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ANTOINE-FRANÇOIS PAYEN, THE 1666 *SELENELION*, AND A REDISCOVERED LETTER TO ROBERT HOOKE

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This note concerns the horizontal eclipse of 16 June 1666, and the Avignon jurisconsult and astronomer Antoine-François Payen's reflections upon it, his *Selenelion ou Apparition Luni-Solaire* (Paris, 1666). Payen argued that observation of a horizontal eclipse had to take into account the effects of both atmospheric refraction and diurnal parallax. Payen sent a copy of his work via the Royal Society's Secretary, Henry Oldenburg, to the Curator of Experiments, Robert Hooke. This hitherto lost gift can be identified as Bodleian Library 4° W 27 (14) Jur, and it still bears Payen's autograph letter of presentation. It reached the Bodleian through Sir Hans Sloane, who acquired some of Hooke's books after the latter's death and who subsequently donated well over 1000 of his duplicates to the Bodleian in the early eighteenth century. Payen's *Selenelion* was included in Sloane's shipments by oversight, as it seems to have been Sloane's only copy. A text and translation of Payen's recovered letter to Hooke are provided, as well as a list of further Sloanian books in the Bodleian formerly owned by Hooke.

Keywords: horizontal eclipse; atmospheric refraction; diurnal parallax; Antoine-François Payen; Robert Hooke; Sir Hans Sloane

PAYEN AND THE HORIZONTAL ECLIPSE

A horizontal eclipse of the Moon takes place when both the Sun and the eclipsed Moon are visible for a short time above the horizon. According to Pliny the Elder, the phenomenon had been recognized two centuries earlier than his time by Hipparchus; and in the most important discussion of the phenomenon in antiquity the Hellenistic astronomer Cleomedes correctly ascribed what he called the 'paradoxical eclipse' to atmospheric refraction, whereby the observed altitude of bodies near the horizon exceeds their actual altitude.[1] The fact of atmospheric refraction itself was well known, and although Ptolemy's *Optics* remained in manuscript until modern times, its discussion, in the fifth book, of atmospheric refraction influenced medieval students of optics, including Witelo, Roger Bacon and John Pecham, and through them their early-modern successors.[2]

The horizontal eclipse continued to exercise early-modern astronomers. Some simply denied its possibility.[3] Others supposed it to be due to atmospheric refraction or the operation of vapours rising from the Earth.[4] Kepler's teacher Michael Mästlin claimed to have observed

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a horizontal eclipse in 1590, and Kepler recalled this observation in his 1604 *Ad Vitellionem Paralipomena* in the context of his own discussions of the refractive properties of the atmosphere.[5] Kepler himself apparently managed to observe a horizontal eclipse in Linz on 26 August 1616, and Pierre Gassendi was frustrated three times by bad weather between 1643 and 1648, before a domestic servant of his caught sight of one at sunrise on the plain of Avignon.[6] By the mid-century, therefore, three horizontal eclipses had been recorded as observed, and the emphasis now shifted to explanation.

Thus it was in 1666, when it was known that a potential horizontal eclipse would take place on 16 June (new style), that the eclipse fanatic and Avignon jurisconsult Antoine-François Payen ascended to the highest point of Montmartre in Paris with some scientific colleagues, among them Henri Justel and Ismaël Boulliau. Very little is currently known about Payen, who was born in about 1610 in Avignon. A civil lawyer and zealous Bartolist, Payen published some scholarly legal as well as astronomical works, and as a young man he seems to have been relatively close to Athanasius Kircher. Payen was responsible for seeing through the press the Jesuit polymath's *Primitiæ Gnomonicæ Catoptricæ* (Avignon, 1635), for which he also supplied some liminary verse. Payen and Kircher corresponded on the sunflower seeds that Kircher used for his heliotropic clocks. He also corresponded with Pierre Gassendi and Gabriel Naudé.[7] Unfortunately, three decades later the Sun was to fail Payen on the morning that he, Boulliau and Justel ascended Montmartre, for the weather was cloudy and their expedition to observe a horizontal eclipse was in vain. However, Payen knew that in Italy Prince Leopold of Florence had sent out three groups of men simultaneously to verify whether the phenomenon reported by Mästlin actually existed in nature. Two groups were foiled by bad weather, like all those situated in other Italian and French locations, but those who had voyaged to the tiny island of Gorgona, 30 miles out at sea from Livorno, were not disappointed, despite the near-disaster of an unwelcome cloud. Shortly afterwards, Payen received the Tuscan account of the observations made by the Florentine academician Alessandro Segni, translated it into French and added his own commentary. This he immediately published, under the title of *Selenelion ou Apparition Luni-Solaire*. The coinage 'selenelion' (a coalescence of the Greek nouns for the Moon and the Sun, terminated as a neuter singular) was his own, and is still in occasional use. Payen offered qualified praise to the Tuscans but regretted their lack of precise measurements other than the data provided by their pendulum.

More importantly, Payen asserted that refraction on its own could not account for a selenelion, which was also caused by the phenomenon of horizontal parallax, more commonly referred to now as diurnal parallax, caused by the difference between a measurement theoretically taken from the centre of the Earth and one actually taken from its surface and from a given latitude. This form of parallax can be disregarded when dealing with objects far beyond the solar system, but not with bodies that are comparatively near the Earth, especially the Moon.[8] This emphasis on parallax was not in fact new: Riccioli, for instance, had noted that Cleomedes's optical explanation was correct, but so too was the admittedly smaller influence of parallax, which Cleomedes had reported but otherwise rejected.[9] French astronomers were increasingly interested in the problem of solar parallax at this time: it had become obvious that improvements in predictive astronomical theories were dependent on reducing solar parallax, which was greatly overestimated in contemporary tables.[10] Payen's reminder that predicting and observing lunar phenomena likewise involved taking into account the effects of refraction and parallax can be understood as complementing the search for the more fundamental, and much harder to observe, value for solar parallax. This is why

the emphasis in Payen's published works is not simply on eclipses as interesting optical effects, but as means to test and refine contemporary predictive tables.

Payen and the Royal Society

Payen, like other virtuosi, maintained an international correspondence, and was keen to establish epistolary contact with the Royal Society in London. Late 1666 would also see the foundation of the Académie Royale des Sciences, and many of Payen's immediate friends were to be closely involved in the new venture. The dedicatee of his *Selenelion*, for instance, was Pierre de Carcavy, Custodian of the Royal Library, friend of Huygens, Fermat and Pascal, one of the first members of the Académie, and himself desirous of opening a correspondence with Henry Oldenburg in London—'Wch certainly I ought to embrace', reacted Oldenburg to Robert Boyle on 25 November 1667 when he heard of Carcavy's designs, 'wth all readinesse and particular acknowledgements'.[11] Oldenburg's enthusiasm, as his editors comment, was probably spurred on by his misconception that Carcavy was the President of the fledgling Académie in Paris, a mistake assisted by the fact that the new society met in the Bibliothèque du Roi, of which Carcavy was the librarian.[12] Justel and Carcavy would later commission Oldenburg to obtain 'every important book' published in England over the preceding 12 years for the French Royal Library, with qualified success.[13]

Payen lost no time getting in touch with Oldenburg himself, and arranged to have a selection of his printed works sent on to the Royal Society through Justel, on whom Oldenburg relied for much of his foreign news. Justel accordingly sent to Oldenburg Payen's *Adulterium Solis et Lunæ*, in which he had predicted the coming horizontal eclipse,[14] his *Sol Larvatus*,[15] and his *Extrait*[16] predicting a solar eclipse in July 1666. Payen then wrote on 27 November to Oldenburg himself, enclosing his new work, the *Selenelion*—a ground-breaking treatise, he claimed,

> since it contains new and curious remarks upon a novel phenomenon, more remarkable than parhelia and paraselenae, which has been neglected by writers of the past sixteen centuries. I shall be obliged to you for letting me know the feelings of your illustrious Royal Society, on the subject of reflections, on the concurrence of the *Rudolphine Tables* with those of Riccioli with regard to the late eclipses, and whether that of 16 June [N.S.] last and that of 11 December next [N.S.] were observed in England. I should be particularly obliged for a note of their observations, in case the serenity of the air was more favorable in your parts than it was in France or Italy; especially at the time of the selenelion or luni-solar phenomenon.

To this he added a postscript: 'Please be so good as to pass this little work on to Mr. Hooke after you have read it, with the enclosed letter, and send me his reply.'[17] Just over a month later, Oldenburg displayed the book at a meeting of the Royal Society along with Boulliau's *Monita Duo*; Boulliau's book was passed on to Seth Ward, and Payen's to Hooke, 'to whose view the author also had particularly designed it'.[18]

The *Selenelion* and the Bodleian Library

Hooke, then, received both the book and the letter.[19] The book was certainly in Hooke's library in 1675, when he included among a list of his books 'Selenelion de Payen. Paris. 1666'.[20] Thereafter it disappears. But in fact Hooke's copy of the *Selenelion* with its manuscript letter of presentation bound between the dedication and the text proper survives in the Bodleian Library, Oxford, shelfmark 4° W 27 (14) Jur. The previous item in 4° W 27 Jur,

Edme Mariotte and Jean Pequet's *Nouvelle Découverte Touchant La Veüe* (Paris, 1668), also once belonged to Hooke: he has signed its title-page, as he usually did with his books, noting that he paid the London-based French bookseller Jean Caillou 6d. for it.

Why are these books in the Bodleian? Hooke's library was, after all, sold at auction in 1703, and it is very unlikely that representatives of the Bodleian attended. The answer lies in an intermediary figure: the *Selenelion* and the *Nouvelle Découverte Touchant La Veüe*, like the other 16 items in 4° W 27 Jur, and indeed the 35 items in 4° W 28 Jur, arrived in the Bodleian amid the vast shipments of duplicates despatched by the omnivorous collector Sir Hans Sloane in various stages between 1700 and 1738. Sloane had absorbed some of Hooke's library after the latter's death in 1703, and as most of Sloane's Hookian titles identified so far do not appear in the sale catalogue for Hooke's library, also auctioned in 1703, we can tentatively date Sloane's acquisition of materials from Hooke's library to that year. Sloane certainly acquired many of Hooke's MSS (never up for public sale), which remain in the Sloane collection in the British Library. We can be certain that these Hookian titles arrived in the Bodleian via Sloane's hand-me-downs because all 18 titles in this pamphlet collection as well as almost all the contents of 4° W 28 Jur (as well as many other quarto pamphlet collections in the Jurisprudence and other Bodleian sequences) bear Sloane's distinctive accession codes, inked alphanumeric marks that Sloane employed to record the entry of every title into his library.

When the Bodleian received all these duplicates (about 1500 separate titles), only the names of Sloane's more obviously weighty gifts (about 430 separate titles) were entered by title into the Benefactors' Register, which noted in passing that Sloane's shipments between 1704 and 1710 had also contained about 1000 extra titles, but *in minori forma*, and hence unlisted. These titles, often already bound together in bundles, were not systematically handled by the Bodleian: if already bound as single titles they were used to plug holes left by ejected duplicates; if bound in pamphlet collections they were put into empty shelving wherever it could be found. This led to the presence in both the Lincoln and the Jurisprudence series, at that date shelved in recently constructed galleries along the middle of what is now Duke Humfrey's Library, of whole strings of Sloanian gifts, gifts that can be identified today only by their tell-tale accession codes.[21]

Payen's presentation copy, then, reached Oldenburg safely, and was then passed to Hooke, in whose library at Gresham College it remained until Hooke's death. The *Selenelion* then passed to Sloane, probably in 1703, next arriving in the Bodleian perhaps as early as 1704, and was certainly shelved by 1707.[22] It is worth noting at this point that there are at least three other Hooke-signatured titles in the Bodleian with the same provenance, although only one of them was entered into the Benefactors' Register (see Appendix). Sloane and his librarians seem to have cared little, if at all, about (at least recent) provenance, and neither did their Bodleian counterparts. Indeed, the Sloanian library was careless in the case of the *Selenelion*, because if it was indeed a duplicate, its twin has gone missing—the Bodleian copy is the only catalogued copy in the British Isles. More probably the *Selenelion* was not a duplicate at all but was swept up by accident along with its surrounds—of which at least one, the *Nouvelle Découverte Touchant La Veüe*, had accompanied it from Hooke's library and is indeed duplicated in the British Library.

The Royal Society and horizontal eclipses

Payen's letter to Hooke was presumably sent to Oldenburg folded, as it still bears creases demonstrating that it was not always located where it now is, so it was Oldenburg or Hooke who mounted the letter in its current position within the pamphlet. It is of interest that Payen

chose to open his contact with the Royal Society by going straight for Hooke as an intellectual patron.[23] Whether Payen knew much about Hooke beyond what was reported in the *Journal des Sçavans* is a question to which we shall return.

Hooke had been aware for some time of horizontal eclipses. He first mentioned the phenomenon in the *Micrographia* (1665), remarking in passing early in the work that

> there may be some instances perhaps of Horizontal Eclypses that may seem very much to favour this supposition of the slower progression of Light then most imagine. And the like may be said of the Eclypses of the Sun, &c. But of this only by the by.[24]

But it was in Observation LVIII that Hooke dwelt at length on the horizontal eclipse, where following astronomical orthodoxy he ascribed it to atmospheric refraction:

> It has been observ'd and confirm'd by the accuratest Observations of the best of our modern Astronomers, that all the Luminous bodies appear above the Horizon, when they really are below it. So that the Sun and Moon have both been seen above the Horizon, whil'st the Moon has been in an Eclipse. I shall not here instance in the great refractions; that the tops of high mountains, seen at a distance, have been found to have; all which seem to argue the Horizontal refraction, much greater then it is hitherto generally believ'd.[25]

Ward's response to Boulliau's *Monita Duo* was printed in the *Philosophical Transactions*, as was a response to the solar eclipse that was the subject of one of Payen's other pamphlets, the *Extrait* originally received by the Royal Society through Justel. This latter response, although unsigned, was probably written by Hooke.[26] But Hooke does not seem to have responded directly to the *Selenelion*, and no further correspondence between the two men survives. Judging from Observation LVIII in the *Micrographia*, it seems that Hooke regarded atmospheric refraction as the sole cause of horizontal eclipses, and displayed no inclination to look further. Hooke's silence is understandable. Especially when verifying predictive tables, parallax adjustment may be crucial for calculating real versus apparent positions. But the *Micrographia* belongs primarily to the genre of optics, and the optical interest of the selenelion was that refraction bent upwards into view an otherwise impossible sight. The fact that parallax simultaneously depressed it was in context of secondary interest, and Hooke consequently neglected or overlooked it.

Perhaps Payen did not know of Hooke's account in the *Micrographia*, which was only reviewed in the *Journal des Sçavans* after Payen had written to Hooke. Hooke did not use the phrase 'inflective veins' in the discussion of refraction in Observation LVIII of the *Micrographia*, but it appeared in his discussion in the *Philosophical Transactions* for 1666, a passage that was also reproduced in the *Journal des Sçavans* for 23 August 1666, where the phrase is translated 'veines *inflectives*'. As Payen's 'uenarum inflectiuarum' in his letter exactly translates this phrase, it seems plausible that he was relying on this later account, probably in its French version alone, because we have no independent evidence that Payen read English. Additionally, the *Selenelion* mentions Hooke only in terms of his wheel barometer, not as a fellow student of horizontal eclipses. If Hooke was indeed the author of the response to Payen's pamphlet on the solar eclipse, then Payen's various 'parallaxes' were mentioned by him without further judgement. As the *Philosophical Transactions* summarized Hooke's statements in the *Micrographia*:

> a *medium*, whose parts are unequally *dense*, and mov'd by various motions and transpositions as to one another, will produce all these visible effects upon the rays of Light, without any other *coefficient* cause: and then, that there is in the Air or *Atmosphere*, *such* a variety in the constituent parts of it, both as to their *density* and *rarity*, and as to their divers mutations and positions one to another.[27]

Payen argued precisely that there was '[an]other *coefficient* cause' for the paradoxical eclipse, and given that all observations of bodies within the solar system are subject to parallax, Payen was technically correct.

Hooke and the Royal Society soon had cause to revisit the phenomenon of the horizontal eclipse. In the *Philosophical Transactions* for January 1667 Hevelius's calculations on the late solar eclipse were reported, along with his detailed illustrations of the lunar eclipse on the previous 16 June.[28] At the meeting of the Society on 4 November 1667, the impending horizontal eclipse on the 20th of that month was noted, and Hooke was ordered to observe it with the astronomer William Ball. By that point Hooke was presumably aware of Payen's arguments. On 4 June the following year, at a meeting from which Hooke was unfortunately absent, Ball was belatedly asked to present their findings, but does not seem to have done so.[29] With that, Payen and his *Selenelion* slip out of Royal Society attention.

Payen's letter to Hooke

Below I present a text of Payen's letter to Hooke with a translation. There are three very minor corrections in the text itself ('tuam' deleted after 'beneuolentiam hanc'; 'uel' (?) deleted after 'Barometri'; and 'mihi' changed to 'mei' after 'dum hos animi'), which point to the holograph status of this letter, as one would expect.

[Text: Bod. 4° W 27 (14) Jur: [A. F. Payen], *Selenelion ou Apparition Luni-Solaire* (Paris, 1666). Marked on title-page with the Sloanian accession code 'q. 35.' and the previous pamphlet numbering '(8)'.]

Clarissimo Viro D. HOOK In Astronomicis ac Dioptricis Peritissimo.

Antonius Franciscus Payenus. In Supremo Parisiensi Senatu Aduocatus. S. D. P.

Ea apud nos est æstimatio tuæ eruditionis, quam Author eruditissimus Diarij Eruditorum sub natiuâ suâ magnitudine, quasi telescopio, sæpiús repræsentauit,[30] *ut uoluerim oblatione opellæ huius, SELENELII nomine nuncupatæ,*[31] *tuam ultrò amicitiam exorare, nec frustrà illam ambire posse præsumo, cum ea quæ solet humanitas eruditos comitari mihi facilè persuadeat, beneuolentiam hanc in me tuam minimè defuturam; Pelleges in hâc opellâ nostrâ, quanto in pretio sit apud me Barometri tui Rotatilis usus ibidem pluries a me commendatus,*[32] *ad excolendas Obseruationes Astronomicas à causis physicis Atmosphæræ utplurimùm uitiatas; Obseruabis quantum ingeniosa uenarum inflectiuarum tua adinuentio nostras cogitationes Confirmauit, etsi de illis obiter solùm mentionem fecerim pag. [].*[33] *aliô opportuniori loco latiùs de illis locuturus. Hic finio ne tædio superfluj sermonis tempus ad eruditas tuas experientias destinatum præcipiam denuo publici boni, ex priuati mei commodi, quo gaudeo, dum hos animi mei addictissimi sensus tibi significo. Vale vir Eruditissime, et si me ad aliquod genus officij, aptum hîc reputes, operâ meâ liberè utere, quâ me tuam beneuolentiam meruisse expressiùs, quam aliâ quæcumque dicendi specie declarabis. Datum Parisiis Nonis Decembris M.DC.LX.VI.*

Translation:

To the most distinguished man Master Hooke, most expert in astronomical and dioptrical matters, Antoine-François Payen, Avocat in the Parlement of Paris, sends greetings.

Such is our esteem of your learning (as the most learned writer of the *Journal des Sçavans* has quite often displayed, as through a telescope, in its true magnitude) that I desired

moreover to entreat your friendship by the offering of this little work, called *Selenelium*. Nor in vain do I presume to be able to solicit it, since that humanity which usually accompanies the learned easily persuades me that your good will towards me will not at all be lacking. You will read in this my little book just how much I value the use of your wheel barometer, which I commend there many times, for the cultivation of astronomical observations so frequently vitiated by atmospheric effects. You will see how much your ingenious hypothesis of inflective veins has confirmed our conjectures, and if I make mention of these things only in passing on p. [], I shall speak at greater length of them in a more opportune place. Here I make an end, lest with the tedium of too much talking, while I make known to you the thoughts of my most devoted spirit, I usurp for my private uses the time allotted to your learned experiments carried out for the public good, in which I rejoice. Farewell, most learned man, and if you consider me fit to perform any type of service for you here, use my services freely; by that means, you will demonstrate that I have deserved your goodwill more clearly than by any other way of saying it. Given at Paris, 9 December 1666.

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I am very grateful to Noel Malcolm of All Souls College, Oxford, for commenting on a draft of this note, and to Peter Duffett-Smith of Downing College, Cambridge, for recalculating by computer the 1666 selenelion for me. For works published before 1700, only the place of publication is given.

Appendix. Hooke's books in the Bodleian

Among the duplicates that Sloane presented to the Bodleian are several titles that we can certainly trace to Hooke's library, because they are signed by him. Only no. 1 below was named by title in the Benefactors' Register. The others have been found more or less serendipitously amid Sloanian pamphlet collections, and as the titles in these collections were predominantly not entered in the Register and can be found only by trawling around in the upper letters and numbers of the Lincoln and Jurisprudence series looking for Sloanian accession codes, it is possible that more such titles will surface in due course. Judging from the *Bibliotheca Hookiana* of 1703, the sale catalogue of the public auction of Hooke's library, several other titles in these pamphlet collections might also plausibly derive from Hooke's library.[34] However, the interesting fact that only one of the titles below appears in the published catalogue indicates either how inadequate that catalogue is for a proper judgement of Hooke's library or that Sloane removed or purchased much of what he wanted before the library was offered to public auction, or indeed a combination of both factors.[35] Finally, it may be noted that the Bodleian is not the only institution in Oxford that holds books ultimately from Hooke's library. Two books in the library of St John's College also bear Hooke's signature: Melchior Adam, *Vitæ Germanorum Medicorum* (Heidelberg, 1620), and Philipp Jacob Sachse de Lewenheimb, *Gammarologia* (Frankfurt and Leipzig, 1665). These were both purchased at the Hooke auction and donated to St John's as part of a larger bequest in the eighteenth century.[36]

8° I 7 Linc

Johann Christoph Sturm, *Philosophia Eclectica*. Altdorf, 1686. Signed on the title-page 'p^d Caillou. 4^s. July 29. 1686. R Hooke'. Listed in the Benefactors' Register (MS Library Records b. 904, p. 53) among Sloane's 1704 gifts. Sloanian accession mark: p 136.

Compare British Library 536 c. 20, lacking accession code, but sole copy, and with the earliest 'Museum Britannicum' stamp, often a sign of Sloanian provenance (David Pearson, *Provenance research in book history: a handbook* (The British Library, London, 1998), p. 92 and p. 95, figures 3.51 and 3.52). This title is listed in the *Bibliotheca Hookiana*.

4° E 3 (3) Jur

Cressy Dymock and Adolphus Speed {often attributed to Samuel Hartlib}, *Cornucopia*. [London, 1652]. Signed on the title-page 'MF [ligatured, i.e. 'Moorfields']. Apr. 16. 1692. 1^{d}. Ro: Hooke'. Sloanian accession mark: d 423. Compare British Library 441. b. 23 (4), also with the accession mark d 423.

4° E 8 (10) Jur

Thomas Streete, *Memorial Verses on the Ecclesiastical and Civil Calendar*. London, 1667. Signed on the title-page 'Lib. Rob: Hooke. præt. 6. Sep. 6. 1672'. This purchase is noted in Hooke's journal for that date.[37] Sloanian accession mark: F 267. Compare British Library 531 l. 13 (5), probably Sloane's copy but cropped; item 6, Thomas Streete's *The Description and Use of the Planetary Systeme* (1674), is not as cropped and bears the accession code 'G 518' in its upper inch.

4° W 27 (13) Jur

[Edme Mariotte and Jean Pecquet], *Nouvelle Découverte Touchant La Veüe*. Paris, 1668. Signed on title-page 'O [with central dot; i.e. symbol for the Sun] 14 October RHooke p^{d} Caillou 6^{d}'. If, as seems likely, the Sun symbol stands for 'Sunday', then the year of purchase can be fixed to 1694, the only year after 1668 and before 1703, when 14 October fell on a Sunday. There is an earlier inscription 'Pour Monsieur Le Vasseur Docteur en Medecine Par son treshumble Seruiteur Pequet'. This work comprises a letter from the physician Edme Mariotte (*ca*. 1620–84) to his fellow physician Jean Pecquet (1622–74), followed by Pecquet's response. This is thus Pecquet's presentation copy to Le Vasseur, presumably Louis Le Vasseur (*fl*. 1668–74), author of *De Sylviano Humore Triumvirali* (Paris, 1668) and translator of Nehemiah Grew, Robert Boyle and Antoni van Leeuwenhoek (*Recueil des Experiences et Observations* (Paris, 1679)).[38] Sloanian accession mark: q 145. Three copies in British Library. Possibly British Library 728 i. 2 (2); 536 i. 8 is Sloanian, but it forms part of the *Oeuvres de Mr Mariotte* (Leiden, 1717), accession mark N 1870, published too late to have been able to duplicate 4° W 27 (13). 4° W 27 (11) in the same volume is also by Mariotte: his *Traitté du Nivellement* (Paris, 1672).

4° W 27 (14) Jur

[Antoine-François Payen], *Selenelion ou Apparition Luni-Solaire*. Paris, 1666. Not signed by Hooke, but obviously his copy because of Payen's presentation letter and the previous title in this volume. Sloanian accession mark: q 35. No copy in British Library.

Notes

1 Pliny, *Natural History*, 2.10.57; Cleomedes, *Meteora*, ed. Robert Balfour (Bordeaux, 1605), pp. 124–125 (i.e. bk 2, ch. 6). See further Thomas Heath, *A history of Greek mathematics* (Clarendon Press, Oxford, 1921), vol. 1, pp. 6–7; vol. 2, pp. 235–238; Alan C. Bowen and Robert

B. Todd (eds), *Cleomedes' lectures on astronomy: a translation of 'The Heavens' with an introduction and commentary* (University of California Press, Berkeley, 2004), pp. 159–163. A succinct contemporary account of horizontal eclipses can be found in Jean Baptiste Riccioli, *Almagestum Novum*, pp. 307–309 (Bologna, 1651).

2 A. Mark Smith (ed.), *Ptolemy's theory of visual perception: an English translation of the* Optics (Philadelphia: American Philosophical Society, 1996), pp. 58–61. For a vernacular recognition that atmospheric refraction can project the Sun above the horizon before it has actually risen, see Nathanael Carpenter, *Geographie Delineated Forth in Two Bookes containing the Sphericall and Topicall Parts thereof*, 2nd edn. (Oxford, 1635), Book 1, p. 39.

3 For example Rudolph Goclenius, *Urania cum Geminis Filiabus* (Frankfurt, 1615), p. 128.

4 For example Andreas Piccolomini, *De Sphæra Libri Quatuor* (Basel, 1568), p. 124.

5 Johannes Kepler, *Ad Vitellionem Paralipomena* (Frankfurt, 1604), pp. 138–139.

6 [Antoine-François Payen], *Selenelion ou Apparition Luni-Solaire* (Paris, 1666), pp. 5–7, with references. Payen's assertion that Pliny personally observed such an eclipse in AD 70 is probably based on an overhasty reading of Pliny's paragraph, which does go on to discuss an event dated approximately to that year. But Pliny does not date the horizontal eclipse itself; he merely states that Hipparchus recognized that it could happen. The *Selenelion* was reviewed in the *Journal des Sçavans* released 6 September 1666 [hereafter *JS* and cited by date of release], in which Payen's engraving of the Gorgona selenelion was also reproduced. This engraving can also be found in Duncan Steel, *Eclipse: the celestial phenomenon that changed the course of history* (The Joseph Henry Press, Washington DC, 2001), p. 59.

7 There is a short entry on Payen in the *Nouvelle biographie générale* (vol. 39, col. 429). The *Catalogue Collectif de France* lists his various legal and astronomical works. For Payen and the Parisian milieu, there are very brief notices in Harcourt Brown, *Scientific organizations in seventeenth century France (1620–1689)* (Williams & Wilkins Co., New York, 1934), ch. 8, esp. pp. 164–165; and Pierre Humbert, 'Les astronomes français de 1610 à 1667: étude d'ensemble et répertoire alphabétique', in *Sociéte d'études scientifiques et archéologiques de Draguignan: Memoires* **63**, 1–72 (1942), at p. 61 (but where the *Selenelion* is misdated). Payen's astronomical works are incompletely listed in J. C. Houzeau and A. Lancaster, *Bibliographie générale de l'astronomie jusqu'en 1880* (new edition by D. W. Dewhirst) (Holland Press, London, 1964), vol. 1, items 12063, 12773 and 12775. For Payen and Kircher see Humbert, 'Les astronomes français', p. 61, where it is claimed that Kircher taught Payen at the Collège d'Avignon; John E. Fletcher, 'Athanasius Kircher and the distribution of his books', *Library* **23**, 108–117 (1968), esp. p. 115; Fletcher, 'Astronomy in the life and correspondence of Athanasius Kircher', *Isis* **61**, 52–67 (1970), esp. pp. 63–64. Fletcher refers to letters preserved in Kircher's correspondence in the Archives of the Pontificia Università Gergoriana (P.U.G.), Rome. A letter from Payen to Kircher in 1666 enclosed five proof sheets on eclipses, asking Kircher to correct them. They had already been examined by Honoré Fabri and Gilles François de Gottignies. Given that this letter is dated 11 June, the proofs will have been not the *Selenelion* but the earlier works on eclipses, perhaps the three titles he also sent to the Royal Society (see below). The Kircher Correspondence Project (http://archimede.imss.fi.it/kircher/) provides an image of this letter (Archives of the P.U.G. 563, fol. 236r). For Payen and Gassendi, see Pierre Gassendi, *Opera Omnia* (Leiden, 1658), vol. 6, pp. 100–101, 118, 223, 440–441, 443–444, 482, 489 and 490. For Payen and Naudé, see A.-F. Payen, *Testimonium adversus Gersenistas Triplex* (Paris, 1652), in the form of a letter from and a reply to Naudé. Payen also corresponded in 1666 with Hevelius on eclipses: see Bibliothèque Nationale, Paris, MS f. fr. 13044, fo.66v (Hevelius to Ismael Boulliau, from Danzig, 29 Oct. 1666): 'Accepi haud ita pridem literas à dn° A. F. Payen, simul etiam eius observationem Eclips. [solis].' (The MS employs the Sun symbol for '[solis].') I owe this last reference to Noel Malcolm.

8 [Payen], *op. cit*. (note 6), pp. 8–10. Discussions of diurnal parallax extend at least as far back as Ptolemy: *Ptolemy's Almagest* (transl. and annot. G. J. Toomer) (Princeton University Press,

1998), bk 4, ch. 1. Payen's contemporary Jacques de Billy (Humbert, *op. cit.* (note 7), pp. 23–24), to add one contemporary example, included tables for adjusting for both lunar refraction and parallax in his *Tabulæ Lodoicææ* (Dijon, 1656).

9 Riccioli, *op. cit*. (note 1), p. 308, col. 1. Bizarrely, Payen treats Cleomedes as the arch-denier of the phenomenon (p. 5). Cleomedes does first say that the phenomenon ought to be dismissed as fabrication immediately before his subsequent recourse to refraction as an explanation, the section that is usually recalled. Perhaps Payen was unforgiving because his own suggestion that horizontal parallax had a part to play had been explicitly denied by Cleomedes, who was indeed therefore discounting Payen's parallax-influenced model. Riccioli, *op. cit*. (note 1), p. 307, col. 2, offered a better account of Cleomedes, noting how after initial denial, Cleomedes then stumbled across the correct explanation *quasi balbutiendo*, 'as if stuttering'.

10 See Albert Van Helden, 'The telescope and cosmic dimensions', in *Planetary astronomy from the Renaissance to the rise of astrophysics* (eds René Taton and Curtis Wilson), pp. 114–117 (Cambridge University Press, 1989). Payen treats the problem of solar parallax in his *Extrait*, p. 3 (see note 17 below for full bibliographic reference).

11 A. R. Hall and M. B. Hall (eds), *The correspondence of Henry Oldenburg* (University of Wisconsin Press, 1965), vol. 3, p. 613.

12 Hall and Hall, *op. cit.* (note 11), p. 615. On Carcavy, see Richard Westfall's entry in the Galileo Project (http://galileo.rice.edu/Catalog/NewFiles/carcavi.html).

13 A. R. Hall and M. B. Hall (eds), *The correspondence of Henry Oldenburg* (University of Wisconsin Press, 1967), pp. 79–80, 100, 173; Leona Rostenberg, *The library of Robert Hooke: the scientific book trade of Restoration England* (Medoc Press, Santa Monica, 1989), pp. 85–86.

14 This seems to be *Caput IV. Ænigma Astronomicum Adulterium [Solis] et [Lunæ] Visibile in Hemisph. Parisiensi, quod Pseudo-umbra illico teget. Anno M.DC.LXVI. Die xvi. Iunij. Si vera fit Kepleri Æquatio Menstrua* (n.p., n.d.) (running title 'Specula Astronomica'), i.e. chs 4–6 (sgs. E1–N1 = pp. [33]-98) of the *Specula Parisiensis Astronomica*. It was addressed to Hevelius, who corresponded with Payen (see *JS* for 13 December 1666). This at least is the fragment at British Library 531 l. 6 (5), possibly of Sloanian provenance, because items 6, 8 and 9 in this set bear traces of Sloane codes, and others bear the early 'Museum Britannicum' black octagonal stamp, often a sign of Sloanian provenance. Given that this and the *Extrait* below are the only Payen titles (other than the Bodleian *Selenelion*) extant in the British Isles, these are probably the copies sent by Justel. The *Ænigma* was reported, with a reproduction of the diagrams on its title-page, in *JS* (31 May 1666). Its alternative title, the *Adulterium*, imitated Juan Caramuel Lobkowitz, *Solis et Artis Adulteria* (Louvain, 1644).

15 Oldenburg's editors decide that this 'does not seem to exist as a separate tract'. But Payen definitely states that Justel sent *trois de mes petits ouvrages*, and it is listed as *edita* in Payen's own bibliography of his works on the verso of the title-page of the *Selenelion* (whence derives the contemporary English bibliography of Payen in Edward Sherburne's *Catalogue of Astronomers Ancient and Modern*, appended to his translation into English verse of the first book of Manilius (*The Sphere of Marcus Manilius*, pp. 107–108 (London, 1675))). Payen's bibliography tells us that the *Sol Larvatus* was also titled *Emblema Astronomicum*, and it can therefore be identified with the work of that title held in the Bibliothèque Nationale, where it is listed as 'Caput VII' of the *Specula Parisiensis Astronomica*. In other words Payen was separately printing and distributing sections of his projected *Specula*; the *Ænigma* and the *Sol Larvatus* comprise chapters 4–7 (i.e. sections 2 and 3) of this larger work. Later in the year he released chapter 8 (i.e. section 4), *Monopolion Cœleste*, with an errata table for the entire work, also in the Bibliothèque Nationale. The *Ænigma* was reviewed in *JS* on 31 May 1666; the *Sol Larvatus* on 21 June (it concerned a solar eclipse predicted for 2 July); the *Extrait* on 12 July (see below for its contents); the *Selenelion* on 6 September (including the illustration that accompanied the pamphlet); and the *Monopolion* on 22 November (it concerned planetary conjunctions).

16 This seems to be *Extrait d'une Lettre de Monsieur Payen Advocat en Parlement, écrit à Monsieur de Montmor Conseilleur du Roy en ses Conseils, & Premier Maistre des Requestes de son Hostel Contenant L'Observation de l'Eclipse de Soleil, arrivee le 2 Juillet 1666 Faite à Paris, par ledit Sr Payen, & par M. Agarrat & Barbier Professeurs és Mathematiques* (n.p., n.d.), i.e. a single quarto sheet without title-page. This is probably British Library 531 k. 38 (2). The copy in the Bibliothèque Nationale is described as: 'En encart, lettre ms. de A.F. Payen en italien qui signe A.F. Payeno datée de Paris, 12 juillet 1666, aux marges rognées' (*Catalogue Collectif de France*); Payen seems to have been keen on enclosing MS letters with his publications.

17 Hall and Hall, *op. cit.* (note 11), vol. 3, pp. 287–289. See also Noel Malcolm, 'The Library of Henry Oldenburg', *Electron. Br. Library J.*, article 7 (2005), for his note on the reception of these books. On contemporary observations of *parhelia*, see *JS* (10 May 1666) and *Phil. Trans. R. Soc.* **1**, 219–222 ([4 June] 1666).

18 Thomas Birch, *The History of the Royal Society of London for the Improving of Natural Knowledge from its First Rise* (London, 1757), vol. 2, p. 137, for 2 January 1667.

19 In what Noel Malcolm terms List 3 of Oldenburg's library, John Collins's list of 'some bookes sent to ye Society and in his [Oldenburg's] custody formerly' (Royal Society, London, MS Domestic V, item 43, transcribed in Malcolm, 'Library of Henry Oldenburg'), we find the adjacent entries 'Bullialdi monita ad astronomos' and 'A booke of m^r^ Payen'. Given that Boulliau's *Monita Duo* and Payen's *Selenelion* were presented simultaneously to the Society and, as we have seen, that the former was handed over to Ward and the latter to Hooke, it seems probable that Collins reconstructed these items from their occurrence in the Society minutes. Ward seems not to have returned his copy to the Society because it is not in their library, but the copy at British Library 530 d. 36 may just be his (it bears the original black 'Museum Britannicum' stamp). Hooke evidently regarded the Payen copy forwarded to him as his own property. Given the contiguity of the Boulliau and Payen works in both the minutes and in Collins's list, it is almost certain that Collins's 'booke of m^r^ Payen' is the *Selenelion*, not his *Adulterium Solis et Lunæ*, *Sol Larvatus*, or *Extrait*.

20 British Library, MS Sloane 949, fol. 7r. My thanks to Felicity Henderson for drawing my attention to this list.

21 All the relevant data are rehearsed in William Poole, 'Francis Lodwick, Hans Sloane, and the Bodleian Library: provenances and marginalia', *Library* (7) **7**, 377–418 (2006). For further examples of using the Bodleian Sloane duplicates to reveal fragments of other prior collections, see William Poole, 'Francis Lodwick's annotations to John Webster's *Academiarum Examen* (1654) and John Dury's *Considerations concerning the Present Engagement* (1649)', *Bodleian Library Rec.* **19**, 129–138 (2006); Poole, 'A fragment of the library of Theodore Haak (1605–1690)', *Electron. Br. Library J.* (2007).

22 The first dated list of Sloanian gifts in the Benefactors' Register is marked 1704. Proceeding along the W shelves in the 'Jur' series, 4° W 29 Jur is not from Sloane's library, and 4° W 30 and 31 were both donated to the library by its own librarian John Hudson in 1707; Sloane's next shipment was registered in 1710. 4° W 30 Jur is Robert Boyle, *Certain Physiological Essays and other tracts* (London, 1669), signed on its title-page 'D. D. Joann. *Hudson* Bibliothecarius'. This volume bears an interesting comment on its flyleaf, worth recording: 'Seeing so excellent a wit as Des-Cartes fail'd so palpably in deducing all thing[s] fro*m* mechanical principles; I am fully convinced y^t^ ye pretence of solving all ye Phænomena of nature by mere mechanisme y^s^ a designe y^t^ will never prove successful.' This book is listed in the Benefactors' Register as no. 73 of Hudson's 1707 donations (erroneously dated there as a 1679 publication) (Bodleian Library Records b. 904, p. 74). 4° W 31 Jur, *Essayes of Natural Experiments made in the Academie del Cimento* (transl. Richard Waller) (London, 1684), is again a Hudson gift, recorded as such on its title-page. In the endpapers there is a reading list on fossils also worth recording: 'Of Shells &c lodg'd in ye bowells of ye Earth &c see Mr Rays three Physico-Theol. Disc. Steno's Prodromus, Dr Hooks Micrography Rays travels from p. 113 to p. 130. Plott of Oxfordshire [/] If you will

consult more Auth^{rs} upon this subject, you may see y^{r} names in a late piece call'd Two Essays sent in a letter from Oxford to a Nobleman in London &c [published in 1695].' This is no. 83 in the same list in the Benefactors' Register. (4° W 25 and 26 Jur are ex-'Linc' books, i.e. part of the 1693 bequest of Thomas Barlow (26 bears his inscription); 4° W 24 Jur is a collection of *orationes* unconnected in provenance to the superior numbers in this string.)

23 For a similar epistolary gambit towards Hooke, see George Hough of St John's College, Cambridge, dated 28 April 1671, accompanying Hough's presentation MS of diagrams for Bernard Varenius's *Geographia Generalis* (1650), which he hoped that Hooke might get published. Hooke does not seem to have done so, nor was it an auspicious time for such a project, because Isaac Newton was to publish his own edition of Varenius with (independent) illustrations in the following year (MS Sloane 917, fols. 2r–3v).

24 Robert Hooke, *Micrographia* (London, 1665), p. 56.

25 *Ibid*., pp. 218–219.

26 Ward's (unsigned) account of the *Monita Duo* is in *Phil. Trans. R. Soc.* **1**, 381–383 ([21 January] 1667). Hooke's (unsigned) summary of the solar eclipse is in *Phil. Trans. R. Soc.* **1**, 296–297 ([9 September] 1666), part of the larger article 'Observations made in several places, Of the late *Eclipse of the Sun*, which hapned on the 22 of *June*, 1666' (pp. 295–297). We can equate this Payen work with the *Extrait* noted above because it is specified in the *Phil. Trans.* report to be in the form of a letter to M. de Montmor, as indeed the *Extrait* was. Bodleian AA 63 Med. is Edmond Halley's copy of *Phil. Trans.*, with MS additions to this passage (p. 296). Ward seems to have passed the *Monita Duo* to Hooke too (see *Phil. Trans. R. Soc.* **1**, 460 ([6 May] 1667)). On Ward and Boulliau, compare Aubrey's remark: 'He [Ward] writ a Reply to Bullialdus, which might be about the bigness of his Astronomi Geometrica, which he lent to some body [forgot] and is lost. In the B^{ps} study are several letters between Bullialdus & Him. and between Hevelius and him' (transcribed from Bodleian MS Aubrey 7, fol. 8r; see further *Aubrey's Brief Lives* (ed. Andrew Clark) (Clarendon Press, Oxford, 1898), vol. 1, pp. 289–290).

27 *Phil. Trans. R. Soc.* **1**, 30–31 ([3 April] 1665). This was reproduced in *JS* (see below).

28 *Phil. Trans. R. Soc.* **1**, 369–371 ([21 January] 1667).

29 Birch, *op. cit.* (note 18), vol. 2, pp. 211 and 293. Atmospheric refraction was a recurring topic of Flamsteed's 1681–84 Gresham lectures (Eric G. Forbes (ed.), *The Gresham lectures of John Flamsteed* (Mansell, London, 1975)). See further Frances Willmoth, 'John Flamsteed's letter concerning the natural causes of earthquakes', *Ann. Sci.* **44**, 23–70 (1987), esp. pp. 53–57.

30 In 1666 *JS* published translations from *Phil. Trans.* of various of Hooke's reports as well as a review of the *Micrographia*, in all seven separate articles: see 18 January (correspondence with Auzout concerning telescopes, animals on the Moon, and atmospheric distortion), 3 May (depth sounders), 17 May (rotation of Mars), 14 June (plano-convex lenses), 23 August (Mars and the problem of the 'veines *inflectives* de l'air'), 30 August (Jupiter and Saturn) and 20 December (long review of the *Micrographia*).

31 That is, *Selenelium*, the Latin form of the Greek neuter used in the title, *Selenelion*, Payen's coinage ('ce Phenomenon, que I'ay pû appeller SELENELION, ou *Luni-Soliare*, à l'exemple des *Parelies* & des *Paraselenes*' ([Payen], *op. cit.* (note 6), p. 5)).

32 See [Robert Hooke], 'A New Contrivance of Wheel-Barometer [etc]', *Phil. Trans. R. Soc.* **1**, 218–219 (1666), itself referring back to the Preface to Hooke's *Micrographia*.

33 [Payen], *op. cit.* (note 6), p.8, 'sur tout si l'on a égard aux veines inflectives de l'air, dont parle *M. Hook* en ses observations de ♂ 1666', i.e. [Robert Hooke], 'The Particulars. Of those Observations of the Planet Mars [etc]', *Phil. Trans. R. Soc.* **14**, 239–242 (1666), where Hooke remarks: 'But such had been the ill disposition of the Air for several nights … [that] the *Inflective veins* of the Air (if I may so call those parts, which, being interspers'd up and down in it, have a greater or less Refractive power, then the Air next adjoyning, with which they are mixt) did make

it [the image of Mars] so confus'd and glaring, that I coud not conclude upon any thing' (p. 240). Hooke used his wheel barometer in conjunction with his telescope (p. 242). Payen recommends doing so too (p. 14).

34 Facsimile in Rostenberg, *op. cit.* (note 13).

35 Frustratingly, all five of these Hooke titles bear different Sloanian accession codes (a Sloanian code corresponds to an often very large *batch* of accessions, not to a single title). So, alas, these books do not point us to one batch in Sloane's accession registers that represents his integral pickings from the Hooke library.

36 See St John's College, Oxford, printed books HB 4/3.d.2.11, and HB 4/4c.6.10. The Melchior Adam volume was originally 'Ex dono Richard Cleark' to the medic Walter Charleton, thence to Hooke, who has signed and dated it 6 July 1694. 'Johannes Noble' adds his signature in 1703, so presumably it was he who bought it at the 1703 Hooke auction (see *Bibliotheca Hookiana*, p. 23; it went for 1s.). Because Walter Charleton did not die until 1707, this book must have been presented to Hooke by Charleton, or shed to the second-hand dealers by the latter in his years of financial difficulty. Hooke's note to the Sachse de Lewenheimb volume shows that he purchased this book for 4s. 9d. at Hussey's auction on 10 October 1691. It was likewise sold at Hooke's auction (*Bibliotheca Hookiana*, p. 27; it sold for 2s. 7d.). Hussey is presumably Sir William Hussey, the merchant and diplomat, who died in 1691. These two books were left to St John's by John Merrick in the eighteenth century as part of his considerable bequest.

37 See H. W. Robinson and W. Adams (eds), *The diary of Robert Hooke M.A., M.D., F.R.S., 1672–1680* (Taylor & Francis, London, 1935).

38 For Pecquet, see the *Nouvelle biographie générale* (vol. 39, cols 443–444); Thomas Hobbes, *The Correspondence* (ed. Noel Malcolm) (Clarendon Press, Oxford, 1994), vol. 1, pp. 247–248, n. 13.