

**Kepler's Tübingen
Stimulus to a Theological Mathematics**

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Doctor of Philosophy
University of Edinburgh
1995



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in memoriam

Charles German Hooper

16.iv.11 - 22.iii.95
Easter Sunday 1911 - Lent 1995

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declaration

I certify that this thesis and the research contained in it are my own original work, and that I have acknowledged all debts to others.

Edinburgh, 22nd March 1995

abstract

Studies of Johannes Kepler (1571-1630) generally treat him as a precursor of the modern scientist; the influences upon him are identified as Platonist or Pythagorean and his theological interests have been ignored, or considered largely as a mystical aberration, unworthy of serious treatment. There has been no serious attempt to place Kepler's work in the wider tradition of mainstream sixteenth-century thought. An investigation of Kepler's intellectual background in the sixteenth century is thus long overdue and potentially fruitful not only for the better understanding of his work but for an appreciation of the origins of Enlightenment thought. This study seeks to portray and analyse the influences and ideas which permeated the life of the university in Tübingen in the second half of the sixteenth century, paying particular attention to the use of theological concepts, astronomical observations, logical demonstrations and the categories of physics, and to the interplay between them.

After the Reformation the University of Tübingen became the central training institution for pastors, teachers and administrators in the Duchy of Württemberg. This important role shaped the university and encouraged discussion about the merits of teaching the traditional, Aristotelian, curriculum in a university which was dedicated to imparting Lutheran ideals. The roots of this discussion are found in the work of Philip Melanchthon, an important influence in Tübingen. Melanchthon defends the study of philosophy because it prepares people for an orderly and ethical life. An essential part of this study is astronomy, since in Melanchthon's view the observation of the regular movements of the skies can raise the human mind to God and bring an appreciation of the order which God had intended for the world.

Melanchthon's defence of the study of astronomy was probably better known to astronomers than to theologians. However, the work of Melanchthon's student Jacob Heerbrand (professor of theology 1557-1600) abounds with references to the 'Book of Nature' and its manifestation of divine providence. The parallel drawn by Heerbrand between the 'Book of Nature' and the 'Book of the Scriptures' encourages the use of similar methods in the interpretation of both: a careful study of what is actually 'written' in the book, in the language in which the book was 'written'. In his biblical justification for the making of exact observations in astronomy, Michael Maestlin (professor of astronomy 1584-1631) draws on these ideas together with the wisdom tradition of the Old Testament, which explicitly teaches that the structures of the natural world can reveal its creator.

Although Melanchthon exhorted students to study the heavens, he in fact subordinated the resulting conclusions to the authority of Aristotle, although he, like most theologians, submitted Aristotle's pronouncements to the Bible. Not all his contemporaries were prepared to bow to Aristotelian supremacy in physics. Their distrust of scholastic philosophy led some sixteenth-century thinkers to seek a philosophical basis for certainty and to assert the primacy of mathematical over rhetorical proof. However, this could lead to difficulties. Maestlin argued that his observation of the stella nova of 1572 and the comets of 1577-78 and 1580 had demonstrated that these phenomena were above the moon, in contradiction to the teaching of Aristotle, who must therefore be wrong. He drew his conclusions on the basis of Aristotelian principles of philosophical demonstration taught by Andreas Planer (professor of logic 1578-1606).

The example of Maestlin shows that the biblical exhortation to study the heavens, coupled with the use of Aristotelian logic in the derivation of authoritative proof, was in the late sixteenth century already producing results which conflicted with Aristotelian physics, and, ultimately, also with the Bible. For Kepler and his contemporaries the Protestant emphasis on a literal interpretation of the Bible and the seeking of God's providence in nature could easily act as the stimulus to an astronomy in praise of God. The intellectual problems which were to arise from taking seriously the biblical call for observation of the heavens were, however, already in the making.

acknowledgements

In the course of researching and writing this thesis, I have been helped and encouraged by a large number of people. First and foremost I wish to thank my supervisors, David Wright and John Henry in Edinburgh and Jürgen Hübner in Heidelberg, who have all given generously of their time and of their knowledge. I have been fortunate to have three experts in such varied fields to whom I could turn for help in the wide range of questions upon which this thesis has touched. I have been lucky too to have supervisors who have had faith in my ideas and have been prepared to let me work on them in my own way, even when not even I knew where it would lead.

In the areas where my supervisors were as bemused as I was, further expertise was needed. None of my work would have been possible without Roy Pinkerton and the rest of the Latin 1A team, who taught me the language I needed to read my sources, and Lorna Ross, who helped me to gain confidence in its use. I am particularly grateful also to Paolo Crivelli for his help in unravelling some of the mysteries of Aristotelian dialectic. The leaders and participants of the summer school at the Herzog August Bibliothek in Wolfenbüttel in August 1994 also contributed a great deal to my understanding of the broader context of Aristotelianism and its reception in the Renaissance. Among them I would like to thank Eckhard Keßler, Charles Lohr and Luce Giard for their help in clarifying my ideas. Kari Kopperi made helpful comments about the relationship between theology and philosophy in Luther's thought. Sachiko Kusukawa shared with me some of her insights into Melanchthon's natural philosophy. Moreover, I was fortunate enough to have the benefit of Heinz Scheible's encyclopaedic knowledge of Melanchthon's works and correspondence. Herr Scheible gave me access to the resources of the Melanchthon Forschungsstätte in Heidelberg and was kind enough to read and comment upon an early version of chapter two.

This project has involved a considerable amount of time spent in Germany. This would have been impossible without financial support, and I am grateful

to the British Academy, the Deutscher Akademischer Austauschdienst, the Erasmus scheme, the *Evangelisches Stift* in Tübingen and the Herzog August Bibliothek in Wolfenbüttel for making this research possible. The Royal Society and the Gordon Rupp Memorial Fund also assisted with book grants.

Much of the research took place in the *Historischer Lesesaal* at Tübingen's university library. I have much appreciated the friendliness and good humour of Herr Reissenberger, Frau Mieter, Frau Lohss and the other *MitarbeiterInnen* whose names I do not know. I would like, too, to thank Frau Irmela Bauer of the university archive for her help and her interest in my project. Frau Knödler and Herr Gebhardt of the *Stiftsbibliothek* have hunted down books which have lain unread in the *Stift* for decades, if not centuries, and allowed me access to the library outside normal hours. Their help has been much appreciated, and I am only sorry that I could never adequately explain how an *Engländerin* came to be working on the history of the University of Tübingen. Perhaps the finished product will speak for itself.

The finished product owes a great deal to Francisca Loetz and Lucy Bosworth, both of whom read, corrected and commented on earlier drafts, looked up references and sent copies of books and articles which I happened to have left behind in the wrong country. Annette Merz and Irene Pieper filled in few final bibliographical details which could only be obtained in Germany. Naomi West helped with the arduous (and apparently never-ending) task of checking the Latin. David Wright and John Henry corrected the final draft with commendable speed and attention to detail. It is thanks to all this help that I am able to finish now instead of in six months' time. Any remaining mistakes in argument or typing are, of course, my responsibility.

Not all support is of an academic nature. This project could not have come to fruition in its present form had it not been for the encouragement of my friends and family. Discussions with Elisabeth Hartlieb were an unofficial *Doktorantinnen Kolloquium*, where all the problems of writing a thesis could be raised. My flat-mates, Martina Ade and Elisabeth Baldamus, helped to ensure that my life in Germany was not only lived in libraries and archives, and Vicki Palmer, Naomi, Tym and Mark West made sure that I had a family

life in Edinburgh. The members of the English Church in Heidelberg and St Columba's by the Castle in Edinburgh reminded me that life is not all about getting the thesis finished. In the past eighteen months, Francisca Loetz has greatly enriched my life with her love, care, warmth and laughter.

Had circumstances been otherwise, this thesis would have been dedicated to my parents: to my mother, who taught me to think theologically, and to my father, who introduced me to the joys of mathematics. Without their influence I would certainly never have embarked on this project, and I can only thank them for the paths which they opened to my exploration.

This thesis is dedicated to my grandfather, who suffered a stroke while it was in its closing stages and who died the day it was handed in.

introduction

Why should a student of church history concern herself with the history of science? And, indeed, why should any historian of science be interested in what a church historian might have to say? These questions are central to understanding the motivation which has shaped this thesis, and so it is proper that they should stand at its beginning. They are questions which challenge 'traditional' divisions between disciplines, which in many cases originate in fact from the post-enlightenment separation between the humanities and science in general, and theology and the natural sciences in particular. The disciplines of history of science and church history are themselves rooted in the historiographical understanding of the eighteenth and nineteenth centuries, which tended to project its own distinctions and categories onto the past. Thus the clear demarcation between the two disciplines is not a reflection of the intellectual situation as it actually was in the past, but is more a representation of the nineteenth- and early twentieth-century understanding of the relationship between science and theology, which is itself based on a particular philosophical understanding of the truth.

Late twentieth-century philosophical understandings of both science and theology are, however, in a state of flux. Theology has long since been forced by philosophers to look to its epistemological basis, and this process has continued in the present century, with particular challenges being posed to biblical theology by modern philosophy of language. However, science

too is having to examine its foundations. Advances in particle physics have brought the natural sciences too to the point at which physics, in particular, must examine its claims to represent the 'real world'. The radical relativism of Kuhn and Feyerabend has suggested that science can have little or no claim to represent the 'truth' about the 'real world', and that the acceptance of its representations is more a feature of the communities which give rise to its research than a claim to any sort of objectivity.¹ A corrective of this view may be found in positions such as the cautious realism of Hesse, who believes that science is able to come closer to representing an underlying reality, even if it can never offer an exact representation.²

The changing perceptions of science and theology have, not unnaturally, led to a reassessment of the relationship, or relationships, between them, and this has in turn given rise to new attempts to understand how that relationship has looked in the past. It is possible to point to three main trends in this changing historical interpretation. The first, which might be termed the 'confrontational' approach, sees science and theology as mutually antagonistic disciplines with separate areas of interest. It is expressed in theologies such as Barthian neo-orthodoxy, with its dismissal of natural theology, and in the philosophical approach of logical positivism. This confrontational approach found its expression in works such as D White's *History of the Warfare of Science with Theology in Christendom* (1896), a history of the attacks on science by Christian theologians. While it may have something to offer in understanding the relationship between science and theology in the late nineteenth and early twentieth centuries, it relies on a set

¹ P. Feyerabend, *Against Method*; T. S. Kuhn, *The Structure of Scientific Revolutions*.

² M. B. Hesse, *Models and Analogies in Science*, and see also A. F. Chalmers, *What is this thing called Science?*

of assumptions about the nature of science and theology which are inappropriate for describing many historical circumstances, and it fails to take into account the fact that many practitioners of science have themselves been believers.

The second understanding of the relationship between science and theology might be characterised as broadly Wittgensteinian. This sees science and theology as different 'language games' with different fields of interest and 'grammatical rules' but still some possibility of communication or 'translation' between the two, particularly in their methodology.³ It is implicit in the work of theologians such as Soskice, who has argued that science and theology are alike in that they produce metaphors of the same reality, if of different aspects of it. Implicit in these metaphors is a claim to have some reference to the reality they describe.⁴ This approach has the advantage of allowing the truth claims of both science and theology to be taken seriously. It may also serve to remind the historian that on the whole scientists with religious faith do not necessarily divorce their 'scientific self' from their 'theological self', but that they may be influenced in their search by their scientific interests for theological representations of the truth and by their religious interests in the quest for scientific truth. The scientific and the theological are expressions of different aspects of the same reality, and as such they may bring conflict but may also mutually inform. The philosophical approach to the relationship between science and theology has thus moved away from the definition of the differences and the preservation of the distinctions between the two, to an appreciation that while these two disciplines may

3 I. Barbour, *Issues in Science and Religion*.

4 J. M. Soskice, *Metaphor and Religious Language*, especially pp. 97-117.

work with different languages and with different methods, they are still concerned with the perception and description of one reality, and that ultimately the same epistemological concerns - those of seeking to speak the truth about a deeper reality - inform both. Such an approach is useful in that it ascribes to both science and theology a serious quest to understand, and does not make any attempt to judge the relative values of the knowledge reached by either discipline; this study assumes such a philosophical interpretation of the relationship between scientific and theological knowledge, and therefore, seeks to take seriously the range of views held by the scholars under discussion.

The third trend in discussing science and theology takes this a step further by seeing both science and theology as products of an interaction of disciplines, practices and ideas within the culture in which they are produced.⁵ This approach is informed by Kuhn's insight that the acceptance of scientific 'truth' depends upon the scientific community which generates it, but it seeks to assess this approach without Kuhn's historiographical shortcomings.⁶ Nevertheless its analyses tend to be less philosophical, focusing not on epistemological questions but on cultural historical factors. It thus seeks to understand how science, theology and other expressions of culture interact with one another to confirm, but also to change, that culture and each other. This attempt to understand contemporary influences and trends seeks to take seriously and to understand on their own terms the issues and factors which moved and influenced thinkers in their own era, rather than as

⁵ S. Pumfrey, P. L. Rossi and M. Slawinski, *Science, Culture and Popular Belief*, offer one of the few collections of such essays. They comment that 'much of the best new work has yet to move beyond the scholarly journals' [p. xi].

⁶ Kuhn's thesis is based upon a reading of history which has not gone unchallenged: see for example J. V. Field, 'On the Revolutions: Copernicus (1543) and Kuhn (1957, 1962, 1987)'.

judged from the twentieth century. This last approach informs this thesis, although influences other than intellectual trends will not be discussed at length.

Given either of the latter two approaches to the relationship between science and theology, it is immediately obvious that it is no longer adequate to treat the history of science and church history as separate, internally coherent disciplines. Science and theology are not and have never been only isolated exercises carried out in a cultural or intellectual vacuum, but are associated exercises, not infrequently done by the same people. Church history's response to this challenge has generally been to move in the direction of social history, to study the patterns of what was actually practised. In recent years there has been a strong move towards understanding church history in terms of cultural history, but this development has generally concentrated on popular culture, rather than seeking to discover intellectual trends.⁷ Until now systematic theologians and historians of science have dominated discussions about the history of science and theology, and there has been little serious attempt by church historians to investigate this field. This state of affairs has produced several problems. The first is that historians of science generally know little about theology; in particular, many of them seem unable to distinguish between Lutheran theology and Reformed (Calvinist) theology. Thus Hooykaas, in an otherwise useful study of the role of religion in the rise of science, subsumes all the different theological trends of Protestantism under the name of 'reformed theology' and appeals only to

⁷ For some of the results of recent research into the history of Reformation and post-Reformation Germany, see R. P.-C. Hsia, *The German People and the Reformation*, and R. W. Scribner, *Popular Culture and Popular Movements in Reformation Germany*. Hsia offers a useful introduction describing the recent trends of research into the Reformation [*ibid.*, pp. 1-9].

Calvin for the 'Protestant' view of the study of nature;⁸ Brooke too refers throughout his discussion of the Reformation only to an undifferentiated 'Protestantism', and compounds this by writing of 'Reformed' doctrine when referring to Philip Melanchthon, a Lutheran reformer.⁹ This first problem is related to a second, namely that historians of theology have been less concerned to identify theological ideas that might have a bearing on the scientific enterprise, and more concerned with the actual theological controversies in which key figures of church history were engaged. Thus there is little material from which the interested historian of science can draw. A third issue is that of periodisation: although the most influential figures in church history were sometimes contemporaries of, or even identical to, the key movers in the history of science, this has not always been the case. They were sometimes separated by a generation or more. This further complicates the picture, for although it may be possible to know what Kepler or Copernicus thought about theology (or, even more easily, Boyle, Newton, Locke and other seventeenth-century experimentalists and philosophers¹⁰), or what Luther, Melanchthon or Calvin thought about the study of the natural world,¹¹ there has as yet been no attempt to investigate the ideas of, for instance, more minor theologians who might have had an influence on major figures in the scientific revolution. This combination of factors means that such studies of science and theology as are theologically and historically aware, while usually excellent in the analysis they present, often leave gaping holes in their historical succession. Thus Funkenstein's study

8 R. Hooykaas, *Religion and the Rise of Modern Science*

9 J. H. Brooke, *Science and Religion*; reference to Melanchthon on p. 97.

10 For literature on seventeenth-century England, see below.

11 See for example, B. A. Gerrish, *The Old Protestantism and the New*, pp. 163-178 (primarily for the views of Calvin and Luther); G. Frank, 'Gott und Natur' and S. Kusukawa, 'Providence Made Visible' (for Melanchthon's natural philosophy and its theological implications).

manages to move from the middle ages to the seventeenth century almost without pausing to mention the developments of the sixteenth.¹²

The most significant exception to this somewhat theologically naive discussion are a series of studies of the scientific and theological environment of seventeenth-century England. In response to Merton's thesis that there was 'a significant interaction between the ethos of Puritanism and the emerging social institution of science,' a considerable body of work has centred on the theological and ecclesiastical allegiances of the experimentalists of seventeenth-century England.¹³ Practically every modern study on science and religion adds something to this debate, but there are also a number of more detailed studies.¹⁴ This emphasis is in many ways understandable, since experimental science as it is known in the twentieth century undoubtedly came into being in the seventeenth. Moreover, it has its positive side, since it has led to the development of a far more differentiated understanding of English theology and its attitude to nature among historians of science than is yet the case for continental, and especially German attitudes.¹⁵ However, it has also, and more alarmingly, brought with it a tendency to conflate seventeenth-century English theological thought and the 'religious origins of modern science.'¹⁶

¹² A. Funkenstein, *Theology and the Scientific Imagination*.

¹³ R. K. Merton, *Science, Technology and Society in Seventeenth-Century England*, p. xvii. J. Henry, 'The Scientific Revolution in England', briefly summarises the criticism of the Merton thesis and offers the most recent restatement of the possible influence of English Latitudinarianism.

¹⁴ Most of these are articles, but there are several useful collections: see, for example, J. E. Force and R. H. Popkin, *The Books of Nature and Scripture*, R. Kroll, R. Ashcroft and P. Zagorin, *Philosophy, Science and Religion in England 1640-1700*, J. W. Yolton, *Philosophy, Religion and Science in the Seventeenth and Eighteenth Centuries*.

¹⁵ This focus on English theology is probably one reason for the failure to appreciate the differences between Lutheran and Calvinist theology, since these differences were much less influential in England.

¹⁶ Klaaren's book, so titled, is in fact a study of Boyle. Subtitled *Belief in Creation in Seventeenth Century Thought*, it traces the influence of Parisian medieval theology of creation (the work of Oresme, Biel, and others) and the work of John Calvin on beliefs

That this combination of problems may be seriously distorting may be seen from the example of the history of research into the life and work of Johannes Kepler. Kepler is chiefly known for his discovery of the three laws of planetary motion, upon which Newton was able to erect his new dynamics, and the significance of this discovery has meant that he has been, and continues to be, an important subject of research in the history of the natural sciences. Together with Copernicus and Galileo, he is famous for reshaping the way in which the universe was seen and for founding his theory upon observations rather than upon the accepted cosmology based on a combination of Aristotle's and Ptolemy's thought. This led many classical historians of natural science to interpret Kepler as an early example of the modern empirical natural scientist,¹⁷ although an interest in theology and various 'mystical tendencies' in his thought were also noted - and generally treated with a good deal of suspicion.

However, as historians of science themselves came to realise, to describe Kepler as a 'natural scientist' in the sense in which the term is used in the twentieth century, or even with its nineteenth-century meaning, is to root him in an anachronism. Kepler's central project was the search for a harmonising principle for the universe, in the course of which he looked to the properties of the 'Platonic solids'¹⁸ and to the theory of musical

about creation held by thinkers in Boyle's milieu [E. M. Klaaren, *Religious Origins of Modern Science*].

¹⁷ An example of this approach would be Koyré's study of Kepler: A. Koyré, *The Astronomical Revolution*, pp. 117-464.

¹⁸ The Platonic solids are the five convex regular polyhedra, the tetrahedron, the octahedron, the icosahedron, the cube and the dodecahedron. A convex regular polyhedron is a solid the sides of which are made up by regular polygons: the tetrahedron, octahedron and icosahedron are made up of four, eight and twenty equilateral triangles respectively, the cube of six squares and the dodecahedron of twelve pentagons. For Plato's formation and application of these polyhedra to the elements in *Timaeus*, see J. V. Field, *Kepler's Geometrical Cosmology*, pp. 4-16.

harmony.¹⁹ His 'mystical tendency' has raised the question of the influence upon him of Neoplatonism. Although he described himself as Pythagorean²⁰ most commentators would emphasise the Platonic aspect of his thought (and the two are, in any case, not easily distinguishable). Field concludes that 'the philosophical outlook in Kepler's cosmological works seems to be best described by some phrase such as "radical Platonism",²¹ while Caspar claims that 'from the beginning [Kepler's] thinking was stamped with Platonist and Neoplatonist speculation, with Pythagoreanism a very strong impulse for his work.'²² In the context of her work on the influence of magical traditions Yates has asked whether Kepler might not best be understood in terms of the Hermetic tradition.²³ Clarke, in his essay on the scientific revolution in Germany, interprets Kepler's work as a move from 'celestial romance' to 'celestial harmonies'.²⁴ Von Samsonow believes that Kepler's philosophical concepts and epistemology lie in the tradition of Nicholas Cusanus,²⁵ and Westman agrees that 'in emphasising the unity of all things and the probable status of human knowledge Cusanus does anticipate Kepler's theories of knowledge and hypothesis,' although '[Cusanus'] cosmological views are antithetical to Kepler's notion of a finite, perfectly ordered world.'²⁶ Westman's study of Kepler's intellectual roots and early thought attempts to

19 *Ibid.*, pp. 112-126.

20 See for example *Harmonices Mundi* 2.25 (KGW 6. 81).

21 J. V. Field, *Kepler's Geometrical Cosmology*, p. 188.

22 M. Caspar, *Kepler*, p. 44.

23 F. A. Yates, *The Rosicrucian Enlightenment*, pp. 222-223. Field agrees that aspects of Kepler's work may be said to 'look Hermetic' [J. V. Field, *Kepler's Geometrical Cosmology*, p. 188]. His correspondence with the lawyer Christoph Besold, himself a peripheral member of Hermetic circles in Tübingen, offers concrete evidence for this tendency [E. W. Gerdes, 'Keplers theologisches Selbstverständnis', p. 373].

24 W. Clarke, 'The Scientific Revolution in the German Nations', p. 101.

25 E. von Samsonow, *Die Erzeugung des Sichtbaren*, p. 90.

26 R. S. Westman, *Johannes Kepler's Adoption of the Copernican Hypothesis*, p. 170. The 'probable status of human knowledge' refers to Cusanus' doctrine that human knowledge can never be certain.

see Kepler through the eyes of the sixteenth century.²⁷ He analyses the mathematical ideas and physical understanding of Kepler's professor of mathematics, Michael Maestlin,²⁸ and the new approach to physics which arose from Kepler's acceptance of the Copernican hypothesis,²⁹ before tracing the development of the Christian-Platonic tradition of divine simplicity from Pythagoras through Augustine to Cusanus.³⁰ In doing so he gives important indications of the developments within sixteenth-century philosophy which made it possible for Kepler to think as he did.

Thus the larger philosophical issues which guided and shaped Kepler's thought have been well investigated, and Kepler's philosophical approach placed in the long tradition of Platonist and Neoplatonist thought as it was passed down through the thought of Cusanus and other late-medieval thinkers to the sixteenth century. While these studies place Kepler's philosophical approach in the broader intellectual context of the sixteenth-century world which shaped it, seeking to identify the philosophical traditions within which Kepler stood, they do not investigate the direct and more specific philosophical influences upon him from the teachers and thinkers whose ideas he himself encountered.³¹ Moreover, they fail to take into account that Kepler lived in an era in which philosophy was still seen as the servant of theology, and in an epoch which was driven by theological concerns. It is these lacunae which provide the impetus for this study.

27 *Ibid.*, p. 11.

28 *Ibid.*, pp. 15-88.

29 *Ibid.*, pp. 104-137.

30 *Ibid.*, pp. 138-177.

31 That such a study may be useful can be seen from Wallace's analysis of the direct philosophical influences upon the thought of Galileo: W. A. Wallace, *Galileo's Logic of Discovery and Proof*.

As would be expected, there have already been attempts to apply a more culturally sensitive approach to Kepler's thought and milieu. Indeed, Kepler's thought is such that it would be well-nigh impossible to argue that his cosmological considerations were 'purely philosophical' in any post-Enlightenment sense. Kepler saw himself as a 'Priest of the Book of Nature', and believed his astronomical research to be the work of interpreting revelation and glorifying God's creation.³² This theological aspect was central to Kepler's own understanding of his work, but, although it has not usually been totally ignored, it has too often been condemned as 'irrational' by his commentators.³³ Those who are concerned with his philosophical approach are particularly prone to fall into this trap: von Samsonow complains that Kepler's use of the metaphor *sacerdos libri naturae* weakens his philosophy by subordinating it to the power of a religious cult,³⁴ and Westman seems to assert that Kepler's theological interests are to be counted 'fanciful and absurd.'³⁵ Such comments seem to say more about the secular world inhabited by many twentieth-century historians of science and philosophy than about Kepler himself. Of those who have taken Kepler's theological side seriously, some seem strangely reluctant to seek its origins in the mainstream theological thought of his day. Thus, Yates' suggestion that Kepler may best be seen in terms of the Hermetic tradition avoids the challenge of locating him in the theological traditions of his time. Such an approach may uncover - indeed has uncovered - interesting and important

³² Kepler to Herwart von Hohenburg, 26.3.1598 (KGW 13.193): *Ego vero sic censeo, cum Astronomj, sacerdotes dej altissimj ex parte librij Naturae simus: decere non ingenij laudem, sed Creatoris praecipue gloriam spectare.*

³³ Bochner's description of Kepler as 'an unanalyzable compound of rationality and irrationality' is a good example of this approach [S. Bochner, *The Role of Mathematics in the Rise of Science* p. 109]. See also R. S. Westman, *Johannes Kepler's Adoption of the Copernican Hypothesis*, pp. 3-9

³⁴ E. von Samsonow, *Die Erzeugung des Sichtbaren*, p. 91

³⁵ R. S. Westman, *Johannes Kepler's Adoption of the Copernican Hypothesis*, p. 10.

trends in sixteenth-century thought, but it raises the question of priorities. Of course it is important to appreciate the wide range of extra-university activities, but it is also important to understand the range of intellectually acceptable ideas taught within the universities. Kepler's approach can then be placed on this spectrum, and need not be categorised immediately as exotic. Hooykaas' attempt to do this is marred by his relating Kepler, who was educated in the Lutheran faculty at Tübingen, to the Reformed *Confessio Belgica* and to the works of, once again, Calvin.³⁶ While the possibility that Kepler was influenced by Reformed thought cannot be excluded, it would be more plausible to begin by attempting to place him within Lutheran thought, rather than turning immediately to Calvinism, at that time condemned in Kepler's home state of Württemberg.

Some attempt has been made to remedy this situation by Hübner in an important study of Kepler and his theological milieu. This investigates the theological trends of the sixteenth century as well as Kepler's own theological beliefs and their relationship to the confessional theologies which were being established in the wake of the Reformation.³⁷ Hübner's work makes a significant contribution towards understanding Kepler in his theological context and towards analysing the connections between Kepler's theological and scientific concerns. Understandably, however, it concentrates upon the issues which divided the confessions: the theological questions surrounding the Eucharist, the presence of Christ and the question of predestination. Hübner does discuss the theological interpretation of nature and the study of nature, but this is of necessity a minor part of his

³⁶ R. Hooykaas, *Religion and the Rise of Modern Science*, pp. 105-106.

³⁷ J. Hübner, *Die Theologie Johannes Keplers*.

study, and he makes no attempt to analyse the connections between this theology and the contemporary teaching of philosophy.

The starting point of this thesis is, therefore, a wish to identify the breadth of direct contemporary intellectual influences upon Kepler. Clearly it has been necessary to limit the scope of the project, and it seems potentially fruitful to investigate the university of Tübingen, the university at which Kepler was educated. Some work has already been done in this area, and practically every biography of Kepler includes a short consideration of the university of Tübingen, usually concentrating on the teaching of mathematics and physics (and following Caspar in incorrectly identifying Vitus Müller as Kepler's professor of physics³⁸), but making some mention of the theologian Matthias Hafenreffer, with whom Kepler remained in contact throughout his life. Gerdes has completed a brief survey of the influence that Kepler's teachers in Tübingen had on his later work,³⁹ and Seck has published an essay on Kepler's course of study in Tübingen.⁴⁰ Seck's work is best seen in the context of the considerable body of German literature on the history of the university of Tübingen and its place in Württemberg's educational system in the sixteenth century. However, much of this concentrates on the structures of the school system and university rather than the content of courses, and there has been practically no attempt at interdisciplinary study.⁴¹ Since Tübingen's university library and archive have, unlike those of most German universities, come unscathed through the perils of national and international conflict, over-enthusiastic archivists, floods, mice and fires, there is a wealth

38 M. Caspar, *Kepler*, p. 44.

39 E. W. Gerdes, 'Keplers theologisches Selbstverständnis'.

40 F. Seck, 'Johannes Keplers Studium in Tübingen'.

41 Attempts at 'interdisciplinary' studies have tended simply to bring together the study of different disciplines in one volume. F. Seck, *Wissenschaftsgeschichte um Wilhelm Schickard* is one such.

of material to be investigated: a study of the content of the teaching at Kepler's Tübingen is thus not only potentially fruitful but also realisable in fact.

The scope of the work already done on the history of education in Württemberg, on the theological scholarship system, or *Stift*, and the university in Tübingen makes it relatively easy to establish the form and the interests of the system within which Kepler was educated, and to discover who his teachers actually were. This 'scene-setting' exercise, necessary to establish the parameters of the rest of the study, forms the first chapter, and a table of the professors at Tübingen during the second half of the sixteenth century is included as an appendix.

The mass of the material available in Tübingen enables an exact assessment of a range of (published) ideas, but makes it impossible to attempt a full interdisciplinary study of every faculty and subject taught in the university. Given that the starting point of this investigation is Kepler's thought, it seemed reasonable to limit the investigation to the interactions between theology, natural philosophy, logic and mathematics, in particular astronomy, as they appear in the publications of Tübingen's professors, with an emphasis upon the work of those within the faculties of arts and theology. This excludes any consideration of rhetorical proof, which has been shown by Moss to be important in the works of Copernicus and of Galileo,⁴² but which seems in any case to have been less valued in Tübingen.⁴³ It also excludes a proper discussion of ethics and influence of physiological theories

⁴² J. D. Moss, *Novelties in the Heavens*.

⁴³ The types of proof used in Tübingen will be discussed in chapter 4 below.

and hierarchies of perception, which would no doubt be an illuminating addition to the discussion. This thesis thus offers an analysis of the trends in the understanding and teaching of theology, natural philosophy, logic and astronomy in Tübingen at the time that Kepler was a student. But it seeks to do so in an inter-disciplinary way by considering not only the views of each professor on his own subject, but the ways in which contemporary thinkers believed these to interact. Thus theological ideas of the professor of astronomy, Michael Maestlin, and the professor of natural philosophy, Georg Liebler, will be examined as well as those of Jacob Heerbrand and Matthias Hafenreffer, who actually taught theology. Similarly, Maestlin's philosophical understanding and his view of physics will be taken into account, and not only those of Andreas Planer, professor of dialectics, and Liebler, who taught physics.

The complexity of this *Fragestellung* made it imperative that some yardstick be found against which the ideas of the professors at Tübingen could be measured. Ideally this would take the form of a broad survey of these currents of thought and learning in early Lutheranism, but since this would require a thesis for itself, it seemed best that it take the form of the analysis of the thought of one contemporary thinker. Clearly the work of Kepler himself would not be appropriate here, since the aim of this study is to provide a means of placing him in the intellectual spectrum of his time. Philip Melancthon appeared to be the ideal candidate, since as a sixteenth-century 'polymath' he makes an appearance in the history of almost every conceivable intellectual field from Reformation theology through education to science and mathematics; he was an important influence in the development of Lutheran theology; and he was involved in the introduction of the

Reformation in the university of Tübingen. Moreover, since Kusakawa has argued that Melanchthon founded and established a specifically Lutheran attitude towards natural philosophy, it seems reasonable to use him as a measure for other Lutheran thinkers.⁴⁴ Melanchthon's work provides a rich source of philosophical and theological ideas, and he seems himself to have been concerned to draw these together into a coherent whole. Unlike Melanchthon, Luther did not address this wide range of issues, and so it would be virtually impossible to explore the complexity of the issues using his example. Chapter two, therefore, includes a brief survey of Luther's attitude towards philosophy and creation, but focuses on a study of the interaction between philosophical, theological and mathematical ideas in the thought of Philip Melanchthon, and an assessment of the latter's direct influence in Tübingen.

Even after making the decision to limit this study to the interactions between theology, natural philosophy and astronomy, it became apparent that the demands of assessing these aspects of the volume of material available in Tübingen would still make it impossible both to complete an adequate analysis of it and to go on to assess whether and how these trends appear in Kepler's thought. This thesis, therefore, does not set out to be a study of the actual influences of his teachers upon Kepler's thought, in the sense that it does not seek to trace the continuities between the ideas of his teachers and those of Kepler himself.⁴⁵ It is a study of Kepler's Tübingen, of the

⁴⁴ S. Kusakawa, 'Providence Made Visible'. It is hoped that the parameters of this thesis will also allow Kusakawa's claim to be tested.

Both Kusakawa and Hübner have indicated the desirability of tracing Melanchthon's influence on Kepler [J. Hübner, *Die Theologie Johannes Keplers*, p. IV; S. Kusakawa, 'Providence Made Visible', p. 118].

⁴⁵ In any case, it is clear that a study of the making of Kepler's thought would have to look far beyond Tübingen to his later encounters with, for instance, the Jesuits in Graz and Tycho Brahe in Prague.

intellectual milieu - or of some aspects of it - in which Kepler was educated. It seeks to uncover the range of opinions which were held by Kepler's teachers, the ideas against which they protested and those for which they argued, and the ways in which they sought to justify their philosophical and theological positions. In search of these, the textbooks written by Tübingen's professors are, of course, considered, but so are the prefaces to such books, in which the author often explained his theological and philosophical position and used this to justify his work. Printed disputations, which usually take the form of lists of theses provided by the professor to be defended by a student, are useful for indicating which material was deemed important by the professor, and also what was actually being discussed with students. Published orations and sermons can show how a professor placed his own faculty or subject within a wider context. Finally, the printed results of inter- and intra-university conflict are indicative of which positions were considered acceptable, and which were condemned out of hand.

A consideration of this material forms the basis of chapters three and four, which offer an analysis of the content, context and justification of the teaching at Tübingen. This takes place against the background of two major questions. The first is that of the origin of Kepler's notion that he as an astronomer could describe himself as a priest of the Book of Nature: what theological understanding of nature underlies this motif, and how widely was it accepted? The answer is sought in the writings of Jacob Heerbrand and Michael Maestlin, with reference also to works by Nicodemus Frischlin, Georg Liebler, Jacob Andreae and Matthias Hafenreffer. It establishes that these men held a variety of theological attitudes towards nature, but that they were united in assigning it some revelatory capacity. Moreover, the

Augustinian idea of the Book of Nature, as it appears in the theology of Jacob Heerbrand, opens the way to the consideration of nature as a text which must be interpreted, presumably according to humanist principles. This theological, humanist understanding seems to have informed Maestlin's approach to astronomy; it provides a clue to the response to the second, more far-reaching, question which lies behind the study. This question is more epistemological than theological: Kepler's work demonstrates that he had turned away from the authority of Aristotle and other ancient philosophers, and that instead he was happy to accept the authority of his own observations. What made this change possible? How did he learn to judge the authority of his own observations, and what criteria was he taught? The humanist principles which underlie Maestlin's attempts to interpret the Book of Nature require that the correct interpretation of the 'text' be found from a study of the text itself, in its original language, without recourse to other authorities or commentaries; this methodology is analogous to the Lutheran approach to interpretation of God's other book, the Bible. In the case of astronomy, this requirement in turn demands a means of determining the accuracy and truth of deductions drawn from observations, and this draws on the understanding of proof and demonstration which was taught in Tübingen. Thus a theological concern leads through astronomical practice to a logical discussion. The disciplines did not exist in isolation: the history of science is not divorced from the history of theology.

chapter one

Tübingen and the educational system in Württemberg

Johannes Kepler was born in Weil der Stadt on 27th December 1571. Weil der Stadt was a *Reichsstadt*, owing allegiance directly to the Habsburg Emperor rather than to the Duke of Württemberg, by whose duchy it was surrounded. In 1576 Kepler's family moved to Leonberg, a neighbouring town in the Duchy of Württemberg. There Kepler attended the German school and later, from 1578, the Latin School.¹ Despite another move from Leonberg to Ellmendingen and back, Kepler took the *Landesexamen* in Stuttgart on 17th May 1583 at the age of eleven,² gaining a place in Württemberg's scholarship system which assured both his further schooling in the state's monastery schools and his university education. Almost eighteen months later Kepler entered the lower monastery school in Adelberg on 16th October 1584. From there he progressed to the higher school in Maulbronn, which he entered on 26th November 1586, passing his *Baccalaureat* on 25th September 1588. He remained at Maulbronn for a further year before a place became free in the *Stift* in Tübingen. On 3rd September 1589 he took up his place in the *Stift*, matriculating at the

¹ These schools would have been run by the same teacher [*Große Kirchenordnung* (1559), fol. 192^r].

² This was slightly earlier than the norm: the *Große Kirchenordnung* laid down that candidates should be between twelve and fourteen years old [*ibid.*, fol. 143^v].

University of Tübingen on 5th October. Kepler was awarded his *Magister Artium* on 11th August 1591, and continued his theological studies in Tübingen until 1st April 1594, when, with the Duke's 'gnädiger Erlaubnis', he left Tübingen and Württemberg to take up his post as mathematics teacher in Graz.³

The scholarship system in which Kepler was educated consisted of monastery school education followed by the study of theology at the University of Tübingen while living in Württemberg's *Stift*. This system was a product of the Reformation in Württemberg, and was determined by a combination of confessional, humanist and political considerations. Its principal aim was to produce learned theologians, 'knowledgeable about the pure biblical and apostolic writings,' who could be relied upon to preach and teach the Lutheran faith in Württemberg's churches and schools and to be loyal to Württemberg's Duke.⁴

Education was central to the implementation of the Reformation in Württemberg. When Duke Ulrich returned to his duchy in May 1534 after fifteen years of exile, he proclaimed his intention of introducing the Reformation into Württemberg:

to support the preaching of the one, holy, Christian gospel, for the glory of God and the blessedness of our subjects' souls, and also for ours, and to establish and plant it in all ends and places of our duchy.⁵

³ For the dates of Kepler's university career, see Hermelink, *Matrikeln*, vol. 1 [207.81], p. 655. For his school attendance see M. Caspar, *Kepler*, p. 39.

⁴ M. Brecht, 'Konzeptionen der Theologenausbildung', p. 31: the products of this system were to be *der reinen Biblischen und Apostolischen Schriften berich*.

⁵ Cited without source by W.-U. Deetjen, 'Vom Stift zu Tübingen', pp. 21-22: *Die Eer Gottes und unser Underthonen Seel Selickeit, sovil an uns, die ainhellige und christenliche Verkündung des waren, reinen und hailigen Evangelions ze fürden und an allen Ende und Orten unsers Fürstenthumbs ufze richten und ze pflantzen*.

To achieve this it would be necessary to install in churches throughout the duchy 'Christian, protestant pastors or preachers of the divine word and truth,'⁶ whose training and theological views had been examined and approved by the Duke or his representatives. Although some of these positions could be filled by monks and priests who had been convinced by Reformation principles, a deficit of pastors and teachers remained. They would have to be trained. It was, therefore, vitally necessary to develop an educational system which could be relied upon to supply the educated, loyal men who were needed to secure the Reformation in Württemberg and to knit the Duchy into a political and confessional unity.⁷

Ulrich's first priority was to reform the University of Tübingen, which in his absence had been integrated into the anti-Reformation campaign of Johann Faber or Fabri, the Vicar General of Constance, had split into opposing factions supporting the Duke and the Emperor,⁸ and which was certainly not a reliable source of Lutheran pastors and teachers. In the summer of 1534, Ulrich appointed two Reformers who were to introduce the Lutheran Reformation into Württemberg: Erhard Schnepff, who was to be responsible for the north of the Duchy ('unter der Steig'), and Ambrosius Blarer, responsible for the south ('ob der Steig'), and with it the university.⁹ However, Ulrich saw the need for a third Reformer who would concentrate on university and educational reforms, and in the late summer entered into correspondence with Philip Melanchthon in an attempt to persuade him to

6 'Christenlich evangelisch Pfarrer oder Verkünder des göttlichen Worts und Wahrheit': *ibid.*, p. 22.

7 For a more detailed analysis of this project see C. Methuen, 'Securing the Reformation through Education.'

8 H. A. Oberman, *Masters of the Reformation*, p. 244.

9 N. Hofmann, *Artistenfakultät*, p. 4.

leave Wittenberg and come to Tübingen. Melanchthon refused, and in his place his friend and colleague Simon Grynaeus from Basel was appointed.¹⁰ Blarer and Grynaeus arrived in Tübingen in the autumn of 1534, and in mid-November they presented to the university senate a rescript from Duke Ulrich which named them as reformers of the university and called for the senate's support in their task. Grynaeus began the task of developing a new structure for the course of study.¹¹

The recommendations made by Grynaeus and Blarer for the reformation of the University of Tübingen followed the pattern established by Melanchthon's educational programme, which formed the basis for educational reformations throughout Lutheran Germany.¹² Melanchthon's educational emphasis was largely humanist, concentrating on the learning and use of Latin and Greek, and on the importance of being able to read all texts, including the Bible, in their original languages, without relying upon later commentators. The syllabus which he (re-)introduced was based upon the seven *artes liberales*. It thus consisted of the *trivium*, the linguistic arts of grammar, rhetoric, and dialectics or logic, and the *quadrivium*, the mathematical arts of geometry,

¹⁰ Roth, *Urkunden*, pp. 161-163, and see also H. Volz, 'Luthers und Melanchthons Beteiligung an der Tübinger Universitätsreform', pp. 66-67.

¹¹ N. Hofmann, *Artistenfakultät*, pp. 4-5.

¹² Melanchthon's ideas influenced the content of school and university curricula throughout Germany. He was largely responsible for what may be described as scholastic Lutheran thought. It was Melanchthon who formed Luther's ideas into a coherent theological whole. Although his official responsibility was to lecture on Greek, theology and philosophy at the University of Wittenberg, where he was a colleague, advisor and friend of Luther, he also advised several cities and states in Lutheran Germany in the establishment of their school systems, wrote the *Confessio Augustana* of 1530, which was the first Lutheran confession of faith, and devised the *Loci communes*, the standard Lutheran theological textbook, first published in 1521, which remained in use during most of the sixteenth century. That his contemporaries regarded him as a significant voice in the articulation of Lutheran thought can be seen from the extent of his correspondence and the wide range of topics which it addresses. The standard study of Melanchthon's educational project is K. Hartfelder, *Philipp Melanchthon als Praeceptor Germaniae*. For his relationship to Luther see B. Lohse, 'Philipp Melanchthon in seinen Beziehungen zu Luther'.

arithmetic, astronomy and music.¹³ Melanchthon stressed the importance and interdependence of all seven liberal arts, although he also noted their subordination to theology and the gospel. The liberal arts and the classical languages were central to Melanchthon's educational principles, for without the languages the disciplines contained in the *trivium* and *quadrivium* could not properly be studied, and these in turn formed the foundation upon which the higher knowledge of theology, law and medicine could be based.¹⁴ All students had to take their *Magister Artium* in the faculty of arts before they could begin studying in one of the higher faculties of theology, law, and medicine: reform of the faculty of arts was, therefore, vitally important since its syllabus was compulsory for all the university's students. If Lutheran theology and exegesis could be incorporated into the compulsory courses in the faculty of arts, they would reach, not just the theologians, but all students, including those who were intending to study law and medicine. The future of the Reformation would be made more secure. This was the intention of Grynaeus's reforms.

Grynaeus attempted to incorporate the study of Biblical exegesis and the catechism into the programme of all students from the beginning of their academic career by requiring attendance at theological lectures for those studying for their *Baccalaureat* and *Magister Artium*. Not only Greek but also Hebrew should be compulsory, and in all areas emphasis must be laid on the reading and understanding of original texts with a corresponding decrease in the use of compendia. The long-standing division between the *via antiqua*

¹³ Melanchthon's support of the mathematical arts is of particular importance and will be considered in the next chapter.

¹⁴ The liberal arts were basic to all of Melanchthon's reforms from the beginning: see especially his disputations *De artibus liberalibus* and *De corrigendis adolescentiae studiis*.

and *via moderna* was to be removed and the two *viae* moulded into one faculty of arts.¹⁵ Although they were agreed that reform was necessary, the university senate resisted Grynaeus's plans, wishing to restrict reforms to the courses of study, and to exclude questions of faith. The senate refused to require attendance at exegetical and catechetical lectures or to make Hebrew compulsory.¹⁶ However, the Duke's *Reformation vnd neue Ordnung* of 1535¹⁷ accomplished much of what the Reformers had hoped, requiring those studying for their *Baccalaureat* to attend lectures on dialectics, rhetoric, New and Old Testament and Greek, while dialectics, physics and Old Testament were compulsory for students working towards their *Magister*.¹⁸ All students were to attend lectures on Cicero's *De officiis*, mathematics and the catechism. Optional courses were poetics, oration and Hebrew, which was deemed unnecessary for those 'who would dedicate themselves to law or medicine after their *Magister*, or who would concentrate on the liberal arts or mathematics.'¹⁹ The two halves of the *Bursa* were combined into a united arts faculty. The two professors of theology were instructed to lecture on the Old and New Testaments on alternate days, and one of them was to teach the catechism and to lecture on the New Testament to all the students of the university.²⁰ The *Reformation vnd neue Ordnung* also clarified the school system in Württemberg, differentiating between the *Trivialschulen*, which were to teach Latin and basic skills, the

¹⁵ N. Hofmann, *Artistenfakultät*, pp. 5ff. In Tübingen the two *viae* had occupied the two halves of the *Bursa*, which was divided down the middle by a wall. Each *via* had five *Konventoren* and there were also four *Kollegiaten*, and professors of mathematics, Hebrew, Greek, poetics and *Oratoria* [N. Hofmann, *Artistenfakultät*, pp. 6-8].

¹⁶ N. Hofmann, *Artistenfakultät*, p. 5-6.

¹⁷ Roth, *Urkunden*, pp. 176-185.

¹⁸ N. Hofmann, *Artistenfakultät*, p. 11.

¹⁹ Eisenlohr, p. 99: Hebrew was deemed unnecessary for those who *sich nach dem Magisteris uff die Recht oder Artzney zugeben, oder so Inn denn freyen kunsten oder Mathematic zu verharren unnd nit weiter trachten*.

²⁰ *Ibid.*, p. 101.

Pädagogium, a college in Stuttgart which prepared students for entry into the university, and the third school, 'genannt academia oder hohen schule', the four faculties of the university itself.²¹ The higher faculties were left largely untouched, although efforts were to be made to find and employ Lutheran professors, and here too Melanchthon's aid was sought. Lutheran professors were encouraged to come to Tübingen, and by the end of 1535 each of the higher faculties of theology, law and medicine had new professors approved by the Duke and accepted by the university, if reluctantly.²²

These reforms, together with its new statutes and professors, went some way towards assuring the University of Tübingen of its identity as a Lutheran institution, and not only the liberal arts but also Lutheran theology were made central to the studies of all students. However, there were still questions about the university's loyalty to the Duke, and to the Lutheran faith, which had not been resolved by the reforming of the university. The necessity of having competent teachers meant that it proved impossible to remove all the professors whose theology or loyalty were deemed suspect, and although some professors left Tübingen of their own accord after the 1535 reforms, their number included several to whom the Reformers had offered further employment.²³ Further, the reform of the university had done nothing to affect student numbers: there was still a lack of a steady supply of pastors and teachers in Württemberg.

21 N. Hofmann, *Artistenfakultät*, p. 11.

22 J. Haller, *Die Anfänge der Universität Tübingen*, pp. 336-337.

23 N. Hofmann, *Artistenfakultät*, p. 9.

In a conscious attempt to ameliorate this situation, Ulrich established the *Herzogliches Stipendium* or *Stift*. This offered scholarships to 'children of poor, pious people, of hard-working, Christian, God-fearing character and background, and suited for study' who were prepared to study theology and enter the service of the Duke of Württemberg as pastors, teachers, or, more rarely, clerks.²⁴ These students were to be supported by Württemberg's towns: on 5th February 1536, Tübingen's town council was instructed to make arrangements to provide twenty-five Gulden each year to support three students who could not afford to pay for their own studies, and other towns in Württemberg were to make similar amounts available.²⁵

Ulrich's attempts at reforming Württemberg were interrupted by political events. The imposing of the Interim after the defeat of the Schmalkadic League at Mühlberg in April 1547 amounted in Württemberg to the reimposition of Catholicism, reintroducing the Mass, returning the monasteries to the Catholic orders, dismissing pastors and professors from their posts, forbidding critical preaching, and censoring literature.²⁶ It was not until the Interim finally came to an end in 1555 with the Peace of Augsburg that Ulrich's son Christoph was able to continue the reformation of Württemberg.²⁷

Under Duke Christoph the educational reforms and the scholarship system established by his father were extended and moulded into an integrated

²⁴ W.-U. Deetjen, 'Vom Stift zu Tübingen', pp. 22-23: *Stipendiaten* were to be *armer, frommer Leut Kinder und ains vleissigen, cristenlichen, gotzföchtigen Wesens und Anfangs und zu studiern geschickt*.

²⁵ J. Hahn and H. Mayer, *Das evangelische Stift in Tübingen*, p. 14.

²⁶ G. Franz, 'Bücherzensur und Irenik', p. 125.

²⁷ The Interim had been lifted in Württemberg in 1552, but the legislative power of the Duke was severely restricted until 1555.

system which was detailed in the *Große Kirchenordnung* of 1559. This was effectively a new constitution for Württemberg: it regulated the Church, the educational system and all aspects of the state's social existence; it laid down the official faith of the Church in Württemberg, based on the *Confessio Augustana*; it instituted a church order and described the selection and appointment of pastors, preachers, deacons and sub-deacons; it dealt with various aspects of civil life, including marriage, the establishment of a common chest for the support of the poor, the regulation of those practising medicine and the punishment of soothsayers and magicians. Most importantly, it detailed an integrated school system, laying down specific guidelines for the regulation of schools and the instruction of children.

Christoph and his advisors had recognised that the *Stift* in Tübingen could function effectively only if it could build on a good basic education. In order to achieve this it was ordered that a German school for boys and girls should be established in every village,²⁸ with a Latin school in larger villages and towns.²⁹ The remaining monasteries in Württemberg were sequestered for the express purpose of turning them into schools for the education of boys who would later enter the *Stift* in Tübingen to study theology, and their assets were used to fund the necessary scholarships.³⁰ The *Stift* was extended to offer up to a hundred places.³¹ Promising pupils in the Latin

²⁸ *Große Kirchenordnung* (1559), fol. 192^v. All the children in Württemberg were encouraged to attend some kind of school, and teachers and pastors were instructed to scold parents who did not send their children [*Große Kirchenordnung* (1559), fol. 194^{r-v}]. At the German schools, pupils were taught to read and write in German and to know their catechism. Religious education was of central importance and teaching was based on the Christian scriptures, including Psalms, Proverbs, Sirach and the New Testament, and on the catechism [*Große Kirchenordnung* (1559), fol. 192^r-193^r].

²⁹ *Ibid.*, fol. 119^{r-v}.

³⁰ M. Leube, *Geschichte des Tübinger Stifts*, p. 135.

³¹ Leube believes the capacity of the *Stift* to have been 100, based upon his understanding of the *Große Kirchenordnung* [*ibid.*, pp. 135-136]. In a sermon preached to

schools who had completed the third class, or, preferably, the fourth, were to be selected by their schoolmasters and sent to Stuttgart to take the *Landesexamen*. Their suitability was assessed on the basis of testimonials from their pastor and their schoolmaster certifying their 'erudition, intelligence, and good behaviour' and an examination by the head of the *Pädagogium* and one of his colleagues in the presence of one or two church leaders. If a boy was accepted, he swore an oath that he would live according to the statutes of the monastery schools, that he would complete his education by proceeding to the *Stift* in Tübingen to study theology, and that he would remain in the service of the Duke of Württemberg for as long as his services were required in the duchy. The boy's parent or guardian had to declare that he had no objection to his son's following this path.³²

mark the university's centenary year in 1577, Jakob Heerbrand, then Chancellor, states that the *Stift* has been extended from its original size of 70 students to cater for 84 and the *Klosterschulen* to offer places to 154 boys [J. Heerbrand, *Ein Predig von der Hohen Schul zu Tübingen*, pp. 20-21].

³² *Große Kirchenordnung* (1559), fol. 144^r-147^r: *Damit vnd aber hierunder richtige Ordnung erhalten / vnd mit auffnehmung der Studiosen in vnsere Kloster Schulen dester weniger gefehlet / geirret / oder vnqualifizierte zugelassen / So soll ein jeder dermassen / anhaltender Junger / zuuorderst vnd ehe er zu dem hierzu bedachten Examen admittiert / von seinem Pfarrherr vnd Schulmeister / seiner Erudition / Ingenij vnd Wolhaltens / vnd dann vnsern Amptleuten auch Gericht selbigen Orts / seines Alters / vnd seiner Eltern thun / lassens / vnd zeitlichen Vermögens / vnd was er sonst für Geschwisterigt / vnd ob dieselben / vnnd wie Christenlich erzogen oder nit / mitbringen vnd fürlegen. Wölche Testimonia vnsere Pfarrherr / schulmeister / Amptleut vnd Gericht (siuer sie getrawen vnd vermeinen / des Jungen Ingenij halber / ein sollich Beneficium an jme wol angelegt / auch seine Eltern / Votmünder oder pfleger Christenlich gesinnet / Willen / Lust vnd neigung haben / jren Son in das Ministerium kommen zu lassen) Jnen auff jr anlangen mittheilen. Doch sollen sie keinen Jungen / so mit einer heimlichen vnnd abscheichlichen Kranckheit beladen were / zu vnsern Kirchenrath weisen / oder kommen lassen. Vnd so es diser Puncten halb vnserer Ordination nach / als obsteht / kein Mangel / alsdann erst seiner Erudition vor vnsern Deputatis angesprochen vnnd erkundigt werden.*

Also / das alle vnd jede / so in vnsere Kloster Schulen anzunemen / nach dem sie jre Testimonia gnügsamlich außgebracht / in vnser Statt Stuttgarten / durch vnsern Paedagogarcham / vnnd einen seiner Collegen / in beysein zweier / oder auffs wenigest eines / ausser vnsern Kirchenrathen / examiniert vnd erfarn werden / Ober der Lectionum / wölche wir hernacher / in den Klostern zu lesen vnd Zu docieren / sonderlichen bestimpt / fähig / vnd mit guttem nutzen vnnd profectu / one hinderung sein selbs vnd der andern Auditorum / dahin zubefürdern seie oder nit / volgents wie sie jne gewißlichen vnd allerdings befinden / sampt jrem luditio seines Ingenij vnsere Kirchenrath in Schrifften auffgezeichnet berichten.

... Vnd dieweil als anfangs gesetzt / alle vnd jede Jungen / so also in vnsern Klostern vnderhalten / jre Studien gäntzlich vnnd allein dahin zurichten schuldig / Damit sie zu den Kirchen Lehr vnd Predigdiensten / mit der zeit zugebrauchen / So will sich auch

Once a boy had been accepted into the scholarship system his education, his food and all his clothing were provided by the state. He could leave only if he gave an undertaking to repay the money that had been spent on his education, although he could be expelled for misbehaviour or for heretical views.

In this way the monastery schools and the *Stift* were formed into an educational system which produced pastors and teachers who were not only theologically orthodox but who had declared their loyalty to the Duke of Württemberg at an early age, who often came from very poor backgrounds, and whose entire education had been financed by the state. The Duke's scholarship system trained Württemberg's teachers and Tübingen's university professors as well as the Duchy's pastors, and it seems to have functioned extremely effectively. By 1584 the Duke's scholarship was producing more trained theologians than Württemberg could employ as pastors or teachers:³³ virtually all of Kepler's school teachers and university professors were themselves products of the *Stift*.³⁴ By 1583, the year before Kepler entered Adelberg, there were around 185 pupils in monastery schools.³⁵ The *Stift* rapidly became so full that there was a waiting list: from 1564 the higher monastery schools prepared students for the *Baccalaureat* while they were waiting for a place.³⁶

gebühren / das sie darzu jre Eltern / Vormünder / oder nächst gesippte Freund / sich herzu obligiern / in Form nachgemelt.

The oath is given on fol. 145^r-147^r.

33 M. Leube, *Geschichte des Tübinger Stifts*, p. 202.

34 For Kepler's school teachers, see J. Hübner, *Die Theologie Johannes Keplers*, p. 4. The educational backgrounds of his university professors will be discussed below.

35 G. Lang, *Geschichte der württembergischen Klosterschulen*, pp. 93-4.

36 N. Hofmann, *Artistenfakultät*, p. 176.

The significance of the *Stift* extended beyond its immediate purpose of educating students. Through its two superintendents it was integrated into the theological faculty: the first superintendent was the second-ranking professor of theology and Dean of the faculty; the second superintendent held the fourth post in the faculty of theology. The senior professor in the faculty of theology was Chancellor of the university and advisor to the Duke.³⁷ Johannes Brenz, Chancellor from 1534 to 1561, and Jakob Andreae, who held the post from 1561 until 1590, were able to exercise a tremendous influence on the theological development of Lutheranism in Württemberg. Brenz was instrumental in the planning and establishment of the system enshrined in the *Große Kirchenordnung* of 1559, which was based upon his theological principles.³⁸ Andreae was deeply involved in the attempts to reconcile the differences between the different Lutheran Churches, and in 1573 he preached a series of six sermons on the differences which had developed in Lutheran circles since the signing of the Augsburg confession.³⁹ These formed the basis of the discussions which led to the writing of the *Formula Concordiae* of 1577.⁴⁰ The *Formula Concordiae* summarised the doctrine of the Church in Württemberg, concentrating particularly on the disputed questions of the nature of Christ and the theology of the Eucharist, following closely the theology proposed by Brenz in the *Confessio Virtembergia*:⁴¹

37 E. Conrad, 'Die Lehrstühle der Universität Tübingen und ihre Inhaber', p. 4.

38 M. Brecht, 'Johannes Brenz', pp. 170-175; H. Fausel, 'Brenz', col. 1409.

39 'Sechs Christliche Predig, Von den Spaltungen, so sich zwischen den Theologen Augspurgischer Confessio, von 1548 biß auff diß 1573. Jar, nach vnd nach erhaben...': G. Franz, 'Bücherzensur und Irenik', pp. 131-132.

40 M. Brecht and H. Ehmer, *Südwestdeutsche Reformationsgeschichte*, p. 436.

41 W. Jens, *Eine deutsche Universität*, p. 117: *Wir glauben, lehren und bekennen, daß der Leib und Blut Christi nicht allein geistlich, sondern auch mündlich mit dem Brot und Wein empfangen wird, wie solches die Worte Christi klärlich ausweisen.*

We believe, teach and confess, that the body and blood of Christ are received not only spiritually but through the mouth with the bread and wine, as the words of Christ clearly show.

We believe, teach and confess that not only those who have a right faith and are deserving receive the true body and blood of Christ, but also those who are undeserving and unbelieving, but that for them it means not life and comfort, but judgement and damnation if they do not repent and reform.

The formula differentiated the Lutherans from both Catholics and Calvinists, damning the Calvinists and Zwinglians for their beliefs. It became the definitive confessional norm for all those in authority in Württemberg when, on 19th July 1577, Duke Ludwig issued a rescript *Zur Einführung und Unterschrift der Formula Concordiae*:

It is our graces' order that you should read the documents which are sent with this and sign both copies in your own hand at the end of each of the summary extracts and the explanations which follow.⁴²

Every town dignitary, pastor and teacher in Württemberg had to sign, as did the professors of the university.⁴³ Literature also had to conform to the *Formula Concordiae*: The *Große Kirchenordnung* had banned the books 'of re-baptisers, and of all sects which are against the Augsburg Confession.' The Rector and the Deans of the university's four faculties were now instructed to approve the orthodoxy of all the books which were printed in Tübingen before publication, and printers, traders in books and all the

Wir glauben, lehren und bekennen, daß nicht allein die Rechtgläubigen und Würdigen, sondern auch die Unwürdigen und Ungläubigen den wahrhaftigen Leib und Blut Christi empfangen, doch nicht zum Leben und Trost, sondern zu Gericht und Verdammnis, wenn sie sich nicht bekehren und Buße tun.

⁴² *Ibid.*, p. 120: *So ist unser gnädiger Befehl, daß Ihr die hiermit übersandeten Schriften lest und jeweils am Ende des summarischen Extracts und die folgenden weitläufigen Ausführung, die beiden Exemplare mit eigener Hand unterzeichnen.*

⁴³ Philip Apian, professor of mathematics and astronomy, refused to sign the *Formula Conrcordiae*. He had come to Tübingen after being forced to leave Ingolstadt when he declined to sign the Pope's Tridentine Bull. Unable to condemn the teaching of Zwingli as 'eine falsche, verwerfe und verdamme [Lehre],' he was expelled from his post in 1582, although he remained in Tübingen until the end of his life [*Ibid.*, p. 121]. Kepler also had moral objections to this paragraph in the *Formual Concordiae* which led to later difficulties with the university authorities, and were a significant factor in his not being appointed to a professorship [M. Caspar, *Kepler*, pp. 258-264; for more theological detail, see J Hübner, *Die Theologie Johannes Keplers*, pp. 45-59, and especially 108-111].

subjects of the Duke of Württemberg were forbidden to print or circulate 'misleading and seductive books in which the errors of the re-baptisers, the Schwenkfeldians, and the sacramentarians appear.'⁴⁴ The achievement of confessional orthodoxy was the central intention of the *Große Kirchenordnung*, and, as a sermon preached by Heerbrand to mark the centenary of the university in 1577 shows, this continued to be a fundamental aim and intention within the university.⁴⁵ Kepler was educated in an educational system which was not only based upon humanist ideals of scholarship but which was explicitly and consciously dedicated to the promotion of Lutheranism and with it the furthering of theological and political unification and stabilisation of Württemberg.

As might be expected given these concerns, Württemberg's school curriculum was focused on the twin aims of a humanist and a confessional education.⁴⁶ At the Latin school in Leonberg Kepler would have learned Latin from Melanchthon's grammar and by reading Cato, Terence's comedies, and selections from Cicero's letters.⁴⁷ Daily prayers and catechism were integrated into the school day, and the whole school attended church on Sundays and sang in the choir.⁴⁸

⁴⁴ G. Franz, 'Bücherzensur und Irenik', pp. 127-129. The books which are to be banned are *verführische Bücher, darinnen der Widerteufer, Schwenkfelder und Sacramentierer Irrtumben*. The 'Sacramentierer' or sacramentarians are Zwinglians or the Reformed Swiss. See also *Große Kirchenordnung* (1559), fol. 91^r-94^v, under the heading *Von Wiedertäufere und allen Sekten, so unwider die Augspurgischen Confession seind*.

⁴⁵ J. Heerbrand, *Ein Predig von der Hohen Schul zu Tübingen*, pp. 12-14.

⁴⁶ Because the *Große Kirchenordnung* describes the syllabus and timetable of Württemberg's schools in great detail, it is possible to gain a very exact picture of what the schools were intended to teach. The details of the timing of classes and the lists of books to be used are not all of relevance here: they are given in C. Methuen, 'Securing the Reformation through Education.' It is, however, difficult to know how exactly the instructions of the *Große Kirchenordnung* were in fact followed.

⁴⁷ *Große Kirchenordnung* (1559), fol. 123^v-131^v.

⁴⁸ *Ibid.*, fol. 132^v.

On entering the monastery school in Adelberg, Kepler began a life directed towards becoming a pastor in Württemberg. His day was strictly regimented with a strong emphasis on religious observance. The school day was structured around early morning prayers, held at 4.00am in summer and 5.00am in winter, morning prayers at 8.00 or 9.00 and evening prayers at around 4.00pm, and the boys took turns to read the daily lesson, sang in the church choir on Sundays and feast days, and attended communion at least six times each year.⁴⁹ Early morning prayers were followed by *lectio theologica*, in the form of biblical studies which stressed both theological and grammatical analysis and sermons preached by the school principal on the texts under consideration, so that the future pastors could learn homiletics.⁵⁰ These sermons considered the theological issues of the day, which in Württemberg in the 1580s meant the refutation of Zwingli's teaching on Holy Communion.⁵¹ Kepler was deeply affected by this discussion, for he found himself attracted by Zwingli's ideas, and the question of the true presence of Christ in the Eucharist remained one which concerned him all his life.⁵²

In the lower monastery school at Adelberg, Kepler studied Latin grammar and read Cicero's *De amicitia* and *De senectute*. He was also instructed in the rudiments of Greek grammar.⁵³ In Maulbronn he was taught more advanced Latin grammar and syntax, reading Virgil's *Aeneid* and Cicero's *De officiis*, was introduced to rhetoric and dialectics from Melanchthon's textbooks, and studied the Greek texts of Aesop's fables and Xenophon's

49 *Ibid.*, fol. 148^v-150^r.

50 *Ibid.*, fol. 150^r-^v.

51 J. Hübner, *Die Theologie Johannes Keplers*, p. 4.

52 *Ibid.*, see particularly pp. 115-119.

53 *Große Kirchenordnung* (1559), fol. 150^v-151^r.

Paideia.⁵⁴ To practise the skills they had learned, the boys took part in *exercitio styli* which comprised the composition of poetry, prose pieces, and letters, and the use of various dialectical and rhetorical forms in argument, disputation, and declamation as a preparation for a university career.⁵⁵

The mathematical sciences were not part of the syllabus as it was described in the *Große Kirchenordnung*. However, the pressure on places in the *Stift* meant that most scholarship students were prepared for the *Baccalaureat* examination while they were still at the higher monastery schools, and this entailed a minimum of three semesters' study of either Aristotle's *Organon* or Agricola's *De inventione dialectica*, rhetorics, Aristotle's *Physics*, and Euclid's *Elements*.⁵⁶ Kepler must, therefore, have begun learning mathematics while he was still at school, but Euclid does not seem to have played a central role in his school career, and it is far from clear that he had been introduced to astronomy before he arrived in Tübingen.

On his arrival in Tübingen, Kepler took up his place in the *Stift* and entered the university to study towards his *Magister Artium*. The requirements, or *lectiones completoriae*, for the *Magister Artium* were further study of dialectics, using either Aristotle's *Organon* or Rudolf Agricola's *De inventione dialectica*, together with lectures on Aristotle's *Ethics* and his *Physics*, on the Old Testament, on Cicero's *De officiis*, and mathematics, including astronomy under the title of *sphaerica et theoricæ planetarum*.⁵⁷ Optional

54 *Ibid.*, fol. 129^r-131^r, 150^v-151^r.

55 *Ibid.*, fol. 129^r-131^r; see also N. Hofmann, *Artistenfakultät*, p. 162.

56 N. Hofmann, *Artistenfakultät*, p. 172.

57 N. Hofmann, *Artistenfakultät*, p. 124. *Sphaera* meant the structures of the universe, and the mathematics necessary to understand them, while *theoricæ planetarum* explained the apparent movements of the stars in terms of circles, epicycles and so on.

studies, or *lectiones liberae*, consisted of poetics, rhetoric and Hebrew, although the latter was obligatory for the scholarship students, or *Stipendiaten*. The *Novissima Statuta* (ca. 1587) recommended the private reading of classical and modern Latin works to complement the university lectures.⁵⁸

Lectures were central to the imparting of both ideas and material. Lectures followed the text upon which they were based and consisted in part of dictation which gave the students access to the most important sections of the text, overcoming the lack of readily available texts, while allowing the professor to highlight what seemed to him to be the most important points.⁵⁹ Emphasis was laid upon the accuracy of the text,⁶⁰ and professors expounded the text under consideration by commenting on its grammatical and syntactical form, discussing its etymology and using examples from all areas of knowledge.⁶¹ In this way a lecture could become the basis for the study of a particular subject which at first sight had little or no connection to the text under consideration.⁶²

The exegetical style of the lectures meant that it was impossible to begin with easier concepts and progress to harder, and it was recognised by

⁵⁸ *Ibid.*, pp. 121-122 This suggestion was made in part as a response to the debate over the merits and demerits of the *autores prophani*.

⁵⁹ *Ibid.*, pp. 142-143.

⁶⁰ A. Grafton, *Joseph Scaliger*, p. 3.

⁶¹ N. Hofmann, *Artistenfakultät*, p. 143.

⁶² Commentaries on classical texts could easily become introductions to classical literature, history or culture [A. Grafton, *Joseph Scaliger*, p. 16]. In Tübingen in the 1560s and 1570s, Jakob Schegk's lectures on Aristotle's *Organon* attracted medical students because of the number of medical examples he used [N. Hofmann, *Artistenfakultät*, p. 143], and the lectures on astronomy given by Nicodemus Frischlin, professor of poetics, in Philip Apian's absence owe more to classical authors than to astronomical works. Frischlin's astronomy, which is based on these lectures, will be discussed in more detail in later chapters.

professors that what they were explaining might be beyond the capacity of some, if not all, of their students. Schegk commented in his lectures on Aristotle's *Analytica priora*:

I couldn't leave this bit out, although you can't really understand it yet. But still, if you pay attention to my commentary, you will understand it. I can't pour it all in with a funnel.⁶³

In an attempt to solve this problem, lectures were complemented by *repetitiones*, in which the material covered was reviewed under the supervision of a *Magister*.⁶⁴ The professors were also expected to review their material: from 1560, they were instructed 'not only to lecture diligently, but to hold frequent public repetitions' of the material. Private tutors were also allowed to offer *repetitoria*, but in the late 1580s they were forbidden to review material in any form other than that in which it had been presented in lectures or to express an opinion contrary to that of the lecturer.⁶⁵

Students were obliged to take part in the *exercitia dicendi*, which were intended to help them absorb what they had learned by writing compositions, poetry, and orations or declamations and by arguing theses in disputations. These had been given new emphasis under the *Novissima Statuta* in about 1587.⁶⁶ As laid down in the 1557 *Vorschriften*, they took the form of a five-week cycle, which between 1560 and 1603 was organised and overseen by Martin Crusius,⁶⁷ a task which brought him into contact with every student in the arts faculty. Crusius was responsible for setting themes, correcting

⁶³ J. Schegk, *Explicatio in priorem librum Priorum Analyticorum Aristotelis*, p.6: *Non potui praeterire haec hactenus, etiamsi iam non potuistis omnia forte intelligere: tamen, cum acceperitis mea commentaria, intelligetis. Ich kans nit mit eim Traechter eingessen.*

⁶⁴ N. Hofmann, *Artistenfakultät*, p. 168.

⁶⁵ *Ibid.*, p. 169. This instruction was almost certainly a result of increasing concern about the theological orthodoxy of the university, which also brought with it censorship of books and publications.

⁶⁶ *Ibid.*, p. 122.

⁶⁷ *Ibid.*, p. 163.

compositions and supervising the declamations and disputations. Themes were given out one week; the next week the declamations were corrected and approved; in the third week the students gave orations in Latin or Greek, or composed poems of different kinds. The remaining two weeks were devoted to disputations.⁶⁸ Declamations might be in Latin, Greek or Hebrew; their rhetorical form followed that which the students had learned from studying Cicero.⁶⁹ Disputations were held under the auspices of the Dean of the faculty of arts, a post which was held by each professor in turn for one year.⁷⁰ They were led by the *Präses*, an MA who was informed of his task two weeks before he was to chair a disputation. The professor proposed a question together with a list of theses to be defended; the *Präses* then prepared four theses, one of which he assigned to each of four students. The student defended the thesis against the combined powers of the assembled faculty: the Dean, the professors, MAs who were continuing their studies in the higher faculties, and other students.⁷¹

A *Stipendiat* attended lectures and took part in the *exercitia dicendi* in the faculty of arts but lived in the *Stift*, where he led a strict religious life similar to that in the monastery schools.⁷² The teaching staff of the *Stift* consisted of the *magister domus* and two superintendents. Unlike the superintendents, the *magister domus*, although expected to have taken his master's degree

⁶⁸ *Ibid.*, p. 160: *Facit ergo id etiamnum hodie: 1mo sabbato proponendo materiam dicendi: altero, corrigens declamationes et subscribens: tertio, aliquot adolescentibus orationes recitantibus. Componunt Latinas et Graecas orationes: componunt carmina Latina et Graeca, saepe varij generis: Tractantur sic quotannis. 7. aut. 8. materiae. Has tres aut. 2. posteriores, Sabbatinos dies, praecedit exercitium Physici, Disputationem proponentis: et eosdem dies sequitur Disputatio Magistrorum.*

⁶⁹ *Ibid.*, p. 161. Each had to be corrected by Crusius, which by 1593, when there were up to 80 candidates, had become a well nigh impossible task.

⁷⁰ Hofmann lists the Deans of the faculty [*ibid.*, pp. 229-232].

⁷¹ *Ibid.*, p. 165.

⁷² *Große Kirchenordnung* (1559), fol. 168^v-169^v.

and studied theology at the University of Tübingen,⁷³ was not a member of the faculty of theology, and from 1557 until 1618 this post was held by the professor of ethics. The *magister domus* was responsible for supervising the daily life of the students, ensuring that they attended lectures and completed their *exercitio styli*, and was also expected to examine each student regularly to assess his progress and to note any immoral, unruly or blasphemous behaviour.⁷⁴ The two superintendents were also expected to maintain close contact to the *Stipendiaten*. The head of the *Stift* generally held the posts of second *ordinarius* in the faculty of theology and Dean of the *Stiftskirche*, while his junior was the faculty's *extraordinarius*.⁷⁵ They and their families were expected to live in the *Stift*, the superintendents were to be present as much as possible, especially at meal times; they were to attend the disputations and sermons given by *Stipendiaten* and to give special lectures in theology which *Stipendiaten* were expected to attend in addition to their university studies.⁷⁶ These had originally dealt with Melanchthon's *Loci communes*, in the form of Spangenberg's *Margarita theologica*, but from around 1582 they were based on Heerbrand's *Compendium theologiae*. The *Stipendiaten* also attended lectures on the Epistles to Timothy and Titus, which were intended to give them an understanding of their future ministry and special *repetitiones* in the *Stift* which were led by the *magistri repetentes* or *Repetenten*, who were appointed from among those *Stipendiaten* who had already taken their master's degree.⁷⁷ These classes covered Greek, Hebrew, mathematics, physics, rhetoric, dialectic and ethics. They were

73 *Ibid.*, fol. 183^v-184^r.

74 *Ibid.*, fol. 184^r-185^v.

75 E. Conrad, 'Die Lehrstühle der Universität Tübingen und ihre Inhaber', pp. 8-9.

76 *Große Kirchenordnung* (1559), fol. 185^v-187^v.

77 *Ibid.*, p. 165^v-166^r. The *Große Kirchenordnung* provides for the appointing of six *Repetenten*, but the quarterly reports list seven.

attended by all the *Stipendiaten* who were attending the arts faculty, and the grade achieved by each student in the subjects covered by the *Repetenten* was sent to Stuttgart every quarter.⁷⁸

Stipendiaten who had taken their master's degree entered the faculty of theology. The *Große Kirchenordnung* instructed that they were to continue their language studies while attending theological lectures:

After completing his Masters degree, each student should immediately begin attending lectures in theology alongside the study of the Greek and Hebrew languages and should practise preaching in the *Stift*, for as long and until he should be called to the ministry of one or more churches.⁷⁹

Students were expected to continue attending disputations and declamations in the faculty of arts, paying particular attention to the principles of dialectics and rhetoric in order to improve the argument and style of their preaching.⁸⁰ Their progress was reported to Stuttgart in the form of grades for preaching and for *exercitio styli*,⁸¹ and later also for Hebrew⁸² and conduct.⁸³ The overwhelming majority of students remained in the *Stift* and continued their theological studies at the faculty of theology until they could be offered a

⁷⁸ These *Quartal Berichte*, or quarterly reports, were sent on *Sebastiani* (20th January), *Georgii* (23rd April), *Magdalena* (22nd July) and *Lucae* (18th October). They are now in the *Stift's* archives. They list the names of the *Repetentes* for Greek, Hebrew, mathematics, music, physics, rhetoric, and dialectics, and report the progress of the students in ethics (*E*, or *Eth*), dialectics or logic (*D* or *Lo*), Greek (*G*), Hebrew (*H*), mathematics or astronomy (*Ma*, *Ast*, or *S* - for *Sphaera*), and physics (*P*). The *Stipendiaten* may have reviewed their ethics lectures with the *Magister Domus*. Possible grades were A, a, B and b: most students normally achieved A or a.

⁷⁹ *Große Kirchenordnung* (1559), fol. 168^r: *Es soll ein jeder nach erlangtem gradu Magisterij im Studio Theologiae ... one verzug die Lectiones Theologicas fleißig neben dem studio graecae & hebraicae linguae zuhören unnd mit predigen im Stipendio sich zu üben ... so lang und biß dero einer oder mehr zum Ministerio erfordert würdt.*

⁸⁰ *Ibid.*

⁸¹ Quarterly reports, *Stift* archive: grades are given for *Co* or *Conc* and for *Ex* or *Stud*. The former refers to *concio*, or preaching; the latter to the *exercitio styli* or to *studium*.

⁸² *Heb* first appears in the quarterly report for *Lucae* (18th October) 1593.

⁸³ *Mores* first appears at *Sebastiani* (20th January) 1594.

position in a parish or a school, although a few completed their doctorate in theology.⁸⁴

Lectures at the theological faculty were primarily structured around biblical exegesis, on the basis of which the professors addressed theological issues. The Duke's decree of 1587 laid down that lectures should cover the Pentateuch, the prophets, the Pauline epistles, Heerbrand's *Compendium theologiae* and Melancthon's *Loci communes*.⁸⁵ This pattern of lectures continued into the early seventeenth century, with occasional excursions into other books of the Old and New Testaments.⁸⁶ The study of theology was geared to preparing its students for parish ministry, and, most importantly, to preach the gospel. Professors were encouraged to tell their students how to interpret the passages under consideration:

Since the students of theology will in general be employed in the service of the Church, and since they do not learn to understand the Holy Scriptures only for themselves, but should also teach others to understand and to find in it their salvation through God's grace, it is necessary that a professor of theology, when he has interpreted and explained a chapter of the Old or New

⁸⁴ The study of theology did not have a fixed duration, and it could not be concluded by a formal university examination other than a doctoral promotion. In an attempt to ensure that there would be enough well-educated theologians to supply the theological faculty and to fill important church positions the *Große Kirchenordnung* laid down that there should always be at least four *Stipendiaten* preparing for their doctorate in theology [*Große Kirchenordnung* (1559), p. 168]. The names of these 'Stud. theol.' are listed in the *Stift's* quarterly reports, and Kepler was never one of them. Since there was no theology degree as such, and an examination did not mark the end of this period of study until the 17th century [J. Hahn and H. Mayer, *Das evangelische Stift in Tübingen*, p. 108], it is misleading to remark, as several commentators have done, that Kepler left Tübingen without completing his degree. Seck suggests that *Stipendiaten* had to take an examination before the *Konsistorium* in Stuttgart before they could be employed as pastors or teachers, which he equates to the modern German *kirchliches Examen* [F. Seck, *Wilhelm Schickard*, p. 17]. This examination certainly existed: all potential teacher and pastors had to demonstrate their orthodoxy, suitability, knowledge and teaching or preaching ability in Stuttgart [*Große Kirchenordnung* (1559), pp. 98-99, 135]. However, since the *Stipendiaten* had been continually assessed on these points it is quite likely that they were exempted from an examination as such. Certainly, the *Große Kirchenordnung* makes no mention of its being expected of them.

⁸⁵ C. von Weizsäcker, 'Lehrer und Unterricht an der evangelisch-theologischen Facultät der Universität Tübingen', p. 37.

⁸⁶ *Ibid.*, p. 22, and see also pp. 30-32.

Testament as well as he can, should immediately point out to his audience the most important theological points (*loci*) of this chapter, and tell them according to the precepts being taught how and in what form these points are to be interpreted in the church, and which it is most useful to include in a sermon, so that the theology students are prepared for the service of the church and practised in the preaching of useful and comprehensible sermons.⁸⁷

Practical skills and contemporary issues were not neglected: particular attention was paid to instructing students in the *theologia practica*, and the weekly disputations were concerned with the controversial theological issues of the time.⁸⁸

Kepler's professors at Tübingen in the arts faculty included Martin Crusius, a renowned humanist, who had been educated in Ulm and Strasburg before arriving in Tübingen.⁸⁹ Crusius was responsible for the *Lectio linguae Graecae sive poetices Graecae*,⁹⁰ teaching Homer three days each week, working his way through the *Iliad*, the *Odyssey*, the *Batrachomyomachia*, Homer's hymns and epigrams and lecturing on Thucydides on the remaining days.⁹¹ He knew not only classical and New Testament Greek, but also modern Greek, and was thus of central importance in the correspondence

⁸⁷ *Herzogliches Memorial*, 1556: cited S. Raeder, 'Jakob Heerbrand', p. 87: *Nachdem auch die Studiosi Theologiae fürnehmlich zu dem Kürchendienst uferzogen, und nit allein die Hailige Schrift für sich selbst zu verstehen lernen, sondern auch andere zu verstehen und Ihr Hail daraus durch Gottes genad zuerholen leren sollen, Hierauf, wie die Notthurfft erhaischen, das ein jeglicher Professor Theologiae, Nachdem er ein Caput vel Veteris vel novi Testamenti seins Vleiss interpretirt, und ausgelegt, gleich darauf den Auditoribus die fürnämbssten locos derselben capitis anzeige, und sie iuxta praecepta dicendi berichte, wie und wülcher gestalt die bemelte loci in der Kürchen zutractiren, und den Predigtkindern nutzlich fürzutragen sey, damit die studiosi Theologiae zu den Kürchendiensten beraittet und in Iren Predigten nutzlich und verstendtlich Disposition zuhallten angefiert und geübt werden.*

This passage also appears in the *Universitätsordnung* of 15th May 1557.

⁸⁸ C. von Weizsäcker, 'Lehrer und Unterricht an der evangelisch-theologischen Facultät der Universität Tübingen', p. 33. He does not give details of what was understood by 'theologia practica'.

⁸⁹ H.-M. Decker-Hauff and W. Setzler, *Imagines Professorum Tubingensium*, vol. 2, pp. 133-134.

⁹⁰ N. Hofmann, *Artistenfakultät*, p. 248.

⁹¹ *Ibid.*, p. 143. The *Batrachomyomachia* is a fragmentary text attributed to Homer but not by him.

between Tübingen's Lutheran theologians and the Orthodox Patriarch in Constantinople.⁹² His interests extended well beyond his own teaching, for he was also the author of a study of Melanchthon's *Rhetoric*;⁹³ he translated numerous sermons into both Latin and Greek for a four-volume collection which provided sermons on the gospel passage set for each Sunday in the church year;⁹⁴ and he had an avid interest in mathematics and astronomy.⁹⁵ Crusius's contact with Kepler was close enough for them to correspond sporadically after Kepler's departure from Tübingen to take up his position in Graz.⁹⁶

Kepler himself records his interest in lectures on Aristotle's *Physics*, *De coelo*, and *Analytica posteriora* in the faculty of arts, and claims to have neglected his *Ethics*.⁹⁷ Aristotle's *Ethics* was taught by Samuel Heiland until 1592, and thereafter by Veit Müller. Both Heiland and Müller had been educated in Tübingen's *Stift*, and both held the post of *magister domus*. Thus, although Kepler claims to have avoided ethics, it must have been difficult for him to escape it entirely, and his marks in the *Stift's* quarterly reports show that he at least attended the *repetitiones*.⁹⁸ Aristotle's *Physics* and *De coelo* were taught by Georg Liebler,⁹⁹ whose textbook, *Epitome philosophiae naturalis* summarises the main points of the *Physics*, *De coelo*,

92 E. Gerdes, 'Keplers theologisches Selbstverständnis und dessen Herkunft', p. 371.

93 *Ibid.*, p. 372.

94 M. Crusius (ed), *De corona anni*.

95 This may be seen from the marginalia in books from his library.

96 *Ibid.*, p. 371.

97 J. Kepler, *Selbstzeugnis*, pp.328-329: *In philosophia textum Aristotelis ipse legit [Keplerus], quaestiones conscripsit in Physica, Ethica fere neglexit, sic et topicis neglectis analytica posteriora sumsit.*

98 For the holders of the lectureship, see N. Hofmann, *Artistenfakultät*, p. 245.

Caspar suggests that Vitus Müller was an importance influence on Kepler [M. Caspar, *Kepler*, p. 44], but he believes him to have been professor of physics. Since Müller taught the ethics that Kepler avoided, this seems unlikely.

99 N. Hofmann, *Artistenfakultät*, p. 246.

Meteorologia and *De anima*. Liebler was himself a product of Württemberg's scholarship system, having studied in the *Stift* from 1537 until 1547 when he was made a pastor in Derendingen. During his theological studies, he had accompanied Erhard Schnepff to the religious summit in Regensburg;¹⁰⁰ he was certainly not uninformed about the theological issues of his day. Lectures on the *Analytica posteriora* were given by Andreas Planer, professor of logic or dialectics, who was concurrently a professor of medicine. Planer had not been a member of the *Stift*, but he had taken his *Magister* in Tübingen and had been a student at Tübingen's medical faculty. From 1571 to 1578 he taught logic and medicine in Strasburg, before returning to Tübingen as professor of logic and of medicine.¹⁰¹ Planer followed in the tradition of Jacob Schegk, who had also taught both logic and medicine from the 1550s until 1577, but Planer seems not to have been as theologically interested as Schegk. The latter had originally studied theology and who had been a priest under Fabri in Constance before the Reformation. After the Reformation, he studied medicine and became a professor in Tübingen's arts faculty, but he never lost his theological interest, publishing tracts on the Eucharistic debates as well as medical and logical treatises. Before being made professor for logic, Schegk had taught natural philosophy from 1536 until 1552.¹⁰² Schegk had taught almost all Kepler's professors in the arts faculty, including Heiland, Müller, Planer and Liebler, and also Michael Maestlin, professor of Kepler's favourite subject, mathematics.¹⁰³

¹⁰⁰ H.-M. Decker-Hauff and W. Setzler, *Imagines Professorum Tubingensium*, vol. 2, p. 146.

¹⁰¹ *Ibid.*, pp. 150-151.

¹⁰² *Ibid.*, pp. 134-135, and see N. Hofmann, *Artistenfakultät*, p. 7-8; 13-14.

¹⁰³ Schegk therefore warrants more attention than he will receive in this thesis, which concentrates on the professors who actually taught Kepler.

Maestlin, who was responsible for the *lectio mathematices et astronomiae* and the *lectio Euclides arithmeticae et geometriae*,¹⁰⁴ was an important influence on Kepler and a life-long friend. It was Maestlin who introduced Kepler to the Copernican system and guided Kepler's studies in mathematics. Mathematical teaching at the university centred on knowledge of astronomy, which included geography, and the *Stipendiaten* were examined on their knowledge of *sphaericae et theoricae planetarum* rather than on Euclid's *Elements*, which they had covered for their *Baccalaureat*.¹⁰⁵ Maestlin too had studied at the *Stift*, and had been *repetent* for mathematics before going on to become pastor in Backnang from 1576 until 1580. Thereafter he held the post of professor of mathematics in Heidelberg for nearly four years before returning to Tübingen.¹⁰⁶ Apian, Maestlin's predecessor, had studied in Strasburg before moving to Ingolstadt as professor of mathematics. Cellius, professor of poetics and history, was another product of the University of Tübingen.¹⁰⁷

A similar pattern was to be found in the faculty of theology. This was normally staffed by four professors.¹⁰⁸ In 1589, when Kepler arrived in Tübingen, Jakob Andreae was still senior professor of theology and Chancellor of the university, as he had been since 1561, but his role as Duke's advisor meant that he was frequently away from Tübingen, and his

¹⁰⁴ N. Hofmann, *Artistenfakultät*, pp. 247, 249.

¹⁰⁵ The *Stift's* Quarterly Reports list the grade for mathematics under the heading *A* or *Ast* (*astronomia*) or *S* or *Sph* (*sphaera*). In the lecture list for 1625 Maestlin lists the *lectio Sphaerica &c et Theoretica* as compulsory (*completoribus*) for those studying towards the MA, while the *Lectio Arithmetica & Geometrica* is *libera*, or voluntary [UATü 15/7a, fol. 11].

¹⁰⁶ H.-M. Decker-Hauff and W. Setzler, *Imagines Professorum Tubingensium*, vol. 2, pp. 147-148.

¹⁰⁷ *Ibid.*, pp. 128-129; 133.

¹⁰⁸ E. Conrad, 'Die Lehrstühle der Universität Tübingen und ihre Inhaber', pp. 5-9 lists the professors and their posts. Further details are taken from the Duke's decree of 1587, cited in C. von Weizsäcker, 'Lehrer und Unterricht an der evangelisch-theologischen Facultät der Universität Tübingen', p. 37.

lectures on the Pauline epistles were often given by the *professor extraordinarius*, Johannes Brenz (junior). Andreae had been a *Stipendiat*, after completing his *Doctor* in theology he had become theological advisor to Duke Christoph and had represented Württemberg in theological matters on countless occasions.¹⁰⁹ The second professor, superintendent of the *Stift* and Dean of Tübingen's parish church was Jakob Heerbrand, who lectured on the Pentateuch. Heerbrand was the only one of Tübingen's professors of theology not to have been educated in the *Stift*. Born in Ulm, Heerbrand had been a student of Melanchthon's in Wittenberg before moving to Tübingen as a deacon before the *Interim*. In 1551 he attained his *Doctor* in theology, and represented Württemberg at the council of Trent. From 1557 he was professor of theology in Tübingen.¹¹⁰ Stephan Gerlach covered the prophets; he was pastor of the parish church and third professor of the faculty. Lectures on Heerbrand's *Compendium theologiae* and Melanchthon's *Loci communes* were given by Georg Sigwart, who had been appointed as *professor supernumerarius* to ease the burden on the faculty during Andreae's absences. After Andreae's death in January 1590 Heerbrand became senior professor, continuing to lecture on the Pentateuch. In November, Gerlach was appointed Dean of the parish church and Superintendent of the *Stift* and instructed to lecture on the Pauline epistles and Hebrews, beginning with Ephesians. Brenz took over the lectures on the prophets although he was not appointed *professor ordinarius*, and Sigwart was made *extraordinarius*, and, exceptionally,

¹⁰⁹ H.-M. Decker-Hauff and W. Setzler, *Imagines Professorum Tubingensium*, vol. 2, pp. 127-128; see also M Brecht, 'Jakob Andreae', pp. 672-679, and G. W. Forell, 'The Formula of COncord and the Teaching Ministry', pp. 39-41.

¹¹⁰ H.-M. Decker-Hauff and W. Setzler, *Imagines Professorum Tubingensium*, vol. 2, pp. 142-143; S Raeder, 'Jakob Heerbrand', 524-526.

minister of the parish church.¹¹¹ In July 1591 Brenz left Tübingen and discussions between the university and Duke Ludwig ensued which culminated in the appointment of Matthias Hafenreffer, former *Stipendiat* and court preacher, as third *professor ordinarius* and second superintendent of the *Stift*. He was responsible for the *lectio prophetarum*.¹¹² The four professors of theology were responsible not only for lectures in the faculty of theology but for preaching the morning and evening sermons in the parish church at which attendance was theoretically compulsory for the *Stipendiaten*. Their theological views must, therefore, have been well known to all the *Stipendiaten*. Most influential of all must have been the theology of Heerbrand, author of the *Compendium theologiae* which was central to their theological studies. Because of their close contact with the students, the two superintendents of the *Stift*, Heerbrand and Sigwart, later Gerlach and Hafenreffer, had potentially the closest relationships to Kepler. Gerlach's influence on Kepler seems, however, to have been minimal,¹¹³ while Kepler and Hafenreffer remained in correspondence for the rest of their lives.

Kepler was educated in a system dedicated to the production of orthodox Lutheran theologians, but which also required the study of languages, mathematics, Aristotelian natural philosophy, ethics, rhetoric and logic. Although these subjects were taught in the arts faculty, they were not

¹¹¹ C. von Weizsäcker, 'Lehrer und Unterricht an der evangelisch-theologischen Facultät der Universität Tübingen', pp. 39-40 Heerbrand objected to Brenz's appointment as third *professor ordinarius*, with which post that of minister of the parish church was usually combined.

¹¹² *Ibid.*, pp. 40-41.

¹¹³ Certainly Kepler did not correspond regularly with Gerlach: only two letters are extant. Like Crusius, Gerlach had contacts with the Orthodox church: he had spent five years as preacher in Constantinople and had a continuing correspondence with the Patriarch Jeremias II [E. Gerdes, 'Keplers theologisches Selbstverständnis', p. 364].

isolated from theology. Students attended concurrent lectures in the catechism and in the New Testament; they and their professors were involved in theological debate. Even this brief glance at the careers of the professors responsible for these lectures shows that not only the professors of theology but all the professors of the arts faculty, with the single exception of Andreas Planer, had themselves studied theology. In their capacities as professors of arts and theology, they were engaged in the university's deliberations about the content of the curriculum, in which the relationship between philosophy and theology was discussed and clarified. It would be extraordinary if individual professors had not developed their own views on the relationship between theology and philosophy, and their own understandings of the ways in which philosophy and theology, natural philosophy and theology, or astronomy and theology, might be related, and they did indeed do so. It is the range of these views and their basis in Lutheranism which will form the subject of the remainder of this thesis.

chapter two

mathematics and astronomy in the thought of Philip Melanchthon

The structure and intentions of Württemberg's scholarship system and of the university in Tübingen meant that Kepler was educated in a system which was geared towards producing practising theologians who would adhere to the *formula concordiae* and preach the gospel according to the theology approved by Württemberg's church and state leaders. However, discussion about the content of the curriculum, and particularly the value of studying natural philosophy and ethics, did not cease with the reformation of the university, the introduction of the *Große Kirchenordnung* and the establishment of the university's new statutes. In the late 1580s and early 1590s, when Kepler was at university in Tübingen, there was still no absolute consensus about the constitution of the course which he followed; in particular, the relationship between the *artes liberales* and theology remained a subject of heated debate between the Duke's visitation committees and the theologians on the one hand and the arts faculty on the other. Their discussions concerned all the subjects taught by the arts faculty, but focused on the relationship between theology and philosophy in general and the place of Aristotle in particular. As such, they reflected a range of different approaches to the relationship between theology and philosophy.

In 1557 and again in 1578 the inspectors of the arts faculty complained that too much time was spent teaching Aristotle, and especially the *Ethics* and *Physics*, which formed the basis of instruction in moral philosophy and natural philosophy. In 1593 the ducal visitors to the arts faculty once more attempted to reduce the time spent teaching the *Ethics* and the *Physics*, recommending that they should be studied in alternate semesters and that more time should be given to theology. Their argument was that philosophy should be taught in such a way,

that the teachers of ethics and of physics may show their listeners where philosophy is in opposition to sacred theology: let them not seduce through the pleasing words of the philosophers!¹

The visitation committee in 1599 recommended

that one should reduce certain lectures in the arts which are not really useful but somewhat extraneous, such as ethics and physics, so that the students can have more time for lectures in theology and the languages.²

The Chancellor, Jacob Heerbrand, who may himself have been a part of the committee of 1593, apparently supported the recommendation that less time should be spent on philosophy. He warned, however, that 'there would be a great protest in the university if one were to say that Aristotle with his *Physics*, his *Ethics* and the *Organon* should be got rid of.'³ The arts faculty reacted as Heerbrand had predicted. They believed that the study of philosophy was essential as a preparation to the study of theology, and, indeed, absolutely vital in such theologically troubled times. Thus Georg

¹ N. Hofmann, *Artistenfakultät*, p. 141: *ut ethicus physicusque monerent auditores suos: ubi philosophia repugnet s. theologiae: ne illis placitis philosophorum seduceretur.*

² *Ibid.*, pp. 141-142: *das man etlich lectiones in artibus so nicht allerdings diennstlich sonnder etwas weitlauffig allß physicam vnnnd ethicam abkürtzen solte, damit die studiosj die lectiones theologicae et linguarum vmb souil mehr konndten.*

³ *Ibid.*, p. 141: *es werde ein groß geschrey der schul geben dz man sagen werde es werde Aristoteles mit seiner Physik, mit seiner Ethic vnd dem Organo ausgemustert.*

Heerbrand may himself have been less opposed to the teaching of philosophy than Hofmann supposes: for a discussion of Heerbrand's attitude to natural philosophy, see chapter 3 below.

Liebler, professor of physics, argued that because of the threat posed by Calvinism the exact study of philosophy had never been so important.⁴ For Liebler, as for the other professors in the arts faculty, it was clear that the study of philosophy provided the basis for the study of theology. In their opinion, the view of the 1599 visitation committee was thus indefensible: the professors of the arts faculty knew that physics and ethics could not take the place of theology, but they were convinced that philosophy provided the foundation upon which theological arguments could be established and understood.

The roots of this discussion can be found in the thought and discussions of the reformers themselves. Although Luther does not condemn philosophy in his writings, he is anxious that its limits, and with them the limits of human reason, must be recognised. Luther argues that moral philosophy, like theology, 'also speaks of a good will and of right reason.'⁵ However, his doctrine of justification leads him to regard theology, or faith, as a necessary prerequisite to philosophy, and his understanding that justification comes only through faith as a free gift of God's grace forces him to deny that good works could earn a person forgiveness for their sins.⁶ Faith must come before good works, and philosophers themselves realise this, for they see that 'in philosophy it is necessary for a person to be justified morally before the work,' and teach that 'in ethics a good will is required before the work.'⁷ Faith is the subject-matter of theology, and thus theology must come before philosophy. Moral philosophy is concerned only with what the reason can understand of goodness, and, therefore, asserts Luther,

4 Hofmann, *Artistenfakultät*, p. 141.

5 M. Luther, *Lectures on Galatians* 1535, LW 26.261.

6 *Ibid.*, 208-209.

7 *Ibid.*, 261.

we say in theology that moral philosophy does not have God as its object and final cause, since Aristotle or a Sadducee or a man who is good in a civic sense calls it right reason and good will if he seeks the common welfare of the state and tranquillity and honesty. A philosopher or a lawyer does not ascend any higher. He does not suppose that through right reason he will obtain the forgiveness of sins and eternal life.⁸

Indeed, philosophy errs if it thinks it can say anything about the theological realm: it is restricted to discussing the moral, ethical sphere of life and to investigating the physical world.⁹ Luther sees natural philosophy, moral philosophy and theology as an ascending hierarchy of disciplines, each of which has a different subject-matter.¹⁰ The distinction between them is reflected by their use of vocabulary. Each attributes its own meaning to certain concepts, and thus recognises the restrictions upon its field of reference, 'for "doing" is one thing in nature, another in philosophy, and another in theology.'¹¹ Luther argues that moral philosophy is a further development of natural philosophy, and that the vocabularies of these two realms must be understood differently. Philosophy can and does bring about a better understanding of its proper subject matter, but its terminology must also be interpreted anew when it moves into another area. Thus a theology which seeks to base itself upon the statements of philosophy is no true theology: it can never be anything but opinion.¹² Good philosophers recognise the restrictions on their discipline and do not try to pretend that they are theologians: thus Aristotle is in Luther's eyes a better philosopher

⁸ *Ibid.*, 262.

⁹ W. Mostert, 'Luthers Verhältnis zur theologischen und philosophischen Überlieferung', p. 365.

¹⁰ M. Luther, *Lectures on Galatians 1535*, LW 26.262. Luther does not make this point explicitly, but the implication that this is an ascending hierarchy is implicit in his discussion of the use of the term 'doing': 'Therefore we have to rise higher in theology with the word "doing," so that it becomes altogether new. For just as it becomes something different when it is taken from the natural area into the moral, so it becomes something much more different when it is transferred from philosophy and from Law into theology.'

¹¹ *Ibid.*

¹² W. Mostert, 'Luthers Verhältnis zur theologischen und philosophischen Überlieferung', p. 360.



than the 'Sophists', because he does not mix the human and the divine.¹³ Within its limits, philosophy is useful and is to be respected, but it can never take the place of theology. Luther does not suggest that philosophy might offer a useful intellectual training.

Despite his approving comments about the value of philosophers who know their place, Luther makes no connection between philosophy and civil law in his theology as it can be seen in the *Lectures on Galatians*. Instead he argues that the law has only two uses. The first, civic, use of the law is to restrain the work of the devil by threatening the wicked with punishment. Thus, the law is 'necessary and instituted by God for the sake of public peace, and of preserving everything, but especially to preserve the course of the gospel from being hindered by the tumults and seditions of wild men.'¹⁴ The second, theological, use of law is to 'increase transgressions' by revealing the existence of sin and the need for the gospel.¹⁵ The law is a curse in the spiritual sense because it shows how much wrong can be done, but within its proper sphere the law is positive. Physical, temporal life is ordered both by society's conventions and by 'laws, political ordinances, and ceremonies'; these are for Luther 'divine blessings in their place,' that is, when they do not transgress into the spiritual realm.¹⁶ But Luther goes no further than this cautious approval of the two essentially negative uses of law. He does not recognise any possibility that law, or reason, can have a positive effect on a person's goodness. Moreover, he does not believe that

13 *Ibid.*, p. 365.

14 M. Luther, *Lectures on Galatians* 1535, LW 26.308-309.

15 *Ibid.*, 309.

16 *Ibid.*, 250-251

the law may be manifested by any objective, observable nature, whether in society or in nature.¹⁷

Melanchthon differs radically from Luther on this point. Luther's denial of the efficacy of good works, and his questioning of the authority of the church left no defined authority against which correct behaviour could be measured, a problem which became pressing in the late 1520s, when civil unrest threatened the course of the Reformation.¹⁸ Problems of interpretation meant that the resultant vacuum could not always be filled by the principle of *sola scriptura* alone, so that some way of defining the relationship between God's revealed word and human judgement had to be found.¹⁹ Melanchthon's response was to argue a third use of the law, a *usus paedagogicus*, besides the *usus theologicus* and the *usus politicus* or *civilis*,²⁰ and to emphasise the teaching of philosophy, in an attempt to establish that the order of society was divinely ordained. For Melanchthon, the study of the law may guide the faithful in leading a correct, godly life and in gaining a purer knowledge of God's will. But study of the law is bound up with the study of philosophy, which Melanchthon considers vital both as a preparation for the study of theology, and because it teaches a basis of morality and ethics and offers a training for a correct life. Melanchthon thus emphasises the importance of moral philosophy, in the form of a detailed discussion of the original text of Aristotle's *Ethics*.²¹ He is concerned to

¹⁷ H. Olsson, *Schöpfung, Vernunft und Gesetz in Luthers Theologie*, pp. 119-123.

¹⁸ See for example S. Kusukawa, 'Aspectio divinatorum operum', p. 43,

¹⁹ G. R. Evans, in *Problems of Authority in the Reformation Debates*, raises many issues which are pertinent to this discussion: see especially pp. 75-77 and p. 205.

²⁰ B. Lohse, 'Philipp Melanchthon in seinen Beziehungen zu Luther', p. 410. Ebeling traces the appearance of this doctrine in Melanchthon's thought [G. Ebeling, *Word and Faith*, pp. 62-78].

²¹ Melanchthon, a humanist scholar, wishes of course to move away from the scholastic debates [P. O. Kristeller, 'Humanism', p. 134-135].

emphasise that the living of a correct life and the study of philosophy cannot of themselves bring about salvation, so that despite his positive assessment of philosophy he follows Luther in drawing a sharp distinction between the sphere of influence of moral philosophy and that of the gospel.²² However, in Melanchthon's view, the study of philosophy may be of positive help in preparing the mind and the soul to receive God by 'inflaming their souls with love and enthusiasm for the truth and rousing them to understanding of the highest things.'²³

Melanchthon sees a close connection between the law of nature and ethical or moral law, the latter being based upon observations of the former. Unlike Luther, Melanchthon's moral philosophy and his derivation of the law are firmly rooted in his natural philosophy,²⁴ which also forms the basis of his doctrines of God and of creation.²⁵ But while these aspects of Melanchthon's thought have been recognised, less attention has been paid to the relationship between Melanchthon's understanding of mathematics and his praise of philosophy or to the role which he assigns to the mathematical sciences, and particularly astronomy, in establishing a basis for his ethical understanding and for his moral philosophy as a whole.²⁶

²² J. Krayer, 'Moral philosophy', p. 323-324.

²³ *Ibid.*, P. Melanchthon, *Praefatio in Theoricae novae planetarum*, CR 2.815: *Nam mihi quoque unum hoc remedium videtur publicarum calamitatum fore, si se nostri homines ad veram veteremque philosophiam convertant: quae cum incendat animos amore ac studio veritatis, et ad intellectum atque admirationem optimarum rerum exsuscitet, una efficit viros bonos ac moderatos, ...*

²⁴ H.-G. Geyer, 'Welt und Mensch' offers an extended consideration of the relationship between Melanchthon's physics and his ethics; Kusukawa also demonstrates this connection [S. Kusukawa, 'Providence Made Visible', especially pp. 178-179; 200].

²⁵ C. Link, *Schöpfung*, vol. 1, p. 82.

²⁶ Kusukawa and Müller-Jahncke have both drawn attention to the role of astrology in Melanchthon's thought, but neither has investigated Melanchthon's views on mathematics in any detail [S. Kusukawa, 'Aspectio divinarum operum'; W.-D. Müller-Jahncke, 'Melanchthon und die Astrologie'].

Much of what follows has appeared in C. Methuen, 'Zur Bedeutung der Mathematik für die Theologie Philip Melanchthons'.

Melanchthon emphasises all seven liberal arts in the context of his educational programme, but he lays a particular emphasis on the place of the mathematical sciences in the curriculum, which is unusual for educators of his time.²⁷ He offers several reasons for this. Melanchthon recognises the practical use of the mathematical sciences in daily life,²⁸ although his confidence in their utility is not his prime motive for including them in the educational curriculum. Far more important to him is the contribution made by mathematics, and particularly arithmetic and geometry, to the training of the mind in logical thinking and thus to the study of philosophy as a whole. Melanchthon defines philosophy to be not 'all opinions about everything' but that knowledge which can be proved, and holds that true philosophy is 'that which departs least from proofs',²⁹ asserting the philosophy of Aristotle to be superior to that of other philosophical schools precisely because it 'seeks

²⁷ The mathematical sciences were not universally accepted as an important or useful part of the school and university curriculum in the sixteenth century. Erasmus believes that arithmetic, music and astronomy should only be sampled [*De recta pronuntiatione*, *CWE* 26.387], unless a pupil expresses a particular interest in them [*De pueris statim ac liberaliter instituendis*, *CWE* 26.336]. He instructs teachers that they should gather knowledge of nature, astronomy, architecture and other related subjects through reading the ancient authors [*De ratione studii*, *CWE* 24.574]. The mathematical sciences were not an essential part of the curriculum. In a similar vein, Juan Luis Vives argued that mathematics tended to divorce the mind from the practical concerns of life and that its study was not, therefore, to be recommended [A. G. Debus, *Man and Nature in the Renaissance*, p. 3].

²⁸ Melanchthon remarked that arithmetic is needed to count anything, and is especially relevant in business transactions [*In arithmeticon praefatio*, *CR* 11.286-287], while geometry is necessary for the construction of houses, bridges and other such works [*CR* 11.287]. Without astronomy there would be no appreciation of time and, since the seasons are bound up with the rising and setting of certain stars, no way of measuring the passing of the year [*De astronomia et geographia*, *CR* 11.294-295]. There would, moreover, be no historical understanding, for it would be impossible to establish when important events had taken place [*CR* 11.296]. Astronomy is also necessary in navigation and for establishing the positions of geographical features and state borders [*CR* 11.296-297], since positions on the earth are determined by observation of the stars [*Praefatio in libros De iudiciis navitatum*, *CR* 5.819]. Both history and geography are important for politics and for the church since they enable the history of religions and states and monarchs to be understood and the sites of important events, particularly in the biblical narratives, to be known [*De astronomia et geographia*, *CR* 11.296].

²⁹ P. Melanchthon, *De Discrimine Evangelii et Philosophiae*, *CR* 12.690: *Itaque philosophiam vocamus non omnes omnium opiniones, sed tantum hanc doctrinam, quae habet demonstrationes.*

Verum autem unum est, ut dicunt philosophi, quare una tantum philosophia vera est, videlicet, quae minimum discedit a demonstrationibus.

proofs most diligently'.³⁰ He argues that arithmetic both shows the order of things and demonstrates how confused things may be differentiated, and these he sees as the first steps in human reasoning.³¹ Therefore, he concludes, 'the first understanding is of number.' Melanchthon believes this to be what Pythagoras meant when he said that the mind is number, 'for he asserted that the soul is a reasoning being which understands things and observes order.'³² Consequently, the human mind recognises numerical order more easily than other kinds of order, and training in arithmetic further facilitates this skill. That is why the Greeks taught arithmetic first and dialectics later: they saw that

dialectics takes its beginnings from arithmetic, and that practice in multiplication and division is the best preparation for syllogism. Thus the power of demonstration can be better understood when arithmetic is known, because this art has the most eloquent proofs.³³

Similarly, geometry as taught by Euclid brings an understanding of the power of proof and teaches logical method.³⁴ Therefore, since arithmetic and geometry teach the beginnings of logic and have certain proofs, Melanchthon believes them to be an obvious and fundamental introduction to learning philosophy.

³⁰ *Ibid.*, 691: *Aristotelis philosophia diligentissime quaerit demonstrationes, ideo una longe omnibus sectis antecellit. Et recte iudicat de fine bonorum et ratione virtutum si quidem de civili vita et civilibus virtutibus intelligitur.*

³¹ P. Melanchthon, *In arithmetice praefatio*, CR 11.290: *[Arithmetica] ostendit ordinem rerum, et monet confusa evolvenda et discernenda esse. Haec sunt initia ratiocinationis in hominibus.*

³² *Ibid.*, 290: *Ideo prima est numerorum intelligentia, idque sensisse opinor Pythagoram, cum definivit, mentem esse numerum; significavit enim animam esse ratiocinatricem, quae discernit res, et ordinem animadvertit.*

³³ *Ibid.*, 291: *Videbant enim Dialecticæ initia sumere ab Arithmetica, et exercitatio multiplicationis et divisionis, optime praeparat ingenia ad Syllogismos. Item vis demonstrationis melius intelligi potest, cognita Arithmetica: quia haec habet maxime illustres demonstrationes.*

³⁴ P. Melanchthon, *Praefatio in Geometriam*, CR 3.108: *Deinde cum demonstrationes Geometricae maxime sint illustres, nemo sine aliqua cognitione huius artis satis perspicit, quae sit vis demonstrationum; nemo sine ea erit artifex methodi.*

The study of philosophy is of central importance to Melanchthon because he believes it to be a prerequisite for a proper civil and moral life and, therefore, for the resolution of the problems facing the church and the state. He argues that philosophy is the only means of producing good, moderate people, which it does 'by inflaming their souls with love and enthusiasm for the truth and rousing them to understanding of the noblest things.'³⁵ That Melanchthon understands these 'noblest things' to include the heavens and the heavenly bodies is to be inferred from his statement that philosophy is maimed and mutilated when the study of astronomy is neglected.³⁶ He bases this assertion that astronomy is central to the proper study of philosophy on the order and harmony which he perceives to be found in the celestial region it describes. The practical applications of astronomy are only possible because the movements of celestial bodies are regular and can be observed and predicted, and Melanchthon deduces that the regularity and usefulness of this order are in themselves a demonstration that the celestial bodies were created by God for this purpose. They reflect the beauty and regularity of a skilled mind, a *mens architectrix*, and could not have come about by chance.³⁷ Therefore, he argues, observations of the heavens are not productive simply in the pragmatic sense that they assist the regulation

³⁵ P. Melanchthon, *Praefatio in Theoricae novae planetarum*, CR 2. 815: *Nam mihi quoque unum hoc remedium videtur publicarum calamitatum fore, si se nostri homines ad veram veteremque philosophiam convertant: quae cum incendat animos amore ac studio veritatis, et ad intellectum atque admirationem optimarum rerum exsuscitet, una efficit viros bonos ac moderatos, ac dissimiles horum, qui nunc propter inscitiam bellum veritati et rectae doctrinae indixerint, et in homines studiosos horribilem crudelitatem exercent, publicas discordias praecipue alunt atque inflammant.*

Compare also *Praefatio in Geometriam*, CR 3.110: *Nam haec nostra aetas satis commonefacit nos, quantum opus sit Reipublicae perfecta doctrina, quia multi passim, tum inopia iudicii, tum quia diserte explicare nihil possunt, sparserunt aut defendunt opiniones absurdas et confusaneas, ex quibus in Ecclesia magna certamina, magnae dissensiones extiterunt. Nec finis horum malorum erit ullus, nisi ad veram et eruditam studiorum rationem iuventus revocata fuerit.*

³⁶ P. Melanchthon, *Praefatio in Theoricae novae planetarum*, CR 2.816: *Recte enim iudicant [viri optimi et doctissimi], reliquam philosophiam mancam et mutilam esse, nisi rerum coelestium cognitio accedat.*

³⁷ This is a recurrent theme for Melanchthon: see, for example, *Praefatio in Theoricae novae planetarum*, CR 2.816; *De astronomia et geographia*, CR 11.297.

of daily life. Rather, such observations lead the observer to a better understanding of this architectural mind which Melanchthon understands to be God.³⁸ This is the highest knowledge which can be achieved through the mathematical sciences, and it can be achieved only through astronomy. Astronomy is, therefore, the most important of the mathematical sciences for Melanchthon; he considers the most important attribute of arithmetic and geometry to be that they form the basis for the study of astronomy. Arithmetic and geometry, he says, are 'the wings of the human mind' by which those with unsullied minds are most easily raised to heaven where they delight in celestial light and wisdom.³⁹

Melanchthon takes this celestial light and wisdom to be a form of knowledge about God. He thinks that observation of the movements of the celestial bodies could reveal several aspects of the divine nature. First, and most obviously, he holds that the wonderful character of the celestial order reveals the creative nature of God to the observer. Such a useful and regular order could not have come about coincidentally. Its very utility in the ordering of human life shows that it must have been created and designed to fulfil this purpose, so that it is an insult against God to assert, with Epicurus, that 'the sun is a vapour set alight and in motion by some chance ... and that the stars

³⁸ For a more detailed assessment of this aspect of Melanchthon's thought, see D. Belluci, 'Gott als Mens', which emphasises the Platonic aspects of Melanchthon's thought.

³⁹ P. Melanchthon, *In arithmeticon praefatio*, CR 11.288: *Sunt igitur alae mentis humanae, Arithmetica et Geometria. Has si alligaverit sibi aliquis praeditus ingenio non sordido, facillime penetrabit in coelum ac libere in coelestium coetu vagabitur, et illa luce ac sapientia fruetur.*

Jardine has pointed out that 'the image of geometry and arithmetic as the Platonic wings of astronomy is commonplace in the period [i.e. late sixteenth/early seventeenth century],' but has been unable to find it in Plato [N. Jardine, *The Birth of History and Philosophy of Science*, p. 186, n.168]. Melanchthon seems to have combined Plato's image of the wings of the soul, which 'take [the soul] up to the regions above, where the gods dwell' [*Phaedrus*, 246] with the view that arithmetic and geometry are the prerequisites of astronomy and the idea that astronomy is a divine science [*Laws*, 817-822]. This image may in fact originate with Melanchthon, who first used it in 1536.

are little clouds similarly illumined by chance.'⁴⁰ Melanchthon believes that to teach such a doctrine of chance would be to 'wage war against human nature, which was clearly founded to understand divine things,' for 'God desired that knowledge of these wonderful courses and powers should lead us towards knowledge of the divine.'⁴¹ Melanchthon is of the opinion that the plan of the creator God may be seen throughout creation from its orderly structure and its usefulness for humankind, but it is most clearly to be recognised in the celestial region.

The order of the heavens does not, however, reveal only the creator God, but may also reveal God's intentions for the world. Melanchthon argues that the regularity of the heavenly motions is intended by God both to help in the planning and fulfilling of human tasks and to remind human beings that 'from [God] comes order both in our own minds and in wider society, and that there are penalties consequent on upsetting this order.'⁴² In this way the order of heavenly laws may be said both to demonstrate the caring nature of God to human beings and to give them information about how to behave.

⁴⁰ P. Melanchthon, *In arithmetice praefatio*, CR 11.288-289: *Scio enim vobis quidem satis persuasum esse, magnam dignitatem et utilitatem esse doctrinae de rebus coelestibus, vosque, ut decet, auribus atque animis abhorreere ab Epicuri deliramentis, qui diridet Astronomiam, et somniat Solem esse vaporem, qui mane ascendatur motu, postea aut deflagret, aut in aqua extinguitur: ita et stellas esse nebulas casu incensas. Haec portenta pro veris affirmare homine indignum est, nedum Philosopho. Nulla tam barbara gens fuit, quae non sentiret, stellas esse certa et durabilia Dei opera, et certis legibus ferri, magnae alicuius utilitatis causa. Quare contumelia est adversus Deum, fingere hanc confusionem rerum, Solem vaporem esse casu inflammatum, et casu ferri, ut Lucretius ait:*

Quo cibus vocat atque invitat euntem

Flammae per coelum pascentem corpora passim.

For Melanchthon's rejection of Epicureanism, see B. T. Moran, 'The Universe of Philip Melanchthon', pp. 10-13; see also S. Kusukawa, 'Providence Made Visible', p. 139.

⁴¹ P. Melanchthon, *Praefatio in Theoricae novae planetarum*, CR 2.816: *Nam Epicureos illos, qui neque pulcherrimos motus coelestium corporum admirantur, neque cognitionem eorum utilem esse contendunt, ne quidem appellatione hominum dignos iudico. Etenim non solum bellum gerunt cum humana natura, quae praecipue ad has divinas res adspiciendas condita est, sed etiam quovmcoi sunt. Voluit enim Deus horum mirabilium cursuum ac virium notitiam, ducem nobis esse ad divinitatis cognitionem.*

⁴² P. Melanchthon, *De astronomia et geographia*, CR 11.297: *Nam cum didicimus inde, esse Deum gubernatorem omnium, intelligimus, ei parendum esse, agnoscimus ordinem ab ipso, et in mentibus nostris et in politica societate institutum esse, et sancitas poenas conturbantium hunc ordinem.*

Melanchthon thinks that the order visible in the heavens demonstrates that God wishes the world to operate in an orderly way. This order therefore offers a pattern for the ethical and moral behaviour which God expects of human beings in society, so that society as a whole and the Church in particular should take it as a model.⁴³ However, the movements of the heavens can also have a more threatening significance. Although the 'understanding about God and about providence' derived from the observation of this order 'arouses souls at once to goodness,'⁴⁴ the stars also offer portents of events - usually disastrous - to come. Melanchthon believes that events in the world may result from particular movements and conjunctions in the heavens, although he is careful to emphasise that the stars are not the only cause of such events and that they do not govern the church,⁴⁵ and does not regard all interpretations of celestial observations as acceptable. Melanchthon distinguishes between the use of celestial observations in an attempt to predict particular aspects of the future, which he rejects as superstition, and astrology, which he defines to be

the part of physics which teaches what effects the light of the stars has on simple and mixed bodies, and what kind of temperaments, what changes and what inclinations it induces.⁴⁶

Superstition has, therefore, no causes which can be derived from physics and does not concern itself to seek what has been ordained by God, while astrological observations are 'observations of physical causes which are ordinances of God.' Just as physics as a whole seeks causes and effects,

⁴³ P. Melanchthon, *Praefatio in Theoricae novae planetarum*, CR 2.815-817.

⁴⁴ P. Melanchthon, *De astronomia et geographia*, CR 11.297: *Nam haec de Deo et de providentia sententia, profecto ad virtutem animos exuscitat.*

⁴⁵ P. Melanchthon, *Praefatio in libros De iudicii navitatum*, CR 5.820-822; *De Orione*, CR 12.51-52.

⁴⁶ P. Melanchthon, *De dignitate astrologiae*, CR 11.263: *Astrologia pars est Physices, quae docet, quos effectus astrorum lumen in elementis et mixtis corporibus habeat, qualia temperamenta, quas alterationes, quas inclinationes pariat.*

so does astrology seek to establish the causes and effects implicit in God's ordinances for the world.⁴⁷ Melanchthon recognises and approves the use of celestial observations and their interpretation for the determining of the correct treatment for a sick person,⁴⁸ for the prediction of catastrophic events such as floods or famines, and for foreseeing such state events as the death of a prince or the collapse of an empire.⁴⁹ The latter might appear to belong better in his definition of superstition, but he sees them as examples of God's action and thus a legitimate part of astrology. However, he maintains that God is not bound by such celestial conjunctions, so that the most important reason for the interpretation of the astronomical observations is to warn of disasters in order that people might turn to God and pray for these disasters to be averted. Not only are astronomical observation and astrological prediction in this way able to demonstrate that God's goodness is 'higher and better than the nature of the stars,'⁵⁰ they also contribute to the increase of piety and thus strengthen the church.

⁴⁷ P. Melanchthon, *An leges damnant praedictiones astrologicas?* CR 10.713-4: *His legibus in codice non damnari praedictiones Astrologicas, sed tantum illas quae non habent causas aut rationes Physicas, quae vocantur a Ptolemaeo ἀνατιολογηταὶ quales sunt augurum praedictiones, et quales sunt multae admixtae Astrologicis, ut cum divinant ex interrogationis tempore, cum pollicentur se caedes, aut furtorum autores indicaturos esse, Quemadmodum in decretalibus iure damnatur sacerdos, qui simulabat se ex Astrolabio quaerere, quomodo deprehendi possent furta. Tales igitur supersticiosae praedictiones damnari illis legibus sentio, quas et ipsi Philosophi improbant. Sed quidam inepti in genere damnant praedictiones Astrologicas, hoc est, eas, quae habent Physicas causas, et rationes. Has hac ratione probamus: Ordinationes Dei in natura observare, pium et utile est, non est superstitiosum. Nam superstitiosa sunt, quae non habent causas Physicas, et ordinationes Dei. Sed observationes Astrologicae sunt observationes causarum Physicarum, quae sunt ordinationes Dei.*

The distinction between valid astrology and superstition may also be found in the writings of Luther [W. Clarke, 'The Scientific Revolution in the German Nations', pp. 98-99] and Calvin [A. Chapman, 'Astrological Medicine', pp. 279-280].

⁴⁸ For an example of such an assessment (not by Melanchthon) see S. Kusukawa, 'Aspectio divinatorum operum', pp. 33-34].

⁴⁹ P. Melanchthon, *Praefatio in Theoricae novae planetarum*, CR 2.817

⁵⁰ *Ibid.*, 817-818: *Saepe fatorum saevitiam lenit Deus, placatus piorum votis. Quare haec quoque gravis causa fuerit, rerum futurarum significationes animadvertendi. Prodest enim commonefieri homines atrocibus siderum minis, ut a Deo opem implorent; deinde ut bonitatem Dei magis agnoscant, cum viderint, aliquam esse superiorem ac meliorem naturam sideribus, quae tristes significationes mitigat.*

Thus it can be seen that Melanchthon believes that the observation of the motions of the celestial bodies could lead the observer to see the creative nature of God, to understand God's care and intention for the world, to derive rules for ethical behaviour and to appreciate the scope of divine free will. What can, in his opinion, never be gained from such observations is faith in and understanding of the salvific work of God in Jesus Christ, because human observations of the heavens belong to the realm of human reason, which cannot itself aspire to the gospel.⁵¹ Melanchthon argues that this restriction on human knowledge and deduction is a product of the fall. In their original state human beings would have been able to understand the nature and will of God directly from the heavens because their own free will would not have opposed God's will by leading them to sin.⁵² With the loss of that sinless state, the gospel became necessary, and this message can never be deduced by human endeavour. Astronomy can reveal the order of God which is inherent in the world, and can open human eyes to God's government and sustenance. It has value and utility in itself; it can offer useful guides to social, ethical and moral behaviour; it can even open the mind to God; but it can never lead to faith or to an understanding of Christ's salvific work.

⁵¹ P. Melanchthon, *De discrimine evangelii et philosophiae*, CR 12.690: *Evangelium non est philosophia aut lex, sed est remissio peccatorum et promissio reconciliationis et vitae aeternae propter Christum, de quibus rebus nihil potest humana ratio per se suspicari.*

⁵² P. Melanchthon, *Praefatio in libros De iudiciis navitatum*, CR 5.822-823: *Si hominum natura mansisset integra, fulsisset in nobis lux divina, gubernatrix omnium motuum, et stellae in materia non contaminata alias actiones habuissent. At nunc in his sordibus infeliciores sunt actiones et extincta est illa lux, quae rexisset omnes humanos motus.*

See also P. Melanchthon, *Liber de anima*, CR 13.169-172, *De imagine Dei in homine*. Melanchthon's discussions would probably have been unacceptable to Luther, who professed ignorance as to the original state of humankind [H. Olsson, *Schöpfung, Vernunft und Gesetz in Luthers Theologie*, pp. 288-289]

Melanchthon's conviction that the interpretation of astronomical observations through astrology can be a valuable tool for understanding the will of God is rooted in his philosophy, or, more specifically, in his understanding of physics. Melanchthon believes that the *mens* which shaped the world - God - is reflected in the structures of the world and in the minds of the human beings who observe the natural world, allowing them to gain insights into God's mind. This is a Platonist understanding.⁵³ But Melanchthon combines it with a hierarchical, geocentric view of the universe which he derives largely from Aristotle, and it is this which allows him to privilege the study of the heavens as he does. Aristotle teaches that the universe is made up of a system of concentric spheres. The sphere of the earth and sphere of the moon's orbit form the two central spheres: the planets move in a further series of spheres, and the stars are placed in the outmost sphere. This is both a physical and a metaphysical system. Aristotle holds that causality works down the spheres so that the movements of the outer spheres have effects on the events of the lower spheres. The central, sublunar sphere is thus furthest away from the causes, and the most corrupt. For Aristotle, the generation and corruption of the physical, sublunar world are caused by its tendency to self-generated motion which arises from the elements. Since the heavenly bodies are clearly also in motion it would seem that they too must in fact be subject to generation and corruption. However, Aristotle understood the substance of the heavens to be non-elemental and their motion to be constant and unchanging, in contrast to that of sublunar bodies which cannot be predicted.⁵⁴

⁵³ D Belluci, 'Gott als Mens'.

⁵⁴ Aristotle expounds his cosmology in the *Metaphysics*, especially Δ , ch 8 [1073a13-1074b14], and in *De coelo*, especially ii.7 (289a11), ii.11 (291a11) and ii.12 (293a5).

Like Aristotle, Melanchthon assumes that the heavens are not subject to generation or corruption and that the material of which they consist does not allow change.⁵⁵ Although there is 'a harmony and accord between the celestial and the lower [sublunar] bodies' which can and should be noted by the human observer,⁵⁶ the heavens are made up not of elements, as the earth is, but of a purer substance, closer to the divine. For Melanchthon the heavens, or the celestial sphere, make up what is effectively an intermediate stage between the sublunar world and God. This metaphysical understanding of the construction of the universe and the relationship between its constituent parts leads Melanchthon to include astrology in his discussion of physics.⁵⁷

Melanchthon's emphasis on astronomy is undoubtedly informed and shaped by his understanding of the relationship between astrology and physics. This connection between astrology and physics is described in the opening discussion of the *Initia doctrinae physicae*, first published in 1549.⁵⁸ In this Melanchthon includes a brief outline of the history of the 'two so-called schools of physics in Greece.'⁵⁹ The first of these, instituted by Thales, considers the effects of the celestial bodies on sublunar material, while the other, as defined by Empedocles and Democritus and improved by

⁵⁵ P. Melanchthon, *Initia doctrinae physicae*, CR 13.223: *Adparet autem coelum non admittere tales alterationes, quia nulla pars corrumpitur. Igitur non est ex materia elementari.*

⁵⁶ P. Melanchthon, *De astronomia et geographia*, CR 11.297: *...ita homines magna voluptate adfici necesse est, cum naturam totam rerum aspiciunt, cum numerorum et magnitudinum proportionem inveniunt, cum coelestium et inferiorum corporum harmoniam et consensum deprehendunt, cum vident omnia certa lege condita esse, ut nos de Architecto admoneant.*

⁵⁷ Kusakawa has shown that Melanchthon's understanding of Aristotelian physics was closely related to his understanding of astrology [S. Kusakawa, 'Providence Made Visible', especially pp. 155-162].

⁵⁸ Although the first edition of the *Initia doctrinae physicae* was not published until 1549, it was probably completed by 1545 [H. Blumenberg, *The Genesis of the Copernican World*, p. 324].

⁵⁹ P. Melanchthon, *Initia doctrinae physicae*, CR 13.182.

Hippocrates, investigates the material and changes inherent in the sublunar material itself.⁶⁰ Melanchthon recognises in the *Initia doctrinae physicae* that the latter tradition has usually been identified with the study of physics, but he defends the usefulness of complementing this traditional understanding through the study of the effects of the stars on the sublunar sphere.⁶¹ While Melanchthon does not use the terms 'astrology' or 'astrologer' to describe this school of physics in the *Initia doctrinae physicae*, in his oration *De dignitate astrologiae* in 1535 he explicitly defines astrology to be the part of physics which teaches about the effects of the stars.⁶² In the manuscript *Physicae seu naturalis philosophiae compendium*, 'a prototype of the *Initia doctrinae physicae* in form and in content' dating from 1543, he specifically describes the school of physics deriving from Thales as 'astrology'.⁶³ Despite his avoidance of the terms 'astrology' and 'astrologer' in the *Initia doctrinae physicae*, the two works deal with the same subject-matter.⁶⁴

That Melanchthon's interest in and conception of astrology was not universally accepted by his contemporaries may be deduced from his reluctance to speak about 'the place of divination' for fear of arousing disagreement.⁶⁵ His hesitation to use the term in the *Initia doctrinae physicae* probably arises from a similar fear. He states that he is fully aware that his consideration of the influences and movements of the stars as a part

⁶⁰ S. Kusakawa, 'Providence Made Visible', pp. 182-183.

⁶¹ P. Melanchthon, *Initia doctrinae physicae*, CR 13.183: *Quantquam autem adiunctio doctrinae de motibus et effectibus celestibus ad hanc considerationem inferioris materiae, utilis est, ... et collatio artium utriusque lumen adfert, tamen quia utraque ars magna est, et latissime patet, usitatum nunc est physicen vocare hanc doctrinam, quae causas mutationum in mixtis propinquas, quae oriuntur ab huius materiae inferioris motu et qualitatibus, patefacit, ut medicus in curanda pleuritide, materiae motum et qualitatem in aegro corpore considerat, intellegit adfluere sanguinem ad locum adfectum.*

⁶² P. Melanchthon, *De dignitate astrologiae*, CR 11.263; (cited at n. 46 above).

⁶³ S. Kusakawa, 'Providence Made Visible', p. 159.

⁶⁴ *Ibid.*, p. 160.

⁶⁵ P. Melanchthon, *De astronomia et geographia*, CR 11.294: *...omissa divinatrice parte, ne quod mihi certamen accersam.*

of physics includes material which does not form part of the normal subject-matter of physics,⁶⁶ but he is adamant that in doing so he has the authority of Aristotle, who also taught that there was a continuity between the celestial and sublunar spheres.⁶⁷ Melanchthon argues that this continuity renders incomplete any study of cause and effect which is restricted to the investigation of the 'proximate causes' (*causae proximae*) within the sublunar sphere.⁶⁸ It is necessary not only that physics take into account the vertical causal connections between the sublunar and celestial spheres when discussing causality but also that it look beyond the celestial sphere to God.

Melanchthon argues that the heavens contain 'vestiges of divinity' which can be exposed and interpreted through the use of geometry and arithmetic.⁶⁹ These traces of God consist in the regularity of the motions of the celestial bodies. While this belief owes something to Aristotle's understanding of the nature of the heavens, the sense that 'the nature of all things cries out that God is good' is taken directly from the biblical tradition.⁷⁰ The appeal to the

⁶⁶ *Ibid.*, p. 161.

⁶⁷ P. Melanchthon, *Initia doctrinae physicae*, CR 13.184-185. For a discussion of the content of Medieval and Renaissance physics see R. Hooykaas, 'Von der 'physica' zur Physik'.

⁶⁸ P. Melanchthon, *Initia doctrinae physicae*, CR 13.183: *Sed Thales non tantum has proximas causas aspiceret, verum longius quaereret efficientes. Cur enim non singulis annis adparent Cometae, si sola materiae agitatio sufficiens causa est? Deinde quae causae sunt, cur haec tanta moles halituum in aëre alias consistit, alias movetur, et quidem diversis motibus? quae causae trahunt aut impellunt eam? Postremo, et effectus longinquiores vestigaret, cur Cometae non solum siccitates, sed pestilentias et magnos gentium motus et mutationes imperiorum significant, ut Cometam, qui arsit initio belli Peloponnesiaci dies quinque et septuaginta, primum horrenda pestilentia secuta est, deinde et multarum urbium tristissima excidia.*

⁶⁹ P. Melanchthon, *Praefatio in Theoricae novae planetarum*, CR 2.817: *Quin potius, ut Plato dixit, Deum semper γεωμετρειν, hoc est, certissimo motu omnia metientem gubernare haec inferiora: ita nos vicissim huius summi artificis lineas considerantes hac pulcherrima Geometria nos oblectemus, quae divinitatem nobis ostendit. Si ob hanc causam praecipue condita est coelestis natura, ut certe est, ut Deum nobis monstret, satis constat, voluntati Dei non parere istos, qui haec divinitatis vestigia non aspiciunt neque inquirunt.*

⁷⁰ P. Melanchthon, *De dignitate arte medicinae*, CR 11.808: *Clamat igitur ipsa rerum natura, et esse Deum, et esse sapientem, bonum, ac beneficium, scelerem vindicam, custodem humanae societatis.*

mathematical nature of reality is, however, more Platonist or Pythagorean. Mathematical analysis is much more successful when applied to the motion of the celestial bodies than when used on motion within the sublunar sphere, and this is itself an indication that the celestial sphere reflects the nature of the mind of God, for, 'as Plato says, God always geometrizes.'⁷¹ The implicit assumption of this argument is that the order of the heavens better illustrates God's intentions than does that of the sublunar world. Because the human mind may be said to be number in its capacity to seek out order and regularity,⁷² and because in this it reflects the mind of God, the study of mathematics offers a vehicle by which the human mind may transcend its restrictions and reach God. Thus the human mind, created by God, reflects the structure of the heavens, also created by God, and in this way human observation of the heavens is able to offer a route to a better knowledge of God. Melanchthon does believe that the sublunar world also displays an order which results from its having been created by God, for in his *Liber de anima* he argues that the beauty and function of the human body reveal God's skill in creating the world, as does the usefulness of the nourishing and healing properties of plants.⁷³ However, in the *Initia doctrinae physicae* he asserts that the order in the sublunar world points the observer in the first

Melanchthon here is referring not to the heavens but to the multitude of plants with healing properties. Following Sirach, he likens God to a doctor. For Melanchthon's use of Sirach, see R. Keen, 'Frömmigkeit und Naturwissenschaft bei Melanchthon'.

⁷¹ P. Melanchthon, *Praefatio in Theoricarum novae planetarum*, CR 2.817 (cited at n. 69 above). It should be remembered that the mathematical techniques available in the sixteenth century were not capable of analysing non-uniform motion, so that local motion was much more difficult to deal with than it was later. In fact, of course, the planets did not move uniformly either, but their motion was a much better approximation to uniform than was that of bodies on the earth. An accurate mathematical analysis of motion first became possible with the development of the calculus in the 17th century.

⁷² P. Melanchthon, *In arithmetice praefatio*, CR 11.290 (cited at n. 32 above).

⁷³ P. Melanchthon, *Liber de anima*, CR 13.137, and compare *De dignitate arte medicinae*, CR 11.808-809.

instance to the influence of the stars, and thus only indirectly to God.⁷⁴ The imperfection of the sublunar sphere has to be transcended if the human mind is to reach God. Similarly, Melanchthon believes sight to be the highest of the senses because it transcends the sublunar sphere and makes observation of the motions of the heavens, and thus knowledge of God, possible.⁷⁵

For Melanchthon, the imperfection of the sublunar sphere seems to be associated with the fact that its motion is not susceptible to mathematical analysis. Because of this, and because of God's nature as a geometer, such order as exists in the sublunar sphere is less indicative of the nature of God than is the order of the heavens. Only the heavenly motions can be interpreted by mathematics, and so mathematics offers the human mind a means by which it can transcend the natural world. In this way the study of mathematics leads the human mind to the heavens, and thence to God.

Melanchthon thinks that the human observer is able to recognise the hand of God in the movements of the heavenly bodies because the human mind also

⁷⁴ P. Melanchthon, *Initia doctrinae physicae*, CR 13.410-412: *Postremae sententiae in libro Aristotelis de Generatione maxime memorabiles hae sunt: Causa perpetuitatis generationum et corruptionum est motus Solis et Planetarum in Zodiaco. Adfirmat igitur aliquam esse actionem stellarum universalem, in fovenda natura, et in conservanda hac inferiore materia, et ciendis insignibus mutationibus materiae. Ideo addit: etiam omnium viventium certas vitae periodos esse. Sed cum mens hunc mirandum naturae ordinem considerat, videlicet ipsas motuum leges, et certas planetarum et animantium species, et modos generationis et periodos durationis, necesse est ratiocinari, aliam esse priorem et intelligentem causam, videlicet, Deum conditorem, cuius consilio totus hic ordo et institutus est, et gubernatur, et conservatur, sicut doctrina de Deo in Ecclesia clarius docet.*

⁷⁵ P. Melanchthon, *Liber de anima*, CR 13.72: *Dominantur inter sensus oculi, quos inquit Plato praecipue nobis duas esse ad agnitionem Dei, intuentes hanc pulcherrimam coeli machinam, ac notantes motuum varietatem, quae non alio sensu, nisi oculorum animadverti potuit. Est et hoc ongens beneficium, quod hoc sensu lucem agnoscimus, quae et mirandum Dei opus est, et magnam naturae partem praecipue ostendit. Et praestantissimas naturas lucidas esse certum est, Deum, angelos, animas, et in corpore spiritus vitales et animales.*

originated in the heavens.⁷⁶ This is because both were created by God: the heavens may be the most perfect part of the natural world, but they are certainly a part of creation. The fallen, imperfect nature of the human mind and soul means that they are no longer directly illuminated by divine light, so that the light of the stars, sun and moon have gained a different, more threatening, influence.⁷⁷ However, the link between higher and lower natures is still such that an individual's character traits are influenced by the position of the stars at birth.⁷⁸ The human being is a microcosm which reflects and is affected by the macrocosm of the stars; therefore, astronomical observations are as natural to a human being as 'swimming to a fish or singing to a nightingale.'⁷⁹ Observing the heavens offers human beings a way to recover some of the direct knowledge of God which was lost through the fall, for such observation 'raises the human mind, cast down to earth, once more to its former heavenly haunts,'⁸⁰ allowing it to regain an understanding of these origins and thus of God. This is what God wants and intends: the study of astronomy, and, by extension, of all the mathematical sciences, is not only open to mathematically-minded human beings, but

⁷⁶ P. Melanchthon, *De astronomia et geographia*, CR 11.294: *Interea tamen generosae mentes, coelo ortae, de patria cogitent, hanc interdum contemplantur...*

⁷⁷ P. Melanchthon, *Praefatio in libros De iudiciis navitatum*, CR 5.822-823 (cited at n. 52 above).

⁷⁸ *Ibid.*, 820: *Postquam autem dictum est, temperamentum et inclinationes ab astris oriri, iam prudentes cogitent, magnam quidem partem haec initia actionum comitari; ut dicitur: naturae sequitur semina quisque suae.*

This was a standard belief in sixteenth-century medicine, and is the reason why horoscopes were used to aid diagnosis. See A. Chapman, 'Astrological Medicine', pp. 279-280, and for Melanchthon's views compare W.-D. Müller-Jahncke, 'Melanchthon und die Astrologie'.

⁷⁹ P. Melanchthon, *De astronomia et geographia*, CR 11.297: *Sua cuique naturae propiissima actio iucundissima est, ut nare piscibus, modulari Lusciniae, ita homines magna voluptate adfici necesse est, cum naturam totam rerum aspiciunt, cum numerorum et magnitudinum proportionem inveniunt, cum coelestium et inferiorum corporum harmoniam et consensum deprehendunt, cum vident omnia certa lege condita esse, ut nos de Architecto admoneant.*

⁸⁰ P. Melanchthon, *Praefatio in Geometriam*, CR 3.108: *Estque haec summa laus Geometriae, quod non haesit in exiguis et his inferioribus machinis, sed evolavit in coelum, et humanas mentes, humi abiectas, rursus in illam coelestem sedem subvexit...*

should rather be seen as an occupation for all which has been commanded by God.

Melanchthon's positive assessment of astrology and his consequent praise of mathematics and of observational astronomy rely upon a physics in which a sharp differentiation is made between the nature of the celestial and sublunar spheres, and, therefore, between the nature of the earth and of the heavens. It might be expected that Melanchthon would offer an explicit theological explanation for this divide, but he does not in fact do so. Indeed, little direct reference to his physics or to his ideas of the use of astronomy is contained in his theological textbook, the *Loci communes*.⁸¹ Although Melanchthon's discussion of the significance of the heavens is permeated with his theological understanding that God created the world, and did so for a purpose, and he himself identifies the pattern of the movements of the celestial bodies and the order of nature with divine providence,⁸² he does not include any explicit discussion of the doctrine of providence in the *Loci communes*. What reference he does make to the natural world and its interpretation is considered under the headings *De creatione*, and *De lege naturae*. In the 1535 edition he explains that Paul in his letter to the Romans [1.20] encourages the study of philosophy in order that 'God's presence in nature' can be considered, for 'the whole of the universe is a sort of

⁸¹ Melanchthon's *Loci communes* first appeared in 1521, and went into many editions. These represent three different versions of the text: the first is that of 1521, which appears in editions printed before 1525. This was revised slightly in 1533, and more radically in 1535. The final version appeared from 1542 onwards [CR 21.2]. The first edition contains only a very short section on the creation, which was completely revised and considerably extended in the later editions. Link points out that Melanchthon's work on physics shaped his understanding of the doctrine of creation, and that his presentation of the doctrines of God and of creation in the final edition of the *Loci communes*, in 1559, reproduce those given in the *Initia doctrinae physicae* [C. Link, *Schöpfung*, vol. 1, pp. 81-82].

⁸² Melanchthon makes this connection in several passages: see for instance, *De astronomia et geographia*, CR 11.297 (cited at n. 42 and n.44 above). This connection is central point to Kususkawa's thesis, for she believes it to be the key to understanding Melanchthon's interest in natural philosophy [S. Kusukawa, 'Providence Made Visible'].

sacrament, because it is a testimony that God is, and that God is wise, good, just.⁸³ He points out that the human mind has been formed by God to study the heavens and to recognise the vestiges of God, but reminds his readers that the Word of God rules this philosophy, just as it does everything else.⁸⁴ There is no mention of any special status for astronomy, although the movements of the heavenly bodies are specifically cited as evidence for God's existence. This discussion is expanded in the later edition,⁸⁵ but the

83 P. Melanchthon, *Loci communes* (1535), CR 21.369: *Ideo et Paulus ad Roma. inquit: divinitatem in natura conspici. ... Voluit haud dubie Paulus insigni verbo uti, ut excitaret nos ad hanc Philosophiam. Addit enim indicia divinitatis ideo proposita esse, ut Dei praesentiam discamus in natura considerare. Tota igitur rerum universitas existimetur esse Sacramentum quoddam, videlicet, quia sit testimonium, quod sit Deus, quod sit sapiens, bonus, iustus.*

84 *Ibid.*, 369-370: *Leges motuum coelestium tam multiplices et tam certae, consensus superiorum et inferiorum corporum, vices temporum, singularum rerum naturae ad certos fines atque usus destinatae, conservatio certarum specierum, nonne satis clare clamitant hanc rerum naturam non exsitere casu, sed certo consilio conditam esse et conservari? Sed expressissimum vestigium Dei est mens hominis, et notitiae menti impressae, honesti, iusti, & conscientiae terrores. Necesse est enim aliam mentem esse, a qua hominum mentes et illae notitiae ortae sunt. Et cum humana mens teneat discrimina iustitiae et iniustitiae, necesse est et in illa aeterna mente sapientiam et iustitiam esse. Sunt igitur humanae mentes imagines quaedam divinitatis, aut, ut ita dicam, specula, in quibus contemplari divinitatem debemus. Indicat praesentiam Dei et politicae societatis generis humani. Palam videmus imperia non posse, nisi divina ope, constitui ac retineri. Videmus homicidas et tyrannos divinitus ad poenam rapi. Adhuc lucet in ipsis mentibus notitia legis de Deo, quod sit Deus, quod sit iustus. Haec notitia esset clarissima, si natura hominis non haberet morbum originis. Is non quidem lucem illam divinam in animis nostris prorsus extinxit, manet enim aliqua notitia legis naturae, sed tamen caliginem quandam offudit animis morbus originis. Nunc piis danda est opera, primum ut verbo Dei iterum accendant illam notitiam, deinde etiam reddant illustriorem, adhibitis signis, quae sunt impressa naturae. Ingens barbaries est, nolle tantum in natura lumen aspicere. Ad haec cum Deus ipse invitet nos ad hanc Philosophiam, profecto non est negligenda: praesertim cum plurimum conducat ad disciplinam et prosit moribus. Exuscitat enim et confirmat in animis religionem et honestas opiniones de praesentia ac iustitia Dei. Fiunt autem illustriora haec iudicia, et propius aspicuntur, cum adhibetur vera physicorum doctrina. Et plura offerent se vestigia divinitatis his, qui studiose inquirunt et considerant naturam, et prudenter philosophantur. Epicuræi facti sunt ἄθεοι, quia corruerunt Physicen. At alios qui recte philosophati sunt, natura ipsa deduxit ad hanc lucem, ut et agnoverint esse Deum, et hanc naturam regi et conservari divinitus contenderint. Extant honestissimae disputationes in hanc sententiam apud Xenophontem, qui cum multa argumenta collegit, tandem inquit, ex his liquide constare, quod non redderint res casu, sed quod mundus sit opificium σοφοῦ τιμος δημιουργοῦ καὶ φιλοζώου. Dulcissima profecto descriptio est, quod Deum vocat conditorem φιλοζώου. Vidit enim ad usum hominum omnia condita esse, ideoque Deo curae esse homines. Iam quorsum attinebat Deum tam anxie elaborare in homine iuvando, tuendo, ornando, si tantum ad hoc exiguum spatium vitae corporalis conditi essemus, Xenoponti lucet in natura rerum, Dei erga nos φιλανθρωπιότα. Quare et nos Christiani naturam aspiciamus, et ibi Dei praesentiam et benignitatem erga nos contueamur. Hoc studium valde prodest ad disciplinam, et confirmat in animis bonas et pias opiniones. Sed tamen haec Philosophia regenda est verbo Dei. Deinde magna pietas est, creaturis sic uti, ut per eas glorificemus Deum, et monstremus in his bonitatem eius ac praesentiam, et agamus ei gratias. Haec obiter dixi, ut indicarem, quatenus mihi placeat haec Philosophia de considerandis vestigiis divinitatis in natura, et ad eam studiosos adhortarer.*

85 P. Melanchthon, *Loci communes* (1542), CR 21.637-643

sentiments remain the same: God created the world, indeed the whole universe, as an act of goodness. This can be recognised from Paul's testimony but it can also be demonstrated from the world itself. Melanchthon believes that this can be shown in nine different ways:

from the order of nature, which could not have arisen by chance
 from the nature of the human mind, which could not have been created by a brute nature
 from the distinction between honesty and turpitude, and similar knowledge of nature, order, or number
 from the truth of knowledge of nature
 from the human conscience
 from political society
 from the series of efficient causes, because it must have an end
 from final causes
 from the interpretation of future events.⁸⁶

⁸⁶ *Ibid.*, 641-643: *Recitabo igitur breviter aliquas demonstrationes, quarum cogitatio ad disciplinam at cofirmandas honestas opiniones in mentibus utilis est.*

Prima ab ipso naturae ordine sumitur, id est, ab effectibus monstrantibus opificem. Impossibile est ordinem perpetuum in natura casu ortum esse et casu manere, aut tantum a materia ortum esse. Praecipuae partes in natura sunt ordinatae, ut manet ordo perpetuus motuum coelestium, ita, ut ex homine homo, ex bove bos nascatur, foecunditatis terrae, perennitatis fluminum, naturalium noticiarum in mentibus humanis. Ergo natura non extitit casu, sed a mente aliqua orta est, quae ordinem intelligit.

Secunda a natura mentis humanae. Bruta res non est caussa naturae intelligentis; mentes hominum habent aliquam caussam, quia homo non habet esse per sese, sed incipit et aliunde oritur: Ergo necesse est aliquam intelligentem naturam caussam esse mentis humanae. Necesse est igitur esse Deum.

Tertia a discrimine honestorum et turpium et aliis notitiis naturalibus, ordinis et numerorum. Impossibile est discrimen honestorum et turpium in mente casu aut a materia ortum esse, item notitias ordinis et numerorum fortuitas esse. Ergo necesse est aliquam mentem architectatricem esse. Et hae duae rationes omnium maxime sunt illustres. Estque dignum consideratione, quod humana mens et illa lux menti insita praecipuum de Deo testimonium est in natura, et quidem inter notitias naturales haec quoque est, quod sit Deus, sicut Paulus inquit, Deus ipsis manifestavit, id est, Deus indidit humanae menti hanc notitiam, quod sit Deus, et simul indidit ratiocinationes illas ex effectibus.

Quarta: Notitiae naturales sunt verae; Esse Deum naturaliter omnes fatentur; Ergo haec notitia vera est. Haec minor esset illustrior, si natura non esset corrupta, sed confirmanda est ceteris argumentis, quae recitavi.

Quinta apud Xenophontem sumitur a terroribus conscientiae. Constat homicidas et alios perpetratis magnis sceleribus horribiles animorum cruciatus sustinere, etiamsi nulla humana iudicia metuant. Est igitur aliqua mens, quae hoc iudicium in animis ordinavit, quae probat recte facta et improbat secus facta.

Sexta a politica societate. Politica societas non est concursus hominum fortuitus, sed certo ordine et iure consociata multitudo; nec posset humana ope tantum retineri, sed experientia testatur aliquo numine ad poenam rapi eos, qui violant hunc ordinem, ut homicidas, incestos, et tyrannos; Ergo est aliqua mens aeterna, quae dedit hominibus intellectum ordinis, ut politicam societatem collant; Item, quae sua ope servat et defendit.

Septima est erudita, sumpta a serie caussarum efficientium. Non est processus in infinitum in caussis efficientibus; Ergo necesse est resistere in una prima caussa. Hanc rationem Physici dilucide explicant. Nam si esset progressus in infinitum, nullus esset ordo caussarum et nullae caussae necessario cohaerent.

Octava a caussis finalibus. Omnes res in natura destinatae sunt ad certas utilitates. Hanc distributionem finium impossibile est aut extitisse casu aut casu manere, sed necesse est consilio architecti factum esse.

Once again, there is no mention of Melanchthon's praise of astronomy, and neither does he discuss the distinction between the heavens and the sublunar sphere. However, Melanchthon seems to be quite clear that what God created is good: he is basically in agreement with the Platonic doctrine that 'God is the eternal mind, the cause of all good in nature,' although he enters the caveat that this statement has been put forward by a human mind and is, therefore, incapable of encapsulating the fullness of God's being, especially since it omits any mention of the Trinity.⁸⁷ Although what God has created is good, there is sin, generation and corruption in the universe. What is the origin of this? Melanchthon recognises that this issue, with its 'infinite labyrinths of dispute', is one of the most difficult for pious people.⁸⁸

Nona a futurorum eventuum significationibus. Certo monstrantur futuri eventus, non modo per prodigia, quae gentes movebant, quorum alia alias causas habent, sed multo magis per vaticinia in Ecclesia, ut Balaam, Iesaias, Ieremias, Daniel praedixerunt mutationes et successiones regnorum. Necesse est igitur aliquam mentem esse praevidentem eas mutationes et praemonstrantem.

These arguments also appear in the *Initia doctrinae physicae* [CR 13.200-202]. They will be discussed in more detail in the next chapter.

⁸⁷ *Ibid.*, 610: *Ut autem descriptionem aliquam Dei teneamus, conferam duas: alteram mutilam Platonis, alteram integram, quae in Ecclesia tradita est et ex baptismi verbis discitur. Platonica haec est: DEUS EST MENS AETERNA, CAUSSA BONI IN NATURA. Quanquam autem haec Platonica descriptio adeo erudite composita est, ut difficile sit iudicare parum exercitatis, quid desit, tamen quia nondum ita describit Deum, ut se patefecit ipse, requirenda est alia illustrior et proprior descriptio. Verba sunt haec: Deum esse mentem aeternam, id est, essentiam, spiritualem, intelligentem, aeternam, causam boni in natura, id est, veracem, bonam, iustam, omnipotentem conditricem bonarum rerum omnium et totius ordinis in natura et humanae naturae ad certum ordinem, id est ad certam obedientiam. Haec omnia complexus est Plato. Sed haec sunt adhuc humanae mentis cogitationes, quae etsi verae et eruditae sunt et ex firmis demonstrationibus natae, tamen addendum est, qualem se Deus ipse patefecerit. Sit igitur haec altera descriptio:*

Deus est essentia spiritualis, intelligens, aeterna, verax, bona, pura, iusta, misericors, liberrima, immensae potentiae et sapientiae, Pater aeternus, qui Filium imaginem suam ab aeterno genuit, et Filius imago patris coaeterna, et Spiritus sanctus procedens a Patre et Filio, sicut patefacta est divinitas certo verbo, quod Pater aeternus cum Filio et Spiritus sancto condiderit et servet coelum et terram et omnes creaturas, et in genere humano condito ad imaginem suam ad certam obedientiam elegerit sibi Ecclesiam, ut ab ea haec una et vera divinitas patefacta certis testimoniis et per verbum traditum Prophetis et Apostolis agnoscat, invocetur et colatur iuxta verbum illud divinitus traditum, et damnentur omnes cultus, qui fingunt alios Deos, et haec vera divinitas in vita aeterna celebretur.

Haec descriptio propius recitat, quis sit Deus, et deducit nos ad patefactionem divinam, sicut in Ecclesia semper haec doctrina tradita est.

⁸⁸ *Ibid.*, 644: *Est autem piaie mentis reverenter de Deo sentire ac loqui, et sententias veras, pias, honestas, comprobatas gravibus iudiciis piorum in Ecclesia, utiles moribus, retinere, nec curiositate ac studio argutiarum quaerere infinitos labyrinthos disputationum.*

He is adamant that it is impossible to argue that there can be two creators, one good and one evil. His emphasis on the goodness of the natural world is in part a denial of this 'horrible, mad affront to God', argued by the Manichees 'on the basis of a corrupt philosophy', which held that sin and evil arose from the natural world, which had been created by an evil Demiurge, while God was associated with the spiritual world. Melanchthon rejects this dualism. For Melanchthon, it is also impossible that God could in any way be thought to have created sin. Because of this, he wishes to deny any philosophy which makes a necessary connection between the first cause, God, and all secondary causes, whether of physics or of the will.⁸⁹ In Melanchthon's view, sin comes about through a perversion of the human will from whatever cause,⁹⁰ and it is thus impossible to argue that God as first cause could have brought this about. As first cause God chose to act through freedom, by giving human beings free will which includes allowing the will to choose evil.⁹¹ God may indeed choose to bring about something

Luther goes as far as to say that the existence of sin in creation cannot be explained, and that no attempt should be made to do so [H. Olsson, *Schöpfung, Vernunft und Gesetz in Luthers Theologie*, pp. 309-313].

⁸⁹ *Ibid.*, 643-644: *Semper omnes sapientes mirati sunt, cum tantus sit ordo naturae in plurimus rebus, unde in genere humano tanta sit confusio, tantum scelerum et calamitatum, morbi et mors. Ac Philosophi partim in materia, partim in voluntate humana causas collocant, partim ad fatum transferunt, quod dicunt esse necessariam connexionem primae causae et omnium secundarum, Physicarum et voluntatum. Et Manichaei ex corrupta Philosophia orti horribiles furores contumeliosos in Deum et perniciosos moribus excitaverunt de duobus diis, bono et malo, at de necessitate, nec leviter quassata est Ecclesia illis vetustis temporibus hac quaestione de causa mali et de Contingentia.*

⁹⁰ *Ibid.*, *De causa peccati et de contingentia*, 643-652. Melanchthon discusses the causes of actions, and, implicitly, the causes of sin frequently: see for example, P. Melanchthon, *Praefatio in libros De iudiciis navitatum*, CR 5.820-821, where Melanchthon argues that all actions are caused either by human will, God, or the devil, which may warp human minds and hearts.

⁹¹ P. Melanchthon, *Loci communes* (1542), CR 21.645-652, especially 647: *Nec propterea Deus est causa peccati. Etsi enim sustentat aliquantisper naturam, tamen defectus illi in mente non efficiuntur ab ipso, et voluntas libera Evae proprie et vere erat causa suae actionis, ac sponte se avertit a Deo.*

See also 651-652: *Nec eodem modo Stoicus et Christianus hanc propositionem intelligunt: Secunda causa non agit sine prima; quia Stoici cogitant similem copulationem in omnibus, seu bonis seu malis, ut est copulatio essentialis maris et feminae in procreatione. Sed Christianis necesse est discernere bona et mala: Secunda non agit sine prima, scilicet sustentante; sed multa facit prima causa praeter secundas, quia est agens liberum. Et secunda libera, ut voluntas Evae vitiose agit sine prima adiuvante, quia talis facultas est libertas. Haec sit explicatio perspicua, non nimis tenuis.*

which at first sight seems evil by manipulating human will, but if God choses to bring it about, it is not evil, but part of God's plan for the world, which is by definition good.⁹² Melanchthon does not explicitly relate his discussion of sin and contingency to his cosmology, but the connection may nevertheless be made. God created a universe which was orderly and good, but this was marred by sin. However, since sin was brought about by human will, and since human beings have no access to the realm above the moon, it would be quite logical to conclude that the celestial sphere was unaffected by the fall. Melanchthon does not state this explicitly, but he does say that human beings would have been able to understand God directly from the heavens if their free will had not intervned and led them to sin.⁹³ This assertion is rooted in his understanding of natural law, or *lex naturae*, which is the natural knowledge and understanding given to the human being by God, which would have been adequate to allow the human mind to know God, had it not been for the fall. The scholastic view had been that divine law, that is the law of Moses and the scriptures, has been given by God because human nature is incapable of grasping God's eternal law directly.⁹⁴ Melanchthon, as a Lutheran, puts more emphasis on fallen human nature in his discussion of divine law in the *Loci communes*. Divine law is only necessary because the fall has made it impossible for human beings to grasp the truth about God; in

Alii sic dicunt: Secunda non agit sine prima positivum quiddam efficiens; Secunda, ut voluntas Evae, agit aliquid delinquens. Hic respondent: Agit non positive, sed aberrans ac deficiens. Haec solutio, si per priorem exponatur, erit planior, et eam esse sententiam huius obscurae solutionis, consentaneum est, ut copulatio primae et secundae caussae talis cogietur, qualem Deus libere agens vult esse, non ut nos copulationem maris et feminae cogitamus.

⁹² *Ibid.*, 645-647. An example would be God's hardening of Pharoah's so that he would not release the Israelites [Ex 7.4]. Augustine had argued that it is impossible to judge the goodness or justice of God human terms: if God does something, it is by definition good, or just [see, for example, A. E. McGrath, 'Divine Justice and Divine Equity']; this seems also to be Melanchthon's position.

⁹³ P. Melanchthon, *Praefatio in libros De iudiciis navitatum*, CR 5.822-823 (cited at n. 52 above).

⁹⁴ T. Aquinas, *Summa Theologicae*, 1a2ae.91.art 4, pp. 29-33.

their pre-fall state they would have been able to do so.⁹⁵ Moreover, Melanchthon identifies the principles of knowledge gained through understanding of the natural world by means of philosophy as a part of the *lex naturae*.⁹⁶ Although Lutheran theology accords much less importance to natural law than that given it by scholastic theology, Melanchthon himself, as has been seen above, actually sees the law as a more positive power for the good than does Luther. Melanchthon's equating of natural and moral philosophy with the *lex naturae* thus allows for the possibility that such knowledge may offer a positive step towards knowing God. Moreover, given the traditional belief that natural law would have been enough without the fall, and Melanchthon's conviction that sin arises only through the distortion of the human will, it is easier to understand his apparent belief that observation of the natural world, and especially the heavens, is capable of offering undefiled knowledge of God. The heavens, created to give direct knowledge of God, are not affected by human sin, and the knowledge that they offer is, therefore, still more pristine than that offered by the sublunar world, which can be affected by human influence. Thus theology and philosophy are intertwined in Melanchthon's cosmological conviction of the perfection of the heavens.

Melanchthon's conviction that God's intention for the world can be gleaned from the heavens and the interdependence between his physics and his

⁹⁵ P. Melanchthon, *Loci communes* (1542), CR 21.687: *Etsi enim inde usque ab initio mundi sonuerunt in Ecclesia Dei vox Legis et vox promissionis gratiae, tamen certo consilio cum constituta est politia israelitica, Lex Dei promulgata est. Voluit enim Deus publico et manifesto testimonio instaurare notitiam illam, quam mentibus humanis in creatione indidit, ut suum iudicium adversus peccatum ostenderet.*

⁹⁶ *Ibid.*, 711ff, especially p. 711: *Ut lumen oculis divinitus inditum est, Ita sunt quaedam notitiae mentibus humanis inditae, quibus agnoscunt et iudicant pleraque. Philosophi hoc lumen vocant notitiam principiorum, vocant κοινὴς ἐννοίας ἐτ̄ προλήψεως. Ac vulgaris divisio nota est, alia esse principia speculabilia, ut notitias numerorum, ordinis, syllogismi, principia Geometrica, Physica. Haec omnes fatentur esse certissima et fontes maximarum utilitatum in vita.*

theology both help to explain his attitude to Copernicus's heliocentric hypothesis. Melanchthon has been portrayed as a strong opponent of Copernicus' ideas who condemns Copernicus as a lover of novelty seeking to prove his own intelligence.⁹⁷ This interpretation is based largely upon the first edition of Melanchthon's *Initia doctrinae physicae*, where he writes:

But some dare to say, either because of their love of novelties or in order to appear clever, that the earth moves, and contend that neither the eighth sphere nor the sun moves, while they assign motion to the other celestial spheres and place the earth among the stars. The joke is not new. There is a book by Archimedes called *De numeratione arenae*, in which he reports that Aristarchus of Samos defended this paradox, that the sun remains fixed and the earth turns round the sun.

And although clever thinkers investigate many causes in exercising their ingenuity, nevertheless to argue absurd ideas openly is not honourable and is a harmful example.⁹⁸

In the second edition of the *Initia doctrinae physicae*, published in 1550, Melanchthon has removed the accusation that astronomers teach the movement of the earth 'either because of their love of novelties or in order to appear clever' and the renunciation of geocentrism is no longer

⁹⁷ T. S. Kuhn, *The Copernican Revolution*, pp. 191-2, and compare B. A. Gerrish, *The Old Protestantism and the New*, pp. 167-8.

⁹⁸ P. Melanchthon, *Initia doctrinae physicae*, CR 13.216: *Sed hic aliqui vel amore novitatis, vel ut ostentarent ingenia, disputarunt moveri terram, et contendunt nec octavam sphaeram, nec Solem moveri, cum quidem caeteris coelestibus orbibus motum tribuant, Terram etiam inter sidera collocant. Nec recens hi ludi conficti sunt. Extat adhuc liber Archimedis de numeratione arenae, in quo narrat, Aristarchum Samium hoc paradoxum tradidisse, Solem stare immotum, et terram circumferri circa Solem.*

Etsi autem artifices acuti multa exercendorum ingeniorum causa quaerunt, tamen adseverare palam absurdas sententias, non est honestum, et nocet exemplo.

Breen and others argue for Melanchthon's anti-Copernicanism on the basis that in a letter of 1541 Melanchthon urges state action against those who believe the demonstration of heliocentrism to be successful [Q. Breen, 'The Subordination of Philosophy to Rhetoric in Melanchthon', p. 25]. Blumenberg makes less of this passage, but also believes it to call for such legislation [H. Blumenberg, *The Genesis of the Copernican World*, p. 324]. However, both seem to me to have misunderstood what is certainly an ambiguous passage. Their interpretation is based on the concluding sentences of a letter from Melanchthon to Burcardus Mithobius which comments on the follies into which Philip of Hessen has been drawn by his unwise love (which included a bigamous marriage). The letter concludes: *Fabula per sese paulatim consulescet; sed quidam putant esse egregium katovrqwma rem tam absurdam ornare, sicut ille Sarmaticus Astronomus, qui movet terram et figit Solem. Profecto sapientes gubernatores deberent ingeniorum petulantiam cohercere* [CR 4. 679]. This final sentence is more likely to be Melanchthon's comment upon Philip's follies and the associated *fabula* than a call for state action against the opponents of geocentrism. It is, however, clear that Melanchthon also regards the ideas of those who 'move the earth and fix the sun' as folly.

characterised as a game.⁹⁹ Melanchthon no longer directly criticises those who teach this theory, but he remains convinced that it should be not taught to those who are just beginning to learn physics. It should rather be reserved for the contemplation of professors and more advanced students, and beginners should be taught the received wisdom, since this is less absurd and because through it students understand that truth is shown by God.¹⁰⁰ This change in Melanchthon's attitude may be attributable to his acquisition of or gaining access to a copy of Copernicus' *De revolutionibus*, which appeared in 1543.¹⁰¹ From the late 1540s, Melanchthon is openly appreciative of the value of Copernicus' observational work and of the contribution which his observations had made to improved accuracy in the measurement of geographical position, in observational astronomy, and in the measurement of the length of the year.¹⁰² More accurate tables of observations mean a better prediction of planetary positions and

⁹⁹ P. Melanchthon, *Initia doctrinae physicae* [1550], fol.39^v: *Sed hic aliqui disputarunt moveri terram, et dicunt nec octavum sphaeram, nec Solem moveri, cum quidem caeteris coelestibus orbibus motum tribuant, Terram etiam inter sidera collocant.*

This development was first pointed out by Wohlwill in 1904, but has only become widely known in English-language literature on Melanchthon in the last twenty years. Kuhn and Breen clearly know nothing of it. For the reasons for Melanchthon's development and his familiarity with Copernicus's *De revolutionibus*, see E. Wohlwill, 'Melanchthon und Copernicus', pp. 261-2, R. S. Westman, 'The Melanchthon Circle', p. 173, and H. Blumenberg, *The Genesis of the Copernican World*, p. 326.

¹⁰⁰ P. Melanchthon, *Initia doctrinae physicae* (1550), fol.40^r: *Etsi autem artifices acuti multa exercendorum ingeniorum causa quaerunt, tamen sciunt iuniores, non velle eos talia adseverare. Ament autem in prima institutione sententias receptas communi artificum consensu, quae minime sunt absurdae, et ubi intelligunt veritatem a Deo monstratam esse, reuerenter eam amplectantur, acquiescant in ea, & Deo gratias agant aliquam accendenti lucem, & seruant in genere humano.* See also E Wohlwill, 'Melanchthon und Copernicus', p. 262.

¹⁰¹ H. Blumenberg, *The Genesis of the Copernican World*, pp. 324-6.

¹⁰² In the memorial address for Caspar Cruciger written by Melanchthon in 1549 and delivered by Erasmus Reinhold, Melanchthon praises Copernicus for the accuracy of his observations [*De Casp. Crucigero, CR 11.839: His et similibus observationibus moti* [of the sun and of equinoxes] *Copernicum magis admirari et amare coepimus.*], and in preface to the tables of Regiomontanus dating from 1552, he lists Copernicus together with Cusanus, Peurbach and Regiomontanus as examples of learned men whose intelligence and knowledge of Greek allowed them to interpret the whole world [*Praemissa libro: Io. Regiomontani tabulae directionum, CR 7.951: tamen aditum multis ingeniosis et discendi cupidis ad perfectionem huius doctrinae patefecerunt, quorum aliqui, ut Purbachius, Blanchinus, Cusanus, Regiomontanus, Copernicus, postea ingeniorum acie et sua solertia, adiuti etiam cognitione Graecae linguae, totum hunc orbem artium illustrarunt.*

conjunctions, and because Melanchthon believes that this aids the understanding the causality of the stars which in turn leads to a better knowledge of God. Thus better observations bring the observer and the interpreter to a better appreciation of God. Copernicus's accuracy certainly deserves praise, even if his cosmology does not.

There is, however, a further development between the first and second editions of the *Initia doctrinae physicae* which demonstrates the limits to Melanchthon's appreciation of observational astronomy. In the first, 1549, edition of the *Initia doctrinae physicae*, Melanchthon explains that there are some who believe that the planets Mercury and Venus orbit the sun directly, and thus the earth only indirectly. Even though he himself does not support this view, he gives the observational evidence for it.¹⁰³ In the 1559 edition, however, an exclusively Ptolemaic discussion of Mercury and Venus is given, and the evidence that they orbit the sun is omitted.¹⁰⁴ The reasons for this change are not clear. It is possible that the more observational parts of the *Initia doctrinae physicae* originate not from Melanchthon but are the work of either Caspar Peucer or Erasmus Reinhold, both of whom were mathematicians who taught at Wittenberg and were close friends and collaborators of Melanchthon but more inclined than he to accept Copernican

¹⁰³ P. Melanchthon, *Initia doctrinae physicae*, CR 13.276. He describes the traditional view, and then continues: *Verum alii quidam, cum viderent hos duos Planetas [i.e. Venus et Mercurius] perpetuo Solem comitari, nec ab eo ultra certos terminos abscedere, crediderunt illos circa Solem tanquam circa suum centrum ferri, ita ut ipsorum sphaerae corpus Solis in medio inclusum habeant. Qui positus omnia horum Planetarum phaenomena aptius ostendit, quam si vel supra Solem, vel infra eum horum Planetarum sphaerae collocentur. Sed nos retinemus antiquissimorum Astrologorum sententiam, quam Cicero quoque, Ptolemaeus et alii recentes Mathematici magno consensu sunt secuti.*

¹⁰⁴ P. Melanchthon, *Initia doctrinae physicae* (1550), fol.89^{r-v}. The passage cited in the previous footnote has been omitted, together with Melanchthon's discussion of the relative distances of the sun, the moon, Mercury and Venus, which precedes it in the first edition.

Blumenberg was the first to point out this change, but he asserts that Melanchthon, 'submitting to all the evidence,' as he puts it, actually taught the view that Mercury and Venus orbit the sun in the first edition of the *Initia doctrinae physicae*, discarding it in the second [H. Blumenberg, *The Genesis of the Copernican World*, p. 327]. This would seem to be a misreading of the first edition.

heliocentrism.¹⁰⁵ If this is so then Melanchthon himself may not have been really familiar with, or convinced by, the observational evidence which appears in the first edition of the *Initia doctrinae physicae*. It would then be relatively easy for him to retract what may later have appeared a dangerously heliocentric description in the light of his own plea for a consistent use of the 'truth' as described by Ptolemy and Aristotle when teaching beginners. Whether the original argument comes from Melanchthon's pen or not, his removal of it requires him to sacrifice observational arguments to preserve Ptolemaic and Aristotelian 'truth', and this he does. His willingness to do so demonstrates clearly that he is not using observations to test his view of the universe, let alone as a measure of the accuracy of the mathematical descriptions in which he finds so much beauty and regularity. Although Melanchthon waxes lyrical about the way in which mathematics and astronomy can describe the movements of the heavenly bodies and with them God's mind, he is not seeking to establish or to correct either a mathematical or a physical description of reality.

In this, Melanchthon is typical of many thinkers, including astronomers, of his day. It was common to use physical and metaphysical theories derived from Aristotle and other ancient philosophers to explain the way the universe worked and to combine these with mathematical descriptions to predict the positions of the planets.¹⁰⁶ Indeed, Melanchthon states clearly, albeit indirectly, that he is not interested in the heavenly motions as a subject deserving attention for and of itself, but as an intermediary stage by which

¹⁰⁵ R. S. Westman, 'The Melanchthon Circle', pp. 174-186.

¹⁰⁶ J. Mittelstraß, ' *Phaenomena bene fundata*', pp. 48-50. There was disagreement about the status of the geometrical forms used in calculating the positions of the planets and about how these should be reconciled with the Aristotelian system of spheres [N. Jardine, *The Birth of History and Philosophy of Science*, pp. 230-244].

the human mind may reach God. It is the study of influence of the motions of the heavenly bodies on the sublunar world in general and on human beings in particular which Melanchthon includes in his physics;¹⁰⁷ the constitution of the heavens and of the heavenly bodies is investigated only in so far as it can reveal and explain this influence. That the mathematical analyses of the heavenly motions do in fact work is for Melanchthon marvellous in the strict sense of the word.

Melanchthon's use of astronomy seems to have arisen from his search for an ethical authority, which was in turn occasioned by the denial of the efficacy of works in Lutheran theology. His use of astronomy should, of course, be seen in terms of the complex inter-relationship between philosophy and theology, or, more precisely, between natural philosophy, moral philosophy and theology, in the whole corpus of his works, and the survey offered here is of necessity only an introduction.¹⁰⁸ However, even this relatively brief consideration seems to indicate that Melanchthon sought an approach which would allow him to deal with a range of issues concerning the relationship of philosophical and theological authority to observational astronomy and predictive astrology and to show the inter-relationships between these different aspects of God's creation. Although Melanchthon undoubtedly understood himself to be in search of the truth, his approach to a problem which had been posed by the theological concerns of the Reformation was to seek a solution through an appeal to a range of philosophical authorities,

¹⁰⁷ P. Melanchthon, *Initia doctrinae physicae*, CR 13.180: *Deinde considerata hominis natura, suspicere in coelum iuaret, et considerare, quae sit cognatio coelestium corporum cum inferioribus, ac praesertim cum homine.*

¹⁰⁸ It is unfortunately beyond the scope of this thesis to undertake the detailed work which still needs to be done on Melanchthon's *Erotemata dialectica* and his philosophical methodology; however, Gilbert offers a brief, comment on Melanchthon's understanding of method and demonstration [N. W. Gilbert, *Renaissance Concepts of Method*, pp. 125-129]

including Aristotle, Plato,¹⁰⁹ the Stoics, Philoponos,¹¹⁰ probably Proclus and Ptolemy, and doubtless others. Although Aristotle is most important of these, his use of this miscellany of ancient authors demonstrates the breadth of influence of their philosophical thought.¹¹¹ Their works were known not only individually but also through a long commentary tradition, for although the endeavours of humanist scholars (such as Melanchthon himself) to return to the original texts led them to reject medieval commentary traditions and to turn to their own translations of the works of Plato and Aristotle, it also led them to translate and study the works of Greek commentators, who had produced a variety of refinements and interpretations of Platonic and Aristotelian thought and of the relationship between them. As the example of Melanchthon shows, the original texts and the commentary tradition were in turn seen by sixteenth-century thinkers through the eyes of their own age and of their own concerns, who produced their own synthesis of what had gone before.

In seeking to establish a solid, authoritative basis for his theological ethics Melanchthon associates the reliability of mathematical proof and the divinity of number with not only natural but also moral philosophy. In his search for a certain ethical authority, Melanchthon appeals to those arguments of different philosophers which best addressed the questions he wishes to

¹⁰⁹ 'Let us love both [Plato and Aristotle]', exhorts Melanchthon [*De Platone*, CR 11, 423].

¹¹⁰ Gilbert asserts that 'when Melanchthon speaks of the "habit" of calling all things back to method, he obviously has in mind the Greek definition of method as found in Philoponos' [N. W. Gilbert, *Renaissance Concepts of Method*, p. 126]. Philoponos was probably the originator of the tradition that ἀγεωμέτρητος οὐδεὶς εἰσέλτω was written over the door to Plato's Academy in Athens [*ibid.*, p. 88].

¹¹¹ It also acts as a warning against speaking too hastily about 'Platonism' and 'Aristotelianism' in the sixteenth century, especially since the authorities whom writers purport to use are not necessarily those they cite: while Jacob Schegk (see below) is writing a defence of Aristotelianism against Ramus, he quotes 'extensively and seriously' from Plato's dialogues in doing so [*ibid.*, p. 36].

raise. It has already been noted that Melanchthon's use of astrology depends upon the Aristotelian hierarchy of the spherical universe with its distinction between the sub- and supralunar spheres. Melanchthon also cites Plato and Pythagoras in asserting the divinity of number and that 'God geometrizes'. In doing so, he associates praise of the elegance of mathematics and its power of proof, which had been recognised by theologians and philosophers to be more exact than that of the proofs of physics and theology since the time of Aristotle,¹¹² with the Platonic contention that number is divine.¹¹³ The combination of these two, essentially different, interpretations of the perfect nature of mathematics with a Christian Aristotelianism allows Melanchthon to argue that mathematical reasoning may offer humanity a means of approaching God by transcending the sublunar sphere, and with it some of the effects of the fall. Although Melanchthon brings his own theological concerns to this problem, the association of mathematical reasoning with the divinity of number and the application of this association in an ethical system is not original to him, but has much in common with Ptolemy's philosophical introduction to the *Almagest*,¹¹⁴ a work which was available to sixteenth-century readers in many editions. Proclus too emphasises the usefulness of linking mathematical demonstration and the divinity of mathematics in his

¹¹² Aristotle points this out in *Metaphysics* E ch. 1 [1026a8-1026a33]. He also points out that it is the view of the Platonists that this is the view of the Platonists [*Metaphysics*, A, ch. 6 and 8 (987b19-37 and 990a30-32)]. Many medieval thinkers, including Thomas Bradwardine, Robert Grosseteste, Roger Bacon, and Thomas Aquinas, recognised and commented on the exactness of mathematical proof, but they submitted mathematics to theology because of the nobility of its subject matter. For a fairly detailed discussion of the notion of the exactness of mathematical proof see A. G. Molland, 'Colonizing the world for mathematics', especially pp. 46-52.

¹¹³ See, for example, Plato, *Laws*, 967-968.

¹¹⁴ See L. C. Taub, *Ptolemy's Universe*, esp. pp. 19-38, 146-154. Taub offers a detailed discussion of the philosophical introduction to the *Almagest* (which work she refers to as the *Syntaxis*) and of Ptolemy's place in Greek philosophical tradition. Although Melanchthon never explicitly refers to Ptolemy's philosophical understanding, their use of mathematics has marked similarities.

commentary to the first book of Euclid's *Elements*, and although his approach has a generally Platonist orientation, his understanding of demonstration is fundamentally Aristotelian.¹¹⁵ His interpretation may also have been attractive to Melanchthon, who almost certainly knew of Proclus' commentary since it had been edited by Simon Grynaeus. Taken as a whole, Melanchthon's approach as portrayed in the *Initia doctrinae physicae* and in his mathematical and astronomical prefaces seems, therefore, to offer a new, Lutheranised, synthesis of ideas which he had encountered elsewhere in the course of his reading, and his views on the place of astronomy and astronomical observation in establishing the basis for a solid philosophy are also based on these. Melanchthon seems more interested in the place of mathematics in this system than in the actual content or form of the mathematical sciences and mathematical reasoning itself. Although he extols the importance of making accurate observations, he is happy to subordinate actual observational evidence to the authority of Aristotle's cosmology by revising his description of the orbits of Venus and Mercury in the second edition of the *Initia doctrinae physicae*.¹¹⁶ Thus, although at first sight Melanchthon appears to appeal to observational astronomy to solve his ethical problems, what he actually does is to appeal to the cosmology which he accepts to be the truth: an Aristotelian view of the universe 'as created by God,' which he is able to reconcile to the traditional interpretation of the biblical understanding of the universe.¹¹⁷

115 N. W. Gilbert, *Renaissance Concepts of Method*, p. 87.

116 See pp. 79-80 above.

117 The Bible, and in particular the Old Testament, is, of course, not based on an Aristotelian cosmology, but there had been a long tradition of interpreting it as if it were, to which Melanchthon tacitly appeals. Wallace-Hadrill traces some of the beginnings of this interpretation in Greek patristic thought [D. S. Wallace-Hadrill, *The Greek Patristic View of Nature*, especially pp. 1-21].

Melanchthon's praise of mathematics is not praise of the ability of mathematics to describe an actual situation. It is, however, perhaps overstating the case to characterise Melanchthon's praise of mathematics as a rhetorical device.¹¹⁸ Although Melanchthon certainly employs his considerable rhetorical skills to promote the study of mathematics, he does so because he attributes a significance to mathematics which does in fact lead to his encouragement of its study, even if it is not accompanied by any great measure of mathematical ability. Further, his emphasis on the study of the mathematical sciences is not unique among his contemporaries and he was clearly offering a contribution to a lively debate. The reception of this contribution will be illuminating for the more detailed understanding of the situation in Tübingen later in the sixteenth century.

The impact of Melanchthon's thought on contemporary discussions was considerable, and the extent of his sphere of influence meant that he contributed to many sixteenth-century debates, while the sheer volume of his correspondence and the breadth of its concerns demonstrate the wide range of questions upon which he was consulted. His central role in the development of Lutheran theology is incontrovertible, as is his influence on the educational establishments of Lutheran Germany. Outside Wittenberg, Melanchthon's educational interests led to his involvement in the establishment and reformation of school systems and universities throughout Lutheran Germany, not least in Tübingen, where, as has been noted above,

¹¹⁸ Breen points out that 'Melanchthon does not regard mathematics as a reliable tool for discovering truth.' This, as has been seen, is essentially a correct understanding of Melanchthon, although Breen bases his argument upon the first edition of the *Initia doctrinae physicae* and upon his misunderstanding of Melanchthon's letter to Mithobius [see notes 74 and 75 above]. However, Breen's concluding comment that he is 'inclined ... to write off as largely rhetorical [Melanchthon's] praise of mathematics as the chief part of philosophy' seems too superficial a judgement. See Q. Breen, 'The Subordination of Philosophy to Rhetoric in Melanchthon', pp. 24-5.

he corresponded directly with the university Senate about the curriculum and advised on the appointment of new professors during the reformation of the university in Tübingen.¹¹⁹ This led to his precepts and priorities being incorporated into both the structures and the curriculum of the newly reformed university. Moreover, his views on mathematics and astronomy were certainly known in Tübingen through his correspondence with Simon Grynaeus, the reformer of Tübingen university who was in Tübingen from 1534 to 1535, to whom Melanchthon's prefaces to the 1531 edition of Sacrabosco's *Sphaera* and the 1535 edition of Peurbach's *Theoricae novae planetarum* are addressed, and who himself edited and wrote prefaces to editions of Euclid's *Elements*, Proclus's commentary on the *Elements*, and numerous other mathematical and natural philosophical works. Melanchthon was also closely associated with Johannes Camerarius, professor of Greek and ducal commissary at Tübingen from 1535, who produced a book of mathematical exercises.¹²⁰ Through these men Melanchthon's ideas had a direct impact on the first generation of post-Reformation professors in Tübingen.

It is apparent from his wide correspondence with people such as Grynaeus and Camerarius on mathematical and philosophical matters that Melanchthon's philosophical views of mathematics were of interest to his contemporaries. In Wittenberg he was also in close contact with a group of mathematicians who were of vital importance in the development of mathematics in post-Reformation Germany.¹²¹ These included Erasmus

¹¹⁹ See above pp. 21-22, 25.

¹²⁰ J. E. Hofmann, *Geschichte der Mathematik*, vol. 1, pp. 140, 176. I have not, however, been able to trace Camerarius' work.

¹²¹ For more detailed discussions of the influence of this group, see R. S. Westman, 'The Melanchthon Circle', especially pp. 174-190, and L. Thorndike, *History of Magic and Experimental Science*, V, ch. 17.

Reinhold, a supporter of Copernicus and an important astronomer in his own right who produced a new set of astronomical tables of motion,¹²² Caspar Peucer, Melanchthon's son-in-law, who succeeded Reinhold as professor of mathematics and Melanchthon as rector at the university in Wittenberg,¹²³ and Georg Joachim Rheticus, an avid disciple of Copernicus, who also made important developments in trigonometry.¹²⁴ Although Melanchthon's own mathematical interests tended towards the philosophical and theological rather than the explicitly mathematical, he held an important position in this group as one of the leading professors in the university, and his involvement in mathematical circles in Wittenberg would suggest that his views on mathematics and natural philosophy were taken seriously by his contemporaries as an informed opinion, worthy of discussion, and, therefore, that they were influential in forming the on-going debate about the status of mathematics. Melanchthon and his circle of colleagues must have had a direct influence on the education of the considerable proportion of professors of mathematics in German Lutheran universities in the mid- to late-sixteenth century who had been educated at Wittenberg,¹²⁵ but it was not only mathematicians who were exposed to their ideas.

Wittenberg produced not only mathematicians but also theologians, doctors, lawyers and philosophers who moved away to teach in other universities, carrying with them the interests and ideas they had encountered in Wittenberg. One of these was Samuel Isenmenger, who taught astronomy

122 R. S. Westman, 'The Melanchthon Circle', pp. 174-178.

123 *Ibid.*, pp. 178-181.

124 *Ibid.*, pp. 181-190: Rheticus visited Copernicus and was instrumental in persuading him to publish the *De revolutionibus*. See also H. Blumenberg, *The Genesis of the Copernican World*, p. 222, and, for Rheticus's achievements in trigonometry, W. W. Rouse Ball, *A Short Account of the History of Mathematics*, p. 226.

125 R. S. Westman, 'The Melanchthon Circle', p. 171.

in Tübingen from 1557 to 1567;¹²⁶ after several short-term appointments he was eventually succeeded by Philip Apian, who came to Tübingen in 1570 from the Jesuit university in Ingolstadt, which had been established in 1556.¹²⁷ When Apian was dismissed for refusing to sign the *formula concordiae* in 1583 he was succeeded by his pupil, Michael Maestlin. Kepler's teacher of mathematics had not, therefore, been directly influenced by Melanchthon.

However, others among his teachers had. The theologian Jacob Heerbrand, superintendent of the *Stift*, had been a pupil of Melanchthon's at Wittenberg between 1538 and 1543 shortly before Melanchthon's reorganisation of the arts faculty in 1545; Heerbrand acclaimed Melanchthon's learning and theology in the preface to his textbook, the *Compendium theologiae*, and his theology was influenced by that of Melanchthon.¹²⁸ Johannes Vischer, professor of medicine at Tübingen between 1568 and 1587, had studied philosophy and theology in Wittenberg in the early 1540s before going on to study in Paris and Strasburg and finally turning to medicine in Italy.¹²⁹ The lawyer, Johannes Halbritter, and Georg Hizler, professor of rhetoric, were also products of post-Reformation Wittenberg.¹³⁰ It is, therefore, legitimate to assume that ideas which were discussed in Wittenberg had permeated to Tübingen.

¹²⁶ *Ibid.*, and compare N. Hofmann, *Artistenfakultät*, p. 247. Westman uses the spelling Eisenmenger; I have followed Hofmann.

¹²⁷ J. E. Hofmann, *Geschichte der Mathematik*, I, p. 177, and cf N Hofmann, *Artistenfakultät*, p. 247. N. Hofmann asserts that Apian was appointed in 1568; Westman dates Apian's arrival to 1569. I have followed N. Hofmann.

¹²⁸ J. Heerbrand, *Compendium Theologiae*, fol. B^r-V. Heerbrand's theology and some of its similarities and differences to that of Melanchthon will be discussed in the next chapter. For Heerbrand's biographical dates see H.-M. Decker-Hauff and W. Setzler, *Imagines Professorum Tubingensium*, vol. 2, p. 142.

¹²⁹ H.-M. Decker-Hauff and W. Setzler, *Imagines Professorum Tubingensium*, vol. 2, pp. 154-155.

¹³⁰ *Ibid.*, pp. 139, 144.

But Melanchthon's influence did not extend only to the circle of his students and his correspondents. For a variety of reasons his ideas and the use of his writings were the subject of discussion during the second half of the sixteenth century. During Peucer's rectorate of Wittenberg after Melanchthon's death in 1560 a conflict developed within the university of Wittenberg between the followers of Melanchthon and 'more orthodox Lutherans' which led to Peucer's condemnation and imprisonment as a crypto-Calvinist in 1576.¹³¹ The crux of the conflict is not clear, but it is likely that it centred on Melanchthon's understanding of the Lord's Supper, and that it was at first only indirectly concerned with his understanding of philosophy and of physics, if at all. However, the two issues could not remain unrelated both because they were intimately connected in Melanchthon's own thinking and because some universities had taken Melanchthon's contribution to physics seriously enough to offer a selection of his works known as the 'Philipus' as an alternative to Aristotle's physics.¹³²

It is possible that Tübingen was one of the universities to have done this, for the *Ordinatio* of 1557 lays down that physics should be taught according to the original text of Aristotle's *Physics* rather than from a *compendium*.¹³³

¹³¹ R. S. Westman, 'The Melanchthon Circle', p. 178. Hellman also refers to this conflict, which she describes as having spread beyond Wittenberg to affect many universities [C. D. Hellman, *The Comet of 1577*, pp. 259-260]. It is important not to confuse this debate with the conflict about logic which developed in the last decade of the sixteenth century and centred on the methodological similarities and differences between dialectics as taught by Melanchthon and that taught by Peter Ramus. The discussion was probably already in progress by the time that the first works were published, and these points may well have been discussed in Tübingen since Jakob Schegk was an early opponent of Ramus.

¹³² B. T. Moran, 'The Universe of Philip Melanchthon', p. 1. One of the universities to do so was Altdorf [*ibid.*]. The *Philipus* included Melanchthon's *Initia doctrinae physicae* and his *De anima*. For the reception of Melanchthon's understanding of mathematics and physics see R. Pozzo, 'Die Etablierung des naturwissenschaftlichen Unterrichts unter dem Einfluß Melanchthons'.

¹³³ Eisenlohr, p. 135, and see N. Hofmann, *Artistenfakultät*, p. 246.

Although the *Ordinatio* does not specify which *compendium* had been in use, this could be a reference to Melanchthon's *Initia doctrinae physicae* (but it might equally be aimed against another work entirely).¹³⁴ There is no concrete evidence for the *Initia doctrinae physicae*'s having been used to teach physics in Tübingen.

On the other hand, Frischlin's preface to his *De astronomicae artis ... congruentia*, published in 1586, makes it clear that during the 1570s and 1580s there was some sort of dispute at Tübingen concerning the teaching and use of Melanchthon's works. Frischlin complains that he has been unjustly censured by Crusius for wishing to ban Melanchthon's works from the university, maintaining that this charge is unfair since the works of the 'Philippus' are no longer used in Tübingen: Melanchthon's grammars, his *Rhetorica* and his *Dialectica* have long since been removed from the curriculum; no student in the arts faculty would be found using his *Initia doctrinae physicae* or his *Ethics*; and his theology has been condemned by a public council.¹³⁵ Although Frischlin's statements about the university are unlikely to be entirely accurate, since he had been sacked in 1582,¹³⁶ it does seem safe to assume that there had been some debate about the use of Melanchthon's works, and it is not inconceivable that that Frischlin is referring to the 1557 *Ordinatio*. Alternatively, Melanchthon's theology and by association the rest of his works may have been the subject of criticism in Tübingen during the imposition of the *formula concordiae* and the associated

¹³⁴ Kusakawa believes that Schegk taught physics from Velcurio's *Epitome philosophiae naturalis*, which was printed many times in Tübingen, and that he consciously avoided using Melanchthon's work [S. Kusakawa, 'Providence Made Visible', pp. 117-118].

¹³⁵ N. Frischlin, *De astronomicae artis ... congruentia*, fol. 3^r. The 'public council' could possibly be a reference to the *Ordinatio* of 1557.

¹³⁶ N. Hofmann, *Artistenfakultät*, pp. 215-216.

purge of crypto-Calvinists which had led to Apian's dismissal in 1583.¹³⁷ Frischlin's comment indicates that the status of Melanchthon's works was being discussed in Tübingen, but any ban must have been of short duration: dialectics and rhetoric continued to be taught in Tübingen's *Pädagogium* on the basis of Melanchthon's texts,¹³⁸ and his grammar, which was part of the syllabus in Württemberg's schools,¹³⁹ was highly praised by Martin Crusius, professor of Greek in Tübingen.¹⁴⁰ Although the *Loci communes* was no longer used as the basis of theological teaching after the early 1580s, its replacement, Heerbrand's *Compendium theologiae*, drew on Melanchthon's theology.

It is, therefore, clear that Melanchthon's theological, linguistic and logical works were still influential upon, and often used by, later generations of professors and students in Tübingen. However, it is more difficult to establish the availability of his works and prefaces on physics and astronomy. Students and professors were largely reliant on their own private libraries after the university library fell victim to a fire in 1534.¹⁴¹ However, the earliest university library catalogues list a large number of sixteenth-

137 *Ibid.*, p. 212.

138 *Ibid.*, pp. 243-245.

139 *Große Kirchenordnung* (1559), fol. 123^v; see also 150^v.

140 M. Crusius, *Libri duo ad Nicodemum Frischlinum*, fol. a^v-v.

141 N. Hofmann, *Artistenfakultät*, p. 91. The university did own some books, but these seem to have resulted in a somewhat haphazard way from donations. Thus they included an arithmetic presented by its author Johannes Scheubel, professor for Euclid, in May 1556 [UATü 5/5, 1, fol. 1], and his edition of Euclid, given in 1562 [UATü 5/5, 4, fol. 6; this is still in the university library (UBTü, CD 2191)]. The university also owned a Hebrew grammar presented apparently by two students in Wittenberg [UATü 5/5.3 fol. 4-5].

In 1570 the university inherited Scheubel's library, which consisted largely of mathematical works, many of which seem to have been acquired by either the university or the faculty of arts [N. Hofmann, *Artistenfakultät*, p. 92. The list of Scheubel's books has been transcribed by B. B. Hughes, 'The Private Library of Johann Scheubel', pp. 421-425, although there are some errors in this transcription. The original of the list can be found in UATü 5/5, fol. 12-14]. Ludwig Gremmp, former professor of law, also left his books to the university on his death in 1583, but since these books had not even been unpacked by 1591, it is clear that the university's books were in a considerable disarray [N. Hofmann, *Artistenfakultät*, pp. 92-93]. Apian's library, which is not itemised, but which included 'globes and instruments' also came to the university on his death in 1592 [UATü 5/5.15, fol. 31].

century works, and if these may be assumed to be representative of the books which were in circulation at the university in the late sixteenth century, then it would seem that both Melanchthon's own works and the texts to which he had written prefaces were still popular.¹⁴² Liebler mentions in a disputation *De anima* held in 1593 that his opinion contradicts that of Melanchthon.¹⁴³ Maestlin certainly knew Melanchthon's *Initia doctrinae physicae* since he cites it in a disputation of 1606;¹⁴⁴ there is no way of telling when he had first read it, although it is likely that he had encountered

¹⁴² Martin Crusius left his library to the arts faculty on his death in 1607. Hofmann believes that these books together with those left to the faculty by Vitus Müller formed the most significant part of the faculty library well into the 18th century [N. Hofmann, *Artistenfakultät* p. 94].

The earliest catalogue of the library of the arts faculty, *Catalogus librorum qui existunt in Bibliotheca Facultatis Philosophiae*, dates from the end of the 17th century. It includes class marks SS, UU, XX, and TT. UU 62(a) is *Georg Purbachii: theorica nova planetarum*, published in Wittenberg in 1580, which included Melanchthon's preface [probably UBTü Bd 32^a, possibly either UBTü Bd33 or Bd35]. UU88 is *Phil. Melanchthonis Initia Doctrinae Physicae*, Lipsiae 1563.

The earliest catalogue of the university library, *Catalogus Bibliothecae Universitatis Tubingensis*, which dates from the late 18th century, lists books by subject and size, giving the class marks of books which appear in the older catalogue of the philosophical faculty and other class marks which seem to refer to other catalogues which are no longer extant. Most of the older mathematical and astronomical works listed in the *Catalogus Bibliothecae Universitatis Tubingensis* have the class mark Y, which suggests that the catalogue of an earlier library of mathematical and astronomical works is missing, and that these books have been in the university's library since the late seventeenth century, if not longer. Among these is a copy of Johannes Schonerus' *De iudiciis navitatum* with a preface by Melanchthon [*Astrologia in folio*, 1], various works by Regiomontanus, which may include the astronomical tables for which Melanchthon had written a preface in 1552 [*Astronomica in folio*, 15, 16, 22], and the complete works of Joachim Rheticus in which Melanchthon's oration in praise of arithmetic may appear [*Mathematica in folio*, 18, 19, 20]. Both catalogues list numerous copies of Euclid's *Elements*, but these do not include either of the editions for which Melanchthon wrote prefaces.

Melanchthon's *Liber de anima* is listed in the earliest catalogue of the Stiff's library [*Catalogus Bibliothecae Stipendii Theologici*, ca. 1680].

Scheubel's books included a copy of Peurbach's *Theorica Planetarum* (102 in Hughes's transcription), although the inventory does not give the edition, and the volume does not in any case appear to have been retained for the library. Books for the library are marked in the inventory with a +. The fact that it was not felt necessary to acquire this for the library may indicate that the university already possessed a copy. (There are now six copies of the *Nova Theorica Planetarum* in the university library in Tübingen, three of which include Melanchthon's preface.)

Although it is possible that books published in the sixteenth century had only been acquired much later by the university or arts faculty libraries, it is not unlikely that the majority of the sixteenth-century publications listed in the later catalogues were acquired during the early seventeenth century. It is probably legitimate to assume that the university library catalogues represent the contents of the libraries either of a range of professors of the late sixteenth and early seventeenth centuries, or, if Hofmann is correct, of Martin Crusius and Vitus Müller.

¹⁴³ G. Liebler, *Disputationes Physicae Tres de Anima*, 3.37, p. 26.

¹⁴⁴ M. Maestlin, *De multiuariis motuum planetarum*, p. 38.

the work much earlier. Copies of several of the works to which Melanchthon had written prefaces could be found in the possession of Kepler's colleagues and teachers.¹⁴⁵ Martin Crusius owned a copy of Peurbach's *Theorica nova planetarum* complete with Melanchthon's preface.¹⁴⁶ A note on the fly leaf of Crusius's copy of Grynaeus's edition of Euclid's *Elements* in Greek¹⁴⁷ suggests that he also either owned or had access to a copy of Archimedes's works in Greek and Latin together with the commentary of Eutocius, which in turn may have been bound together with an edition of Schonerus's *De iudiciis navitatum* which contained Melanchthon's preface.¹⁴⁸ From these indications alone it is clear that Melanchthon's mathematical prefaces and his physics were available to and used by at least two of Kepler's teachers and that the ideas contained in them were being discussed in Tübingen.

This consideration of Melanchthon's mathematical ethics and the questions which have been raised about its reception demonstrate that mathematical issues were not divorced from theological and philosophical discussions at sixteenth-century universities. Melanchthon welded his philosophy to his theology through his astrological understanding of the significance of the heavens, an understanding which led him to praise the exact study of the heavens, even if it did not lead him to accept cosmological changes based

¹⁴⁵ It can be seen from the names inscribed in several volumes in Tübingen's university library that several belonged to students at the university between 1560 and 1590. Maestlin presumably had his own library of mathematical works but nothing is known of this.

¹⁴⁶ G. Peurbach, *Theorica nova planetarum*, UBTü, Bd 32^a. This volume probably belonged to Crusius since the title page bears his initials and the volume is copiously annotated in Crusius's hand. These notes begin *ex astronomica Petri Apiani*, and include the date 13. Oct. 1562 [page 17]. They are mostly explanations of the trigonometric calculations needed to define planetary motion and do not refer to Melanchthon's preface.

¹⁴⁷ S. Grynaeus (ed), *Euclidis Elementa*, UBTü, CD 2187.

¹⁴⁸ A note on the fly leaf of UBTü, CD 2187 in Crusius's hand lists three books:
Nichomachi Gerasim Arithmetica. In pappen, in D libros Scheubelij.
Euclidis musica, optica, catoptrica. In 4^a
Archimedes Graece et latine, et Eutocius. In folio

A book corresponding to this last is in the university library, UBTü Cd 680. It is in one volume with Schonerus's *De iudiciis navitatum*, including Melanchthon's preface, and Peter Apian's sine tables.

upon such observations. Melanchthon's field of influence meant that these views were widely published and accessible far beyond the walls of Wittenberg. And yet, despite his influence, Melanchthon was only one of a number of people who were discussing and writing about such issues. The following chapters seek to examine the range of these and associated ideas which were being discussed and taught at Tübingen during the 1580s and 1590s.

chapter three

the theological understanding of the natural world

The availability of Melanchthon's books and prefaces in Tübingen demonstrates that his view of the natural world was accessible to the interested reader, but does not necessarily imply that it was actually being taught there. Indeed, it is difficult to glean a detailed picture of the reception of Melanchthon's ideas of the natural world, despite the obviously influential part played by the *Loci communes* in defining Lutheran beliefs. It is particularly difficult because, although Melanchthon briefly explains his understanding of the natural world in the *Loci communes*, his defence of the study of astronomy and his praise of the divine attributes of mathematics do not appear there explicitly, but are restricted largely to the prefaces he wrote for astronomical and mathematical textbooks. His view of mathematics and the importance of astronomy in the study of philosophy must, therefore, have been better known to readers of his astronomical prefaces than to the many students of his theological textbook, and while all theologians, in Tübingen and elsewhere, had first to complete a course in the arts faculty of their university, there is no guarantee that even a student interested in the natural world would have read any of Melanchthon's prefaces.

Nor is there any way of knowing how widely Melanchthon's *Loci communes* was actually read. What can, however, be established is that it was one of the books prescribed for study in Tübingen. The terms of the reformation of

the university and their codification in the *Große Kirchenordnung* meant that almost all students at Tübingen were exposed to some kind of theological teaching. This must have included some consideration of the doctrines of creation and providence, even if its focus was generally the correct, Lutheran approach to such questions as the ubiquity of Christ and the understanding of the Lord's Supper,¹ but the exact content of this cannot be known. For the students of the *Stift*, however, it is possible to be more certain of the content of their theological teaching. The 1559 *Große Kirchenordnung* instructed that they were to attend lectures in theology based upon Johannes Spangenberg's *Margarita theologica*, itself based upon the second edition of Melanchthon's *Loci communes*.² From the early 1580s this was replaced by Jacob Heerbrand's *Compendium theologiae*,³ which remained in use until around the turn of the century, when it was replaced by Matthias Hafenreffer's *Loci theologici*.⁴ Each of these works contains some consideration of the importance and significance of the natural world; in particular, the work of Jacob Heerbrand, who taught both Maestlin and Kepler, is permeated with a sense that God's presence may be discerned in the structures and order of the natural world. Maestlin himself wrote a theological justification of the study of astronomy, which gives some indication of his views. Similarly, Frischlin's attack on astrological prognostication seems to be based, at least in part, upon a theological understanding which is different from Maestlin's. From these works it is,

1 J. Hahn and H. Mayer, *Das evangelische Stift in Tübingen*, pp. 126-128.

2 *Große Kirchenordnung* (1559), fol.140^v. Spangenberg's *Margarita theologica* was first published in Wittenberg in 1541 and is based on the second version of Melanchthon's *Loci*. An edition was printed in Tübingen in 1565 and it is this which will be cited here.

3 Heerbrand's *Compendium theologiae* was first published in 1573 in Tübingen.

4 J. Hahn and H. Mayer, *Das evangelische Stift in Tübingen*, p. 127. However, Heerbrand's work remained that recommended in the *Große Kirchenordnung* even as late as 1660 [*Große Kirchenordnung* (1660), pp. 242-3].

therefore, possible to build up an understanding of the range of views which were current at Tübingen.

Spangenberg's *Margarita theologica* reproduces in a condensed form Melanchthon's doctrine of creation as found in the 1535 edition of Melanchthon's *Loci communes*. Thus it teaches the *creatio continua*, emphasising the sacramental aspect of the natural world, but says nothing explicitly about the doctrine of providence. However, both the *creatio continua* and the sacramental understanding of creation imply the doctrine of providence in the sense that they assume God's present involvement in the world and its affairs. Thus, in Spangenberg's sacramental understanding of creation, just as the bread and wine at the Eucharist are physical, visible expressions of God's spiritual feeding of the recipients' souls, so too the creation, its order and its usefulness are a visible manifestation of God's wisdom, goodness and care for the world.⁵ Moreover, since human minds have been created in the image of God, they ought to contemplate the divine, presumably (Spangenberg seems to imply but does not explicitly state) through their observation of, and interaction with, the natural world.⁶ Providence, in the sense that it expresses God's care for and continuing government of the created world, is also intrinsic to the idea of *creatio continua*, which teaches that creation is not one, finished act, but that it continues in the on-going care of God for the world. The seeds of Melanchthon's later, explicit, understanding that the doctrine of divine

⁵ J. Spangenberg, *Margarita theologica*, p. 104: *Quomodo agnoscitur Deus in creaturis & naturis rerum? Tota rerum vniuersitas est Sacramentum & testimonium quoddam, quod sit Deus, quod sit bonus, iustus, sapiens. Item motus coelestes, vices temporum, conseruatio specierum, satis clamant, mundum & naturas rerum non existere casu, sed certo consilio condita esse, regi & conseruari.*

⁶ *Ibid.*: *Deinde humanae mentes sunt imagines diuinitatis, & specula, in quibus contemplare diuinitatem debemus.*

providence is closely bound up with that of creation are thus contained in his earlier discussion of creation as perpetuated by Spangenberg.

Belief in providence meant that a Lutheran believer could be sure that God's intentions would be manifest in the events that he or she underwent.⁷ A similar view to Melanchthon's is also found in Luther's theology of creation, for the latter virtually identifies creation and providence.⁸ This virtual identification is also a recurrent theme in Heerbrand's theology. Heerbrand following Psalm 148, maintains that 'The whole of creation, the heavens, the angels, the sun, the moon and the whole earth should sing aloud that God exists, that God is their architect and creator, that God is wise, omnipotent and good.'⁹ Because he believes that the order that may be perceived in the universe proclaims God's care for it, he believes the understanding that God continues to care for the world to be implicit in the recognition that God has created the world. In this way creation proclaims divine providence as well as God's creative power. It is, therefore, no surprise that Heerbrand virtually collapses the two doctrines, describing the way in which divine providence may be recognised in the world in terms virtually identical to those he uses in his discussion of creation. The first argument for God's providence is the order and beauty of the world, the variety of its species, the human mind in its capacity to know God and distinguish between good and evil, and the certain ends for which all this has been created. This series of arguments,

⁷ See S. Ozment, *Protestants*, pp. 202-204 for the ways in which this belief affected one Lutheran's life and allowed him to justify an unpopular marriage to his family.

⁸ C. Link, *Schöpfung*, vol. 1, p. 34, and see also H. Olsson, *Schöpfung, Vernunft und Gesetz in Luthers Theologie*, pp. 369-371].

⁹ J. Heerbrand, *Compendium theologiae*, p. 133-134: *Quid est finis Creationis? Primo: vt Deus hinc agnoscat omnipotens, sapiens & Beneficus (Rom 1.20). Opus enim commendat artificem. Et totum hoc vniuersum clamat esse Deum. Vult ergo ab omnibus creaturis agnosci & celebrari. Ps 148. Laudate Dominum de coelis. Laudate eum omnes Angeli eius. Laudate eum Sol & Luna: Laudate eum omnes stellae. Laudate dominum de terra, dracones & omnes abyssi, ignis, grando, nix, glacies, &c. Vide totum Psalmum.*

as Heerbrand himself says, is identical to that through which he demonstrated the existence of God from the *liber naturae*.¹⁰ The second argument for providence is that the Bible assures its readers of God's care for the world,¹¹ and the third argument is the miraculous care that God has in the past taken of the world, for instance in saving Noah, his family and all the animals from the flood.¹² There are likewise three types of divine providence: the order of the world, the special capabilities of humankind, created in the image of God, and the care of God for the elect, the people of Christ.¹³ The recognition of the order of the world also has a practical consequence for faith. Because this order shows that the world has been

¹⁰ *Ibid.*, pp. 176-177: *Estne providentia talis apud Deum? Esse, multa testantur argumenta. Primum, hic mundus, & omnium, quae in eo sunt, rerum dispositio, ordo, distinctio, pulchritudo, varietas & perpetuitas specierum, homo ipse μικροκοσμος, mens hominis, & in ea notitia de DEO, discrimen honestorum & turpium, & quod ad certos fines omnia sunt condita: quae impossibile est temere extitisse, aut fortuito, & non potius a mente sapiente & omnipotente esse, regi, conseruari & gubernari. Sicut supra in loco de Deo est dictum.*

¹¹ *Ibid.*, pp. 177-178: *Deinde testantur hoc ipsum sacrae literae, Iob 14 [v 5] Breues dies hominis sunt, numerus mensuum eius coram te est. Constituisti terminos eius, qui praeteriri non potuerunt. Ps 139: In forme meum viderunt oculi tui, ac super librum tuum dies vniuersi scripti sunt, qui futuri erant, & nec vnus adhuc ex eis esset.*

Heerbrand also cites Jer. 10.12-14, Ps. 19.1-6, Ps. 135.5-7 and Luke 21.9-11.

¹² *Ibid.*, p. 178: *Tertio, hoc ipsum probant miracula Dei & extraordinaria opera: conseruatio Noah cum familia, & animalibus reliquis in diluuio per arcam [Gen 19].*

Heerbrand also cites God's gift of manna from heaven to save the people of Israel [Ex 16] and the saving of Shadrach, Meshach and Abednego from the furnace and of Daniel in the lions' den [Dan 3 & 6].

¹³ *Ibid.*, pp. 178-179: *Quot & qui sunt gradus seu modi providentiae diuinae? Tres. Qui? Primus vniuersalis Dei Providentia nominari potest, qua Deus vniuersam naturam a se conditam, & inclinationem & modum naturae agendi, incolumen seruat & sustentat, videlicet, ordinem regularum motuum in corporibus coelestibus, vices temporum, foecunditatem terrae, animantium, & alias res vtiles & necessarias ad vitae conseruationem. De qua loquitur Ps. 104 nempe creatione & sustentatione rerum. Ex qua aeternitatas, potentia, sapientia, bonitas, iusticia Dei, cognoscuntur. Ps 105: Oculi omnium in te sperant, DOMINE, & tu das illis escam [this appears in fact to be a misquotation of Ps 103.26]. Mt 10 [v. 29]: Duo passeret asse ueneunt, & vnus ex his non cadit super terram sine Patre vestro. Act 17: In ipso viuimus, mouemur & sumus. Coloss 1: Omnia per ipsum constant.*

Secundus potest vocari specialis quo omnes creaturae Deo iubenti & volenti obtemperant, mandataque ipsius exequentur, ac seruiunt ipsi, sine tuando pios sine puniendo impios. Non enim alligatos est Deus ad causas secundas, vt Stoici deliarunt, vt non possit aliter agere, quam illa cient. Liberrime enim vtitur earum ministerio, qua omnes & singulae, ignis, nix, glacies, spiritus procellarum, grando, faciunt verbum eius. Ps 148. Ignis, non vrit in fornace Babylonis ita Deo volunte. Syrach. 39 [v.30]: Ignis, grando, fames & mors: omnia haec ad vindictam creata sunt: Bestiarum dentes, & scorpij, & serpentes, & romphea, vindicans in exterminium impios.

Tertius nominari potest peculiaris Dei Prouidentia, quae est Electorum, seu credentium in Christum, qua Deus regnat in Ecclesia sua, & in eius membris est efficax, docet, iustificat, regit, consolatur, regenerat, saluat. Nonit Dominus viam iustorum. Qui habitat in adiutorio altissimi, &c. Omnes capilli capitis vestri numerati sunt, vnus non decidit, sine voluntate Patris vestis coelestis. [Pss 1; 91; Matt. 10].

created and continues to be cared for by God, it ought also to encourage people to worship God and to lead a prayerful and pious life with patience in adversity, since from this order 'we know that all good things are to be sought for from God,' and should, therefore, be diligent in seeking to do good.¹⁴

Unlike Heerbrand, Matthias Hafenreffer emphasises the differences between creation and providence.¹⁵ Creation, Hafenreffer believes, is the action of God 'by which God the Father, by his most free and wonderful will, has formed all most wonderful things through the Son in the Holy Spirit, so that he may declare his great goodness, wisdom and omnipotence, and communicate them to rational creatures, by which means he may in turn be known and celebrated.'¹⁶ Providence, on the other hand, is the action of God 'by which God not only sees and knows everything, but conserves and controls all things so immediately that all things may admit to the glory of his divine name and the salvation of the good, and that the unholy may expect his punishment.'¹⁷ Divine providence may, however, be recognised from the regularity of the created universe, from the motions of the celestial bodies and the order of society, all of which were created by God.¹⁸ Although for Hafenreffer the doctrine of providence is still implicit in that of the creation,

¹⁴ *Ibid.*, p. 134: *Quia Deus adhuc omnia administrat, sciamus ab ipso omnia bona petenda esse. Et postremo aduersa omnia patienter ferenda. Quia Deus haec dat & aufert: praesertim cum sciamus, diligentibus ipsum, omnia cooperari in bonum.*

¹⁵ Hafenreffer's textbook, *Loci theologici*, first appeared in 1600, but he had been teaching at the theological faculty from 1591.

¹⁶ M. Hafenreffer, *Loci theologici*, p. 13: *Quid est creatio? Creatio est actio Dei, qua Deus Pater liberrima & optima voluntate, per filium suum, in Spiritu Sancto, res omnes, optimas condidit: vt immensam suam bonitatem, sapientiam, & omnipotentiam declaret, atque creaturae Rationali communicaret, a qua vicissim agnosceretur & celebraretur.*

¹⁷ *Ibid.*, p. 16: *Quid est Providentia Dei? Est Actio Dei, qua non solum omnia videt ac nouit, sed res vniuersas ita praesens conseruat & moderatur, vt omnia ad diuini sui nominis gloriam & bonorum salutem cedant: impios vero sua maneat vindicta.*

¹⁸ M. Haffenreffer, *De providentia Dei*, fol. 2^r: *Quod sit providentia probatur. ... 2. Ordo enim in Politica societate, motuum coelestium, temporum & generationum vices, conscientiae impiorum pauores; poenae vniuersales & speciales, singula DEI prouidentiam luculenter ostendunt.*

he is more careful to distinguish between the two than is Heerbrand, and his emphasis is much more on biblical revelation than on the possibilities of recognising God from the natural world.

Following Melanchthon, Spangenberg teaches that some knowledge of God is communicated to the human intellect by means of natural law. Natural law, the *lex naturae*, is the knowledge of divine law which has been impressed upon human nature. Before the fall, it would have been possible for the human mind to reach the fullest possible human understanding of God through its understanding of this law; after the fall, however, the *lex naturae* could no longer suffice, and God added the written law to provide an aid to human understanding, which would not have been necessary before the fall.¹⁹ According to Melanchthon and Spangenberg, natural law can yield the understanding that God exists, that God sustains and cares for the world, that God is good and just, will punish evil and reward good, and that God is to be obeyed.²⁰ All these aspects of God's nature are to be recognised in the natural world, and thus Melanchthon believes that understanding of the *lex naturae* may be increased through the study of natural philosophy: for him, as for Luther, the doctrine of natural law is consequent upon that of creation.²¹

¹⁹ J. Spangenberg, *Margarita theologica*, p. 14: *Quare igitur tradita est lex Mosi, cum antea esset lex naturae? Etsi illud lumen, & illae notitia inditae menti hominis ante lapsum, in natura nondum corrupta, erant certae & integrae, & habebunt firmum assensum, tamen postea valde obscuratae sunt vitio originis, & est infirmus assensus, saepe etiam excutiuntur dubitatione & propemodum obliterantur. Ideo Deus addidit legem scriptam, ut lex naturae voce diuina renouata, clarior & illustrior redderetur. Simul etiam ut extaret testimonium verbi Dei, quod haec notitia naturalis sit lex Dei.*

²⁰ *Ibid.*, pp. 13-14: *Quid est lex naturae? Est notitia legis diuinae, naturae hominis a Deo impressa, qua intelligit esse Deum, esse conditorem & gubernatorem, bonum & iustam esse, benefacere iustis & punire iniustos, & ei deberi obedientiam.*

²¹ See above, pp. 75-76. Luther's understanding of natural law and its place in his theology of creation is discussed in C. Link, *Schöpfung*, vol. 1, pp. 52-54.

Heerbrand places less emphasis upon the connection between natural law and the natural world, perhaps because his understanding of the law is closer to that of Luther than to that of Melanchthon. Although he mentions natural law, he distinguishes only between divine and human law,²² rather than using the traditional division into divine, natural and human law which had been taken over by Melanchthon.²³ Human law consists of the laws which are necessary to ensure that society functions properly. Heerbrand sees natural law as a part of divine law, which is the knowledge of God which can be achieved without the gospel; it is one and the same as the decalogue,²⁴ and teaches the wisdom and goodness which were also expressed in Christ. Divine law as a whole was originally inscribed on human minds, was obscured through the fall, but has been renewed in the decalogue and the TORAH. Such direct knowledge of God as is left to human beings after the fall may, therefore, indeed be said to be divine law.²⁵ For Heerbrand, then, natural law is no longer a separate category, but has been subsumed under divine law, which he in turn contrasts with the gospel: people should gain all possible knowledge from the law, but because of the

²² J. Heerbrand, *Compendium theologiae*, p. 284: *Quotuplex est lex? Duplicem docendi causa faciemus, a causis efficientibus immediatis, Diuinam, & Humanam, quae probabili ratione a magistratu politico est lata, qua vel occasiones seruandi Legem Dei, vel circumstantias in executiones Legis Dei, puniendis deliquentibus sancit.*

²³ T. Aquinas, *Summa theologiae*, 1a2ae.91.art. 1-4, pp. 19-27.

²⁴ This identification of the natural law and the law of Moses can be traced back to the Church Fathers [C. Link, *Schöpfung*, vol. 1, p. 52]; it is an important aspect of Luther's understanding of natural law [H. Olsson, *Schöpfung, Vernunft und Gesetz in Luthers Theologie*, pp. 160-166].

²⁵ J. Heerbrand, *Compendium theologiae*, pp. 286-287: *Quae est [lex] Divina? Vna est & eadem Lex naturae cum Decalogo quae Naturae Lex diuinitus omnium hominum mentibus est inscripta: nisi quod per & propter lapsum primorum parentorum sit obscurata.*

Quid docet Lex naturae? De Deo, quod sit aeternus, iustus, sapiens, omnipotens, vt omnes gentes sint inexcusabiles. Itam discrimen honestorum & turpium. Et hinc de officijs vitae humanae, quae Christus hac sapientia expressit: Omnia quaecunque vultis, vt faciant vobis homines, eadem & vos facite illis.

See also J. Heerbrand, *De lege diuina*, thesis 15, pp. 2-3: *Etsi autem Deus, in creatione, indidit mentibus hominum illustres notitias, de se, suaque voluntate, tamen per & propter lapsum primorum parentorum, illae sunt valde obscurate, ideoque repetitae, & renouatae in Decalogo, vt illustriores redderentur & vt extaret testimonium aliquod Dei, has notitias, adhuc post lapsum reliquas, vere esse legem Dei.*

fall the gospel with its message of salvation through forgiveness of sins, is necessary.²⁶ However, the knowledge of God which Heerbrand sees as being gained from divine law is precisely that which he says is testified to by the creation. Thus, the natural world is still understood as giving access to divine law, even though Heerbrand does not associate the study of natural philosophy with the understanding of divine law in the way that Melanchthon does. In Heerbrand's theology, the place of natural law has been eroded, so that it is considerably less important to him than it had been to Melanchthon. This development might be said to be completed in the work of Hafenreffer, who does not even use the term natural law.²⁷

Despite the differences in the status accorded *lex naturae* by Melanchthon and Heerbrand, they do have a common understanding that, had the fall not taken place, divine law in its original, natural, form, would have been sufficient to introduce the fullest possible understanding of God into human beings. This raises the question of the effect of the fall on the natural world. It has been noted above that Melanchthon's discussion of the attributes of the heavens seem to imply a belief that the supra-lunar world has retained its pristine, pre-fall state, even though the post-lapsarian human mind is no longer capable of fully understanding what the heavens can communicate of God. This understanding seems to be coupled with the identification of sin as a specifically human problem, deriving from the misuse of human free will. Hafenreffer argues this position at length in his disputation *De providentia Dei*, although he does not draw the conclusion that only the parts of the

²⁶ J. Heerbrand, *Compendium theologiae*, pp. 323-327, especially p. 324: *Quae igitur sunt discrimina vtriusque doctrinae [Legis et Euangelij]: Primum a notitia, & forma notitia vtriusque. ... Etsi autem haec notitia [ex lege], per & propter primorum parentium lapsum sit obscurata, tamen non penitus est extincta. Euangelium vero Ministerium est, & dicitur absconditum a seculis.*

²⁷ M. Hafenreffer, *Loci theologici, De Lege*, pp. 200-216.

universe affected by human actions can be affected by the human fall. For a thinker whose understanding of the world was based upon Aristotelian causality, with its hierarchical understanding that lesser causes could not produce effects in higher bodies, this would, however, be a logical conclusion to draw. Despite Melanchthon's tendencies towards this position, neither he nor any of the theologians teaching at Tübingen explicitly argued it, and it might seem unlikely that anyone would ever have done so explicitly, were it not for the evidence provided by Nicodemus Frischlin in his work *De astronomicae artis ... congruentia*.

Frischlin's *De astronomicae artis ... congruentia* was first published in 1585, some three years after Frischlin had left Tübingen. It is probably based on the lectures in mathematics and astronomy which he had held while Apian was absent from his post in 1569-70 and 1571-72.²⁸ The work opens with a discussion of the possible influences of the heavens and the stars on events of the sublunar sphere. Frischlin asks 'whether God furnished the sun, the moon, and the other stars with certain qualities by which they affect the elements, such that they are the causes of generation and corruption, or the signs of stormy weather to come?'²⁹ In response to this question, Frischlin embarks on a discussion of the attributes of the universe at its creation in comparison to its present, post-fall condition. His understanding of the actual mechanics of creation is drawn from a combination of Greek and Christian sources: the elements were created first and the rest of the seven

²⁸ N. Hofmann, *Artistenfakultät*, p. 247 n. 58.

²⁹ N. Frischlin, *De astronomicae artis ... congruentia*, p. 4: *Annon autem Deus Solem & Lunam, caeteraque astra, suis quibusdam virtutibus armauit: quibus Elementa afficiant: vt sint causa generationis & corruptionis: ac signa quaedam venturarum tempestatum?*

days' creation followed.³⁰ Originally, God fashioned the universe so that none of its bodies should be affected by any other or have to be moved from its natural position. As an example, Frischlin quotes Moses, who, he says (giving no biblical reference) teaches that before the fall there was no rain, since the whole face of the earth would have been irrigated by a kind of dew. Similarly, the biblical injunction to be fruitful and multiply together with God's commendation of the seeds and fruits of the plants and trees to the care and use of human beings (Gen. 1.28-29) show that the power of procreation, seeds and fruits were contained in the elements of the earth from the beginning.³¹ Indeed, God created the sun and the stars, which have their own, proper uses, only after the creation of the elements with their appropriate faculties.³² Frischlin cites Basil's fourth homily to show that the heat of the sun calls for the earth's power to stimulate growth but actually causes neither the power of growth nor the growth itself.³³ Moreover, Frischlin argues, God would not have exposed innocent, naked human

³⁰ This understanding of creation has a long history. Hints of it may already be found in Augustine's discussion of the creation of earth, air and water [Augustine: *De Genesi ad litteram, liber imperfectus*, 4.18, p. 156].

³¹ N. Frischlin, *De astronomicae artis ... congruentia*, pp. 4-5. Frischlin's response to the question cited above begins: *Nequaquam, si quidem ad primam mundi creationem respicias. Deus enim omnia totius mundi corpora ita initio conformavit: vt excepta lucis & tenebrarum vicissitudine, de qua postea dicemus, nullum corpus ab vlllo aliorum posset affici: suoque contrario permutari. Equidem lucis actio: quae non κατ' ἄλλοθεν ἀλλ' κατ' εὐτελέχειαν, non ἐκτικῶς, sed σχετικῶς, ac subito, sine omni motu agit. Noluit autem Deus Elementa a se inuicem pati, in se mutuo agere: noluit Deus aërem alieno calore modo intepescere, modo refrigerari, & modo aqueo humore & imbribus irrigari, modo rursum exiccari: sed voluit illum natiuis & propriis qualitatibus, hoc est, vitali vigore perpetuo esse eundem: totamque terram vbique locorum circumdare: & animantibus viuificum quendam spiritum, cum iam vitalem, & genialem facultatem, ipsis Elementis indidisset irrigatam. Deinde vim procreatricem, ac semina omnium rerum haudquaquam corporibus coelestibus, sed ipsis Elementis, ac ipsi terrae indiderat Deus, dicens: producat terra omnem herbam virentem, & facientem semen, & arborem pomiferam, quae faciat fructum iuxta genus suum: cuius semen in SEMETIPSO sit super terram.*

³² *Ibid.*, p. 5: *Et factum est ita. Solem vero & Stellas postea demum in alium vsum creauit, cum iam vitalem, & genialem facultatem, ipsis Elementis indidisset.*

³³ *Ibid.*, p. 6: *Quia enim nonnulli iudicant Solem esse causam terrae nascentium: qui vi caloris vim terrae e profundo in superficiem protrahat: ideo Sole vetustior est terrae exornatio.*

For a more modern (if brief) assessment of Basil's view of astronomy, see D. S. Wallace-Hadrill, *The Greek Patristic View of Nature*, pp. 9-11.

beings to the hurts of heaven, the clouds of Orion or the rains of the Hyades; it follows that when astrologers attribute such powers to the stars it is a fabrication, for they would never say that had there been no fall the stars would not exert their powers.³⁴ Either the astrologers must concede that the stars must have caused the weather from the beginning of creation, a position which Frischlin has just shown to be untrue, or they must argue that the fall of humankind caused God to curse the heavens as well as the earth. But this is also untrue, for the material of the heavens did not change after the fall: Adam's fall was the fault of his own will, or of the devil's influence, and cannot be attributed to the stars.³⁵ As a result of Adam's fall, the earth, and not the heavens, was cursed by God. Frischlin does not wish to deny absolutely that the heavens have an influence on the sublunar elements by virtue of the differences of their material,³⁶ but he maintains that any such influences were created by God, are intrinsic to the creation, and must have existed before the fall. The heavens are still in their original, pre-fall state.

Despite his arguments for the heavens' retention of their original, perfect nature, and his readiness to concede a measure of influence to the heavens, Frischlin believes that God has created the sublunar sphere to be capable of

³⁴ *Ibid.*, pp. 6-7: *Praeterea constat, quod hominem nudum fecerit Deus. At quae obsecro fuisset haec iniuria, nudum hominem, & innoxium, coeli iniuriis, & nimbose Orioni, ac pluuiialibus Hoedis exponere: siquidem talis fuisset stellarum potentiae, qualem ipsis affingunt Astrologi: nisi dicant, homine non lapso, vires suas non fuisse exercitatura astra.*

³⁵ *Ibid.*, p.7: *Aut enim hoc concedant necesse est, fuisse has vires excitandarum tempestatum, initio statim a Deo inditas sideribus: aut post lapsum hominis demum impressas, & coelo non minus, quam terrae a Deo maledictum. Sed quia nullum talem vnquam effectum producturae fuerant, si homo non pecasset: frustra conditae fuissent: aut certe magna coelo illata fuisset mutatio, si demum post lapsum nouarum virtutum accessisset creatio. Quorum neutrum poterit, absque grauim in Deum contumelia, affirmari. Parum ergo aut nihil abest, quin Christiani scilicet Astrologi dicant, Adamum non vnus tantum Diaboli instinctu, & propriae voluntatis impulsu, sed etiam vi stellarum, ad peccatum fuisse pertractum: ne videlicet cogantur fateri, nullam astris vim aut inclinationem, vt sic dicam, inesse.*

³⁶ *Ibid.*: *Interim tamen non negamus, coelo & astris vim quandam vniuersalem inesse mouendi haec inferiora, pro diuersitate materiae subiectae aliter atque aliter: posteaquam videlicet terrae, propter hominis peccatum, a Deo est maledictum.*

generating growth and change without any need for outside intervention. Therefore, astrology has no place in physics. He is openly against any type of astrological prognostication on the grounds that such knowledge is available only to God, to whom all times are present.³⁷ His approach is thus somewhat different from Melanchthon's, although their presuppositions about the physical nature of the universe seem to be very similar. In his discussion of prognostication, Frischlin argues that it is misleading for doctors to attribute a person's character to the position of the stars at their birth, for this negates human free will, which was created in the image of God. He cites Chrysostom and Augustine in support of this position.³⁸ Just as Melanchthon had argued that there was a part of astrology which belonged to physics, and a part which was superstition, so Frischlin explains that the interpretation of the stars is not true mathematics, but is only described as such by the vulgar: it is really a type of 'consorting with demons which deceives the soul,'³⁹ and as such is to be avoided. Unlike Melanchthon,

³⁷ *Ibid.*, p. 3: *Annon etiam in signa futurorum euentuum Deus istas faces accendit? Minime. ... Solam vero futuri scientiam sibi reseruauit Deus: cui omnia sunt praesentia, nihil futurum, nihil praetorium.*

³⁸ *Ibid.*, pp. 142-147, under the heading *Vbi ergo praedictiones & diuinationes Astrologorum, de futuris tempestatibus, aut Genethliacorum de fato hominum, si nullae sunt tales in astris qualitates?* See especially p. 145: *De his perspici facile potest, neque fatum, neque fortunam, neque natiuitatem, neque cursum siderum res nostras gubernare. Nam si hoc largiamur, quid porro necesse fuerit adhibere labores atque sudores, vt a vitijs immunes simus? siquidem fato decretum est, fore aliquem malum; etiamsi molestias infinitas suscipiat, malus erit. Vel potius dici malus nequaquam debet, qui a necessitate ad hoc impellitur. Quod si etiam bona valetudo atque morbi a fato pendent? superuacaneae sunt opum impensae, superuacanea medicorum accessio superuacanea denique victus ratio, quam morbo aliquo laborantes accurate seruant. At cum haec superuacanea non sint (quo enim pacto id dici possit? cum magnam ex his vtilitatem percipi conspiciamus) iacet haec de Fato fabula, iacet omnis de natalicio sidere oratio. Non enim homines vlli necessitati subiecti sumus, sed potius electionis libertate ac voluntatis arbitrio diuinitus ornati.*

³⁹ *Ibid.*, pp. 146-147: *Augustinus item de doctrina Christ. cap 22. Sed ex ea relatione velle nascentium mores, actus, euenta praedicere, magnus error, & magna dementia est. Et apud eos quidem, qui talia dediscendo didicerunt, sine vlla dubitatione refellitur haec superstitio. Constellationes enim quas vocant, notatio est siderum, quomodo se habeant, cum ille nasceretur, de quo isti a miseria miserioribus consuluntur. Quare istae quoque opiniones, quibusdam rerum signis, HVMANA PRAESVMPTIONE INSTITVTIS, ad eadem illa, quasi quaedam cum Daemonibus pacta & coniuncta referendae sunt. Idem Augustinus eod. lib. cap 21. Perniciosae (inquit) superstitionis homines sunt, qui Genethliaci, propter natalium dierum considerationem, nunc autem vulgo Mathematici vocantur. Nam & ipsi, quamuis voram stellarum positionem, cum quisque nascitur, consectentur, & aliquando etiam peruestigent: tamen, quod inde conantur vel*

Frischlin does not wish to encourage any type of astrological consideration. But even Frischlin cannot get completely away from the idea that God may communicate with humankind through celestial signs. In an extended poem on the super nova of 1572 he cites the example of the star of Bethlehem to show that signs of God's will for the world which could be read in the heavens,⁴⁰ and even in his *De astronomicae artis ... congruentia* he concedes that the celestial bodies reveal the wisdom and goodness of God,⁴¹ and that the Bible teaches that the heavens proclaim the glory of God. But, he points out, it is also written that the earth proclaims the glory of God, and in fact human beings, in the complexity and order of their bodies and souls, are themselves the best manifestation of God's greatness.⁴² He

actiones nostras, vel actionum euenta praedicere: nimis errant, & vendunt imperitis hominibus miserabilem SERVITVTEM. Nam quisquis liber, cum ad huiusmodi Mathematicum ingressus fuerit, dat pecuniam, vt seruus inde exeat aut Martis aut Veneris, vel potius omnium siderum, quibus illi, qui primi errarunt, erroremque posteris propinauerunt, vel bestiarum propter similitudinem, vel hominum, ad ipsos homines honorandos composuerunt vocabula. Plura in hanc sententiam lege apud eundem August. lib. 2 de Genes. ad literam, cap. 17. vbi inter caetera sic affirmat Augustinus. Quapropter (inquit) bono Christiano, siue Mathematici, siue quilibet impie diuinantium maxime dicentes vera, cauendi sunt, ne CONSORTIO DAEMONVM animam deceptam, pacto quodam societatis irretiant. ... Pertinent huc dicta Scripturae Leuit 19. & 20. Deut 4. 13. & 17. Esaias 47. Item illud Ieremiac 10. Nolite iuxta vias gentium discere: nolite a signis Coeli timere, quae timent gentes, quia leges populorum VANA E sunt.

⁴⁰ N. Frischlin, *Consideratio nouae stellae*, p. 8:

*Et quis venturum neget hanc portendere CHRISTUM?
Et quisquam signum non putet esse Dei?
Scilicet aetheria, cum primum Christus ab aede
Venit, & e pura virgine natus homo est.
Igne promicuit coelesti in vertice stella:
Stella coruscanti prodigiosa face:
Quae praeueunte viam monstrabat lampade coecam,
Aurorae egressis de regione Magis.*

⁴¹ N. Frischlin, *De astronomicae artis ... congruentia*, pp. 8-12, especially p. 8: *Cur ergo in signa dicitur creasse Deus luminaria Coeli? Duae potissimum ob causas. Primum enim faces illas voluit Deus sapientiae ac bonitatis suae signa esse: vt homines illa intuentes cogitarent de Deo, ipsumque rerum omnium faterentur opificem, qui sapienter & causa boni fecisset omnia: neque existimarent illa corpora casu extitisse, aut timore forri: quae tam certos quotannis perficerent cursus. Deinde voluit esse signa seruitutis, non dominij aut virtutis alicuius effectricis.*

See also p. 9: *Igitur (quantum ex his intellego) finis Astronomiae non erit tantum cognitio temporis, sed etiam noticia Dei? Ex astris, eorumque motu perpetuo aeqabili, quatenus signa sunt, nihil aliud discimus: quam illa corpora non extitisse casu, sed a sapientissimo & optimo architecto esse condita: & cum illi seruiant ac militent, non habenda pro Dijs, aut numinibus, sed pro rebus creatis: quae faciant voluntatem Domini: sicut Dauides in Psalmis testatur, & nos quotidie precando consistemur.*

⁴² *Ibid.*, p. 11: *At scriptum est, quod coeli enarrent gloriam Dei? Etsi potentia & sapientia Dei praecipue in coelestibus corporibus, eorumque rapidissimis motibus*

doubts whether those who neglect the study of the Bible to concentrate on the heavens can reach a proper understanding of the nature of God, for he believes the Bible to be essential for such an understanding. He doubts too that astronomical work is really a task given by God to humankind, since, he points out, the Bible's creation stories contain no specific command to study the heavens, whereas the care of the land and the naming of animals, fish and birds are specifically entrusted to human care.⁴³ Probably he would want to argue that celestial appearances such as the star which heralded the birth of Jesus are examples of special communications by God, and that the mistake of the astrologers is to believe that communications can be found in the normal course of the universe.

Frischlin's criticism of almost all types of astrological interpretations was tacitly, if not overtly, a criticism of Melanchthon's position. Frischlin asserts in the preface to his work that Melanchthon's works, including the *Initia doctrinae physicae*, had been banned from Tübingen,⁴⁴ and although he does not cite Melanchthon at any point in his argument against astrology, the

conspicitur: tamen eius gloriam non soli enarrant coeli sed etiam terra: quae est scabellum pedum Dei. Nam Deum etiam laudant ignis, grando, nix, glacies, spiritus procellarum: quae faciunt verbum eius: item omnes montes & colles: omnes arbores frugiferae, & omnes cedri: bestiae & vniuersae pecudes, & volucres, & serpentes. In primis autem homo μικρόκοσμος, manifestissimum est prouidi ac sapientissimi conditoris opus, & euidētissimum diuinae omnipotentiae argumentum.

⁴³ *Ibid.*, pp. 9-10: *Quae vero Dei sit essentia: & quae illius erga genus humanum voluntas, hoc ex astris minime cognoscimus: sed ex solo verbo Dei. Neque enim mundi opifex hominem iussit coelum intueri, vt inde voluntatem Dei perdisceret: (nihil enim aliud potuit ex astris colligere, quam esse opera digitorum Dei: neque aliud inde obseruare, quam vices temporum) sed posuit illi legem, ex qua cognosceret voluntatem patris coelestis. ... iussit etiam Deus hominem procreare sobolem, & dominari piscibus maris, volucribus coeli & bestiis terrae, omnibusque ac singulis speciebus indere nomina, ac nihil ab illis mali sibi timere. Sed de notandis sideribus & appellandis, aut de futuris casibus inde praesagiendis ac pertimendis, nihil homini praeceptum esse audio; nihil in sacris literis earumque interpretibus, de hac re lego. Neque absque causa factum credamus, quod tam procul ab astris remouerit hominem Deus: cui coelorum virtutes & substantias voluit esse occultas: vt potentiam & bonitatem Dei, ijs in rebus admirari potius, quam scrutari assuesceret. Qui ergo neglecto Dei verbo, astra contemplantur: his contrarium euenire solet: vt pro creatore & opifice, res creatas & conditas admirentur, ac suspiciant: tñademque pro diuinis numinibus ea colant & inuocent: sicut Chadaeis, Aegyptijs & Graecis accidisse Basilius testatur.*

⁴⁴ See above p. 90.

positions he is attacking include aspects of Melanchthon's Christianised, 'providential' astrology as well as the more specific predictions which had been condemned as superstition by Melanchthon himself. Perhaps it was this indirect criticism of Melanchthon which moved members of Wittenberg's faculty of arts to formulate their comments on Frischlin's work. Written in 1584, before Frischlin's book had even been officially published, their remarks criticise his work for its lack of mathematical understanding, but also for failing to understand the value of the type of astrology which, as a part of physics, should be retained.⁴⁵

⁴⁵ StAS A 274, Bū 45, #5: *De libro tuo astronomico, vir clariss. & Dr. colende, significatum nobis prius non fuit, quam literas a te hoc nomine acciperemus. Iam antea priuatim eius inspirandj copia data est a Dn. pastore nostro. cuidam e nostris collegis, qui et quod uisum fecit, de hoc ad Dn. pastorem retulit, ad te ut perscriberetur. Cum autem duo sint, in quibus liber iste consumitur, astronomica sunt euismodi, vt suum locum habent: nisi quod hypotheses astronomicae ibi perstringuntur, de quo inertiae suae patrociniū (quanquam perperam) arripient, qui in hoc genus disciplinarum alioquim negligere et odisse solent. In Astrologicis cardo negocij vertitur, contra quae vt diceres, institutam abs te hanc scriptionem apparet. Ac ut fateamur, quod res est, odio et rephensione merito sunt digni, qui nihil non futuri ex astris pollicentur, et ad singularia descendentes, inanij spe metuque homines suspendunt: quorum temerarium audaciam vel impietatem potius, nos quoque execramur, cum multis modis illa noceat rebus tum publicis tam prouatis.*

Sed vt propterea vis omnis abrogetur coelo sideribusque agandi in haec inferiora, neque tum concedere videris, dum diserte ais, occulto quodam vigore res sublunans confoueri: de quibus occultis, vt de alijs natura abditis & retrusis, quin aliqua vere sint cognita, non est dubium, quorum praedictio etiam, sobria profanij nihil continet. De sanito nostro Melanthe notum est ex ipsius scriptis & orationibus, quid et quantum huic μαθητικῆ tribuerit, et quomodo ἀστρολογητικὰ a caeteris distinxerit, quorum caussae aliquae in natura sunt manifestae. Quanquam enim quae Ptolemaej sunt in hoc genere, non aequae probantur vniuersa: quoniam tamen metas diuinationj praefigit, τὸ δυνατόν καὶ χρήσιμον, ea siue superstitione in scholis retineri possunt. Nequa tam vetustaem hic veneramur, quam veritatem, vsu et exemplis comprobata: quam tum tu in aeris quoque & tempestatum mutationibus reijcis, prouestij nobis videris paulo longius. Tollatur ex artibus abusus et superstitio, atque hic fatum Stoicorum excludatur: caetera quae pars sunt physicae retineantur, iisque temere obstrectare, metas sit. Haec respondere ad literas tuas voluimus, quae ut pro tua humanitate in bonam partem accipias, vt bono animo scripta sunt, reuerenter et officiose oramus. Librum a Reuerendo Dn. M. Dalmanto accipies. Bene vale. Datae Witebergae VI Cal Janua Anno Christi meunte 1584.

Tuj Studiosiss.

Decanus et Collega docentium philosophiam, in Academia Witebergensi.

StAS A 274 Bū 45 comprises a series of commentaries on Frischlin's *De artis astronomiae* which were presumably sent to the Duke of Württemberg during the course of the dispute between Frischlin and Tübingen's arts faculty. Maestlin's response to Frischlin, which will be considered below, is also part of this collection. I have unfortunately not been able to examine all the available commentaries in detail, but they would probably offer a good indication of the range of sixteenth-century opinion on the place of astrology and its relationship to mathematics and theology.

Frischlin's critical attitude towards astrological prediction is reflected in the preface to a series of five sermons given by Jacob Andreae on Luke 21.10-19, where Jesus warns that before the end of the world

Nation will rise against nation, and kingdom against kingdom; there will be great earthquakes, and in various places famine and pestilence, and there will be terrors and great signs from heaven.

Andreae preached these sermons shortly before an eclipse of the sun 'which will take place in this year 1567 on the nineteenth day of April at seven minutes after midnight,'⁴⁶ which he expects to give rise to a considerable amount of astrological speculation in his congregation, and it is against such prognostications that Andreae wants to speak. Andreae wishes to counter the speculation he fears will be occasioned by the eclipse by arguing against the use of astrology for prognostication on the grounds of its uncertainty, and because it claims knowledge which is proper to God alone.

Andreae agrees that heavenly signs may herald misfortune, but he argues that it is impossible for anyone but God to know for whom. When a particular celestial conjunction appears in the sky, it is not seen only by one person, or even one country, but may be visible from many parts of the earth. Thus it is ridiculous to argue that it is intended for this person or that. Astrology is

nothing other than a careful observation of the movements of the heavens, and a comparison of these with those earthly events which are taking place at the same time. Educated people do this for years at a time until they find a general rule that when the heavens and the stars appear so, or when this or that eclipse takes place, this or that disaster occurs on earth in some country

⁴⁶ J. Andreae, *Nach dem Lauff der irdischen Planeten*, fol. Aa 2^r: *Es würdt in disem 1567. jar den neundtentag Aprilis / siben minuten nach mittag / ein grosse erschreckenliche Fünsternuß der Sonnen am Himmel geschehen werden / dergleichen in vil jaren keine gewesen ist / Darvon ohn allen zweifel / die natürliche Meister / so sich vmb der Stern / vnnd des Himmels lauff verstehn / allerley / besonders aber vil vnglück beschreiben vnnd weissagen werden.*

or other. From these rules they dare to say that when such signs appear in the heavens, similar events will happen on earth.⁴⁷

But in reality, this procedure can establish no such connection, especially since no calculation can possibly be accurate to the minute. No sensible mathematician, and far less any Christian, should apply predictions taken from the heavens to any particular person or land. Predicting particular events from the motions of the heavens is about as certain as throwing a die, he concludes.⁴⁸ To follow such practices is to live according to the wrong rules. The problem is that human beings are curious: they want to know things that they should not expect to know, such as whether the summer will be dry or wet, what diseases will be rife, and this is what brings them to turn to annual prognostications. In fact, the prophet Jeremiah has said 'Do not be afraid of the signs of the heavens,' and in reality it is the course of the heavens which is determined by what happens on earth.⁴⁹ The only true

⁴⁷ *Ibid.*, fol. Aa 2^v-Aa iii^r: *Sternkunst kann nit auff gewisse Länder deuten: Ob nun wol hie vilermelte natürliche Meister nach irer Kunst sic vnderstehn / ettlicher massen solche Zeichen vnderschiedlich auff die Länder vnnd sondere Personen zudeuten / vber wuolche das vnglück außgehn soll / so ist sie doch zuschwach / sollichs zuerreichen.*

Was die Sternkunst sey für sich selbst: Dann vnserer Astrologorum Kunst / ist im grund nichts anders / (wann sie am besten ist) denn ein vleißige betrachtung des Himmels Lauffs / vnnd desselben mit den irdischen Händlen vergleichung / so zu jeder zeit sich auff Erden erzeugen / wölche gelehrte Leut vil Jar nach einander auffgezeichnet / vnd alßdann darauß ettliche allgemeine Regel gemacht / wann der Himmel / vnd desselben Sterne also gestanden / die oder jhene Finsternuß gestehen worden / ist diß vnd jhenes vngluuck auff Erden vber dises oder ander Land gangen. Auß wölchen Regeln hernach Mutmassungen geschehen / wann solliche Zeichen im Himmel sich erzeugt / es werde dergleichen widerumb auff Erden geschehen.

⁴⁸ *Ibid.*, fol. Aa iii^r: *Der Astrologorum Weissagung seind nit gewiß: Das es aber nach solchem mutmassen allwegen / vnd zu aller zeit gewißlich vnd nicht anderst geschehen solt / wann gleich des Himmels Lauff getroffen / vnd vmb ein Minuten dei Rechnung nicht fehlete / das würdt kein verstendiger Mathematicus / noch vil weniger ein Christ sagen / wie ich dann von dem berhümeten Mathematico (so meines wissens auff disen Tag in Teutschland lebet) dergleichen vil vnd oft gehört / wölcher die Weissagung / so auß des Himmels Lauff gemacht / da sie auff besondere Personen vnd Landschafften gezogen / vergleicht einem / der mit Würffel spilet / da gantz vngewiß ist / ob er all Seß / oder alle Eß werffen werde.*

⁴⁹ *Ibid.*, fol. Aa iii^v- Aa iv^r: *Die Welt ist fürwitzig: Dann nach dem das menschlich Geschlecht gantz fürwitzig ist in allen sachen / vnd immer ein ding vor der zeit wissen will / als nämlich wie es künftige Jars wittern / ob der Winter kalt oder warm / der Sommer trucken oder naß sein sein / Item / was für Kranckheiten regieren / ob die Früchten wol oder vbel gerhaten / ob frid oder vnfrid im Land sein werde / (dann von disen Artikeln für nemlich handeln alle die / so nach des Himmels Lauff / auff alle Jar Practicken schreiben) so hat jnen vnser lieber Herr Gott disen fürwitz selbst büßen / vnd seine Glaubigen nicht auff des Himmels Lauff / oder deselben außrechnung weisen wollen / dann er durch den Propheten Jeremiam sagy: Ihr sollt euch nicht fürchten für den Zeichen des Himmels / als die jhnen ein*

way to judge how to live one's life is to follow God's precept, which means keeping God's order and rule for the church and the world. This does in fact make it possible to predict when a person or community will experience 'good or bad weather, peace or conflict, health or sickness, inflation or fair prices, freedom or servitude,' for 'as long as one keeps to our Lord God's church and civil order, which was received through his grace by the Jews in the Old Testament and us Christians in the New, one will always, without fail, be assured of good weather, health, peace, fair prices and good years.' Those who do not will suffer bad weather, plague, war and famine.⁵⁰

Andreae claims to have heard all this 'from the most famous mathematician who lives in Germany today,' but in fact his arguments are very close to those of Pico della Mirandola's *Disputationes adversus astrologiam divinatricam*.⁵¹ In the course of his argument, Andreae effectively reverses the understanding that the heavens have influence on the earth. His explanation for this is that God controls everything, including the courses of the heavens, and can alter these at will. In this way God can use the heavens as necessary, to allow time for Joshua to defeat his enemies

ungluock zubereitten noch würcken sollen) sonder auff den Lauff des Erdreichs / das ist / auff das Leben vnnnd Wandel der Menschen / nach wölchen sich auch des Himmels Lauff richten muß / wie sollichs nicht allein seine herzliche zusagungen vnnnd trewungen / sonder auch die Exempel heiliger Schrifft bezeugen.

⁵⁰ *Ibid.*, fol. Bb ii^r: *Dis ist ein seine enfaltige Practick / vnd gemeiner Bawrenpraktick / darnach sich jederman weißt zurichten / vnnnd darauß leichtlich urtheilen kan / ob man sich eines gutten oder bösen Wtters / des Friden oder Vnfridens / Gesundheit oder Kranckheit / Thewrung oder Wolfeile der Früchten / Friheit oder Dienstbarkeit zuuersehen habe. Dann so man vnsers Herrn Gottes Kirchen vnd Policeyordnung helt / wölchedie Juden im alten / vnd wir Christen im newen Testament / durch sein gnad wol halten könden / so hat man sich gewißlich vnnnd vnfehlbar guts Wetters / Gesundheit / Fridens / wolfeiler Zeit / vnnnd Jar zuuersehen. Da man aber die Kirchenordnung Gottes nicht helt / da soll man sich gewißlich nichts / denn Vngewitters / Pestilentz / allerley Kranckheiten / des Vnzifers der Rauppen / Krieg / Blutuergiessen / Hungers vnd aller Plagen versehen / vnd da sich das vngluock ein weil verzeucht / so soll es hernach dest schwere vnd mit hauffen kommen.*

⁵¹ For a summary of this work, see J. Tester, *A History of Western Astrology*, pp. 207-212. Chapman, however, points out that there was widespread knowledge of such arguments by the late sixteenth century, and, although he is discussing Elizabethan England, his findings probably also hold for Germany [A. Chapman, 'Astrological Medicine', p. 280].

[Joshua 10.12-14], for instance, or to encourage the faith of King Hezekiah [2 Kings 20.8-11], even though this is against their normal 'ways and properties'.⁵² There is, therefore, no real point in trying to study the normal course of the world, since God will alter this as necessary.⁵³ Instead, it is necessary to seek to understand and to do the will of God. As far as Andreae is concerned, it is not the positions of the actual planets which herald disaster and decline for Germany, but the people's neglect of God's word, the iniquities of the Roman church, and in particular, the 'gluttony, drunkenness, excess, pride, vanity, envy and unfaithfulness' that he sees all around him. These are the true heralds of disaster, and thus these human faults may be seen as 'earthly planets', which bring about such a dire state of an affairs that God is forced to send a warning of the end of the world.⁵⁴

In this series of sermons, Andreae displays no interest in the understanding of the normal course of the natural world. He concentrates entirely on the way in which God can alter that course to aid the faithful. The study of natural philosophy seems to have played no part in Andreae's theological understanding; there is no sense here that it may be possible to know God through this kind of knowledge, and there is no trace of the kind of Christianised astrology which is found in Melanchthon's thought. However, despite his reservations about astrology, Andreae has to concede that such

⁵² J. Andreae, *Nach dem Lauff der irdischen Planeten*, fol. Aa iv^r: *Dann der Herr hat alles / vnnd demnach auch des Himmels Lauff in seiner Hande / vnd richtet dieselbige nach seinen willen vnd wolgefallen / wölche an kein Creatur gebunden / sonder frey vnnd vngebunden ist / nach dem sich all Creaturn / auch offtermals wider jhr art vnnd eigenschafft richten müssen. Die Sonn / wölche jhren stetten vnauffhörlichen lauff hat / muß zu der zeit Josua stillstehn / biß er seine Feind erlegt [Joshua 10] / vnnd zur zeit Histia hindersich gehn / das er an Gottes zusagung nicht zweiffelte [2 Reg. 20].*

⁵³ This is close to the Medieval Terminist, or Ockhamist, position as described by Funkenstein [A. Funkenstein, *Theology and the Scientific Imagination*, pp. 57-58]. It is also closer to Luther's position than to that of Melanchthon, for Luther does not see any virtue in trying to find God through an objective order [see pp. 52-53 above].

⁵⁴ J. Andreae, *Nach dem Lauff der irdischen Planeten*, pp.1-3.

celestial phenomena are in some sense messages from God. In another sermon, preached in 1581, he reacts to the appearance of a stella nova in 1572, and two comets in the winter of 1577-8 and in 1580, a series of astronomical events which had no doubt aroused anxieties among his the people of Tübingen and clearly called for some theological response: they were after all, signs sent by God. Andreae comments that they should be read as warnings of the wrath of God, and possibly as precursors of the last days.⁵⁵ Moreover, although in his introduction to the sermons on Luke 10 Andreae, like Frischlin, cites Jeremiah as a biblical injunction against astrology and is adamant that no astrological predictions, whether specific or general, should be made by any Christian, he is so familiar with the idea that celestial conjunctions are in general the precursors of dire events that he can refer to human vice as 'earthly planets' which are the terrestrial parallels of the celestial signs which mark the coming of the last days. While Andreae's attitude towards popular astrology is negative, the idea that the conjunctions of the planets should be read as warnings is so deeply engrained in him that he can apply its vocabulary to human vices.

Although Maestlin has been understood as an opponent of astrology,⁵⁶ his position is in fact closer to that of Melanchthon than to that of Frischlin or Andreae. In his *Iudicium* on Frischlin's *De astronomicae artis ... congruentia* Maestlin makes a brief response to Frischlin's attack on virtually all forms of

⁵⁵ M. Crusius (ed), *Corona anni*, vol. 1, p. 34: *Emendatione praesertim vitae: Stella noua 1572; Cometae duo 1577&1578; 13. Decembris 1581: Hortantur nos ad officium, cum aliae magnae causae, tum tres, quas ab annis iam deum vidimus, formidabiles stellae & cometae. Etiam proximae hebdomadis die post Dominicum diem tertis, hora ciciter septima matutine, terribilis apparuit nibium inflammatio. Tanquam igitur instet dies Domini: Seriam a peccatis nostris poenitentiam agamus: vt venientibus malis declinatis, illius in altera vita beati & tuti status, gratia & beneficio Christi compotes fiamus.*

The fact that both Crusius and Andreae recognise the stella nova of 1572 as such demonstrates the attention they paid to contemporary debate: see pp. 158-160 below.

⁵⁶ R. A. Jarrell, 'Astronomy at the University of Tübingen', p. 17.

astrology and associated denial of the validity of any biblical justification for the study of astronomy. However, these issues were clearly of less concern to Maestlin than the major mathematical mistakes which are to be found in Frischlin's work.⁵⁷ Nevertheless, it can be seen from his work on the 1580 comet that Maestlin is happy to associate political and natural disaster with the appearance of this comet.⁵⁸ For him this has a theological explanation: like Melanchthon, he is convinced that the stars have been established by God to be secondary causes for actions on earth, and that their most important function is to announce God's intentions for the world. He notes that the birth of Jesus was heralded by the appearance of a star, and the crucifixion marked by an eclipse. The sun, moon and stars were set in place by God to be of use to humankind: their movements should be marked, and attempts should be made to interpret them correctly, for this is wisdom and

⁵⁷ M. Maestlin, *Iudicium de opere astronomico D. Frischlini*, fol. 10^r: *Huc pertinet, lib. 3. cap. 6. quaest. 1. inconuenientissima citati Sacrae Scripturae Deut. 4. Ne oculis eleuatis ad coelum videas Solem et Lunam etc. quasi Deus ipse, qui alibi Gen. 15. Isa. 40. oculos in coelo attollere iubet, ibi astrorum obseruationem, studiumque astrnomiae sedulum perhibeat. Sicut hanc suam sententiam apertis verbis lib. 1. cap. quest. 6. asseueram: do prodere non veretur. Cum tamen nihil tale ex contactu illo sumi possit Moses enim ibi causam exponit, quare Deus nulla forma visibili coram populo in monte Horeb apparuerit: Ita sci illa similitudine deceptus populus respiceret vel ad homines, vel ad rumenta super terram, vel ad vermes in terra, vel ad pisces in aqua sub terra, vel ad volatilia in aëre sub coelo, vel ad solem et lunam et stellas in coelo, nec illis similia confingerent simulachra, atque adorarent ea. Ita Lactantij locus lib. 2. cap. 4. de origine errorum, quem autor citat lib. 1. cap. 1. quest. 6. Similiter non impugnat obseruationes Astronomicas, sed occasionem idolatrice earum gentium, qui Deum non cognouerunt, descripsit. Quod si omnino autor metuit, ne quos Christianorum qui sique Solis et Lunae occasione in idolatriam vunt, quae abominanda dicta gentium, quali est lib. 5. cap. 2. quaest. vltima ex lib. 11. Apulei de nominibus et numine techne, tyronibus sed tenera creare praecinit, quae reticuisse salius fuisset?*

Ita non vero, dum autor paruam diligenter perpendit verba veterem Scriptorum, sit, vt in crassissimos errores delubatur.

⁵⁸ M. Maestlin, *Comet 1580*, pp.1-3: *Si vlllo tempore insolita prodigia in coelo conspecta sunt mortalibus, vix tamen arbitror, sicut nec vllio verterum monumentis proditum est, quod vnquam praeteritis annis tanta eorum copia tantaque frequentia apparauerit, quanta his paucis praeter lapsis annis non vulgaria, sed maxima & tristissima passim obseruata sunt, adeo vt si annalibus tam vetera, quam recentia consignanda essent, vix illorum memoria fouet, propter creberrimam horum & multitudinem & magnitudinem.*

... Recencebo autem hic quaedam portenta (quis enim omnia & singula vidisset vel conscriberet, cum alioqui in istis diuinis prodigijs observandis admodum sims negligentes vel caecutientes) his 1580. & 1581. annis obseruata, quibus quid aliud cernimus, quam Dei iram succensam, glaiumque ipsius strictum esse, quo feriat omnes, longanimitate eius tanto tempore abutentes.

leads to knowledge of the truth.⁵⁹ But, he comments in his work on the 1580 comet, despite the clarity of the heavens' revelation of God, the sinfulness of human beings results in a remarkable inability to understand what God has

59 M. Maestlin, *Epitome astronomiae*, fol. *4^r.*6^r: *Et ne singula commemorando ad instituto, quod in praesentia ad Astronomiam dirigitur, longius digrediar: Quanti aestimanda sit Astrorum scientia apparet ex magnificis & iucundissimis elogijs, quibus in sacra scriptura Astra tanquam prae caeteris illustrissima omnipotentiae, sapientiae et bonitatis Dei testimonia & specimina exornantur (Isa 38.1-8). Isa: Levate in excelsum oculos vestros, & videte quis creavit haec? que educit in numero Militiam vel Exercitum eorum et omnia suis nominibus vocat, a multitudine virium, & robore virtutis, vt ne vnum quidem deesset (Isa 40.26). Qui facit Arcturum & Oriona, & Hyades, & interiora austri. Qui facit magna & incompraehensibilia, quorum non est numerus; Dominus nomen eius (Ps 146.6; Job 9.9-10; Amos 5.8). Coeli enarrant gloriam Dei. In Sole posuit tabernaculum suum, ipse velut gigans &c (Ps 19.1-6). Verbo Domini coeli firmati sunt & spiritu oris eius virtus eorum (Ps 33.6). Laudate eum Sol et Luna, Stellae, et Lumen, coeli coelorum &c (Ps 148.3ff). Sic appellantur Militia, Exercitus coeli, gloria astrorum, Ornatus illustris in regione celsa Domini (Dan 2.20-22 [Maestlin has Dan 3]; Sir 43). Hinc non raro ad promissionum suarum certitudinem sanctis demonstrandam, ad astrorum motus, velut indubitata symbola, Deus ipse prouocat. Abrahamo, quem Iosephus Astronomum fuisse, & a Chaldaeis Mathematicum studia ad Aegyptios detulisse, et docuisse, testatur, vt de certitudine multiplicationis seminis confirmatus, crederet contra spem in spem, Deus monstrat stellarum multitudinem. Iosepho regiam maiestatem, qua patrem & fratres in fame sit seruaturus, depingit in insomnijs, non modo per manipulos, sed etiam per reuerentem adorationem Solis, Lunae, & vndecim stellarum. Hiskiae Regi vitam prorogaturus ad annos 15, Deus signum velut sacramentum proponit Solem per loca per acta reducem, ipso & propheta coram in horologio Achaz spectantibus. Magis praeconem qui eos ad filium suum vnigenitum incarnatum et natum inuitaret, inter alia collocat. Toti mundo Deum naturae pro salute humani generis crucifixum mori, phaenomeno coelesti inusitatae eclipsis patefieri voluit. Sicitaque supernatales apparentiae commendant, motus naturales, siquidem illae non agnoscerentur, nisi hi prius cogniti essent. Ita nomen Solis non indignum Salvatore nostro Malachias putauit [Mal 4.2]. Non aliter tam Apostoli [1 Cor 15.40-41] quam Prophetae [Dan 12.3], & ipse Christus futuri seculi gloriam splendore Solis, Lunae & differentium lumine stellarum describunt (Mat 13). Maximum autem illustre est testimonium Mosis. Fiant luminaria in firmamento coeli, & diuidant diem & noctem, & sint in signa & tempora, & dies & annos &c [Gen 1.14-18]. Quem temporum vsum Psaltes [Ps 104] & Syracides [Sir 43] confirmant. Fecit lunam in tempora, Sol cognouit occasum suum. Mensis nomen eius accipit, & crescent mutationibus est mirabilis. Ita signotum vsum & appellationem, quam Deus iam olim eis imposuerat, Hieremias Propheta astris beneuole largitur [Jer 10.11-13]: Dum enim ipse tam eo quam aliis locis, superstitiosum metum Iudaeorum, qui more gentium, praesertim Chaldaeorum adorantium sydera velut numina, infaustos eorum positus desperabundi pertimescebant, increparet: Astra non quidem creatores Deos, attamen Signa esse confitetur. Idcirco hortatur, vt ad ipsum Deum, qui, vt ibidem ait, in fortitudine & sapientia terram fecit, & in prudentia coelos extendit, sese conuertant supplices velut ad causam causarum primam, nec more GENTIUM, omnem spem salutis, aut metum interitus in causas secundas syderum signa collocent [Mt 16.1-4]. Eodem modo Saluator ipse cum Iudeorum praeposterum discernendi tempus aduentus Messiae iudicium redargueret, obseruationem signorum seu faciei coeli disertis verbis approbat [Lk 12.52-56]. Eiusdem etiam generis est, quod Deus exardescens iram suam denunciaturus, et tristia temporum fata descripturus, comparat ea tristibus astrorum apparentijs. Isa: Stellae coeli, & Orion non expandunt lumen suum, Sol est obtenebratus in ortu suo, & Luna non splendet lumine suo [Isa 139-11]. Item: Quomodo cecidisti de coelo Lucifer, qui mane oriebaris. Syr: In iracundia eius impeditus est Sol, & vna dies facta est sicut duo [Sir 46.4; Josh 10.12-15].*

Non igitur est quod miremur, Salomonem Regem Sapientissimum non modo interpraecipuam Sapientiae suae gloriam non postremum locum contribuisse Astrorum cognitioni [Sap 7] sed etiam Ecclesiasten suum ab Astronomicis apparentijs exordiri non erubuisse [Eccl 1]. Neque quod Zorobabel adolescens coram Dario Rege de Veritate dicturus [3 Esdr 4.33-35], ad orationis suae principium Astronomiae commendationem delegit, admirabimur.

laid out before their eyes; God has had to send a comet to awaken the world to its evil. The comet is thus a sign of the covenant between God and humankind, but, equally, it is a sign of God's wrath.⁶⁰ However, it not only symbolises the evil that is to be found on earth; it demonstrates the power and the wisdom of God and reminds people of the effects of praying to God for relief of their misery.⁶¹ Celestial phenomena can, therefore, also be a reminder of the sinful nature of humankind and an incitement to a better, more pious life.

That the position of Maestlin on astrology is in many ways similar to that of Heerbrand is probably no coincidence, since Heerbrand was one of the professors who taught Maestlin theology. Heerbrand was so convinced that the heavens could announce the intentions of God that on December 17th, 1577 he chose not to preach on the gospel for the day, but on the 'terrible, miraculous sign in the heavens, the new comet'. After explaining that the gospel for the day (Luke 8.40-56: the healing of the bleeding woman and of Jairus's daughter) should be read as a reminder that all fears and needs should be brought before God, a reminder especially appropriate 'in these

⁶⁰ M. Maestlin, *Comet 1580*, fol. A3^r: *Sed praeter hanc, astra aliam etiam famam, etsi non hominibus, Deo tamen non minus gratam, spargunt quando videlicet peccatorum nostrorum atrocitate & multitudine supra modum offensus, ad vindictam properare cogitur Deus, praecones suas, qui classicum cantent, qui de ira & vltione praemoneant, si forsitan, inueniretur, qui se murum interponens, iram eius amoliretur, nobis spectandos producit. Ij sunt tristifacie lucentes Cometae, tremenda chasmata & alia huiusmodi ominosa portenta. Hos buccinatores velut virgas furoris sui, non minus vult observari, quam iridis arcum, coniunctionis & foederis inter Deum & hominen signum. Sic praeterito anno, praeterquam quod varijs chasmatis fama ingrata de ira Dei ardescende ad nos delata est: postremo anni quadrante cometa truculento & minaci vultu eandem inculcauit.*

The reactions of astronomers to this and other comets will be discussed in more detail in the next chapter.

⁶¹ *Ibid.*, fol. A3^{r-v}: *Omnibus vero cometis inesse solet, vt non tantum de impendentibus malis comunefaciant, sed etiam tam de potentia, quam sapientia Dei creatoris testantur, haud dubie, vt intelligamus Deum non nisi extrema necessitate adactum poenas peccatorum infligere, ob quod etiam in ipsa ira misericordiae non immemor, mauult clementiae suae ludus proponere, vt bonitate ipsius potius quam suppliciorum metu deterriti ab iniquitatibus deflecteremus. Sin vero Deus hoc modo nihil profecerit, vt intelligamus, quam durum sit telum necessitas, in manibus eius cuius potentia Cometam lucere fecit.*

difficult times', Heerbrand turns to the comet. He tells the congregation that 'the almighty and just God has awoken for us another preacher, and set it on a high pulpit in the heavens, namely that terrible, great and terrifying sign in the heavens, the comet ... so that he gives another sermon for the whole world which we should observe, and listen to what it is preaching to us.' Heerbrand wants first to discuss the meaning of the comet, before turning to an explanation of the effect it should have on the congregation's behaviour.⁶² To the first point, he reminds the congregation that the Psalmist warns people to take care not to be like horses and mules, which are forced into obedience with bits when they do not go where they should: the comet is the swinging of God's sword, a warning to 'wild, raw, animal-like people who do not pay any attention to God's word or miracles' that they should take notice of God's wrath against the world and reform themselves before they are forced to and punished.⁶³ From the appearance of the comet it should

⁶² J. Heerbrand, *Ein Predig von dem newen Cometen*, pp. 1-2: *Ich solte ietzo / geliebte im Herren Christo / etwas sagen vnnd predigen von dem heutigen Euangelio / in wölchem vns zwey schöne vnnd herzliche Wunderwerck vnsers Herren Jesis Christi werden furgehalten / eines von dem arbeitseligen Weiblin / wölches zwölf Jar lang ein beschwerliche Kranckheit gehabt / darauff jr auch alle jr Haab vnd Gut gegangen / vnd jr doch von keinem Artzet mocht geholffen werden. Aber der Herr Christus / als sie jme auß Glauben seines Kleides Saum anrüret / macht sie alsbald gesund. Das ander / von deß Obersten der Schulen / mit namen Jairus / Töchterlin / wölches der Herr Jesus Christus / als es schon gestorben / von dem Tod / als auß einem tieffen schlaff / erwöcket / dadurch sein Allmacht / vnd gegen den ellenden vnd betrübten / so zu im lauffen / sein leutseligkeit / gnad / güte / barmhertzigkeit vnnd hülf / in allerley Beschwerden / Creutz vnd leiden erzeiget.*

Wolches zu disen kümmerlichen zeitten vnnd geschwinden Leuffen / ganz tröstlich / damit wir lehrnen / vnd wissen / zu wem wir vnser zuflucht in ängsten vnd nöten haben sollen.

So hat uns aber der Allmächtig vnnd gerechte Gott / ein andern Prediger diser tagen erwecket / vnd auff ein sehr hohe cantzel / an den Himmel / auffgestellet / Nemlich das gantz erschrockenlich / groß vnnd grewlich Wunderzeichen am himmel / den Cometen / oder wie mans nennet / den Pfawenschwanz / dardurch er der gantzen Welt / ein andere Predig thut / vnnd fürhelt / den wir sollen anschawen / vnd hören was er vns predige.

Derhalben dann wir auch auff dismal etwas dauon wöllen sagen.

Vnd zum ersten / wie wir diß Himmelsch Wunderzeichen den Cometen / sollen anschawen / auch was er bedeute.

Zum andern / wessen wir vns dargegen sollen verhalten.

⁶³ *Ibid.*, pp. 2-3: *Wir sollen aber dis Wunderzeichen am Himmel nicht wie die Kühe ein new Schwenthor ansehen / wie vns auch der heilige Geist durch den heiligen Propheten Daud warnet / vnd spricht: Seiet nicht wie Roß vnd Maulthier / die nicht verstendig seind / wölchen man Zaum vnnd Biß mus ins Maul legen / wann sie nicht zu dir wöllen.*

Wie man dann solcher vil wilder / roher / sichere vnnd vihischer Menschen findet / die nicht vil nach Gottes Wort / noch Wunderwercken fragen / bewege sie auch nicht hart /

be apparent to all that God's anger with the world is a serious matter, just as the sword on the table at a trial shows the prisoner that body and life are at stake.⁶⁴ Moreover, experience shows that the comet's warning should be taken seriously, for it has long been known by the wise and educated that the appearance of a comet heralds disaster: all people should be beware, for through the 'poisoning and upsetting of the air which will come about through the comet when it goes out,' the cattle will die, the fruit will rot, there will be drought, shortages, and therefore inflation, war, pestilence and political instability.⁶⁵ Heerbrand hammers his point home by citing a list of comets which have appeared in history and the dire events which followed.⁶⁶

He then turns to the consequences which this comet should have for the people who see it. As a result of this warning, Christian people should behave 'like pious children, who fall on their knees before their father and

es zeige gleich Gott der Herr für Zeichen was er wölle / gleich wie sie auch nichts auff seine Schelt vnd Trauwort geben.

Sonder sollen das wol mercken / vnd wissen / daß diser Comet / ein gewlich Zeichen deß erschrockenlichen Zorns Gottes wider die Welt / von wegen ihrer Sünden / vnd vnbußfertigen Lebens seie / da er sich auffmachet / die Rüt vnd sein Schwerdt in die Hand nemet / er schwinget vnd sehen laßt / dieselbige heimsuchen vnd sraffen will.

⁶⁴ *Ibid.*, p. 3: *Dann zu gleicher weiß / wie an vilen orten / als auch allhie / von Weltlicher Oberkeit geschicht / wann man ein Ubelthäter will verrechten / oder für Gericht stellen / so leutet man anfangs das Rechtglöcklin vber jn zum drittenmal / da sich hie zwischen die Richter versamlen. Darnach / so legt man ein blos Schwerdt auff den Tisch in der Rhatstuben / fieret vnd stellet den armen Menschen für / klagt jn an vmb Leib vnd Leben / da sihet er wol / daß es kein Spiegelfechten / wie auff der Fechtschul / sonder rechter ernst ist / vnd gilt jhme Leib vnd Leben.*

⁶⁵ *Ibid.*, pp. 3-4: *Also gibt die langwürige erfahrung zweier tausent Jar biß anher / da wiese vnd gelehrte Leut ihre fleißige achtung darauff gegeben / gemerckt / vnd beschriben haben / daß die Cometen allwegen vor grausamen grossem Unglück hergangen / vnd dasselbige zuuor verkündiget / wölches auch gemeiniglich also bald darauff eruolget.*

Als da seind / vergiftung vnd verfälschung deß Luffts / wölche von den Cometen geschicht / wann sie erlöschen. Daher dann kompt deß Vihes sterben / vnd verderbung der Früchten / vngewöhnlich Dürre vnd Hitz / auch vnfruchtbare zeit / darauß dann Thewrung entsteht.

Item entpörung vnd auffrhür / ein vnd vberall der Feinde / grausame Krieg vnd Blutuergiessen / hefftige vnd starcke Pestilentz / tödtlicher abgang grosser Herren vnd Regenten / Enderung vnd zerrüttung der Regiment / verhörung vnd zerstörung der Länder vnd Völcker / Enderung der Gesetz / Sitten vnd Ordnungen / vnd was anders mehr dergleichen ist.

⁶⁶ *Ibid.*, pp. 5-7.

beg for mercy and forgiveness.⁶⁷ Is it not so that when there is a fire, the community works together to stave off the emergency by bringing water to put it out? This fire should cause them to do likewise. In this case, though, the water required is the 'hot tears which spring from contrite and penitent hearts and run down the cheeks.' The comet is a call to repentance and for a resolve to live a better life, so that the punishments of which this comet is a herald should be mitigated after all.⁶⁸ If the people confess and are contrite, God will be merciful, and the disasters heralded by the comet will not come to pass.⁶⁹ If, on the other hand, God's punishment should be inflicted despite prayers and repentance, it must be borne gracefully as just retribution for sin, necessary for ensuring eternal life.⁷⁰ In the event, as

⁶⁷ *Ibid.*, p. 9: [Wir] sollen thun / wie fromme Kinder / die vor dem Vatter auff die Kni niderfallen / vmb gnad vnd verzeihung bitten / vnd sagen: Ach lieber Vatter verzeihe mir / vnd vergib mir das / ich hab vnrecht gethon / ich wils mein lebenslang nicht mehr thun / ich will ein frommes gehorsames Kind sein / &c.

⁶⁸ *Ibid.*, pp. 9-10: Oder / als wann ein Fewr oder Brunst außgeht / da laufft jedermann zu / Mann vnd Weib / jung vnd alt / einer erwischt ein lederin Aimer / das ander ein Rübél / das dritt ein Geltle / der vierdt gshirret geschwind sein Roß an /setzt ein / vnd fehr mit dem Wasserfaß dem Brunnen oder Ammer zu / füllet das Faß / füren vnd tragen also Wasser zu dem Fewr / schutten es darein / damit das Fewr gedämpfft vnd gelöscht werde.

Also zeigt vns der groß Comet an / daß ein groß Fewr vnd Brunst vorhanden seié / nemlich / das Gottes Zorn angebrunnen sei / wie ein grawsames Fewr / das ist ein gemeine Brunst / vnd geht vns / wie zubesorgen / aalle an. Da sollen wir alle vnd jede Wasser zutragen / vnd helffen löschen.

Was ist aber das für wasser? Nicht in der Ammer drunden / oder auß S. Jorgen Brunnen draussen vor der Kirchen / Sonder das Wasser / das da fleußt auß vnsern Augen / die heisse Zäher / die auß büßfertigem vnd zerschlagenem hertzen entspringen / vnd fliesen vber die Backen herab.

Da wir in vns selber gehn sollen / ein jegliches seine Sünde von hertzen erkennen / berewen vnd beweinen / dem Allmächtigen Gott zu Füßen / vns also in die Rütten vnd Schwert fallen (da sich dann keiner solle oder wölle herauß ziehen) vmb Gnad vnd verzeihung vnserer Sünden / vnd milterung der woluerdienten Landtstraffen vnd Plagen / stehenlich bitten.

⁶⁹ *Ibid.*, p.15: Wann man sich nun von gantzem hertzen zu jhm bekert / vnd von Sünden absteht / so will er sich widerumb / mit gnaden zu vns keren / wie er auch durch den Propheten Jeremia sagt: Plötzlich rede ich wider ein Volck vnd Königreich / daß ichs außreutten / zerbrechen vnd verderben wölle. Wo sichs aber bekeret von seiner Bosheit / dawider ich rede / so soll mich auch rhewen das Vngluck / das ich ihm gedacht zuthun [Jer 18.7-8].

⁷⁰ *Ibid.*, p.16: Vermögen wir aber (von wegen anderer Vnbüßfertigkeit) die wolverdiente Landstraffen / bey Gott nicht abtragen / sonder muß das Kalb (wie man spricht) mit der Kuh gehn / vnd kein besserung zuuerhoffen / wie es sich darin laßt ansehen / als wöll es alles zum End lauffen / so soll sich doch ein jeder / dem sein eigen heil / vnd ewige der Seelen seligkeit lieb vnd angelegen / dahin rüsten / vnd schicken / daß wir dem ewigen Vngluck entrünnen / vnd das ewige Leben / Freud / vnd Hertzlichkeit / nach disem ellenden Jamerthal / erlangen mögen / Wie Gott durch den H. Propheten Jsaia tröstet: Prediger /

Heerbrand remarks in a sermon for harvest thanksgiving given in the autumn of 1578, God was indeed merciful, and none of the threatened calamities came to pass. (One might assume that this would be cause for praise of the congregation for their repentance and prayer, but Heerbrand instructs them only that they should be thankful for God's mercy.) The harvest was in fact especially good, and could be gathered in peace: let God be thanked!⁷¹

Heerbrand may have preached few such sermons,⁷² but even his having preached these ones betrays his interest in understanding and interpreting the natural world and its events as acts of God. This concern is echoed in his theology. This can be seen in part from the way in which the doctrines of creation and providence are interwoven with one another in Heerbrand's theology, as has been discussed above, but it is also reflected in his use of the Augustinian concept of the *liber naturae*, and his attribution to it of a complementary, if inferior, authority to that found in the *liber scripturae*.⁷³

Heerbrand's *Compendium theologiae* opens with a consideration of the holy scriptures, the canon and their status as inspired by the Holy Spirit,⁷⁴ before

spricht er / von den Gerechten / daß sie es gut haben / dann sie werden die Frucht jrer Werck essen [Is 3. 10].

⁷¹ J. Heerbrand, *Ein Erndt vnd Herbst Predig*, fol. 1^v: *Dieweil dann nu / der gnädig vnd Barmhertzig Allmächtig ewig Gott / vns auß sondern gnaden diese Jar / wölches doch ein boses ansehen gehabt / vnd vil grewlich dauon geweissaget / wie vns auch er selber durch den erschrockenlichen Cometen / so eben jetzt vor einem Jar erschienen / gedrowet / so mitiglich gesegnet / vnd ein so reiche Erndt / vnd Herpst gegeben (vnd im Friden mit Gluck hat lassen einbringen) Sollen wir billich solches mit hertzlicher vnd schuldiger danckbarkeit erkennen.*

⁷² There is a similar reference in a sermon preached on Jonah 3 in 1583 and printed in Latin translation in M. Crusius (ed), *Corona Anni*, 1, pp. 25-27, but I know of no others.

⁷³ Augustine, *De Genesi ad litteram, liber imperfectus*, pp. 143-146]. This motif is generally identified with Augustine, although Glacken notes that 'it was already well developed by John Chrysostom (died 407)' [C. J. Glacken, *Traces on the Rhodian Shore*, pp. 203-204]. For a brief history of its use, see H. M. Nobis, 'Buch der Natur', pp. 958-959 [who gives an incorrect reference to Augustine's work: he refers to *De Genesi ad litteram*, MPL 32.219ff (a different work which is actually found in MPL 34.245-486), rather than to *De Genesi ad litteram, liber imperfectus*, MPL 34.219-337!].

⁷⁴ J. Heerbrand, *Compendium theologiae*, pp. 1-32.

turning to a discussion of God. The existence of God, Heerbrand explains, can be proved by reference either to the *liber naturae* or to the *liber scripturae*. The *liber naturae* comprises

all of this universe: the world, certainly, and all that is in it, its beauty, order, and all things which have been founded for settled purposes, likewise the settled motions of celestial bodies, human beings themselves - the microcosm - the wonderful arrangement, constructions and system of the whole world and all its parts, the conservation and propagation of the species and also their generation, the succession of times, the order and series of causes systematic among themselves, the multitude of portents of things to come, the rewards of prayers and the punishments of the wicked (many even in this life). It is the testimony of the conscience in all human beings, &c. These things testify that the Architect is a wise, omnipotent, good being who has created all these things and preserves and governs them. For the work shows the artisan. An effect cannot be without cause, nor can it come from itself. For that reason this world must come from another cause. For this arrangement of atoms has not been made fortuitously or without reason, nor by chance, but by a wise and omnipotent originator.⁷⁵

The *liber scripturae* is of course the Bible.⁷⁶ Although the Bible gives more certain proofs of God's existence than those provided by the *liber naturae*,⁷⁷ and shows God's trinitarian nature, which also cannot be known from the *liber naturae*,⁷⁸ it is not the only source of revelation. Heerbrand cites eight arguments from the 'natural' world to prove the existence of God. These arguments in effect reproduce the proofs of the existence of creator and

⁷⁵ *Ibid.*, pp. 32-33: *Quid est liber naturae? Est totum hoc Universum, mundus nempe, & omnia, quae in eo sunt: cuius pulchritudo, ordo, & quod omnia ad certos usus sunt condita, regulares item motus corporum coelestium homo ipse μικροκοσμος & sic miranda dispositio, compages & σύστημα, totius mundi & omnium partium eius, conseruatio & propagatio specierum, ac similitudo in generatione, vicissitudines temporum, ordo, & series causarum inter se cohaerentium, praesagia rerum futurarum multiplicia, praemia piorum, & poenae sceleratorum, multorum etiam in hac vita: testimonium conscientiae in omnibus hominibus, &c. Testantur haec, Architectum esse sapientem, omnipotentem, beneficium, qui haec omnia creauit, conseruet & gubernet: Opus enim commendat artificem. Item: Effectus non potest esse sine causa, nec a seipso. Ergo hic mundus est aliunde. Non autem ex fortuito atomorum concursu, nec temere, aut casu, sed a conditore Sapiente & Omnipotente est actus.*

⁷⁶ *Ibid.*, p. 32: *Quod est liber scripturae? Est scriptura sacrosancta, & dicitur Biblia, ab excellentia horum Scriptorum, quorum author est Spiritus Sanctus, immediatus, a quo inspirati, locuti sunt sancti Dei homines.*

⁷⁷ *Ibid.*: *Haec [scripturae] autem multo certius testantur esse Deum, quam causae illae ex rerum natura desumptae, quae intentionibus, & seruijs conscientia certaminibus, propemodum euanescent.*

⁷⁸ *Ibid.*, pp. 10-13.

creation offered by Melanchthon in the final version of the *Loci communes*,⁷⁹ although Heerbrand excludes Melanchthon's final argument that God's existence can be known from the foretelling of future events, which is essentially based upon scriptural passages.

Heerbrand explains that God can be known to exist from 'the perpetual order in nature, which cannot have begun by chance or only from matter. Such is the perpetual order of celestial motions and of the preservation of species.' It was this order which allowed the apostle Paul to write to the Romans (Rom. 1.20) that the invisible attributes of God can be discerned and understood through those things which have been made.⁸⁰ Heerbrand underlines this point with his fourth argument: that observation or knowledge of nature is both a proof of the existence of God and an indication that God should be worshipped was obvious even to barbarians who did not themselves know how God should be properly worshipped, as the example of Cicero shows: how much more obvious should it be to Christians.⁸¹ The nature of the human mind itself is another indication that the world has been made by an intelligent creator, for 'an unintelligent thing cannot be the cause of an intelligent nature. Human minds have some cause, because humankind began to be, and it began from something else.'⁸² Therefore, whatever

⁷⁹ See above, p. 72, ch.2 n. 86. In some cases Heerbrand reproduces Melanchthon's arguments word for word.

⁸⁰ J. Heerbrand, *Compendium theologiae*, p. 33: *Quibus argumentis id probas? Primum: ab ordine in natura perpetuo, qui non potest casu esse ortus, aut tantum a materia. Sicut est perpetuus ordo motuum coelestium & specierum conseruatio. Quemadmodum & Apostolus Rom 1 dicit: Inuisibilia Dei a creatura mundi per ea, quae facta sunt, intellecta conspiciuntur.*

⁸¹ *Ibid.: Quarto: a noticijs naturabilis, quae sunt verae. Esse Deum, naturaliter omnes nouerunt & fatentur. Deus enim illis manifestauit. Non ulla unquam gens tam barbara fuit aut effera, quae non nouerit esse Deum, eumque colendum, etiamsi, quomodo is colendus sit, ignorant, teste Cicerone.*

⁸² *Ibid.: Secundo: a natura mentis humanae. Bruta res non potest esse causa naturae intelligentis. Mentis hominum habent aliquam causam, quia homo incipit esse, & aliunde oritur. Ergo &c*

created the human mind must itself have been intelligent. Later he argues that it therefore follows that human beings were created in the image of God, so that they are especially well able to recognise God's wisdom, justice and sanctity.⁸³ Through their intellects, which reflect God in a special way, human beings have an affinity to God, and through God to the natural world, which enables them to recognise it as God's work.

But it is not only the observation of nature *per se* which can reveal the existence of God. Because all order has been created by God, knowledge of any sort of order or number is a recognition of the order which God has set into the world. In particular, knowledge which distinguishes the honourable from the shameful is an indication of the created order.⁸⁴ Thus Heerbrand draws an explicit parallel between the natural, in the sense of the physical world, and the order of society. Just as God's existence can be known from observation of the universe, because it is not a chance arrangements of atoms, so too can it be seen in 'political society, which is not an arrangement of humans by chance but a binding together of the multitude by a definite order and law.'⁸⁵ Similarly the creator of the *liber naturae* can be recognised from the 'fears of the conscience,' which awaken evil-doers to an awareness of the wickedness of their actions, for such an awareness

⁸³ *Ibid.*, p. 163: *Quid est Imago Dei, ad quam initio homo conditus scribitur, Gen 1? Est conformitas & similitudo hominis, quae congruebat cum Deo, estque vera iusticia & sanctitas; omniumque virium hominis in anima & corpore integritas, per omnia cum lege Dei congruens, coniuncta cum vera libertate, immortalitate, & rerum omnium domino. Ita enim cum homo conditus est ab inition a Deo, vt in eo luceret vera Dei agnitio, sapientia, iusticia, sanctitas, veritas, &c vt Deo viribus suis concreatu obedire, legisque ipsius satisfacere perfecte posset: Sicut cognatum & perspectam habuit Adam rerum omnium creatarum naturam, Genes 2, non moreretur, sed perpetuo viueret. Sicut Deus iustus est, sapiens, bonus, verax immortalis, liberrimus.*

⁸⁴ *Ibid.*, p. 33: *Tertio: a discrimine honestorum & turpium, & alijs noticijs ordinis & numerorum.*

⁸⁵ *Ibid.*, p. 34: *Sexto: a politica societate, quae non est fortuitus hominum concursus, sed certo ordine & iure consociata multitudo.*

must have been imparted to their souls by another mind.⁸⁶ Therefore, for Heerbrand, as for Melanchthon, the order of society is part of the perceived order of the natural world; the two are intimately connected, and both come from God.

Heerbrand's final arguments for the existence of God as seen in the *liber naturae* are drawn from Aristotle's causal philosophy. The creation of the world can be deduced 'from the series of efficient causes: this does not go on for ever but must end in one first cause.'⁸⁷ This one first cause is God. In his discussion of creation, Heerbrand explains that the 'impulsive cause' of creation is the 'immense goodness of God', while the instrumental cause is 'God's omnipotent word.'⁸⁸ The eighth argument is taken from Heerbrand's understanding of the final causes, or uses, of the natural world. The universe is teleological in character, for 'all things in the whole world are destined for a fixed use,' he argues, and 'this is not by chance or for no reason but from an intelligent mind.'⁸⁹ The very usefulness of the created universe is seen by Heerbrand, as it had been by Melanchthon before him, as a demonstration of the existence of God, who created everything for its own purpose.⁹⁰

86 *Ibid.*, pp. 33-34: *Quinto: a paoribus conscientiae. Homicidae & alij quantumuis potentes, patratu magnis sceleribus (vt Alexander Magnus interfecto Clito inter pocula &c) horribiles tamen animorum sustinet, etiamsi nulla hominum iudicia metuant. Est ergo aliqua mens, quae hoc iudicium in animis hominum ordinavit.*

87 *Ibid.*, p. 34: *Septimo: a serie causarum efficientium: Non est processus in infinitum, sed necessario in vna prima consistendum est.*

88 *Ibid.*, p. 128: *Quae est causa impulsiva Creationis? Immensa Dei bonitas. ... Quae est causa instrumentalis? Verbum Dei omnipotens.*

89 *Ibid.*, p. 34: *Octavo: a causis finalibus. Omnes res in toto mundo ad certas utilitates sunt destinatae. Id casu fortuito aut temere factum non est, sed a mente intelligente.*

90 *Ibid.*, pp. 134-135: *Quis est finis creationis? ... [2] In vsu hominum omnia sunt condita, ideoque Mundo & omnibus, quae in eo sunt conditis, homo creatur, cui dominum uniuersorum traditur, quae omnia illi seruiant.*

Such benefits include the ability to tell time and distinguish the seasons of the year, based on the stars, and also, more immediately, the use of animals and plants to provide food, clothing and heat.

On the basis of these arguments, Heerbrand is able to demonstrate that the *liber naturae*, by which he means the natural world in the widest sense - including human society and moral conventions - can reveal the existence of God, even though he believes too that the Bible can reveal aspects of God's nature and intentions which cannot be known from the natural world. Similarly, although the actual course of creation can be known only from the Bible, the natural world reveals God as its creator. Indeed, its revelation of the Creator God is, in fact, the most important final cause of creation:

The whole of this universe, and all things that are in it, were principally created by God that its architect may be known and celebrated through his works (Rom 1.20), as may his omnipotence, wisdom and goodness (Job 12). Ask the beasts, and they will teach you; or the birds of the heavens, and they will show you; speak to the earth, and it will reply, and the fish of the sea will tell you. Who does not know that the hand of God has made all these things?⁹¹

Therefore, a better understanding of the complexity of the order of the natural world should awake in the observer a greater sense of wonder at the power and wisdom of the Creator. But because the Bible may reveal aspects of the creation which the natural world itself cannot reveal, such as the fact that it was created in seven days,⁹² such observers, in the main natural or moral philosophers, must always be ready to concede that their deductions may turn out to be false when compared to biblical testimony. Examples of philosophers who have drawn false conclusions from their observations of the natural world are Galen, whose response to the first chapter of Genesis was to say that Moses had written much about creation

⁹¹ *Ibid.*, p. 128: *Quae est causa finalis? Totus hic mundus, & omnia quae in eo sunt, principaliter propter Deum creata sunt, vt huic architectus ex suo opere cognosceretur & celebraretur, Rom. 1. Omnipotens, Sapiens, Bonus. Job 12. Nimirum interroga iumenta, & docebent te, & volatilia coeli, & indicabunt tibi: Loquere terrae, & respondebit, & narrebunt pisces maris. Quis ignorat, quod haec omnia manus Dei fecerit?*

⁹² *Ibid.*, pp. 129-131.

but proved nothing, Epicurus, who thought that the world came into being from a chance association of atoms, and Aristotle, who believed the world to be eternal. In fact, Heerbrand argues, since all these ideas are countered by the biblical testimony of *creatio ex nihilo*, all these 'mathematical proofs' are wrong, and can only be seen as misguided attempts to contradict the doctrine of creation.⁹³

⁹³ *Ibid.*, pp. 122-123: *Esse creationem proba? Galenus legens primum caput Geneseos, in quo totius mundi, & omnium, quae in eo sunt, creationem Moses descripsit, ridendo dixit: Mosen multa de creatione scibere, sed nihil demonstrare.*

Aristoteles mundum aeternum esse sensit.

Epicurus ex fortuito atomorum concursu extitisse cum delirauit.

Sciendam est igitur, Scripturae Sacrae testimonia & oracula multo nobis quibusuis Mathematicis demonstrationibus certiora esse & firmiora cum illorum author sit Deus, qui est veritas & ea nobis patefacit. Illa autem testatur, Deum ex nihilo, id est, ex nulla alia praeexistente materia, coelum & terram creasse. Quia praeter ipsum nihil fuit.

See also p. 133: *Quae pugnant cum Creatione? Epicuræorum furores, affirmantium omnia ex fortuito atomorum concursu esse facta. Quod plane esse impossibile, conuincit ordo in natura pulcherrimus, regulares motuus corporum coelestium, fines denique certi, ad quos singula sunt condita. Similiter & Philosophorum errores de mundi aeternitate, qui Scripturae Sacrae testimonijs, qua nobis Christianis firmissimae sunt demonstrationes, refutantur.*

It is actually not at all clear that the Bible teaches a *creatio ex nihilo*, although this has been standard doctrine for most of the Christian era [for a discussion of the history of this interpretation, see G. May, *Schöpfung aus dem Nichts*].

Note Heerbrand's equating of 'mathematical proofs' with the demonstrations offered by the ancient philosophers. Heerbrand's colleagues at Tübingen use similar arguments for the supremacy of theology. Thus, the philosopher Andreas Planer explains in the introduction to his *Scientia demonstrandi* that no proof can take the place of faith in the holy scriptures [A. Planer, *Scientia demonstrandi*, preface, unnumbered page 7^v-8^r: *Vt .n. a summis incipiamus & descendamus ad infima, in sacrosancta Theologia verbo Dei in sacris literis reuelato simpliciter credendum, nullasque alias probationes quaerendas esse docetur. Quaerat hic aliquis quae huius discriminis ab alijs scientijs sit causa, sine hac demonstrationis doctrina eam reddere non potest. Cum enim superiores semper scientiae principij rationem habeant erga inferiores: & principijs credendum sit, hoc habitu fidei res sacras cognoscendas esse dubitare non possumus. Cum primum namque hoc negatur, verbo Dei aliquid certius minusque sit dubium, quod quam impium & blasphemum sit omnibus patet. Nec certitudo solum verbi Dei ex demonstrationis praeceptis contra aduersarios ostenditur: sed sine demonstratione in nulla Theologiae parte quicquam peragitur. Quomodo enim reus maledictionis diuiniae non desperabit, nisi secundum principiorum doctrinam promissionibus diuinis nihil certius firmiusque esse sciuerit: & ita ἀμεταπλότος qui nihilo in tota vniuersitate se demoueri patiat, fiat?...], although he has earlier explained that dialectic methodology can also be used in theology [A. Planer, *Orationes tres*, p. 49]. Similarly, Jacob Andreae points out the superiority of theology over the proofs of the mathematical disciplines. But the truths of theology and its doctrines cannot be proved in the same way as mathematics: they are a matter of faith, and their principles, which are the only guides in times of ecclesiastical strife, are to be found in the bible [J. Andreae, *De studio sacrarum literarum*, fol. D^r-^v: *Habet enim & Theologia multo firmiores, quam Mathematicorum Disciplina Demonstrationes, quamuis hae rationi & sensib. non ita expositae sint, quas sola fides capit. Sed quemadmodum illi, non nisi datis κλωαῖς εὐνοίας, principijs & postulatis concessis, nihil demonstrare possunt: Sic nos quoque in professione Doctrinae coelestis certiora principia habemus omnium patrum consensu confirmata, ex quibus non difficile est etiam intricatissimas controuersias Ecclesiasticas dirimere, earumque veritatem quasi ob oculos spectandam proponere, quod in controuersis de persona Christi, eiusque Maiestate, ad quam iuxta humanam Naturam ad Dexteram Dei**

The same problem arises for those who engage in philosophical deductions about divine providence, and in this case is exacerbated by the fact that God acts in the world in two ways, but that the natural world can reveal only one of them. Heerbrand believes that the God-given nature of the created universe is sustained, conserved and governed by God's general providential action; it is this order which is apparent in the regularity of the *liber naturae*, which operates according to the secondary causes which God created and continues to sustain. It is precisely this order which is the object of natural philosophy in general and of physics in particular when it seeks to understand interactions between bodies and chains of causes and effects. Physics is thus intimately connected to the understanding of God's general providential action.

God is, however, also free to introduce change into or impose impediments upon this order: these are the special actions of providence which are revealed only in the Bible.⁹⁴ Heerbrand's examples of such special actions include the parting of the Red Sea (Ex. 14.22), the stopping of the sun to help Joshua (Josh. 10.13), the fire in the furnace of Babylon which did not burn (Dan 3.24-27), and, most importantly, God's salvific action through the

exaltatus est, omnibus, omnibus, DOMINO dante, planum faciemus, quae nobis & fidem & doctrinam de Coena Domini apertissime contra infelicem superiorum annorum disceptationem confirmabit.

Quare non est, vt de pia animorum consensione & reconciliatione in Religione desperemus, si modo omnibus positis peruersis praeiudicijs, & opinionibus conceptis, soli veritati addicti, nos Deo & verbo filius reuelato, humiliter subijcientes, νόημα ἡμῶν in obsequium Chrisit captiuum ducamus].

⁹⁴ J. Heerbrand, *Compendium theologiae*, p. 131: *Quid praeterea ad creationem pertinet? Rerum conseruatio, gunernatio & sustentatio. Non enim Deus diseossit a suo opificio, sicut faber discedit a domo, aut nauis a se extracta, eam postea fortunae committens: sed perpetuo adest, gubernat, conseruat, & sustentat naturas a se conditas. Idque liberrime non alligatus causis secundis, quas potest pro sua liberrima voluntate mutare, promouere, impedire: iuxta illud Psal. 131. Deus autem noster omnia quaecunq;e voluit, fecit, in coelo & in terra.*

Church.⁹⁵ His belief that the Bible reveals God's overriding of secondary causes forces Heerbrand to argue for the limitations of all philosophy: philosophers may, and often do, understand very well how the world normally works, according to the secondary causes which God has set up; philosophy can support biblical testimony, as when it provides proofs of God's existence. But because God can be seen to have acted in special ways in the past, philosophers must be prepared to bow to the witness of the Bible and yield to its authority when it conflicts with their own theories.

Although Heerbrand has his reservations about the value of such philosophical views as counter or contradict the scriptures, he is keen to harness those which support his biblical interpretation of the natural world as the expression of God's care for humankind, and use them to extend his understanding of how God works in the world. Thus, he explains in his sermon on the comet of 1577 that 'the learned' - for which read, in this case, Aristotle - teach that comets are formed by the coagulation of the emissions of the earth below the lunar sphere and the subsequent ignition of these.⁹⁶ In the same way, he explains, the comet may be seen as a symbol of the sins of the people on earth which rise like evil vapours to God, who ignites them as a warning when he has had enough.⁹⁷ Heerbrand's use of

⁹⁵ *Ibid.*, pp. 17-18.

⁹⁶ Aristotle, *Meteorologia*, 344a5-345a10 (bk. 1 ch. 6).

⁹⁷ J. Heerbrand, *Ein Predig von dem newen Cometen*, pp. 4-5: *Es halten die Gelehrten gemeinlich / daß die Cometen herkommen vnd entstehn von den Dämpffen der Erden / wölche von dem Gestirn deß Himmels hinauff in die Luft gezogen / vnd alda von der Hitz vnd bewegung angezündt werden / vnd also ein Brunst daroben vnder dem Himmel seien.*

Also seind auch die Sünden der Menschen / so auff Erden wohnen / ein stinckender Dampf vnd Rauch / der obersich steigt für Gott / wie dann auch die heilig Schrift / vnd Gott der Herr selber also dauon redet: Die stimme deines Bruders Abels Blut / schreyet zu mir von der Erden [Gen 4]. Vnnd abermals: Das geschrey zu Sodoma vnd Gomorrha ist groß / vnd ist für mich kommen / &c [Gen 18] vnnnd verursachen / reitzen vnd zünden seinen Zorn an / daß er entbrennet / wie ein Fewr / vnd laßt sich sehen vnd mercken durch diß eusserlich vnd sichtbar Zeichen / wölches da ist gleich als ein Rütten (wie es dann auch einer Rütten vnnnd Bässem gleich sihet) daß er vorhanden sey / vnnnd die Welt vmb jhrer Sünden willen zuschwingen vorhabe.

Aristotle's physical explanation allows him to see the comet almost as a sacrament, in that it is a physical sign of the spiritual state of human sinfulness, which has reached a point which calls for urgent action. He even finds a biblical justification for this interpretation in references to Abel's blood crying from the ground [Gen. 4. 10] and the sins of Sodom and Gomorrah calling to God [Gen. 18.20].

Heerbrand's appreciation of the place of natural philosophy may also be seen in a disputation *De magia*, held on December 15th, 1569.⁹⁸ Here he is concerned to explain the difference between natural magic, by which he means the study of nature, and illicit magic, or superstition.⁹⁹ The practitioners of the former are 'dedicated to the study of the doctrines of God, the motions of the celestial bodies and of natural things;' through natural philosophy they seek to understand the mysteries, properties, and qualities of nature which may be found through the exercise of the mind. This is what is called natural magic. It produces ideas, such as those of the Greek philosophers, which are rightly used to educate boys, for natural magic leads to the best knowledge of God which can be gleaned by the post-lapsarian human mind from contemplation of the natural world without the aid of revelation.¹⁰⁰ The common usage of the word magic to refer to 'sophists and

⁹⁸ The year is not given, but since the disputation was printed in 1570 it was presumably held the previous year.

⁹⁹ For the equivalent distinction in Melancthon's thought, see p. 60 above.

¹⁰⁰ J. Heerbrand, *De magia*, p. 1: *Propositio prima. Magorum nomen honestissimum fuit apud Persas. Hoc enim illis tribuebatur, qui doctrinarum studijs de Deo, motibus corporum coelestium, ac rerum naturalium erant dediti, & excellabant (sicut apud Graecos Philosophi) quibus etiam Regij pueri educandi tradebantur.*

2. *Hi quia naturae secreta altius rimantur, & naturalem Philosophiam inquirent, abdita illius mysteria, qualitates, proprietates, & totam rerum naturam, quantum quidem acie mentis, & ingenij humani fieri potest, scrutantes, ac penitius introsipientes, admiranda efficiunt opera, humanum captum fere excedentia, quae naturalis Magia dicitur.*

3. *Haec Professio Magorum laude fuit dignissima, quod cognitio illa, dux est ad Dei agnitionem, talem, qualem mens humana post lapsum extra verbum Dei reuelatum, ex naturae contemplatione concipere potest.*

tyrants' and to those who do evil in general should not be allowed to disguise the positive possibilities contained in natural magic.¹⁰¹ On the other hand, evil magicians do also exist. They are those who have entered into a pact with the devil and exercise prohibited arts, calling on demons and generally acting against the word of God and natural law. They are testified to throughout both sacred and profane literature.¹⁰² Bad magic comes in many different forms, which are all equally deserving of horror and abomination.¹⁰³ Heerbrand defines a division between natural and evil magic in the same way as Melanchthon differentiated between astrology and superstition: the kind of magic which 'has no causes in natural things or the word of God' is superstitious, vain and sacrilegious.¹⁰⁴ For example, although magicians may appear to have healed by using the powers of demonic magic, such as incantations, demons can never actually heal. Such cures, whether of people or cattle, are really effected through knowledge of the properties of herbs and other natural powers.¹⁰⁵ Heerbrand's point is that

¹⁰¹ *Ibid.*, p. 2: 4. *Verum vt fieri consuevit in plaerisque alijs quoque rebus, vt homines ijs non contenti, latius euagentur, & mala quaedam affuant, vnde ipsae quoque res male audiant, & vocabula reddantur odiosa: idem his quoque honestissimis accidit studijs, & Professioni Magiae.*

5. *Hinc factum est, vt & Magorum, & ipsius Magiae vocabulum, sicut Sophista, Tyrannus, & id genus alia, infame sit, & malam in partem accipiatur.*

¹⁰² *Ibid.*: 6. *Magi enim dicuntur, qui pacta cum Diabolis facientes, ab ipsis, vel ex libris, illicitas & interdictas artes (vt ita loquar) discunt, certis characteribus, exorcismis, concepta verborum qualiumcunque forma, additis certis ritibus, daemonia euocantes, vt aliquo modo respondeant, vel faciant aliquid contra verbum Dei, aut naturae legem, vel ordinem in natura diuinitus institutum.*

7. *Hinc Magia, Professio illa, vsus & exercitium Diabolarum istarum illicitarum, & prohibitarum rerum vel artium.*

8. *Esse autem tales, sacrae & prophanae literae, tum etiam ipsa rerum experientia, proh dolor, plus satis testantur.*

¹⁰³ *Ibid.*, p. 3: 11. *Multae praeterea sunt & fuerunt Magiae species, sicut varia extant cum in sacra Scriptura, tum apud prophanos authores nomina & vocabula illarum prohibitarum artium impiarum, quae aliqua ex parte, Dei beneficio, apud Christianos interciderunt.*

12. *Haec Magia non vnum tantum in se, aut simplex continet peccatum, sed multa, eademque horrenda & abominanda.*

¹⁰⁴ *Ibid.*, p. 8: 49. *Quae cum causas in rerum natura & verbo Dei nullas habeant, superstitiosa, vana, impia, adeoque sacrilega esse, sciendum est.*

¹⁰⁵ *Ibid.*, pp. 4-5: 21. *Quod vero curationes istas per exorcismos & incantationes institutas, effectus quandoque sequitur, mirum videri nemini debet.*

transubstantiation, together with certain rites, including the blessing of water and the anointing of the sick, which were understood as sacraments by the Roman Church, are actually 'impious and blasphemous magic' because they neither have a natural cause nor are divinely ordained,¹⁰⁶ and his direct intention in this disputation is not to encourage the study of natural philosophy. Nevertheless, by associating the positive properties of natural magic with the study of natural philosophy, he displays at the very least an open attitude towards this study, and seems to be encouraging, if tacitly, the study of the natural world.

Heerbrand's association of natural philosophy with the *liber naturae* and his encouragement of the study of the natural world should not be allowed to obscure the fact that he regarded philosophy of all kinds as subordinate to

22. *Nam Daemones, vt Tertullian inquit, dum affligere cessant, curasse videntur.*

23. *Neque tamen interim negauerim, aliquando Diabolos vere curare homines & iumenta.*

24. *Notas siquidem habeant & cognitatas herbarum, & aliarum rerum naturalium vires.*

25. *Quam ad rem non indiget characteribus, aut exorcismis illis Magorum, sed naturalia sunt, ex quibus etiam sine verborum istorum prolatione effectus sequitur erat.*

Although the Latin refers to 'exorcisms', I have used 'incantations', as it is clear from other parts of Heerbrand's argument that not all exorcisms are necessarily evil. Indeed, there are many biblical examples of Jesus's casting out devils, and hence exorcising, although Heerbrand does not refer to these. Luther defended the use of exorcism, although he did not believe it necessary to exorcise children before baptism, as had been the medieval practice [W Nagel, 'Exorzismus II', pp. 753-754.

For a useful discussion of the differences between natural magic and superstition, see S. Clarke, 'The Rational Witchfinder'.

¹⁰⁶ *Ibid.*, pp. 13-16, theses 82-79, especially: 83. *Certis enim & conceptis verbis, certis ritibus, certis carminibus, certis characteribus, & crucibus plurimis, & sic vere Magice, atque incantatione mera, tribuere se arbitrantur, atque nugantur rebus, quas hoc modo exorcisant, sine omni verbi diuini mandato, ordinatione, & institutione, nouas & supercoelestes vires, quas nec ex naturalibus causis, nec divina ordinatione habent.*

... 95. *Nam quod Apostolus ait: Sanctificari creaturas per Verbum Dei & Orationem [1 Tim 4.5], non de Magico isto Sacrificolorum exorcismo salis, aquae, olei, herbarum, cereorum, &c loquitur: sed de cibis, quos non vult prohiberi, quemadmodum Pontificij faciunt, quod Apostolus doctrinam Daemoniorum & Apostatarum appellat: verum pios ijs vti secundum verbum Dei, quo in cibum concessit ea omnia, cum precibus & gratiarum actione, quibus ad vitae sustentationem consecrantur, vt eorum vsus fiat licitus & concessus.*

... 97. *Cum igitur horrendus sit abusus Nominis & Verbi Dei in exorcismis, & incantatione Magorum & Sacrificolorum Pontificiorum, ideo Magica haec, abominationem in conspectu Dei esse sciendum est.*

Heerbrand's intention is polemical against the Catholics, but there were problems in distinguishing between magic and religion within Catholicism too [R. W. Scribner, *Popular Culture and Popular Movements in Reformation Germany*, pp. 17-47].

the authority of scripture. However, such a subordination was common to virtually all sixteenth-century thinkers, including philosophers themselves. Despite this qualification, it cannot be denied that Heerbrand's theology offers a definite place for the study of the natural world through his understanding that God's general providential action is revealed in the normal course of the world and that a better understanding of this will lead to a better understanding of God as creator and sustainer of the world. Moreover, Heerbrand's adoption of the term *liber naturae* to describe the source of such knowledge of the natural world has two important consequences. Firstly, it removes the natural world and its study from the arena of the law, with the ambiguous, largely negative connotations it held for Lutherans, and places it firmly alongside the scriptures as a source of revelation. Secondly, Heerbrand opens the way to the possibility that the natural world may be treated as a 'text' which can, and should, be read for a correct interpretation, an appealing approach since the problem of the correct interpretation of texts lay at the centre of the humanist movement, and the question of the correct interpretation of the Bible was fundamental to the Lutheran Reformation. Heerbrand himself considers biblical interpretation at some length in two disputations held in 1582 and 1591.¹⁰⁷ He understands a 'correct' biblical interpretation to be one which reveals the 'unique, true, certain, and perpetual meaning' of the text.¹⁰⁸ This is only

¹⁰⁷ J. Heerbrand, *De scripturae sacrosanctae interpretatione* and J Heerbrand, *De scripturae sacrae interpretatione*.

¹⁰⁸ J. Heerbrand, *De scripturae sacrosanctae interpretatione*, fol. Aii^r-v: 2. [*Sacrae Scripturae*] *unica, vera, certa, & perpetua est sententia, quam literalem, historicam, vel Grammaticam vocant, ea nempe, quam ipsa verba in propria sua significatione suppeditant & subministrant.*

3. *Vnde grauissime peccauit Origenes, eumque secuti, quod hac fere neglecta, in Allegorias omnia propemodum conuertit, doctrinamque & Religionem Christianam, ludibrio Ethnicis exposuit.*

4. *Multo vero horribilius peccauerunt, qui quatuor Scripturae S. S. sensus sunt commenti: Historicum, Allegoricum, Anagogicum, & Tropologicum vt nihil fere amplius in ea syncerum, aut integrum remanserit. Sed cuius licuerit ex quouis quiduis fingere, & ita cum*

possible with knowledge of the language in which the scriptures were originally written.¹⁰⁹ The writings of the church fathers may be used to understand the scriptures, but care must be taken since scripture is infallible, but the fathers certainly (and by their own admission) are not.¹¹⁰ Obscure passages of scripture are to be explained by references to other scriptural passages,¹¹¹ or by the analogy of faith, by which Heerbrand means an

Scriptura S. ludere, eamque discerpere, quemadmodum Catelli lacinias, aut Leporis exuuias, & pellem.

5. *Haec non praepostera tantum est sapientia, aut stulticia potius, sed impietas maxima. Oracula scilicet Spiritus sancti & verba Dei, nobis ad salutem in Scriptura S. proposita, ita peruertere, inque varios detorquere sensus, quos illi homines ociosi, & stolidi affixerunt.*

¹⁰⁹ J. Heerbrand, *De scripturae sacrae interpretatione*, pp. 6-7: 40. *Tum vero facta quadam familiaritate cum ipsa lingua Diuinarum Scripturarum, in ea, quae obscura sunt aperienda & discutienda, pergendum est, vt ad obscuriores locutiones illustrandas, de manifestioribus sumantur exempla, & quaedam certarum sententiarum testimonia, dubitationem de incertis auferant.*

41. *Obscuritas autem oritur & occurrit vel ex phrasi, lingua, & genere sermonis, propter ignotam linguam & peregrinam phrasin, qua libri sacri scripti sunt: vel ex sententia ipsa perplexiori.*

42. *Sicut idem Augustinus ibid.em loquitur, in haec verba scribens: Duabus autem causis non intelliguntur, qua scripta sunt, si aut ignotis aut ambiguis signis obtegantur, (signa autem vocat vocabula).*

43. *Sunt autem signa propria vel translata. Propria dicuntur, cum his rebus significandis adhibentur, propter quas sunt instituta: vt cum dicimus bouem, intelligimus pecus, quod omnes nobiscum Latinae linguae homines hoc nomine vocant.*

44. *Translata sunt, cum & ipsae res, quas proprijs verbis significamus, ad aliud aliquid significandum vsurpantur, vt cum dicimus bouem, intelligimus pecus: sed per illud pecus rursus intelligimus Euangelistam.*

45. *Contra ignota signa propria, magnum remedium est linguarum cognitio. Et Latinae quidem linguae homines (quos nunc instruendos suscipimus) & duabus alijs ad Scripturarum diuinarum cognitionem habent opus; Hebraea scilicet & Graeca, vt ad exemplaria praecedentia recurratur, si quam dubitationem attulerit Latinorum interpretum infinita varietas.*

46. *Et idem ibid.em iterum: Quis interpretus vera locutus sit, nisi exemplaria linguae praecedentis legantur, incertum est.*

47. *Hinc & a veteribus inter Canones haec Augustini relata est sententia: Vt veterum librorum fides de Hebraeis voluminibus examinanda est: ita nouorum veritas graeci sermonis normam desiderat.*

48. *Quod si ergo phrasis obscuritatem pariat, cognita phrasi linguae peregrinae, puta Hebraeae vel Graecae, sententia sit manifesta.*

¹¹⁰ J. Heerbrand, *De scripturae sacrosanctae interpretatione*, fol. C^r: 55. *Quare impium est, quod nos a Scriptura ipsa, quae oraculum est Spiritus S. ad humanas & incertas ablegant interpretationes.*

56. *Negari enim non potest, quia in omnibus propemodum veteribus Patribus, nonnulli errores & interpretationes cum Scriptura Sacra pugnantes iuueniantur.*

57. *Sicut Irenaeus Chiliarum errorem probauit. Tertulianus Montani haeresin, quae & in ipso est damnata. Cyprianus ab haereticis baptizatos, rebaptizandos decreuit in suo concilio Nationali siue Provinciali, qui est Donatistarum error. Hieronymus secundas nuptias improbauit, fornicationi conferens. Augustinus totos libros Retractionum scripsit.*

¹¹¹ J. Heerbrand, *De scripturae sacrae interpretatione*, pp. 11-12: 74. *Est autem Scriptura per Scripturam interpretanda, sicut Apostolus monet: Prophetiam analogam fidei esse debere, vt etiam Patres ipsi senserunt & docuerunt.*

appeal to the Lutheran principle of justification by faith.¹¹² These principles preserve those of humanist scholarship: a return to the original text, in the original language, to provide a reading which is based on that text and not on the writings of other, perhaps less informed 'authorities'. The measure of faith provides the ultimate test of an interpretation.

Heerbrand's understanding of the natural world as a separate source of revelation may, in part, arise from the wish to avoid an ambiguity in Melancthon's application of philosophy in a theology which is meant to be based upon the principle of *sola scriptura*. This can best be seen through the example of the eight proofs of the existence of God cited by both Heerbrand and Melancthon, which Heerbrand attributes to the *liber naturae*. Melancthon uses these proofs without any qualification or apparent hesitation, although it must have been clear to him that they are all taken from natural or moral philosophy and that none has a biblical basis. If pressed he would presumably have explained that such arguments from

75. *Omnis autem quaestio non per aliud, quod quaeritur, habebit resolutionem, nec ambiguitas per aliam ambiguitatem soluetur apud eos, qui sensum habent, aut aenigmata per aliud maius aenigma. Sed ea quae sunt talia, ex manifestis & consonantibus, & claris accipiunt absolutiones [Iren. lib.2. cap.10].*

Et idem: Quoniam ostensiones, quae sunt in Scripturis, non possunt ostendi nisi ex Scripturis [Idem lib. 3. cap. 12].

... 79. *Ideo autem Scripturam per Scripturam interpretandam esse asserimus: nam idem est Spiritus S. quo edita sunt oracula diuina.*

¹¹² *Ibid.*, p. 5: 32. *Etsi autem multa de profunditate, difficultate & obscuritate Scripturae sacrae a multis dicantur, propter res a ratione humana abstrusas & absconditas, quae in eis continentur: sciendum tamen est, sententiam eiusdem atque sensum doctrinae coelestis plerisque Christianis esse notum.*

... 34. *Quibus autem obscura sit Scriptura, Apostolus Paulus docet, 2. Cor. 4 scribens: Quod si adhuc velatum est Euangelium nostrum, in his, qui pereunt, velatum est: in quibus Deus huius seculi excaecauit sensus incredulorum, ne illusceret illis lumen Euangelij gloriae Christi.*

35. *Et ea ipsa illustrantur perpetuo Scripturae consensu, fidei Analogia, & observato Spiritus sancti scopo, facta collatione ad loca clariora. Sicut etiam Augustinus docet.*

See also p. 15: 99. *Sic reliqua plurima in Scriptura S. loca de operibus eorumque iustitia, adeoque alia omnia, quae difficultatem aliquam habent, secundum analogiam fidei sunt interpretanda, ne cum fundamento, articulis fidei, & praecipuis capitibus doctrinae Christianae pugnent.*

100. *Sicut Apostolus monet [Rom 12]: Scripturae Prophetiam, hoc est interpretationem, analogiam esse debere fidei, nempe de Christo: & hoc vult; vt explicatio consentiat cum doctrina coelesti de Christo. Hic enim totius Scripturae sacrae scopus est.*

natural law could be assumed to be implicit in the Bible, even if they were not explicitly stated. But Melancthon's attitude towards law was, as has been noted above, more favourable than Heerbrand's. Moreover, several of these arguments for the existence of God fall right outside anything that could be seen as a literal interpretation of scripture, and Heerbrand regarded the literal interpretation of the 'unique, true, certain, and perpetual meaning of the scriptures' as the only valid interpretation of the Bible. In general, too, he regarded Augustine as the best authority on scriptural interpretation (despite his recognition that Augustine, like all the Fathers, could make mistakes of interpretation), and Augustine was the originator of the parallel between the *liber naturae* and the *liber scripturae*. In Augustine's distinction between the *liber naturae* and the *liber scripturae*, Heerbrand had an ancient authority for a reading which allowed him to distinguish between biblical and philosophical arguments while preserving a possible revelatory capacity for the latter. The authority of knowledge drawn from the natural world is in this way made parallel, if subordinate, to that of knowledge drawn from the Bible, seen by all Protestants as the only true authority for faith. Heerbrand thus ascribes to knowledge gained from the natural world a positive authority which may of itself aid human understanding of God. This authority is shown in a strikingly visual way in the Latin and Greek translations of Heerbrand's and Andreae's sermons which were included by Crusius in his collection of sermons for the church year. Crusius cites in the margin biblical references which support the point being made by the preacher. For Heerbrand's sermon on Jonah 3 they read: 'Genesis 6; 2 Peter 2; Genesis 19; Matthew 3, and through celestial portents.'¹¹³

¹¹³ M. Crusius (ed), *Corona Anni*, 1, p. 26: ... *et per prodigiosa coelestia*. There are similar references for Heerbrand's sermon on the 1577-8 comet [pp. 22-24] and Andreae's sermon on Matthew 11 [pp. 31-34].

Heerbrand's explicit use of the parallel between the *liber naturae* and the *liber scripturae* to support the authority of knowledge gained from the natural world marks one of the earliest reappearances of this interpretation in post-Reformation theology,¹¹⁴ but it also represents the most sophisticated formulation of this theology which is to be found in sixteenth-century Tübingen. Although Hafenreffer purports to take it up in his *Loci theologici*, he fails to understand the significance of the distinction between the two books. Thus, while Heerbrand's arguments from the *liber naturae* are drawn from natural philosophy, Hafenreffer's 'proofs from nature' for the existence of God are actually based upon biblical texts, specifically Romans 1.20 and 2.15.¹¹⁵ Natural philosophy plays a much less important role in Hafenreffer's thought than it does in that of Heerbrand and Melanchthon.

It might have been expected that Tübingen's astronomers or natural philosophers would seize upon the term *liber naturae* to justify their work,

¹¹⁴ Luther refers to 'the whole of creation (as) the most beautiful book, or bible, in which God himself has described and pictured himself' [C. Link, *Schöpfung*, p.52], but he also believes that the *opera Dei* manifested in creation can only be truly known through the *verbum Dei* of the Bible [H. Olsson, *Schöpfung, Vernunft und Gesetz in Luthers Theologie*, pp. 437-438].

Melanchthon also refers to nature as a 'mirror or book, in which we can see God', but he does not draw the parallel between the *liber naturae* and the *liber scripturae* as Heerbrand does [P. Melanchthon, *Initia doctrinae physicae*, CR 13.198: *Hanc doctrinam de Deo mens humana circumferens, tanquam liber est et speculum monstrans Deum.*].

¹¹⁵ M. Hafenreffer, *Loci theologici*, pp. 2-3: *Quomodo probas esse Deum? Bifarium: 1. Ex libro naturae. 2. Ex Scriptura sacra.*

Quomodo probas ex natura: I Ex ipsis creaturis, Nam hunc mundum non temere extitisse, sed propter ordinem & admirandum veritatem rerum, a sapientissimo & potentissimo quodam Architecto productum esse, facile omnibus patet.

Rom 1.20 Inuisibilia Dei e creatione mundi per ea, quae facta sunt, intellecta conspiciuntur, sempiterna quoque eius potentia & diuinitas: Ita vt (Gentes) inexcusabiles.

II Ex hominum, tam malorum quam bonorum, conscientijs. Quia boni recte factorum testimonijs gaudent: mali vero (etsi nullam hominum vlticem vim metuant) scelerem conscientijs tacite misereque torquentur.

Rom 2.15 Ostendunt opus legis (diuinae) scriptum in cordibus suis, testimonium reddente illis conscientia, & inter se inuicem cogitationum accusantium, aut etiam defendentium.

Ex communi omnium Gentium & populorum testimonio. Nam nulla vsquam gens, tam fera est & barbara, cuius mentem non aliqua Deorum imbuet opinio: & quae non, licet ignoret, qualem Deum habere deceat, tamen habendum sciat.

but in fact it does not appear in the works of either Maestlin or Liebler. Liebler refers his theological justification of the study of the natural world to his understanding that there is one law which shapes both nature and society, which human intellects should strive to understand.¹¹⁶ This law was put in place by God, and despite the fall, the natural world retains aspects of the 'original, pristine wisdom which was given to our first parents' and which shaped the world; God can certainly be known through the contemplation of nature.¹¹⁷ However, although Liebler is convinced that such 'contemplation' should involve not only the diligent teaching and faithful transmission of the writings of the ancient Latin and Greek philosophers, but also an accurate explanation of all the parts of philosophy,¹¹⁸ he does not advocate abandoning these authorities.¹¹⁹ It is by applying the philosophy of Plato or of Aristotle that it is possible to recognise the attributes of the mind which has created the world.¹²⁰ This *mens* is God; who has shaped all things. Planer too believes that *mens* is the principle of principles, by which

116 G. Liebler, *Epitome philosophiae naturalis* (1589), preface, unnumbered folios α6^v-α7^v.

117 *Ibid.*, fol. β^v-β3^r, especially fol. β2^v: *Has tantas res, aliasque multas cum complectatur Physica, nequaquam aspernenda est, sed diligenter ad cultum animi & pietatem cognoscenda. Nec propterea omnino est abijcienda, quod non omnium rerum manifestas, firmas & certas causas proponat: sed hae qualescunque reliquiae pristinae sapientiae, qua primi parentes nostri a Deo erant ornati, diligenter asseruandae, & in magno honore sunt habendae: donec hac peccatrice carne exuti, non per creaturas Creatorem, sed in Creatore creaturas cognoscere ualeamus.*

118 *Ibid.*, fol. β3^r: *Quae in Academiam nostram ceu caput respiciunt: in qua, quod in alijs inchoatum est, perficitur: & summa professorum diligentia & sedulitate non solum Latinae & Graecae linguae authores artesque dicendi fidelissime traduntur, sed omnes philosophiae partes accurate explicantur.*

119 Liebler's philosophy will be discussed in greater detail in the next chapter.

120 G. Liebler, *Epitome philosophiae naturalis* (1589), fol. β^r: *Ita enim Plato a physicis motionibus ad inquisitionem diuinae essentiae peruenit: & Aristoteles in Physicis a motu ad motorem usque primum, primamque omnium rerum causam ascendit. Series enim causarum & ordo naturae immutabilis, & certissimae motuum leges manifeste conuincunt nos, vt cogamur statuere, esse aliquam mentem simplicissimam, aeternam, infinitae potentiae, sapientiae & bonitatis, φιλόσοφον καὶ φιλασθητόν vt suavissime inquit Xenophon, a qua haec omnia dependeant & gubernentur.*

knowledge may be known,¹²¹ but he makes no link between human and divine *mens*, and does not, therefore, apply this idea to God.

Such philosophical considerations make virtually no appearance in Maestlin's discussions of the study of the heavens. Although Maestlin himself does not use the metaphor of the natural world as the *liber naturae*, he does interpret the scriptures as a call to their readers not only to study the words of the Bible itself, but to observe the objects and phenomena which have been created by God and commended to humankind. Like Liebler, Maestlin believes that the world is shaped by the wisdom of God, and he draws explicitly on the wisdom tradition of the Old Testament in his theological justification for the study of the natural world, making many references to the apocryphal book of Sirach, or the Wisdom of Solomon, and also drawing on Job, Proverbs and the wisdom Psalms.¹²² The wisdom tradition teaches that God's wisdom permeates the created world and links the creation to a proper understanding of God. Maestlin's use of this tradition to justify the study of the of nature allows him to explain how it is

121 A. Planer, *Scientia demonstrandi*, pp. 32-33: *Quid ergo sentis de prima opinione? Constituit illa opinio nihil sciri, nisi quod demsonstratione sciatur, & propterea nullam principiorum esse scientiam. Sed Aristoteles contradicit: Nos (inquit) sentimus & affirmamus, non omnem scientiam esse apodicticam, & talem, quae demonstratione & medio cognoscatur, sed illam noticiam, qua principia & ἀμεσοὶ προτάσεις cognoscuntur, esse ἀναπόδεικτον & indemonstrabilem. Nam quod hoc necessario statuendum sit, inde perspici potest: Si enim necesse est sciri priora, & ea ex quibus conficitur demonstratio (quoniam incognita & ignota ad probandum conclusum adhiberi non possunt), & in illis immediatis principijs substistimus, vitantes sic infinitatem, qua scientiae aduersatur, neque aliquod illorum medium, rationem, & causam, adeoque aliam demonstrationem in medium adferre licet: ex necessitate profecto haec ipsa principia erunt ἀναπόδεικτα & indemonstrabilia. Neque solum ἀναπόδεικτον aliquam rerum scientiam ponimus, sed insuper statuimus etiam esse ἀρχὴν τῆ ἐπιστήμης, id est, principium scientiae, quo τοὺς ὅρους, ipsos simplices terminos apprehendimus & intelligimus: id autem principium τὸν νοῦν esse, in fine libri secundi posteriorum analyticaorum docet Aristoteles, secuti idem etiam lib. 6. Ethic. affirmat mentem esse principium, non solum primorum, sed etiam τῶν ἐσχάτων, extremorum. Et sic mens est principium principiorum, primum & simplicissimum principium, quo quaeuis alia principia in scientijs & disciplinis intelligimus & constituimus.*

See also *ibid.*, pp. 597-599.

122 This is true of all Maestlin's prefaces in which his theological discussions appear, but it is particularly clear from the preface to his textbook, the *Epitome astronomiae*. Sadly his sermons, which might have given a more detailed understanding of his theology, seem to have disappeared.

that this study can lead to knowledge of God without having to turn to Platonic philosophy or to adopt explicitly Heerbrand's use of the *liber naturae*. Because God's wisdom is the creative force which shaped creation, it can be accessed through a proper study of that creation. Thus, Maestlin argues, citing Romans 1.20, Psalm 19.1 and Isaiah 49.18 in his support, since creation reveals God, and especially since the particular certainty of astronomical knowledge is a gift from God, it is the duty of human beings to consider not only the natural world as a whole but 'the causes of the stars' and to accept the information of their own eyes.¹²³ Of these observations and investigations, those of the celestial bodies are among the most important and yield clear information about God because they document the greatness of God and the divine traces which God has left in the universe.¹²⁴ This means that the heavens yield particularly precise knowledge of God, and more precisely the movements of the stars can be observed, the better the knowledge of God's great works and of providence that will result.¹²⁵ For

¹²³ M. Maestlin, *Comet 1580*, fol. A2^r-v: *Idcirco vel maxime huc referendum erit Platonis dictum, quod si alibi grata, certe in astrorum scientia gratissima de Deo fama audiatur, & eam ob causam astrorum consideratio adeo aliena ab homine esse non debeat, vt absque crimine eam negligere non possit, quippe, qui propter astra contemplanda oculos acciperit. Haec a veritate non declinare sacrae literae testantur, D. enim Apostulus eis astipulatur, dicens: quod ex visibilibus his, quae Dei inuisibilia sunt, cognouerint [Rom 1]. Consentint & Psalter: Coeli enarrant gloriam tuam & opera manuum tuarum annunciat firmamentum [Ps 19]. Sic Isaias, levate in excelsum oculos vestros, & videte quis creavit haec, qui educit in numero militiam eorum, & omnes ex nomine vocat, prae multitudine fortitudinis & roboris, virtutisque eius, neque vnum reliquum fuit [Isa. 49].*

¹²⁴ *Ibid.*, fol. A2^r: *Memorable est quod Plato de artibus dixit: Gratam Dei famam audiri in artibus. Quo omnes homines, maxime vero, qui literarum studijs incumbunt, officij sui admonere voluit, vt meminerint, se diuinitus non at torporem & ignauum ocium, nec terrenis tantum inhaerendo, ad fodiendum & volutandum coenum, quod porcorum est, procreatos esse, sed secum reputent, sicut omnia propter hominem, ita se homines propter Deum, vt Stoici dixerunt, natos esse, officij igitur sui partes exigere, vt quae creatoris sunt, celebrare scilicet & laudare nomen eius in operibus suis (hoc enim unicum Deo reddere possunt) quaerant, inuestigant & reddant. Etsi autem diuina maiestas, omnipotentia, & bonitas in omnibus artibus, & in omnibus naturae operibus, minutissimis etiam quibus vis elucescat, & quaesita inueniatur: multis tamen partibus, quod supra nos est corpus coeleste, & astrorum scientia, in hoc genere caetera omnia excellunt. Etenim si vllibi illustria & magna cernuntur diuinitatis documenta & vestigia: in his profectao clarissima & maxime demonstrantur.*

¹²⁵ M. Maestlin, *Epitome astronomiae*, fol. *6^v: *Quis ergo hanc astrorum scientiam non maximo haberet precio, cum astra fabricata esse videat singulari Dei providentia, ad amplianda magnifica Dei opera, quibus scrutando nunquam satiari possumus, siquidem multo his maiora sunt abscondita [Sir 43]? Attamen quae creata sunt omnia, dat pie agentibus cognoscenda.*

Maestlin the most important aspect of this study is that it should include a careful study of what is really happening in the natural world, for this will yield a better knowledge of God. There are not only biblical precedents for this, for Plato recommended that God be sought through the medium of the arts and also the Stoics believed that all creatures should celebrate and praise their maker by investigating and observing God's works.

To this study Maestlin brings the principles of textual interpretation as laid down by Heerbrand. The 'text' which is the subject of this study comprises natural events such as wind, rain or hail, the human body, and, of course, the heavens. Maestlin believes that when natural phenomena are properly understood, they may be seen to extol God's sanctity, justice, omnipotence and mercy (as described in Sirach 43);¹²⁶ similarly medicine may yield important insights into God's caring nature because of its appeal to anatomy, which is a wonderful testimony of God since the human body was designed by God, who watches over and guides the growth of each baby in the mother's womb.¹²⁷ Astronomy, however, is most important of all, for it yields the most exact and perfect knowledge of God. In preparation for this study of the natural world, it is necessary to learn the language in which the book is 'written'. Although Maestlin, unlike Melanchthon, never cites the Platonic 'God always geometrises,' he is clear that the 'language' needed for the interpretation of the heavens is mathematics, and in particular geometry,

¹²⁶ *Ibid.*, fol. *3^v-*4^r: *Hanc ob causam haec ipsa studia passim tota Scriptura sacra creberrime non modo verbis nudis egregie commendat, sed & obiecta eorum velut speculum, quibus ipsum rerum opificem intentis oculis intueamur, proponit & monstrat. Quot quaeso augmentis libro lobi, dum sanctitatem, iustitiam, omnipotentiam et clementiam Dei extollit, tota Philosophia naturalis, siquidem integer ille liber fere totus in eo est, vt naturas rerum, animalium, ventorum, pluuiarum, grandinum, tonitruum, corporum coelestium, stellarum &c commemorat, commendatur? Hoc idem apud Syracidem potissimum cap 43 sit.*

¹²⁷ *Ibid.*, page 5: *Non minus praeclare tam anatomia, quam formatio hominis in vtero materno per admirandam providentiam & gubernationem Dei [Ps 139], item per fragilitatem hominis [Sap 7] insinuat? ita Medicina apud Syracidem (Sir 38) & Isaiam (Isa 38).*

which shaped the heavens from the beginning. Mathematical principles and reasoning must be brought to bear if any sense is to be made of what has been observed.¹²⁸ Thus, Maestlin argues, in order to appreciate the revelation of God seen in the comet of 1580, it is not enough to approach it through the medium of astrological precepts which allow it to be defined according to the causes of physics: rather, it is necessary to understand the comet in terms of its subjection to astronomical laws.¹²⁹ But although scripture exhorts human beings to study the heavens, the fundamental principles, or hypotheses, of astronomy cannot actually be found in scripture. They have to be derived from mathematics and physics, which can inform the human mind, which has been created in the image of God.¹³⁰

As a trained Lutheran theologian and pastor, Maestlin turns to the Bible in search of a theological justification and explanation of his work, which leads him to assert, not just that the practice of astronomy is desired by God, but

¹²⁸ M. Maestlin, *Iudicium de opere astronomico D. Frischlini*, fol. 9^{r-v}: *Cum Astronomia orbis illos suos nequaquam per Geometriam in coelum deportet, sed in coelo eos inueniat, inuentos vero per Geometriam demum examinaret, atque cognitioni mentis subijciat. Coelum inde a prima creatione, suas certas partes, sicut et stellas, sortitum est, in quas et distributum utique manet, etsi nemo hominum ullius Geometriae cognitionem haberet. Quoniam ergo coeleste corpus simplicissimum, et perfectissimum et rotundum, sicut physici ex proprijs fundamentis docent, quomodo ipso aliena erunt illa principia, si se: Astronomia coeli figuram rotundam, coelique motum rotundum, quae qualitates continuae sunt, examinat, et cognitioni mentis subdit, atque metitur per quantitatum illarum propriam scientiam, quae est Geometria; easque secundum partes, prout quantitates continuae partem extra partem, siue aliam ab alia numero discretam atque separatam habent, per scientiam huic rei propriam, numeret?*

¹²⁹ M. Maestlin, *Comet 1580*, fol. A3^v: *Porro alterum illud, partim ab alijs iuxta Astrologorum praecepta tractatur, quatenus nimirum secundum Physicas causas de eo definiri potest, partim quod singulari diuinae providentiae reliquendum est: Alterum autem, quod magnitudinem prodigij astronomice excuminat, ego mihi etiam enucleandum proposui, motum videlicet, locum aliasque proprietates, sicut & in superiori Cometa feceram, quatenus astronomicis legibus astrictus est: vt ex eo gloria diuina melius elucescere possit.*

¹³⁰ M. Maestlin, *Epitome astronomiae*, fol. *6^v: *Quis non toto pectore eam amplecteretur, cum audiat scientiam eorum, vna cum vniuersis fundamentis suis tot oraculis diuinitus traditis nobis commendari & confirmari? Etenim si probe examinemus sacrum Codicem, haud difficile est ex eo omnium fundamentorum Astronomiae (quae hoc libro Hypotheses nominantur) veritatem euincere et obtinere, adeo vt si cunctis physicorum & Mathematicorum rationibus abstinendum foret, in his solis nihil vltra desiderari posset. Quod anne de alijs theoreticis scientijs similiter dici & probari possit, dubito. Sic igitur nihil, nisi plenior & magis exquisita tractatio, rationi humanae relicta videtur, quae tamen & ipsa ad Dei imaginem creata, vt hoc praestare possit, diuinitus admirandi sagacitate informata est.*

that astronomy involving the making of the best, in the sense of the most accurate, possible observations is the kind of astronomy which is called for in the Bible. It is no coincidence that this argument appears in the preface of a work devoted to disproving the Aristotelian theory of comets: Maestlin wishes to 'read' the heavens directly from the original, and to be allowed to contradict hitherto accepted authorities, and he is here seeking an authority for the making of exact observations which will allow him to make such contradictions. He finds it, as might be expected, in the Bible, the authority of which can always overrule that of the philosophers.

The context, and some of the content, of Maestlin's biblical justification is not unique to him. A strong conviction that God's purposes and intentions may be read from the course of the natural world is to be found also in Heerbrand's theology and in Liebler's understanding of the relationship between natural philosophy and theology. In theory Heerbrand's emphasis on the importance of the natural world as the *liber naturae* does not privilege the study of the heavens as Melanchthon had; in practice the common belief that comets were portents of misfortune forced theologians, even those, such as Andreae, who were suspicious of astrology, to offer an interpretation of such celestial phenomena in a way that would be consistent with their theology. Thus, in practice, the interpretation of celestial phenomena was also privileged by the theologians. As an astronomer, Maestlin had an understandable tendency to follow this lead, and to seek his own justification for his work in the Bible. As an astronomer, however, it was clear to Maestlin that he had to look beyond the Bible for the principles which would allow him to carry out the work to which he felt himself called. Similarly, he needed to look outside the Bible for a measure of the truth of the conclusions which he

would draw in the course of his work, since the theological yardstick of justification by faith, used by Heerbrand to judge the accuracy of his biblical interpretation, was obviously not appropriate to astronomy. In search of this measure, Maestlin, in common with other of his contemporaries, turned to philosophical, logical judgements of truth and authority. It is these which will be considered in the next chapter.

chapter four

astronomy, physics, and the authority of observation

Once the natural world is viewed as a 'text' which may be read and interpreted, certain issues of that interpretation are raised. These centre on the question of how the correct interpretation is to be established, and include the problem of how earlier interpretations, in the form of traditional writings on natural philosophy, are to be treated. It becomes necessary to ask whether the writings of Aristotle, in particular, of Plato, of Pliny, of Plutarch, and others should be considered as representing the truth about natural philosophy. Not all sixteenth-century scholars were prepared to raise this question, and those who were had to seek not only a theological, but also a philosophical justification for what they were doing. This chapter examines the attitude of Tübingen's professors, and in particular Michael Maestlin, to the teachings of Aristotle, and the ways in which they sought to ensure that their interpretation of the natural world could be argued to be the correct one. It therefore analyses their attitudes towards ancient authorities, their use of observational evidence, and the ways in which the truth and uniqueness of an interpretation could be established.

The use of older authorities and commentaries was a central issue in humanist interpretation. In the case of the interpretation of the natural world, these 'commentaries' take the form of earlier writings in natural philosophy, among which the most important were of course those of Aristotle. If the natural world is to be treated as a 'text' which must be read, the question of

determining the authority of different interpretations becomes urgent, and this immediately raises the question of the status of these earlier writings on the natural world. Heerbrand's understanding of the natural world as the 'Book of Nature' may have made it easier for a natural philosopher or an astronomer to question the ancient authorities, but the question of authority had, of course, already been raised. As has already been noted, Melanchthon subordinates actual observational evidence - that Mercury and Venus may be orbiting the sun - to received wisdom in the form of Aristotelian cosmology.¹ This apparent contradiction is by no means unique to Melanchthon, for, as Gilbert has noted,

there were few sixteenth-century authors who did not protest at one time or another their complete independence of authority. Most of these protests were then followed by a complete reliance on traditional philosophy and a conspicuous lack of original ideas.²

The widespread acceptance of this somewhat ambiguous attitude of apparent openness to originality but actually dependent upon traditional views, makes it even more remarkable that in the course of the sixteenth century observations began to be taken seriously by some people. It is, therefore, worth investigating contemporary attitudes towards authority and the reasons given for accepting or rejecting it.

The problem of interpretation was, of course, well-known to the Reformers, since Reformation debates hung almost entirely on questions of biblical interpretation. Heerbrand, as has been noted above, believed that there was a uniquely true interpretation of the scriptures which could be found by a careful reading of the text. When problems arise, the 'analogy of faith' should

¹ See above, pp. 79-80, 84-85. It would be useful to know whether he treats medical, anatomical evidence in the same way.

² N. W. Gilbert, *Renaissance Concepts of Method*, p.xxiii.

be used to decide the issue.³ For Heerbrand, the one true interpretation of the Bible can almost invariably be established directly from the text, although some kind of yardstick may in some cases be needed to clarify obscurities. Heerbrand is, however, also adamant that the truth as it is known from the Bible is not different to the truth as it is known elsewhere, so that there is one picture of the world into which all knowledge must fit. This is why philosophy may not be allowed to contradict the truth of the Bible, but it is also the reason why knowledge gained from the study of the natural world or the observation of society may be used to help people to understand God's will for the world. Heerbrand's worldview is one which does not admit contradictions. All events - indeed, whatever happens in the world - are a part of God's plan and are, therefore, essentially consistent with one another.

Melanchthon's attitude towards the truth is similar, and so it is possible for him to assume throughout his consideration of astronomy that the results of observations of the heavens will not contradict other 'truths' known from elsewhere. For Melanchthon, astronomical observations are self-explanatory and will yield conclusions which are part of a consistent God-given picture of the universe. Melanchthon does recognise that some interpretations deviate from this picture, but these, he seems to imply, are not part of the picture of truth (and thus should be taught only to more advanced students). The assumption that there is only one way of looking at the world, and that this way leads to a truth which is as knowable as God wants it to be, does not, however, address the question of how this truth can be established. For this it is necessary to turn to dialectics.

³ J. Heerbrand, *De scripturae sacrae interpretatione*, theses 35 and 100, pp. 5; 15.

Dialectics, according to Andreas Planer, professor of logic at Tübingen, is the art which offers the means of establishing truth and distinguishing it from falsity. He explains in an oration on this art that dialectics is not itself a type of knowledge or a discipline, but is a method or tool, necessary to all disciplines.⁴ Dialectics offers a means of judging whether a proposition is true or false, and a method by which this can be done is necessary in every branch of knowledge.⁵ Only one method is necessary for this, because, although there are many different kinds of knowledge, there is only one truth. Therefore, while law, medicine, theology or philosophy each has its particular knowledge, there is only one way or instrument of gaining that knowledge and knowing its truth, just as there is only one art of sailing, regardless of which part of the ocean a ship is on.⁶ Planer concedes that different disciplines and branches of knowledge may - and do - use different principles, definitions and types of proof. He argues, however, that while different methods are used within different disciplines, there is one method which is necessary to all these different methods.⁷ This is the art of

⁴ A. Planer, *Orationes tres*, p. 54: *Nulla namque est [Dialectica] scientia, nulla ars quae Methodo hac syllogistica carere possit: cum in singulis aliquid ex alio colligatur.*

⁵ *Ibid.*, pp. 45-46: *Cum ornatissimi Auditores, multae sint scientiae ac disciplinae rerum quarumque praestantissimarum, & hae ipsae, variae admodum, difficiles, arduae & abstrusae, quarum veritas difficilimos habeat explicatus, nisi sit via quaedam & ratio inuestigandi veri in profundo abditi, & regula praeterea sit quaedam iudicandi inuenta, verane ea sint, an falsa: non nimis certe confidendum videtur, nos scientiae posse compotes fieri.*

⁶ *Ibid.*, pp. 48-49: *Instrumenta vero tractandarum scientiarum, non vt ipsae scientiae multae sunt, multiplicia existunt, sed vnicum tantum inquirendi veri in omnibus artibus ac scientijs instrumentum est certissimum & absolutissimum, nec cuius scientiae suum quoddam proprium ac vernaculum. vt enim faber vnico instrumento, malleo securi, varia, eaque multum dissimilia, efformat opera, nec singulis efficiendis singula sunt accommodanda instrumenta: sic vno etiam instrumento veritatem rerum in scientijs inuestigare possumus: veritas enim ipsa, in omnibus rebus non nisi vna existit: quare eius etiam inquirendae vnicum tantum est instrumentum. Nec vt multis modis in errores & falsitatem inducimur, sic multis etiam modis & instrumentis veritatem rerum consequimur: falsitas quippe per se multiplex est, sed veritas, vt dixi, vna est naturam & conditionem essentiae cuiusque rei, quae vna etiam est, & semel, authore Aristotele, consequens. Proinde non Iurisperiti propriam, nec Medici vernaculam, nec Theologi denique aut Philosophi peculiarem veri inueniendi rationem habent: sed communis quaedam est via in omnibus disciplinis & scientijs, vt communis etiam est ars gubernandi navem, in quacunque maris parte sit sita.*

⁷ This distinction has its roots in Platonism but is common in the Renaissance: see N. W. Gilbert, *Renaissance Concepts of Method*, p. 6.

dialectics. Planer illustrates this in the preface to his textbook, *Scientia demonstrandi*, where he likens all of knowledge to a building which is approached by only one road, the way or method of demonstration. Within the building different staircases, or methods, lead to the different rooms of the various disciplines.⁸ These staircases are the different ways of knowing, some of which define and divide clearly and simply, while others are confused. And yet there is only one building, and one road leading to it, and so there is only one reason, and, therefore, there is only one method and one instrument and, in the larger sense, one way.⁹

In this way Planer opens the way to a search for a universal method, applicable to all spheres of knowledge, through which apparently different disciplines may be united into one and recognised to be part of the same truth. For many educators during the sixteenth century, including Melanchthon, the search for method was identified with the search for an efficient and effective didactic method,¹⁰ and this is to some extent true of Planer. He explains that the mind is the instrument of all knowledge, but that the mind has to be trained; this training is part of the method encompassed

⁸ A. Planer, *Scientia demonstrandi*, fol. 4r: *Quamuis autem fastigium omnis scientiae vnum est, & ad id solius demonstrationis via ascenditur: domicilium tamen hoc varijs distinctum est gradibus & cubiculis: atque alijs scalis ad Medicinae, alijs ad Iurisprudentiae, alijs ad Mathematicae peruenitur habitaculum.*

⁹ A. Planer, *Orationes tres*, p. 49: *Singulis sane scientijs, singulas res subiectas esse, libenter fateor: singulas scientias, suis quibusdam certis principijs vti, quae ad alterius generis rerum scientiam applicari nec debeant, nec possint, non inuitus do: alias scientias, pluribus causarum generibus, alias, paucioribus sua demonstrare proposita, lubens concedo. Nec repugnat nobis, quod aliae scientiae ἀπλούστερον, aliae ἀκριβέστερον suas definiant, diuidant, medijs rationibusque deuinciant & astringant res. Haec inquam, & his similia, libenter concedo: at ex illis neutiquam conuincitur, diuersa quoque & multa, pro scientiarum varietate, inquirendi veri constituenda esse organa & instrumenta: sed vna omnino & communis est ratio, qua singula, vel vera, vel falsa esse noscuntur, in qua ratione res omnes, licet valde sint dissimiles, conueniunt & consentiunt. Vnius illius rationis inueniendae, vna est via, vna Methodus, vnum instrumentum & organum.*

¹⁰ N. W. Gilbert, *Renaissance Concepts of Method*, pp. 68-73; see also W. J. Ong, *Ramus, Method and the Decay of Dialogue*, pp. 236- 239, whose analysis is similar, although his emphasis is different.

by the art of dialectics, as described in Aristotle's *Organon*. But the *Organon* is more than simply an educational method: it is the 'tool of all tools, ... the hand of all philosophy and knowledge,'¹¹ with which it is possible to investigate and confirm the truth and to separate truth from falsehood.¹² Planer believes that the method of dialectics is so well known to his auditors that he hardly needs to describe its aims, but he does so anyway. Dialectic method offers the means by which individual things, including the principles of higher sciences, may be not only defined but also confirmed 'by exquisite reasoning.' Dialectics makes it possible to go beyond 'common appearances' to what is hidden, allowing the essence of natural things to be ascertained by contemplation. When investigating causes and reasons, the syllogisms of dialectics also allow a distinction to be made between what is necessarily true and what is only probably true.¹³ The reason of dialectics

¹¹ A. Planer, *Orationes tres*, p. 51: *Habet etiam anima nostra instrumentum quoddam, quo intelligit & ratiocinatur, quod authore Aristotele in problematis, nihil aliud est, quam mens & intellectus. sic enim praeclare scribit: Ἔστι γὰρ καὶ ὁ νοῦς τῶν φύσει ἐν ἡμῖν ὡπερ ὄργανον ὑπάρχον, quasi mens sit organum & instrumentum percipiendi disciplinas. Sunt etiam mentis ipsius quaedam organa, ipsae videlicet artes & scientiae, quibus recte & consentane res intelligimus & tractamus: sic eodem in loco scribente Philosopho: Ἔστι γὰρ νοῦ μὴν ὄργανον ἐπιστήμη, τούτῳ γὰρ ἐστὶ χρῆσιμος, καθάπερ αὐτὰ ἀληθῆ: hoc est, mentis instrumentum est scientia, menti namque utilis scientia est, vt tibicini tibia. Iam porro ipsarum scientiarum, quae organa sunt mentis, vt modo diximus, instrumentum est & ὄργανον, ipsa ars Dialectica, modum & rationem tractandarum scientiarum praescribens. Quare recte librum hunc, quo artem Dialecticam absolutissime tradidit summus Aristoteles, inscripsit ὄργανον ὄργανων, καὶ τὴν χεῖρα τῆς φιλοσοφίας, hoc est, manum Philosophiae & scientiae omnis: est enim, & manus, organum organorum, vt ex. 3. de anima libro est euidens.*

¹² *Ibid.*, p. 50: *Itaque, cum multa instrumenta inuestigandi veri in singulis disciplinis esse non possint, vt ex his quae diximus, perspicitur, & singulae nihilominus scientiae suarum rerum veritatem non demonstrent, nec Methodum sciendi doceant, sed materiam tantum suppedient: sequitur certe, vnicum tantum & communissimum esse instrumentum, quo omnes scientiae suarum rerum veritatem, inuestigent, inuentam confirmant, confirmatam a falsitate & errore separent atque distinguant. Hoc organum & instrumentum inuestigandi veri tractandarumque scientiarum, quod sit ars Dialectica, vel me tacente, optimi auditores, iam intelligitis.*

¹³ *Ibid.*: *Ea enim, qua Methodo singulae res definiendae, docet: & cum saepe hac in parte vel a doctissimis in omnibus professionibus peccari soleat, regulas etiam quasdam proponit, quibus & falsas aliorum definitiones coarguere, & veras item nostras exquisitissimis rationibus confirmare & stabilire valeamus. His definiendi praeceptis Iurisconsultus, Medicus, Theologus, & Philosophus instructus, tales definitiones conficere potest, quae rerum essentijs maxime quadrant & conueniunt, quod nihil aliud esse, quam veritatem inquirere, paulo antea monui. Eadem haec ars, id quod generale, quod commune, quod confusum in singulis habetur disciplinis, apte & rite in species per certas differentias diuidere & distinguere docet: vt tanto rectius cuiusque rei naturam seorsim & per se*

promotes an 'internal' truth, that is, one which is always true and cannot be negated, as can the apparent truth demonstrated by means of oratory or rhetoric.¹⁴ However, the proofs of dialectics are not always certain, since certainty depends on the subject matter and not only on the form of the truth. Nevertheless Planer is seeking a way of ridding all sciences of the errors, opinions and ignorance shown by so many authors, and he believes that the way to do this is through the proper use of demonstrative method.¹⁵

Proofs may be stronger or weaker, depending on the subject matter and on the strength of the argument. Melanchthon regards Aristotelian philosophy as 'seeking proofs most diligently',¹⁶ and, therefore, as being the best representation of the truth available to him (except, of course, where it conflicts with the gospel). This acceptance of Aristotle's authority presumably lies behind Melanchthon's apparently unquestioning recourse to Aristotelian cosmology and his rejection of observational evidence which conflicts with that cosmology. He seems not to have entertained the possibility that Aristotle could be wrong about these matters. Perhaps Melanchthon had managed to remain unaware of the fact that explorers had found people living in the equatorial regions of the earth, held by Aristotle to be uninhabitable, for this discovery offered clear evidence of Aristotle's

contemplari & intueri valeamus, detracta quasi veste communitatis illius, sub qua tecta latebat. Ars haec Dialectica, singularum in disciplinas quaestionum & problematum causas & rationes inuenire, inuentas certis Syllogismorum formis astringere, astrictasque materiae ratione, necessariae ne sint, an probabiles tantum, iudicare & discernere docet.

¹⁴ A. Planer, *Disputationes logicae tres*, p. 12: 8. *Equidem verbo & voce, hoc est, esteriore oratione, negari possunt etiam verissima alioquin axiomata, cum aduersus illum exteriorem λόγον semper possimus instare, aliquid negare & contra disputare: sed interiorem λόγον, quem respiciunt Syllogismi & demonstrationes, non semper possumus negare, sed assentiri tandem, & conscientia ipsa victi, veritati cedere cogimur.*

¹⁵ A. Planer, *Orationes tres*, p. 62: *Refertae sunt omnes quasi scientiae multis erroribus, opinione & ignorantia authorum, vt mehercle necessarium plane sit, ex demonstrationum doctrina cancellos omnes errorum probe cognoscere, vt eos vitare & declinare valeamus.*

¹⁶ P. Melanchthon, *De Discrimine Evangelii et Philosophiae*, CR 12.691 (cited at ch. 2 n. 30 above).

fallibility.¹⁷ Others however, were only too aware of the problems raised by such discoveries, and, although Melanchthon's position was still shared by many in the sixteenth century, the questions raised by such discoveries, together with a general dissatisfaction with scholastic philosophy, raised doubts about the authority of the views of Aristotle and other ancient philosophers and stimulated the search for new ways of establishing the truth. Among those who embarked on this search was Melanchthon's friend and colleague Simon Grynaeus, who produced new editions of Euclid's *Elements* and of Proclus's commentary on the *Elements*, writing prefaces and introductions to these works and many others. His introduction to Euclid's *Elements* is of particular interest for its understanding of mathematics as a methodological tool for interpreting observational evidence.¹⁸

Melanchthon states that mathematical proof is the clearest because it demonstrates how confused things may be unravelled and understood,¹⁹ but offers no further methodological discussion of the use of mathematical proof either in his mathematical prefaces or in the *Initia doctrinae physicae*. Grynaeus's preface to Euclid's *Elements* is a far more detailed philosophical treatise and offers an interesting complement to Melanchthon's work. Grynaeus argues the philosophical importance of mathematics on the

¹⁷ For a discussion of the implications of these discoveries, see K. A. Vogel, 'Neue Welt Nirgendwo?' Maestlin was well aware of such discoveries and of their implications: see, for example, *Epitome astronomiae*, p. 158: *Quid est Zona torrida? Est spacium coeli vel terrae, compraehensum inter ambos tropicos.*

Quare torrida vocatur? Quod calore Solis quasi adusta sit. Cum enim radij Solis ei semper incumbunt, in ea recti sint. Rectis angulis eos in sese reflecti, & inde vehementissimum aestum excitari necesse est, quam ob causam eam non habitabilem esse veteres censuerunt.

¹⁸ Unfortunately little is known about Grynaeus and his work, which would merit a full length study of their own. From the books being published in Basel, where Grynaeus seems mostly to have lived and worked, it can be seen that there was considerable interest there for the study of mathematics, natural philosophy and medicine.

¹⁹ *In arithmeticon praefatio Georgii loachimi*, CR 11.291-292.

grounds of the exactitude of its arguments and its proofs. He believes that, although 'the common people of our age' have commonly misunderstood the study of mathematics, pursuing it only for profit and believing it to be a sterile subject of points and lines,²⁰ those who learn mathematics properly will appreciate the great clarity of its examples and its normative character as a basis for all other disciplines.²¹ Despite the initial difficulties associated with learning mathematics, it should be the first subject to be learned, for the benefits of this knowledge are more admirable than those arising from the reading of any book.²² Through this one discipline of mathematics the human mind is admitted to understanding of the whole universe,²³ and thus to an understanding of the most beautiful works of God: the other arts are bound to the earth, while mathematics frees the human mind to appreciate the wondrous spectacle of God's works.²⁴

²⁰ S. Grynaeus (ed), *Euclidis Elementa*, fol. a2^r: ...& vulgus nostri seculi studiosorum de Mathematicis non recte sentire, illos ipsos etiam propemodum qui profitentur constat: dum in illa figurarum sterilitate plerique praeter mutos linearum ductus nihil cernentes, etiam usum inesse aut omnino nullum, aut praeter eum quem in mundi contemplatione simplicem habet, nullum putant.

²¹ *Ibid.*: ... cum solae hae, supra quam ex professo docent, recte disciplinas omnes caeteras persequendi, illustre maxime claritate sua exemplum, & uelut normam prebeant.

²² *Ibid.*, fol. a2^{r-v}, especially fol. a2^v: Quae doctrina in primis perfectisque periclitata corporibus, ut illa superior in figuris primis, in caeteris uim deinceps eandem seruat. Atque haec hactenus $\sigma\tau\alpha\chi\epsilon\lambda\alpha$ rerum sunt mathematicarum omnium, ut quorum uis in omnibus certa uersatur. Quemadmodum enim qui legere uult, elementa discit prius, & ijs assidue recurrentibus utitur in uocibus omnibus exprimentis, sic qui metiri quidquam instituit, figurarum omnium in quas primas formae resoluuntur naturam teneat prius necesse est. Ex his elementis uelut fonte uberrimo quidem, sed recondito, & non cuius scaturiente, omnis latitudinum, longitudinum, profunditatum, omnis agrorum, montium, insularum mensio, omnis de coelo per instrumenta syderum observatio, & gnomonice tota, omnis machinarum uis et ponderum ratio, omnis in cogendo spiritu, omnis apparitionum qualis in speculis, in pictura, in phantasmatis est, diuersitas manat. Quibus de rebus omnibus propemodum, authoris eiusdem libellos eruditissimos, & in sua eosdem lingua, mox aedemus. Leuiores sunt haec, sequitur fructus admirabilior.

²³ *Ibid.*: Inconuersum est enim in clarissimum mundi theatrum hac disciplina genus hominum admissum, machinae totius mundanae inuentu medio, cardinibus inuentis, orbis figura totius explorata, tum unius cuiusque praecipuorum corporum, et terrae in medio mundi, situ uastitateque deprehensis, idque ex ista rerum immensitate, disciplinae unius ui.

²⁴ *Ibid.*, fol. a3^r: Cum ex isto toto disciplinarum orbe, nulla sit meo quidem uidere, etiam pia & diuinis rebus consecrata mente, magis digna, magis accommodata, quam quae in operis Dei conspectum animum pulcherrime traducit, & coeli terraeque positus profundissimo stupore, mentem complet. Ac quanquam usus hic primus magnificus, tot tamque mirabilium huic disciplinae subiectarum rerum cognitione, talis est: ut hunc praeter, omnis caeterarum artium notitia ueluti caeca, nubibusque inclusa, & inter densa terrarum illiberaliter, & subtilitate mentis humanae indigne haereat, nec unquam in aperta mundi

Unlike Melanchthon, Grynaeus does not elaborate upon the theme of the divine importance of mathematics. Although Grynaeus cites Plato to emphasise the importance of studying mathematics and refers to the latter's praise of the discipline's great beauty and clarity,²⁵ he does not quote Plato's statement that God always geometrizes; nor does he introduce the idea that the mind is number. Grynaeus is less interested in the possibly divine attributes of mathematical knowledge than in the power of its proofs, for his chief concern is the quest for a certain philosophy which should be anchored in 'sacred things' such as the knowledge and wisdom of God, but which should also have recourse to rigorous methods which render impossible another lapse into the kind of 'monstrous absurdities' to which he believes scholastic philosophy, and, by association, theology to have been prone.²⁶ Like Melanchthon, Grynaeus, citing Aristotle, turns to geometry as the most clear and certain means of learning the reasoning associated with such a philosophy,²⁷ but, unlike Melanchthon, he leads on into a discussion, albeit brief, of how such reasoning actually functions and what it can achieve.

progrediatur: tum admirabilius est arbitror, quae ista in pectore humano sit uis, quae in ista, loca tot milibus myriadum seposita, sese penetrarit, quae illa tam stupescenda ratio, animum per summa naturae spectacula circumducit.

²⁵ *Ibid.*, fol. a5^r: *Plato igitur quoties ab incunabulis format studium, quod facit non semel, suscitandae mentis, & ad rerum omnium speculationem rite comparandae, uiam hanc unicum esse clarissime & copiosissime pluribus in locis docet: de republica septimo, de legibus iterum & iterum, in Epinomide, in Thaeteto. commemorare enim locos diserte lubet. ne quis testem in re tanta desiderare posset.*

²⁶ *Ibid.*: *Eos contra retroactis etiam seculis, quicumque ad has disciplinas uelut anchoram sacram, non diligenter respexerunt, totum hoc turbulentum & tumultuarium philosophorum genus inquam, in monstrosam absurditatem relapsos uidemus: dum alij, tale quidque esse quale appareret, solem etiam hunc pedali non maiorem, alij nil prorsus posse percipi: quidam nil esse prorsus, ac ne deum quidem ipsum, non sentirent solum, quod faciunt multi, sed propalam contenderent. Horrendum est, discendi pernicatiam & temeritate, seipsam necessario ludificante, in lucis operum & sapientiae dei execrationem, homines euehi.*

²⁷ *Ibid.*, fol. a3^v: *Quid quod ipse Aristoteles, lucem disputationibus omnibus suis, non aliunde cumque e geometricis infulsit? locos mille proferre possem, cum abstrusissimae res demonstrationum geometricarum ui prorsus erutae & in lucem prolatae sunt.*

Grynaeus believes the mathematical sciences to be important in dialectics because they offer a means of transcending the ambiguity of words²⁸ and a way out of the confusion of different texts and methods with which he and his contemporaries are confronted.²⁹ He is particularly interested in the part which philosophy plays in interpreting what the senses have experienced;³⁰ he maintains that all the works of nature are subject to the measure of the eyes,³¹ and notes that, since interpretation is not implicit in observation, it is important to have clear principles both to guide the interpretation of what has been observed and to prevent the kind of subverting tendencies which in the past led physics, for instance, to discuss God's immortality, a matter about which Grynaeus believes physics should have nothing to say.³² Mathematical principles are the best means of proceeding in the interpretation of observations, since they start from few principles, and proceed by clear proofs, as can be seen from the example of geometry.³³

²⁸ *Ibid.*, fol. a2^r: ... ac cum ignotas res, uerbis diu sonuisset, postremum abijcerent damnarentque.

For Grynaeus's view of mathematics as a solution to this problem, see fol. a3^{r-v}.

²⁹ *Ibid.*, fol. a4^v: *Erat igitur methodus, id est ordine quanque rem explicandi ratio inuenta ueteribus, eam consecratam literis ad nos transmiserunt: habemusque non solum methodum, sed hac scripta monumenta ueterum plurima, cum Aristotelis ipsius, tum aliorum insuper haud paucorum. Dissimulant hodie homines, & calore discendi, quacumque datus locus est in medium maximorum studiorum primum irrumpunt. In qua quidem confusione rerum non dubito, quin unicam recte uereque discendi, exemplar geometria, fato quodam hanc discendi cupidatem & feruorem temperatura, nunc potissimum emerit: quo tempore pro ut ingenium cuisque fert aut occasio, in inmensam & tot ambagibus inuolutam studiorum syluam studiosi praecipitantur: ac dum quomodo discant plurimum, pensi solum habent, quid, quomodo, quo ordine discant, ne cogitant quidem. Igitur in aceruum, sine iudicio, sine ui ulla certa, congerunt. ubi necesse est, ut quanto diutius incumbatur, tanto maiore confusione obruat animus: malo quo haud scio an ullum in terris miserabilius sit.*

³⁰ *Ibid.*, fol. a4^r: *Rerum aliae sub sensum cadunt, in quibus idcirco euidentis notitia nulla est, quoniam causis intus abditis omnia fiunt. ignem esse calidum indicat sensus, causa latat. Atqui scientiae consecutio, causae notitia tota constat. Aliae ab omni procul sensu positae, mente sola intelliguntur: aptae contemplationi quantum in ipsis est, sed ob debilitatem animi, per sensus tamque discendi rudimenta sese attollentis, difficillimae.*

³¹ *Ibid.*, fol. a2^v: *Igitur totum hoc naturae opus mentis oculis subiectum tenemus.*

³² *Ibid.*, fol. a3^v: *In Physicis nullum artificem, cum artis principia subuertente obligatum esse congredi, & illud in quod tam multi impegerunt, communibus fabricatam demonstrationem, fidei non firmae satis esse, deum immortalem cumque abstrusam rem, quam clare unius tantum exempli monitu quale utrunque sit ostendit. Iam ipsa principia, demonstrationem non ingredi, sed eorum ui confici tantum, exemplis hic mille patet. quo loco satis interpretum sese inscitia saepe detexit.*

³³ *Ibid.*, fol. a4^{r-v}.

Thus, mathematical methods can bring clarity to obscure points.³⁴ Grynaeus mentions in passing that this methodology might also be put to good use in deciding ethical questions,³⁵ but ethics is not his central concern. That remains the question of the definition of a proper philosophy which will help the mind to interpret accurately what it has experienced through the senses and not lead it to compromise itself with God.

Grynaeus's concern with the role of mathematics in interpreting the experiences of the senses demonstrates an interest in epistemology and the interpretation of observations which is not found in Melanchthon's thought. Although Grynaeus does not discuss explicitly either the relationship of observations to cosmology or the problem of the authority of ancient philosophy, his concern with problems of interpretation and the search for a methodology which will give rise to an authoritative and certain philosophy could easily raise the question of the relative authority of contemporary observations and received understanding. Thus, Grynaeus's discussion of the relationship between observation and mathematical methodology offers an analysis of the importance of mathematics which was written in the context of a dialogue with Melanchthon himself, but which shows rather different emphases. Although both authors appeal to mathematics in the context of a search for a correct, reliable authority, be it in ethics or in philosophy as a whole, Melanchthon effectively settles the question through an appeal to another, ancient, authority, while Grynaeus seeks the most

³⁴ *Ibid.*, fol. a3^v-a4^r: *Ac quid ego unum alterumue dialecticae praeceptum memoro, cum nullius omnino non evidens hic imago reperiatur? Ut si quis mentis humanae morem, simulacro quodam expressam uelit, nullo possit melius, quam geometricae, quae methodi totius absoluta & perfecta formula est, domestica insuper luce sua mirabiliter fulgens. Ergo discredendi uis penes dialecticem est quidem, sed obscura tantisper, dum mathematicarum disciplinarum claritate iuuetur.*

³⁵ *Ibid.*, fol. a4^r: *In rebus caeteris longe secus sit, quis bonus, liberalis, fortis sit uir, nec simpliciter nec statim intelligitur, quoniam hae rationes in quibus maxime rebus versentur, tum quo ambitu & fini claudantur, aegre videre est.*

reliable possible interpretation of what he can see with his own eyes. For Grynaeus, mathematical method plays an important role in establishing the correct interpretation of observations and the constituent parts of an authoritative philosophy. In this way he lays methodological foundations which do not simply justify the making of exact observations (for which Melanchthon had offered far more detailed philosophical and theological arguments than Grynaeus does in this preface) but allow such observations and their implications to be taken seriously. Thus, Grynaeus appears to allow for the possibility that the making of exact observations may lead to the overturning of traditional teachings about what has been observed.

There is clear evidence that Grynaeus's methodological discussion was not only available but also discussed in Tübingen in the latter part of the sixteenth century. Crusius's copy of the Grynaeus edition of the *Elements* is copiously annotated; from the annotations it can be seen that Crusius read and analysed the preface in some considerable detail when he studied the *Elements* with Philip Apian in 1571.³⁶ Grynaeus's questions about the status of observation and the usefulness of mathematical method were, therefore, certainly known to and discussed by at least two members of Tübingen's arts faculty in the early 1570s. It is perhaps no coincidence, since Philip Apian was Maestlin's teacher, that such questions about the interpretation of observations and the authority of the resulting conclusions find expression in Maestlin's discussion of the methodology which he had

³⁶ The volume S. Grynaeus (ed), *Euclidis Elementa*, [UBTü, CD 2187] belonged to Crusius, having been presented to him by a student in 1565 [see title page]. Grynaeus's preface and pages 1-76 are heavily annotated. On the final (unnumbered) page of the Latin preface is a note dated 9th January 1571 which reads: *Tybinga explicare Euclidem coepit D. D. Phil. Apianus. 7. Martij. MDLXX. Ego vero M. Crusius has eius annotationes, ab Ioan. Lango iuniore Menningensis discipulo et conuictore meo Tybingae, qui illum audiuit, decerpsi. 9. Janu. 71.* For convenience this page will be henceforth referred to as fol. a5^r-5^v.

developed in considering the stella nova of 1572 and the comets observed in the winter of 1577-8 and the late autumn of 1580.³⁷

As has already been remarked, Maestlin's biblical justification for the study of astronomy places a strong emphasis on the need for accurate observations. Maestlin is convinced that an accurate understanding of God's creation will lead to a more precise knowledge of God and of God's intentions for the world. This emphasis on God's call to exactness allows Maestlin to defend the controversial results of his observations of the 1572 stella nova and the two comets. On the basis of his measurements of the parallax of these phenomena, Maestlin concludes that they are all supralunar, rather than sublunar, and thus he contradicts the teachings of Aristotle that comets are sublunar and that no change can occur in the supralunar region. Maestlin believes that the exactness of the observations by which he has measured the parallax (or lack of it) of these phenomena, combined with his use of geometrical and arithmetical proofs allows him to draw conclusions, the truth and certainty of which are to be rated higher than the authority of the opinions of Aristotle, Pliny, and other ancient philosophers.

The brightness of the stella nova which first appeared in November in 1572 drew it to the attention of many observers, among whom were Maestlin and Philip Apian. Exact observations showed that the stella nova did not move, and this raised a question about how this celestial object was to be classified. Peter Apian, father of Philip, an astronomer and geographer who taught

³⁷ Maestlin may have read Grynaeus's work himself: in a disputation of 1606, Maestlin cites Grynaeus, 'Med. & Math.' as an authority on comets [M. Maestlin, *De multiuariis motuum planetarum*, p. 36], but it is not clear which of Grynaeus's works Maestlin had read, nor when he had read them.

mathematics at the university in Ingolstadt,³⁸ did not question Aristotle's theory that comets were generated in the sub-lunar sphere by the accretion of elementary matter, but in the course of his observations of comets during the 1530s he not only recorded their position and motion but also observed that the comet's tail always pointed to that part of the sky which was opposite to the sun.³⁹ When the stella nova first appeared in November 1572, most people, including the majority of astronomers, took it to be a comet, although some commented on the absence of a tail.⁴⁰ In seeing it as a comet they were drawing the most legitimate conclusion possible from the point of view of Aristotelian physics, which defined all such unusual celestial apparitions as comets and taught that they were located in the sub-lunar sphere. The lack of discernible parallax led some observers, including Philip Apian, to realise that they were observing a supralunar phenomenon; these observers described the phenomenon as a supralunar comet.⁴¹ However, Peter Apian's work combined with their own observations led a small minority of observers to question whether the stella nova, which had no perceptible motion and no tail, could in fact be classified as a comet at all. One of those who recognised the stella nova to be not a comet but a new star was

³⁸ S. Günther, *Peter und Philipp Apian*, pp. 8-9.

³⁹ His books contain diagrams of the comet's tail. Apian had observed the comet of 1531, the second comet of 1532, and the comets of 1533, 1538, and 1539. Although Girolamo Fracastoro had in fact observed the direction of the tail of a comet earlier than Apian, the observation was attributed to Apian by his contemporaries. See C. D. Hellman, *The Comet of 1577*, pp. 88-90. See also her 'The Role of Measurement in the Downfall of a System' for further discussion of observations of these other celestial phenomena.

⁴⁰ There were many considerations of the 'comet of 1572': see for instance Theodore Graminaeus, *Erklerung oder Auslegung eines Cometen* (a Catholic tract which is basically a denunciation of Luther), Georgius Busch, *Von dem Cometen, welcher in diesem 1572 Jar in dem Monat Novembris erschienen*, and Andreas Nolthius, *Observatio & Beschreibung des Newen Cometen*. Nolthius comments that this 'comet' has no tail.

⁴¹ C. D. Hellman, *The Comet of 1577*, p. 90. In England, John Dee and his pupil Thomas Digges also observed the position of the stella nova very accurately, concluding that it was a supralunar comet moving away from the earth with linear motion [R. A. Jarrell, 'Michael Maestlin', p. 116]. Tycho Brahe concluded that the stella nova was in the region of the fixed stars and, therefore, that it was neither a comet nor a meteor [C. D. Hellman, *The Comet of 1577*, pp. 112-113]. Rudolph Gualther in Zurich believed the nova to be a new, sublunar star [see C. D. Hellman, 'A Poem on the Occasion of the Nova of 1572'].

Maestlin, who was at that time *repetent* for mathematics at the *Stift*. In his *Demonstratio astronomica loci stellae novae*, published in 1573, Maestlin concludes that what he has observed cannot be a planet because it is too far away and does not move: since it is above not only the moon but also the planets, he decides that it must be part of the celestial sphere and, therefore, a new star.⁴² As such it represents a change in the heavens, not simply above the moon, but in the sphere of the stars, previously assumed to be perfect and immutable, and offers a strong challenge to the physics of Aristotle and of other philosophers who believe that the celestial sphere to be perfect and immutable. Such opinions, or at least the authority of such opinions, are, in Maestlin's opinion, to be deplored, for they are directly contradicted by his observations.⁴³ Maestlin is quite prepared to assert the authority of conclusions drawn from what he had seen with his own eyes against that of the traditional teachings on cosmology passed down by ancient philosophers.

Maestlin's conclusion that the *stella nova* is above the moon and has no motion is based upon his measurements of its parallax. Applying the same method to the comets observed in 1577-8 and in 1580, he determines that neither comet can be moving in the sub-lunar sphere, asserted by Aristotle to be the region in which comets come into existence, but that both are above the moon. In his explanation of the motion of the 1577-8 comet, he explicitly,

⁴² M. Maestlin, *Demonstratio astronomica loci stellae novae*, pp. 28-29. Frischlin published a poem on the *stella nova*, which, he commented, 'despite Aristotelian and astronomical teachings, I firmly believe to be a new star' [N. Frischlin, *Consideratio nouae stellae*, fol. A2^r].

⁴³ M. Maestlin, *Demonstratio astronomica loci stellae novae*, p. 28: *Quod si veritati consonaret, merito repraeheremus (sed illorum autoritate) & Aristotelem, & Ptolemaeum, si nullis retro seculis mutationem in orbe praesertim stellato depraeherensam asserentes, nobis hactenus imposuissent. Verum hos omnes mutatio coloris huius Stellae, & magnitudinis diminutio sufficienter coarguunt. Alij singulis centenis vel quadringenis annis huiusmodi sydera redire, commenti sunt: Quae ab illis quidem dicuntur, sed nullius seculi phaenomenis comprobantur.*

if reluctantly, uses a Copernican, heliocentric analysis to explain the motion of the 1577-8 comet, concluding that it was located in the Copernican sphere of Venus;⁴⁴ he describes the 1580 comet in terms of the more traditional geocentric cosmology, coming to no precise conclusions about its location.⁴⁵ Once again, Maestlin is one of very few observers to conclude, against Aristotle, that the comets are not in the sub-lunar sphere.⁴⁶

Maestlin's work on the 1577-8 comet was written while he was a pastor in Backnang. In the prefatory epistle of this work, which is dedicated to the Duke of Württemberg, Maestlin explains that he has taken the time to make many exact observations of the comet's position, and has then applied to these observations 'the proofs of geometry and arithmetic' to reach his conclusions, and thus 'a greater admiration of these works to the glory of God's name.'⁴⁷ In this work he has tried to show the exact motion of the comet from his observations, bearing in mind that from the day it appeared until the day of its extinction it did not depart from 'certain astronomical laws', and he has come to the conclusion that the comet is like another star.⁴⁸ That is to say, the observations show that the comet does not have its place among the elements, but that it moves in the sphere of Venus, and that it is

⁴⁴ M. Maestlin, *Comet 1577-8*, p. 54.

⁴⁵ Jarrell gives a useful summary of Maestlin's work on the 1580 comet [Jarrell, 'Michael Maestlin', pp. 123-126], but offers no explanation for Maestlin's non-use of Copernicus.

⁴⁶ Hellman lists around one hundred works about the 1577 comet which are still extant [C. D. Hellman, *The Comet of 1577*, appendix] and offers a detailed investigation of thirty treatises. Five authors, Maestlin, Brahe, Roeslin, William IV of Hesse-Kassel and Cornelius Gemma, argued that the comet was above the moon.

⁴⁷ M. Maestlin, *Comet 1577-8*, dedicatory epistle, unnumbered page 4: *Sedulius igitur & plurimis meditationibus, praeuentibus tamen observationibus certis, & mediantibus demonstrationibus Geometricis & Arithmeticis, collegi admirandas diuini huius operis varietates, & easdem ad gloriam nominis Dei in hoc suo opere conscripsi.*

⁴⁸ *Ibid.*, page 5: *Ego enim hoc solum enucleare tentavi, ut ex observationibus exquisitis & certis, veros eius motus explicarem, quos a prima apparitionis die ad extinctionem usque serauit, certissimis Astronomicis legibus non minus alligatos, quam de quanquam alia stella compertum est.*

the same distance from the earth and from the 'centre of the universe'. The comet's path can be computed and known by using true, exact observations as the basis for geometrical proofs and arithmetical calculations. Maestlin hopes that such proofs cannot be avoided or overturned.⁴⁹

Maestlin goes on to say that he has not found any comparable description of any other comet's motion. He deplors the fact that the explanations of the ancients have been accepted without question, and criticises the many astrologers who have wasted so much time in their musings about the effect of the comet that they have failed to see how far in error were their assumptions about its place, movement and distance.⁵⁰ Maestlin sees it as his task as a mathematician to make exact observations and to use these to collate the work of ancient astronomers such as Hipparchus, Ptolemy and Albategnius, and of more recent astronomers such as Regiomontanus, Peurbach and Copernicus.⁵¹ This will enable him to understand the rationale behind the divinely ordained movements of the stars and allow him to compile more accurate astronomical tables, and, he implies, thus to lay more solid foundations upon which judicial astrology can be established.⁵²

⁴⁹ *Ibid.*: *Quaesierat enim is sibi sedem, non inter elementa, sed in Veneris sphaera quodam orbe, cuius circumductum etiam tanta observantia secutus est, ut ex eo motus eius & locus in suo circulo sub orbe stellato simul & distantia a terra & mundi centro, quouis momento computari & sciri possit, quemadmodum haec omnia ex observationibus veris extracta & demonstrationibus Geometricis cum calculo Arithmetico tam probe munita spero, ut a quoquam eludi aut everti non possint.*

⁵⁰ *Ibid.*: *Huiusmodi in aliorum Cometarum ante hac uisorum descriptionibus non invenio. Deplorandum autem magis est, quod hoc ipsum in huius Cometae explicationibus non itidem ab aliis factitatum est, ut nimirum hoc modo, quae ab antiquis accepimus, nostris observationibus illustraremus, naturaeque contemplationes apertiores redderemus. Sed non absque dolore video, plerosque Astrologos haec tanquam ociosa, & indigna, in quibus conscripturus effectus Cometae occupetur, penitus negligere, cum tamen haud dubie a veritate iudiciorum declinare necesse habeant, qui in statu, loci, motu, & distantia eius terra toto coelo errant.*

⁵¹ Westman has analysed Maestlin's mathematical calculation of the comet's orbit and compared it with the actual orbit [R. S. Westman, 'The Comet and the Cosmos', pp. 12-19.], and I shall not reproduce his work here.

⁵² M. Maestlin, *Comet 1577-8*, unnumbered pages 5-6: *Etsi enim hactenus Mathematicam abstractam & concretam mihi nonnihili familiarem fecerem, in concreta tamen, cui motuum coelestium considerationes subiacent, ego Astronomiae potius, quam*

Maestlin is clear that what he is doing is not judicial astrology, but, because he believes that God has created the universe the way that it is meant to be, he also believes that astronomical knowledge of the comet can only be of benefit, for it will reveal God's great wisdom and power.⁵³

The prefatory epistle to Maestlin's work on the comet of 1581, written while he was professor of mathematics at the university of Heidelberg and once again addressed to the Duke of Württemberg, elaborates and develops the same themes. Maestlin seems more concerned to defend the legitimacy of his astronomical work than he had been in 1578, perhaps because his work had been subject to criticism in the meantime,⁵⁴ and he offers a more sophisticated argument and use of biblical authority than that which he had written five years earlier. Once again, Maestlin uses biblical testimony about God's creation of the heavens to argue that exact observations of the motions of the heavenly bodies are necessary, citing ancient philosophers to support his case, but here he goes on to describe the methods by which such observations can be made and, perhaps more importantly, conclusions

Astrologiae incubui. Cum enim ex multiplicibus aliorum eruditorum virorum querelis, & etiam proprijs experimentis intellexissem, in motuum tabulis & calculo aliquid desiderari, quanquam motuum rationes siue hypotheses ab Artificum diuina solertia probe iuuentae & demonstratae sint, quod ipse calculus tamen faciem coeli nonnihilo vel excedat, vel ab eo deficiat: Ideo illi me dedere coepi, ut observationes in coelo complures ego ipse notarem si forsitan ex earum collatione cum antiquissimorum Hipparchi, Ptolemaei, Albategni, & recentiorum Regiomontani, Peurbachii, Copernici & aliorum observationibus, possem breui (si modo Deus vitam & vires mihi largiatur) calculum ad absolutam & diu expectatam integritam reducere. Hinc factum est, ut Astronomiam Astrologiae perpetuo praeposuerim.

⁵³ *Ibid.*, page 6: *Quare iudicium Astrologicum mihi hic arrogare nec possum nec volo, sed id alijs relinquo, quorum multos video admodum esse sollicitos, ut audacter (siquidem hoc facile est) diuinent. Hanc igitur ob causam quatenus Astronomicae scientiae Cometa subditur, a me explicatus est, ut Dei Opt. Max. sapientia & omnipotentia hic, ut & in alijs, conspiciatur.*

⁵⁴ I have not found any contemporary criticism which is specifically directed at Maestlin's treatise on the comet of 1577, but a range of criticism of similar assertions is still extant. As early as 1573 Andreas Nolthius was arguing that comets (although he is, of course, discussing the stella nova) could not be located above the moon 'wie etliche irrig furgeben' and praising Copernicus, the 'diuinus artifex', who had observed comets to be below the moon [A. Nolthius, *Observatio & Beschreibung des Neuen Cometen*, fol. Biii^v. In 1578 Johannes Praetorius Joachimus, professor of mathematics in the university of Altdorf, offered a comprehensive criticism of Apian's conclusions on the grounds that they contradicted the teachings of Pliny and of Aristotle [J. Praetorius, *De Cometis*, fol. C^r-V.

drawn from them. These remarks are complemented by the opening theses of his disputation *De astronomiae hypothesisibus siue circulis sphaericis et orbibus theoreticis*, held in Heidelberg in 1582, one of very few of his disputations to have survived.

Maestlin's certainty about his results rests upon his confidence in his methodology. In his disputation, Maestlin argues that, because it is not possible to ascend to the heavens, astronomical investigations have to be a *posteriori*; thus astronomy seeks universal explanations on the basis of the observation of particular appearances of motion. Having made the most exact observations possible, and presupposing the principles and hypotheses of astronomy (which include the convictions that astronomy is more mathematical than physical, and that all celestial motion is circular, equal and regular),⁵⁵ the astronomer proceeds by a process of reasoning to

⁵⁵ The principles of astronomy are set out in M. Maestlin, *De astronomiae principalibus*.

Some clarification of the meaning of the term 'hypothesis' may be useful here. While Maestlin does occasionally use this term to describe one of the several possible mathematical explanations of the observations, he more usually uses it in the Aristotelian sense (discussed below) to refer to the apparently true postulates upon which his argument is founded. The only case of the former usage that I am aware of is in 1606, in the disputation *De multivariis motuum planetarum* [thesis 97, p. 53], where he refers to the 'usual hypothesis' [i.e. the Ptolemaic]. The term should certainly not be understood not in the modern sense of a possible solution which has to be tested. A hypothesis in the Aristotelian sense is similar to an axiom in Euclidean geometry, although it has a weaker claim to be true: a hypothesis appears to be true in that it accords with external conditions; it is taken as true; but it cannot be proved. An axiom, on the other hand, is internally true, 'of its own power. Although Maestlin does not define the term 'hypothesis' explicitly, he is working within an Aristotelian context and it is clear from Planer's logical treatises and disputations that this was the accepted use of the term [see for example A. Planer, *Disputationes logicae tres*, thesis 9, p. 12: *Hypothesis est, quando, demonstrabili quodam principio utens, qui docet, idipsum non demonstrat, ac nihilominus id verisimile tamen videatur discenti: quando autem quod ponitur, tale fuerit, ut in neutram partem opinando magis sit propensus, qui discit, aut contrario magis assentitur, quod concedendum proponitur, αἰτιμα est, ac postulatum dicendum*]. See later in this chapter for a discussion of the role of hypothesis in dialectics for Planer.

For the difference between axiom and hypothesis, see W. Risse, *Die Logik der Neuzeit*, 1, p. 258. Risse gives an accurate description of this difference but he goes on to refer to the Ptolemaic, Copernican and Tyconic astronomical hypotheses: this use seems to me anachronistic, although it is possible that it was Kepler, whom Risse cites here, who introduced the new connotation. Certainly, a discussion of the astronomical hypotheses similar to that contained in Maestlin's *De astronomiae hypothesisibus* appears at the beginning of *De multivariis motuum planetarum* [theses 3, 8, pp. 2-3], a disputation held in

work out which combination of orbs, spheres and circles could have given rise to the observed phenomena. This process involves the analysis of the motions of the stars, to find the best combination of circular motion, and the examination of this result using the proofs of geometry and arithmetic to ensure that it is not against the hypotheses of either physics or astronomy. The end result is an interaction of spheres and orbs with circular motion by which the phenomena can be 'saved'.⁵⁶ The mathematical explanations, or 'causes', of the apparent motions of the celestial bodies arising from this process will not necessarily be unique, and therefore true, although in some cases they will be. Thus Maestlin points out in his astronomy textbook, the *Epitome astronomiae*, that it is possible to arrive at apparently different ways of explaining the observed phenomena which are actually mathematically equivalent (such as the Ptolemaic and Copernican systems).⁵⁷ However, he

Tübingen nearly twenty-five years later. This would certainly suggest that Maestlin held and taught the same fundamental understanding of hypothesis throughout his teaching career.

⁵⁶ M. Maestlin, *De astronomiae hypothesibus*, fol. A2^r-v: *Thesis I. Inuestigationem Circulorum & Orbium coelestium censemus a posteriori inchoandam esse, hoc est, ab apparentijs motuum particularibus, quae vniversali experientiae aequalitatis reclamare videntur: non autem a priori, siquidem in aetheream regionem nemo ascendere potest, qui omnia coram spectet.*

II. *Fieri autem istud statuimus, quando Artifices apparentiam motuum diligenter obseruant, & inde, praesuppositis tamen & iam ante demonstratis Astronomiae fundamentis (de quibus peculiari Disputatione egimus) sedulo inquirunt, cuiusmodi orbibus aut circulis hoc alioque modo circumuentibus tale phaenomenon possit produci, & saluari.*

III. *Quod si igitur istiusmodi ratiocinatione (videlicet ἀναλύσει motuum stellae cuiuspiam, & indagatione orbium certorum istis motibus satisfaciendum) orbis positi fuerint, & eorum magnitudines, positus, centra, poli & reuolutiones exquisitissime per demonstrationes Geometricas & Arithmeticas examinata, non modo ad amussim omnibus observationibus consentire, verum etiam contra prima fundamenta & principia astronomica & Physica nullo modo pugnare depraehenduntur: Certissime statuimus, quod etiam reuera, aut tales orbis sint in coelo hisce motibus stellam agitantem, aut (quod idem est) orbis illi coelestes sint his ab artificibus positus conformes, id est, tales, qui plane idem praestare possunt: quemadmodum Eccentricus & Concentricus orbis conformes sunt.*

The disputation referred to in thesis II is presumably that *de astronomiae principalibus et primis fundamentis* of which is also extant and will be discussed below.

The term 'to save the phenomena' was frequently used of the task of astronomy. In an attempt to reconcile the epicycles and eccentrics of the Ptolemaic system with Aristotelian cosmology it was asserted that the ptolemaic description of the movements of the planets was a purely mathematical means of explaining what could be seen and enabling astronomical prediction. Having no physical reality it could not be in opposition to Aristotle's concentric spheres. See, for instance, N. Jardine, *The Birth of History and Philosophy of Science*, pp. 225-257, and J. Mittelstraß, 'Phaenomena bene fundata'.

⁵⁷ M. Maestlin, *Epitome astronomiae*, p. 390-391: *Anne per solos hos orbis hactenus expositos phaenomena motus planetarum demonstrari & saluari possunt?*

believes his conclusion that the comet is further from the earth than the moon to be incontrovertible. In chapter 5 of his treatise on the 1580 comet, under the heading 'that this comet is not sublunar, but is illuminated in the height of the aether',⁵⁸ Maestlin asserts that his conclusions, which have been reached through many exact observations of the parallax of the comet and the use of 'geometrical proofs', give rise to an understanding of the motion of the heavens which is correct 'ex necessitate'. He recognises that this understanding contradicts the opinions of the ancient astronomers, and concludes that either their observations or the conclusions they drew from them must have been wrong.⁵⁹ Maestlin defends himself against those who have not made their own observations and still criticise his conclusions: he recognises that errors may easily be made both in observations, and in

Quanquam orbis, quos hactenus ex communi Artificum plerorumque sententia exposuimus, motuum planetarum apparentijs satisfaciant, numerosque motibus congruos in tabulas scribendos demonstrent: Eadem tamen apparentiae, iisdemque numeratam mediorum motuum quam prosthaphaereseon, saepenumero etiam ex alijs orbibus eodem plane modo & quantitate producuntur. Vt: proprietates orbis eccentrici ad amissim saluari etiam possunt per eccentricum ferentem epicyclum, si modo tribuatur concentrico periodus eccentrici, & epicycli conuersio statuatur aequalis vni anomaliae eccentrici restitutioni, & epicycli semidiameter eccentricitati aequalis proportione.

... Cum itaque tot modi ad eundem scopum sese conferant (sicut ab Artificibus Ptolemaeo, eius Commentatore Nicolao Kabasilla, Regiomontano, Copernico & alijs demonstratur), qui nam eorum locum habeant, & in coelo existant, facile discerni non potest, cum omnes sint rationabiles: perpetua tamen & numerorum & apparentiarum consonantia credere cogit, esse eorum aliquos. Artifices igitur maluerunt eos eligere, qui simpliciores essent.

⁵⁸ M. Maestlin, *Comet 1580*, p. 30: *Caput V. Cometam hunc sublunarem non fuisse, sed in alto aethere illuxisse.*

⁵⁹ *Ibid.*, pp. 31-32: *Sed de his certissimum perhibet testimonium parallaxis qua ipse omnino destituebatur, nam etsi ego aliquoties vna & eadem pluribus observationibus motum eius inuestigauit, nunquam tamen maiorem differentiam inueni quam quantam motus ipsius diurnus postulabat. Ex quo non probabiliter, sed ex necessitate euincitur, Cometam hunc non modo omnem elementorum regionem transcendisse, sed in summo aethere locum sibi quaesiuisse.*

Quanquam autem haec omnibus, qui diligenter motum eius inuestigare voluerunt, manifesta esse potuerunt, non tamen dubito, nonnullus nihilominus Cometam istum in hunc inferiorem mundum detracturos, & pro elementari habituros esse, propterea, quod principio isto ualde infirmo fascinati, rem etiam Deo (vt Plinius ait) improbam iudicant, dicere, coelestem machinam mutationum non expertem esse, adeo enim sanctionum veterum Philosophorum tenaces sunt, vt propter eas rectissime factum putent, si euidentissimis experientiae contradicere, nec non proprijs suis obseruationibus vim facere, non pudeat. Stellam, quam ante octennium 16 mensibus vidimus vel etiam ultra, quantis ambagibus quidam sese torquebant, ne aetheream dicerent? Quid de proximo cometa adhuc iam nonnulli sentiant, scriptis nuperrime aeditis testantur, quod videlicet Philosophiae veteris (in cometarum doctrina) coniecturas & auctoritatem etiamnum in tanta veritatis luce pluris faciant, quam certissimas ex diligentissimis obseruationibus demonstrationes Geometricas, quibus sciunt falsitatis nihil inesse.

calculations and deductions made from observations, but he has drawn his conclusions on the basis of many observations rendered even more accurate through the use of instruments, and his reasoning can be checked. It is the teachings of Aristotle about the place, origin, material, and motion of comets and about the upper regions of the air which should be criticised, for in the light of Maestlin's own observations these seem to be pure conjecture originating in Aristotle's own mind rather than in physics. Maestlin comments in conclusion that it is impossible to gain certain knowledge about such phenomena by considering their nature, whereas the measurement of parallax cannot be contradicted.⁶⁰

Maestlin's argument is that if the hypotheses or principles, the observations and the process of argument are all correct, then the conclusions drawn will also be correct. He understands that it is necessary to go through a process of reasoning in order to draw conclusions on the basis of observations, and also that the more observations it is possible to make, the more reliable these conclusions will be. In asserting this, Maestlin is following Aristotelian

⁶⁰ *Ibid.*, pp. 32-34: *Sed hae intelligendo faciunt, vt nihil intelligant, cum enim caeteris minutissimis rebus, oculatissimi, & vt parest, acutissimi censores sint, decebat utique eos, quando proprijs observationibus vel non possunt, vel propter alias occupationes non licet, ea de quibus prolixè disputant, examinare, vt probationes vtriusque partis diuidicassent prius, quam a sententia causam incepissent, quod si fecissent, certe cognouissent, quantum illorum, qui cometam istum elementarum statuerunt, principia vacillent, dum vel infirmis observationibus, quibus error facillime se latenter insinuans, toto coelo errare facit, innixi sunt, vel nullius praecij observationes protulerunt, vel etiam futilibus argumentis, mathematico nomine indignis rem tractarunt. Ego igitur certitudini observationem (non quidem omnium sed quarum fundamenta confirmata sunt, quibus omne quod errori occasionem subministrare potest, praecuetur, Astronomum enim observationibus deditum, nisi magnam prudentiam in tempore, instrumentis, iusto, & commodo stellarum positu, adhibeat, quam facile labi possit, multis experimentis edoctus sum) & inde demonstrationibus Geometricis plus fidei habendum duco, quam illorum pertinaciae, qui veterum sententias, nullis nisi coniecturas comprobatas, veras esse contendunt.*

Haec certe tria hoc octennis noua & insolita in aethere conspecta astra, me conuicerunt, ut quaecunq; Peripateticorum fuit sententia de cometarum loco, ortu, materia, inflammatione, motu, de aëris & ignis regionibus superioribus, &c. mihi suspecta sint, dubitationis in promptu est, quod illa ex physicis vel ex cerebro suo collectis coniecturis, ipsisq; Cometis demum agglutinatis, potius, quam rationibus comprobantur, haec vero phaenomena ex naturae penetralibus per certissimam, quam fallere posse impossibile est, parallaxeos doctrinam, eruditis demonstrationibus contrarium non docent.

principles for the interpretation of phenomena by means of inductive reasoning as described by Planer in his *Scientia Demonstrandi*. Planer asserts that this process can lead to true knowledge, or *scientia*, and points out that the use of induction is the only way to attain knowledge from the evidence of the senses.⁶¹ The evidence of the senses is meaningless without the process of induction which allows particular observations to be understood as universal. It is this transition from the particular to the universal which is vital for the establishment of *scientia*, which must be not only true, but also universal.⁶²

Maestlin identifies this process of drawing conclusions on the basis of observations and reasoning as *a posteriori*, asserting that no *a priori* knowledge of the heavens is possible because it is impossible for human observers, trapped on earth, to see directly what is taking place. Although Maestlin's inductive logic would appear to be conclusive, it is based upon a very different understanding of *a priori* and *a posteriori* from that of Planer. Maestlin does not directly define these terms, but his use of them would indicate that he believes *a priori* knowledge to be knowledge which can be grasped directly, without the use of reasoning, while *a posteriori* knowledge relies on the interpretation of information, in this case in the form of

⁶¹ A. Planer, *Scientia demonstrandi*, pp. 228-230, see especially pp. 229-230: *Quomodo probas ea quae per inductionem cognoscuntur, non sine sensu cognosci? Quod impossibile sit inducere sine sensu ex eo patet, quod omnis inductio dit ex rebus singularibus, res autem singulares solo sensu percipiuntur, non enim contingit singularium accipere & acquirere scientiam alio modo, quam per sensum, quod probari potest duobus illis modis quibus res addiscimus & earum scientias comparamus nobis. Neque enim apodixi & Syllogismo Epagogico aliquid addiscimus, si vniuersale cognitum non adhibemus ad singulare, hocque ipsi καθόλου cognito, per sensum subijciamus. Neque etiam altero modo, quo per inductionem discimus aliquid, discere possumus τὸ καθέκαστον sine sensu, quoniam inductio non est sine sensu: Quoniam ergo scientia non accipitur sine vniuersali, vniuersale autem non accipitur sine inductione, neque induction accipitur sine sensu, liquet scientiam non accipi sine sensu, & sic per consequens εἰ τίς ἀίσθησις ἐκκλέουται, ἀνάγκη ἐπιστήμην τινὰ ἐκκλείουσαι.*

⁶² *Ibid.*, pp. 12-16.

observations, and the drawing of conclusions from it.⁶³ Thus, if it were possible to ascend to the heavens, argues Maestlin, it would be possible to have *a priori* knowledge, but this is not possible for observers trapped on the earth. For Maestlin the distinction between *a priori* and *a posteriori* does not seem to rest upon the type or direction of the proof, but on the necessity or otherwise of a middle, reasoning stage.

Planer defines *a priori* and *a posteriori* rather differently, but more traditionally, as reasoning which derives effects from causes (*a priori*) and causes from effects (*a posteriori*). He associates them too with the Aristotelian distinctions between the demonstration of the fact (ὅτι ἐστὶ, often known as demonstration *quia*) and demonstration of the reasoned fact (διότι, or demonstration *propter quid*). The more certain type of proof is the demonstration of the reasoned fact, for this gives a proof not only that something is, but of why it is: that is, it demonstrates the true cause of the thing's essence, which is not known from a demonstration of the fact.⁶⁴ Although not all demonstrations ὅτι ἐστὶ and demonstrations διότι can be associated with either *a priori* or *a posteriori* reasoning, Planer associates demonstration διότι with reasoning which demonstrates effects and observed phenomena from causes (*a priori*), while reasoning ὅτι ἐστὶ derives the causes from their effects and premisses from their conclusions (*a posteriori*).⁶⁵ Thus for him, *a priori* reasoning, that which argues from causes

⁶³ I am grateful to Paolo Crivelli for bringing this point to my attention.

⁶⁴ A. Planer, *Disputationes logicae tres*, p. 19: *Thesis 1. Non similiter atque una et eadem ratione ea, quae demonstrantur in disciplinis, demonstrari solent, sed alias simpliciter demonstratur aliquid esse, nulla essentiae ipsius causa allata, quae demonstratio ὅτι ἐστὶ vocatur scilicet: interdum autem, non contenti communiore illa notitia, & imperfectiore γνώσει, qua tantum constat nobis rem esse, vltius progredimur, exquirentes etiam veram causam essentiae illius rei, quare nimirum res ita habeat, & hoc modo comparata sit, quae demonstratio διότι vocari solet.*

⁶⁵ A. Planer, *Orationes tres*, p. 62: *Necessaria porro rerum in disciplinis veritas, non vno semper eodemque modo demonstratur, sed alias effectus, παινόμενον & proprium quoddam πῶς per suas certas ostenditur causas, quae διότι est & dicitur demonstratio,*

to effects, produces a stronger proof and more certain knowledge than the *a posteriori* reasoning from effects to causes. Although Maestlin's understanding of *a posteriori* reasoning is rather different from Planer's, Maestlin's reasoning does in fact also fall under Planer's category of *a posteriori*. Since Planer's distinction between *a priori* and *a posteriori* adds the caveat that *a posteriori* reasoning can of itself never produce the most certain proofs, it is in theory impossible for Maestlin's *a posteriori* argument to lead him to certainty.

In fact, Planer (following Aristotle) does allow for the possibility that an *a posteriori* demonstration may be converted into an *a priori* demonstration; or, less specifically, that a demonstration of the fact may be converted into a demonstration of the reasoned fact. This possibility rests upon his distinction of the two types of proof. Within the same discipline, demonstration of the fact differs from demonstration of the reasoned fact in two ways: if something is demonstrated or concluded not immediately (that is, if it is demonstrated by means of a middle term, or a syllogism), the demonstration cannot end in the first cause, for if it did the demonstration would be by the reasoned fact. Alternatively, if a demonstration of the fact is an immediate demonstration, it must be demonstrated through what is 'better known to us,' and not through its cause, since, again, a demonstration through the cause would be a demonstration of the reasoned fact.⁶⁶ A conversion of the

alias per effectum monstratur causa, & praemisse per conclusionem: quod sit in demonstratione ὅτι ἐστὶ.

See also A. Planer, *Scientia demonstrandi*, fol. 5^r: *In hac enim via quidam ab ipsa regia ad ignorantiae scopulos recurrunt, & per priora ac digniora demonstrant posteriora, atque effectus causis illustrant: quidam vero ab ignorantiae specu egressi ad scientiae solium progrediuntur, & per posteriora ac ignobiliora comprobant priora: Causasque ex effectibus & signis inuestigant. ... vnde hae principes appellantur, & demonstrationes τοῦ διότι a priori, illae ministrantes siue mechanicae, atque demonstrationes τοῦ ὅτι a posteriori habere dicuntur.*

⁶⁶ A. Planer, *Disputationes logicae tres*, p. 19: 3. Ἐπίστασθαι τὸ ὅτι & τὸ διότι τῆ αὐτῆς ἐπιστήμης, *duobus modis differt: Primus est demonstrationis ὅτι ἐστὶ in vna & eadem*

demonstration of the fact into a demonstration of the reasoned fact is possible if it can be shown that the middle term of the demonstration is immediate to what is being demonstrated, or if the converse of the argument from the effect to the cause is also true.⁶⁷ There are also two conditions under which such a conversion is impossible: if the middle term cannot be converted it is possible to have knowledge but it is not knowledge of the cause, or if the cause can lead to different middle terms to that which was used in the middle demonstration.⁶⁸ The implication of this when considering arguments from an effect to a cause is that if the cause demonstrated from the effect can have effects other than that from which the cause has been derived, then there can be no knowledge of the reasoned fact, but if it can be shown that the derived cause can only have the observed effect, then the demonstration may be taken to be of the reasoned fact, and, therefore, more certain. This appears to correspond with Maestlin's reasoning for determining that the comets he has observed must be above the lunar sphere: from his measurement of the comet's parallax, he can use a geometrical demonstration to calculate the position of the comet; since this is the only possible geometrical explanation of his measurements he can reason that the measurements he has made from his observation are caused by the comet's position above the moon and conclude that this is the true explanation. The apparent motions of the planets, on the other hand, can be

scientia & disciplina integra modus, quando non immediatis quidpiam demonstratur & concluditur; tunc enim non sumitur prima causa, quod in demonstratione διότι sit: Alter est modus demonstrationum ὅτι ἐστίν, si demonstratur quidem aliquid immediatis, sed tamen non per causam, sed per id, quod notius nobis est inter illa, quae sunt ἀντιστρέφοντα.

⁶⁷ *Ibid.*, p. 20: 4. *Ex demonstratione ὅτι in primo modo efficere possum demonstrationem διότι, si mediatam causam, quae fuerat in demonstratione ὅτι compleuero, & immediatam reddidero; Secundus quoque modus demonstrationis ὅτι transformabitur in demonstrationem διότι, si e conuerso per causam effectum monstraueris, & non per effectum causam, vt antea.*

⁶⁸ *Ibid.*: 5. *Sunt etiam duo modi demonstrationis ὅτι, qui non possunt transmutari in demonstrationem διότι: primus est, quando media non conuertuntur, & est notius tamen id, quod non est causa: Alter est, quando medium extra ponitur, adeoque causa remota pro medio adfertur in secunda figura, non autem prima & immediata causa assignatur.*

explained by several different geometrical formulations, of which the truth of one cannot be judged against that of another.⁶⁹

Maestlin's methodology has three components: his observations, the astronomical hypotheses, and the process of reasoning used to reach the conclusions. The use of hypotheses had been one of the points at issue between Jacob Schegk and Petrus Ramus,⁷⁰ and it also has an important place in Planer's discussion of dialectics. Schegk makes a distinction between hypotheses and axioms. He believes there to be three levels of knowledge: the lowest is that knowledge which is gained through indirect and incomplete proof, the second is the more complete knowledge found through proof itself, and third is the incontrovertible knowledge of metaphysics, which is free of hypothesis. The two lower levels of knowledge depend upon propositions which are generally true, but which are not necessarily true: these are definitions and hypotheses. For Schegk, hypotheses are not true in themselves, as are axioms, but depend on

⁶⁹ Although this is what Maestlin taught, he appears to have been himself convinced that the Copernican system was superior to - and a more accurate depiction of reality than - other hypotheses [see C. Methuen, 'Maestlin's teaching of Copernicus'].

Maestlin's method is essentially the same method as that used by Galileo, as described by Wallace, which is the method of demonstrative regress as described by Zabarella. Wallace points out that 'it is impossible to have a science of astronomy, in the Aristotelian sense of *scientia*, without making use of the demonstrative regress. One cannot begin *a priori* with demonstrations of the reasoned fact for the simple reason that the causes on which such demonstrations would have to be based cannot be sensed immediately. If they are to be known at all, such knowledge can only come through *a posteriori* reasoning' [W. A. Wallace, *Galileo's Logic of Discovery*, especially pp. 194-197; for Zabarella's logical thought see H. Mikkel, *An Aristotelian Response to Renaissance Humanism*].

Zabarella's work on logic cannot have been known to Schegk, since it did not appear until 1578, after Schegk's death. Apian is unlikely to have known it while he was still teaching and although it may have been known to Maestlin and Planer, I have found no reference to it in Tübingen. However, the ideas which shaped Zabarella's thought in Padua may well have found their way to Tübingen with Philip Apian and possibly Johannes Vischer, a professor of medicine who arrived in Tübingen in 1568, both of whom had worked in Ingolstadt, which had close links to Padua. [Biographical details of Apian and Vischer are found in H.-M. Decker-Hauff and W. Setzler, *Imagines Professorum Tubingensium*, vol. 2, pp. 128-129; 154-155.]

⁷⁰ This debate was published in *P. Rami & Jacobi Schegkii epistolae, in quibus de logicae artis institutione agitur*, and continued in Schegk's *Hyperaspistes responsi*.

outside circumstances, rather than upon the internal logic of the proof. There are also true assumptions which are necessary: these are not hypotheses, but hypotheses must be based upon them.⁷¹ Schegk thus introduces the possibility that a hypothesis may be false, although he maintains the Aristotelian understanding that a hypothesis is one of the principles upon which a proof is based.

Planer does not preserve Schegk's distinction between axioms and hypotheses, but he too emphasises the necessity of ensuring that a proof is based upon correct hypotheses. Thus he argues that although the demonstration of certain knowledge is founded upon definition and the use of syllogism, all exact reasoning in every discipline assumes principles - axioms, hypotheses, and postulates - the truth, power, and nature of which must be carefully examined and considered to avoid errors in reasoning.⁷² Failure to do this, together with the 'use - or, better, abuse - of the common principles' which are the basis of the syllogistic process, are common sources of error in reasoning. That such mistakes can be made even by the best philosophers, comments Planer, may be seen from the example of Plato's *Timaeus*, in which Plato derives a different understanding of the elements to that which is described by Aristotle in *De coelo*. Opinions based

⁷¹ W. Risse, *Die Logik der Neuzeit*, I, pp. 256-259.

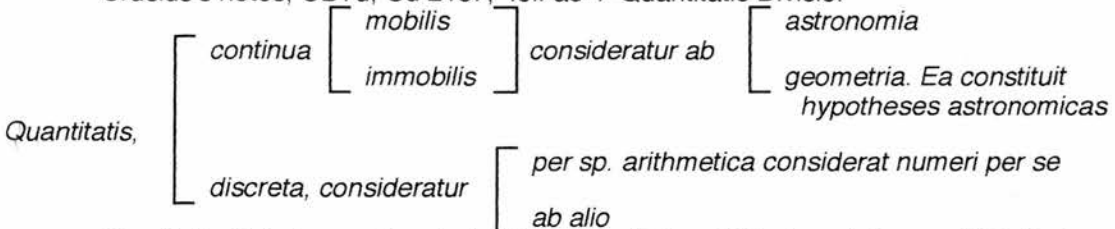
⁷² A. Planer, *Orationes tres*, p. 60: *Nam primum quidem, cum syllogismus ipse Demonstratiuus compositum quidam sit, ac in multos saepe dissolubilis syllogismos, quae dissolutio tam diu procedit, donec in principijs quibusdam definat: diligenter certe principiorum veritas & ratio, vel Platone authore, in omnibus scientijs est consideranda: falsis enim positis & constitutis principijs, subinde in progressu impingimus, & in errores, quod multorum naufragio ostendere possem, incidimus: quippe cum exquisitissimum & necessarium quoque verum, quale in syllogismo consideratur ἀποδεικτικῶ & ἐπιστημονικῶ, non nisi exquisitissimis etiam rationibus & principijs investigetur. Quare principiorum, Axiomatum, hypothesium, postulatorum, quae in omnibus sunt scientijs & facultatibus, vis, natura, conditio, veritas denique, accurate examinanda & ponderanda est. Examinis vero huius principiorum rationem, aurea haec Analyticorum praecepta continent. Principijs illis primis omnium demonstrationum, ne error in progressu irrepere queat, pensitatis, natura etiam terminorum & propositionum consideranda.*

on false hypotheses or principles are erroneous and should be recognised as such.⁷³

Hypotheses are thus of central importance in establishing the basis of a science and the effectiveness of its proofs, as Maestlin himself recognises. But where are these hypotheses and principles to be found? Crusius states quite explicitly that geometry supplies the hypotheses for astronomy,⁷⁴ and Maestlin also comes to this conclusion in his disputation *De astronomiae principalibus*.⁷⁵ This disputation opens with a consideration of the subject matter of mathematics and physics and their relationship to astronomy in which Maestlin compares the objects of physics and of mathematics. The former are natural, mobile bodies, which are subject to corruption and are

⁷³ *Ibid.*, pp. 61-62: *Succedit modo via & ratio inquirendi terminos necessarios, falsa, fallacia, & aliena media, quibus propositum non demonstratur, sed vel paralogismi, vel ψευδογραφημάτων quaedam ijs conficiuntur, vitandi: quam etiam rationem, omnibus numeris absolutam, Demonstrationum praecepta persequuntur, multis vtilissimis Theorematis, de transitu rationem ex genere in genus, de vsu, vel abusu potius communium principiorum, de modis ac differentijs & causis errorum & ignorantiae in omnibus figuris syllosisticis: ques tractatis certe in omnibus scientijs summe vtilis est & necessaria. Quis enim ignorat, quam saepe summi etiam homines, posthabitis illis praeceptis, grauissime in disciplinis hallucinati sint, & etiamnum aberrant? An non vitiosa μεταβάσει de genere in genus, Timaeus apud Platonem primorum corporum naturalium naturas, differentijs figurarum demonstrare fuit saggessus, vtcunque ἀσύμφωνα sint τὰ σχήματα τῶς σώμασιν, auctori Aristotele in lib. de coelo? Et quem latet, Brysonem, tetragonismum probare conatum fuisse, vitiosa ad suum propositum communissimi cuiusdam principij applicatione? Refertae sunt omnes quasi scientiae multis erroribus, opinione & ignorantia aucthorum, vt me herele necessarium plane sit, ex demonstrationum doctrina cancellos omnes errorum probe cognoscere, vt eos vitare & declinare valeamus. Vt enim praeuisa, quod dicitur, tela, minus nocent: sit scopulos quasi errorum & ignorantiae praecognoscens animus noster, minus in illos impingere solet.*

⁷⁴ Crusius's notes, UBTü, Cd 2187, fol. a5^v: *Quantitatis Divisio.*



The similarity between Crusius's schema and Maestlin's description would indicate a common source, which is likely to have been the lectures of Philip Apian. It would also be interesting to investigate possible links with Peter Ramus, who also refers the study of astronomy only to that of geometry [R. Hooykaas, *Humanisme, Science et Réforme*, p. 32].

⁷⁵ Although this is an early disputation, held at Heidelberg, similar theses appear at the beginning of *De multivariis motuum planetarum*, held nearly twenty-five years later. These questions must have occupied Maestlin's mind for much of his university career.

perceived by the senses, while the objects of mathematics are noetic and unchanging, having been abstracted from physical material by the mind. Thus, physics concerns itself with material objects, while mathematics is concerned with the noetic forms hidden in the material.⁷⁶ Thus, notes Crusius, the subject of geometry is noetic, because its 'material cause', that is, ideal triangles, circles, and so on, has been abstracted from material.⁷⁷ The noetic forms may best be seen as quantities, which may be discrete or continuous, mobile or immobile, and it is these that are the subject of different branches of mathematics. Thus, according to Crusius and Maestlin, ultimately following Pythagoras (but probably more immediately Philip Apian), arithmetic and music deal with discrete quantities, while geometry is concerned with the magnitudes of continuous, immobile quantities, and astronomy, which deals with continuous, mobile quantities.⁷⁸ Although astronomy appears in this list of mathematical disciplines, it differs from

⁷⁶ M. Maestlin, *De astronomiae principalibus*, fol. A2^r-v: *quaestio: Cum disputationem de Astronomiae principalibus fundamentis, quibus ipsa, dum explicat, demonstrat & saluat omnes apparentias motus Stellarum, communiter innititur, instituerimus: Quaestione non indignum censemus; Anne Astronomica scientia ad Physicam potius, an vero ad Mathematicam referenda sit?*

Thesis I. Physicae obiectum est Corpus naturale quatenus mobili, αἰσθητόν.

II. Mathematica vero τὰ νοητὰ considerat, ἐξ ἀφαιρέσεως ὄντα, ab omni materia physica abstracta.

III. Hinc cum physica materia propter accidentium contagionem varijs mutationibus obnoxia sit, de ea tantum καθόλου disserere possumus, quae vniversalia in singularibus saepe numero fallere possunt.

III. Mathematica autem materia νοητή; existens, ab illis physicis alterationibus immunis est, ob quam causam, quae ἐν καθόλου de ea demonstrantur (verbi gratia) de Circulo vel Triangulo, quatenus Circulus vel Triangulum est, non quatenus ligneus, aereus, eburneus, &c. rata etiam sunt in omnibus singularibus.

V. Physica ergo formas suas certae PHYSICAE materiae applicatas considerat: Mathematica autem de formis ab illa PHYSICA materia secretas disputat.

VI. Non quod omni materia destituatur. Ea enim vt dictum, νοητή est, longe nobilissima, vtpote quae propter secretionem summam ἀκριβειαν forre potest.

⁷⁷ Crusius's notes, UBTü, Cd 2187, fol. a5^v: *Obiectum, vel Causa materialis Geometriae. Alij materiale, alij immaterialum, dicebant, sed obiectum Geometriae est mediae equidem naturae: nempe imaginarium: abstractum imaginatione a materia: Graeci vocant φαντασμον. Difficilius potest verum demonstrari in Physi. quam in mathematicis.*

⁷⁸ M. Maestlin, *De astronomiae principalibus*, fol. A2^v-A3^r: *XII. Propterea vt omnes Matheseos species sub vno genere comprahenderentur, Pythagorei eas distinxerunt secundum diuersas quantitatis continuae & discretas considerationes.*

XIII. Sub quantitate enim discreta, ea, quae per se spectatur, Arithmetica: sub ea vero, quae alterius comparatione cognoscitur, Musica numerarunt.

XIII. Sic sub quantitate continua immobili, Geometricam: sub mobili, Astronomiam posuerunt.

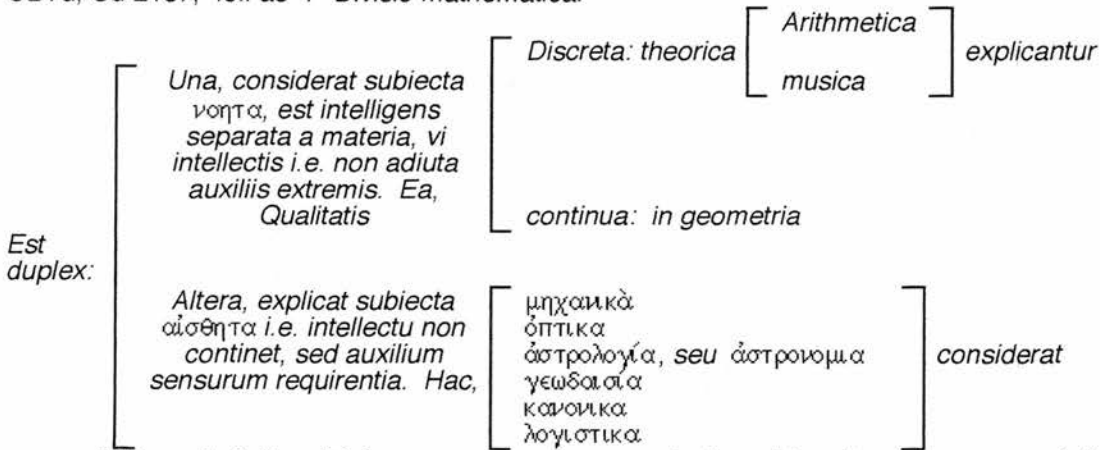
geometry and arithmetic in that its subject is not really noetic at all. The subject of pure geometry, like that of arithmetic, is made up of quantities which exist only in the mind and do not have to be perceived by means of the senses, while the subject of astronomy depends on observational evidence. Thus both Crusius and Maestlin make a further distinction between the subject of geometry and arithmetic, which is noetic, while the subject of astronomy and the other practical mathematical sciences, mechanics, optics, geodesics, canonic (practical music) and logistics (practical arithmetic), requires the aid of the senses.⁷⁹ It is the interpretation of the noetic forms as they appear in the material of the heavens which is the business of astronomy, and thus the principles of astronomy may be said to be supplied by geometry.

This categorisation of astronomy puts it into the philosophical category of a 'subalternated' discipline. Planer shows that the principles of one science

⁷⁹ *Ibid.*, fol. A3^r: XV. *Geminus vero duobus summis generibus distribuit, videlicet τῶν νοητῶν & αἰσθητῶν.*

XVI. *Sub illis compraehendi statuit, Arithmetica, Geometria, & Musicam theoreticam, tanquam quae in materia νοητῆι positae omnino sint a physicis materijs alienae; Sub his vero Astronomiam, Canonicam seu Musicam practicam, Logisticam seu Arithmeticam practicam, Opticam, Geodesiam, Mechanicam posuit, quandoquidem obiectorum Sensilium proprietates ex abstracta Mathematica inquirent.*

Crusius gives a schematic representation of the same distinctions: Crusius's notes, UBTü, Cd 2187, fol. a5^v: *Divisio mathematica.*



This and similar divisions are not uncommon in the sixteenth century: see J. S. Freedman, 'Philosophy Instruction', pp. 127-129.

are not drawn from that science itself, but that they instead must come from another connected, or 'subalternated' discipline. Subalternate disciplines form a *genus* or family of disciplines which deal with the same subject but on different levels. They feed into each other so that the conclusions in one discipline can function as the principles of a lower, subalternated discipline. Planer gives the examples of medicine, which is subalternated to physics, and practical music, which is subalternated to the theory of music.⁸⁰ In his oration on Galen, Planer describes the subalternate relationship between physics and medicine in more detail: medicine is not only a matter of empirical experience and the practical gathering of herbs and roots, but also requires the study of the liberal arts and the understanding of certain reasoning because these enable better understanding of experience and better care of the body.⁸¹ Therefore, knowledge of physics and of causes and reasons as described by Aristotle is necessary to provide a good grounding for the practice of medicine. Galen's *Ars paruae* offers examples of how the different disciplines are linked with one another, for it describes

80 A. Planer, *Disputationes logicae tres*, pp. 20-21: 8. *Composita nonnunquam est ex diuersis disciplinas vnus quaesiti & ἐπιστητοῦ, contemplatio eo quod nimirum alterius sit disciplinae vtrumque, puta, & ὅτι ἐστὶ, & διότι, vnus propositi considerare, siue iam diuersae illae scientiae, sed tamen subalternatae, integrae sint disciplinae, siue tantum particulares quaedam ἐπιστήμαι vnus generis subiecti.*

9. *Scientiarum subalternarum quaedam eodem nomine non veniunt, & appellantur, sed aliud est subalternantis, & aliud subalternatae nomen, vt Physica & Medica; quaedam autem eodem nomine appellantur, & fere συνώνυμοι sunt, vt Musica theorica, & Musica practica eodem nomine appellantur, habent etiam idem subiectum, nempe sonum, sed tamen non sunt simpliciter συνώνυμοι, cum vna sit theorica, altera practica, quae duo ὁπλῶς συνώνυμα non sunt.*

81 A. Planer, *Orationes tres*, pp. 34-35: *Quid, quod vt certa remediorum genera, certosque molitionum Medicarum modos obseruatione quadam in brutis primi deprehenderunt & constituerunt homines Medici, vt Galenus in lib. de sectis docet. Homines etiam Idiotae, vetulae ἀγύρται καὶ ῥιζοτόμοι, in tantum Medicina & Empirica gaudent, qua sibi suisque opitulentur, vt quasi nulla ars sit, quae plures professores habere videatur, quam Medicina. Quanto ergo magis conuenit liberalium artium studiosos & homines eruditos, non tantum Empirica, sed certis rationibus nixa & suffulta artis huius Theoremata quaedam, quae ad salubritatem corporum suorum pertineant, auide & libenter cognoscere velle? Et indignaum profecto est, vt, dum aliarum praestantissimarum artium cognitione animum suum quis excolit, interim corporis sui notitiam & custodiam vsque adeo negligere velit, vt vel idiota quouis, qui saepe magno cum fructu sibi suisque, certis quibusdam experimentis opitulari & consulere nouit, sit ea in re imperitior: cum, quantum aliarum rerum scientia eos antecellat, tanto quoque propriae sanitatis conseruandae notitia eosdem superare debeat.*

the elements and their properties and powers as described in the *Physics*, *De coelo*, *De ortu ac interitu* and the *Meteorologica*.⁸² The elements are the basis of medical knowledge, as both Galen and Hippocrates have said.⁸³ But similar elements can produce different phenomena in different people, depending upon their temperament, and so it is necessary to have skill in conjecture, to seek out the cause of the different phenomena. This is found primarily in physics.⁸⁴ Because medicine is based in physics, it is the method of physics, and especially a careful and exact reading of Aristotle, which are of most use in perfecting the science of medicine, for it is in this way that medicine's principles are established and enabled to bear fruit.⁸⁵ In this way it is true to say that 'the *physicus* ends where the

⁸² *Ibid.*, p. 36: *Atqui non solum ad sanitatem tuendam, notitia huius libri omnibus doctis iuuenibus inseruit, quin potius in hoc libro, longe maximus Philosophiae naturalis vsus et vera exercitatio ostenditur, imo finis, fastigium & extrema manus atque perfectio illius aliqua continetur. Nam nono est, qui ignoret vulgare illud & communissimum dictum, quod ibi incipiat Medicus, vbi desinat Physicus: notum quin etiam est Aristotelis illud, quod de valetudine & morbo, non solum Medici verum etiam Physici sit, aliquo usque causas & rationes reddere: quasi manca adhuc & imperfecta sit Philosophia naturalis, si non ab eiusdem terminis in fines scientiae Medicae perueniamus: cuius vtriusque dicti, illustria in hoc libello habemus exempla. Etenim, quam multa de Elementis, de qualitibus primis & secundis, de earum viribus, efficacia, natura, proprietatibus disserunt ipsi Physici, in quorum cognitione, finem quasi artis suae statuunt, vt videre licet apud Aristotelem lib. 2. & 3. de coelo, primo & secundo de ortu ac interitu, in Meteorologicis, praesertim vero quarto, paruis naturalibus, & alibi.*

⁸³ *Ibid.*, p. 36: *Illam vero & Medici ab Elementis, tanquam primis principijs, suam auspicantur artem, & hinc ad reliqua vterius in arte sua contendunt & procedunt: id quod Hippocratem in libro de Natura humana, & Galenum in lib. de Elementis luculenter praestitisse cuius apparet.*

⁸⁴ *Ibid.*, p. 37: *... talium & similium plurimorum φαινόμενον & effectus, quibus ceu signis in cognitionem temperamenti cuiusque partis peruenire στοιχειωτικῶς licet, causas et rationes petimus, ex vi illa, natura et actionibus qualitatem praesertim primarum, quarum officia generatim quidem descripsit primo ipse Physicus, Medicus vero in specie magis illa excolit, expolit, ac quam late sese diffundant, in artis suae operibus demonstrat: sicuti praeclara eius rei exempla habebimus in generatione & differentijs pilorum, in oculorum symptomatibus, canicie, caluicie, coloribus, in animi moribus & affectibus, ingeniorum diuersitate, & similium eius generis rerum tractatione.*

⁸⁵ *Ibid.*, p. 39: *Proinde, haec mea lectio non tantum Medicis futurus, sed Physicis etiam, vsui futura est: horumquidem notitiam maiore vsu et exercitatione confirmando ac perficiendo, illorum vero artem, vt paulo post monebimus, legitime bonaque methodo constituendo & incipiendo. Nam ut quod sentio dicam, is nequaquam Physicus perfectus mihi videtur, qui lectis vel obiter Acroamaticis Aristotelis libris, de principijs rerum, de forma, de materia, de priuatione, de loco, de inani, de infinito, de tempore, de motu, mouentibus & mobilibus disputare potest, nisi vterius et procedat, ac in terminos veniat scientiae Medicorum. Nam vtcunque praeclarissima illa & liberalis hominis cognitione dignissima sint: non tamen ita magnum vsum habere videntur, si quis simpliciter ijs acquiescat, nec ad prima ascendat Medicorum principia: vbi tum primum deprehendere licet, quinam*

medicus begins,'⁸⁶ and thus medicine is subalternated to physics. In the same way, astronomy may be said to be subalternated to geometry.

But what is astronomy's relationship to physics? For Maestlin, astronomy is concerned with the examination and explanation of the motion of celestial bodies, and this is not a part of physics because the appearance of the motion is explained using mathematical proofs rather than the proofs of physics, which deal with the causes of change rather than with the causes, or explanation, of motion.⁸⁷ Like Crusius, Maestlin makes a distinction between the noetic mathematical sciences, which are arithmetic and geometry, and the remaining mathematical sciences, including astronomy, in which information must be abstracted from what has been perceived by the senses before mathematical reasoning can begin.⁸⁸ However, he is clear that astronomy should be referred to mathematics, and particularly to the pure disciplines of arithmetic and geometry, and not to physics.⁸⁹ Although

communissimorum illorum Philosophiae naturalis Theorematum sit usus fructusque amplissimus.

⁸⁶ *Ibid.*, p. 36 (cited at n. 82 above).

⁸⁷ M. Maestlin, *De astronomiae principalibus*, folA2^v: VII. *Astronomia vero principaliter circa coeleste corpus occupatur, sic vt apparentiarum motus eius causas inuestiget, dimetiatur & numeret. Ipsa enim est scientia, quae motus corporum coelestium scrutatur & explicat.*

VIII. *Ipsam ergo compositam esse patet. Physicae enim propter obiectum seu materiam subiacet: Mathematica vero secretior, videlicet Geometria & Arithmetica suppeditant ei demonstrationes velut formam. Apparentia enim motuum non physicis, sed mathematicis rationibus demonstrantur.*

IX. *Quare sicut Forma dignitate sua materiam antecellit, ita Astronomia, sicut & caeterae scientiae compositae, quae ad physica obiecta demonstrationes ex abstracta Mathematica asciscunt, ad Mathematicam potius, quam ad Physicam referenda est.*

X. *Veruntamen etsi a physicis rationibus omnino abstinet, quia tamen a physica non tantum obiectum, sed & principalia seu prima fundamenta mutuatur: simul etiam probationes eorundem physicas retinet, quales sunt de figura & motu Coeli, figura, motu, seu quiete, loco, magnitudine Terrae.*

Note Maestlin's conviction that he is actually dealing with the motions of the bodies themselves: such attitudes were challenged in contemporary Italian physics, which believed astronomy to be concerned with quantity as applied to the heavens rather than the heavens themselves [W. A. Wallace, *Galileo's Logic of Discovery and Proof*, pp. 108-109]. Neither Maestlin nor Liebler adopted this strict distinction.

⁸⁸ M. Maestlin, *De astronomiae principalibus*, thesis XVI, fol. A3^r, (cited at n. 79 above).

⁸⁹ M. Maestlin, *De astronomiae principalibus*, thesis IX, fol. A2^v (cited at n. 87 above))

Maestlin would be happier if the fundamental principles of astronomy did not conflict with those of physics, he emphasises that the two disciplines have separate concerns. One of Maestlin's major criticisms of Frischlin's *De astronomiae artis ... congruentia* is that in it Frischlin confuses the two disciplines and reproduces the arguments of physics rather than those of mathematics, which are proper to astronomy.⁹⁰

The problem with Maestlin's strict division between astronomy and physics is, of course, that one of the most fundamental presuppositions in his approach to astronomy, namely that the motion of the heavens will be regular, equal and circular on account of the nature of the heavens, is not mathematical at all but based upon his understanding of physics. Moreover, a consideration of the heavens, in the form of Aristotle's *De coelo*, was also taught as part of the physics curriculum.⁹¹ For this reason, Liebler also discusses the relationship between mathematics, including astronomy, or astrology, and physics in his textbook, *Epitome philosophiae naturalis*. Philosophy, for Liebler, is the science that seeks to know and explain nature and substance. Although Liebler discusses other divisions of philosophy, including those of Plutarch and Plato, Liebler accepts the Aristotelian understanding that philosophy is made up of theology, mathematics and physics, of which categories physics is the lowest.⁹² The subject of physics

⁹⁰ M. Maestlin, *Iudicium de opere astronomico D. Frischlini*, fol. 3^v-5^v.

⁹¹ The status of astronomy had been confused from the time of Aristotle, who defined it to be a mathematical science in the *Metaphysics*, but treated it in *De coelo* and the *Physics* as the part of physics closest to mathematics [N. Jardine, *The Birth of History and Philosophy of Science*, p. 229].

⁹² G. Liebler, *Epitome philosophiae naturalis* (1589), pp. 1-6, especially p. 1: *Atque tum Philosophia definienda erit, Naturalium diuinarumque substantiarum scientia & explicatio. Interdum pro iis accipitur disciplinis omnibus, quae veritatis tantum & scientiae causa exquiruntur, quarum tres ab Aristotele numerantur lib. 6. Altioris Philosophiae: Mathematica, Physica & Theologica, siue sublimior quam sit Physica, Philosophia.*

is the change and alteration that takes place in natural bodies.⁹³ Like Maestlin, Liebler argues that mathematics deals with quantities, without motion or change, whereas physics considers the material things themselves, with their motion and change. However, for Liebler it is obvious that the mathematician and *physicus* are concerned with the same 'natural bodies,' and he believes that it is also important not to lose sight of the connection between the form and the material.⁹⁴ Liebler sees astronomy as one of several 'mixed sciences' which mediate between the pure mathematical disciplines, arithmetic and geometry, and physics. These mixed sciences have a natural subject, but use mathematical proofs. Since the mathematical sciences, and particularly the mixed sciences, are concerned with the same material subject as physics, Liebler is unable to preserve the strict distinction between the two disciplines advocated by Maestlin. Liebler is convinced that the two types of knowledge must be related to each other, and that one kind of reasoning must lead to the other, especially since mathematics can only define and prove form, while the uses of physics are far wider.⁹⁵ The difference between, astronomy and physics,

⁹³ *Ibid.*, pp. 6-7: *De Physica*: ... *Nunc de Physica dicimus, quam Cicero vertit naturae obscuritatem, siue de natura & rebus occultis doctrinam, siue naturae rationem: sed sub illa comprehendit etiam Theologiam, seu primam Philosophiam, & Mathematicam. Nos hoc loco accipiemus vocabulum Physices sue Physiologias in propria & genuina significatione. Deriuatur enim a verbo φύω, quod significat nascor siue orior: quo significatur, esse illam cognitionem earum duntaxat rerum quae oriuntur & occidunt, quatenus oriuntur & occidunt. Quare illam libet sic definire: Physica est scientia naturalium substantiarum siue corporum: hoc est, quae docet & explicat omnium rerum quae natura subsistant, & caducarum, principia, causas, effectus, partes, denique omnes proprietates, quaeque illis per se insunt. Ergo & principiorum tractatio ad physicam pertinet, cum sine principiis substantia cognosci non possit: & temporis, motus, loci, infiniti, cum sint propria substantiarum naturalium. Aeternitatem vero nunquam illis tribuit meus libellus.*

⁹⁴ *Ibid.*, p. 58: *Cum Mathematicus & Physicus considerent ea quae in sunt corpori naturali, quaenam inter utrumque, est discrepentia?*

Haec est. Mathematicus species quantitatis, quae suae scientiae sunt subiectae, sine motu considerat: & proinde a materia abstrahit, nec eas quatenus in materia sunt definit, aut proprietates earum exquirat. Physicae vero res, quia sine motu intellegi non possunt, a subiectis quibus necessario insunt, seiungi nequeant: qua propter ita definiuntur & considerantur a physico, vt forma cum materia semper copulata intelligatur esse.

⁹⁵ *Ibid.*, p. 59: *Porro, vt hoc quoque obiter admoneam, duae tantum sunt disciplinae pure mathematicae, Arithmetica et Geometria: reliqua, vt Musica, Astrologia, Optica, mixtae sunt, & mediae inter mathematicas & physicas, eo quod subiecta quidem habeant naturalia,*

then, is not so much their subject-matter, which is identical, but their arguments, or proofs, which differ significantly, and the breadth of application of these proofs. In Liebler's view, physics, unlike astronomy, is concerned primarily with causes. Just as the concern of physics to establish causes and effects had led Melanchthon to distinguish astrology (as part of physics) from superstition, so too does a similar distinction allow physics to be distinguished from astronomy. Physics is concerned with celestial bodies in so far as their movements produce effects on earth, while Maestlin, although concerned to discover the 'causes' of this motion in the form of mathematical solutions, is not interested in any possible causation of natures. In this way his interest in the celestial bodies is quite different from that of Liebler, whose discussion of celestial bodies in physics is very much focused on the effects which the stars may have on the earth, particularly in terms of the weather that they initiate.⁹⁶

seu mobilia (vt Astrologus coeleste corpus, Musicus sonus, Opticus radium seu lineam visuam) sed demonstrationes ad illas adhibeant mathematicas. ... Nam quae Mathematicus considerat, sunt omnia propria corporis naturalis: quemadmodum & quae physicus. Explicandum igitur ante omnia discrimen fuit vtriusque disciplinae. Et mathematicus vno tantum causae genere demonstrat & definit, nempe forma: physicus omnibus vtitur.

⁹⁶ *Ibid.*, pp. 234-236: *Qua substantia sunt astra? Eadem est substantia astrorum, quae orbium in quibus sunt: id quod non solum ijs quae hactenus dicta sunt, consonum est, sed etiam veterum auctoritate probatur. Nam qui igneum esse coelum putabant, eiusdem quoque naturae astra esse concedebant. Nobis tamen, quod astris inferiora haec calefiant, persuadere non debet, igneam illis esse substantiam. Caloris enim illius non ignis, sed motionis celeritas causa est: quemadmodum alias etiam res motu incalescere cernimus. Ita quidem hoc loco Aristoteles. Mihi tamen non videtur calorem in his inferioribus a motu stellarum fieri, nisi ex accidente: imo sol si non moueretur, sed perpetuo verticibus nostris immineret, multo maiorem adferret aestum. Mouetur autem coelum non vt calefaciat, sed vt vires suas astra cum subiectis partibus, alijs atque alijs communicent pro materiae recipientis habilitate. Nec verum esse arbitror, quod Mirandulanus libro aduersus Astrologos tertio contendit, Coeli praeter communem luminis & motus influentiam nullam peculiarem vim esse: sed coelesti quidem calore haec inferiora viuificari & vegetari: frigus autem & siccitatem ex accidente fieri. Vidimus enim hybernos quosdam dies admodum calidos, & contra aestiuos valde frigidus: quod fieri non posse existimo, nisi astris quibusdam peculiaris aliqua vis inesset, hisce qualitibus inferiora haec corpora afficiendi. Vires autem illas astrorum a proprijs ipsorum formis prouenire arbitror: vt ab Orione atque Praesepibus humorem, a Canicula aestum, a Cynosura aut Helice frigus. cuius accessione nostrum hoc frigus adeo intenditur, vt etiam glacies creetur. Illud autem fieri non potest tantum priuatione, vt Cardanus censet. nam priuationis nulla est vis aut efficacia. Stellae vero, vt redeamus ad Aristotelem, in suis sphaeris ita mouentur, vt ipsae quidem non ignescant: aër autem qui infra illas est, incalescit, atque ea maxime parte qua sol est. Proinde eius accessu & recessu aestas & hyems creatur.*

While Liebler does not follow Melanchthon by including a discussion of the effects of the stars upon human nature in his account of the effects of the stars, he does echo Melanchthon's dismissal of the anti-astrological stance of Pico della Mirandola, teaching that it is the nature of the stars to have effects upon earth. For him, then, physics is concerned to establish these relationships while astronomy is concerned to establish ways of understanding the movements of the celestial bodies, which may then be used by physics. Thus, despite Maestlin's reluctance to assert any close relationship between the subject of physics and that of the mathematical sciences, both he and Liebler categorise astronomy as one of a group of mathematical sciences which can only be known through the senses and which are subordinate to arithmetic and geometry. Astronomy is thus subalternated to both geometry and physics, a possibility which seems not to be envisaged by Planer.⁹⁷ This status is, however, common to all the mixed sciences, which, as Liebler explains, refer to the same 'natural bodies' as physics, but treat them mathematically. What distinguishes astronomy from the other mixed sciences, however, is its subject. It is the only mixed science to deal with the heavens, and thus the only one in which one can be 'sure' of the principles of motion, since it is only the material of the heavens which is perfect and generates only circular motion.⁹⁸ This knowledge provides Maestlin with the hypothesis he needs to define the 'language' in which the heavens are written, and thus with the means of interpreting observations.

⁹⁷ Paduan logicians taught that sciences might be subalternated by principles or by subject or by end, and that while physics could subalternate to itself only practical sciences, mathematics could subalternate both speculative and practical sciences [W. A. Wallace, *Galileo's Logic of Discovery and Proof*, pp. 102; 107].

⁹⁸ Liebler states this quite explicitly in his discussion of the substance from which the heavens are made [G. Liebler, *Epitome philosophiae naturalis* (1589), pp. 118-119: *An vero corporis coelestis perfectioni id non repugnat, cuius motus est omnium perfectissimus: qui autem per accidens sit motus, reliquis est posterior: cum omne accidens ex aliquo quod per se sit dependeat, & nexum sit? Quod coelum per accidens in loco esse dicitur imperfectionem motus eius non arguit*].

Maestlin's emphasis on the need to interpret observations is one of his major points of difference with Liebler. Although Liebler, unlike Maestlin, emphasises that the two disciplines are concerned with the same bodies treated in different ways, he does not bring into his discussion the question of how information about the phenomena under consideration is to be gained. For Liebler physics is not an empirical study, but involves the reading and proper understanding of the works of Aristotle and other philosophers such as Plato and Pythagoras. Perhaps Liebler is reacting here against Ramus's belief that physics should be based in some kind of empiricism,⁹⁹ for he is certainly a decided opponent of Ramus, and a stern critic of what he saw as Ramus's inability properly to differentiate between disciplines. Liebler's prime criticism is of what he sees as Ramus's failure to distinguish between metaphysics and theology, but he is also concerned to defend the boundaries of other sciences. Liebler's concern about the dangers inherent in Ramus's work was great enough to induce him to add a defence of Aristotelian natural philosophy against Ramus's criticism of Aristotle to editions of his *Epitome philosophia naturalis* published in and after 1575, devoting a special preface and substantial passages of his text to an explanation of the 'pernicious sophistry' of Ramus's position and an explanation of why it was not tenable.¹⁰⁰ It must be said, however, that Liebler does not specifically defend natural philosophy against the charge that it should be more empirical; he simply treats it as a totally non-empirical study. Liebler's position is consistent with his belief that the works of the ancient philosophers, in particular Aristotle, but also Plato, Pliny, Plutarch,

⁹⁹ R. Hooykaas, *Humanisme, Science et Réforme*, pp. 33-44, especially 33-35.

¹⁰⁰ G. Liebler, *Epitome philosophiae naturalis* (1589), fol. β4^rff., and sections throughout the work. This *Praefatio ad lectorem* appears in all editions from 1575.

and to a lesser extent Pythagoras, describe the universe as it has been created by God,¹⁰¹ so that the making of observations about the natural bodies under consideration is simply not necessary to the study of physics. Physics involves a consideration of the natures of these different bodies and the ways in which they interact, as defined by the philosophers. Liebler, therefore, has nothing to offer in support of Maestlin's observationally based methodology. Nor does Planer, who as a professor of medicine might be expected to have made some appeal to direct observation. He, however, seems to have held firmly to traditional Galenic understandings of his discipline and not to have adopted the more empirical approach of Vesal.¹⁰² Astronomy, on the other hand, concerns itself with observed phenomena, and cannot help but appeal to observation.

It follows from this that an important difference between astronomy and physics is the kind of proofs which the two disciplines offer. The proofs of physics are derived from the nature and material of the bodies, their effects and causes, while the proofs of astronomy are mathematical. Thus the third component of Maestlin's astronomical methodology is the use of geometrical and arithmetical reasoning, often regarded (not only by Melanchthon) as having the most certain proofs. From the context in which Maestlin refers to these demonstrations, it is clear that he at least is referring to actual mathematical arguments, using mathematical terms and quantities. However, this is not always the case: the claims for the strength of

101 *Ibid.*, fol. 9^f-v.

102 For a discussion of the beginnings of empiricism in medicine, see R. Toellner, '*Renata dissectionis ars*', and see also J. J. Bylebyl, 'The School of Padua'. Paracelsian medicine probably arrived in Tübingen with Jacob Heß, who taught in Tübingen's medical faculty from 1599 until 1613. For the influence of Heß on Johann Valentin Andreae and his Rosicrucian circle, see M. Brecht, 'Johann Valentin Andreae', pp. 280-283. Christoph Besold, the Tübingen lawyer, was involved on the fringes of this group.

mathematical or geometrical proof seem in some cases to refer to a way of arguing rather than to actual mathematical processes. Thus when Grynaeus argues that mathematical principles should guide the interpretation of observational evidence since the certainty of geometrical method and the elegance of mathematical proof will yield the most certain results possible, and because such proofs are not subject to the same kind of disputes as are the meanings of words, he seems to be bordering on the application of the principles of mathematical proof to other disciplines.¹⁰³ The certainty of geometrical demonstration, the beauty of its proofs and its use in demonstration also make up the most important of the 'uses of geometry' noted by Crusius in his comments on Grynaeus's preface; Crusius attributes this methodological insight to Galen and to Aristotle in the *Posterior Analytics*,¹⁰⁴ and these authorities probably lie at the root of Schegk's concern with mathematical proof, the application of which also seems not to be restricted to the mathematical sciences. The emphasis on the elegance and strength of 'geometrical proof' is also found in Schegk's work in the context of his struggle towards 'a conception of method as the instrument for distinguishing the true from the false in all the sciences.' Schegk followed Themistius and other commentators who had illustrated Aristotle's theory of knowledge through reference to Euclidean theorems. Their work led Schegk to investigate geometry in the light of the principles of the *Posterior Analytics*,

¹⁰³ See p. 155 above.

¹⁰⁴ Crusius's notes, UBTü, Cd 2187, fol. a5^v: *Utilitates Geometriae*. 1. Hoc studium, quod a praestantiss. viris excultum, honestiss. est. 2. Geometria certis demonstrationibus certitudinem rerum exprimit: contra Academicos, qui de omnibus rebus dubitabant. 3. etsi doctrina de Deo est Ecclesiae propria: tamen etiam in universa mathematica inuenitur et satis clara de Deo sunt testimonia. 4. In Geometria pulcherima methodus est: quam in alijs etiam studijs multi secuti sunt. 5. sine ea, aliae artes perfecte disci non possunt. Huic uetustissima per honore argenta, petita: huius Dialectica extracta: et Arist. in Analyt. post. 6. Aditum Geometria facit ad reliquas partes Astronomiae. 7. Galenus scribit, se nunquam intellexisse Demonstrationes: priusquam didicerit Geometriam. Volebant veteres pueros 14 annorum ad Geometrias et Arithmeticos duci: quia aliter ad altiora ipsos ascendere non posse putabant.

an enterprise which was 'deliberately chosen to offset the literary and poetical traditions of the rhetoricizing tradition.'¹⁰⁵ The proofs of Euclidean geometry, unlike those of syllogistic method, allow the establishment of an ascending series of propositions, each of which may in turn be used as the basis for further proofs. Perhaps it was this which encouraged Schegk to apply geometrical principles to dialectics. This endeavour was another point of conflict between Ramus and Schegk,¹⁰⁶ but it met with considerable appreciation in Tübingen, and Liebler praises Schegk for applying the demonstrations of mathematics and the proofs of Euclid in his approach to all philosophy.¹⁰⁷

Planer regards the proofs of mathematics as having a special certainty, but does not believe that they may be applied to other disciplines. In his discussion of proof he makes it clear that he follows Aristotle in holding that the fewer and simpler the principles of a science, the more elegant the science, so that for him arithmetic is a more elegant science than geometry, because the latter deals with points which have position, whereas the former deals with 'points' which have no position or substance.¹⁰⁸ The further away from the material, or substantial, it is possible to get, the more elegant the science. Thus he argues that mathematical proofs, like those in the other 'higher sciences', are always certain, while those in the subalternate

¹⁰⁵ N. W. Gilbert, *Renaissance Concepts of Method*, pp. 158-162.

¹⁰⁶ Ramus maintained that mathematics does not have the most powerful demonstrations [N. W. Gilbert, *Renaissance Concepts of Method*, p. 162]; the question of whether or not mathematical reasoning was causal was the subject of much debate in Italy in the second half of the sixteenth century, particularly in Jesuit circles [W. A. Wallace, *Galileo's Logic of Discovery and Proof*, pp. 111-114].

¹⁰⁷ G. Liebler, *Oratio funebris de vita ... D. Iacobi Schegkii*, pp. 8-10.

¹⁰⁸ A. Planer, *Disputationes logicae tres*, p. 23: 19. *Tertius modus ἀκριβείας scientiarum est, quod illa scientia sit exquisitior & accuratior, quae ex simplicioribus & prioribus, adeoque paucioribus, principijs & causis procedit, quam illa, quae procedit ex compositis, & quae se habent ex appositione, quo nomine Geometria minus est exquisita, quam Arithmetica, cum vnitas, quam haec considerat, sit οὐσία ὄρετος, punctum autem, de quo agit Geometria, sit substantia habens positionem.*

sciences are not.¹⁰⁹ Planer views mathematical reasoning as offering demonstrations which are at the same time of the fact and of the reasoned fact, because the cause is not accidental to a mathematical proposition. In this the mathematical disciplines are different from other disciplines.¹¹⁰ Planer is not at all convinced that such proofs can be applied outside mathematics, or, indeed, that any proofs can be applied in other disciplines. He points out, as Luther had, that the same word or term may have different meanings in different disciplines, and that this precludes the transfer of proofs from one discipline to another. The only exceptions to this rule are the subalternated disciplines, in which the lower disciplines and, therefore, their terms, are 'contained' in the higher.¹¹¹ In these cases, Planer seems to

¹⁰⁹ A. Planer, *Disputationes logicae tres*, thesis 10, p. 21: ... *sed considerare τὸ ἴδιον pertinet ad superiores & Mathematicas, quae absque sensu causas & rationes rerum mente contemplantur, & subiectum secretum absque materia naturali & sensibili considerant, quo accidit, ut saepe ignorent ipsum ὅτι ἐστὶν in rebus singularibus, quod cognitum habent inferiores & practici.*

¹¹⁰ A. Planer, *Scientia demonstrandi*, p. 167: *Sed in Mathematicis disciplinis simul est τὸ ὄν, & τὸ ἴδιον, nec prius conclusae mathematica vera esse cognoscantur, quam fuerint causis suis demonstrata, sed simul ambo percipiuntur & cognoscuntur, quoniam nimirum Mathematica secreta sunt, nec praeter formam & definitionem rei, aliam aliquam causam est accidens ad demonstrandum assumant Mathematici, sed tales duntaxat terminos, qui per se de se inuicem praedicantur, & vndiqueque sunt reciproci ac ἀντίστροφα, quod in alijs disciplinis tamen, quarum rationes non διαγράφουσι, sed διαλόγοις constant & perficiuntur, fieri non solet.*

¹¹¹ *Ibid.*, pp. 93-95: *Declara exemplo, qua ratione nimirum ex scientia in scientiam non possit fieri transitus in demonstrando, si plane diuersa sunt subjecta? in Geometria, inquit Aristoteles, demonstrari non potest, sed contrariorum sit eadem scientia: pertinet enim huius demonstratio ad Metaphysicam, quae contemplatur ens quatenus ens, sicuti Geometria considerat ens, non quatenus ens, sed quatenus continuum. Haec autem plane sunt diuersa subiecta, ens quatenus ens, & ens non quatenus est ens, sed quatenus continuum. Quare ad Gemetriam non pertinebit demonstrare quod vna sit scientia contrariorum, sed tantum ad Metaphysicam.*

Sed nunquid tunc potest fieri transitus, si subjectum nomine sit idem? Profecto nec tunc potest fieri transitus, si subjectum nomine sit idem, reipsa autem diuersam, sed & tum ad idem genus pertinent extrema & media demonstrationum, nec extra illud scientia euagatur, cum quae sunt extra, rebus subiectis accidant, & per se nullo modo possint inesse. Vnde Geometria non potest vel debet demonstrare quod duo cubi constituent vnum cubum, seu non docet duplare cubum, quomodo duo cubi sint vnus cubus, & qua ratione vnus cubus duobus sit aequalis. Etiam si .n. Geometra de cubo quoque disserat, & hac ratione subiectum nomine sit idem: aliud tamen cubum vocat, & aliud Arithmeticus. Sic iniustitia & iniustitia etiam si commune sit vocabulum, quod consideratur a Theologo & ab Ethico, tamen non habent eadem propria & media, quae ex Ethica in Theologiam, vel contra, transferre non debent. Quemadmodum autem modo diximus in Geometria non posse aut debere etiam demonstrari, quod contrariorum sit vna scientia, sed neque quod duo cubi sint vnus cubus, ita generatim & in vniuersum neque quaeuis alia scientia potest vel debet demonstrare, nisi si quaedam ἐπιστήματα ita se habent ad se inuicem, ut vnum sub altero contineatur, sicuti se habet optica ad Geometriam, & Musica ad Arithmeticam.

be talking only about demonstrations in mathematical sciences in the sense of the proofs which are contained within each science (such as geometrical proofs within geometry), and not about mathematical demonstrations applied within other mathematical sciences (such as the use of geometry in astronomy) or even in quite other contexts. The certainty of mathematical proof is emphasised by the contrast Planer makes between the proofs of mathematics and those of other proofs within philosophy: echoing Grynaeus's assertion that mathematics is surer than words, Planer notes that mathematical proofs are not susceptible to fallacies in the same way as proofs in dialectics, since mathematical terms are not open to misinterpretation in the same way that philosophical terms are.¹¹² But Planer also comments that mathematical proofs are not suitable to all subjects, so that it is necessary to tailor the method to the subject matter since a more subtle, persuasive method is more appropriate to some areas of knowledge, such as ethics, just as mathematicians do not need to be persuaded of the truth of their propositions through orations.¹¹³ Clearly Planer knows of cases in which mathematical proof - or the methodology of mathematical proof - has been applied to other disciplines, but it cannot be said how this was done.¹¹⁴ The terms of this comment suggest that the use of mathematical, or geometrical, method was so much an accepted part of dialectics in Tübingen that justification had to be found for the use of other

¹¹² A. Planer, *Disputationes logicae tres*, p. 17: *In Mathematicis & disciplinis non similiter paralogismus est & committitur, atque in Dialecticis disputationibus: quoniam nulla est homonymia, cum ante demonstrationem praecognoscatur statim, quid nomine cum subiecti, tum praedicati, tum vero praesertim etiam medij, intelligatur: In Dialecticis vero disputationibus facilius in paralogismos propter homonymiam quis labitur, cum eandem non distinguat Dialecticus, sed indefinite arripiens vocabula non raro paralogismum conficit.*

¹¹³ A. Planer, *Orationes tres*, p. 63: *Notum enim est illud Aristotelis ex Metaphysices libro α. minore, quo monet, τὴν ἀκριστολογίαν μαθηματικὴν, non in omnibus artibus exquirendam esse, & illud primo Ethicorum, quo dicit, eruditi esse, subtilitatem requirere in omni genere eatenus, quo ad rei natura patiat. nec Mathematicarum Oratorijs πιστεῖσθαι persuadere debere, nec ab Oratore necessarium rationem requirendam.*

¹¹⁴ A study of the work of Jacob Schegk might offer some enlightenment on this point.

methods in the non-mathematical sciences. Knowledge of this application of mathematical proof is not, however, restricted to Planer: the use of the term 'mathematical proof' to denote proofs which are not always mathematical in the stricter sense may also be observed in the works of Heerbrand and Andreae, both of whom contrast the claims of 'mathematical' or 'geometrical' proofs unfavourably with those of 'theological' proof.¹¹⁵ Heerbrand, at least, is referring here to more general philosophical proofs, such as those offered by Aristotle for the eternity of the world. These, however, are not the type of proofs which Maestlin means when he writes of the use of geometrical methods.

Although Heerbrand and Andreae use the term 'mathematical proof' to refer to rather different reasoning from than used by Maestlin, the contrast they draw between this and 'theological proof' offers a salutary reminder that ultimately all these measures of truth are to be judged theologically. This position is shared by Maestlin. For all his attempts to come up with a convincing methodology, he still turns to the Bible as the ultimate authority to allow him to use these philosophical proofs to their full potential. It is precisely because he is able to argue his exact observations are the response to a biblical injunction that he is able to use the results of these observations to contradict the teachings of Aristotle. Since biblical authority is superior to that of authority, observations made as a result of such a biblical exhortation can also be assigned an authority which supersedes Aristotle's. Maestlin cannot, however, be said to be anti-Aristotelian. His criticism of Aristotle is not severe, being a contradiction of only a quite minor part of Aristotle's cosmology. Moreover, Maestlin's methodology almost

¹¹⁵ See above, ch. 3 n. 93, pp. 127-128.

certainly has its origins in his understanding of Aristotelian dialectic, and the 'astronomical principles' upon which this methodology rests still depend upon the Aristotelian understanding of the hierarchy of the heavens. Despite his realisation that Aristotle's cometary theory was wrong, Maestlin seems never to have questioned the idea that what moved above the moon was perfect, just as he never queried the hypothesis that all celestial motion must be circular. His criticism of Aristotle was criticism of a particular, and comparatively minor, part of *De coelo*, not of the whole Aristotelian corpus or of Aristotelian methodology.

Similarly, both Liebler and Planer see philosophical authority as subordinate to, but consistent with, biblical truth. Neither shows any tendency to doubt the established Peripatetic philosophy, and although Planer does set out to treat the ancient philosophers critically, this amounts to a criticism of the views of Plato and other ancient philosophers when they oppose Aristotle. But the tone at Tübingen cannot be said to have been anti-Aristotelian. The university seems to have known no sweeping criticism of Aristotle of the kind made by Ramus in his *Aristotelicae animaduersiones*, despite Ramus's criticism of Aristotle's being well known there through his dispute with Schegk. Indeed, his successors (who were, after all, also his pupils) seem to have followed Schegk in being more inclined to spring to Aristotle's defence than to join the attack, and Schegk's work established a tradition of criticism of Ramus's position which was continued by the next generation of professors. Thus Liebler, as has been noted above, angled his textbook to defend Aristotle against Ramus, and Planer included in his oration on dialectic method a few pungent remarks about Ramus's failure to distinguish

between different kinds of proof.¹¹⁶ This does not, however, mean that Ramism can be excluded as an influence at Tübingen since students at Tübingen in the 1580s were exposed to arguments against Aristotelianism through the medium of such apologetic.¹¹⁷

Ramist philosophy is of course not the only possible influence in Tübingen. Although the curriculum was based upon the works of Aristotle, the works of Liebler, and to a lesser extent those of Planer, are leavened by appeals to other philosophers. Plato and Pythagoras, noticeable for their absence in Maestlin's discussion of the stars, make a more than fleeting appearance in Liebler's *Epitome philosophiae naturalis*. Planer mentions Plato's *Timaeus*, and its (in his view erroneous) views on creation, in his oration on dialectics,¹¹⁸ and discusses Plato's theory of ideas at length in his *Scientia demonstrandi*.¹¹⁹ The names of the Italian Neoplatonist school are, however, almost entirely absent: of them only Pico della Mirandola warrants a mention. Perhaps their ideas had not yet permeated to Tübingen; if they had, they were clearly not seen as major new contributions to the understanding of the truth. Nor was actual observation of the natural world regarded as important, except by Maestlin; Liebler's physics owes nothing to new observations, but is concerned to bring together the wisdom of ancient philosophers in the best possible synthesis.

In the second half of the sixteenth century, then, members of the arts faculty in Tübingen were seeking the best way to establish a philosophy which

116 A. Planer, *Orationes tres*, pp. 60-61.

117 Annotations in a copy of the 1586 edition of Liebler's *Epitome philosophiae naturalis* which belonged to Johannes Fabri, a student in the arts faculty from 1598 to 1600, show that he was interested in Ramus's criticisms of Aristotle [UBTü Aa 833].

118 A. Planer, *Orationes tres*, pp. 61-62.

119 A. Planer, *Scientia demonstrandi*, pp. 133-139.

would not be susceptible to sophistry and delusion. In approaching this task they tended to discount rhetorical proof, appealing rather to dialectics. There was a general recognition of the strength of mathematical proof, and a tendency to encourage the use of 'geometrical proofs' in philosophy. Some questions about the authority of ancient philosophers, especially Plato, were being raised, but the basis of their methodology was still firmly Aristotelian. Although criticisms of Aristotelian logic were known and discussed within the faculty, Aristotelian authority remained almost unchallenged.

Maestlin was in some ways an exception to this rule, for he was prepared to use his own observations as the basis for criticising some aspects of Aristotelian cosmology. However, he never criticised Aristotle wholesale, and in fact the very methodology upon which he based the authority of his observations was Aristotelian in origin. Further, his astronomy relied on the traditional Aristotelian understanding of the heavens as perfect, even though Maestlin had concluded that change could take place in this region if it was willed by God. Thus astronomy in Tübingen, like celestial physics, was still shaped by a strong sense that everything above the moon is perfect. And, like the study of natural philosophy as a whole, it was conducted in terms of the conviction that, ultimately, everything that takes place in nature can, and does, reveal God.

conclusion

This thesis makes no claim to be an exhaustive study of the University of Tübingen in the late sixteenth century. There is still much work to be done, particularly in the fields of natural philosophy and logic, before it will be possible to gain a full picture of the university and its life. What has been attempted here is the identification of interactions between the theological and philosophical thinking of the professors at the University of Tübingen while Kepler was a student there, focusing in particular upon attitudes towards the study of nature, the potential of the natural world to reveal God, and the ways in which the true interpretation of the natural world could be identified.

Nature's capacity to reveal God is an important aspect of the thought of Melanchthon, as has been shown by both Kusukawa and Frank, and re-emphasised here, with particular attention paid to Melanchthon's understanding of astronomy. Kusukawa has suggested that the emphasis on natural philosophy present in Melanchthon's thought was the mark of a specifically Lutheran approach to natural philosophy. She may be right in suggesting that Melanchthon's approach to the natural world was quite different to that of Calvin or Zwingli, but the evidence of Lutheranism as it was manifested in Tübingen in the late sixteenth century suggests that not all Lutherans were as keen as Melanchthon to emphasise the study of nature. The theologian Jacob Andreae and the maverick poetics professor

Nicodemus Frischlin both viewed the study of nature more with suspicion than with enthusiasm. Nor does Matthias Hafenreffer display any interest in the study of the natural world, despite his characterisation of it as the *liber naturae*. There is, however, a strand of Lutheran theology, more positive in its attitude towards the study of nature, which can be traced directly from Melanchthon to Kepler: Jacob Heerbrand, one of Tübingen's professors of theology and a teacher of Kepler, had been a student of Melanchthon in Wittenberg. Heerbrand taught that God is revealed not only in the Bible but also through the natural world. The understanding of the ubiquity of Christ, with its possible interpretation of the whole world as God's body, seems to be less important here than Heerbrand's theology of providence and in particular his conviction that it was important to understand the normal workings of providence, as well as God's special actions in the world. Herein lies Heerbrand's major difference from Andreae, since the latter was more concerned with pointing to God's special providential actions. For Heerbrand, the possibility that the natural world could reveal the normal workings of God's providence, and thus God's intentions for the world, meant that the study of the natural world must be taken seriously. The subject of this study is not only nature, in the sense of natural phenomena such as plants, animals, and the human body, but also society and, most importantly, the movements of the heavenly bodies. Thus Heerbrand, in practice if not in theory, regards the heavens as especially important in revealing God's intentions for the world. In this Heerbrand follows Melanchthon.

The privileging of astronomy is an important aspect of Melanchthon's discussion of the ways in which nature may reveal God. Melanchthon draws on both biblical and philosophical traditions here. The Bible teaches that

God is revealed in the natural world; the idea that the essence of nature is mathematical may be traced back to Plato and Pythagoras; the belief that the heavens are made of more perfect material than that of the sublunar sphere is however, purely Aristotelian. This Aristotelian understanding, combined with a theological conception of evil which lays the blame for sin on the misuse of human will, supports the notion that the heavens, still in their pristine, created condition, may reveal God better than can any other natural phenomena.

A similar conviction that the study of the heavens can achieve a better knowledge of God informs the work of Michael Maestlin, and almost certainly lies behind Kepler's theological approach to astronomy. This has, of course, already been pointed out by Hübner and others; what can be added to their analyses is the suggestion that this understanding is rooted in a Christian astrology which allows celestial phenomena to be interpreted explicitly as God's messages for the world. Maestlin uses this theological justification as a basis for his belief that the study of the heavens should be the most exact study possible since, he argues, the more accurate the observations made, the better the knowledge of God's intentions that will be attained. While he is not the first to assert this principle - it too may be found in the works of Melanchthon - Maestlin is one of the first to put it into practice by using his own observations to correct the views of ancient philosophers. In doing this, Maestlin draws on and articulates an explicit methodology by which he hopes to identify with some certainty the most accurate possible interpretation of the heavens.

Maestlin's methodology calls upon Aristotelian principles of logic and proof, also taught to Kepler at Tübingen. Notably, Maestlin states that there are three phases to establishing accurate proof: the observations, which should be as accurate and exact as possible; the reasoning, which should be geometrical; and the hypotheses. Maestlin is concerned more with the first two elements of his methodology: he seeks to make his observations more accurate and to use the most certain method of reasoning, namely that found in geometry. However, he draws his hypotheses about the 'perfection' of planetary motion directly from physics and does not question them. Planer on the other hand places some emphasis on the necessity of establishing the truth of hypotheses. Given Maestlin's methodology and Planer's insistence on the need to check the truth of hypotheses, it is surely no coincidence that, when his calculation of the orbit of Mars yields a result which is far less accurate than the observations upon which it is based, Kepler is led to question the hypothesis that the motion of celestial bodies must be circular. Like Maestlin, Kepler could be sure that his observations were the most accurate possible, and, also like Maestlin, he was using geometrical methods, also the most certain possible. Therefore, if accurate observation and correct calculation still lead to incorrect results, the fault must lie with the hypothesis, the third element of Maestlin's methodology. In this way Kepler is able to discard a conviction which had been central to the work of Maestlin and astronomers down the ages, that of the circular motion of the heavens. Thus Kepler, using Maestlin's methodology, is able to go one step further than Maestlin, and to discard this age-old assumption that perfect material will yield 'perfect', that is, circular, motion.

Theologically and logically, Kepler can justify this step in the same way that Maestlin had done: God set up the heavens to be viewed exactly, and to do that, it is necessary to take a critical attitude towards, and if necessary discard, the false conclusions or hypotheses of earlier commentators. His approach is based on his explicit application of the Augustinian motif of the *liber naturae*, learned no doubt from Heerbrand's theological lectures and textbook. This motif not only encourages the study of the natural world, but also implies that the heavens should be interpreted according to humanist ideals. It thus allows a critical approach to authorities, such as Aristotle, and the strong possibility that they might be wrong, and a way of interpretation, which is found in Maestlin's adaptation of Aristotelian dialectics. Although Maestlin was prepared only to challenge a minor aspect of Aristotle's cosmology, that the credit for making the step away from received authority to observational authority should be given to Maestlin and those of his colleagues who stuck to their convictions in the matter of the heights of the stella nova and comets, rather than to Kepler, whose more radical conclusions simply took the same principles further. Whether other observers, such as Peter and Philip Apian or Tycho Brahe, were motivated by similar theological arguments to those used by Maestlin and Kepler is a question which would bear further investigation.

Maestlin seems to have penned his theological justification for the study of astronomy in the supreme conviction, shared by all those of his contemporaries who have been considered here, that the study of God's two books would not produce contradictions. This conviction can also be found in Heerbrand's understanding of biblical interpretation, which emphasises that there is only one interpretation of the Bible. It is rooted in theological

and philosophical belief that there is only one truth which is internally consistent and can be known. This was widely held throughout the sixteenth century and beyond. The idea that all truth is consistent with the Bible seems not to have been a major problem for Maestlin, although it may have been one of the reasons why he maintained in his teaching that the question of whether the earth or the stars moved was one which could not be conclusively settled. By teaching this view, Maestlin was able to practice an astronomy which was open to new developments but still consistent with literal biblical interpretation. Kepler, who was a confessed advocate of the Copernican system, was forced back to the four-fold interpretation of the Bible so derided by Heerbrand: the biblical statements about the sun's standing still must be seen as relative or metaphorical statements.

Despite his awareness that Copernicanism may cause problems for a literal biblical interpretation, Kepler remains insistent that the study of the *liber naturae* and that of the *liber scripturae* must be combined. Indeed, he has a deep theological need to maintain the link between them, for otherwise he would be unable to justify his astronomical work by saying that it is to the glory of God. Kepler's work is, however, already throwing up criticisms of biblical authority similar to those which Maestlin had made of Aristotle. As confidence in the kind of scientific methodology and observation used by Maestlin and Kepler grew, the criticisms of the Bible became more severe. It is ironic that it was a concern for biblical theology and the tools of biblical interpretation which led the fledgling natural sciences into a position from which their practitioners had ultimately to question the authority of the Bible as it had been understood in the sixteenth century.

Clearly Kepler could have found inspiration for the motivation and methodology of his theological astronomy in the works of his professors at Tübingen. Nevertheless, several factors might be said to be 'missing' from Tübingen. One is the role of reason. Although Planer is convinced that the search for truth is the search for the ultimate *mens*, and Liebler associates the divine *mens* with the order of the world, there is little sense of the identification of reason and nature which will be found in the thinkers of the Enlightenment. Certainly it is not one of the major motivations for the study of the heavens, at least among professors in Tübingen. Another absence, perhaps related to the first, is that of the ideas of Nicholas Cusanus, who, as noted in the introduction, has been identified as one of the most important philosophical influences upon Kepler. Although Kepler himself speaks of having read Cusanus's work while at Tübingen, he is not considered in the work of any of Kepler's professors. This may mean that Cusanus was a discovery that Kepler made for himself, or it might be a reflection of the limitations of printed sources rather than of the actual situation (what people talk about may not be that same as what they are prepared to print). In any case Kepler could and clearly did read for himself works that were not included in the official curriculum, and Cusanus's works may have been among these.

A third absent factor is one of the major surprises of this study. Melanchthon had identified astronomy as the way to understanding the mind of Plato's geometer God, but this motif seems to have been of little interest to Tübingen's professors. Where is Platonism? Where, for that matter, is Neoplatonism, or the Hermetic trends which are to be found in Kepler's thought? They seem not to have been at all current in Tübingen's university

circles. The only possible candidate as a source of Platonism among Kepler's teachers is Georg Liebler, who certainly knew of the work of Pico della Mirandola and had read Scaliger's *Exotic exercises*, said by Kepler to have been popular among his generation of students. There appear to have been no debates about the Neoplatonic tradition at Tübingen, no discussions of alchemy, not even much attention paid to Paracelsian medicine. This apparent absence of Hermeticism and Neoplatonism is remarkable, especially given the appearance of the Rosicrucian circle in Tübingen scarcely a generation later. What, it may well be asked, was going on in Tübingen outside the university?

Perhaps, however, the search for these traditions is less pressing than it might at first seem. In Kepler's case, at least, the stimulus to observe and to attempt to relate his observations to the truth need not have come from any explicitly hermetic or alchemical tendencies, since it could be found in Maestlin's methodology. The example of Maestlin shows that the biblical exhortation to study the heavens, coupled with the use of Aristotelian logic in the derivation of authoritative proof, was in the late sixteenth century already producing results which conflicted with Aristotelian physics, and, ultimately, also with the Bible. For Kepler and his contemporaries the Reformation's emphasis on a literal interpretation of the Bible and a Lutheran tendency to seek God's providence in nature could easily act as the stimulus to an astronomy in praise of God. Once the step away from Aristotelian authority had been made, the intellectual problems which were to arise from taking seriously the biblical call for observation of the heavens were already in the making, for the questioning of Aristotle's understanding would lead ultimately to a questioning of biblical authority. But these problems were still in the

future, and the truth, theological and scientific, could still be assumed to be one. For Kepler, his education at Tübingen acted not as a deterrent, but as a stimulus to a theological mathematics.

appendix one: holders of university posts 1550-1600

tables

i) Faculty of Theology¹

	1st <i>ordinarius</i> Chancellor Ducal advisor	2nd <i>ordinarius</i> 1st superintendent of the <i>Stift</i> , Dean of the <i>Stiftskirche</i>	3rd <i>ordinarius</i> Pastor of the <i>Stiftskirche</i>	<i>extraordinarius</i> 2nd superintendent of the <i>Stift</i>
1550	Johannes Brenz 1534-1561			
1560	Jacob Andreae 1561-1590	Jacob Heerbrand 1557-1590	Dietrich Schnepf 1556-1586	Johannes Brenz jun. 1562-1590
1570				
1580			S. Gerlach 1587-90	
1590	Jacob Heerbrand 1590-1599	Stephan Gerlach 1590-1612	vacant 1590-92	
1600			Matth. Hafenreffer 1592-1612	Joh. Georg Sigwart 1590-1618

From 1576-1590, the university appointed a *supernumerarius* to cover Andreae's lectures:
 1580-1587: Stephan Gerlach
 1587-1590: Joh. Georg Sigwart

ii) Faculty of Arts²

	Mathematics and Astronomy	Geometry and Euclid	Physics	Organon
1550	Philip Imser 1537-1557*	Johann Scheubel 1543-1570	J. Schegk 1536-52	
1560	Sam. Isenmenger 1557-1567+			Johann Hylebrand 1556-1564
	Joh. Bloss 1568-69		Georg Liebler 1552-1594	Jacob Schegk 1564-1577
1570	Philip Apian	1570-1583		
1580				
1590	Michael Maestlin	1583-1631		
1600				Michael Ziegler 1594-1615

* Feb. 1557-Sept. 1557: Johann Hylebrand

+ Spring 1568: Johann Hylebrand

July 1568-Sept. 1570: Johann Bloss

¹ See E. Conrad, 'Die Lehrstühle der Universität Tübingen und ihre Inhaber', pp. 8-9.

² See N. Hofmann, *Artistenfakultät*, pp. 238-250.

	Ethics	Rhetorik	Greek language and poetics	Latin poetics and history
1550	Matthias Garbitius 1544-1559	Paul Calwer 1553-1556	Matthias Garbitius 1537-1559	Melchior Volmar 1543-1556
		B Mettelin 1557-59		short app'ts*
1560	Samuel Heiland 1559-1592	Georg Hitzler 1559-1587	Martin Crusius 1559-1607	S. Culingius 1561-7
1570				
1580				
1590	Veit Müller 1592-1626	Martin Crusius 1584-1607		
1600				

* 1556-1558: Johann Seckerwitz
 1558-1560: Michael Toxites
 June-Aug 1560: Johann Seckerwitz

For details of the holders of other posts, such as Hebrew and Music, see N. Hofmann, *Artistenfakultät*, pp. 238-250.

iii) Faculty of Medicine³

	1st <i>ordinarius</i>	2nd <i>ordinarius</i>	3rd <i>ordinarius</i>
1550	Leonard Fuchs 1535-1566		Jacob Schegk 1553-1577
1560			
1570	Johannes Vischer 1568-1587	Georg Hamberger 1568-1599	Andreas Planer 1578-1606
1580			
1590	Daniel Mögling 1587-1603		
1600			

iv) Faculty of Law⁴

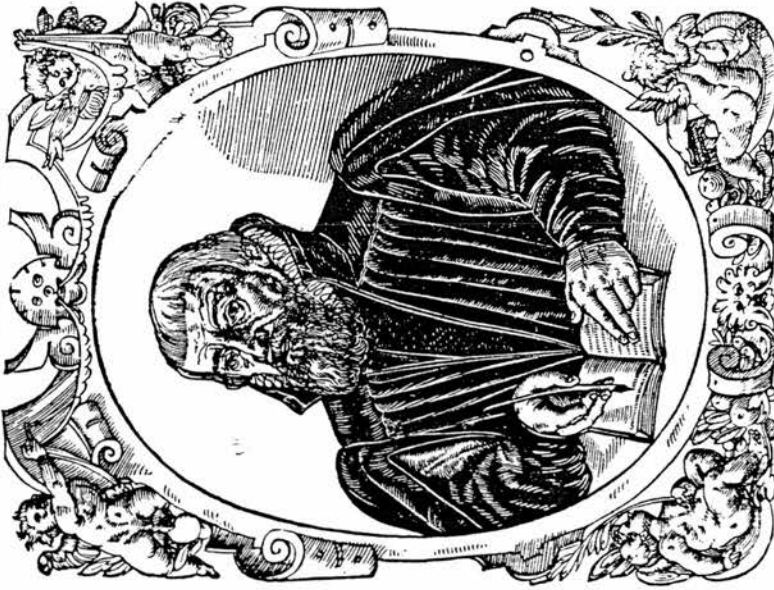
	1st <i>ordinarius</i>	2nd <i>ordinarius</i>	3rd <i>ordinarius</i>	4th <i>ordinarius</i>	5th <i>ordinarius</i>	6th <i>ordinarius</i>
1550			Jacob Cappelbeck 1543-1584	Nikolaus Varnbühler 1544-1591		Chilian Vogler 1553-1585
1560	Anastasius Demler 1521-1591	Johannes Hochmann 1561-1603				
1570						
1580					Andreas Laubmeier 1581-1595	
1590			Matthias Enzlin 1585-1613		Johannes Halbritter 1560-1627	
1600						

³ See H. Röckelin and C. Bumiller, *Nikodemus Frischlin*, pp.44-45.

⁴ See H. Röckelin and C. Bumiller, *Nikodemus Frischlin*, pp.44-45.

plates

I M A G O
 Reuerendi & Clarissimi Viri, Dn.
 IACOBI HEERBRANDI, SS. THEOLOGI & DO-
 ctoris, & eiusdem in iudicia Tubingensi Academiæ Professoris, ibidemq[ue]
 Ecclesiæ Præpositi, & apud Academiam Cancellarij, nec non illu-
 strissimi Ducis VVuerttembergici, D.D. FRIDERICI
 C. I. & Conſiliarij dignissimi. Anno Ætatis 75.



Jacob Heerbrand
 reproduced from Erhard Cellius, *Imagines Professorum
 Tubingensium*, p. 38

I M A G O
 Reuerendi & clarissimi Viri, Dn.
 MATTHIÆ HAFENREFFER, SS. THEOLO-
 gicæ Doctores, & Professoris in iudicia Tubingensi Academiæ, ibidemq[ue]
 illustrijs Stipendijs Superintendentis vigilantissimi:
 Anno Ætatis 36.



Matthias Hafenreffer
 reproduced from Erhard Cellius, *Imagines Professorum
 Tubingensium*, p. 42

I M A G O
 Clarissimi Viri, Dn.
MICHAELIS MAESTLINI, MATHEMATI-
carum Artium, in inclita Tubingensi Academia Professoris:
 Anno Christiano 1596. *Ætatis 45.*



Michael Maestlin
 reproduced from Erhard Cellius, *Imagines Professorum Tubingensium*, p. 84

I M A G O
 Clarissimi Viri, Dn.
MARTINI CRYSII, V. LINGVÆ, ET
Oratorie in inclita Tubingensi Academia Professoris: Anno
Christi 1596. Ætatis 70.



Martin Crusius
 reproduced from Erhard Cellius, *Imagines Professorum Tubingensium*, p. 80

I M A G O

Clarissimi Viri, Dn.

GEORGII LIEBLER, PHYSICES IN INCLYTA
Tubingensi Academia Professoris & Pedagogarchae VVirttembergica
unde donati: Anno Christiano 1596. Aetatis 70.



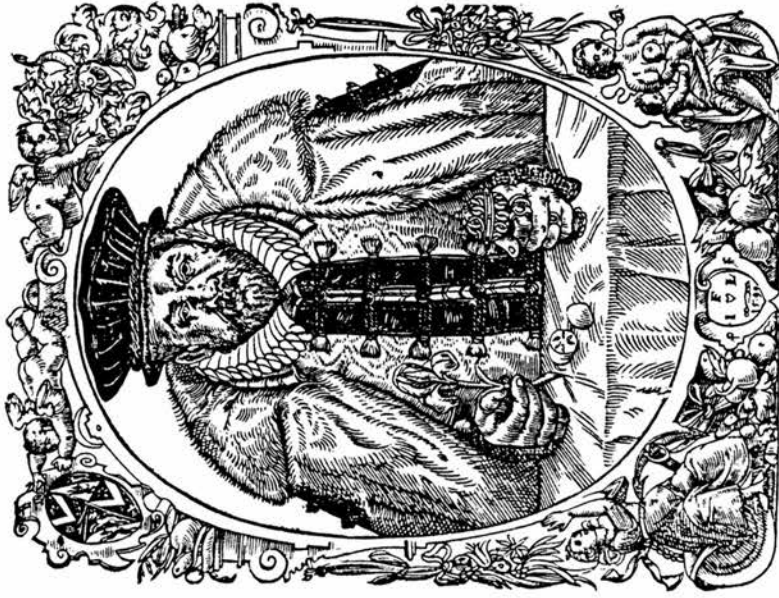
Georg Liebler

reproduced from Erhard Cellius, *Imagines Professorum*
Tubingensium, p. 78

I M A G O

Nobilis & Clarissimi Viri, Dn.

ANDREAE PLANERI, PHILOSOPHICAE, AC
Medicine Doctoris, ac vtriusq[ue] in Academia Tubingensi
Professoris: Anno Christiano 1596. Aetatis 30.



Andreas Planer

reproduced from Erhard Cellius, *Imagines Professorum*
Tubingensium, p. 70



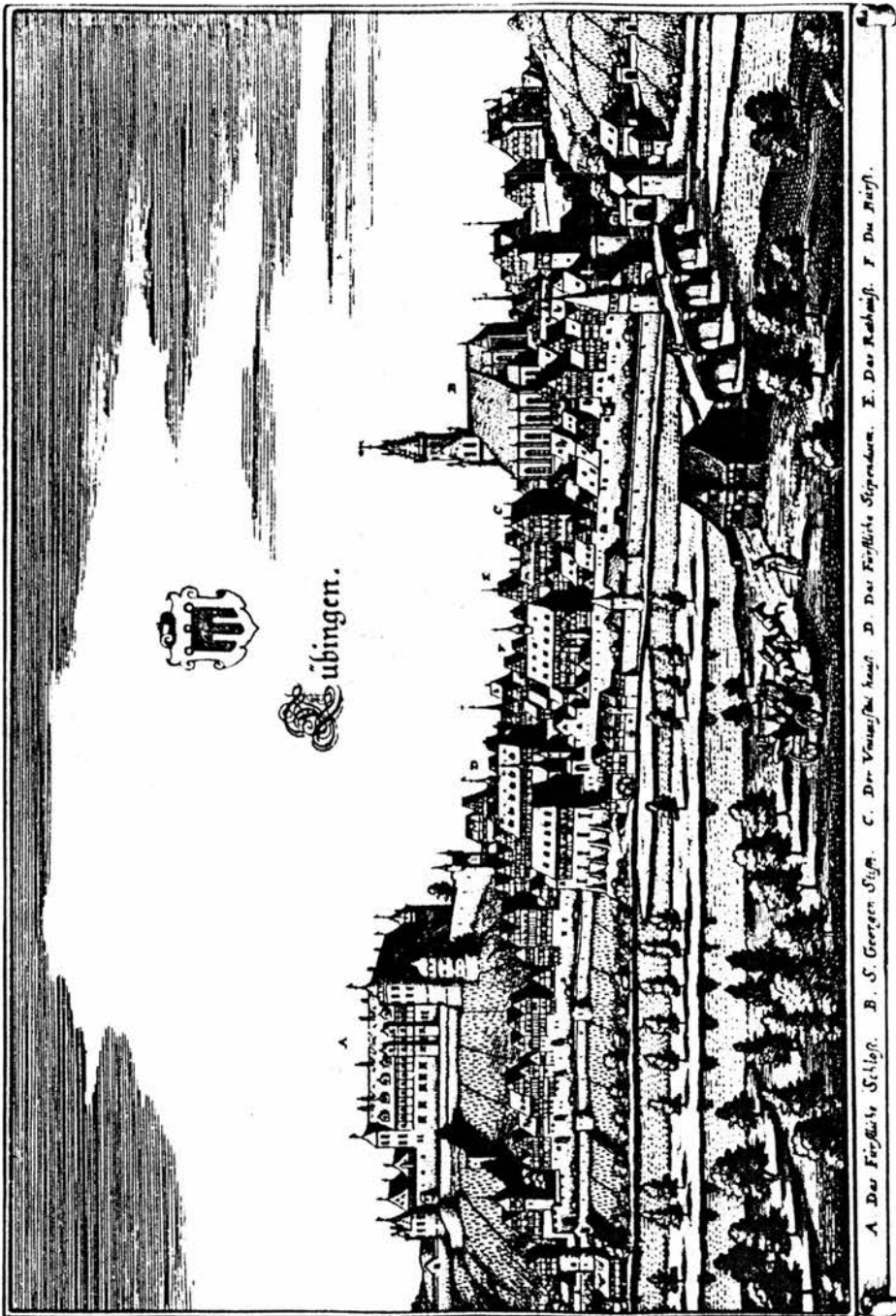
Philip Melancthon
reproduced from Hedwig Röcklein and Casimir Bumiller,
Nicodemus Frischlin, p.56



Nicodemus Frischlin
reproduced from Hedwig Röcklein and Casimir Bumiller,
Nicodemus Frischlin, p.56



Johannes Kepler
reproduced from Johannes Hemleben, *Kepler*, p. 139



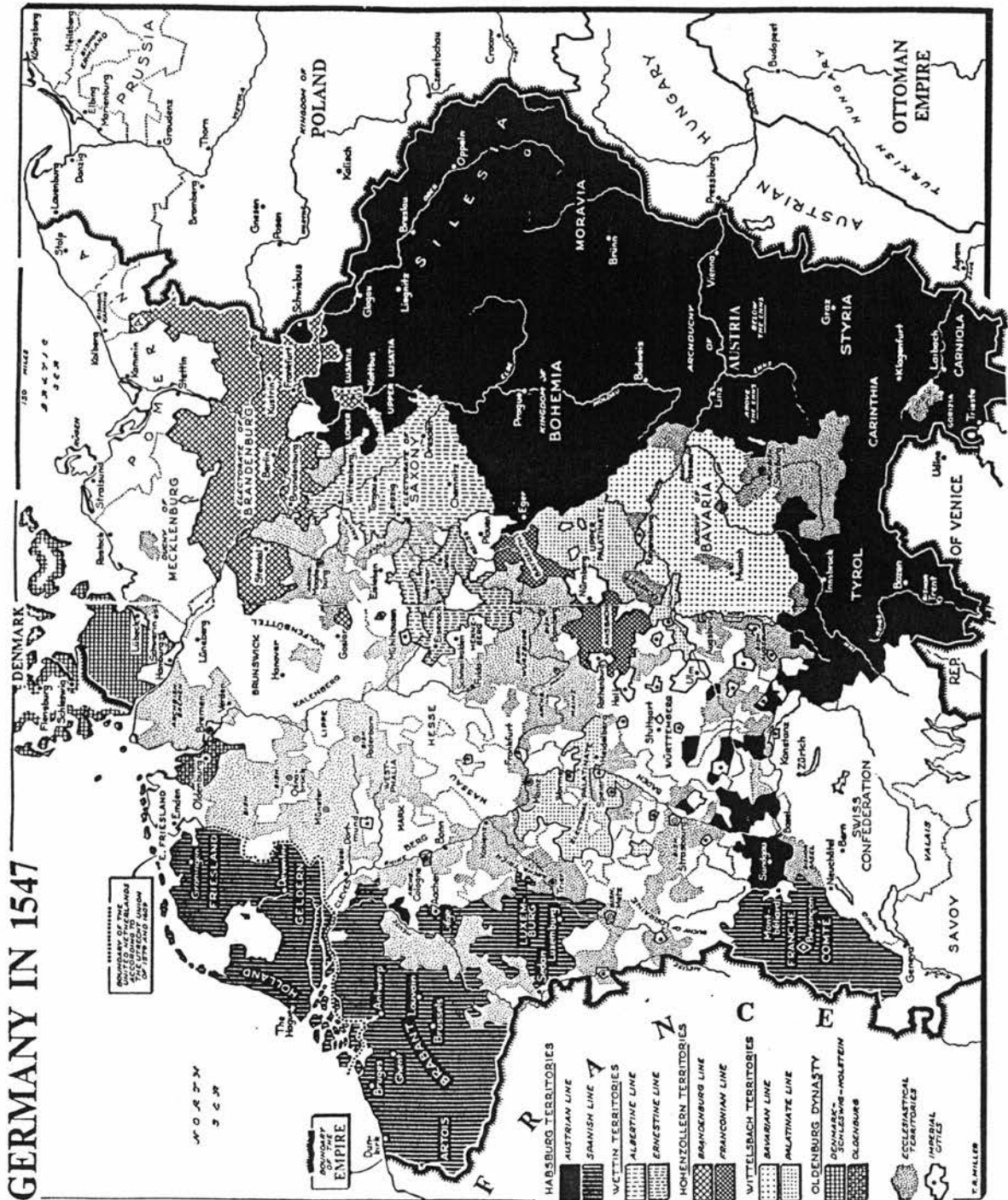
Tübingen in 1643, showing the Stiftskirche (B), University (C) and Stift (D)
reproduced from postcard from Gebrüder Metz Verlag

appendix two

maps

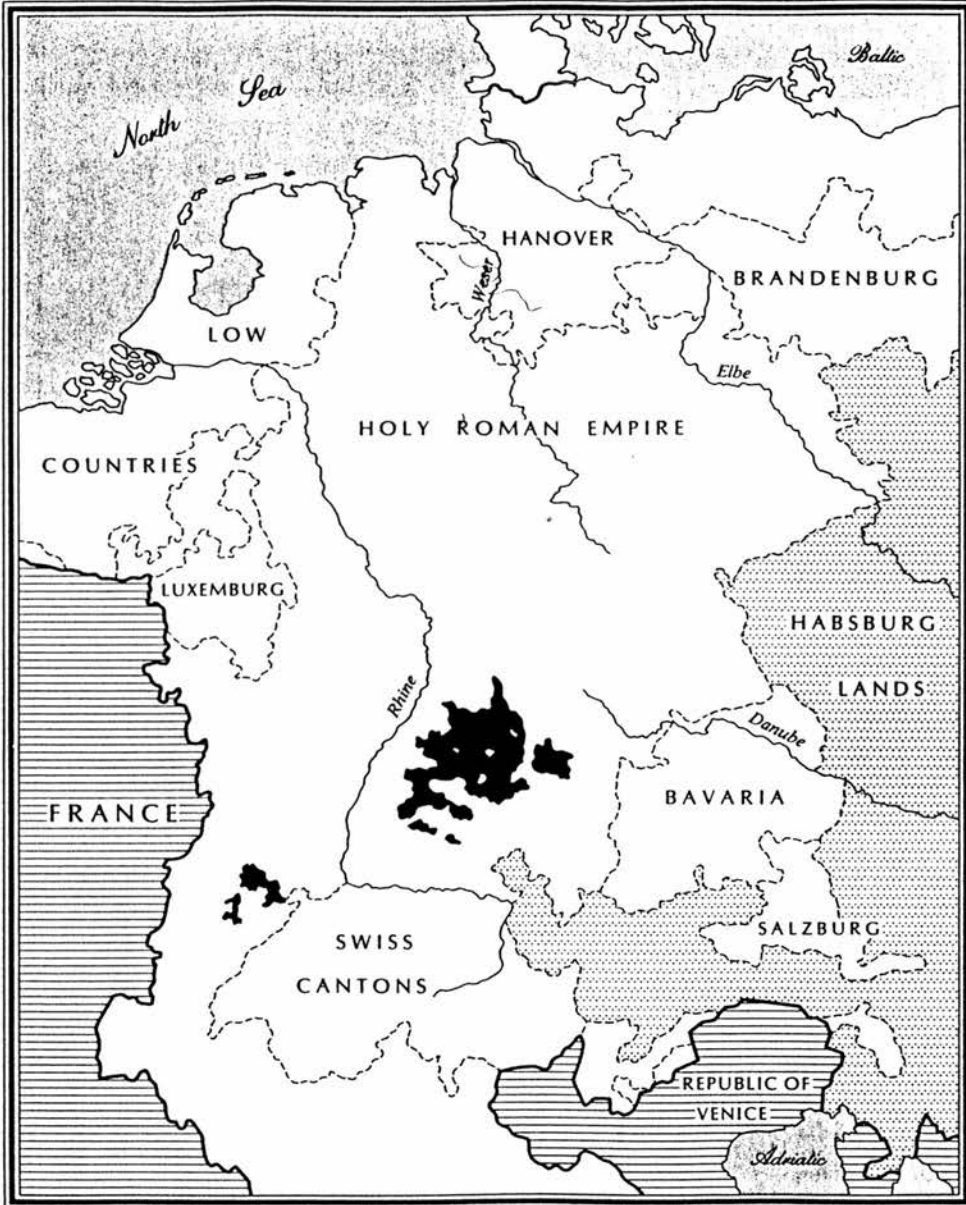
i) Germany 1547

reproduced from Hajo Holborn, *A History of Modern Germany: The Reformation*, pp. 202-203



ii) **Württemberg in the Holy Roman Empire**

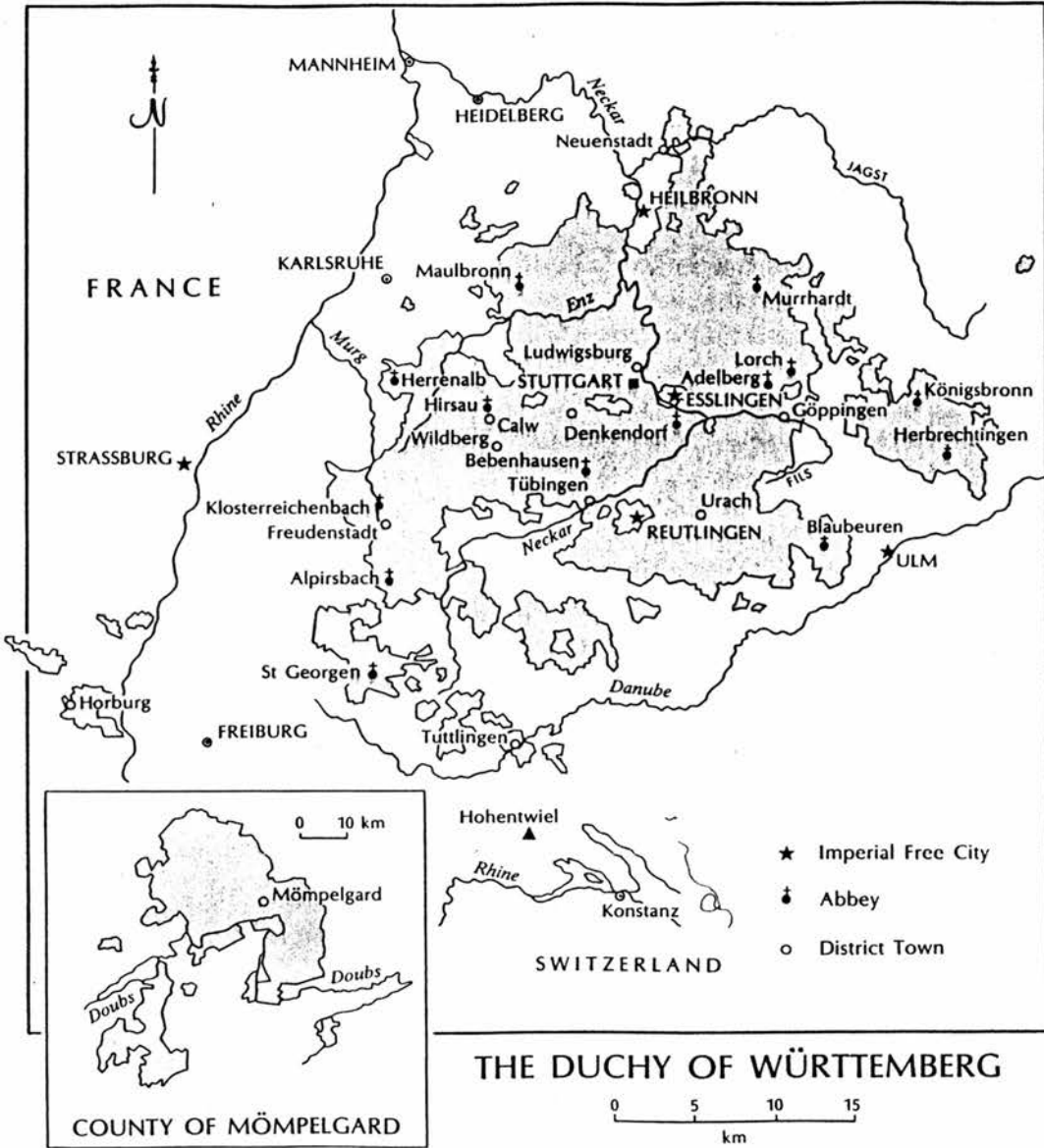
reproduced from James A. Vann, *The Making of a State: Württemberg 1593-1793*,
frontispiece



WÜRTTEMBERG IN THE HOLY ROMAN EMPIRE

ii) The Duchy of Württemberg

reproduced from James A. Vann, *The Making of a State: Württemberg 1593-1793*, p. 49



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abbreviations

i) works

- ARG** *Archiv für Reformationsgeschichte.*
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- CHRP** **Charles Schmitt, Eckhard Keßler and Quentin Skinner** (eds), *The Cambridge History of Renaissance Philosophy*, Cambridge University Press, Cambridge 1988.
- CR** **C. G. Bretschneider** (ed), *Corpus Reformatorum*, vols 1-21, C. A. Schwetschke, Halle 1834-1860.
- CRE** **Craig R. Thompson** (ed), *The Collected Works of Erasmus*, University of Toronto Press, Toronto/Buffalo/London 1975-.
- DSB** **Charles Couston Gillespie** (ed), *Dictionary of Scientific Biography*, Scribners, New York 1970-1980.
- Hist Ed Quart* *History of Education Quarterly.*
- Hist Sci* *History of Science.*
- Hist Uni* *History of Universities.*
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- KGW** **Max Caspar, W. von Dyck and Franz Hammer** (eds), *Keplers Gesammelte Werke*, C. H. Beck, Munich 1938-1990.
- LW** **Jarosláv Pelikan and Helmut T. Lehmann** (eds), *Luther's Works*, Concordia, Philadelphia 1955-1986.

- MBW** **Heinz Scheible** (ed), *Melanchthons Briefwechsel*, Frommann-Holzboog, Stuttgart-Bad Cannstatt 1977-.
- NZSTh** *Neue Zeitschrift für systematische Theologie und Religionsphilosophie.*
- RGG** **Kurt Galling** (ed), *Die Religion in Geschichte und Gegenwart*, J. C. B. Mohr (Paul Siebeck), Tübingen (3rd edition) 1957-1965.
- SCJ** *Sixteenth Century Journal.*
- TRE** **Gerhard Krause** and **Gerhard Müller** (eds), *Theologische Realenzyklopädie*, Walter de Gruyter, Berlin/New York 1977- .
- WAr** **J. A. Smith** and **W. D. Ross** (eds), *The Works of Aristotle*, Clarendon, Oxford 1908-1952.
- ZTK** *Zeitschrift für Theologie und Kirche.*

ii) places

- StAS** Staatsarchiv, Stuttgart
- UBTü** University Library, Tübingen
- UATü** University Archive, Tübingen

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- UATü 5/5: *Acta Universitatis Bibliothek [sic]*
- UATü 5/14: *Konduktionsbuch*
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- UATü 15/7a: Arts Faculty - *Ordo lectionum, Paedagogium, Vota in senatu*
- UBTü CD 8187, final page of preface: Crusius's notes
- UBTü Mh 446: *Catalogus Bibliothecae Universitatis Tubingensis*
- UBTü Mh 448: *Catalogus Bibliothecae Stipendii Theologici*
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