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short article

What do we talk about when we talk about premodern science?

A review of Shapin, Steven, *The Scientific Revolution*, University of Chicago Press, 1996

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Abstract

Although Shapin in his book claims a freedom from anachronism, it is not without anachronistic orientations. He cannot hesitate, at least occasionally, to represent the sciences of the Middle Ages as teleological, mythic, non-experimental, non-mechanical knowledge and strongly under the influence of the religious discourses. It seems he is not able to hesitate about a comparison between modern mechanical science and ancient sciences. This comparison, I believe, usually leads to underestimate the premodern sciences, at least for the young readers. In some places, Shapin follows a completely partial approach. He presents the rivals of the modern science in seventeenth century as a vulgar knowledge, which leads the reads to see no difference between ancient sciences and the vulgar knowledge of the nature. Although Shapin is aware of the rhetoric of those times, he never tries to represent a pure image of the scientific-mathematical knowledge of the sixteenth and seventeenth centuries

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Among the general works on the history of the Scientific Revolution of the seventeenth century, one may see many titles which follow some sort of anachronistic approach, by showing the revolutionary scientists of seventeenth century as some heroes and the scientists of the Middle Ages as some fundamentalists lacking any good logic. In the second half of the twentieth century, some historians, among them A. C. Crombie, showed that the revolutionary scientists of seventeenth century were not without non-scientific ideas of Middle Ages, nor were the scientists of the Middle Ages unfamiliar with the scientific and experimental methodology. This new approach to the history of science should perish any sign of anachronism of the history books. Nevertheless, several of the new historians, claiming a freedom from anachronism, are not without anachronistic orientations. They cannot hesitate, at least occasionally, to represent the sciences of the Middle Ages as teleological, mythic, non-experimental, non-mechanical knowledge and strongly under the influence of the religious discourses. It seems they are not able to hesitate about a comparison between modern mechanical science and ancient sciences. This comparison, I believe, usually leads to underestimate the premodern sciences, at least for the young readers.

The Aristotelian natural philosophy is usually understood as a non-mechanistic approach to understand the nature, not only because of its teleological explanations of the phenomena, but also for that it does not explain the natural phenomena by putting forward a mathematical mechanism. If a mechanism is nothing more than a system of simple components, each moving the others, in a well-organized manner to produce the natural phenomena, then it is fair to say that Aristotelian natural philosophy is a non-mechanistic knowledge. Unfortunately, the teleological Aristotelian explanations have been interpreted as some sort of animistic approach to know the natural phenomena. Steven Shapin in his *Scientific Revolution* writes:

> So, for Aristotle and his followers' all-natural motion had a developmental character. … The resonance between traditional accounts of natural motion and the texture of human experience is evident. Human beings offered teleological or goal-orientated accounts of their own movements. Why does the shepherd move toward his cottage? Because he forms a purpose to be where he wishes. Why do the flames leap up out of the fire?

> Because they aspire to be at their natural place. It is in just this sense that traditional physics on the eve of the Scientific Revolution had a human-scaled character. The basic character of the categories used to explain how rocks move was recognizably similar to that of those used to account for how we move. For that reason, one may loosely refer to such traditional views of matter as "animistic," attributing soul-like properties (the Latin *anima* means soul) to natural objects and processes.[1]

Although Shapin in a footnote adds "it is important to note that Aristotle himself warned against the idea that "nature deliberates"", I think this remark is shorter than to prevent the reader from ascribing an animism or even "anthropomorphism"[2] to Aristotelian natural philosophy and subsequently to underestimate the premodern science as a mythical knowledge. In the following pages Shapin writes:

> That a suction pump could draw water up at all was traditionally taken to depend on water's abhorrence of a vacuum, its attempt to rise up to prevent a vacuum from forming at the top, while the limited height of the column might be treated as a quantitative measure of the strength of that abhorrence. Consequently, the traditional explanation of a well-known, and practically important, effect was explained by ascribing purposelike characteristics to a bit of nature, in this case to a quantity of water.[3]

One may expect that Shapin explicitly warns the reader that this nature's "abhorrence" of a vacuum is not in fact an Aristotelian doctrine. Aristotle in his *Physics* argues against the existence of the vacuum through some proofs by contradiction and never uses an "anthropomorphistic" language.[4] The idea "Natura abhorret vacuum" was introduced for the first time by François Rabelais in his *La vie de Gargantua et de Pantagruel* in the 1530s; a series of novels which

1. Shapin, Steven, *The Scientific Revolution*, University of Chicago Press, 1996: p 29.
2. Shapin 1996: 30.
3. Shapin 1996: 38.
4. Aristotle. *Physics*. IV, 6–9.

tells of the adventures of two giants, Gargantua and his son Pantagruel.[1]

The fact that the revolutionist scientists of the seventeenth century rhetorically attribute this vulgar notion to Aristotelian intellectual system should not deceive us. Unfortunately, not only Shapin does not explicitly draw a line between Aristotle and the Aristotelians of seventeenth century, but also writes:

> Aristotelianism possessed resources that were in principle valuable for combating naturalism, for example, its endorsement of the immortality of the soul and its rejection of determinism[2]

while the nature was the central notion of Aristotelian natural philosophy. Although there are signs of accepting the chance in Aristotle's writing, but there is no "rejection of determinism" in his works. W.F. Hardie even believes that it seems sometimes that Aristotle "accepts a restricted determinism which asserts or implies that actions are determined".[3]

By asserting the Aristotle's "endorsement of the immortality of the soul", Shapin must mean nothing more than a Thomistic interpretation of Aristotle. As we know Aristotle, unlike Plato who held that

> at death the body decays while the soul departs to live another life, thought of the soul simply as a 'form', …; Hence, for Aristotle, the soul does not exist without the body. … Only in the thirteenth century, St Thomas Aquinas sought to develop an Aristotelian conception modified to accommodate Christian doctrine.[4]

Here, it seems that Shapin fakes a religious Aristotelian way of thinking.

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1. Soukhanov, Anne H. (2000). *The Encarta Book of Quotations*. New York, New York: Bloomsbury Publishing Plc. p. 780.
2. Shapin 1996: 44.
3. Hardie, W. (1968). Aristotle and the Freewill Problem. *Philosophy,43* (165), 274-278: p. 274
4. Swinburne, R. 1998, 'Soul, nature and immortality of the' In: *Routledge Encyclopedia of Philosophy*, Taylor and Francis.

In some places, Shapin follows a completely partial approach. He presents the rivals of the modern science in seventeenth century as a vulgar knowledge, which leads the reads to see no difference between ancient sciences and the vulgar knowledge of the nature. He, for example, writes:

> Bacon also agreed with many other seventeenth-century natural philosophers that the uninstructed senses were apt to *deceive* and that the senses needed to be methodically disciplined if they were to yield the authentic factual stuff philosophical reason could work on. Just as theory uninformed by fact was to be rejected, so the disastrous state of much existing natural knowledge was often referred to the role of uninstructed sense and undisciplined sensory reports. To untutored sense, the moon looked no bigger than an apple pie and the sun appeared to go round the earth. It was educated reason, not simple sense, that allowed moderns to "see" the moon as very big and the sun as still.[1]

This is not only Bacon who rhetorically blurs the distinctions between vulgar and the well-defined ways of observation in science (for example Ptolemaic astronomy), but also Shapin does not show any disagreement. It is not surprising, because Shapin thinks that the most powerful argument against heliocentrism proceeded from

> the vileness of our earth, because it consists of a more sordid and base matter than any other part of the world; and therefore must be situated in the centre, and at the greatest distance from those purer incorruptible bodies, the heavens.[2]

It is fair that the revolutionists of those times had to fight on more than one front, but the historians, as Shapin nicely knows, should not trust in their misrepresenting of their enemies. Shapin never refers to Ptolemaic geometric-experimental arguments in the *Almagest* for the centricity and immobility of the Earth, to show that Ptolemy never admits arguments based on "incorruptible bodies" or "anthropocentrism". Although Shapin is aware of the rhetoric of those times, he never tries to represent a pure image of the scientific-mathematical knowledge of the sixteenth and seventeenth centuries.

1. Shapin 1996, p. 93.
2. Shapin 1996, p. 24.

Instead of any reference to the fifteenth century astronomers, among them Peuerbach (1423-1461) and Regiomontanus (1436-1674), and their scientific achievements in mathematical-experimental astronomy; he prefers to present a long description of mythical books on zoology of wonderful creatures, like Ulisse Aldrovandi's *Ornithology* (1600).

Shapin knows that "twentieth-century historians and philosophers have only with difficulty sufficiently distanced themselves from the rhetoric of their predecessor moderns to offer a close assessment of the relation between seventeenth-century modernist rhetoric and historical realities"; but he follows that "Copernicus's new astronomy preserved Aristotle's assumption about the perfection of circular motion",[1] which have to be understood next to his statement on the Ptolemaic cosmology:

> Ptolemy's geocentric system incorporated Greek views of the nature of matter. … while earth tends to fall until it reaches the center of the universe, … heavenly bodies naturally tend to move in perfect circles, and the stuff of which they are made is itself perfect and immutable.[2]

As we know, by Ptolemy's books, the orbits of the planets were not known circular, rather some geometrically well-defined paths originated from a mechanism of celestial spheres. Those spheres rotate circular, not because the circle was hold, by Ptolemy or even Aristotle, to be the most complete figure, but for this simple reason that the path resulting from the rotation of any shape, including ellipse or cube, is circular. There is no any other shape could make these periodical motions better than sphere, which may be rotate in a nested arrangement. Not to mention that the ellipsoids and cubes may not rotate inside each other.

As Shapin shows, the mechanism is one of the turning point of the Scientific Revolution. Nevertheless, regarding the concept of mechanism mentioned above, we can understand the Ptolemaic cosmology as a mechanical explanation of the planetary motions. Ptolemy and his followers presented a mathematical model of nested

1. Shapin 1996, p. 67.
2. Shapin 1996, p. 24.

celestial spheres, one moving the other with uniform motion, to produce the non-uniform motions of the planets. Although Ptolemy and his Islamic followers believed in this Aristotelian natural law that the cause of the movements of the celestial spheres is nothing more than the wills of the souls joint to the spheres, this law had no explanational role for these movements. No Ptolemaic astronomer would say that the planet x would retrogrades at ecliptic longitude l, at the time t, because of the will of the soul of its sphere, rather he would say this motion is due to the angular velocities of its epicycle and the deferent spheres and their eccentricities. The deferent rotates the epicycle, and the epicycle rotates the planet in a mechanical manner, just like the gears of a watch. Shapin does not forget to mention that "machine making was inspired by observation of the rotating heavens".[1]

However, distinguishing some sort of mechanism in the ancient sciences may smell anachronism, it is not the case, once Ptolemy himself holds that his cosmology is not far from a machine. He writes in his *Planetary Hypothesis*:

> … in this book, our purpose is to put forward only a summary of these mentioned things [the motions of the heavenly bodies], in such a manner that their representation become easy in our imagination and in the imagination of those who want to build instruments upon them … by the mechanical approach (*Madhhab al-Mikhānīqī*)[2], namely engineering (*al-Ḥīyal*)".[3]

By "mechanical" instruments, Ptolemy probably means the instruments similar to the planetarium of Antikythera which has been built more than one century before him. Such machines could be the source of inspiration for the astronomers to see the cosmos from a mechanical point of view. Henryk Grossmann (1881-1950) in his article believes that the growth of mechanical instruments and machines inspired the philosophers and physicists to see the entire

1. Shapin 1996, p. 31.
2. Ptolemy uses probably the Greek word "μηχανικός", meaning "of or pertaining to machines" and the Arab translator prefers to keep the Greek word and adds "al-Hiyal" only as a suggestion.
3. Morelon, Régis (ed.) (1993), 'La version arabe du Livre des hypotheses de Ptolémée', *Mélanges de l'Institut dominicain d'études orientales du Caire,* 21, 7-85.

universe as a great machine.[1] In a similar historiographical approach one may follow the trace of mechanism in the Ptolemaic cosmology: celestial spheres rotate in simple uniform motion, they make rotate each other by direct physical contact, they has no intrinsic relationship to each other and the complicated motions of the planets are the outcome of infinite circular uniform rotations of the orbs. Should not forget that the rotation of the orbs was under the universal laws of Aristotelian teleological natural philosophy, but it does not make this cosmology anthropomorphistic or even teleological.

These critical comments should not lead us to forget the value of Shapin's book. He famously shows the points where the revolutionists, like Galileo, were not without non-scientific orientation. In his critical review of the nobelist Steven Weinberg's *To Explain the World: The Discovery of Modern Science*, he exactly distinguishes Weinberg's anachronistic judgments of the ancient science.[2] Unfortunately, according to what mentioned above, his book is not without anachronistic claims as well.

1. Grossmann, Henryk (2009), "The Social Foundations of the Mechanistic Philosophy and Manufacture", in *The Social and Economic Roots of the Scientific Revolution*, , G. Freudenthal and P. McLaughlin (editors), Boston Studies in Philosophy of Science.
2. Shapin, Steven. "Why Scientists Shouldn't Write History; Plato was 'silly', Bacon 'overrated', Galileo 'behind the times', at least from the point of view of a modern physicist", *Wall Street Journal* (Online); New York, 13 Feb 2015.