Studies in History and Philosophy of Science 51 (2015) 82–88

Contents lists available at ScienceDirect

Studies in History and Philosophy of Science

journal homepage: www.elsevier.com/locate/shpsa

Copernicus, Epicurus, Galileo, and Gassendi

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ARTICLE INFO

Article history:
Available online 27 February 2015

Keywords:
Atoms;
Continuity;
Galileo;
Gassendi;
Heliocentrism;
Motion

ABSTRACT

In his *Letters on the motion impressed by a moving mover*, the theory of the motion of composite bodies put forth by Gassendi is strikingly similar to Galileo's. In other of his writings, however, his description of the motion of individual atoms is understood very differently. In those places, he holds (1) that individual atoms are always in motion, even when the body that contains them is at rest, (2) that atomic motion is discontinuous although the motion of composite bodies is at least apparently continuous, and (3) that atomic motion is grounded in an intrinsic *vis motrix*, motive power. In contrast, composite bodies simply persist in their state of motion or rest in the absence of outside interference. Unfortunately, Gassendi neglects to explain how his accounts of atomic and composite motion fit together, and it is difficult to see how they could possibly be integrated. My goal is to explain, given this difficulty, why he accepted both the Galilean theory of the motion of composite bodies and the Epicurean theory of atomic motion.

In his *Letters on the motion impressed by a moving mover*, Gassendi offers a theory of the motion of composite bodies that closely follows Galileo's. Elsewhere, he describes the motion of individual atoms in very different terms: individual atoms are always in motion, even when the body that contains them is at rest; atomic motion is discontinuous although the motion of composite bodies is at least apparently continuous; and atomic motion is grounded in an intrinsic *vis motrix*, motive power, while composite bodies simply persist in their state of motion or rest in the absence of outside interference. Gassendi does not make much effort to explain how his accounts of atomic and composite motion fit together, and it's difficult to see how they could possibly be integrated. My goal is to explain, given this difficulty, why he accepted both the Galilean theory of the motion of composite bodies and the Epicurean theory of atomic motion.

I

In August 1625, Gassendi (1959) wrote the first of several enthusiastic letters to Galileo. He enclosed a copy of his recently published *Exercitationes paradoxicae adversus Aristoteleos* (*Exercises in the form of paradoxes against the Aristotelians*), described some of his observations of sunspots,[1] and told Galileo:

> I have embraced your Copernican opinion in astronomy with so much intellectual pleasure that … my mind, unfettered and free, wanders through the immense spaces as if the chains of the common world system have been broken off (6.4b).[2]

Some further correspondence about observational astronomy followed soon after (6.10a–11b, 6.36b–37a). Galileo sent Gassendi a copy of the *Starry Messenger*, along with a telescope, via his patron Peiresc.[3] Gassendi seems to have kept this telescope for the rest of his life; at any rate, his will gives instructions on what to do with 'Galileo's morocco leather telescope'.[4]

In March 1632, Gassendi sent Galileo a copy of his *Mercurius in sole visus*, which recorded the 1631 transit of Mercury across the sun (6.45b). The transit of Mercury had been predicted by Kepler, and Gassendi's observation—generally considered to be the first

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http://dx.doi.org/10.1016/j.shpsa.2015.02.003
0039-3681/

[1] These observations were published in his posthumous *Opera Omnia* (Gassendi, 1658), where they are included in the *Commentarii de rebus caelestis*. See e.g. 4.232.
[2] All references are to the *Opera Omnia*, cited by volume, page, and column.
[3] Baumgartner (1988), 175.
[4] Fleury and Bailhache (1955) includes Gassendi's will.

observation of a transit of Mercury—thus constituted empirical evidence in favor of heliocentrism.

That November, Gassendi wrote to Galileo again, saying that he had just read the *Dialogue Concerning the Two Chief World Systems*, which Galileo had sent via their mutual friend Élie Diodati, and praising both the book itself and Galileo's 'genius' (6.53b).[5] On April 30, 1633, Gassendi's friend, the astronomer Ismael Boulliau, informed him that Galileo was in Rome, where he was supposed to respond to the Inquisition (6.411b–12a). A few weeks later, in a letter to Tommaso Campanella,[6] Gassendi explained:

> [F]rom a recent long letter from Galileo, I have learned that he will soon be in Rome, where he has been summoned. This is astonishing, since he has published nothing without approval. But it is not for us to know these great things … (6.56b).

This mixes sympathy with caution in a manner that is characteristic of Gassendi.

It is not clear precisely when news of Galileo's condemnation reached Gassendi. He seems to have been unsure of exactly what was happening for quite a while. But in December 1633, he wrote to Peiresc—who had tried to intercede on Galileo's behalf[7]—thanking him for sending news of Galileo's situation and explaining: "I would happily write [Galileo] a note, but I don't know how to begin; everything about this is so touchy …".[8]

In January 1634 Gassendi wrote to Galileo again:

> Great expectation keeps me waiting (o great glory of our age) for news of what has happened to you. For although ignorant rumor has been spread repeatedly, nevertheless, I hardly trust it until the matter has been seen clearly (6.66b).

He recommended the serenity that, he said, is typical of Galileo. But he still did not seem to believe that things were all that serious. At any rate, he expressed the hope that Galileo might send him some new lenses for his telescope, since, he says, none as good can be found in Venice, Paris, or Amsterdam. Later that year, Galileo did.[9]

After this, Gassendi continued to correspond with Galileo from time to time. For instance, when Galileo lost sight in one eye, Gassendi tried to comfort him by telling him that we can only see out of one eye at a time anyhow. In case this was not much help, he also shared his sadness about the recent death of his friend and patron Peiresc (6.94a–5a). None of these letters mention Copernicanism, Galileo's condemnation, or anything about the science of motion.

II

In 1640 Gassendi wrote two *Epistolae de motu impresso par motore translato* (*Letters on the motion impressed by a moving mover*)[10] that played an important role in spurring debate about the Galilean science of motion in France.[11] The letters paraphrased a great deal of material from Galileo's *Two Chief World Systems*, together with some material from *Two New Sciences*. Gassendi also added a fair amount of new material of his own, which was intended to buttress the Galilean science of motion by explaining its underlying physical causes. This explanation ultimately led Gassendi to make some drastic modifications to the Galilean science of motion. These modifications did not, however, affect what we call Galilean relativity and what Gassendi refers to as Galileo's "theorem that *if the body we stand on is moving, everything about motion and moving things will occur and appear to us just as if the body were at rest*" (*De motu* 1.1; 3.478a).[12]

Gassendi's theory of the motion of composite bodies describes their motion in mathematical terms. He does not have anything that can really be called a *theory* of the motion of atoms, and he never offers quantitative description of the motion of atoms. However, he does make some remarks about how atoms move that are roughly Epicurean in inspiration. These remarks make it extremely puzzling how the motion of composite bodies is supposed to relate to the motion of their atomic components. One would expect Gassendi to say that atoms and the bodies they compose move in the same way, following the same rules. But this is not his view. Instead, he holds that there are three major differences between atomic motion and the motion of composite bodies:

(1) Composite bodies can either be at rest or in motion, but the atoms that compose them are always in motion.
(2) Composite bodies persist in their state of motion or rest in the absence of outside intervention because there is no reason for that state to change. (This is, of course, an ancestor of the notion of inertial motion.) Atoms also persist in their state of motion and rest, but the reason is very different: atoms have an essential *vis motrix* that is always realized in motion.
(3) Atoms move in leaps—in intervals of motion that are interspersed with intervals of rest—while the bodies they compose appear to move continuously. This continuity may be only apparent. Nevertheless, it explains why the motion of composite bodies is open to mathematical description, while the motion of atoms is not.

Gassendi does not make much effort to explain how his roughly Galilean theory of the motion of composite bodies fits with his roughly Epicurean view of the motion of atoms. And indeed, it is difficult to see how the two accounts could possibly be integrated. Thus my goal is to explain why Gassendi accepted them both.

III

The explanation is relatively straightforward in the case of the Galilean theory, for Gassendi's interest in the Galilean science of motion was primarily motivated by the belief that Galilean

[5] One of the things he praises is Galileo's recognition of the limits of human understanding: "What is really marvelous is that, when human sagacity cannot proceed further, the candor of your mind is such that you always acknowledge the weakness of our nature in good faith. For however plausible your conjectures may be, nevertheless, for you they are no more than conjectures. And you do not make pretences or allow them, as the common philosophers are accustomed to do. How justly you appraise the value of things!" (6.53b). This is something Gassendi himself emphasized, especially early on, in the *Exercitationes*.

[6] The other notable feature of Gassendi's very brief correspondence with Campanella is that Campanella—who spent twenty-seven years in prison—seems to have warned Gassendi to be careful in his handling of Epicureanism. Gassendi replied that he was arguing against the Epicurean view of Providence, as Campanella insisted, and that he always bore in mind what was appropriate for him to say "as a Christian and theologian" (6.54b).

[7] See the letter from Diodati to Gassendi of 10 November, 1634 (Galileo, *Opere*, 16.153).

[8] To Peiresc, 28 December 1633 (Galileo, *Opere* 15.368). It is not clear what Peiresc had told Gassendi.

[9] See the letter from Diodati to Gassendi of 10 November, 1634 (Galileo, *Opere*, 16.153).

[10] These are reprinted in volume 3 of his *Opera Omnia*.

[11] See Galluzzi (2000) for a detailed account of this debate—which he calls 'the second Galileo affaire'—and Gassendi's role in it.

[12] Galileo himself did not call this a theorem.