to forms. A form becomes the mere "state and condition of things, resulting

[29] *Ibid.*, p. 451.

[30] William R. Newman, *Atoms and Alchemy: Chymistry and the Experimental Origins of the Scientific Revolution* (Chicago: The University of Chicago Press, 2006) is an excellent exposition of early modern alchemy centred around Sennert and his influence on Boyle.

[31] The six-volume textbook of Casimir de Toulouse, *Atomi peripateticae* (1674), was an attempt to combine atomist and Aristotelian perspectives. Casimir rejected substantial forms and insisted that the building blocks of natural bodies were atoms, differentiated by their size, shape and motion. He argued for *vaculoae*, or gaps, surrounding atoms at all levels of matter, including subtle matter. He even proposed that animals could be explained in terms of the shape and motion of atoms. His work created some controversy within the Catholic Church and, by 1680, its volumes 2–6 were placed on the *Index* with the notation *donec corrigantur*.

[32] See Paul Richard Blum, "Aristotelianism 'More Geometrico': The Case of Honoré Fabri", in *Conversations with Aristotle*, eds. C. Blackwell and S. Kusukawa (Aldershot: Ashgate, 1999). See also Lynn Thorndyke, *A History of Magic and Experimental Science*, 8 vols. (New York: Columbia University Press 1941–1958), vol. VII, chap. 23, for a discussion of Étienne Natalis, another Aristotelian corpuscularian, and Fabri.

[33] For the similar case of Gorlaeus, see Christoph Lüthy, *David Gorlaeus (1591–1612): An Enigmatic Figure in the History of Philosophy and Science* (Amsterdam: Amsterdam University Press 2013).

from the connection of material principles"[34]. Unlike classical atomists and unlike some of his contemporaries, for whom ultimate causal explanation is given in terms of primitive motion directed by God, for Hill, God acts directly on the atoms through a force: "The prime force, the efficient, active, universal cause, the simple, absolute essence, the foundation and root of all material power is God"[35]. Thus Hill was more of an eclectic than a systematic philosopher; ultimately, he retained elements of Aristotelian psychology and argued that his principles were in accordance with Catholic beliefs.

Basso was also a non-standard atomist. In his work, *Philosophiae naturalis adversus Aristotelem*, he alternates exposition and criticism of Aristotle with exposition of what he calls the philosophy of the ancients, that is, of Aristotle's predecessors, by which he means Plato, Empedocles, and especially Democritus[36]. The philosophy he wishes to recover is atomism. Rejecting the matter–form debates altogether, he proposes that matter makes up its own natural *minima* by arrangement of homogeneous and incorruptible atoms; these "retain their differences when conjoined"[37]. According to him, the ultimate constituents of bodies are the minimal particles of matter he calls "atoms". These atoms are smaller than the invisible internal organs of the tiniest animals; they are pre-existent, incorruptible, and limited in number. They were created by God at the beginning of time and, setting aside the possibility of their annihilation by God, they are indestructible. Each atom is a homogeneous simple body possessing a particular nature that persists in mixtures; when atoms enter into composition, they make up natural minima having their own proper natures. According to Basso, there are four kinds of elementary atoms (other than the ether), coinciding with the four scholastic elements.

For Basso, all mutations – generation and corruption, alteration in quality, and augmentation and diminution in quantity – are explicable at the level of the ultimate constituents of matter. Generation and augmentation in quantity are the gathering together of atoms or clusters of atoms; corruption and diminution in quantity are the dispersing of atoms that were previously united. Alterations in quality result from atoms of one kind being substituted for atoms of another:

[34] Nicholas Hill, *Philosophia Epicurea, Democritiana, Theophrastica proposita simpliciter, non edocta* (Geneva 1619), pp. 13–14, aph. 35.

[35] *Ibid*., p. 28, aph. 110.

[36] Sebastian Basso, *Philosophiae naturalis adversus Aristotelem. In quibus abstrusa veterum physiologia restauratur, et Aristotelis errores solidis rationibus refelluntur*, 2nd Ed. (Amsterdam, 1649 [1621]). I cite the 1649 edition. For more details about Basso's life and times, see Christoph Lüthy, "Thoughts and Circumstances of Sébastien Basson, Analysis, Micro-History, Questions." *Early Science and Medicine* 2, (1997): 1–73.

[37] Sebastian Basso, *Philosophiae naturalis adversus Aristotelem. In quibus abstrusa veterum physiologia restauratur, et Aristotelis errores solidis rationibus refelluntur*, 2nd Ed. (Amsterdam, 1649 [1621]), p. 27; see also the resumé, p. 67: "quod ex primis illis qua constituebant, rerum particulis, ita res omnes componi assererent, ut in composito propriam naturam retinerent."

> Infinitely varied parts can be composed in many ways from these primary particles, which are so different among themselves; it is not difficult to understand that by the subtraction or addition of any particle, or by a variation in the arrangement of parts, some parts can be easily converted into the nature of others[38].

Thus, for Basso, completely new generation is an illusion; what happens instead is the continuous reorganization of atoms[39]. He attempts to disprove the scholastic doctrine that the four elements can assume new substantial forms and thus can be generated from one another[40]. Rebutting this doctrine is particularly important to him since, for scholastics, it contrasts with the doctrines of Democritus about the incorruptibility of atoms.

Basso introduces the ether as a fifth element into the world of atoms, in part to explain rarefaction and condensation, and in part to explain why atoms move[41]. The ether is material, and it consists of atoms[42]. It is far more tenuous than the elementary atoms; it permeates every kind of object insofar as it fills the gaps between the atoms of the four elementary kinds. It is the cause of the motion of atoms and, in this way, the cause of the mutations of bodies. Atoms of the four elementary kinds do not possess motive power; they are put into motion solely by something external, namely, the ether[43]. Basso does not consider the possibility that atoms may have their own principle of motion. Given that Basso does not envision a principle of inertia and does not mention the late scholastic account of *impetus*, introducing empty space into the universe would have the unwelcome consequence that the continuity of the ethereal motion would be disrupted. As a result, Basso rejects the void: nature abhors a vacuum[44].

Since, for Basso, the atoms of ether do not penetrate or pass through the elementary atoms but permeate only the interstices existing between the elementary atoms[45], even when the elementary atoms form a compound, the ether is an external

[38] *Ibid.,* p. 72.

[39] *Ibid.,* pp. 9–10.

[40] *Ibid.,* p. 118 et seq.

[41] Basso credits the Stoics for having discovered the ether, or *Spiritus* (*Ibid.*, p. 300: "En tibi Stoici clari manifestarunt), though he also maintains that Democritus had atoms moving in the ether, in opposition to Aristotle's report that Democritus defended the existence of the void (*Ibid.*, p. 305).

[42] See, for example, *Ibid.*, p. 220; p. 382–384.

[43] See *Ibid.*, pp. 300 et seq.

[44] *Ibid.*, p. 300: "vacuum . . . a quo natura abhorret"; p. 311: "vacuum, a quo Natura abhorret." As long as he denies the void, Basso cannot have recourse to the atomist explanation of rarefaction and condensation as changing ratios of atoms to void. And since he also repudiates the Aristotelian explanation of the phenomenon as change of qualitative form, he is compelled to use the ether. According to Basso, the phenomenon occurs when "all similar natural minima are diminished" with the result that "the object becomes condensed, and when their quantity is increased, the object becomes rarefied." (*Ibid.*, pp. 293–294.) For these natural minima to increase, the ether needs to interpose itself between the atoms of the body; in this way the gaps between the elementary atoms grow wider as the volume of the body increases: "by penetrating into the parts of air it separates them from one another, occupying a greater place." (*Ibid.*, p. 300.) Condensation is simply the reverse of this process

[45] *Ibid.*, pp. 304 et seq.

principle of motion; the atoms of ether do not become constituent parts of compound bodies and, thus, do not play the role of an internal principle. Moreover, the ether is continuous insofar as any atom of ether is always adjacent to some other ethereal atom and participates in the motion which is shared by all ethereal atoms. It moves every elementary atom according to its own aptitude. Given that part of the aptitude of an atom is having a proper place, each kind of atom has its proper place. And since Basso is a geocentrist, the atoms of earth belong at the centre of the universe, surrounded, in order, by the regions of water, air, and fiery atoms. Though the ether is the cause of motion, it is totally inert in itself. It is in constant need of being kept in motion by a higher cause. God is the higher cause on which the ether depends, not only for its motion but also for its directing of the motion of the elementary atoms. The ether is always dependent on God's continually infusing motive force as well as directing its motion to its proper ends: "By means of this spirit God moves the single elements not differently than they would move if this motive power were innate in them"[46].

Basso, then, is a kind of Democritean atomist (as opposed to a *minima naturalia* theorist): his atoms are indestructible and do not transmute into one another. However, he is a rare kind of atomist who denies the void, filling his universe with an ether that does not combine with other atoms. His atoms provide him with a decidedly non-scholastic theory of change: all change is due to the local motion of atoms. But Basso's universe is inert. Its primary cause of motion is God, who imparts motion to the ether; the ether, in turn, moves the various particles.

There were, of course, other atomists who are mentioned in one or another of the list of *novatores*. Some of these are difficult to categorize as either alchemical atomists or renovators. Like Hill and Basso, Francis Bacon and Galileo uttered various corpuscularian pronouncements, though unlike them neither made atomism a focus of their philosophies[47]. Bacon's atomism was equivocal: he initially propounded some atomist and vacuist notions, but these were later replaced by or subordinated to a Paracelsian matter theory[48]. Galileo was somewhat more forthcoming. In his 1638 *Discorsi*, Day One, he talks about how fire goes snaking among the minimum particles of various metals. This was a repetition of some now notorious atomistic views issued in his 1623 *The Assayer,* where he advanced a conception of heat opposed to the commonly held one, in which heat is thought of as an accident, affection, or quality residing in the heated material. He did the same for fire, which he said, "consists of a multitude of tiny

[46] *Ibid.*, pp. 284, 307 et seq.

[47] Galileo's corpuscularianism did not go unnoticed. An anonymous accuser denounced him to the Sacred Congregation for the Doctrine of the Faith, equating Galileo's corpuscularianism with the atoms of Democritus: "If one admits this philosophy of accidents as true … it makes greatly difficult the existence of the bread and wine which in the Most Holy Sacrament are separated from their substance" (Pietro Redondi, *Galileo Heretic* (Princeton: Princeton University Press 1987), p. 334). The accuser further argued that Galileo's doctrine is inconsistent with the interpretations of the Eucharist propounded by various church councils, including the Council of Trent.

[48] See, for example, Graham Rees, "Atomism and Subtlety in Francis Bacon's Philosophy", *Annals of Science,* no. 37 (1980): 549–71.

particles of such and such shape, having such and such velocity"[49]. The affection called heat therefore results from the particles of fire penetrating into a body[50]. As we said, ultimately, Descartes and the Cartesians made the lists as *novatores* and even as atomists. Ironically, they were condemned using the precedent of the 1624 condemnation against the alchemical atomists. No matter how vociferously they defended themselves against it, the charge was repeated throughout the 17th century.

While allowing that his matter theory was not identical to atomism[51], Descartes' scholastic critics argued that it suffered from exactly the same difficulties. The Jesuits of Clermont College claimed in 1665 that "the Cartesian hypothesis must be distasteful to … theology, because it seems to follow from the hypothesis that (i) too much is attributed to the fortuitous concourse of corpuscles, which favors the atheist; (ii) there is no necessity to allow a substantial form in man, which favors the impious and dissolute; (iii) there can be no conversion of bread and wine in the Eucharist into the blood and body of Christ, nor can it be determined what is destroyed in that conversion, which favors heretics"[52]. In their three-fold critique, the Jesuits were issuing the standard complaint against atomism, about the "fortuitous concourse of corpuscles," objecting to the proposition that man's substantial form is not necessary and raising the issue of the explanation of the Eucharist, which became the focus of opposition to Cartesianism in the second half of the 17th century, as it was for the atomists in 1624[53].

Linking Descartes' matter theory and atomism, and criticizing it as such, continued unabated during the 17th century. The censors of Angers criticized the collegiate lectures of the Oratorian Priest Eugene Fromentier because of the Cartesian

[49] Galileo Galilei, *Opere*, (Florence: Barbera, 1890–1909), ed. A. Favaro vol. 6, p. 350.

[50] "The operation of fire by means of its particles is nothing other than, in moving, it penetrates all bodies by its extreme subtlety, dissolving them quickly or slowly, depending upon the number and velocity of tiny particle of flame. … But that there is in fire, in addition to shape, number, motion, penetration, and contact, some further quality called 'heat,' I cannot believe," (*Ibid.,* pp. 350–51).

[51] Descartes was a corpuscularian who denied atoms and the void as against reason; this is forcefully stated in *Principles* IV, art. 202, That the Philosophy of Democritus differs as much from ours as from the generally accepted one. This did not prevent some Cartesians from espousing atomism. For example, in his 1666 *Le discernement du corps et de l'ame,* Gérauld de Cordemoy offered a variation of Cartesian mechanical philosophy – everything in the physical world is explained in terms of the size, shape, and motion of particles – but one that required atoms and the void. He rejected the indefinite division of body and the Cartesian identification of space and extension. He distinguished body and matter, matter being an assemblage of bodies, and claimed that bodies as such were impenetrable and could not be physically divided or destroyed. These views were intended as an answer to his criticism of the Cartesian principle of individuation of bodies as shared motion. According to the principle, a body at rest between other bodies would have to constitute a single body with the other bodies, even though we have a clear and natural idea of a body at rest between other bodies. Cordemoy proposed that shape, rather than motion, distinguishes the indivisible atoms. See Gérauld de Cordemoy, *Le discernement du corps et de l'ame* (Paris, 1666), First Discourse, 1–26, esp. pp. 11–12.

[52] Henry Oldenburg, *The Correspondence of Henry Oldenburg* (Madison: University of Wisconsin Press, 1966), A. eds. R. Hall and M. B. Hall, vol. II, p, 435.

[53] For more on this very large topic, see, among others, Roger Ariew, *Descartes and the Last Scholastics* (Cornell Univ. Press, 1999), chap. 7 and 9, or Tad Schmaltz, *Radical Cartesianism* (Cambridge: Cambridge University Press, 2002).

and atomist elements found in them[54], even though they recognized that Descartes formally rejected atomism:

> The opinion of Epicurus and Democritus, that the world has been formed by the fortunate encounter of atoms and small bodies flying about from all parts, has been treated as extravagant and impious. One wants to believe that Descartes and his followers do not teach that the universe was made by chance and without God's providence, but, at bottom, what they say is not different than what Democritus and Epicurus advance, since Descartes only wants God to have created all matter, divided it into almost equal parts, agitated these parts in various directions, each to its own proper center, and several around a common center; after that, God can remain at rest […] Is there something more odious in Epicurus' opinion not found in Descartes' hypothesis?[55]

Similar tactics can be found in the quadripartite textbook of the Dominican Antoine Goudin. Goudin spends almost thirty pages of his text arguing against Cartesian principles[56]. He disputes, for example, Descartes' conservation of quantity of motion based on God's immutability. According to Goudin, God can, without inconsistency, augment, diminish, or vary the motions he has given bodies. He also argues against Descartes' molecules as first principle: the principle of things must be something substantial; they must vary according to the variety of things. Extension is not something substantial; neither is shape and motion. Attributes such as these do not really vary from thing to thing; thus extension, shape, and motion cannot be the principle of things. For Goudin the core of his argument is that the molecules of Descartes can no more explain the variety of animals with sensation and life than can atoms. In fact, though he knows fully well and cites the *Principia* passages against Democritus, Goudin begins his discussion of Descartes' principles by referring his reader to his previous criticism on the principles of the atomists; as he says, "Since the principles of Descartes do not differ from those of the atomists in their principal points, they are refuted by the reasons we have just given"[57].

In his prior disputation against the atomists[58], Goudin argued that there are no atoms, and even if atoms are accepted *per impossibile*, they cannot provide any foundation as first principle. His line of reasoning is that, however small a body, it is always divisible; thus, there are no indivisible bodies, that is, no atoms. He considers the reply that atoms are so small that nature cannot abide a smaller body – they are divisible mathematically, or only by an operation of the mind, but that they are indivisible naturally and in reality. Goudin replies that atoms are different from one

[54] François Babin, *Journal ou relation fidele de tout ce qui s'est passé dans l'université d'Angers au sujet de la philosophie de Des Carthes en l'execution des ordres du Roy pendant les années 1675, 1676, 1677, et 1678* (Angers 1679), p. 36

[55] *Ibid.,* p. 41.

[56] Antoine Goudin, *Philosophia juxta inconcussa tutissimaque Divi Thomae dogmata* (Paris, 1726 [1668]), vol. 2, art. 4, pp. 16–44.

[57] *Ibid.*, vol. 2, art. 4, p. 16.

[58] *Ibid.,* vol. 2, art. 3, pp. 10–16.

another – they have different shapes from one another, one longer, one larger. Nature therefore allows things smaller than some atoms. He asks rhetorically: what would prevent the branch or hook of an atom to be broken into two atoms, since there are such smaller proportions in nature? So, there are no atoms; but even if there were atoms, Goudin asserts, they cannot be the principle of all things because they are not sufficient in themselves to explain the generation of sensitive and animate life out of their combinations alone – witness the exception made for humans and the insuperable difficulties with accounts of animals as machines without sensation. Ultimately, atoms and their combination cannot explain differences in kind. Finally, they cannot be reconciled with the mysteries of the faith.

There were, of course, other kinds of atomists during the 17th century, including physical and mathematical ones, such as Hobbes, and metaphysical ones, such as Leibniz. While Leibniz might have flirted with physical atomism, in his mature thought at least, he denied both physical and mathematical atoms and argued for a formal or metaphysical atom[59].

[59] "In the beginning, when I had freed myself from the yoke of Aristotle, I accepted the void and atoms, for they best satisfy the imagination. But on recovering from that, after much reflection, I perceived that it is impossible to find the principles of a true unity in matter alone, or in what is only passive, since everything in it is only a collection or aggregation of parts to infinity. Now, a multitude can derive its reality only from true unities, which have some other origin and are considerably different from [[mathematical]] points [[which are only the extremities and modifications of extension,]] which all agree cannot make up the continuum. Therefore, in order to find these real entities, I was forced to have recourse to a formal atom, since a material thing cannot be both material and, at the same time, perfectly indivisible, that is, endowed with a true unity." (G. W. Leibniz, "A New System of the Nature and Communication of Substances…," in *Philosophical Essays* (Indianapolis: Hackett, 1989), eds. R. Ariew and D. Garber, p. 138. For Leibniz's criticism of Cordemoy, see Roger Ariew, *Descartes Among the Scholastics* (Leiden: Brill Academic 2011), chap. 4. For more on Leibniz's atomism, See Marin Lucio Mare, "Leibniz's More Fundamental Ontology: from Overshadowed Individuals to Metaphysical Atoms," in *Für unser Glück oder das Glück anderer*, ed. W. Li, (Georg Olms Verlag, 2016), Volume IV, pp. 269–284.