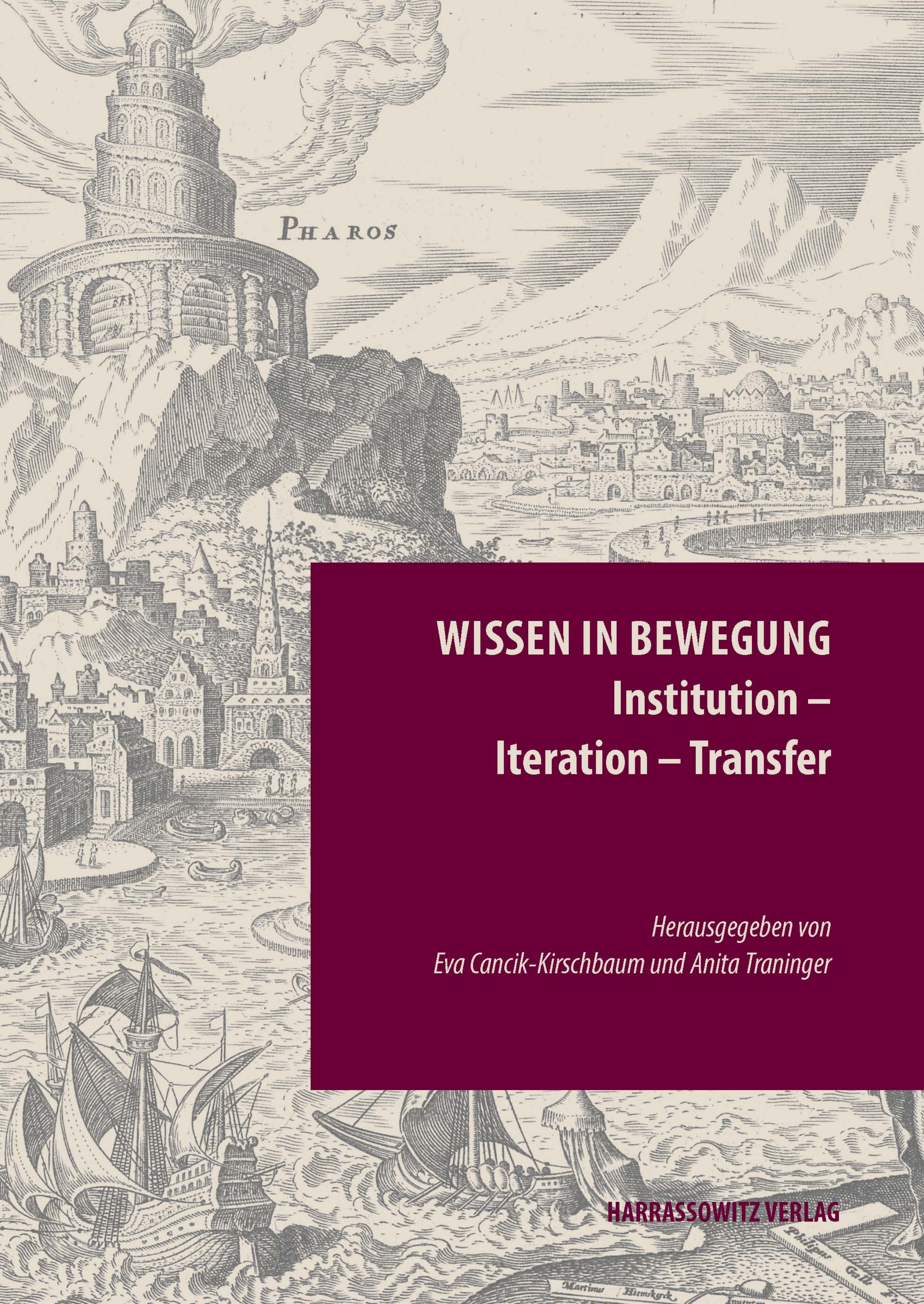

WISSEN IN BEWEGUNG

Institution – Iteration – Transfer

Herausgegeben von
Eva Cancik-Kirschbaum und Anita Traninger

HARRASSOWITZ VERLAG

Wissen in Bewegung

ISBN Print: 9783447104982 — ISBN E-Book: 9783447194143

Episteme in Bewegung

Beiträge zu einer transdisziplinären Wissensgeschichte

Herausgegeben von Gyburg Uhlmann
im Auftrag des Sonderforschungsbereichs 980
„Episteme in Bewegung.
Wissenstransfer von der Alten Welt
bis in die Frühe Neuzeit“

Band 1

2015
Harrassowitz Verlag · Wiesbaden

ISBN Print: 9783447104982 — ISBN E-Book: 9783447194143

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Publiziert werden Beiträge, die im Umkreis des an der Freien Universität Berlin angesiedelten Sonderforschungsbereichs 980 „Episteme in Bewegung. Wissenstransfer von der Alten Welt bis in die Frühe Neuzeit“ entstanden sind.

Gedruckt mit freundlicher Unterstützung der Deutschen Forschungsgemeinschaft (DFG).

Abbildung auf dem Umschlag:
Philips Galle (Stecher) / Maarten van Heemskerck (Inventor), *Pharos*, Kupferstich, 1572, Herzog August Bibliothek Wolfenbüttel: Graph. A1: 783p.3

Bibliografische Information der Deutschen Nationalbibliothek
Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über http://dnb.dnb.de abrufbar.

Bibliographic information published by the Deutsche Nationalbibliothek
The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available on the internet at http://dnb.dnb.de.

Informationen zum Verlagsprogramm finden Sie unter
http://www.harrassowitz-verlag.de

Gedruckt auf alterungsbeständigem Papier.
Druck und Verarbeitung: Hubert & Co., Göttingen
Printed in Germany

ISSN 2365-5666
ISBN 978-3-447-10498-2
e-ISBN PDF 978-3-447-19414-3

Institutionalised Metaphysics of Astronomy at Early Modern Melanchthonian Universities

Pietro Daniel Omodeo

Metaphysics, Institutions and the Dynamics of Astronomy

In the history of astronomy, issues pertaining to "metaphysics" and to "institutions" are apparently unconnected. On the one hand, the problem of the metaphysics of astronomy pertains to the philosophy of science, and specifically to the rational foundations of theories informing scientific practices; on the other hand, institutional considerations pertain to the social embedment of science at a micro-level as well as at the level of wide cultural and political spheres. In this essay, I introduce and treat the question of the interconnection between the institutional side and the metaphysical one. My case study is the astronomical culture in the historical and cultural context of the Melanchthonian institutional networks of universities between the sixteenth and the mid-seventeenth centuries.

As far as the "metaphysics of astronomy" is concerned, its investigation requires that intellectual historians unveil the theoretical and epistemological premises of past mathematical and physical knowledge about the heavens. In premodern times and in the early modern period, these ranged from natural philosophy to theology, anthropology and ethics. Metaphysics legitimated theories and approaches; it was the ground on which paradigms were constructed for the explanation of celestial motions, their geometry and their causes.

As to the institutional side of pre-classical astronomy, schools and universities, courts, informal circles and networks constituted the spaces where astronomical knowledge was established and transmitted.[1] These institutions (which were more or less formalised) were the places where scholars also reflected on the validity and the foundations of the knowledge they developed. Historical reconstructions of knowledge institutions in medieval and early modern Europe can rely not only on manuscripts or printed sources but also benefit from extensive archival documentation comprising administrative documents, teaching curricula, university statutes, formal and informal letters, annotations in books, juridical and ecclesiastical witnesses and drafts of printed books. Relying on this wide basis of historical evidence, the cultural historian of medieval and

1 In the following, "pre-classical" astronomy refers to the discipline prior to the "classical" physics of Isaac Newton.

ISBN Print: 9783447104982 — ISBN E-Book: 9783447194143

early modern Europe can gather detailed information about contexts, environments and interpersonal exchanges.

The systematisation of astronomical knowledge within established philosophical and theological frameworks secured its endurance and transportability. This point is relevant for an assessment of the interrelation between the metaphysics underlying astronomy (its principles, concepts and methods), and the institutional settings of transmission of this discipline up to the early modern period. Operating in a sort of loop, institutionalised a prioris sanctioned and reinforced scholarly practices, which, in turn, demonstrated the validity of the institutional values. These values were inscribed in the metaphysico-theological foundations of both, the institutions and the discourses taking place within them. In astronomy, terrestrial centrality and immobility, the finitude of the universe and the perfect geometry of heavenly motions were inscribed in the highly systematised Aristotelian *physica* and *metaphysica* and reinforced by Biblical exegesis. Well-established principles of pre-classical astronomy often descended from metaphysical and physical concerns. Such was the disciplinary distinction between celestial physics and mathematical astronomy, fields deputed to causally explain (*propter quid*) and geometrically render the heavenly phenomena (the *quia*), respectively.

So far I have mentioned the "internalist-externalist" bipolarity of intellectual factors and social structures. What about the *dynamics* of the early modern scientific discourse? The intended mission of medieval and early modern universities was preservation, namely the iterative transmission of traditional knowledge to future generations. Their aim was not to produce change but to *repeat* the same. Thus, as I will show for Renaissance astronomy, epistemic processes in institutional settings were often imperceptible and transformations of knowledge often occurred against the explicit intentions of the historical actors. Lectures and commentaries on authoritative sources – the teaching of which was sanctioned by academic statutes and curricula – were not expected to alter the knowledge preserved in the classics and in the textbooks. Rather, academic forms of knowledge transmission such as commentaries or other codified genres (e.g., *summae*, *exercitationes*, *quaestiones* and *disputationes*) were aimed at clarifying authoritative sources for students and at securing the conservation of the tradition – e.g., the Aristotelian legacy in natural philosophy and the Galenic one in medicine. The transmission, re-edition and annotation of an elementary textbook such as Sacrobosco's *De sphaera* for many centuries is an instance of iteration in teaching. The simplicity of this Scholastic introduction to astronomy was both its pedagogical strength and limitation. Only small additions to the body of established knowledge were integrated, often in the form of an *excursus*. The most authoritative reformer of Lutheran universities, the humanist Philipp Melanchthon, was not original in choosing Sacrobosco as a textbook for astronomy classes at Wittenberg. He even composed an introduction to it, in epistolary form, addressed to the learned Greek scholar Simon Grynaeus.

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Still, no transfer comes about without change. Efforts to preserve a body of knowledge unintentionally produce internal dynamics, even when the appearance is that of crystallized epistemic systems. The injection of novel views, transferred from outside a scholarly tradition but adapted to its requirements, can accelerate such processes. As I will argue, this was the case with the reception of Copernicus and Descartes in the German university system. Adaptation, in turn, means mutual transformation of that which is received as well as the receiving environment. In the history of astronomy, eclecticism and hybridisation are the rule rather than the exception. Moreover, in order to comprehend the epistemic changes occurring through iterative practices of transmission, one should consider micro-histories, that is, the actions, decisions and efforts on the part of individuals on the level of personal exchanges, negotiations and conflicts taking place in cultural institutions. Hence, three levels in the study of epistemic dynamics should be considered: first, the internal dynamics concerning the advancement and modification of knowledge itself (e.g., the reworking of planetary theory recycling Ptolemaic geometrical devices); second, epistemic accelerations caused by external factors (e.g., the injection of Copernican astronomy and Cartesian natural philosophy into the Aristotelian tradition of the Melanchthonian universities); and third, individual perspectives and interpersonal transactions (e.g., those between scholars or between teachers and pupils). Reformers of teaching curricula, such as Melanchthon in Protestant Germany, often played a major role in the revision of earlier traditions.

My present endeavour is to illustrate such institutional-metaphysical dynamics in science on the basis of the developments of astronomy that took place at Melanchthonian universities from the first half of the sixteenth century to the second half of the seventeenth. What makes this process intriguing for cultural historians of science are a series of unique historical factors. First, the Reformation and Philipp Melanchthon's revision of university curricula (at Wittenberg and other German universities following its example) launched and institutionalised a scholarly tradition that lasted at least one century. Its pillars were the Lutheran creed, humanistic literacy and Aristotelian natural philosophy. In this context, mathematical astronomy became a curricular discipline fostered for several reasons, not least of which was Melanchthon and his followers' belief in astrology as the science of divine Providence. A second unparalleled aspect was the advance of this discipline in the century after Johannes Regiomontanus' recovery of Ptolemaic methods in Latin Europe and after Nicholas Copernicus' heliocentric synthesis of astronomy, which was first made public with the appearance of *De revolutionibus orbium coelestium* in Nuremberg in 1543, but had already circulated through scholarly networks in an incomplete form for about thirty years. While Copernicus' work challenged the general conception of cosmological order, his direct or indirect followers profoundly transformed many other aspects of the medieval worldview. To mention the most explosive conceptions that emerged during the Renaissance, Tycho Brahe's cometary theory

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made the fluidity of the heavens a generally accepted view, and his claims concerning the measurement of Mars' parallax irremediably undermined Ptolemaic planetary theory on an observational basis; Galileo Galilei's physics opened a space of legitimacy for the theory of terrestrial motion within natural philosophy and his telescopic observations made the notion of cosmological homogeneity plausible; Johannes Kepler's celestial physics accounted for the elliptic orbit of the planets and rejected two well-established principles of astronomy, namely the separation of physical and mathematical accounts of heavenly phenomena, and the perfect circularity of all heavenly motions; and a series of daring philosophers such as Giordano Bruno and René Descartes developed natural philosophies at odds with Aristotle's physics, offering better foundations for novel doctrines such as post-Copernican astronomy or post-Galilean mechanics. All of these scientific advances shook the foundations of university curricula and called for tremendous efforts to secure the continuity of academic traditions.

The Creative Phase: Copernican Scholasticism
Geocentric Copernicanism in the Wittenberg Network (1543–1588)

The beginning of the transformation of astronomical theories in the context of early modern Protestant universities was ignited by Copernicus' work, which was slowly received and reworked in the Wittenberg environment and in its network of German reformed universities to fit their scholarly and teaching requirements as well as their philosophical foundations, mainly resting upon Aristotle.[2]

Melanchthon strongly supported the teaching of mathematics as part of a humanistic education. This included mathematical astronomy.[3] Therefore, Melanchthon's program secured the teaching of this discipline in the centres that adhered to his academic reform. He authored introductions to traditional textbooks that he chose as standard references for his students and that were reprinted countless times. His introduction to Sacrobosco's *De sphaera* was a letter to Grynaeus (written in August 1531) in which he emphasised the religious and pedagogical value of astronomy as a form of the contemplation of divine

2 On the Melanchthonian network of astronomers, see Lynn Thorndike, *A History of Magic and Experimental Science*, 8 vols, London/New York 1923–1941, vol. 5, p. 378; Claudia Brosseder, *Im Bann der Sterne. Caspar Peucer, Philipp Melanchthon und andere Wittenberger Astrologen*, Berlin 2004, pp. 11–17; Robert S. Westman, "The Melanchthon Circle, Rheticus and the Wittenberg Interpretation of the Copernican Theory", in: *Isis* 66 (1975), pp. 163–193; and idem, *The Copernican Question. Prognostication, Skepticism, and Celestial Order*, Berkeley 2011, chap. 5, "The Wittenberg Interpretation of Copernicus's Theory", pp. 141–170.

3 Karin Reich, "Philipp Melanchthon im Dialog mit Astronomen und Mathematikern. Ausgewählte Beispiele", in: *Mathematik und Naturwissenschaften in der Zeit von Philipp Melanchthon*, ed. Franz Fuchs, Wiesbaden 2012, pp. 27–58.

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creation.[4] Melanchthon also prefaced Sacrobosco's *Computus ecclesiasticus*, on the Christian calendar, and Georg Peuerbach's *Theoricae novae planetarum*, on planetary theory. His support for astronomy included astrology, culminating with Joachim Camerarius and his translation of Ptolemy's *Quadripartitum*.[5]

Wittenberg became an irradiating centre of Copernicus' astronomical work. Here Copernicus' pupil Georg Joachim Rheticus, the editor of *De revolutionibus*, taught mathematics, while his colleague Erasmus Reinhold worked out the first astronomical tables based on Copernican parameters, the *Prutenicae tabulae* (1551). Leading intellectuals in Wittenberg had a bias toward geocentrism for theological and physical reasons. Martin Luther is reported to have reacted with scepticism to the Copernican hypotheses because they seemed to contradict the Bible.[6] Philip Melanchthon condemned Copernicus' hypotheses as well, on the basis of considerations from natural philosophy. In Melanchthon and the philosopher Paul Eber's introduction to physics, *Initia doctrinae physicae* (1549), the Copernican theory is rejected on account of its incompatibility with Aristotelian cosmology and scriptural passages. Melanchthon went so far as to prevent professors from teaching novel astronomical theories:

> Although subtle practitioners take into consideration many [different hypotheses] in order to exercise their intellects, nonetheless the youth should know that they [the practitioners] do not dare to affirm such theories. In their first education, [students] shall appreciate opinions transmitted with the shared consensus of the practitioners, which are minimally absurd. If [students] grasp that truth is manifested by God, they will embrace this [truth] with reverence and be satisfied with it.[7]

Pillars of the Melanchthonian humanistic education were proficiency in the *humanae litterae*, the study of the liberal arts as well as familiarity with the Biblical languages (Latin, ancient Greek and Hebrew). Whereas Aristotelianism was excluded from theology, it remained the philosophical backbone of all other studies, from logic to natural philosophy and medicine. The intended but not accomplished rupture with the Scholastic tradition led to the production of new

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4 Cf. Isabelle Pantin, "La lettre de Melanchthon à S. Grynaeus. Les avatars d'une apologie de l'astrologie", in: *Divination et controverse religieuse en France au XVIe siècle*, ed. Robert Aulotte, Paris 1987, pp. 85–101.

5 Cf. Stefano Caroti, "Melanchthon's Astrology", in: *Astrologi Hallucinati. Stars and the End of the World in Luther's Time*, ed. Paola Zambelli, Berlin 1986, pp. 109–121.

6 Martin Luther, *Werke, Tischreden*, Weimar 1912–1921, vol. 1, p. 419.

7 Philipp Melanchthon, *Initia doctrinae physicae*, Leipzig 1563, f. 31v. On Luther, Melanchthon and Copernican astronomy, see Emil Wohlwill, "Melanchthon und Copernicus", in: *Mitteilungen zur Geschichte der Medizin und der Naturwissenschaft* 3 (1904), pp. 260–267; Bruce Moran, "The Universe of Philip Melanchthon. Criticism and the Use of the Copernican Theory", in: *Comitatus* 4 (1973), pp. 1–23; and Walter Thüringer, "Paul Eber (1511–1569). Melanchthons Physik und seine Stellung zu Copernicus", in: *Melanchthon in seinen Schülern*, ed. Heinz Scheible, Wiesbaden 1997, pp. 285–321.

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textbooks in which Scholastic concepts and views were embraced and transmitted without reference to the sources nor to the story of their transmission.[8] Melanchthon and Eber's physics is a case in point. The natural philosophy they wanted to convey to their students was Aristotelian in its essence, but it was presented in a systematical and synthetic form focused on the subject matter (clarification and discussion of concepts, problems and theories) without extensive mentioning of the *auctoritates* and their transmission. They also stuck to Aristotelian cosmology and rejected the Copernican system as irreconcilable with natural philosophy.

The Wittenberg mathematician Reinhold checked the astronomical sections of the *Initia doctrinae physicae* and made minor improvements, as witnessed by the handwritten corrections in the Nuremberg manuscript.[9] However, the corrections concern the details of the work and not its vision. But what was Reinhold's attitude toward crucial cosmological issues such as planetary hypotheses and terrestrial motion? This astronomer, who has been regarded as 'the leading mathematical astronomer of the sixteenth century' second only to Copernicus, was enthusiastic about Copernicus' geometrical devices.[10] He especially appreciated the fact that Copernican epicyclical models respected the so-called "astronomical axiom" according to which celestial motions are uniformly circular about their centres.[11] The justification of this principle rested on metaphysical and perhaps aesthetic reasons that went beyond technical astronomy. Aristotle's philosophy supported this axiom originally based on a distinction between the imperfect sublunary realm, where the elements have vertical tendencies toward their "natural places", and the perfect celestial realm, where celestial bodies accomplish perfectly circular motions. In the case of epicyclical models, the principle of circular uniformity implied the uniformity of speed of all circular components of planetary models. Copernicus succeeded in the task of conforming astronomy to this requirement by substituting Ptolemy's equants for geometrically equivalent epicyclical models. This achievement elicited Reinhold's enthusiasm but his appreciation did not go as far as to imply his adherence to the heliocentric system. In fact, he never embraced heliocentric and geokinetic views, also due to his close association with Melanchthon and his loyalty to the Wittenberg scientific programme. In particular, Reinhold's edition with commentary of the first book of Ptolemy's *Almagest* (1549) bears witness to

8 Cf. Peter Petersen, *Geschichte der aristotelischen Philosophie im protestantischen Deutschland*, Leipzig 1921, pt. 1, section 1, chap. 1–4, and Heinz Kathe, *Die Wittenberger philosophische Fakultät* 1502–1817, Cologne/Weimar/Wien 2002, vol. 2.

9 Cf. Thüringer, "Paul Eber".

10 Cf. Owen Gingerich, "Erasmus Reinhold and the Dissemination of Copernican Theory", in: idem, *The Eye of Heaven. Ptolemy, Copernicus, Kepler*, New York 1993, pp. 221–251; idem, "Reinhold, Erasmus", in: *Dictionary of Scientific Biography* xi (1975), pp. 365–367.

11 Owen Gingerich, *An Annotated Census of Copernicus'* De Revolutionibus (Nuremberg, 1543 and Basel, 1566), Leiden/Boston 2002, pp. 97–98 and p. 105.

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the endurance of geocentrism after Copernicus, even in an environment receptive to his work.[12]

Reinhold appreciated Copernicus' mathematics but not his violation of acknowledged physical principles. In his manuscript commentary on Copernicus, *Commentarius in opus Revolutionum Copernici*, he hinted at the possibility of accepting the latter's devices without renouncing geocentrism, which was a matter of planetary modelling through geometrical transpositions.[13] Reinhold's successor as the professor of mathematics in Wittenberg, Melanchthon's son-in-law Caspar Peucer, continued his "translation" of the Copernican models showing that his model for the precession of the equinoxes and the so-called "trepidation" of the starry heavens could be adapted to a geocentric frame. It was sufficient to transfer some of the motions Copernicus allotted to the Earth to the celestial sphere of the fixed stars. Peucer's astronomical hypotheses, or *hypotyposes*, were published anonymously in Strasbourg in 1568 (as *Hypotyposes orbium coelestium, quas appellant theoricas planetarum*) and then with the author's name in Wittenberg in 1571 (as *Hypotheses astronomicae, seu Theoriae planetarum*); they exerted a conspicuous influence on the cosmological debate at the end of the century. The Strasbourg mathematician Conrad Dasypodius carried out their first anonymous publication and conjecturally ascribed the work to Reinhold. This incorrect ascription reinforced the conviction among learned scholars that the reputed author of the Copernican *Prutenicae tabulae* had also designed a geocentric revision of Copernicus, the details of which had not yet been developed.[14]

The Silesian mathematician Paul Wittich occupies a special place among those who reworked *De revolutionibus* with a geocentric perspective. In two preserved copies of *De revolutionibus* he develops geometrically equivalent planetary models, thereby varying Copernicus' theory. In his diagrams, he demonstrated how to translate Sun-centred models into Earth-centred ones.[15] Wittich strongly influenced the next generation of European scholars working on planetary theory. Among them were several British scholars who brought continental astronomical and mathematical expertise to their country, including Henry Savile, founder of the Savilian professorships of astronomy and geometry at Ox-

12 Pietro D. Omodeo and Irina Tupikova, "Post-Copernican Reception of Ptolemy. Erasmus Reinhold's Commented Edition of the *Almagest*, Book One (Wittenberg, 1549)", in: *Journal for the History of Astronomy* (2013), pp. 235–256.

13 Aleksander Birkenmajer, "Le *Commentaire* Inédit d'Erasme Reinhold sur le *De revolutionibus* de Nicolas Copernic", in: *La science au seizième siècle*, Paris 1960, pp. 171–177, repr. in: *Études d'histoire des sciences en Pologne*, Wrocław etc. 1972, pp. 761–766.

14 Peter Barker, "The Hypotyposes orbium coelestium (Strasbourg, 1568)", in: *Nouveau ciel nouvelle terre. La révolution copernicienne dans l'Allemagne de la Réforme (1530–1630)*, eds. Miguel Ángel Granada and Edouard Mehl, Paris 2009, pp. 85–108.

15 Owen Gingerich and Robert S. Westman, "The Wittich Connection. Conflict and Priority in Late Sixteenth-Century Cosmology", in: *Transactions of the American Philosophical Society* 78/7 (1988), pp. 1–148.

ISBN Print: 9783447104982 — ISBN E-Book: 9783447194143

ford; John Craig, court physician to King James; Duncan Liddel, founder of the chair of mathematics at Aberdeen.[16]

The physical import of Wittich's geometrical considerations became clearer a decade later, when geo-heliocentric systems proliferated. The publication of two mathematical and astronomical works in 1588 launched the idea of this new system, according to which the Earth is at the centre of the cosmos, the Sun and the Moon encircle it, while the planets encircle the Sun. The first of these two publications is entitled *Fundamentum astronomicum* and was authored by the court mathematician to Rudolph II in Prague, Nicolaus Reimers Ursus. The second, entitled *De mundi aetherei recentioribus phaenomenis*, was authored by the noble Danish astronomer, Tycho Brahe. Both Ursus and Brahe were acquainted with the talented Silesian mathematician Wittich and had been influenced by him.

The geo-heliocentric systems of these two scholars were not identical. While Ursus maintained that the Earth is at the centre of the system and rotates so as to produce the appearance of the daily rotation of the heavens, Brahe was firmly convinced of the Earth's immobility. Moreover, unlike Ursus, his system assumed that the solar and the Martian 'orbits' intersect. The simplest reason for this feature is that it resulted from Brahe's geometrical translation of Copernicus' theory into a geocentric framework. But this is not the reason Brahe offered to his opponents. He claimed that he had empirical evidence of this remarkable intersection, namely his observation, in 1582, of a Martian parallax larger than that of the Sun. Even though he could not have been able to measure Mars' parallax, whose range is smaller than the accuracy of his measurements, he used this claim as empirical evidence to legitimate the intersection of the paths of Mars and the Sun, and also to claim the priority of his "discovery" over the work of his competitor, Ursus. On the basis of this fictitious observation, Brahe argued that Mars comes closer to the Earth in its opposition than the Sun. Ptolemy could not explain this proximity, as Brahe claims in *Apologia de cometis*, directed at the criticism of the Scottish mathematician John Craig (1589). Brahe remarks that only two sets of hypotheses could account for Mars' proximity, either the Copernican system or a geo-heliocentric system.[17]

These publications of the late 1580s triggered a polemic over priority in the "discovery" of geo-heliocentrism that lasted more than one decade, in which

16 On the impact of the two Savilian chairs and their relevance to the scientific culture of early modern England, see Mordechai Feingold, *The Mathematicians' Apprenticeship. Science, Universities and Society in England, 1560–1640*, Cambridge 1984, p. 25 and p. 32. On Liddel, see Pietro D. Omodeo, "L'*iter* europeo del matematico e medico scozzese Duncan Liddel", in: *Preprints of the Max Planck Institute for the History of Science – Berlin* 438 (2013) and the edited volume *Duncan Liddel (1561–1613), Networks of Polymathy, and the Northern European Renaissance*, ed. Pietro D. Omodeo, Leiden/Boston (in press).

17 Tycho Brahe, *Apologia de cometis*, in: idem, *Opera Omnia*, ed. John Louis Emil Dreyer, 9 vols, Copenhagen 1913–1929 (Reprint Amsterdam 1972), vol. 4, p. 475.

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Brahe accused Ursus of plagiarism and the latter answered in crude terms. Even Kepler was co-opted by Brahe in his struggle for the recognition of his priority. Brahe required Kepler to write against Ursus as a condition for his appointment in Prague as Brahe's assistant in 1600.[18] Brahe was notoriously jealous of his theory and accused other scholars working with it without appropriately referencing his authorship of plagiarism. For instance, in 1591, he accused the Scottish mathematician Liddel of unduly appropriating his doctrines, after he was informed that Liddel was teaching the geo-heliocentric theory at Rostock and Helmstedt.[19]

The Consolidation Phase: Tychonic Scholasticism Geo-Heliocentrism in the Baltic Network (1588–ca. 1650)

In the frame of the geocentric consensus informing teaching and research at Melanchthonian universities, planetary theory was steadily transformed as a reaction to the Copernican challenge until the geo-heliocentric compromise was reached. Copernicus' explanation of planetary retrograde motions as resulting from the heliocentric paths of the planets was safeguarded. Its intelligibility and aesthetic value persuaded Melanchthonian astronomers of the likelihood of the heliocentric revolutions of the planets. At the same time, the perceived physical and theological shortcomings of terrestrial motion and solar centrality and immobility could be solved thanks to the geo-heliocentric "third way", in which the Earth remained the centre of the lunar monthly cycle, of the solar annual revolution and of the fixed stars' daily rotation.

After the creative reception and variation of the Copernican paradigm a phase of consolidation followed. After debates on planetary modelling and hypotheses from the mid 1540s to 1588, culminating with the Ursus-Brahe synthesis, this system was adopted as a standard view among late-humanistic astronomers and scholars working in Philippist academic centres (that is, in universities and gymnasia where Melanchthon's legacy was alive). Consider, as a clear instance of this trend, the developments in astronomical teaching at the Gymnasium of Szczecin. The *Pedagogium illustre Stetinense* can be regarded as a typical teaching institution for such a late-humanistic environment. It had close ties with the most important scholarly centres of northern Germany and the Baltic area (especially Copenhagen, Gdańsk, Königsberg, Rostock and Wittenberg). Brahe exerted a conspicuous influence in this region, especially due to his prestige and that of his pupil, the Copenhagen professor Christian Longomontanus. The latter composed a work in planetary theory, *Astronomia Danica* (1640), which was the last synthesis of the astronomical tradition started by Reinhold and a

18 Nicholas Jardine, *The Birth of the History and Philosophy of Science. Kepler's 'A defence of Tycho against Ursus' with Essays on Its Provenance and Significance*, Cambridge 1984.

19 Christine Jones Schofield, *Tychonic and Semi-Tychonic World Systems*, New York 1981, pp. 145–160.

ISBN Print: 9783447104982 — ISBN E-Book: 9783447194143

defence of this legacy against innovators such as Kepler.[20] The *Paedagogium* was the most important teaching institution in town. Although it did not have the high status of a university (as was the case, in Pomerania, with Greifswald), many students, mostly from Pomerania and the Baltic area, attended it to seek an education in the arts.[21]

Szczecin's adherence to a form of late Scholasticism did not hinder the adaptive reception of scientific innovations, which were embedded into the pedagogical and philosophical programme of the School. The Tychonic system was received very early and inserted into an Aristotelian metaphysics that went beyond the original intentions of the Danish astronomer. The Szczecin professor of theology and Hebrew Daniel Cramer had studied at Rostock and Wittenberg and was the author of a series of Aristotelian textbooks on logic, rhetoric and metaphysics: *Synopsis Organi Aristotelis* (Wittenberg, 1595), *Synopsis trium librorum Rhetoricorum Aristotelis* (Leipzig, 1597) and *Isagoge in Metaphysicam Aristotelis* (Hannover, 1594 and Wittenberg, 1601). Cramer dedicated the latter to Brahe whom he knew personally. In the prefatory letter to the second edition of his textbook on metaphysics (Szczecin, February 1601), he even claimed that his speculations were the philosophical counterpart of geo-heliocentric astronomy and that Brahe was very favourable to his work. The two men had discussed the relationship between astronomy and metaphysics during a visit that Cramer had paid the astronomer at his castle-observatory of Uraniborg seven years earlier. Cramer celebrated his visit as an encounter between Urania and Metaphysica, presenting his work as a philosophical support for Brahe's theory.

The form of Cramer's *Isagoge in Metaphysicam Aristotelis* follows Melanchthon's introductions to ethics, physics and psychology, i.e., it is an Aristotelian treatment of disciplines renouncing arguments from Scholastic authority as well as references to sources and to medieval or contemporary commentaries.[22] Cramer, who was well-acquainted with Brahe, proposed using the Scholastic theory of the separated intellects, or movers, to explain the origin of heavenly motions. The source of heavenly motions was a much-debated issue after Brahe and his contemporaries renounced the traditional notion of material spheres transporting celestial bodies. A new account had to be devised. Cramer conceived the causal action of the Aristotelian movers not as applied to material spheres but rather as directly applied to planets travelling through the fluids of the ether.

20 A significant study of Brahe's international network is John Robert Christianson, *On Tycho's Island. Tycho Brahe and His Assistants 1570–1601*, Cambridge 2000. On Longomontanus and the Tychonic reactions to Kepler, see James R. Voelkel, *The Composition of Kepler's "Astronomia Nova"*, Princeton 2001, pp. 142–169.

21 Cf. Martin Wehrmann, *Geschichte des Marienstifts-Gymnasiums zu Stettin*, Szczecin 1894.

22 See Petersen, *Geschichte der aristotelischen Philosophie im protestantischen Deutschland*, p. 284, and passim.

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One can find Cramer's reflection on the meaning of Tychonic astronomy for metaphysics and the interrelation between the latter discipline and the science of the heavens in the last part of the *Isagoge*. In the 1594 edition he deals with the number of movers necessary to produce the complex celestial phenomena.[23] However, Cramer does not give a complete answer to this question but limits himself to clarifying how this number could be deduced from astronomical theory. In accordance with Aristotle's *Metaphysics* XII 6–7, he argues that the existence of a first mover can be inferred from the motion of the heaven of the fixed stars. Following the spirit and not the letter of *Metaphysics* XII 8, Cramer asserts that the movers responsible for planetary motion, or 'second movers', should be derived from astronomical theory. Whereas Aristotle followed Eudoxus' cosmology of concentric spheres, Cramer regarded this theory as outdated and has having already been substituted in antiquity for better theories using epicyclical models. In recent years, Cramer writes, Brahe had been "the Prince of Astronomy" who corrected the errors of his predecessors and brought astronomical theory to perfection. Thus Cramer invites philosophers to establish the exact number of movers and intellects on the basis of this theory.[24] As one reads in a chapter of the 1601 edition of the *Isagoge* entitled 'Hence, How Do Stars Move Without Spheres?' (*Quomodo ergo stellae sublatis Orbibus moventur?*),

> Just as it was once believed that no sphere is moved by itself – actually, nothing moves itself – but it was assumed that a special intelligence or mover assisted the sphere, similarly you should assume that the stars are not moved by some instruments in analogy to terrestrial beings moving by their feet, water animals by fins, and birds by wings. Rather, they are moved by the proper and regular ὁρμῇ, that is, the impetus of their own mover. We must believe that, in the same manner in which this [mover] assisted a solid sphere according to the opinion of the ancients, it assists any star moving without spheres. We have insisted on this aspect to manifest the reason why it is not necessary to abandon the movers, although the spheres have vanished.[25]

Cramer's metaphysics of astronomy must have met with success among Brahe's followers. Cramer's conceptions possibly informed the views of scholars such as

23 Daniel Cramer, *Isagoge in Metaphysicam Aristotelis*, Hannover 1594, p. 216.

24 Ibid., pp. 216–218.

25 Daniel Cramer, *Isagoge in Metaphysicam Aristotelis*, Wittenberg 1601, p. 182: 'Sicut nullus orbis olim credebatur a seipso moveri (ut et nihil aliud seipsum movet) sed orbi praefixus astare putabatur peculiaris intelligentia seu motor; ita quoque statuendum tibi erit non moveri stellas beneficio instrumentorum, sicut se terrestria pedibus, aquatilia primis, volatilia alis promovent; sed cieri propria et regulari ὁρμῇ seu impetu sui motoris, qui sicut ex veterum opinione astabat orbi, ita iam stellis sine orbibus latis astare credatur. Quae ideo tantum monuimus ut manifestum sit, qua ratione etiam destructis orbibus, non ob id motores e medio tollere necess[ari]um sit.'

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Longomontanus. The latter in fact censured the central idea of Kepler's *Astronomia nova* of a celestial physics that provides an explanation for celestial geometries in forces and renounces traditional epicyclical models. According to Longomontanus, Kepler's physicalisation of astronomy downplayed the dignity of this "very celestial" discipline. As a reaction to his critics, Kepler deemed it necessary to take a position on the metaphysical foundations of the Tychonic system. He accused his Tychonic opponents of introducing a plurality of separate intellects contrary to the unity of creation. By contrast, Kepler sought a unitary principle of planetary motions, which he located in the Sun at the centre. He also intended to develop a celestial physics in which the solar force offers the unitary physical explanation of planetary motions mirroring the one God of monotheistic Christianity.[26] Kepler's objections did not persuade Baltic Tychonians to abandon their hypotheses. Rather, they continued criticising the "physical shortcomings" of Kepler's astronomy for many years.

The development of the teaching of planetary theory at Szczecin should be further investigated concerning astronomical disputations. In fact, although academic disputations rarely aspired to originality, they are important documents in so far as they reveal the conceptions that were generally accepted at the time as well as the slow curricular changes in universities or gymnasia.

In 1613, the student Joachimus Lizovius held a cosmological disputation, entitled *Disputatio physico-mathematica de mundo eiusque praecipuis partibus* (*Physico-Mathematical Disputation on the World and Its Main Parts*). His views were strictly Aristotelian. For instance, his list of the planets is conventional and he does not even mention the existence of competing systems: 'The number of the planets is seven. Their order departing from the fixed stars is the following: Saturn, Jupiter and Mars, which are said to be the superior [planets], the Sun, which is said to be the mean [planet], Venus, Mercury and the Moon, which are called the inferior [planets].'[27] According to Lizovius, 'earth' does not designate a planet but only the heaviest of the four Aristotelian elements. As such, earth rests immobile at the centre of the world.[28]

In the decades following this disputation, views on planetary theory were gradually transformed. In 1618, Cramer's son, Daniel Cramer Junior, defended a

26 Miguel Ángel Granada, "'A quo moventur planetae?' Kepler et la question de l'agent du mouvement planétaire après la disparition des orbes solides", in: *Galilaeana* 7 (2010), pp. 111–141, especially pp. 128 and ff. On Kepler's reference to Cramer's metaphysical theory, see Johannes Kepler, *Astronomia nova*, in: idem, *Gesammelte Werke*, vol. 3, Munich 1990, pp. 97–98; idem, *New Astronomy*, trans. William H. Donahue, Cambridge 1992, pp. 169–170.

27 Joachimus Lizovius (def.) and M. Christophorus Hunichius (pres.), *Disputatio physico-mathematica De mundo eiusque praecipuis partibus*, Szczecin [1613], f. A2^{v}, th. 20: 'Sunt Planetae numero 7 hunc ordinem post stellas fixas servantes, videlicet: 1. Saturnus, 2. Jupiter, 3. Mars, qui superiores dicuntur, 4. Sol, qui dicitur medius, 5. Venus, 6. Mercurius, 7. Luna qui inferiores nuncupantur.'

28 Ibid., f. B2^{v}-B3^{r}, th. 106.

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Trias Quaestionum Physico-Mathematicarum (Szczecin, 1622). The three issues he disputed were, first, the origin of comets, second, terrestrial motion, and third, the water cycle. Concerning the issue *de Terrae motu*, Cramer remarks that this is a very controversial topic and that both his father and Brahe reject terrestrial motion:

> This time, I will discuss only this form of change; I [will] not [consider] its various affections but only this one, namely terrestrial motion. But, you might ask, why motion? And not rather rest? Does not everybody who considers this theory of terrestrial motion regard it as monstrous? This was also Tycho's opinion, which my father shares, and this was the main reason that led him to construct those new hypotheses of his. I know all this very well and will consider this issue as conjectural [*tanquam ex tripode*].[29]

Indeed, Cramer Junior does not depart from geocentrism. He repeats the classic arguments against the eccentric location of the Earth and directs them explicitly against Copernicus and Kepler.[30] However, he does undertake the task of demonstrating the possibility of the axial rotation of the Earth. In this manner, Cramer Junior embraces the geokinetic theory of Brahe's adversary, Ursus, which meanwhile had been supported by many Tychonians, such as Longomontanus, and before him by David Origanus, professor of mathematics at Frankfurt on Oder.[31] Cramer Junior's disputation is comprised of a long list of arguments in favour of the axial rotation of the Earth. Among them, one finds the so-called "Achilles argument" according to which it is easier to ascribe daily rotation to a relatively small body such as the Earth rather than to the huge body of the sphere of the fixed stars.[32] Metaphysical arguments are brought up as well. One reads that because rest is nobler than motion, the higher dignity of the heavens requires them not to move. As a consequence, the Earth must produce daily rotation around the poles of the world.[33] Another argument in favour of terrestrial motion is derived from William Gilbert's magnetic theory considering the Earth to be a huge and mobile magnet.[34]

29 Daniel Cramer Junior, *Trias quaestionum physico-mathematicarum*, Szczecin 1622, f. C1r, th. 4: 'Terrae ergo haec vice solum inhaerentes, non de variis eius affectionibus disceptabimus, sed de unica duntaxat, videlicet de Terrae motu. Sed, inquies, quid de motu? Cur non potius de quiete? Non sententiam hanc de Terrae motu cuilibet statim audienti esse monstrosam et ipsa Tycho Dn Parenti meo coram fassus est, et ob id maxime commotum fuisse, novas et coelestes suas hypotheses extruere. Scio haec probe, et tanquam ex tripode prolata teneo.'

30 Ibid., f. C1v: '1.

31 Ibid., ff. C1v-C2r. On Origanus' astronomy, see my paper "David Origanus's Planetary System (1599 and 1609)", in: *Journal for the History of Astronomy* 42/4 (2011), pp. 439–454.

32 Ibid., f. C2r.

33 Ibid.

34 Ibid., f. C3v. The success of Gilbert's *De magnete* (1600) in Szczecin is witnessed by the appearance of a new edition there, in 1628. This Pomeranian edition was a remedy against

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Additionally, Cramer Junior discusses the Aristotelian criticism of terrestrial motion based on the observation of the vertical fall of heavy bodies. Natural philosophers regarded this as incompatible with the thesis of a ground shifting due to terrestrial motion. According to Aristotle's theory of natural places, heavy bodies strive toward the gravitational centre as to their natural place; this point of convergence of falling bodies was considered to be identical with the cosmological centre. Cramer Junior criticises this view by resorting to another Aristotelian principle: 'Natural motion is eternal.' He observes that rectilinear motion cannot be natural, since it is not eternal but ends as soon as an element reaches its natural place. Only circular motion never ends. Hence he concludes that terrestrial rotation is natural.[35]

Cramer Senior introduced geo-heliocentrism to Szczecin; Cramer Junior the theory of the axial rotation in a geo-heliocentric framework. In 1644, the Szczecin physician Laurentius Eichstadius still adhered to these hypotheses in his astronomical tables which, according to his intentions, were in agreement with Brahe's observations and adhered to his hypotheses. Eichstadius attempted to reach a synthesis between Kepler's *Rudolphine Tables* (1627) and Longomontanus's *Astronomia Danica*, as one apprehends from the annotations, digressions and explanations accompanying his tables.[36] Only twenty years later does one find a disputation defending Copernican heliocentrism. Its author was a Swedish nbleman, Benjamin von Schröer. In spite of what the title suggests, his *De quotidiana telluris revolutione Exercitatio Astronomica* (1664) was not limited to a discussion of the axial rotation of the Earth. Rather, von Schröer defended the Copernican theory:

> Among the most recent [scholars], the Dane Longomontanus, a worthy astronomer, asserted that the Earth always remains in its lowest location and does not admit any other motion but the one producing days and nights. Tycho Brahe, the noble Dane and a new Hipparchus, posited planetary theories [*sphaerae*] as follows [...].

After a description of the Tychonic system, von Schröer concludes that

> [Brahe's] hypothesis is not new. It is just an inversion of Ptolemy's and Copernicus'. One can find out in Gassendi [...] what the system of the

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the rarity of this worthy book, as the editor – a certain Wolfgang Lochman – explains in the preface. William Gilbert, *Tractatus sive Physiologia nova de magnete magneticisque corporibus et magno magnete tellure Sex libris comprehensus* [...] *Omnia nunc diligenter recognita et emendatius quam ante in luncem edita, aucta et figuris illustrata opera et studio Wolfgangi Lochmans / I.U.D. et Mathemati[co]*, Szczecin 1628, *praefatio*.

35 Cramer Junior, *Trias quaestionum*, f. D1^{v}-D2^{r}.

36 Laurentius Eichstadius, *Tabulae harmonicae coelestium motuum tum primorum, tum secundorum, seu doctrinae sphaericae et theoriae planetarum. Innitentes potissimum exactissimis observationibus et hypothesibus Nobilissimi Tychonis Brahei, solertissimi Astronomiae instauratoris*, Szczecin 1644, f.):(2v.

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> world that Tycho Brahe brought forward looks like, and what the reasons for his invention are and for the credit accorded to it by his followers up to the present day – essentially his condemnation of Copernicus' terrestrial mobility as contrary to the Sacred Scriptures, as he believed. See also Kepler's *Epitome of Copernican Astronomy*, which abundantly demonstrates that the coherence of Tycho's worldly system is extremely fragile and implies many errors.[37]

Von Schröer's defense of Copernicus repeats standard arguments developed in the cosmological debates of the sixteenth century. Its most striking aspect is the author's literal adherence to the theory of *De revolutionibus orbium coelestium*. Von Schröer does not take into account the developments of planetary theory and celestial physics after Copernicus. For instance, he follows Copernicus' bizarre attribution to the Earth of a threefold motion. In addition to the daily and the annual motion, von Schröer accepts the *third* Copernican motion, the *motus declinationis* deputed to maintain the inclination of the terrestrial axis and to produce the precession of the equinoxes and its alleged irregularities. The most illustrious supporters of heliocentrism had already criticised and abandoned this special motion in the 1580s! Moreover, von Schröer does not take into account the recent developments in celestial physics, such as the elliptical path of the celestial orbits presented by Kepler in the first decade of the seventeenth century. This fact makes him appear as a "pure Copernican". In other words, in his disputation, he substitutes geocentrism for heliocentrism, but he does not dismiss the *axioma astronomicum* of the Reinholdian school, according to which planetary motions are circular or composed of circular motions.

The case of Szczecin shows how gradual the transformations of astronomy and planetary theory in university teaching were. Publications linked to the School of Szczecin permit us to reconstruct step by step the slow transformation of planetary theory from Aristotelian and Ptolemaic geocentrism to a Tychonic geo-heliocentric and geostatic system, the geo-heliocentric and geokinetic system *à la* Ursus and pre-Keplerian heliocentrism. In this context, Cramer's *Isagoge in metaphysicam* permits us to assess the institutional metaphysics of astronomy underlying the work of seventeenth-century Baltic Tychonians. Von Schröer's

37 Benjamin von Schröer, *De quotidiana telluris revolutione Exercitatio Astronomica*, [Szczecin] 1664, ff. C3^{r-v}: 'Ex Recentioribus *Longomontanus Danus*, nec ignobilis Astronomus, statuit: Terram suo loco infimo fixam manere, nec ullum alium motum admittere praeter illum, quo dies noctesque dirimantur. Tycho Brahe, Nobilis Danus, novusque Hipparchus, ita collocat sphaeras […].' And: 'Quae hypothesis [Tychonis] non est nova, sed inversa saltem Ptolemaica et Copernicana. Quale autem sit Mundi systema, quod Tycho Brahaeus induxit, et quibus rationibus illud excogitarit, nempe Copernico Terrae mobilitatem improbans, tanquam Sacris Literis suo opinatu adversantem, et ab ejus sectatoribus hactenus propugnatum, legas apud Gassendum […]. Item Keplerum in Epit. Astron. Copernicanae […] ubi pluribus demonstrat, integrum systemam mundanum Tychonis maxime veluti luxari, et multos prodere errores.'

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Copernican disputation marked the passage to Copernican hypotheses seventy years after the first apparition of Cramer's *Isagoge*.

The Conservative Phase: Cartesio-Copernicanism Philosophical Foundations of Astronomy in the Cultural Transfer from the Netherlands to Middle Europe (ca. 1650–ca. 1680)

Beginning in the 1590s, Brahe's prestige led to the consolidation of his system as a standard view in German and Baltic academic centres. A period of consolidation began in which little variation to Brahe's cosmology was allowed even to students defending astronomical disputations. Kepler's theory of forces and celestial physics was not welcomed by the followers of Brahe and the Wittenberg tradition, who sought the foundations of astronomy in metaphysics rather than in physics. No wonder that this environment also reacted very negatively to attempts to introduce Cartesian natural philosophy and connect it with Copernican issues.[38] I will illustrate this conservative continuation of the Melanchthonian tradition by considering anti-Cartesian polemics that erupted at Frankfurt on Oder in the 1650s when the mathematician Johannes Placentinus started teaching Descartes' natural and cosmological views.[39]

Placentinus was appointed *professor ordinarius* of mathematics at Frankfurt in 1653. He came from Leszno, Poland, where he probably attended the local gymnasium, reformed according to the pedagogical principles of Johannes Comenius. As a wandering student, he frequented Baltic, German and Dutch gymnasia and universities: Gdańsk (1648), Königsberg (1649), Groningen (1651), Leiden (1652) and Heidelberg (1653).[40] At Groningen, the Greek and history professor Tobias Andreae and the theologian Samuel des Marets introduced him to Cartesian philosophy; at Leiden, he studied under the supervision of the theologian Abraham van der Heyden and the philosopher Johannes de Raey.[41] The latter was particularly committed to merging Cartesian philosophy and the

38 Insightful remarks about the curricular challenges and difficulties of embedding the humanism of the new philosophy in early modern universities can be found in Peter Burke, *A Social History of Knowledge. From Gutenberg to Diderot*, Cambridge 2008, pp. 35–44.

39 I mainly base my reconstructions on documents preserved in the *Brandenburgisches Landeshauptarchiv* in Potsdam (hereafter referred to as BLHA) as 'Acta betreffend Placentini', sign. Rep. 86 Universität Frankfurt an der Oder, Nr. 45, and in Berlin GStA PK (*Geheimes Staatsarchiv Preußischer Kulturbesitz*, hereafter GStA PK) as 'Acta des Königl. Geheimen Staats-Archivs betreffend der Philosophorum [zu Frankfurt a. O.] Irrungen unter sich (1655–1659)', sign. I HA Rep.51, Universität Frankfurt/Oder, Nr. 94.

40 Cf. Ludwik Chmaj, "Jan Placentinus-Kołaczek. Nieznany Kartezjanin XVII wieku", in: *Archiwum historii filozofii i myśli społecznej* 1 (1957), pp. 71–81 and Pietro D. Omodeo, "Central European Polemics over Descartes. Johannes Placentinus and His Academic Opponents at Frankfurt on Oder (1653–1656)", in: *History of Universities* 2 (2015) (in press).

41 Johannes Placentinus, *Renatus Des-Cartes Triumphans, id est, Principia Philosophiae Cartesianae in Alma Viadrina ventilata atque defensa*, Frankfurt/Oder 1655, unnumbered folio but f. 3^r ab incipit.

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Scholastic tradition. In 1654, de Raey published the syncretistic *Clavis philosophiae naturalis, seu introductio ad naturae contemplationem Aristotelico-Cartesiana* (1654), in which he reads Aristotelian theses through a Cartesian lens.[42] His effort was not isolated; in the 1650s there were other attempts to bring together the new philosophy and the academic tradition. The Duisburg professor Johannes Clauberg wrote on the reconcilability of Cartesian reason and Reformed faith in publications such as *De cognitione Dei et nostri, quatenus naturali rationis lumine, secundum veram philosophiam, potest comparari, exercitationes centum* (1656). Another aspect of this early Scholastic reception of Descartes was the Cartesian revision of Copernican astronomy, which I would label "Cartesio-Copernicanism". In 1652, Christopher Wittich defended in Duisburg a disputation entitled *[Dissertatio] altera [quae] dispositionem et ordinem totius universi et principalium ejus corporum tradit, sententiamque nobilissimi Cartesii, de vera quiete et vero motu terrae defendit* (1652), in which he presents Descartes' natural philosophy as the foundation of the Copernican system.[43] Similarly, Daniel Lipstorp of Lübeck promoted Cartesian philosophy in connection with the Copernican system. In 1653, he printed a small tract entitled *Copernicus redivivus* in Leiden. It was a Copernican apology reworking a series of theses that Lipstorp had disputed one year earlier at Rostock. One decisive argument for the reconciliation of terrestrial motion and Biblical exegesis it presents is the Cartesian idea of the mobile immobility of the Earth. According to this perspective, our globe is at rest *in itself* while celestial vortices transport it around the Sun.[44]

Placentinus was well acquainted with the philosophical debates going on in the Netherlands and in the main centres of the German reception of Descartes. However, as professor he was not expected to disseminate new philosophical and scientific ideas. At the moment of his appointment at Frankfurt, his colleagues made it clear to him that students should not be exposed to novel theories. As one reads in the documents,

> He [Placentinus] should abandon all opinions differing from the genre of philosophy that is accepted in our [university]. In the case that he adheres to some new doctrines, he should keep them to himself and renounce disseminating them among the students.[45]

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42 Cf. Roger Ariew, *Descartes among the Scholastics*, Leiden/Boston 2011, pp. 146–150. Cf. Roger Ariew and Marjorie Grene, "The Cartesian Destiny of Form and Matter", in: *Early Science and Medicine* 2/3 (1997), pp. 321–322.

43 See Rienk Vermij, *The Calvinist Copernicans. The Reception of the New Astronomy in the Dutch Republic, 1575–1750*, Amsterdam 2002, pp. 146–148.

44 Ibid., pp. 142–146. Cf. Siegmund Günther, "Lipstorp, Daniel", in: *Allgemeine Deutsche Biographie* 18 (1883), p. 746.

45 GStA PK, I HA Rep.51, Universität Frankfurt Oder, Nr. 94, *Acta des Königl. Geheimen Staats-Archivs betreffend der Philosophorum [zu Frankfurt a. O.] Irrungen unter sich (1655–1659)*, f. 56v: 'Daß er alle frembde, ungewöhnliche, und vom Philosophandi genere apud nos recepto

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Despite this admonishment, as soon as he was appointed, Placentinus engaged in a series of natural and cosmological disputations and publications in which he presented scientific and philosophical doctrines at odds with traditional Aristotelianism. He tackled issues such as sunspots and cometary theory in his *Observatio Eclipseos Solaris peracta in Alma Viadrina* (1654). In the same year, he defended heliocentrism and offered new insights on tidal theory in some *Theses mathematico-physicae de Terra* and in a *Dissertatio, Fluxum et Refluxum Oceani, demonstrans*. Further publications on terrestrial motion appeared in the subsequent years: among them, a *Discussio mathematica erotematis, An Terra moveatur?* (1655), and a *Dissertatio, delationem Terrae annuam, et circumgyrationem diurnam circa proprium centrum* (s.d.).[46] Following Lipstorp, Placentinus distinguished between *motus localis* (local motion) and *delatio* (shift), to argue that the Earth does not move due to local motion while fluid celestial matter transports it around the Sun and twists it about its axis. His conception of the Earth by analogy with a small object such as a straw transported by the current of a river was derived from Descartes' *fable cosmogonique* about the 'mobile immobility' of the Earth. The original intention of the analogy was to remove the heliocentric system from the censure of theologians appealing to biblical literalism; it is possible that Placentinus, too, wanted to avoid theological criticism.

In 1655, Placentinus organised a series of disputations, one per week for ten weeks, in which ten students discussed all aspects of Descartes' *Principia philosophiae*. The themes were grouped into four sections: epistemology, the theory of matter, cosmology in general and the Earth in particular. Placentinus allotted particular importance to cosmology (three disputations out of ten) and to the study of the Earth as a planet and as the place of observable elemental phenomena (five disputations). The disputations were privately discussed in the circle of his pupils; nonetheless, they elicited vehement reactions on the part of his colleagues.

Placentinus' main opponents were the professor of Greek Georg Mellman, the logician Johannes Waltherus Lesle, the natural philosopher Philipp Beckmann and the theologian Friedrich Beckmann. They invited him several times to abandon his endeavour and to stick to the academic tradition prescribed by the statutes. As one reads in a denunciation sent to the Brandenburg chancellor Thomas von Knesebeck on 26 January 1655,

> Before and after such disputes we warned him both in a friendly and in a severe manner that he should fully conform to the pacts, to his oath of

abweichende opiniones fahren laßen solte. Hette er etliche newe opiniones, so solte Er dieseleben für sich behalten, mit nichten aber unter die studiosos proseminiren.'

46 The *Dissertatio* is printed as an appendix to Johannes Placentinus, *Vier Nachdenkliche Fragen und* Instantien *aus denen* Physical*ischen und* Astronom*ischen Wissenschaften genommen*, Frankfurt/Oder 1659.

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> obedience; we reminded him [that he should follow] the statutes and the princely admonitions, and invited him to abandon his endeavor.[47]

The denunciation concerned the most scandalous among Placentinus' views. Some of them were strictly Copernican, e.g., the thesis that the Earth is a planet ('daß die Erde ein Planet sey'), and that it is one of the wandering stars ('daß sie ihres situm inter stellas erraticas habe'). Other theses derived from Descartes' *Principia*, especially those concerning matter as *res extensa* as well as the vortex theory explaining the origin of the Earth and its planetary revolutions around the Sun.

In late 1654, Placentinus' enemies censured the publication of one of his works dealing with terrestrial motion. Their version of the facts is as follows:

> When he apprehended that the professor of physics had brought a disputation, *On the World*, to the printing shop, he read it there and, full of anger, quickly delivered his disputation *On the Shift of the Earth* to the printing shop, only one day later. It entailed not only the aforementioned novel theories but also insults. Therefore, when the Magnificent Rector was informed of this issue, he decreed that such a disputation should be given to our dean in order to be censured.[48]

After his adversaries interrupted the printing of his disputation *De delatione Terrae* (13 November 1654), Placentinus wrote a letter of protest (23 November) to Friedrich Wilhelm, Elector of Brandenburg asking for his intervention. He accused the rector of attacking him for personal reasons. The latter had removed the manuscript from the typesetter and gave it to Lesle for censure. Not satisfied with this, he had posted the title of the disputation at the entrance door of the Church and tore it apart during mass. Placentinus writes:

> I, as a subject, cannot hide from Y[our] P[rincely] S[erenity] that, while I defended and circulated the mathematical truth according to my conscience and to all the writings of my predecessors, I have been harshly persecuted by some academic members in an excessive manner, and I have been troubled in my office. In particular, D[r] Beckmann, magni-

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47 GStA PK, I HA Rep.51, Universität Frankfurt/Oder, Nr. 94, *Acta des Königl. Geheimen Staats-Archivs betreffend der Philosophorum [zu Frankfurt a. O.] Irrungen unter sich (1655–1659)*, f. 57v-58r: 'Vor vndt nach solcher Disputationis intimation haben wir ihn zum oftern freundlich, auch ernstlich, vermahnet, ihn seines pacti, iuramenti de obedientia der statuten vndt des Churfl. rescripti, das er sich in allen den statutis Academia et Facultatis conformiren solte, erinnert, vnt begehret, das er von seinem proposito abfahren wollte.'

48 Ibid., f. 59*r*: 'Als Er vernommen, daß *Professor Physices* eine *disputationem de Mundo* in die druckerrey gegeben, hat Er sie daselbst durch gelesen, und eylendes den andern tag drauf seine *disputation de Delatione Terrae* zum verdruß, in der druckerey gebracht: darin nicht allein vorbesagte *novitates*, sondern auch stachelworte gefunden worden, so gar, daß auch der herr Magnificus [Rector], nach dem es Ihm zu ohren gebracht, solche *disputation* der Censur Unsers *Decani* zu vbergeben rathsam erachtet.'

ISBN Print: 9783447104982 — ISBN E-Book: 9783447194143

> ficent Rector *pro tempore* removed my disputation *On the Motion of the Earth* from the typesetter, against the consensus of his colleagues and without informing me in advance, and handed it to the dean of the Philosophical Faculty, M[aster] Lesle, for censure, against the consuetude and the statutes. Moreover, he posted its title page at the entrance of the church and tore it apart during mass to the great disappointment of the students and other people.[49]

According to Placentinus' report, rector Beckmann went so far as to threaten the printer with corporal punishment if he completed the publication of the censured disputation.[50]

On 24 March 1656, the anti-Cartesian philosophers wrote a long accusation of Placentinus, whose main allegation was that he infringed upon disciplinary boundaries and teaching matters not pertinent to his chair of mathematics.

> For the precious oath that we swore on the statutes and our conscience, we cannot accept the election of a man as dean who so wantonly insists on innovating everything; who [moves] from mathematics, [a discipline] that requires a man's complete and exclusive dedication, to logic and physics, thereby invading the fields of other professors; who disrespects so much the Elector's order [*rescript*] from Berlin [forcing him] to undergo censure; who confuses the students with unusual and obscure dogmas that fill the ears and not the intellect (so that the Academy falls into poor repute); and who should not become dean and 'teach the old masters their art' ['correct Greek and Latin verses and orations']. [We cannot accept] that he swears the dean's oath, [swearing] that he will uphold the statutes and will guarantee their respect by everybody (something that he cannot do according to his principles, fundaments and hypotheses).[51]

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49 GStA Rep.51, Nr. 94, f. 64*r*: 'Und kan E[urer] Churf[ürsltichen] D[urchlauchten] in aller Unterthänigkeit nicht bergen, daß in dem ich *veritatem Mathematicam*, so ich in meinem gewißen und meiner *Antecessorum scriptis* allhier befunden, *defendiren*, und *propagiren* wollen, von einem und dem anderen *membro Academico* zur Ungebur hesslig verwolget und in meinem Ampt *turbi*ert worde, und hatt absonderlich Herr D. Becmannus p.t. Magnificus Rector, vor 14. Tagen nicht allein meine *disputation de motu terrae*, *citra consensum suorum Collegarum*, und ohne einige mir zuvorgethanen errinnerung, auß der druckerey weggenommen, und dieselbe dem *Decano Facult. Phil. M. Lesle* zu *censuriren*, *contra consuetudinem et Statuta* ubergeben, sondern auch dem angeschlagenen titul derselben von der Kirchenthür, nicht ohne großem ergerniß der studierenden Jugend, und anderer leute, in der Meße abreisen laßen.'

50 Ibid., f. 64r.

51 Ibid., ff. 13r-v: 'Unser Thewrer in die *statuta* geschworner Eyd und gewißen, wollen es dergestalt ja nicht leiden, daß wir einen Menschen, der so Muttwillig alles zu innoviren sich erkühnet; *post habita Mathesi, quae totum hominem requirit*, in die *Logicam* und *Physicam* anderen *Professoren* eingerumpelt: so viel Churfürstlichen *rescriptis* von Berlin, der *Censur* sich zu untergeben, refrangiret; die Jugend mit ungewöhnlichen finsterseltzamen *dogma-*

ISBN Print: 9783447104982 — ISBN E-Book: 9783447194143

In the midst of the polemics, Placentinus appealed to the case of David Origanus as a precedent. Origanus had been a reputed professor of mathematics and cosmological innovator at Frankfurt. As noted above, Origanus was a Melanchthonian astronomer and a supporter of geo-heliocentrism and of the axial rotation of the Earth. Still, he was no philosophical reformer, nor was he willing to question the philosophical foundations of the astronomical tradition he belonged to. Placentinus' opponents were ready to point out Origanus' commited stance against anti-Aristotelian *novatores* such as the Calvinist philosopher Pierre de la Ramée and his followers. In their eyes, Placentinus repeated and aggravated the philosophical heresy of the Ramists. The denunciators suggested that the Elector treat the Cartesians in the same manner as the Ramists. This comparison was designed to suppress Placentinus' programme by referring to previous controversies and the ban on de la Ramée's philosophy from several German universities including Frankfurt on Oder.[52]

The main disagreement with Placentinus was philosophical, as his scorn for Aristotle was seen as incompatible with the university's mission. As his opponents wrote: '[...] We always directed ourselves according to the statutes that we swore, and we never desired anything but the respect of what they literally say, that is: *None shall recede from the philosophy that has been transmitted to us*; and: *We will defend the consent on the Peripatetic doctrine*.'[53]

Adherence to the Peripatetic doctrine was *the* criterion of inclusion in the Philosophical Faculty, following the motto 'Universities will exist as long as Aristotle is taught in the classes.'[54]

The quarrel could not be settled by internal institutional mechanisms. The intervention and arbitrage of the duke became necessary. Friedrich Wilhelm eventually intervened but his settlement of the controversy was contrary to the expectations of the most traditionalist professors. Not only did he declare his support for Placentinus, his independence and *libertas docendi*, but he also appointed him court mathematician. This promotion, in 1656, marked Placentinus' legitimisation among his colleagues. On the title page of his next publication, he emphasised his new status: 'Johannes Placentinus, Mathematicus Electoralis Brand. et Prof. Ordin., p[ro] t[empore] Amplis. Facult. Decanus'

tibus, aures, non intellectum implentibus (darüber die *Academia* in bösen ruff bey den exteris gerahten) beirret; zum *Decanat, corrigendis Graecis et Latinis carminibus et orationibus* nicht geschickt ist p. zum *Decano* erwehlen, oder Ihme das *Juramentum Decani*, daß er die *Statuta* halten, auch verschaffen sol, daß sie von allen gehalten werden (welches er, *secundum principia, instituta, et hypotheses suas* auch nicht halten kan) auferlegen.'

52 Ibid., f. 12v. On Ramist controversies in Germany, see Howard Hotson, *Commonplace Learning. Ramism and Its German Ramifications 1543–1630*, Oxford 2007 and Riccardo Pozzo, *Adversus Ramistas. Kontroversen über die Natur der Logik am Ende der Renaissance*, Basel 2012.

53 Ibid., f. 10r-v: 'Wir haben unß iederzeit nach Unseren beschwornen *Statutis* gerichtet, und nichts anders, alß was die in munde führen, begehret, nemblich: *Nemo a recepto apud nos philosophandi genere recedat. Item: Tueamur consensum doctrinae Peripateticae*.'

54 Ibid., f. 13r: 'Tamdiu durabunt Academiae, quamdiu Aristoteles audetur in Cathedris.'

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(Johannes Placentinus, Mathematician of the Elector of Brandenburg and Ordinary Professor, Presently Illustrious Faculty Dean). These titles were listed on a disputation in which Placentinus, following his Cartesian teachers, proposed a syncretistic interpretation of Aristotle and Descartes, *Syncretismus philosophicus inter Renatus Des-Cartes et Aristotelem institutus*.

After the polemics and his rise to faculty dean and court mathematician, ten years of intense intellectual and cultural activity followed for Placentinus. Regrettably, his career ended in a tragic manner. In 1666, he was declared insane and, as a consequence, enchained and committed to house arrest. This meant not only the end of his academic career, but also of his individual freedom. His wife and daughters were also taken away from him. The details of these events and the reasons for these extreme measures against Placentinus are still obscure. Hopefully, I will be able to reconstruct them through further archival research. I am especially interested in the connection between his marginalisation and conviction on the one hand and his Cartesian polemics on the other.[55]

I should remark that the tragic end of Placentinus' career did not hinder the continuation of Cartesian scholarship at Frankfurt. However, this did not take place at the Philosophical Faculty but rather at the Faculty of Medicine. In this context, cosmological issues became less relevant, whereas medical Cartesianism, especially problems pertaining to physiology and to the mind-body relation, were animatedly discussed within the framework of the new mechanistic conceptions. The Cartesian physician Tobias Andreae was appointed in 1674 and, under his supervision, a series of medical disputations took place on controversial issues such as the treatment of mental illness and the healing of the body through the mind.[56] These developments seem to parallel those occurring in other parts of Europe in the same years, which reveal '[…] two large phenomena in seventeenth-century Cartesianism, first the widespread criticism and condemnation of Cartesian physics and second the multiplication of more empirical Cartesianism. There is surely a relationship between these two movements.'[57] Placentinus' failure to consolidate the teaching of Cartesian natural philosophy and Cartesio-Copernicanism at the Philosophical Faculty was due to

55 The most important documents have already been summarised in a recent publication by Andrea Lehmann, "'Nun ist wohl keiner bey dieser Stadt, so den traurigen Zustandt gedachten Placentini nicht von Herzen solte Beklagen.' Tragisches Ende der Karriere des Mathematikprofessors Johannes Placentini", in: *Jahresbericht/Forschungsstelle für Vergleichende Universitätsgeschichte (Frankfurt/Oder)* 6 (2011), pp. 40–56. Still, the connection between these later facts and the earlier polemics has not yet been studied.

56 Cf. Tobias Andreae, *Dissertatio philosophico-medica de homine microcosmo*, Duisburg 1665 and the trilogy of exercitations *De conjugio mentis et corporis*, *De cura mentis per corpus* and *De cura corporis per mentem*, Frankfurt/Oder 1679. On Andreae's activity as a Cartesian professor of medicine in Duisburg, cf. Francesco Trevisani, Descartes in Germania. *La ricezione del cartesianesimo nella Facoltà filosofica e medica di Duisburg (1652–1703)*, Milan 1992, chap. 3.

57 Roger Ariew, "Censorship, Condemnations, and the Spread of Cartesianism", in: *Cartesian Empiricism*, eds. Mihnea Dobre and Tammy Nyden, Dordrecht 2013, pp. 25–46, here p. 25.

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the strenuous resistance of scholars who considered these innovations to be incompatible with the academic tradition. It seems that medical Cartesianism was easier to accept. However, medical followers of Descartes did not pass up any opportunity of criticising their colleagues at the Philosophical Faculty.

Significantly, the medical disputation *De conjugio mentis et corporis* (1679) promoted by Andreae and defended by the Alsatian student Clemens Joseph Brecht began with a criticism of the 'philosophers' for their ill-founded speculations:

> Although the ancients and also some of the most recent philosophers talk in a profuse and elegant manner about the cognition of ourselves in ethics and politics, so that those who are not enough versed in the contemplation of their selves mistake some appearance for a palace; if one investigates what are the foundations upon which this is erected, one will remark that these look rather like sand than like rock.[58]

This criticism might be interpreted as an attack against those scholars of the Philosophical Faculty who had opposed Placentinus' natural and cosmological innovations.

Concluding Remarks

In this essay I considered the interactions between cosmology and Protestant Scholasticism from the mid-sixteenth century to the mid-seventeenth, with a particular focus on institutions and knowledge transfer within the Melanchthonian network of universities and gymnasia in northern Europe. The Wittenberg network of reformed universities was the site of the earliest reception and adaptation of Copernicus' theory. In order to assimilate the results of *De revolutionibus* to physical and theological requirements – especially the notion of the centrality and immobility of the Earth – a process of hybridisation between Copernicus and Ptolemy was initiated, which eventually led to geo-heliocentric cosmologies. As I argue above, the iterated teaching of planetary theory in a typical Melanchthonian gymnasium (the *Paedagogium illustre* of Szczecin in the early seventeenth century) crystallised around a set of assumptions including geo-heliocentrism and the so-called astronomical axiom concerning the circular uniformity of planetary motions. These assumptions made novel astronomy suit a late-scholastic metaphysical framework but also hindered the reception of innovations such as Kepler's elliptic orbits, which were seen as infringing upon the beauty of heavenly perfection. In the second half of the seventeenth century, the

58 Clemens Joseph Brecht (subjiciet) sub presidio Tobiae Andreae, *De conjugio mentis et corporis*, [Frankfurt/Oder] 1679, f. A1^r: 'Hinc est quod licet Veteres et quidam recentiores Philosophi, in Ethicis and Politicis ex nostri ipsius Cognitione tam speciose multa afferant, ut primo aspectu illis, qui in contemplatione sui ipsius non satis versati sunt, nescio quod non palatium referant; attamen si in fundamenta quibus id super structum est inquiras, illa potius arena, suam saxum referre deprehendes.'

ISBN Print: 9783447104982 — ISBN E-Book: 9783447194143

established tradition of Protestant Scholasticism had to resist the incursions of natural philosophers adhering to Cartesianism and eventually to find a compromise. I illustrated this phenomenon with the example of the introduction of Cartesio-Copernicanism in Frankfurt on Oder in the 1650s.

In my reconstruction, I brought into focus the mechanisms of assimilation, transformation and the establishment of novel cosmological and natural doctrines (namely Copernican planetary models, geo-heliocentricism and Cartesio-Copernicanism) in well-established academic curricula and cultural traditions. These were marked by specific practices of teaching and of knowledge dissemination, by customary forms of recruiting professors and by disciplinary separations linked to the hierarchy of the faculties (e.g., the subordination of the professors at the Faculty of Philosophy to those of Medicine or Theology), as well as by the constant reference to a codified corpus of canonical texts (and textbooks) prescribed in the statutes. In the wake of Melanchthon, Aristotelianism was allotted a central function in the organisation of knowledge, scientific production and teaching at German protestant universities. This reliance did not imply the crystallisation of cosmological and natural conceptions in the form of an immutable body of doctrines, nor did it imply a strict adherence to the letter of a small set of canonic authors and works. Conflicts between innovators and traditionalists often led to negotiations and intellectual convergence between novel and old doctrines. This was the case with the geocentric assimilation of Copernican astronomy that was fostered by Melanchthon in Wittenberg and by his collaborators and followers, beginning with Reinhold, the professor of mathematics, and continuing with his pupils all over Germany and protestant northern Europe. This was also the case with later German scholars courting controversy by quarrelling over the legitimacy of Descartes' approach to nature and astronomy and the absorption of Cartesian philosophy as a basis for natural and cosmological theorisations in the form of what has been evocatively called *cartesianische Scholastik*, a fusion of Cartesianism with scholastic philosophy. These remarks on the reception of Copernicus and Descartes point to the syncretistic productivity of the transfer and integration of natural knowledge. This is especially evident in the establishment in Baltic northern Europe of an astronomical school supporting geo-heliocentrism as the most viable intersection between Copernicanism and geocentrism at the end of the sixteenth century and in the early seventeenth century. Scholars such as the Danish astronomer Longomontanus at Copenhagen continued the work of Brahe and raised metaphysical objections to Kepler's celestial physics. This criticism was continued in Szczecin: it rested on late Scholastic premises, such as the distinction between mathematics and physics and between a physical and a metaphysical treatment of celestial harmonies. During the seventeenth century, the premises upon which these scholars worked were undermined by attempts to physicalise mathematics and by an incipient celestial physics bringing together causal explanations and geometrical modelling of heavenly phenomena. In this phase, that of the decline

ISBN Print: 9783447104982 — ISBN E-Book: 9783447194143

of the protestant Aristotelian tradition, loyalty to tradition played a conservative role in the controversies over Cartesian philosophy in Germany just as it did in the Netherlands. The outcome was a Scholastic reworking of Descartes' philosophy and a Cartesian reworking of Scholasticism, which was the best possible compromise between scientific innovation and institutional requirements.

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ISBN Print: 9783447104982 — ISBN E-Book: 9783447194143