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Establishing an astronomical network from Danzig: Johannes Hevelius' exchange with the European scientific community**

DURING THE COURSE OF THE SEVENTEENTH century in Europe, one sees the rise of scientific circles, groups, and societies, many of which were either in England or in France. However, there were also scientific practitioners working in other parts of Europe who regardless of their relative geographical isolation, nevertheless cultivated and promoted both personal and professional relationships with many of their colleagues in England, France, and throughout Europe. In some cases, their correspondence with the rest of the European scientific community was so prolific that they were able to establish their own "virtual" scientific networks from their homes.

This paper focuses on one of Europe's preeminent astronomers of the seventeenth century, Johannes Hevelius, who lived, worked, and established his own network from Danzig (modern-day Gdansk). His travels around Europe early in his life formed the basis of many of the relationships that he would nurture in his later years. With the advent of the new scientific societies, correspondence with newer acquaintances increased significantly, especially through the efforts of Henry Oldenburg, secretary of the Royal Society of London. Although Hevelius worked in distant Danzig, he took advantage of friendships with foreign virtuosi whom he had met on his travels during his youth, as well as correspondence with scientific societies. Hevelius' case demonstrates how, despite geographic location, he was far from a lonely figure working in isolation. Instead, he was able to actively participate in the promotion and dissemination of astronomical knowledge and encouraged others to do so as well. His case also demonstrates the ease with which these individuals could communicate with each other over wide spaces throughout Europe at the time.

In the seventeenth century, intellectual circles, groups, and societies all shared a quality of "internationalism." Practitioners sought it out as a means of bringing the European scientific community closer together. In some cases, this meant certain individuals traveled to other parts of Europe to then bring back scientific knowledge and theories and introduce them to their own fellow countrymen. Travels both within and outside one's home country demonstrate the fluidity of movement throughout Europe. One could be a "member" of multiple circles or groups, and it certainly was to the individual's advantage to be a part of as many groups as possible in the promotion of his own work. Correspondence made it possible to communicate with others on the latest scientific theories and ideas and turned most scientific circles into "virtual" circles — when members of any group could not be there in person, they were represented through their work and correspondence. Communication involved collaboration and discouraged individuals from carrying out their work in isolation or seclusion. What initially began as cross-currents of information, developed into relatively sophisticated scientific circles and groups well before the creation of the Royal Society and the Académie des Sciences. In most cases, individuals who participated in these various informal circles or first academies were part of a larger network of scientific practitioners of the European scientific community and the republic of letters.

One of these individuals was Johannes Hevelius who was born on 28 January 1611 in Danzig to a prosperous brewer. He was a product of a Lutheran education, although he did not receive formal

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schooling at a Lutheran university. From 1618 to 1624, he was a student at the Danzig *Gymnasium Academicum*. After a brief time away from Danzig to learn Polish, he returned in 1627 and began formal studies in astronomy and mathematics under the tutelage of Peter Krüger, whose private lessons also included instrument-making and engraving. In 1630, Hevelius went to Leiden to study jurisprudence, but he did not receive a degree and left soon after for a lengthy tour of London and Paris where he stayed two years before being called home in 1634 to work at his father's brewery. In 1641, Hevelius became an honorary magistrate in Danzig and in 1651, he became a city councilor. While holding these offices, he was still responsible for running the family brewery and he continued to pursue his astronomical interests. He married twice, first to Katharina Rebeschke in 1635, and then to Catherina Elisabetha Koopman (thirty-six years his junior) in 1663 — a year after his first wife's death. Elisabetha played a very important role in the running of his observatory, not only as a hostess and housekeeper, but also as a very capable observer and assistant.

It was Hevelius' two-year tour through Europe from 1632 to 1634 that cemented most of his early relationships with colleagues and led to a continued correspondence with them in later decades. While in Holland, he had some dealings with the Huygens family. In London, he met John Wallis and Samuel Hartlib among others. Paris is where he met Gassendi and Ismael Boulliau. In Avignon, he called on Athanasius Kircher. He also wanted to travel to Italy to meet Galileo and Scheiner, but because of his parents' concern over his safety, he traveled briefly through Switzerland and Germany instead before returning home to Danzig.

Of all his acquaintances made on his travels throughout Europe, the one with Boulliau would prove to be the strongest and last the longest. Boulliau actively pursued and created his own "circle" of acquaintances and correspondents, and shared information between them. In the late 1640's and again in 1651, Boulliau made a number of journeys to Italy, Germany, Holland, Danzig (where he stayed with Hevelius), and even Constantinople, making and renewing acquaintances wherever he went. Boulliau's impressive correspondence with Hevelius, a correspondence that lasted from 1648 to the mid-1680's, is testimony to his meticulous patience and his desire to share with others the latest scientific information.[1] In addition to viewing him as a good friend, Boulliau never ceased to admire Hevelius' work,[2] and he traveled once more to Danzig in 1661 in order to renew his friendship with Hevelius and to learn more about the nature of Hevelius' "instruments and methods of observation."[3] Hevelius even mentions Boulliau's trip to Danzig and his assistance in Hevelius' acclaimed work, the *Machina coelestis pars prior* (1673).[4]

In the decades following his travels throughout Europe, Hevelius immersed himself into his astronomical pursuits with vigor. His reputation as one of the most respected and admired astronomers of Europe arose from the expert use of his wide collection of instruments that were considered by many among the most spectacular astronomical apparatus in Europe. His instruments were technologically-superior, but they were also artistic wonders — heavily ornamented with figurines and other decorations in the Baroque tradition, a style representative of "an industry that was not yet able to detach itself from the ancient tradition of the craftsman as an artist." [5] Hevelius also used telescopes to observe the sun, moon, Jupiter's satellites, and Saturn. He housed all his instruments in his own observatory which he finished building in 1657. "Stellaburgum," as it was called, was built over the roofs of three adjoining houses, and was considered the finest observatory in Europe until "1671 and 1676 when the French and English national observatories were established in Paris and Greenwich." [6] The observatory

[1] See Henk J.M. Nellen, "La Correspondance entre Boulliau et Hevelius," in *Ismaël Boulliau (1605–1694) Astronome, Épistolier, Nouvelliste et Intermédiaire Scientifique. Ses Rapports avec les Milieux du "Libertinage Érudit"* (Amsterdam & Maarssen: APA-Holland University Press, 1994), p. 469–96.

[2] L.C. Béziat, "La vie et les travaux de Jean Hévélius," *Bulletino di Bibliographia e di Storia delle Scieze Matematiche e Fisiche* 8 (1875), p. 539.

[3] Béziat, "La vie et les travaux de Jean Hévélius", p. 537.

[4] Hevelius, *Machina coelestis pars prior* (Gedani, 1673), p. 374.

[5] Maurice Daumas, *Scientific Instruments of the Seventeenth and Eighteenth Centuries*, trans. and ed. by Mary Holbrook (New York: Praeger Publishers, 1972), p. 48.

[6] Ivan Volkoff, Ernest Franzgrote, and A. Dean Larsen, *Johannes Hevelius and his Catalog of Stars* (Provo, Utah: Brigham Young University Press, 1971), p. 23.

was so impressive that many individuals, both astronomers and royalty among others, paid visits to it over the years. This included the king of Poland, John II, Casimir and his wife, Maria Ludovica Gonzaga. Louis XIV of France also sent him a yearly grant for his work. In 1679, Hevelius received one of his most important guests of all, the young English astronomer Edmond Halley.

Hevelius argued during his entire career that accuracy depended on prolonged, meticulous observations, carried out with diligence and patience. Continuing the Tychonic tradition of observation, Hevelius always acquired a great multitude of measurements from his different instruments so that he could filter out any errors that might accrue.[7] Despite the progress in instrumentation between the time of Hevelius and Tycho, Hevelius remained, for the most part, an adherent of the Tychonic tradition. What best characterizes him as the last astronomer of the Tychonic school was his continued advocacy of naked-eye sights on measuring instruments even though he was aware of the opinions of others who depended on lenses for taking measurements. His deep-rooted conviction to defend naked-eye sights is demonstrated by the sentiment found in his work — "The naked eye is preferred."[8]

Hevelius' firm belief that telescopic sights affixed to traditional measuring instruments such as quadrants and sextants were unsound, led to an infamous controversy with Robert Hooke of the Royal Society.[9] Hooke advocated the use of telescopic sights and micrometers and continuously argued that Hevelius' work was inferior because he persisted in his use of naked-eye sights. For his part, Hevelius claimed that one should use what one is used to and he never backed down from his position. Throughout the controversy, Royal Society members appeared to be in a dilemma because they advocated Hooke's position, but at the same time, did not wish to alienate one of Europe's greatest astronomers. Furthermore, Hooke's snide comparisons between Tycho and Hevelius, and his sarcastic attitude towards Hevelius' work, only served to further frustrate these individuals. Oldenburg was especially incensed because he had developed a personal friendship with Hevelius since the beginning of their correspondence.[10] Oldenburg reassured Hevelius that he wanted to protect him and his work from "ill-wishers,"[11] and he added that Hooke's contentions had not "weakened the Royal Society's regard for Hevelius."[12]

The controversy, which began in the 1660's, lasted for two decades and became the focus of many of the letters that passed between Hevelius and his colleagues, particularly in letters to and from the Royal Society. This is best demonstrated in the correspondence between Hevelius and the English astronomer, John Flamsteed. In 1676, Hevelius and Flamsteed exchanged a number of letters in which they compared measurements and discussed instruments, especially the use of telescopic sights. Flamsteed tactlessly drove the point home that measurements were substandard without the use of telescopic sights and he also mentioned to Hevelius that a couple of Hevelius' measurements were slightly off. Hevelius responded with a letter of his own that left Flamsteed anxious and confused.[13]

[7] Allan Chapman, *Dividing the Circle: The Development of Critical Angular Measurement in Astronomy, 1500–1850* (London: Ellis Horwood, 1990), p. 82. Hevelius' *Machina coelestis pars prior* is even organized like Tycho's *Astronomiae instauratae mechanica* (1598), in which Tycho described his instruments, the use of pinnules (open sights), divisions, and his observatory "Stjerneborg," on the isle of Hven.

[8] "Praestat nudo oculo," from the celestial map of the northern hemisphere in *Firmamentum Sobiescianum*, Gedani, 1690 (Volkoff, Franzgrote, and Larsen, *Johannes Hevelius and his Catalog of Stars*, 46).

[9] The Hevelius-Hooke controversy over the relative merits of naked-eye versus telescopic sights is discussed at great length in my doctoral dissertation, "Converging Elements in the Development of Late Seventeenth-Century Disciplinary Astronomy: Instrumentation, Education, Networks, and the Hevelius-Hooke Controversy" (Virginia Polytechnic Institute and State University, 2001).

[10] By the year of Oldenburg's death (1677), the two had been corresponding with each other for fourteen years. Counting only those letters found in A. Rupert Hall and Marie Boas Hall's, *The Correspondence of Henry Oldenburg*, vols. 1–13, Oldenburg sent fifty-six letters to Hevelius, and Hevelius replied with fifty-three. Therefore, they exchanged, on average, four letters a year, although there were more letters exchanged in the first few years of their correspondence.

[11] 15 May 1676, in A. Rupert Hall and Marie Boas Hall, eds. *The Correspondence of Henry Oldenburg*, vol. 12 (London: Taylor and Francis, 1986), 295.

[12] 27 January 1677, *Oldenburg Correspondence*, vol. 13, p. 197.

[13] 23 December 1676, in: Eric G. Forbes, Lesley Murdin and Frances Willmoth (eds.), *The Correspondence of John Flamsteed, The First Astronomer Royal. Volume One 1666–1682* (Bristol and Philadelphia: Institute of

Hevelius deviated from more technical issues over the merits of his own sights and instead, touched on his opinions of quarrels, testimony and reputation, the need for astronomers to be certain before they make any knowledge-claims about the heavens, and even jealousy. He informed Flamsteed that it is "distasteful" in his opinion for friends to quarrel, and he believed Flamsteed had cast all of Hevelius' measurements into doubt based on two potential errors. As he declared to Flamsteed,

> if every mistake were to be avoided, one must be an angel not a man.... You need not have at once overthrown the whole observational method of another friend on account of one or two observations.[14]

Furthermore, Flamsteed's singular observation cannot be the standard by which all others are based. Hevelius then instructed Flamsteed to be prudent about making knowledge-claims without double-checking his own work first ("for in no way at all can we fly before we receive wings").[15] Hevelius' letter ended with a somewhat despondent and melancholy note:

> It will be enough for me if I am merely numbered among those who were willing to attempt something with the greatest effort, although they did not always hit the mark in everything. For in difficult things it is enough to have wished to.

He realized that it would never be possible to please everyone in every way and hoped only that he had accomplished his own personal best.[16]

Flamsteed was dismayed that Hevelius had reacted in such a way to his letter. Oldenburg ultimately was able to reassure Hevelius and smooth his ruffled feathers by explaining that Flamsteed never attempted to offend him in any way,[17] to which Hevelius responded that he had not been offended and that he only had wished Flamsteed not debase all his observations without having seen them first.[18] Oldenburg never had a chance to read this letter — he died before it reached England. Though Flamsteed remained a firm advocate of telescopic sights, he continued to respect Hevelius' work and the merit of his observations. And several years later, Flamsteed even wrote to a colleague of his that he had reversed his opinion of Hevelius' measurements after examining his new work, the *Machina coelestis pars posterior* (Gedani, 1679) — a gift he had recently received from the author.[19]

When Oldenburg died in 1677, so too did the systematic correspondence. The decline in correspondence was not a domestic, but rather an international, problem. In view of the rapid turnover of the office of Secretary of the Royal Society, foreigners found it difficult to know to whom they should address their letters.[20] Besides, it was more difficult to cultivate friendships with multiple secretaries. Hevelius, one of Oldenburg's most frequent correspondents, was not even aware that Oldenburg had died until almost a year after the event. Foreigners would have undoubtedly lamented the loss of such a noteworthy and diligent correspondent, not only on a personal level, but also on a professional level, because after Oldenburg's death, it became more difficult to learn of the most recent events and experiments of the Royal Society.

Only two years after Oldenburg's death, on 26 September 1679 (while Hevelius was away from his observatory), a servant of his, in a fit of vengeance, started a fire that eventually burned down the observatory, many of Hevelius' manuscripts, and all of his instruments. Fortunately, Kepler's manuscripts,

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Physics Publishing, 1995), p. 516–25. Also in: Eric G. Forbes, "Early Astronomical Researches of John Flamsteed," *Journal for the History of Astronomy* 7 (1976), p. 133–4; and John Flamsteed, *The Gresham Lectures of John Flamsteed*, ed. by Eric G. Forbes (London: Mansell Information/Publishing Limited, 1975), p. 37.

[14] *Flamsteed Correspondence*, vol. 1, p. 518–20.

[15] *Flamsteed Correspondence*, vol. 1, p. 524.

[16] "I very much doubt whether I have satisfied everyone in everything; but can anyone please everyone to any great extent? Certainly nothing meets with approbation in every respect" (Hevelius to Flamsteed, 14/24 April 1679, *Flamsteed Correspondence*, vol. 1, 687).

[17] 19 April 1677, *Oldenburg Correspondence*, vol. 13, p. 247–8.

[18] 28 November 1677, *Oldenburg Correspondence*, vol. 13, p. 363.

[19] 16 July 1679, *Flamsteed Correspondence*, vol. 1, p. 697.

[20] Marie Boas Hall, *Promoting Experimental Learning. Experiment and the Royal Society 1660–1727* (Cambridge: Cambridge University Press, 1991), p. 99. Secretaries to the Royal Society included Nehemiah Grew (1677–79), Thomas Gale (1679-81 and 1685–93), Francis Aston, and, of course, Robert Hooke (1677–82).

Hevelius' correspondence, and most of his bound books (including his star catalog) were saved.[21] One of Hevelius' daughters, who was home at the time the fire started, saved the works by throwing them out the window before they could be damaged or destroyed. Despite Hevelius' devastation at the damage caused by the fire, he immediately began rebuilding his observatory and replacing it with new instruments, although they never were as good as the originals.[22]

Hevelius' correspondence with members of the Royal Society decreased in the years following the fire — in large part because of Oldenburg's death. Nevertheless, Hevelius kept busy by rebuilding his observatory and continuing with his observations, as demonstrated in a series of lengthy letters to the Royal Society in the years before his death. Some of these letters contained specific measurements and diagrams of lunar phases and eclipses;[23] others were on conjuctions of the superior planets;[24] still others were on occultations, especially of Jupiter by the moon.[25] In 1683, Hevelius also sent the Royal Society a "Historiola" of comets to 1683 that was read 28 November 1683, entered in the Letter Books and ultimately published in the *Philosophical Transactions of the Royal Society*.[26]

Hevelius eventually died on his birthday, 28 January 1687. His "Catalog of the Fixed Stars," which had fortunately been preserved from the fire, had not been completely published by the time of his death. Hevelius' wife, Elisabetha, who had assisted him with the observations and measurements, ultimately saw to the publication of her husband's works, which were all collected and published in one volume in 1690. *Prodromus*, which means "forerunner," contained Hevelius' methodology and instruments used in compiling his star catalog. The *Prodromus Astronomiae*, with a preface written by Elisabetha, was bound together with two other works, *Catalogus Stellarum Fixarum* and *Firmamentum Sobiescianum* (dedicated to King Jan III Sobieski).[27]

Hevelius' career and correspondence reveal that he was linked to the scientific community of the seventeenth century despite his location in Danzig. Fortunately, he also traveled himself and had many visitors to the observatory — he certainly was not the lonely astronomer working in isolation. And even during the controversy with Hooke that cast doubt on all of his work, his connections and promotion of astronomical work remained constant. In the wider context, moreover, Hevelius' exchange with the European scientific community represents a vivid picture of the great strides made in astronomy in the late seventeenth century despite the fact that he was on the losing side of the controversy with Hooke. Being a part of this scientific exchange contributed to defining the role of the astronomical practitioner in the late seventeenth century. These networks certainly brought practitioners together "socially," but the correspondence also reveals that knowledge about the heavens depended upon comparisons between the results of individuals. Presenting one's observations and measurements to the larger European community fashioned his identity as an astronomical practitioner. Consequently, in establishing his own astronomical network from Danzig, Hevelius was not only making and reinforcing acquaintances, he was also promoting astronomy at every opportunity with specific expectations regarding the use of astronomical instruments, the sharing of measurements and observations, and the participation of individuals as active members in the astronomical community.

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[21] Capellus, "A Letter on the Hevelian Conflagration ..." (1679), in: E.F. MacPike, *Hevelius, Flamsteed, and Halley: Three Contemporary Astronomers and Their Mutual Relations* (London: Taylor and Francis, 1937), p. 109–10.

[22] Volkoff, Franzgrote, and Larsen, *Johannes Hevelius and his Catalog of Stars*, p. 4.

[23] 9 January 1682, Hevelius to Gale, in Johannes Hevelius, *Papers*, in the Special Collections of The Dibner Institute Library of the History of Science and Technology; 21 February 1682, Hevelius to Royal Society, *Papers*; 10 December 1685, Hevelius to Royal Society, *Papers* [at the end of this letter, he mentions his *Prodromus Astronomiae* and his "Catalog of the Fixed Stars" (*Uranographia*)].

[24] Date uncertain, but read at the Royal Society meeting of 24 October 1683, Hevelius to the Royal Society, *Papers*. In this "Historiola," Hevelius specifically listed the distances between Saturn and Jupiter measured with his "micrometers."

[25] Date uncertain, but read at the Royal Society meeting of 24 October 1683, Hevelius to Royal Society, *Papers*. Another letter came three years later and was written on 10 April 1686. There are two copies of the April letter, both of which contain observations of the occultation of Jupiter by the moon as well as measurements of the diameter of Jupiter. In the same letter, Hevelius includes a table comparing calculations obtained by himself, Kepler, Lansberg, Boulliau, Riccioli, and Wingio.

[26] (*Philosophical Transactions*, vol. 13, no. 154) Date uncertain, *Papers*.

[27] Hevelius observed hundreds of new stars and created new constellations, some of which are still used to this day.