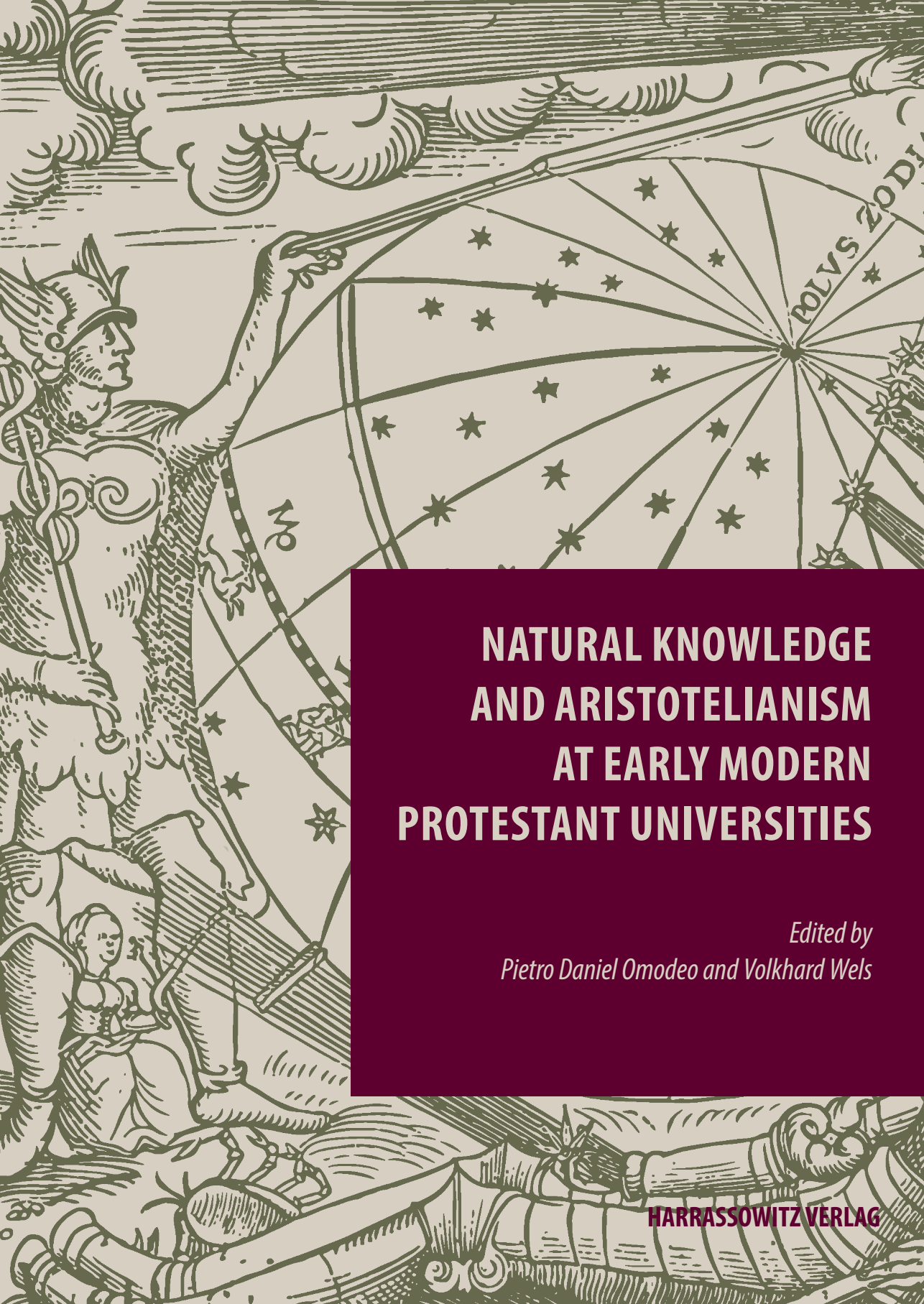

NATURAL KNOWLEDGE AND ARISTOTELIANISM AT EARLY MODERN PROTESTANT UNIVERSITIES

Edited by
Pietro Daniel Omodeo and Volkhard Wels

HARRASSOWITZ VERLAG

Natural Knowledge and Aristotelianism
at Early Modern Protestant Universities

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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“

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Die Reihe „Episteme in Bewegung“ umfasst wissensgeschichtliche Forschungen mit einem systematischen oder historischen Schwerpunkt in der europäischen und nicht-europäischen Vormoderne. Sie fördert transdisziplinäre Beiträge, die sich mit Fragen der Genese und Dynamik von Wissensbeständen befassen, und trägt dadurch zur Etablierung vormoderner Wissensforschung als einer eigenständigen Forschungsperspektive bei.
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Preface

Andrew James Johnston and Gyburg Uhlmann

Since its inception in July 2012, the Collaborative Research Centre (CRC) 980 "Episteme in Motion. Transfer of Knowledge from the Ancient World to the Early Modern Period", based at the Freie Universität Berlin, has been engaging with processes of knowledge change in premodern European and non-European cultures.

The project aims at a fundamentally new approach to the historiography of knowledge in premodern cultures. Modern scholars have frequently described premodern knowledge as static and stable, bound by tradition and highly dependent on authority, and this is a view that was often held within premodern cultures themselves.

More often than not, modern approaches to the history of premodern knowledge have been informed by historiographical notions such as 'rupture' or 'revolution', as well as by concepts of periodization explicitly or implicitly linked to a master narrative of progress.

Frequently, only a limited capacity for epistemic change and, what is more, only a limited ability to reflect on shifts in knowledge were attributed to premodern cultures, just as they were denied most forms of historical consciousness, and especially so with respect to knowledge change. In contrast, the CRC 980 seeks to demonstrate that premodern processes of knowledge change were characterised by constant flux, as well as by constant self-reflexion. These epistemic shifts and reflexions were subject to their very own dynamics, and played out in patterns that were much more complex than traditional accounts of knowledge change would have us believe.

In order to describe and conceptualise these processes of epistemic change, the CRC 980 has developed a notion of 'episteme' which encompasses 'knowledge' as well as 'scholarship' and 'science', defining knowledge as the 'knowledge of something', and thus as knowledge which stakes a claim to validity. Such claims to validity are not necessarily expressed in terms of explicit reflexion, however – rather, they constitute themselves, and are reflected, in particular practices, institutions and modes of representation, as well as in specific aesthetic and performative strategies.

In addition to this, the CRC 980 deploys a specially adapted notion of 'transfer' centred on the re-contextualisation of knowledge. Here, transfer is not understood as a mere movement from A to B, but rather in terms of intricately entangled processes of exchange that stay in motion through iteration even if, at first

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glance, they appear to remain in a state of stasis. In fact, actions ostensibly geared towards the transmission, fixation, canonisation and codification of a certain level of knowledge prove particularly conducive to constant epistemic change.

In collaboration with the publishing house Harrassowitz the CRC has initiated the series "Episteme in Motion. Contributions to a Transdisciplinary History of Knowledge" with a view to showcase the project's research results and to render them accessible to a wider scholarly audience. The volumes published in this series represent the full scope of collaborating academic disciplines, ranging from ancient oriental studies to medieval studies, and from Korean studies to Arabistics. While some of the volumes are the product of interdisciplinary cooperation, other monographs and discipline-specific edited collections document the findings of individual sub-projects.

What all volumes in the series have in common is the fact that they conceive of the history of premodern knowledge as a research area capable of providing insights that are of fundamental interest to scholars of modernity as well.

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Introduction

Pietro Daniel Omodeo and Volkhard Wels

The role of universities in the developments of the scientific culture of early modernity has been the subject of intense scholarly debates and research for several years. New studies have changed the opinion, widespread only fifty years ago, that knowledge institutions were not particularly relevant to the advance of modern science. Such a negative judgement on the history of universities and their culture was connected to the predominant notion of the Scientific Revolution which was seen as an intellectual rupture with all that preceded the mathematization of nature which culminated in Isaac Newton's *Philosophiae naturalis principia mathematica* (1687). Historians of science especially tended to dismiss Aristotelianism and scholasticism. They perhaps believed they could retroactively take a side in old polemics, namely those opposing Galileo Galilei, the 'Copernicans', and the empiricist and mechanical philosophers against the 'bookish' professors. But the resulting narratives often neglected two fundamental aspects of science as a cultural phenomenon: first, the relevance of controversy as a motor of intellectual advance, particularly in the natural sciences, and, second, the relevance of education, especially university formation, as a shared background against which conceptual innovation can be appreciated. Moreover, the canon of disciplines and contexts relevant to the history of science cannot be restricted to a few select sciences—basically the mathematized natural sciences that were cherished by nineteenth-century and early twentieth-century epistemologists in the wake of positivism. But closer scrutiny of the *reality* of early-modern scientific culture forces us to embrace a broader conception of science, one capable of addressing the interdisciplinary entanglements of paradigmatic disciplines such as astronomy and mechanics with astrology, alchemy, natural philosophy, theology, and so forth. The Aristotelian environment of reformed universities and institutions of early modernity offers a suitable area of inquiry into the dialectics of tradition and innovation which characterized a time of scientific transformation. This volume is dedicated to the study of early-modern 'episteme in motion': the evolution of scientific knowledge and its categories within confessional and cultural-political institutional settings.

Studies on the institutional foundations and university embodiments of intellectual history flourish today. The importance of institutions of higher education for early modern science has been at the center of influential works such as those by Charles B. Schmitt on university Aristotelianism during the Italian Renaissance, Mordechai Feingold on the mathematical apprenticeship at English

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institutions, and Antonella Romano and Ugo Baldini on the teaching of science at Jesuit colleges.[1] Specific studies have been devoted to the socio-cultural settings of early-modern universities in Catholic Italy, Protestant Germany, and more broadly in Europe that point to their cultural-political dimensions as well as to the habitus of an academy that passed from a fundamentally oral to a written and ultimately printed culture.[2] The encounters, negotiations, and hybridization of scholarly traditions and novel approaches to nature have been variously treated. Among many possible instances, in this volume we will address Cartesian scholasticism, rhetoric and epistemology in Renaissance Germany, and the Aristotelian metaphysics that guided the developments of post-Copernican astronomy in northern European Protestant centers.[3] Moreover, Edward Grant has helped us to understand the complexity of lasting the transformations of scholastic philosophy, which survived the end of the medieval system of education and became part of the scientific discourse of modernity.[4] Studies on the connections of Protestantism and science have often stressed the cultural and theological background of scientific debates. Among others, Sachiko Kusukawa looked at the concept of providence underlying Melanchthonian scientific culture, whereas Theo Verbeek and Rienk Vermij reconstructed Calvinist theological-philosophical controversies over the introduction of Copernicus and Cartesian philosophy into Dutch reformed universities.[5] Astronomical culture in Protestant environments

1 Charles Schmitt, *Studies in Renaissance Philosophy and Science*, London 1981; Mordechai Feingold, *The Mathematicians' Apprenticeship: Science, Universities and Society in England 1560–1640*, Cambridge 1984; Antonella Romano, *La contre-réforme mathématique: Constitution et diffusion d'une culure mathématique jésuite à la Renaissance*, Rome 1999; Baldini, Ugo, *Saggi sulla cultura della Compagnia di Gesù (secoli XVI–XVIII)*, Padua 2000; also see Marcus Hellyer, *Jesuit Natural Philosophy in Early Modern Germany*, Notre Dame 2005.

2 See Paul F. Grendler, *The Universities of the Italian Renaissance*, Baltimore 2002; William Clark, *Academic Charisma and the Origins of the Research University*, Chicago 2006; and Ku-ming Chang, "From Oral Disputation to Written Text: the Transformation of the Dissertation in Early Modern Europe," in: *History of Universities* 19/2 (2004), pp. 130–187.

3 See, among others, Roger Ariew, *Descartes among the Scholastics*, Leiden 2011; Riccardo Pozzo, *Adversus Ramistas: Kontroversen über die Natur der Logik am Ende der Renaissance*, Basel 2012; Pietro Daniel Omodeo, "Metaphysics Meets Urania: Daniel Cramer and the Foundations of Tychonic Astronomy," in: *Unifying Heaven and Earth: Essays in the History of Early Modern Cosmology*, ed. Miguel A. Granada, Patrick Boner and Dario Tessicini, Barcelona 2016, pp. 159–186.

4 Edward Grant, *Much Ado about Nothing: Theories of Space and Vacuum from the Middle Ages to the Scientific Revolution*, Cambridge 1981 and id., *Planets, Orbs and Spheres: The Medieval Cosmos (1280–1687)*, Cambridge 1994.

5 Sachiko Kusukawa, *The Transformation of Natural Philosophy: The Case of Philip Melanchthon*, Cambridge 1995; Theo Verbeek, *Descartes and the Dutch: Early Reactions to Cartesian Philosophy 1637–1650*, Carbondale 1992; and Rienk Vermij, *The Calvinist Copernicans: The Reception of the New Astronomy in the Dutch Republic, 1575–1750*, Amsterdam 2002. Also, see Johan Arie van Ruler, *The Crisis of Causality: Voetius and Descartes on God, Nature and Change*, Leiden 1995. On the interplay of Protestantism and science, cf. Peter Harrison, *The Bible, Protestantism, and the rise of natural science*, Cambridge 1998; Charlotte Methuen, *Kepler's Tübingen: Stimulus to a*

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has received much attention, including in seminal studies by Robert Westman.[6] However, the inquiry into the contributions to science of smaller religious groups such as the Socinians is still a desideratum in the history of science.

Although accurate studies on early-modern German Protestant universities already exist,[7] there is still much work to be done to clarify their roles in the scientific advances of the seventeenth century. The editors of this volume have already contributed to the study of early university culture in connection with Melanchthon's curricular reforms and their impact and dissemination through the networks of Protestant universities and gymnasia.[8] This volume aims to continue this line of inquiry, substantially integrating existing scholarship on early-modern intellectual history within its institutional settings, and contributing to the overarching, comparative study of epistemic networks.[9]

We specifically deal with forms of the institutionalization of science and the role of Aristotelianism as the backbone of knowledge at early-modern Protestant universities. This was a dynamic tradition, which we regard as a form of 'mobile episteme' in line with the research program of the Collective Research Centre *Episteme in Motion* and the ERC endeavor *EarlyModernCosmology*. The transformation of academic science depended on its circulation through institutional and intellectual connections. Every passage, transfer, and exchange of knowledge implied a reformulation and often deep alteration, even in those cases in which the explicit intention of the historical actors was to preserve and secure a received canon of knowledge such as the *corpus Aristotelicum* or Aristotelian methodologies of inquiry. As a matter of fact, an inter-pollination of 'early' forms of knowledge and 'modern' perspectives produced changes of content, theory, and experience. The fields concerned with major hybridizations and shifts range

Theological Mathematics, Aldershot 1998; and Dino Bellucci *Science de la nature et Réformation: La physique dans l'enseignement de Philippe Mélanchthon*, Rome 1998.

6 Robert S. Westman, "The Melanchthon Circle, Rheticus and the Wittenberg Interpretation of the Copernican Theory," in: *Isis* 66 (1975), pp. 163–193.

7 See, among others, Barbara Bauer, (ed.), *Melanchthon und die Marburger Professoren (1527–1627)*, Marburg 1999; Heinz Kathe, *Die Wittenberger philosophische Fakultät 1502–1817*, Vienna, Cologne, Weimar 2002; Rolf Darge (ed.), *Der Aristotelismus an den europäischen Universitäten der frühen Neuzeit*, Stuttgart 2012.

8 Volkhard Wels, "Melanchthon's Textbooks on Dialectic and Rhetoric as Complementary Parts of a Theory of Argumentation", in: *Scholarly Knowledge. Textbooks in Early Modern Europe*, eds. Emidio Campi, Simone De Angelis, Anja-Silvia Goeing and Anthony T. Grafton, Geneve 2008, pp. 139–156; id., *Manifestationen des Geistes. Frömmigkeit, Spiritualismus und Dichtung in der Frühen Neuzeit*. Göttingen 2014, pp. 89–130; Pietro Daniel Omodeo with Karin Friedrich (eds.), *Duncan Liddel (1561–1613): Networks of Polymathy and the Northern European Renaissance*, Leiden 2016; id., "Institutionalized Metaphysics of Astronomy at Early-Modern Melanchthonian Universities," in: *Iteration und Wissenswandel*, ed. Eva Cancik-Kirschbaum and Anita Traninger, Wiesbaden 2016, pp. 51–78.

9 This topic is presently being investigated by the ERC project "Institutions and Metaphysics of Cosmology in the Epistemic Networks of Seventeenth-Century Europe," at Ca' Foscari University of Venice (Horizon 2020 Research and Innovation Programme, GA n. 725883 *EarlyModernCosmology*).

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from astronomy to astrology, medicine, soul theories, alchemy, physics, and biology. In this process, methodology was reassessed and transformed as well. In this respect, logic, rhetoric, theories of argumentation and epistemology should be regarded as an integral part of the early-modern transformation of *episteme*.

The encounter between Aristotelians and *novatores* who proposed new natural viewpoints should be considered in its ambiguity and complexity. Such encounters could take various forms ranging from adaptation to assimilation, transformation, demarcations, and exclusion. Aristotelian and scholastic philosophy have often been judged as an intellectual dead end, intrinsically flawed by excessive reliance on tradition and written sources instead of curiosity and the exploration of the book of nature with 'unprejudiced eyes'. The historical category of the 'Scientific Revolution' once epitomized the idea of the abrupt emergence of a new science of nature in contrast to preexisting, prejudiced knowledge. The contributions in this volume question the static vision of pre-modern academic culture, despite its reliance on received forms of knowledge. They explore the intricacies of a story in which conflict and negotiation are important elements together with the harmonization and synthesis of eclectic elements. In the sixteenth and seventeenth centuries, Aristotelianism was not a fossilized relic of the past, an unchangeable set of norms and doctrines. Rather, it was a movable philosophy capable of interacting and merging with—and reacting to—impulses coming from many directions, for instance Parcelsism in medicine, Cartesianism in physics and physiology, and Ramism in methodology.

The confessional element of early modern philosophy and science continuously emerges as a significant epistemic drive. In the context of Protestant institutions, Aristotelianism was often connected with 'Philippism', that is to say, Melanchthon's intellectual and pedagogical legacy. The curricular reform that Melanchthon introduced at Wittenberg and spread throughout its institutional network was not restricted to theological faculties. The confessional implementation of a humanistic Lutheran culture with marked Aristotelian bias invested astronomy (Erasmus Reinhold, Kaspar Peucer), physics (Paul Eber), alchemy (Andreas Libavius), and medicine (Daniel Sennert), to mention some of the most relevant fields (and authors). The essays in this volume will address the main figures of this tradition, which was particularly lively in late-humanistic centers such as the universities and gymnasia of Rostock, Helmstedt, Frankfurt (Oder), Copenhagen, Königsberg, Altdorf, and Marburg. Much research is still required to fully clarify the relevance of this intellectual process for the natural science that radiated far beyond German-speaking territories.

In addition, Aristotelian-Melanchthonian natural philosophy can be considered in its more or less intended opposition to competing currents that were marked by different religious tendencies and alliances. Melanchthon's followers confronted philosophical projects (such as Ramism in the sixteenth century and Cartesianism in the seventeenth) that were considered to be tinged with Calvinist bias for contingent historical reasons, namely, their geographical origin. However,

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philosophical currents did not threaten the Philippist hegemony as much as theological ones, for instance the Gnesiolutheran rejection of methodological Aristotelianism for theological reasons during the sixteenth century. At a different level, neo-Platonic and philosophically heterodox tendencies backed anti-academic attitudes. The explosive potential of intellectual divergences clearly emerges from the conflict opposing the Paracelsists, on the one hand, and Thomas Erastus and Andreas Libavius, on the other. In this and many other cases, both sides of the polemic should be taken into consideration in order to comprehend the cultural strategies and scientific policies underlying different scientific programs.

In chapter one, Volkhard Wels explores the link between Melanchthon's logic and rhetoric, which the Philippists saw as the methodological basis for natural investigations, particularly alchemy. Wels particularly deals with the rhetorical definition of a pedagogical genre (*genus didascalicon*), which Melanchthon introduced in 1530 in his *Rhetoric*. The aim of this genre was to secure knowledge and information on specific themes and to present them in a plain and comprehensible manner. Andreas Libavius's 'alchemy' is an illuminating case of the application of such requirements. In following Melanchthon's rhetorico-methodological requirements, Libavius undertook a reformulation of alchemical knowledge, in which the usefulness of Philippist Aristotelianism was magnified through its application to empirical knowledge. Libavius proposed a new codification of alchemy by moving away from the arcane language that was typical of the discipline in the Middle Ages.

According to Günter Frank in the second essay of this collection, the relevance of natural knowledge for Protestant theology was mainly due to Melanchthon's conception of the providence of God, seen as the architect who created the well-ordered *machina mundi* and keeps it in motion. In his conception nature is not only God's creation but also the *genesis* or the 'origin' of worldly beings, according to the etymology of the Latin word '*natura*'. Melanchthon especially looked at nature as an important medium of divine revelation, equivalent to the Sacred Scriptures. Therefore, he defended the idea that humans can grasp God's wisdom and justice through nature on the basis of anthropocentric premises. In this manner, he supported a 'creationist optimism' in contrast with Luther's rather pessimistic rejection of the notions of man as God's image (*imago* or *similitudo Dei*).

Sascha Salatowsky expands on these topics in chapter three. His contribution deals with the question of the relevance of physics in early modern religious culture. He engages in an inter-confessional comparison which takes into account various religious settings. These settings are relevant to assess the transformations of the conception of the divine in connection with the 'new physics', especially insofar as time and space are concerned. Salatowsky compares viewpoints on the essence of God that go beyond scriptural exegesis and which are marked by different confessional contexts. Specifically, he deals with the Catholic scholastic Francisco Suárez, the Calvinist and crypto-Socinian Conrad Vorstius, the Lutheran Johann Gerhard and the Socinian Christoph Stegmann. Salatowsky ar-

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gues for the proximity between the arguments of the Catholic Suárez and the Lutheran Gerhard as far as God's relation to time and space are concerned. By contrast, the other natural theologians considered here, Stegeman and Vorstius, rejected the paradoxes entailed in the idea of a God-space-time relation for different reasons. In fact, they embraced a pre-enlightenment position directed towards a rational foundation for religion.

Pietro Daniel Omodeo and Jonathan Regier readdress a classic theme in the history of Renaissance astronomy, namely the Wittenberg reception of Copernicus (chapter four). Luther and Melanchthon's skepticism or even criticism relative to the Copernican hypotheses did not lead to the rejection of his astronomical work, but rather to its transformative reception. The reconstruction of the institutional context of the earliest reception of Copernicus's *De revolutionibus orbium coelestium* (1543) helps us understand the reasons for attempts to transpose Copernican parameters and models onto a geocentric framework, and eventually onto a geo-heliocentric one, which became typical of Protestant circles from the 1580s onwards. Attentive consideration of the manuscript version and various editions of Melanchthon and Eber's *Introduction to Physics* (*Initia doctrinae physicae*) sheds new light on the intricacies of the so-called 'Wittenberg interpretation' of Copernicus.

In chapter five, "Nicolaus Andreae Granius: Physics and Cosmology at Helmstedt," Stefano Gulizia outlines the epistemic and pedagogical foundations of teaching Aristotelian cosmology against the background of the universities of Rostock and Helmstedt at the turn of the seventeenth century. These objectives are achieved by the case study of a Swedish mathematician, Nicolaus Andreae Granius (ca. 1569—1631), who, in addition to being a cross-cultural mediator in the Baltic region, was also appointed as a professor of natural philosophy in Helmstedt and had strong ties among the 'Caseliani', a circle of Protestant humanists interested in theology, logic, and medicine. Granius was educated in Germany as part of a new class of intellectuals who used Lutheran academic relations in a climate of relative tolerance to reevaluate the methodological ramifications of Zabarella's Aristotle within their work. As Gulizia shows in his chapter, Granius's experience reveals the polycentric cultural processes that were animated by academic disputes and circulated through humanist techniques of note-taking.

Barbara Mahlmann-Bauer (chapter six) discusses the progressive decline of astrology as a science, specifically looking at the Socinian contribution to the debates. The profound changes in astronomy during early modernity did not immediately marginalize astrological practices. Rather, the two sides of the science of the heavens coexisted and reinforced each other for a while. Yet, the legacy of medieval allegations against astrology on theological and ethical grounds entered the Renaissance debates, and was eventually received and reinvigorated by Socinian and reformed scholars. Andreas Dudith-Sbardellati's circle in Breslau is a case in point: religious motives accompanied a keen interest in astronomy together with the rejection of astrology. The intellectual legacy of this group lasted

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up to the late seventeenth century in connection with cometary apparitions and controversies (in 1618/19, 1652–1654, 1664/65 and 1680–1682).

Anna Jerratsch describes the Aristotelian elements underlying Protestant conceptions of comets in chapter seven. Her overview of sixteenth-century and seventeenth-century developments of cometary theories begins with a presentation of the Renaissance attempts to cope with comets as 'challenging objects'. Initially, comets were treated as multilayered objects that integrated elements derived from natural philosophy, astrology, and theology. The German-speaking literature on comets offers a wide body of sources on the phenomenon. In such popular texts, comets were seen as harbingers of famine, war, and diseases and interpreted in accordance with astrological viewpoints, theological doctrines, and natural philosophical theories. Jerratsch considers the progressive dissolution of the integrated view of comets (astrological-theological-physical) and especially points to the marginalization of astrology.

In chapter eight, Miguel Ángel Granada considers the Danzig professor of philosophy Bartholomäus Keckermann as an early modern defender of the Aristotelian doctrine of comets as sublunary meteorological phenomena. Keckermann saw the mathematical determination of the heavenly nature of comets as an attack against scholastic physics. He raised fundamental doubts concerning the reliability of astronomical instruments and mathematical computations as a counter-argument against their celestial nature. In contrast to mathematical astronomers, he believed that comets are produced by atmospheric exhalations and allotted them a theological overdetermination as signs of divine intervention into nature. Mathematicians promptly reacted to his allegations. Among them, Christoph Hunichius defended the thesis of comets' superlunarity and argued for their exclusively natural origin. The polemic opposing Keckermann and Hunichius is paradigmatic of the institutional development of the natural sciences at the crossroads of tradition and innovation.

Bruce Moran's contribution deals with alchemy (chapter nine). He shows that the Latin terminology of logic, as taught at Protestant universities on the basis of Aristotle, Ramus, and Melanchthon, was at the basis of the linguistic choices of Andreas Libavius' chemical Œuvre. Libavius acted in a context in which many scholars were dismissive of Aristotelian logic in the name of a Ramist reform, but his efforts were directed at creating a synthesis of Aristotle and Ramus. Such an eclectic sythesis formed the basis for his chemical science, a two-sided theoretical-practical project resulting from the interconnection of *scientia* and *ars*. In spite of his intention to purify chemistry from the metaphysical implications of hermetic alchemy, Libavius did not succeed in establishing the teaching of his old-new science at universities.

Libavius is also at the center of Elisabeth Moreau's essay (chapter ten). She deals with the development of his pharmaceutical theory of elemental mixtures based on a merging of Hippocratic-Galenic humoral pathology with medieval *alchemia medica*. Such an endeavor was rooted in the conception that every human

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being has his or her own inner principle. This principle is marked by a similitude to the creator and is the result of the composition of *materia*, *forma*, and *privatio*. This triad was directed against the Paracelsian *tria prima* doctrine embraced by the physician Petrus Severinus. Libavius accused his opponents of unduly abandoning the Aristotelian ground of alchemical concepts and principles.

Bernd Roling (chapter eleven) presents the occult doctrines of the hermetic thinker Johann Ludwig Hannemann in Kiel in the passage from the seventeenth to the eighteenth century. These occult doctrines constituted a special path to natural philosophy informed by Platonism and Paracelsism that implied the rejection of key terms and concepts of Aristotelian philosophy, especially *forma specifica* and *privatio*. As an alternative, Hannemann proposed a dynamic conception of reality as a material stream, which is organized by God and animated by the world-soul of Platonic origin. Materiality was reduced to three Paracelsian principles, *sal*, *sulfur,* and *mercurius*, which Hannemann traced back to a mythical Nordic alchemical tradition.

Simon Rebohm (chapter twelve) looks at the editorial practice of commenting as documented by the *Miscellanea curiosa*, a multi-volume medical and natural encyclopedia that was published under the auspices of the scientific society *Academia naturae curiosorum* (later *Academia imperialis Leopoldina*) from 1670 onwards. The early volumes of the *Miscellanea* are marked by the large presence of commentaries referring to Aristotle. These references often had a rhetorical meaning, as they served to introduce new natural viewpoints. After 1676, references to Aristotle abruptly disappeared as a consequence of the new scholarly direction of the editorial project.

Martin Urmann concludes the volume with a comparative study on the French academic context (chapter thirteen). He specifically discusses the change in the relationship between *natura* and *ars* that occurred when Cartesian language theories penetrated conceptions of rhetoric during the seventeenth century. The essay first considers the reception of Descartes by the French universities and *collèges* in order to explore what can be called the epistemic transfer between Aristotelianism and the new Cartesian philosophy. The focus then shifts to Bernard Lamy's conception of rhetoric as presented in his principal work *De l'art de parler* (1675). Based upon the Cartesian theory of passions, Lamy's book redefines rhetoric in a way that current research has labelled a 'grammar of affects'.

The essays in this volume thus bring into focus the institutional mechanisms of the transformation of traditional knowledge and its capacity to merge, adapt, or react to novelty against the background of early-modern religious reforms. The 'stability' of received forms of knowledge, particularly Aristotelianism, resided in its 'mobility'. In Protestant institutional contexts, Aristotelian thought proved to be adaptable and compatible with the natural and theological views brought forward by Melanchthon and, later, with the mechanical philosophy and other conceptions linked to contemporary advances in science. Explicitly anti-Aristotelian currents, such as Ramism, Paracelsism, radical Platonism, and hermeticism,

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were more difficult to integrate into the university curricula. Aristotelianism sometimes acted as a transformative force that was deeply theoretical as was the case with the geocentric reception and transmission of Copernicus in the Wittenberg connection. Alchemy, astronomy, and astrology, alongside cometary theories, natural philosophy, and theology are the most important dimensions of early modern science investigated in this volume. They are reconstructed in their cultural embedment as part of a science that was established, continued, and constantly revised in the mobile settings of knowledge institutions.

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Melanchthon's Logic and Rhetoric and the Methodology of Chemical Knowledge in Libavius's *Alchymia*

Volkhard Wels

The point that I make in this paper is relatively simple. I aim to show that Andreas Libavius's methodical treatment of chemical knowledge in his 1597 book *Alchemia* has its roots in the method developed by Philip Melanchthon in his textbooks on rhetoric and logic half a century earlier. This is my first claim. My second claim is that the method that Melanchthon laid out in his books and that Libavius later took up and applied to chemistry has bearing for the content of the knowledge that it is applied to. For both Melanchthon and Libavius, the methodical treatment of knowledge is informed by a strong rationalist, anti-speculative thrust. It is precisely the speculative and religious dimensions of knowledge that Melanchthon's method excludes from the domain of natural philosophy. As Bruce Moran has already demonstrated in detail, Libavius's pointed critique of Paracelsus follows out of his methodical treatment of chemical knowledge,[1] which, as I want to show in this paper, is wholly reliant on Melanchthon.

I'll begin by saying a few basic things about Melanchthon's concept of method. Then I will show how Libavius draws on the concept in his own textbook on logic and applies it in his *Alchemia*. Both the structure and the content of the chemical knowledge described in the book make clear that Libavius was a student of Melanchthon. Third, I will show how Libavius's concept of method sets him apart from both the older traditions of alchemy and the Paracelsians. In contrast to them, Libavius treated chemistry as a body of technical knowledge, and in doing so, he drew on technical texts on smelting. Finally, I would like to show how

1 Bruce T. Moran, *Andreas Libavius and the Transformation of Alchemy. Separating Chemical Cultures with Polemical Fire*. Sagamore Beach, Ma 2007. Among Moran's other works on the subject, see Bruce T. Moran, "Medicine, Alchemy, and the Control of Language: Andreas Libavius versus the Neoparacelsians", in: *Paracelsus: The Man and His Reputation, His Ideas and Their Transformation*, ed. Ole Peter Grell, Leiden 1998, pp. 135–149; Bruce T. Moran, "Andreas Libavius and the Art of 'Chymia'. Words, Works, Precepts, and Social Practices", in: *Bridging Traditions. Alchemy, Chemistry, and Paracelsian Practices in the Early Modern Era*, ed. Karen Hunger Parshall a.o. Kirksville, Missouri 2015, pp. 59–78. See also his contribution to this volume. Owen Hannaway, *The Chemists and the Word: the Didactic Origins of Chemistry*. Baltimore, London 1975, pp. 124–151 already discussed Libavius's concept of method and its relation to Melanchthon and Ramus.

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method functions as an anti-speculative, anti-metaphysical epistemological principle in the works of both Melanchthon and Libavius.

1 Melanchthon on Method

In an oration from 1536 with the title "On Philosophy", Melanchthon makes the following praise of method:

> Furthermore, there are two things for the acquiring of which great and varied knowledge and long practice in many arts are necessary, namely method and style of discourse. For no one can become a master of method, unless he is well and rightly versed in philosophy—indeed in that one kind of philosophy that is alien to sophistry, searches for and discloses truth properly and by the right path. Those who are well versed in these studies, and have obtained for themselves the habit (*hexin*) of relating to method everything that they want to understand or teach to others, also know how to represent methods in religious discussions, how to clear up what is complicated, pull together what is scattered and shed light on what is obscure and ambiguous.[2]

Thus, Melanchthon holds method and rhetoric, "methodus et forma orationis", to be the decisive elements of the transmission of knowledge. Method is the procedure one has to follow to find the truth and present it in a systematic fashion ("ordo et recta via"). While method provides guidelines for the orderly presentation of knowledge, rhetoric deals with the linguistic form this presentation takes. The points that Melanchthon summarizes in his short text from 1536 are things he had discussed in detail in his textbooks on logic and rhetoric: the book on logic dealt with method, that on rhetoric on linguistic form.

Logic and rhetoric were Melanchthon's two core interests.[3] The first version of his textbook on logic was published in 1520, the last in 1528. The first version of the book on rhetoric was published in 1519, the last in 1547. Both were bestsellers

2 Philipp Melanchthon, *De philosophia*, in: idem, *Werke in Auswahl Bd. 3: Humanistische Schriften*, ed. Richard Nürnberger, Gütersloh 1969, pp. 88–95, here p. 91: 'Deinde duae res sunt, ad quas comparandas opus est magna et varia doctrina, et longa exercitatione in multis artibus, videlicet, methodus et forma orationis. Nemo enim fieri artifex methodi potest, nisi bene et rite assuefactus in philosophia, et quidem in hoc genere philosophiae, quod alienum est a sophistica, quod veritatem ordine et recta via inquirit et patefacit. Qui in eo studio bene assuefacti <hexin> sibi paraverunt, revocandi omnia ad methodum, quae intelligere aut tradere aliis cupiunt, hi norunt etiam in disputationibus religionis informare methodos, evolvere intricata, dissipata contrahere, obscuris et ambiguis addere lumen.' I quote the English translation by Christine F. Salazar, see Philip Melanchthon, "On Philosophy," in: *Orations on Philosophy and Education*, ed. Sachiko Kusukawa, transl. Christine F. Salazar. Cambridge 1999, pp. 126–132, here p. 128.

3 On the close relation between dialectics and rhetoric see Volkhard Wels, "Melanchthon's Textbooks on Dialectic and Rhetoric as Complementary Parts of a Theory of Argumentation", in: *Scholarly Knowledge. Textbooks in Early Modern Europe*, eds. Emidio Campi, Simone De Angelis, Anja-Silvia Goeing and Anthony T. Grafton, Genf 2008, pp. 139–156.

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in the sixteenth century, and about 100 editions of each were published in the run of the century. It is nothing contentious to say that most students who studied at Protestant universities in the sixteenth century used Melanchthon's textbooks in their basic studies in the *artes* faculty.

But what exactly does this method that Melanchthon develops in his book on logic consist of? The answer actually seems pretty banal. Melanchthon describes his method as a sequence of ten questions that should guide research on any given object of study. The questions are: 1. What does the word or concept that signifies this object mean? 2. Does the object exist? 3. What is the object? In other words, how should it be defined? 4. What parts make up the object? 5. What are the object's types and subtypes? 6. What causes it (both its efficient cause and its final cause)? 7. What are its effects? 8. What things belong to it ("adiacentia")? 9. What is related to it? 10. What are its opposites? According to Melanchthon, if one can answer these ten questions, then one knows the most important things about the object in question.[4]

By formulating these ten questions, Melanchthon was the first to bring the concept of method into European theory of science.[5] From the very beginning, Melanchthon's method was both a method for determining what knowledge is relevant for a given object of study and a method for presenting this knowledge in a clear, didactically efficacious form. Melanchthon's ten methodical questions are a sort of checklist that one can use to see if one knows everything pertinent there is to know about a given object of study and if one has put this knowledge in the right order. Thus, Melanchthon's method is not yet the kind of method for acquiring knowledge like those developed in the seventeenth century. It is just a method for presenting knowledge, which is an important point to keep in mind.

While Melanchthon's method is supposed to help guide research into the content of an object of study, its linguistic form—"forma orationis"—is treated by rhetoric. Melanchthon's textbook on rhetoric lays out the complement of the method of dialectic: the *genus didaskalikon*.[6] Melanchthon's concept of *genus didaskalikon* adds a new category to the Antique doctrine of the *genera dicendi*. Ancient rhetoric had three *genera dicendi*: the *genus iudiciale*, the *genus demonstrativum* and the *genus deliberativum*—speech at a court of law, advisory speech, and speech that praises and chastises. Melanchthon supplemented this classification with a

4 Philipp Melanchthon, *Erotemata dialectics*, in: idem, *Opera quae supersunt omnia*, ed. Carl Gottlieb Brettschneider. Bd. 13, Halle 1846, col. 508–752, here col. 573–578.

5 On the concept of method in the Early Modern period in general see Neal W. Gilbert, *Renaissance Concepts of Method*, New York, London 1960, as for Melanchthon there pp. 121–128. A more recent survey can be found in Peter Schulteß, "Die philosophische Reflexion auf die Methode", in: *Die Philosophie des 17. Jahrhunderts. Bd. 1: Allgemeine Themen, Iberische Halbinsel, Italien*, ed. Jean-Pierre Schobinger, Basel 1998 (= Grundriss der Geschichte der Philosophie, begründet von Friedrich Ueberweg, völlig neubearb. Ausg. Hg. von Helmut Holzhey), pp. 63–120.

6 See Philipp Melanchthon, *Elementa Rhetorices. Grundbegriffe der Rhetorik*, ed., transl. and comment. Volkhard Wels, Berlin 2001, pp. 41–59. Available in open access: http://nbn-resolving.de/urn:nbn:de:kobv:517–opus-51446

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fourth genus because he thought that it failed to account for a wholly distinct type of speech act, namely, speech that does nothing but transmit knowledge.

According to Melanchthon, the *genus didaskalikon* has the exclusive purpose of *docere*, of transmitting what we would today call information. If one only wants to inform his listeners and readers and make things comprehensible for them, says Melanchthon, he has to use clear, grammatically correct language that dispenses with all ornaments and flourishes. In his book on rhetoric, Melanchthon describes in detail the criteria that exclusively informative speech acts and texts should adhere to.

Melanchthon's concept of the *genus didaskalikon* puts rhetoric and logic in close relation to one another, making them practically interdependent. The *genus didaskalikon* makes the method that Melanchthon developed in his book on logic into a central aspect of rhetoric itself. It constitutes the rhetorical complement to the logical method of describing an object in a clear, correct, systematic fashion. For Melanchthon, every explanation—in the broadest sense of the term—is an instance of the *genus didaskalikon*. The *genus didaskalikon* is the speech act that describes an object in a methodical, clear, comprehensive way using sober, matter-of-fact language.

Melanchthon was before his time. In the early sixteenth century, he was calling for something that the Royal Society in London would still be calling for in the mid-seventeenth century when laying out how they thought their new form of knowledge learned through experiment should be presented: namely, for a "plain style" that dispenses with all rhetorical ornamentation. The following passage from Thomas Sprat's 1667 *History of the Royal Society of London* is relatively famous:

> They [that is, the members of the Royal Society] have therefore been most rigorous in putting in execution, the only Remedy, that can be found for this extravagance: and that has been, a constant Resolution, to reject all the amplifications, digressions, and swellings of style: to return back to the primitive purity, and shortness, when men deliver'd so many things, almost in an equal number of words. They have exacted from all their members, a close, naked, natural way of speaking; positive expressions; clear senses; a native easiness: bringing all things as near the Mathematical plainness, as they can: and preferring the language of Artizans, countrymen, and Merchants, before that, of Wits, or Scholars.[7]

This is pretty much what Melanchthon was saying more than a century earlier.[8]

7 Thomas Sprat, *The History of the Royal Society of London for the Improving of Natural Knowledge*, London 1667, p. 113. The context of this quote is reconstructed in Werner Hüllen, *"Their manner of discourse". Nachdenken über Sprache im Umkreis der Royal Society*, Tübingen 1989. Tina Skouen, "Science vs. Rhetoric. Sprat's 'History of the Royal Society' Reconsidered", in: *Rhetorica* 29 (2011), pp. 23–52 treats Sprat's position in the history of rhetoric.

8 The only difference between the demands of Melanchthon and those of Sprat—and it is a very important difference—is that Melanchthon is aware that the "plain style"—or the *genus*

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2 Method in the Works of Libavius

This brings me to my second point: Andreas Libavius's adoption of Melanchthon's teachings on rhetoric and method. Published in 1597, Libavius's *Alchemia* has rightfully been crowned as the first ever textbook on chemistry. The work constitutes nothing other than the first attempt to give a systematic account of chemical knowledge in sober, clear, unembellished language. In doing so, Libavius fulfills the prescriptions set forth by Melanchthon in his concept of *genus didaskalikon*, which, as is easy to show, is not a matter of coincidence. In 1595, two years before publishing his *Alchemia*, Libavius published a textbook on logic whose title itself lays bare the work's reliance on Melanchthon: "Two books on logic, the first book containing the rules of logic taken from the best authors, especially from Aristotle, Petrus Ramus and Philipp Melanchthon […]".[9]

It is easy to understand why Aristotle is named first, because every textbook on logic is ultimately based on the works of Aristotle. I can't say much about the extent of Ramus's influence, but it seems to not have been nearly as significant as that of Melanchthon. In some places, sections of Melanchthon's books on logic and rhetoric are simply transcribed word-for-word, and in others, they are paraphrased or reformulated. Perhaps most importantly, Libavius imitates the structure of Melanchthon's textbook on logic. Because the book was written based on lessons Libavius held, one can probably imagine that Libavius simply rephrased parts of Melanchthon to fit his own needs as a teacher, adjusting them to fit the newest principles laid out by Ramus.[10] At any rate, Libavius's book is not an original work, but a remake of Melanchthon's textbook on logic.

So naturally, Libavius's book also has a chapter on method.[11] And like Melanchthon's, Libavius's method is a method for presenting and organizing knowledge, not a method for acquiring or producing it. Using Melanchthon's words, Libavius says that every methodical presentation begins with precise definitions and proceeds by naming the object's parts, its subcategories, its causes, etc. This is doubtless drawn from Melanchthon's ten questions.

But Libavius's logic is not really what interests me here, which is why I'd now like to turn to Libavius's application of Melanchthon's method in his *Alchemia*. His use of the method enabled him to do nothing less than write the first real chemistry

didaskalikon—is a rhetorical art that is difficult to achieve. In contrast, Sprat seems to believe—like so many other natural scientists in the following centuries—that the "plain style" is simply a matter of dispensing with all rhetoric and attempting to come as close as possible to mathematics. Melanchthon's view that the "plain style" is itself a rhetorical artifice is much more modern than this naïve view. There is no non-rhetorical language.

9 Andreas Libavius, *Dialecticae emendatae libri duo in quorum hoc priore continentur praecepta dialectica ex optimorum autorum, praecipue Aristotelis, P. Rami et Ph. Melanchthonis sententiis usuque rationis eruta, congesta, itaque exposita, ut ubivis discentibus possint esse usui*, Frankfurt/M. 1595.

10 Libavius strongly distances himself from Ramism in the foreword to the *Alchemia*, f. b2^{r}: "Ramisticas argutias ineptasque nugas quas ineptiunt hodie multi, ad Cynosares abire iubeo."

11 Libavius, *Dialecticae emendatae libri duo* p. 287. Here, too, Libavius combines ideas—and phrases—from Melanchthon and Ramus.

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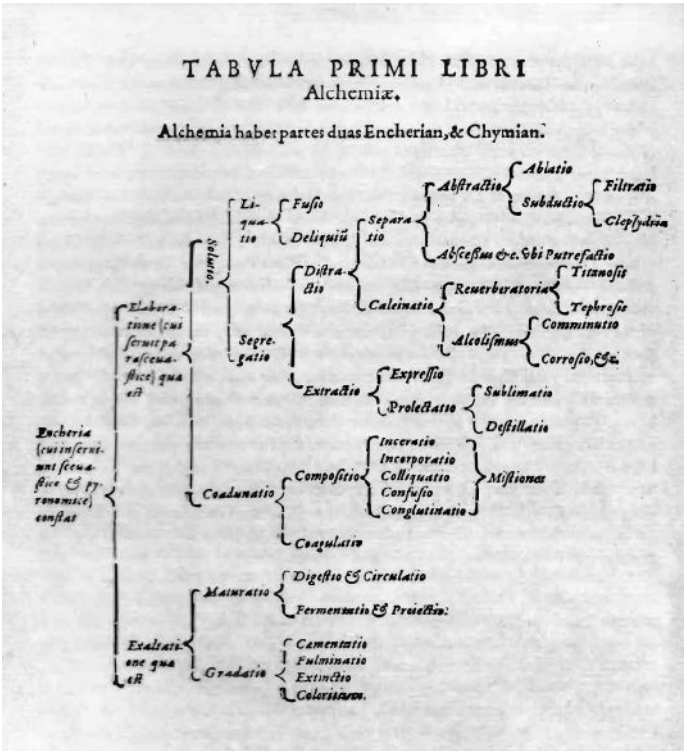

Fig. 1a: Graphic depicting the structure of the *Alchemia*

textbook. The title page itself makes clear that Libavius wants to provide his readers with a methodical presentation of chemical knowledge. The work was composed "primarily by bringing together scattered bits of knowledge from the best of the older and newer authors and various general writings; on the basis of theoretical contemplations and extensive practical experience, they are then presented in a careful methodical fashion (*Methodo accurata explicata*) and forged into a complete work."[12] "Methodo accurata explicata" is a clear reference to Melanchthon's method.

The textbook is structured in line with the method. Libavius begins with a definition of chemistry and then goes on to a chapter on the constitutive parts of alchemy, thus following Melanchthon's ten questions. The first part of the *Alchemia* deals with the "Encheria," or "equipment and tools," along with chemical processes like sublimation, filtration, distillation, calcification, and rotting. The

12 Andreas Libavius, *Alchemia […] e dispersis passim optimorum autorum, veterum et recentius exemplis potissimum, tum etiam praeceptis quibusdam operose collecta, adhibitisque ratione et experientia, quanta potuit esse, methodo accurata explicata et in integrum corpus redacta*, Frankfurt/M. 1597. A German translation was published in 1964: *Die Alchemie des Andreas Libavius. Ein Lehrbuch der Chemie aus dem Jahre 1597*, transl. Friedemann Rex, Weinheim/Bergstraße 1964.

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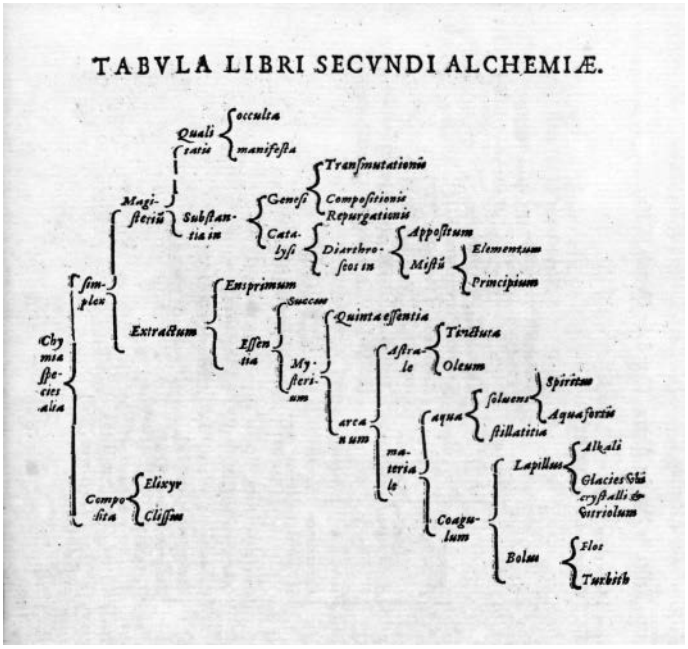

Fig. 1b: Graphic depicting the structure of the *Alchemia*

second part treats "Chymia," or the end products of chemical processes. Examples include liquids, extracts, elixirs, essences, powders, and oils. A diagram on the first pages of the *Alchemia* gives a visual depiction of the system of chemical knowledge, a form of presentation clearly influenced by Ramus.

But Melanchthon's method doesn't just guide the overall structure of the book—it is also used to organize the individual chapters. Every chapter begins with a definition of a chemical process and the requisite instruments and materials, then proceeds to a description of its subcategories and parts, which is then followed by a description of the process's chemical qualities and its practical uses. It is this methodical, systematic form of presentation that distinguished Libavius's *Alchemia* from all its predecessors and made it the first textbook of chemistry.

Indeed, Libavius too thought that the methodical structure of the *Alchemia*—both as a whole and in its parts—was his primary accomplishment. The introduction and the preface are nothing other than a justification of the method. The first sentence of the introduction states that he, Libavius, systematized chemical knowledge "led by a method that aims to convey knowledge" ("ductu methodi scientiis informandis attributae").[13] He continues by writing that, while there are of course many extant observations and bits of knowledge, he was trying to de-

13 Libavius, *Alchemia* f. a2[v].

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duce the general categories for classifying them. In other words, chemistry as a discipline was not, in his eyes, lacking concrete knowledge. What it lacked was a methodical presentation of this knowledge in clear language.[14] Libavius states in no ambiguous terms that readers should not expect to learn "new experiments" (*experimenta*, which might also be translated as "new experiences") from his book, because he had simply brought together what others had already observed before him. He simply provided the form of presentation, "expositio et modus docendi." And if he is successful in this venture, he says, he'll be happy: "If the presentation and form of exposition are mine, that's enough for me."[15]

3 Libavius's Concept of Chemistry: Critique of Traditional Alchemy and Paracelsus and the Use of Technical Literature on Smelting

Libavius's consequentially methodical treatment of chemical knowledge distinguishes his work from both traditional alchemy and from Paracelsus and his followers. The method alone is what separates his work from traditional alchemy, not the discrete knowledge itself. Indeed, Libavius held high the findings of traditional, pre-Paracelsian alchemy. What Libavius disliked about it was its obscurantism and secretiveness, the fact that the old alchemists didn't make their findings accessible to a broad audience. He criticizes them for either not publishing their work or, when they did, only distributing it in manuscripts that were difficult to obtain and were written in a highly codified language that used all kinds of obscure terms. Of course, he was talking about the imagistic language of traditional alchemy with its green lions, unicorns, dragons, hermaphrodites, bathing kings, and beheaded ladies.

Nevertheless, he offered a defense of what this language concealed, writing that it was wrong to believe that it was just a bunch of charlatanism and fraud:

> Of course I know that excellent, reliable authors referred to one and the same thing with all kinds of different terms, and strange terms to boot, in order to keep their findings secret and protect them from being maligned; however, I would like you to share in my conviction that their thinking was always genuine and sound, because it was not just deceptive chatter, but represented the correspondence of facts and experience: there is no reason to put these men on the same level as frauds and tricksters.[16]

14 Libavius, *Alchemia* f. a2^{v}: ‚Catholica silent, nec est amussis ad quam revocari singularitates et iudicari queant. Itaque evenit ut cum plures eiusdem rei extent formulae, non sit promptum iudicare, nec ad quod caput artis pertineant, quove nomine sint appellandae, nec quam legitime sint descriptae.'—'There is nothing said of general concepts, and there is no guiding rule that would allow us to order and analyze the discrete facts. Thus, when there are multiple "formulas" for the same material, it is difficult to say where they belong in the canon of chemistry, what name they should be referred to by, and if they are described in an adequate fashion.'

15 Libavius, *Alchemia* f. a4^{r}: 'Si mea est expositio et modus docendi, sat est.'

16 Libavius, *Alchemia* f. a3^{r}: 'Non quidem ignoro, etiam praestantes probatosque autores occultandi sua inventa et arcendi improbitatem caussa, variis, iisque monstrosis nominibus eadem appelalsse: sed tibi persuasum velim, concordem constantemque ipsorum fuisse

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Thus, for Libavius, the imagistic language of traditional alchemy was not a sign of charlatanry. Rather, he viewed it as what we would today call a technical language:

> For people who are unfamiliar with the key precepts of the discipline of chemistry, everything sounds, as one says, mysterious, even if they are expressed in clear, well-defined concepts that the adepts can understand. Thus, all the arts remain foreign to outsiders, particularly when they are not translated into vernacular and the termini technici (*vocabula disciplinae*) change.[17]

He criticizes traditional alchemy for its failure to present its findings in a systematic manner, its habit of merely making lists of discrete observations without trying to integrate them into a system, and for its obscurantism and secretiveness. He writes that lots of alchemists make you promise a hundred times that you won't tell anyone about what they say before they entrust you with their arcane knowledge.[18] Libavius thought that the end effect of this secretiveness was that alchemy never made any real progress: if people can't publicly discuss and test the alchemists' findings, then they can't try to verify or falsify them either:

> There are also people of the opposite conviction who believe that it is disgraceful that certain arcana be published in such clear words. They claim that you have to do it like the philosophers and adepts, who conceal otherwise clear things through obscure words and teachings and reserve science for their followers (*filii doctrinae*). I have no need to counter these people; for me there are no arcana; if there are any, God has made them accessible through science (*disciplina*), keen minds, and experience.[19]

For this reason, Libavius did not give the "concealed procedures" a place in his text, because, as he states in no uncertain terms: "In order to test them, they have to have been public for a long time. Thus, if they are kept secret, they cannot be counted as part of the art."[20]

Thus, it is clear that, beyond its strict scientific function, Libavius viewed his methodical presentation of chemical knowledge as a plea for openness and ac-

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semper mentem, quam cum non dictio fallax, sed rerum concursus et experientia aperuerit: non est ut hos impostorum similes facias.'

17 Libavius, *Alchemia* f. a4^{r}: ‚Qui disciplinae Chymicae morem non callent, ab his occulta sunt omnia quae dicuntur, etiamsi manifestis exponantur, suisque notis, quas intelligent satis initiati. Ita omnes artes ab extraneis sunt remotae, praesertim si non in vulgi transferantur sermonem et vocabula disciplinae mutent.'

18 Libavius, *Alchemia* f. a2^{v}.

19 Libavius, *Alchemia* f. a3^{v}: ‚Audies aliquando etiam in adversam partem inclinantes, qui turpe iudicabunt arcana quaedam publicari tam mnaifestis verbis. Imitandum esse Philosophos, qui rem manifestam nominibus, modoque docendi occultarunt, filiisque doctrinae reliquerunt. Non opus est mihi adversus hos responsione: arcani enim mihi nihil est: si quid es, Deus patefecit per disciplinam, artificesque praestantes et experientiam.'

20 Libavius, *Alchemia* a4^{v}: ‚Ut comprobentur, diu in publico esse debent. Non ergo habentur pro artificiosis, si sunt occulti.'

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cessibility in science and the publication of chemists' findings. He believed that scientific progress could only be made if alchemists put an end to the obscurantism and secretiveness of traditional alchemy. Not only must findings be verifiable and falsifiable, he claimed—they also have to be made public.[21] Thus, Libavius was already stressing the need for scientific community half a century before Robert Boyle made similar claims.[22]

While Libavius's criticisms of traditional alchemy are thus relatively moderate, his criticisms of Paracelsus and his school are considerably harsher. He writes that while traditional alchemy strove to be difficult to understand, Paracelsus and his followers didn't want to be understandable at all. He complains that even in those places where Paracelsus says something about real chemical knowledge and not just about theological and metaphysical speculations, you still have to proceed with caution, "because he deliberately covers everything with all kinds of mysterious references, obscuring even the most obvious things, and doesn't want people to be able to understand him."[23] Thus, Libavius takes pains to underscore that people should in no way confuse chemistry with what Paracelsus had made of it:

> Chemistry is not a discovery of Paracelsus; it should not be traced back to him; and this book, along with the commentary, will make clear that only the most miniscule part of chemistry has anything to thank the work of Paracelsus, even though the public already has access to works much superior to anything that grubby magician could have ever achieved. It would be a sad state of things for chemistry if it had to build on the works of Paracelsus.[24]

Because Bruce Moran has said pretty much everything there is to say about Libavius's critique of Paracelsus, I would like to turn to another part of the preface to the *Alchemia*, which leads back to the concept of method. In the preface, Libavius doesn't limit himself to distancing his project from Paracelsus and stating his partial affinity with traditional alchemy. He also explicitly mentions the techni-

21 In the same section in the first edition of the *Alchemia*, Libavius wrote that he would gladly amend his text and asked readers to write him if they were to find any errors, which he would then correct. Libavius, *Alchemia* a4 v: 'Qui boni sunt et liberali ingenio nati, in quibus videbunt me deficere, aut ipsi edent meliora, aut ad me edenda in commentariis mittent.'

22 See Stephen Clucas, "Alchemy and Certainty in the Seventeenth Century", in: *Chymists and Chymistry. Studies in the History of Alchemy and Early Modern Chemistry*, ed. Lawrence M. Principe. Sagamore Beach 2007, pp. 39–51. Clucas compares the claims of Boyle and Libavius, arguing that while Libavius plead for clarity and verifiability in order to make chemistry a *scientia* in the Aristotelian sense, Boyle wanted to make experiment into the bedrock of chemistry.

23 Libavius, *Alchemia* f. b^{v}: 'Sed eo pauciora valde trepidanter allegavi, quod studiosissime omnia implicet aenigmatis et obscuret etiam manifestissima, nec velit intelligi.'

24 Libavius, *Alchemia* f. b^{v}: ‚Chymia non est inventum Paracelsi: ad eum referri non debet et minimam etiam artis partem huius notitiae deberi, ostendet hic liber cum commentariis, quanquam iam in publico existant longe nobiliora, quam unquam impurus ille magus potuit assequi.'

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cal knowledge of the "steel works people" ("Metallhüttenleute"), that is, smelters who worked at the mines. Libavius was in all likelihood referring to works like Georg Agricola's *De re metallica* (published in 1556), so-called smelting manuals, "Probierbüchlein," or books on assaying silver and gold, and other purely technical writings. These kinds of technical works had always existed alongside strictly alchemical writings. Indeed, Agricola's *De re metallica* contains a critique of alchemy that is in many ways similar to that of Libavius.[25]

Libavius explicitly states that he wants to raise the technical knowledge of these workers to the level of a philosophy, which is to say, to the level of an *ars*, a university discipline:

> I also don't have anything to fear from the judgment of those who will say that my work has given smelters and other craftsmen a place in the world of philosophy, people who have up to now been held far from philosophy and demeaned to the level of menial workers. Because when chemistry is no longer just the servant of medicine, but comes to be recognized as a noble part of the knowledge of nature (*contemplatio physica*), then the engineers (*mechanici*) will ascend the throne of physics.[26]

This is a remarkably prophetic statement: if chemistry is founded on the knowledge of craftsmen, then the engineers will ascend the throne of physics. While Paracelsus based his chemical knowledge on theological and metaphysical speculation, Libavius wanted to base chemical knowledge on the technical knowledge of the artisans.

This brings me to my next point. I would now like to return to Philip Melanchthon's concept of method as a systematic presentation of knowledge. Melanchthon's method is not just a formal procedure that leaves the knowledge that it is applied to untouched. The knowledge produced by methodical procedure is not the same as knowledge brought forth by speculation or divine revelation.

A simple reference to Descartes' *Discours de la méthode pour bien conduire sa raison, et chercher la vérité dans les sciences* (1637) suffices to demonstrate this claim. Like for Descartes a century later, method had a critical function for Melanchthon. In other words, the rationalism expressed in Melanchthon's method determines the very content of the knowledge that it structures. Thus, Descartes was not the first one to conceive of method as the enemy of speculative knowledge and modes of acquiring knowledge based on speculation. Melanchthon, too, had the very same aim.

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25 Georg Agricola, *De re metallica*, Basel 1556. Widmung, f. a3^{r}: ‚Sunt alii multi de hac re libri, sed omnes obscuri: quod scriptores isti res alienis, non propriis vocabulis nominent: et quod alii aliis atque aliis vocabulis, a se confictis, utantur, cum res nun mutent.'

26 Libavius, *Alchemia* a4 v: 'Nec formidanda mihi est eorum iudicum sententia, qui dicent mea opera effectum ut et fabris metallurgis, aliisque opificibus hactenus e Philosophica libertate ad servilia abiectis, sit tutus in philosophia locus: cum enim Chymia non tantum ministra sit medicinae, sed et physicae contemplationis pars honoratior, in solium physicae evehentur mechanici.'

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4 Method as an Anti-Speculative Principle of Knowledge in the Works of Melanchthon and Libavius

The implications of Melanchthon's method become clear when one takes a look at the way he applied it to theology in his 1521 *Loci communes theologici*. Melanchthon's *Loci communes theologici* has rightly been called the first dogmatic textbook of Lutheranism. Following the plan laid out in his works on logic and rhetoric, Melanchthon defines the central concepts of theology, identifies its subcategories and its parts, describes its causes and effects, and explains what is related to them and what their opposites are. In doing so, Melanchthon subordinates theology to the rules of logic. This is not something that should be taken for granted, and it stands in sharp contrast to the works of the early Luther.[27]

The preface of the *Loci* states clearly and precisely that the truths of Biblical revelation have the same degree of certainty as the statement "two multiplied by four equals eight."[28] It continues that all the other principles of belief can be deduced from these truths of revelation with the same certainty. Belief and logic are not contradictory for Melanchthon. For him, logic is, as the universally applicable method of knowledge, no less an instrument of theology than it is for every other discipline. Sure, in contrast to disciplines like mathematics, theological propositions cannot lead us to demonstrative, absolutely necessary proofs. But the deduction of these propositions out of the contents of the Bible can be tested with the hermeneutic-philological principles that Melanchthon formulates in his rhetoric and the laws of method laid out in his logic.[29]

Nevertheless, this is not to say that Melanchthon subordinates the whole of theology to reason as Descartes's followers would do later on. One of the first sentences of the 1521 *Loci theologici* states that theology contains "mysteria divinitatis" that are inaccessible to reason. Melanchthon counts among these "mysteria" the Holy Trinity, the incarnation of Christ, and the Divine creation of the world ex nihilo. These "mysteria divinitatis," Melanchthon writes, cannot be analyzed—they can only be marveled at.[30] They are beyond the grasp of reason and method, which for Melanchthon means that they mark the end of theology as science and the beginning of the domain of speculation. This makes the method's significance for theology quite clear.

I think we can well illustrate Melanchthon's position with the famous concluding sentence of Ludwig Wittgenstein's *Tractatus logico-philosophicus*: "Whereof one cannot speak, thereof one must be silent." Like Wittgenstein, Melanchthon

27 See Volkhard Wels, *Manifestationen des Geistes. Frömmigkeit, Spiritualismus und Dichtung in der Frühen Neuzeit*, Göttingen 2014, pp. 77–84.

28 Philipp Melanchthon, "Loci praecipui theologici von 1559" (1. Teil), in: idem, *Werke in Auswahl*. Bd. 2.1, bearb. v. Hans Engelland, fortgeführt von Robert Stupperich, Gütersloh 1978, praefatio p. 190.

29 Melanchthon, "Loci praecipui theologici von 1559", praefatio p. 190.

30 Philipp Melanchthon, „Loci communes rerum theologicarum seu hypotyposes theologicae. 1521", in: idem, *Werke in Auswahl*. Bd. 2.1, bearb. v. Hans Engelland, fortgeführt von Robert Stupperich, Gütersloh 1978, p. 19.

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was a logician who saw his task in demarcating the limits of language, which he thought were identical with the limits of reason.[31] What one can and must speak about are the central concepts of Christian theology, which are of the utmost significance for the life of a Christian. These are the "loci communes theologici," which God revealed in the Bible: the power of sin, the law, grace. These make up the bedrock of dogmatic theology. But about the "mysteria divinitatis," like the Holy Trinity, the incarnation of Christ, and the *creatio ex nihilo*, one cannot speak. They cannot be grasped with reason, and thus cannot be grasped with language.

Conclusion

That brings me to my conclusion: my basic claim is that the way Libavius applied Melanchthon's method to chemical knowledge is grounded in reason, which means that it is explicitly against mixing chemical knowledge with religious speculation.

Libavius's methodical organization of chemical knowledge paved the way for a new conception of chemistry as a science free of metaphysics that built on the knowledge of craftsmen. This new orientation of chemistry was an explicit attack on Paracelsus, because he and his followers were engaged in nothing other than investing chemical knowledge with metaphysical subtleties. The chemistry of Paracelsus and his followers was only marginally interested in empirical knowledge and observation, primarily drawing its insights from divine inspiration and religious, metaphysical speculation.

The examples are countless, so I'll just take up three here chosen more or less at random: Oswald Croll, Alexander von Suchten, and Heinrich Khunrath. Oswald Croll's *Basilica Chymica* (1609) has the metaphysical speculations of the Paracelsus school written all over its cover.[32] The title page states that the book seeks to use chemistry to clarify the Holy Trinity by bringing it into analogy with all kinds of other trinities. It is precisely the Holy Trinity—the fact that God is at once one and three—that Melanchthon claimed could not be grasped by reason. Thus, Croll treats chemistry less as a form of technical knowledge and more as a complement of Kabbalah and magic.

In his *De tribus facultatibus* (written before 1590, published in 1608), Alexander von Suchten seeks to give a chemical explanation of the act of *creatio ex nihilo*

31 The comparison of Humanist philosophy of language with Wittgenstein's "ordinary language philosophy" has been around for some time now. I make this comparison in the same vein as Lodi Nauta, *In Defense of Common Sense. Lorenzo Valla's Humanist Critique of Scholastic Philosophy*. Cambridge, Mass; London 2009, pp. 269–291. On page 288, Nauta claims that both share "the basic conviction that philosophical problems are rooted in a misunderstanding of language."

32 Oswald Croll, *Basilica chymica continens philosophicam propriam laborum experientiam confirmatam descriptionem et usum remediorum chymicorum selectissimorum e lumine gratiae et naturae desumptorum*, Frankfurt/M. [ca. 1611]. Ndr. Hildesheim, Zürich, New York 1996. On the differences between Libavius and Croll see Owen Hannaway, *The Chemists and the Word: the Didactic Origins of Chemistry*, Baltimore, London 1975.

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Fig. 2: Title Page of Croll's *Basilica Chymica*

by using Paracelsus's doctrine of principles.[33] According to him, salt, sulfur, and mercury are the three principles that can explain the act of creation described in Genesis; importantly, mercury represents the divine spirit that entered the world itself on the first day of creation. Suchten was not the only one to try his hand at such speculation. The followers of Paracelsus made nothing less than the creation of the world into a choice object of speculation, seeking to study its chemical dimension. The "physica mosaica," or chemical interpretation of Genesis, pretty much became its own text genre among the Paracelsians. Heinrich Khunrath's

33 Alexander von Suchten, *De tribus facultatibus*, in: idem, *Chymische Schriften*, ed. Ulrich c. Dagitza, Frankfurt/M. 1680, pp. 357–382.

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Fig. 3: Rebis—Etching from Khunrath's *Amphitheatrum*

Amphitheatrum sapientiae aeternae solius verae, christiano-kabalisticum, divino-magicum, nec non physico-chymicum, tertriunum, catholicon (1595/1609) is probably the most famous among them.[34] Khunrath seeks to provide an alchemical, kabbalist, magical explanation for nothing other than Melanchthon's "mysteria divinitatis": the *creatio ex nihilo*, the Holy Trinity, and the incarnation of Christ.

Libavius wasn't interested in any of this. His *Alchemia* contains no theological speculations and no metaphysics. Instead, Libavius gives the reader definitions, classifications, and descriptions of concrete chemical instruments, materials, and processes. This is what I meant at the beginning of this paper when I said that Libavius was a student and follower of Melanchthon. The application of Melanchthon's method to chemical knowledge had massive consequences for what counted as chemical knowledge and what did not.

Chemical knowledge was cleansed of all theological speculation and—again in Libavius' own words—ascended as technology the throne of physics.

34 See the new edition: Heinrich Khunrath, *Amphitheatrum Sapientiae Aeternae—Schauplatz der ewigen allein wahren Weisheit, vollständiger Reprint des Erstdrucks von [Hamburg] 1595 und des zweiten und letzten Drucks 1609*, eds. Carlos Gilly, Anja Hallacker, Hanns-Peter Neumann and Wilhelm Schmidt-Biggemann, Stuttgart-Bad Cannstatt 2014.

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