On Sunspots: Galileo Galilei and Christoph Scheiner translated and introduced by Eileen Reeves and Albert Van Helden

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Eileen Reeves' and Albert Van Helden's *On Sunspots* offers the first complete English translation of Christoph Scheiner's and Galileo Galilei's epistolary debate regarding the physical nature of sunspots. It thus comprises Scheiner's six letters, written above the pseudonym 'Apelles latens post tabulam' ('Apelles hidden behind the canvas') and published as the *Tres epistolae de maculis solaribus* and the *Accuratior disquisitio* in 1612, along with Galileo's three responses, published as *Istoria e dimostrazioni intorno alle macchie solari e loro accidenti* in 1613. In addition, Reeves and Van Helden supply several chapters and appendices of original explanatory material, setting the debate in its contemporary contexts, summarizing its contents, formally reconstructing its arguments, and outlining its significance for the history of science. The sunspots debate was an important episode that well deserves the comprehensive treatment it receives. Reeves and Van Helden succeed in elaborating an important scientific performance by Galileo and Scheiner within their intellectual community. They have produced a handsome volume that will be of essential use to scholars and students of Galileo and of early modern science.

Once the telescope became known in 1609, its use to examine the Sun was inevitable. At first overcoming the Sun's brilliance by crepuscular sightings or viewing through clouds, observers were surprised to find that its face was continually besmirched with irregular spots. Large sunspots had been occasionally observed by the naked eye, even in antiquity, and were taken as portentous omens or as transits of inferior planets; but the telescope revealed the spots to be quotidian features of the Sun's appearance. They were seen to cross the solar body, sometimes joining together or splitting apart,

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in about 15 days. Most observers agreed that the lack of parallax and the consistency of reports from different locations proved that the spots were neither instrumental artifacts nor local atmospheric disturbances and had to be closely associated with the Sun itself, if not on it. It was equally agreed, however, that the spots should not be there. The long-dominant Aristotelian natural philosophy held that the heavens were a realm of immutable perfection—of immaculate orbs rotating uniformly in place. A spotted Sun was a theoretical oxymoron. Hence, the question became, 'What were the spots? What did the appearances signify?' Scheiner, trying to accommodate the new observations to the prevailing philosophy, supposed that they were swarms of small bodies orbiting the Sun—like the moons Galileo had recently discovered orbiting Jupiter. Galileo, happy to overturn Aristotelian natural philosophy, thought the spots were on the surface of the Sun, comparable to terrestrial clouds.

This much formed the philosophical kernel of Galileo's and Scheiner's dispute, but it was set within a filigree of patronage and politics. The letters became a virtual courtly contest, where establishing prestige and authority over the claims of the rival was as important, or more so, than establishing the truth. Novelty, clever argument, witness testimonials, and *bons mots* were all darts in the authors' quivers.

In almost every respect, Galileo began on the higher ground. With the publication of *Sidereus nuncius* in 1610, he had gained fame for his discovery of lunar mountains and Jupiter's moons, and he subsequently announced the phases of Venus and the 'companions' of Saturn (not yet known to be rings). All this had secured international recognition as the authority on telescopic astronomy, a position at the Florentine court, and election to the exclusive Accademia dei Lincei, the premier collection of *avant garde* Italian literati, who in turn threw their weight behind the publication of his letters. Galileo had the privilege of responding to letters that he had already seen. He was also a more competent mathematician, a better stylist, and possessed the significant advantage of being right. Nevertheless, perhaps still insecure in his newfound eminence, Galileo aggressively pressed his position, sticking the knife in at every opportunity and often giving it a twist. Galileo dismissively responded to Scheiner's Latin letters in Italian—which the German could not read—even after the patron organizing the exchange gently complained of the difficulty of translation [252]. Scheiner was not a very skilled astronomer or geometer

but Galileo haughtily harped on every mistake. Having pointed out an inconsistency in Scheiner's ordering of the planets in the solar system, for instance, Galileo gratuitously comments that Scheiner, as if lazy-minded,

> cannot totally free himself from those fancies previously impressed on him, fancies to which his intellect still returns from time to time, habituated to assent by long custom. [95]

Scheiner was understandably stung by Galileo's attacks and an increasing acrimony grew between them.

In retrospect, Galileo's animosity was unfortunate. For one thing, Scheiner was a Jesuit, whose order was committed to secular education alongside religious instruction and thus had an institutional interest in the mathematical and empirical sciences. As Reeves and Van Helden helpfully relate, Scheiner was part of an extensive network of observers and collaborators within the order, emanating from the leading mathematicians of the age—the mathematics faculty of the Collegio Romano, the Jesuit flagship institution. Moreover, the order was favorably inclined toward Galileo at the time. They saw him as an allied progressive opposed to more reactionary elements of the Counter-Reformation. Those same professors at the Collegio Romano had ratified Galileo's astronomical discoveries and lauded him in person in 1611. The wrangle with Scheiner began the process, aggravated by later disputes and European intrigues, that converted the Jesuits from potential allies into leading protagonists of Galileo's condemnation in 1632–1633.

The letters also reveal that Scheiner himself was open to persuasion. His letters begin in an earnest tone of modest but guileless pride in his observations. He seems a sincere scholar offering new knowledge and anything but a rigidly orthodox Aristotelian. In fact, he published anonymously without the express consent of his superiors precisely because he adopted modern, heterodox views. Scheiner admits that empirical observation and mathematics can be decisive in natural philosophy. He rejects the Ptolemaic universe in favor of a Tychonic system in which at least Mercury and Venus orbit the Sun and Jupiter has satellites of its own. His account of the solar spots also postulated a multitude of new celestial bodies moving non-uniformly around the Sun. Scheiner seems, therefore, to have been the perfect candidate for conversion, not alienation. In his sniping,

Galileo misses the important fact that Scheiner had freed himself from Aristotelian 'fancies' and was thus already partly on his side. In the event, and to his credit, Scheiner actually accepted the substance of Galileo's criticisms. In the course of his letters, he admits that appearances required much more irregularly shaped solar satellites orbiting much closer to the Sun than he first thought; and later in his career, he would adopt Galileo's view entirely, placing the spots on the surface of the Sun, though he remained stubbornly, even spitefully, opposed to Galileo's Copernicanism.

All the while, the letters document important advances. Galileo and Scheiner standardize the method of sunspot observation by which the Sun's image is projected by a telescope onto paper. They report numerous observations and publish detailed images, here lavishly reproduced in large format. The letters also contain an early statement of Galileo's inertial principle, the announcement of Saturn's changing appearance, comments and predictions about Jupiter's moons, methodological discussions regarding the role of observation and mathematical argument in natural philosophy, and so on. Thus, the letters illuminate the production of scientific knowledge in the early 17th century. They show how evidence combined with rhetoric was used to establish claims and how the entire process was embedded in patronage and institutions. The letters also demonstrate the receptivity and awareness of Galileo and his work on the part of his contemporaries. They also reveal much about the personality of the correspondents.

Reeves and Van Helden clearly explicate all these aspects of the exchange. Their effort is greatly helped by their decision to present the letters in chronological order, so that Galileo's first two letters separate Scheiner's first three letters (the *Tres epistolae*) from his latter three (the *Accuratior disquisitio*), which are then followed by Galileo's last letter. The translation is further surrounded and interspersed with short informative chapters on the history of sunspot observations, Scheiner, the development of the debate, and its aftermath. Altogether, the arrangement helps the reader keep track of the discussion and makes the entire book fluid and compelling. The book ends with additional appendices presenting the front matter from the *Istoria e dimostrazioni*, formal reconstructions of some of the more technical arguments, additional correspondence, and a useful bibliography. All, especially the translations themselves, are gracefully

written in luminous prose, with a concision that never interferes with comprehension.

However, there are quibbles; most of them—literally—at the margins. In the first place, the translation of the *Istoria e dimostrazioni* is missing the marginal postils published in the original volume. Moreover, there are no indications of the corresponding pagination in volume 5 of the Edizione Nazionale, where the original texts are collected. This makes it difficult for scholars to find parallel texts in the original and is surprising in a volume intended for serious use. Also, the footnotes are of uneven tone and purpose. Some are clearly elementary; others provide references for advanced scholars. Similarly, the explanatory chapters are basic. Suitable for undergraduates, they do not add anything novel to the literature. The formal appendix, meanwhile, will be of interest only to a few specialists.

Finally, and only because the book will surely become a standard reference, I feel compelled to question Reeves' and Van Helden's translation of Galileo's statement regarding conserved motion, which is perhaps the most famous passage in the entire correspondence. Here is the original:

> *[E] però, rimossi tutti gl'impedimenti esterni, un grave nella superficie sferica e concentrica alla Terra sarà indifferente alla quiete ed a i movimenti verso qualunque parte dell'orizonte, ed in quello stato si conserverà nel qual una volta sarà stato posto; cioè se sarà messo in stato di quiete, quello conserverà, e se sarà posto in movimento, v. g. verso occidente, nell'istesso si manterrà.* [Favaro 1890–1909, 5:134]

This is rendered:

> And therefore, with all the external impediments removed, a heavy body on the spherical surface concentric to the Earth will be indifferent to rest and to movement toward any part of the horizon, and it will remain in the state in which it has been put; that is, if it has been put in a state of rest it will remain in it, and if it has been put in motion, toward the west, for example, it will remain in the same state. [125]

In the last sentence, 'istesso' ('the same') should refer back to 'movimento' ('movement'), not, as Reeves and Van Helden have it, 'stato' ('state'). Compare this, for instance, to Drake's translation, 'it will

maintain itself in that movement' [1957, 113] or to Finocchiaro's, 'it will remain in that motion' [2008, 98]. The trouble is that Reeves and Van Helden, by subsuming 'movement' into the 'state' of a body, efface the opposition between motion and rest that seems present in the text, suggesting that motion and rest are both mere 'states' of a body, continuous with one another. Of course, modern physics would eventually adopt this principle; but the translation seems to anachronistically impute that later development to the text.

These criticisms ultimately pale at the overall achievement of the book. *On Sunspots* is a welcome addition to the Galilean corpus in English. It will prove a useful and informative text to a wide range of students and scholars of a wide range of subjects. Best of all, it is a pleasure to read.

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