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Research proposal [Part B1]
(Part B1 is evaluated both in Step 1 and Step 2,
Part B2 is evaluated in Step 2 only)

Nova Scientia. Early Modern Scientific Literature and Latin

NOSCEMUS

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Host Institution: Leopold-Franzens-Universität Innsbruck

Proposal duration in months: 60

Proposal summary
Fundamental changes occurred in the study of nature between the late 15th and 18th centuries, leading to the emergence of modern science as we know it. This process would have been impossible without Latin as the scientific *lingua franca* of the era, just as today's science is hard to imagine without English. At present, this crucial role of Latin is insufficiently acknowledged, and the hundreds of thousands of scientific texts written in Latin have largely remained neglected. This severely limits the scope of research into the history of early modern science, an otherwise thriving field.
The proposed project intends to decisively advance our understanding of the interrelation of Latin and science in early modern times. By applying the methods of Latin philology, yet at the same time reaching out to historians of science, it will establish early modern scientific literature in Latin as an interdisciplinary research field. This will be accomplished

(a) by examining and classifying the formal variety and range of content of this literature to create an overall picture
(b) by analysing its function as a medium of communication within and beyond the scientific community.

To realise the first of these objectives, a tripartite database for authors, early modern texts, and secondary literature will be compiled and a sourcebook with a selection of digitally searchable texts put together, both of which will be made available online. A monograph will provide an overview structured according to the literary genres of early modern scientific literature in Latin. The second objective will be achieved through a series of interlinked monographs, whose analyses will build on the system of ancient rhetoric, the most important communicative paradigm of the early modern age. On this basis, four key functions of Latin scientific texts will be assessed: naming new phenomena; describing and explaining them; convincing others of the views expressed; and promoting science.

Section a: ***Extended Synopsis of the scientific proposal (max. 5 pages)***

The proposed project constitutes the first attempt ever at mapping the field of early modern Latin scientific literature and evaluating its vital role in the history of science in conveying scientific contents to the contemporary audience.

The early modern period was crucial in the history of science. Between the later 15th and the 18th centuries, modern science began to emerge as a conceptually unified field from a variety of independent disciplines (termed "early modern science" in the following, cf. Park/Daston 2006, 3–4). Just as modern science is inconceivable without English as its *lingua franca*, the early modern developments in science would have been impossible without Latin, Europe's former *lingua franca* of learned discourse and science in particular (Waquet 2002). Latin had inherited this role from the Middle Ages, where it had been without serious vernacular competition; and although it gradually lost its monopoly in the early modern period, it remained relevant in most areas at least until the 18th century. Its linguistic dominance was embedded into the cultural dominance of humanism. Early modern scientific authors received a thorough humanist education and often combined scientific and humanist activities in their careers.

Latin's supremacy in early modern science manifests itself on many levels: In terms of quantity, more scientific texts were written in Latin than in any single vernacular, as suggested by Latin's dominance on the early modern book market in general and proven by sources such as the catalogues of the Frankfurt and Leipzig book fairs (Waquet 2002, 81–95). In terms of content, Latin scientific literature covered the whole range of early modern disciplines (cf. Park/Daston 2006, 365–723), in terms of literary genre, it used forms as diverse as the scientific monograph, the encyclopedia, the short research paper, and didactic epic. Latin was the preferred language of most key figures from Copernicus to Newton, Linné and Gauß. Early champions of the vernaculars such as Galilei and Robert Boyle depended on Latin translations for their international impact (Pantin 2007). Latin and Greco-Latin vocabulary is still strongly present in the sciences today, take the technical terms of individual disciplines (Nybakken 1959) or supra-disciplinary key terms like "fact" (< *factum*) or "evidence" (< *evidentia*).

1. Research context

In general, the Latin part of early modern science receives insufficient attention today. This is only partly the result of a common prejudice identifying the vernaculars with progress and Latin with backwardness. Above all, the situation reflects the general decline of Latin skills in the modern scientific community. As a consequence, the existence of Latin sources is often ignored, and topics which require Latin skills are avoided in many areas of early modern studies (Ludwig 1991). True, there is a considerable number of projects on early modern science which work with Latin sources. This holds for collected works of figures like Kepler or Euler, for editions of single works, and nowadays also for internet projects such as the *Linnaean Correspondence* or the *Newton Project*. Much analytical work – some projects conducted at the Max Planck Institute for the History of Science, monographs such as Ogilvie 2006, and articles such as Glei 2012, for instance – rely on Latin texts. Yet compared to the vastness of the field, these initiatives are but few and far between. Also, most of them restrict their focus to big names, and Latin sources are viewed rather as means to other ends than as objects of research in their own right.

Accordingly, we currently have no overall picture of the early modern scientific literature written in Latin, of its forms, contents, and functions. While a history of the less numerous scientific writings in the vernaculars was produced a hundred years ago (Olschki 1919–27), nothing of the like exists for the scientific writings in Latin. It is telling that the respective volumes of the authoritative *Cambridge History of Early Modern Science* (Park/Daston 2006; Porter 2003) do not even feature an entry titled "Latin" in the 25–30 fine-print pages of their indexes. Students of early modern science are often unaware of the major role Latin played in their discipline and of the immense body of extant Latin texts. The now common practice of citing Latin works only if a vernacular translation is available, and then only in translation, both testifies to the general obliviousness and contributes to its perpetuation. The 99% of Latin works without a modern translation, on the other hand, are simply left aside.

These practices have had two highly problematic consequences:

(a) We are missing a vast amount of factual information, which has created a distorted picture of early modern science. Accounts of the development of 16th century geography, for example, have hitherto overlooked the most detailed description of a single region extant from that time, Thomas Schöpf's description of the Canton of Bern (Korenjak 2013b). Robert Hooke's English *Micrographia* (1665), regularly cited as the first treatise on microscopy, is in fact predated by Petrus Borellus' *Observationum microscopicarum centuria* (1656). And the far-reaching conclusions drawn from the supposedly revolutionary style of Robert Boyle's experimental reports (*New Experiments*, 1660; cf. Shapin 1984) should be revised, as the same style is already found in earlier Latin authors such as Caspar Schott (*Mechanica hydraulico-pneumatica*, 1657).

(b) We are prevented from fully appreciating an aspect that was elementary to the success of early modern science, viz. the way science was communicated to readers within and beyond the scientific community. As proponents of the approach known as "rhetoric of science" (e.g. Gross 1996) have pointed out for several decades, insight into mechanisms of communication is essential for comprehending the spread and adoption of new findings and theories. To disregard how early modern science was explained, argued for and popularised within the Latin-based *res publica litteraria* ("republic of letters"; Waquet 1989) of its time means losing sight of one of its most important aspects.

Over the last decades, a number of developments have taken place which give reason for hope and make the project presented here appear timely. The most important of these are the Digital Revolution and the rise of Neo-Latin studies. By digitising huge amounts of early modern Latin texts, Google Books, Gallica and many similar projects have made the problem of their neglect fully visible and at the same time put the means to solve it at our disposal. Moreover, recent progress in Optical Character Recognition (OCR) gives hope that a substantial part of this material can be converted into digitally searchable formats in the near future.

Neo-Latin studies, i.e. the study of early modern Latin, have become a discipline in its own right from the 1960s onwards. Being in most cases trained as classicists, Neo-Latinists initially privileged belles-lettres, which they mainly studied for their relationship to their ancient models, and showed little interest in scientific literature. Recently, however, increasing attention is paid to the interaction of Neo-Latin literature with its contemporary context and to its contribution to Europe's spectacular development; the outlook of Neo-Latinists has broadened to include factual and technical texts. The three companions to Neo-Latin literature published since the 1990s emphasise the importance of Latin in early modern science and dedicate some chapters to scientific prose (IJsewijn/Sacré 1990–98, 2:324–61; Ford et al. 2014, 667–717; Ogilvie 2015). The first attempt to record and analyse the entire Neo-Latin tradition of a certain European region, untertaken by some colleagues and myself in the *Tyrolis Latina*-project, has likewise highlighted the relevance of scientific literature (Korenjak et al. 2012, 189–97, 355–61, 555–63, 833–61, 1022–45, 1151–54). When founding the Ludwig Boltzmann Institute for Neo-Latin Studies (LBI), the first research institute worldwide dedicated entirely to Neo-Latin (*http://neolatin.lbg.ac.at/tags/institute*), we did so with the express intent to examine Neo-Latin as a progressive force in early modern Europe. While our current research programme focusses on politics, religion and the history of mentalities, the importance of early modern science in all these fields has soon become evident. Neo-Latin scientific literature is the subject of several papers by myself (e.g. Korenjak 2013a, 2013b, forthcoming) and of the final chapter of my history of Neo-Latin literature (Korenjak 2016, 234–53). Launching a project dedicated exclusively to this topic is a logical next step.

2. The project

2.1. Objectives

The overwhelming majority of Neo-Latin texts is simply unknown to date. A solid source basis is of course mandatory for any research, but it does not make sense to postpone analysis indefinitely until all available sources are assessed. Following a model that has been found fruitful in the *Tyrolis Latina* and the LBI, the present project accordingly pursues two objectives, one documentary, the other analytical:

(a) The Neo-Latin scientific literature from the late 15th to the late 18th century will for the first time be charted in some detail. The resulting overall picture will be representative in terms of genre, discipline, time and place (below, 2.2.1). As mentioned before, Neo-Latin scientific literature covers the whole range of early modern scientific disciplines: pure and applied mathematics, physics (coalescing from a number of subfields), astronomy/astrology, natural history (comprising botany, zoology and mineralogy), various forms of geological research, geography and cartography, alchemy/chemistry, medicine and a host of minor disciplines from glaciology to demography. Moreover, it features an astonishing variety of generic forms, many of them alien to modern science. Among the more common, one may refer to monographic treatises, encyclopedias, dictionaries, commentaries, textbooks, experimental reports, expedition reports, collections of observations, dissertations, journals (containing research papers and reviews), letters, biographies of men of science, academic orations and didactic poetry – not to mention such groups of texts as do not constitute genres properly speaking, for example prefatory paratexts (below, 2.2.3, "Promotion") and translations. To map out this largely uncharted territory constitutes an indispensable prerequisite for any further research.

(b) The communicative impact of Neo-Latin scientific literature will be analysed. As intimated above, effective communication was vital to the success of early modern science. Researchers had to inform each other of new facts over long distances, to explain ideas that were inherently difficult to grasp, to defend notions flying in the face of received wisdom and to promote the utility and importance of their activities in front of sceptical contemporaries. Latin constituted an ideal instrument to these ends: In contrast with a widespread prejudice, the old language

was easily flexible enough to express a host of new findings and concepts (below, 2.2.3, "Naming"). It was understandable to every educated person throughout the continent, ensuring the Europe-wide exchange of facts and ideas. Latin's venerable age and its links to traditional humanism compensated for the shocking newness of early modern science and made it look like a natural continuation of longstanding trends. Finally, Latin's rhetorical tradition (cf. Lausberg 1960; Ueding 1992–2011), which enjoyed unprecedented diffusion in print (c. 12'000 editions of c. 4000 titles from 1460 to 1700: Green/Murphy 2006, cf. Mack 2011) and was absorbed by everyone at school, was perfectly suited to communicate scientific results within and beyond the scientific community. In order to work out the historical significance of Neo-Latin scientific literature, its achievement in bringing science to its readers will be comprehensively analysed.

The realisation of these objectives will alert Neo-Latinists and historians of science alike to the existence and importance of Neo-Latin scientific literature and pave the way for a fruitful collaboration between the two disciplines. It will thus become possible to address numerous desiderata which must needs be left out in the project itself: a library of important Neo-Latin scientific works (with introduction, translation and notes), *opera omnia*-editions of great figures such as Athanasius Kircher, the digitisation and digital exploitation of huge text corpora such as scientific dissertations (Marti 1982), digital dictionaries of the technical languages of various disciplines, to name just a few. Last not least, the elucidation of early modern Latin science will enable a reassessment of the vernacular science which grew out of it and developed in interaction with it. In sum, the project will lead to a better understanding of early modern science as a whole.

2.2. Main research outputs

The project will operate on three levels building one upon the other and stretching from the digital processing of raw materials (2.2.1) to an analytical overview of Latin scientific literature (2.2.2) and to an in-depth analysis of its communicative dimension (2.2.3). Levels 2.2.1 and 2.2.2 will mainly contribute to the first, 2.2.3 to the second of the two above-mentioned objectives. At level 2.2.1, we will furthermore from the beginning reach out to historians of science by presenting the field, pointing out desiderata and inviting collaboration. The same goal will be pursued by advertising the project on its homepage as a contact point for problems with Neo-Latin texts (concerning, e.g., the meaning of single terms, the interpretation of difficult passages or even the translation of shorter works). A series of five workshops (one per year) on pertinent topics – e.g. digitisation of Latin scientific texts; Latin and the vernaculars in early modern science – will also bring Neo-Latinists and historians of science together from the outset. Finally, historians of science will regularly be invited to give guest talks and to discuss their research with the team members.

2.2.1. Documentation: digital tools: A tripartite semantic database (Semantic MediaWiki) for authors, primary texts (constituting the centrepiece) and secondary literature will be compiled by all team members and serve as a working tool for all of them in turn. Similar, if somewhat simpler databases have proved extremely useful in both the *Tyrolis Latina*-project and the LBI. Heuristic problems will be overcome with the help of early modern catalogues such as the ones of the Frankfurt and Leipzig book fairs, genre-specific collections such as F. Oudin's *Poemata didascalica* (1813) for didactic poetry, catalogues such as Marti 1982 for dissertations, general reference works such as the *Dictionary of Scientific Biography* (1970ff.) and the facilities of the net (which allow looking for genre-specific titles such as *Historia plantarum*, for instance). Representativity will be ensured by using the categories of genre, discipline, time and place (of publication) as a heuristic grid. The database will keep growing over the whole project duration, comprising c. 1500 items of primary literature in the end. For each work, the bibliographical data (including early modern editions and vernacular translations as well as an English translation of the full title), a classification in terms of genre and scientific discipline, a general description (including an English version of the table of contents, if one exists) and notes on points of special interest will be given. It will also be indicated if there exists a modern edition/translation or if this is a desideratum. The database will be freely accessible on the project's homepage. Foreign researchers will be invited to contribute data sets of their own which will be integrated after an examination by the team members.

From the works listed in the database, c. 200 particularly typical items will be published online, resulting in a digital sourcebook – the first systematic selection of early modern scientific literature in Latin, providing a clear idea of the whole breadth of the field. Each work will be presented in a short introduction based on the informations given in the database. In addition to a facsimile, the text will be converted into a digitally searchable format, making use of the transcription platform "Transkribus" run by the Digitisation and Digital Preservation Group (DEA) of the University of Innsbruck. If a freely available translation exists, a link to it will be added. Each item will be referenced to similar datasets in the database so that it can be used as a starting point for research in a certain field. After the end of the project, the database and the sourcebook will remain accessible via the Central Computer Service of the University of Innsbruck and the research data repository Zenodo.

2.2.2. Mapping the field: one monograph: The gist of 2.2.1 will be condensed into a monograph to be

written by myself which will provide an analytical overview of the field. The introduction will briefly review early modern science, Latin as Europe's learned language of the time and the interplay between science and Latin, including tensions between linguistic classicism and the need for innovation, the development of the technical languages of the scientific disciplines and the relationship between Latin and the ascending vernaculars. The main part will present a genre-by-genre review of early modern scientific literature in Latin. The treatment of each literary genre will start from an overview of ancient/ medieval models and contemporary related genres (including the vernaculars). Its formal features (length, structure, style, vocabulary, verse or prose) will be described and it will be characterised in terms of content (disciplinary range, level of technicality). The social and institutional environment of the genre and its intended readership will be elucidated and its historical development delineated. In order to substantiate the general analysis of each genre, one typical specimen will be examined in-depth along the aforementioned lines. In its final section, the book will go beyond a simple enumeration and characterisation of genres: It will sketch an overall image of Latin scientific literature as a meaningful *system* whose generic constituents colluded to introduce science to an unprecedented range of environments from universities and courts to learned societies and private households.

2.2.3. Analysis: four interlinked monographs: Each of the four postdocs employed in the project (below, 2.3.1) will pursue her/his own sub-project autonomously which will result in a monograph. These books will pick up where my own breaks off and realise the project's second objective: They will comprehensively demonstrate how Latin literature, drawing on its rhetorical heritage and developing it further in the process, succeeded in bringing science to its readers. The sub-projects are interlinked and overlap at some points, as they describe four stages of this achievement which build upon each other: naming, description and explanation, persuasion and promotion.

Naming: Giving new things and concepts names is an indispensable prerequisite of scientific progress. As a name establishes something as an object of scientific enquiry, what is named and how it is named decisively influences the course a discipline takes. In early modern science, names where overwhelmingly given in Latin, its only linguistic handicap, namely its weakness in word composition, being overcome with the help of Greek wordstems and composition. This was the greatest naming operation in human history up to this point. Its *results* are with us till today and are comparatively well-known, if mainly because of and according to the practical needs of modern scientists (e.g. Nybakken 1959). By contrast, little research has been done on the *process* itself.

This sub-project will first analyse early modern theoretical reflections about naming, which were informed to a large degree by rhetorical concepts (e.g. metaphor, neologism) and humanist preoccupations (how far should unclassical words be tolerated?). Next, different techniques of naming and the reasons behind them will be examined: Was a preexisting word given a new meaning (neologism of sense) or was a new word formed (neologism of form)? Was a new name introduced tacitly or explicitly, by a "stipulative definition" (Robinson 1950, 60)? Finally, three types of names of increasing generality and conceptual importance will be distinguished and separately analysed: first, the plethora of names for newly detected entities in areas such as natural history (including the *systems*, the nomenclatures, they formed); second, expressions such as *technica* ("technology") or *gas* ("gas"), introducing new notions which proved influential beyond the borders of any single discipline; third, meta-concepts such as *inventio* ("discovery") or *experientia* ("experience") which became cornerstones of the modern notion of science in the new meanings they acquired in early modern times and whose history has hitherto, despite their obvious Latin origin, mainly been studied with reference to the vernaculars (cf. Wootton 2015, 251–428).

Description and explanation: Early modern science presented its audience with plenty of new facts and circumstances that were inherently difficult to imagine and to grasp. Scientific authors therefore faced the challenge of imparting their findings as simply, clearly and graphically as possible. This was partly achieved through images, diagrams and mathematical formulas (e.g. Kusukawa 2012). But to produce good images was difficult and costly, and many disciplines were not (yet) amenable to mathematisation. Precise description and explanation in words was therefore indispensable. Theoretical guidance was provided by the rhetorical system which comprised both functions under the heading of *docere* ("teaching"). Precepts for description were primarily given under the headings of *narratio* ("report"), *evidentia* ("graphic depiction") and *ékphrasis* ("exhaustive account"). Help for explanation was offered by instruction for the *genus humile* ("plain style") and for the stylistic virtue of *perspicuitas* ("clarity").

The sub-project will study how this theoretical apparatus was put to different uses in three kinds of scientific writings: Natural historians were as a rule not concerned with explanation, but exclusively with vivid and unequivocal description. Astronomists, physicists and mathematicians, by contrast, whose reasonings were highly abstract and removed from everyday experience, had to put a lot of effort into explaining what they actually meant. While both of these groups primarily wrote for their peers, authors of popular genres such as dialogues or didactic poems addressed a lay audience and had to adjust their descriptive and explanatory techniques accordingly.

Persuasion: Early modern scientific authors often contradicted prevailing opinions and disagreed with each other over crucial issues. If possible, they resorted to incontestable evidence or mathematical

demonstration to decide the matter under discussion. But often, there was no hard proof at hand. In such cases, verbal persuasion was called for. Much has been written about theories of proof and persuasion in early modern science (Serjeantson 2006). But little thought has been given to their rhetorical underpinnings, despite the well-known influence of legal thinking on scientific argumentation (e.g. Daston 2002) and despite the fact that rhetoric was first and foremost a technique of forensic speech. Analysis of how persuasion worked in early modern scientific practice has been confined to a few famous vernacular authors such as Galilei and Robert Boyle. These omissions will be rectified in the present sub-project.

The material basis will be provided by a number of texts from major scientific controversies, for example concerning atomism, the Ptolemaic, Copernician and Tychonic world systems, the nature of fossils or the sexuality of plants. These texts will be analysed according to the three dimensions of rhetorical persuasion: rational argument (*lógos*), the self-presentation of the speaker (*éthos*) and the emotional arousal of the audience (*páthos*). Early modern science made full use of all of these – which is why it often makes for a colourful read, sharply contrasting with the style of modern science. It will thus be studied how authors tried to convince their readers rationally, applying the ramified theory of courtroom argumentation; how they catered for their trust by presenting themselves as well-respected members of the scientific community, as selfless labourers and even as heroes risking life and limb for scientific progress (and their opponents as the opposite); and how they swept their readers off their feet by the evocation of sublime natural spectacles, by the idea that science furthered the understanding of God's plan and, on the stylistic level, by the devices of the "great style" (*genus grande*).

Promotion: Being understandable and convincing was not enough. In an age when science was often satirised as freakish and absurd (Lynall 2012), scientific authors also had to explain why their results were worthwhile in the first place. The need to do so became even more urgent because print had transformed the book into a marketable commodity and science had to sell. The most important medium to further this aim were paratexts (Genette 1987; for Neo-Latin examples, Enenkel 2015). Soon, no important book appeared without a number of preliminary elements such as frontispieces, letters of dedication, prefaces to the gentle reader, letters and laudatory poems addressed to the author by friends and colleagues and so forth. Individually, these texts just advertised the book in question. Collectively, they promoted science as a whole. Once again, the necessary tools were provided by the rhetorical tradition, esp. by its prescriptions for the encomium, the speech of praise.

Starting from a disciplinarily, geographically and chronologically balanced selection of major works with a rich paratextual apparatus (e.g. Ch. de l'Ecluse, *Rariorum stirpium historia*, 1583; F. Viète, *Opera mathematica*, 1646), the topics of early modern science promotion and the rules which governed its use will be disclosed. Key features to be studied include recurring praiseworthy aspects of science (e.g. hard work, usefulness for society, enhancement of piety through better knowledge of God's plan), metaphoric descriptions of science (as heroic endeavour, hunting for truth, unveiling of Nature), the depiction of science not only as something novel, but also as a natural continuation of the humanist tradition, and the presentation of important men of science and discoveries as emblematic figures and foundational acts respectively.

2.3. Project management

The team will consist of myself (50% for years 1–5), four postdoc researchers (100% for years 1–5 each) and one information scientist (50% in years 1 and 5, 20% in years 2–4). All postdocs must have excellent Latin and experience in Neo-Latin studies. Expertise in the rhetorical tradition, in history of science and (for the sub-project on naming) in linguistics will be requested. A degree in the natural sciences will be an additional asset. For the third and fourth sub-projects, two strong candidates, Johanna Luggin and William Barton (cf. B1c), both of whom have dealt extensively with scientific texts in their dissertations, have already declared their interest.

The project will be hosted by the University of Innsbruck. Innsbruck is a leading centre of Neo-Latin studies and extensive experience in conducting long-term projects which involve large amounts of source texts has been gathered there (cf. above, 1, and B1c). The philological, heuristic and organisational problems typical of a major Neo-Latin project will thus all be solvable.

This holds especially for time management. The database, on which work will focus in year one, will be sufficiently filled after that year for work on the monographs to begin. (While writing this application, I have already compiled c. 250 datasets of primary works and more comprehensive lists for genres such as didactic poetry and paratexts.) The monographs will be finished after year four, and one year will be left for the publication process and the setup of a follow-up project (cf. above, 2.1).

The biggest challenge, mustering enough expertise in history of science, will be met as follows: First, I am personally familiar with the field (see B1c); to some degree, the same holds for the two above-mentioned postdoc candidates. Second, more expertise will be acquired by an adequate recruitment policy. Third, an advisory board directed by Prof. Ian Maclean (Univ. of Oxford) and manned with five experts who between them cover most areas of early modern science will be set up. Fourth, the project will from the beginning actively reach out to historians of science (above, 2.2).

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