Claudius Ptolemy and Self-Promotion

A study on Ptolemy's intellectual milieu in Roman Alexandria

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Contents

Preface

The aim of this study is to situate Claudius Ptolemy within the social and epistemological context of his time and place of activity. These latter coordinates are the second century CE and Alexandria. The social context is the Roman Principate of Hadrian and Antoninus, and Alexandria as the capital city in the specially important province of Egypt, governed by an equestrian prefect. The thesis argues that Ptolemy seriously engaged in a basic arena of social competition in this context, which is knowledge. I shall study the ways in which Ptolemy can be shown to engage in such competition, from the display of his astronomy on an inscription to his magnificent presentation of the *Almagest*, and mainly through a deliberate self-presentation as a philosopher-mathematician. I will only explore in detail the works that have been considered early in Ptolemy's production, mainly because in them we can find many more clues to Ptolemy's self-definition.

My basic influences are Reviel Netz's studies on the social milieu of the Hellenistic mathematicians, both as part of his *The Shaping of Deduction in Greek Mathematics* (Netz 1999) and of *Ludic Proof* (Netz 2009). On the period explored here, the recent approaches to scientists collected in König and Whitmarsh's *Ordering Knowledge in the Roman Empire* (König and Whitmarsh 2007) have been very inspiring. There is also the volume with collected papers edited by Gill, Whitmarsh, and Wilkins *Galen and the World of Knowledge* (Gill et al. 2009), although the numerous digressions of Galen on his writing context not only provide possible parallels for Ptolemy, but also produce envy for the evident contrast

with Ptolemy's silence.

The main contribution of this dissertation is the contextualization of a crucial mathematical author, Claudius Ptolemy, within the intellectual world in which he lived, including philosophy, literary traditions, rhetorical practice, and patronage.

Now I will briefly explain the contents of the chapters. The first three chapters deal with individual works, respectively with the *Canobic Inscription*, the *Harmonics*, and the *Criterion*. In the fourth chapter I will analize formal characteristics observable in the distribution of the text in these three works –which I will study within the context of ancient education– as well as in others. The fifth chapter addresses a specific social connection of Ptolemy, dealing with the dedicatee of half of his extant works, Syrus, for whom I will propose an identification. In the first part of this chapter the rest of Ptolemy's works are reviewed, so it is a good place to look at for the contents of individual works. In the sixth and final chapter I explore the similarities and the differences between the self-presentation in the *Almagest* and in the three works studied in the first chapters: with this aim I analyze both the preface of the *Almagest* and an epigram preseved before the preface.

Finally, my thanks go first to the scholarship provided by the Spanish Ministerio de Educación for four years' almost full-time dedication (FPU ref. AP2008-04105), then to Jaume Sastre who decided to share with me his interest in the history of ancient mathematics and helped me greatly in the first stage of my research, and to Reviel Netz who tutored my stay of three months (from September to November 2010) at the Department of Classics at the Stanford University. Reviel Netz also kindly read the chapters of the thesis in a first phase of redaction, making very useful criticisms of which I hope to have taken advantage. I also thank the organizers of symposia at the University Carlos III of Madrid (2010) and at the University of Manchester recently (2013), and to my research group, 'Graecia Capta', in the Department of Greek Philology at the University of Barcelona which organized the 'Second Sophistic Seminars', because in all these places I have been able to present and discuss my research. I also thank Mar Márquez who has kindly read and corrected some of my papers,

helping me with such an important matter as scientific communication. As regards the members of my department, Ernest Marcos read nearly the whole manuscript of the thesis in the summer of 2013 in a record timing. Pau Gilabert read and commented a paper on the *Criterion*; the chapter on the *Canobic Inscription* was read and feedbacked by Jaume Pòrtulas. I also thank the members of the comitee, who will read and evaluate this dissertation. And finally I thank my tutor Francesca Mestre, who has been supporting and encouraging me in many ways throughout the whole process, both conceding me the relative freedom I wished for my project, and making always very useful suggestions about the general aim as well as the details regarding the style of the text. It goes without saying that, despite the help of all these people and the many more which I have omitted, the errors I have commited are only mine.

Introduction

This study is going to be about the mathematician Claudius Ptolemy –mostly known by his astronomical treatise *Almagest*– and his working context. Alexander Jones summarizes the *communis opinio* about our subject in the following way in his introduction of a volume of collected essays about Ptolemy's influence.[1]

> Among the scientific authors of the ancient Graeco-Roman world, none gives us such a strong impression of writing for posterity as Ptolemy. He lives in a time when learned and eloquent men seek and attain public adulation and private patronage, when the physician Galen performs dissections of pigs and sheep before the elite of Rome and when the sophist Alexander the 'Clay Plato' dazzles the Athenian masses as much by his grooming and deportment as by his declamation. From this milieu Ptolemy is utterly remote. Outside of his books he is nothing; no contemporary mentions the man, and no later account of his life or person will preserve an authentic report. He addresses his books without flourish to a certain Syros, about whom we know nothing, and in them there is no personality, no reference to himself as an observer, scholar, and theoretician, no allusion to his environment.

My aim throughout will be to qualify this picture. Perhaps the crucial question would be: does our lack of information about Ptolemy imply that he is 'utterly remote' from Galen's world, from orators, and from the quest for private patronage?

It is true that Ptolemy's personality almost disappears in his books, but this is common to the mathematical style of all times: it is for this reason that we have indeed very little

[1] Jones 2010, xi.

information about the social class within which ancient mathematicians were active (Netz 1999, 279). Reviel Netz studied the texture of Greek mathematical texts, showing how its precise formal restrictions function as definition of genre (Netz 1999, chapters 1-6). Mathematical treatises do traditionally not allow for digressions: the mathematical text is always performing mathematics. So we don't have the opportunity to learn about Ptolemy's social milieu in the same way that we learn about Galen.

The demography of ancient mathematics seems to provide negative evidence for the question whether mathematics played an important role in the political and social arena: in the same work Netz showed that mathematicians were a tiny group basically without school structures (Netz 1999, 277-292).

Probably the peak-moment in the demography of Greek mathematicians was the Hellenistic period, with a focus in Alexandria. Netz studied the common aesthetics of the net of mathematicians that can be seen operating in this period, who, as we know from the preserved letters introducing the treatises, wrote their treatises for each other (Netz 2009). From this period we have the evidence that Eratosthenes –who was nevertheless not only a mathematician– enjoyed the patronage of the Ptolemaic Alexandrian kings.

In the Roman period the scenario seems to be different from Hellenistic times: we don't hear anymore about mathematicians sending treatises to each other, and the topics of their works are less specialized. The treatises of Vitruvius, Hero, and Nicomachus show an attempt to make accessible large bodies of technical knowledge to non-experts: Vitruvius is the clearest case, since he writes his treatise for Augustus, and he presents the contents –which extend not only to architecture but also to many other branches of the sciences– in an elementary way. Hero of Alexandria, perhaps less obviously so, also tried to connect various technical disciplines and introduce them with philosophical comments. Nicomachus wrote treatises on elementary mathematics and music theory that could have served to understand Plato's mathematics. Ptolemy, although perhaps the most mathematically demanding among these authors, shows analogous features: his *Almagest* is a systematization

of Greek astronomy, as he himself declares, and his preface is full of Platonic philosophy. Perhaps this preface is the only exception to Jones' assertion that Ptolemy addresses his books to Syrus without flourish. However, it is an important exception: the *Almagest* was a big work in 13 books. As part of her recent dissertation about technical ecphrasis, Courtney Roby studied these general characteristics of technical treatises in the Roman world, in connection with the context of their authors (Roby 2010).[2]

Does this not suggest that mathematicians entered to some extent the world of common knowledge in Roman times? What appear to be the first treatises of Ptolemy –the *Canobic Inscription*, the *Harmonics*, and the *Criterion*– seem to address recognised disciplines pertaining to the *enkyklios paideia*: astronomy, music, and logic. Of course, not every leisured Roman was interested in these disciplines as in rhetoric –which was necessary for public life– but nevertheless there was a demand for it. The extant elementary treatises on astronomy and music are an evidence for this, as well as the casual remarks on astronomy and harmonics in authors such as Plutarch and Philo of Alexandria. Then there is at least the theoretical possibility that some individuals were interested in reaching an advanced knowledge in these areas as an extension of their intermediate education. It is then possible that Ptolemy had began his career as one of these individuals. Ptolemy's dedicatee Syrus may have been another such individual.

Given my objective of assessing the degree in which Ptolemy was in the mainstream Graeco-Roman culture, I will seek thoughout my dissertation for features of Ptolemy's works occurring in non-mathematical authors. The more such features I am able to collect and explain, the more I will be able to claim that Ptolemy was within the world of his more visible contemporaries.

Now I will discuss specific bibliography on Ptolemy. To my knowledge, there is no previous study focusing on the social milieu of Ptolemy, Roby's above-mentioned dissertation being perhaps the closest approximation to it. However, the philosophy in Ptolemy's

[2]See on Vitruvius, Ptolemy and Hero e.g. Roby 2010, 259-60.

works, which will have a fundamental role for my study, has been studied both by Liba Taub (Taub 1993) –although she did not include the wholly philosophical treatise *Criterion*– and later by Jacqueline Feke in her dissertation (Feke 2009). These were probably the first comprehensive studies of Ptolemy's philosophy after that of Boll in 1894 (Boll 1894). A very important contribution in between was that of Anthony A. Long, with an essay about Ptolemy's *Criterion* to which I owe much (Long 1988).

While Taub emphasised how problematic was the ascription to Plato or Aristotle of Ptolemy's philosophical opinions, necessarily questioning some of Boll's assertions, Feke successfully demonstrated the coherence of Ptolemy's philosophy throughout all his works, and contextualized it within the Middle Platonic and Aristotelian commentary tradition of his time. However, since Feke's aim was basically to show Ptolemy's coherence, she neglected issues such as the possible evolution in the use of philosophy in Ptolemy's works, the immediate plausible context of Ptolemy's philosophy in his Alexandrian education, and the motivation for the use of such philosophy in his works. These are precisely the factors on which I will focus, or rather, the factors towards I will zoom out.

The scientific aspect of Ptolemy has been well studied, especially for individual works. The bibliography is large, so I will only provide the references which have been most useful for my study, and the ones which are more relevant in general. Thus, for the *Canobic Inscription* we have the important paper by Hamilton, Swerdlow, and Toomer showing that the inscription predated the *Almagest* (Hamilton et al. 1987), and Swerdlow's more recent study about the last part of the inscription, to which I am indebted for his study of the possible relation between the astronomical part and the musical section at the end (Swerdlow 2004). Only a year later came Jones' edition and annotated translation of the inscription, which sets my starting-point for the discussion of the placing of the inscription (Jones 2005a). Jones' edition of another astronomical inscription, the so-called Keskintos inscription, has also been important in my assessment of the context of the inscription by Ptolemy (Jones 2006).

As regards Ptolemy's *Harmonics*, the first name that comes to mind is that of Andrew Barker, who, apart from translating and annotating the major part of the Greek corpus of musical theorists, including Ptolemy (Barker 1989), also made an important contribution to the understanding of the mathematical part of Ptolemy's *Harmonics* in a more recent book (Barker 2001). Again Barker is responsible for my survey of the Aristoxenian and the Pythagorean traditions of music theory in the Roman world, which he studied between these two projects (Barker 1994). The book by David Creese on the harmonic canon is also very interesting because it focuses on an important device used by Ptolemy in his treatise (Creese 2010).

For the mathematics in the *Almagest*, we have the useful study of Pedersen, which I have used also for my account of the *Planetary Hypotheses* (Pedersen 1974, rev. ed. 2010). There are many publications by James Evans that serve as a good introduction to Ptolemy's astronomical methods and to ancient astronomy in general (Evans 1984, Evans 1999). The now classical translation of the *Almagest* is that of Toomer, which comes with a summary introduction (Toomer 1984).

The *Almagest* is perhaps the work with most bibliography, although not especially modern: this is mainly due to the critical attention it received following Duhem's controversial essay which suggested a non-empirical intention for various branches of ancient natural science (Duhem 1990, 1st ed. 1908). This was especially influent for astronomy, in particular in the case of Ptolemy's *Almagest*, perhaps the ancient text where Duhem's thesis could best be tested. In part this controversy produced the influential book by the astronomer R. R. Newton, *The crime of Claudius Ptolemy* (Newton 1977), with extreme accusations against the empiricity and the sincerity of Ptolemy's methods. This has generated a vast amount of literature, of which I will cite only some instances (Goldstein 1997, Lloyd 1978, Geus 2004). It is interesting to quote Lloyd conclusions about his survey of Duhem's controversy:[3]

> Where we may well agree that the astronomers (like other scientists) often

[3] Lloyd 1978, 220-1.

> simplified their problems and sometimes advanced positions for the sake of argument, Duhem again exaggerated in representing Greek astronomical hypotheses in general as adopted purely for the sake of calculations. Dynamical and other physical factors, as well as considerations of mathematical simplicity, could be appealed to in deciding between theories.

Let us now go on with the rest of the works. Ptolemy's astrology is not very well represented in recent bibliography, although again Anthony A. Long published an essay focusing on a topic relevant for my short survey of Ptolemy's *Tetrabiblos*, the philosophical debate over the principles of astrology (Long 1982). There has been published a relatively recent edition of the text for the Teubner collection, by W. Hübner (Hübner 1998).

Relating to the most technical extant works of Ptolemy, the *Analemma* and the *Planisphaerium*, Nathan Sidoli's dissertation about the applied mathematics used by Ptolemy has been very useful for my assessment of Ptolemy's methods and aims in these difficult treatises (Sidoli 2004).

About the *Geography* and the *Optics* I will say very little, but it would be useful to provide some bibliography: the whole Greek text of the *Geography* has recently been the object of a new edition in two volumes, with a German translation (Stückelberger and Grasshof 2006), and Berggren and Jones had previously translated and annotated the theoretical chapters (Berggren and Jones 2000). A good introductory treatment of the methods used by Ptolemy in this work is provided by Geus (Geus 2013). Sidoli in the mentioned thesis also deals with the *Geography*, as well as with the methods of the *Optics*. For the latter work, there is the annotated translation by A. Mark Smith (Mark Smith 1996), and a comparative study of the mathematical methods of Ptolemy's sources by the same author (Mark Smith 1999). Lejeune edited the surviving Latin version in an exemplary edition with a long introduction (Lejeune 1989). In relation to Ptolemy's mathematical methods in general, and more introductory than Sidoli's treatment, we have a synoptic survey of Ptolemy's works by Germaine Aujac (Aujac 1993).

Now I turn to modern bibliography on the context of Graeco-Roman mathematics not specifically on Ptolemy. I have already mentioned two representative books by Netz. From around the same date, we have a monographic study by Serafina Cuomo on the Late Ancient mathematician Pappus of Alexandria (Cuomo 2000), and a collection of essays by herself on technology and culture in the Greek and Roman worlds (Cuomo 2007). In the preface I have also mentioned the collection edited by J. König and T. Whitmarsh, with some essays on scientific texts (König and Whitmarsh 2007).

As regards other cultures, a similar work has been done by Robson, who studied the mathematics of Ancient Mesopotamia (e.g. Robson 2008). More generally on ancient science, we have the abundant bibliography by Geoffrey E. R. Lloyd, especially focusing on a comparative study between Greek and Chinese science and medicine (e.g. Lloyd 1996, Lloyd 1990). I will not deal in detail with medicine in my study, so I will not attempt to show the state of the question in this discipline. However, I will repeat the reference I made in the preface about the volume of collected essays edited by Gill, Whitmarsh, and Wilkins (Gill et al. 2009), which is important for Galen's context, as well as Mattern's study on Galen's rhetoric and self-promotion (Mattern 2008).

As regards rhetoric and competition in general in the ancient world, Gleason's study on the strategies of the sophists has been important for me (Gleason 1995). There is also a recent collection of papers on the second sophistic edited by T. S. Schmidt and P. Fleury (Schmidt and Fleury 2011), as well as Whitmarsh's useful summary on the same theme (Whitmarsh 2005), and his more general study on the Greek literature in the Roman empire (Whitmarsh 2001). For patronage, Saller's recent survey has successfully defended the important role in society that this form of social relationship still held in imperial times (Saller 2002).

The Greek intellectual world under the empire is nowadays an established field of research on its own right, but it had to fight against old classicist prejudices until not long ago, as Gleason reminds in her introduction to the study of sophists which I have mentioned

above. Authorities such as Gibbon or Wilamowitz labeled the Greek literature under the empire as decadent, effeminate or ill on the basis of its frequently archaizing and imitative nature, in comparison with the Attic literature which was the model, both for Roman Greeks and for moderns: however, the difference, as Gleason remarks, is that 'originality *per se* was not considered a virtue by the Greeks themselves'.[4] Perhaps this could be comparable to the *querelle* about Ptolemy's sincerity and the accusations that Ptolemy plagiarized the Hellenistic astronomer Hipparch.[5]

Greek literature under the Roman empire is now generally studied as part of a highly textualized culture conscious of its own past.[6] It is not my aim here to provide a picture of the state of the question on this topic, since it is enormously vast and would not be especially relevant for my investigation. I will just briefly focus on one clear exponent of this bookish culture which was perhaps paradoxically sophistic declamation, where improvisation (this is, freedom from the written or memorized text) was an important matter.[7] In the surviving declamations imitation and role-playing are important factors, which Gleason relates to the importance of stylised behaviour in ancient life, prominently within the patron-client relationships where imposing one's presence must have been fundamental.[8] So sophistic declamation would be a sort of virtuosic development of practices of every-day life. At the stage, the performing *virtuoso* sought to impress the audience with his vast *paideia*.[9] This is where the rhetorical education of sophists came to the fore, where many characteristics of the rhetorical exercises with which they used to prepare themselves in the schools of rethoric became evident.[10]

[4]Gleason 1995, xvii-xviii.

[5]To mention perhaps the most famous case, cf. on Ptolemy's star-catalog and R. R. Newton's accusation of plagiarism from Hipparch's catalog the summary in Thurston 1998, 10-11.

[6]Whitmarsh 2001, 45.

[7]I mean that the importance of improvisation was an actual debate itself: cf. the discussion on improvisation in Philostratus' *Lives of the Sophists*, 482-4, and on the specific case of Aelius Aristides, 581-5.

[8]Gleason 1995, xxii.

[9]Whitmarsh 2005, 41.

[10]Morgan 1998, 201 notes the subtle boundary between rhetorical exercises and 'professional' declamations.

Throughout this study I want to argue that in a minor degree Ptolemy in his works also used similar weapons as the sophists to a similar aim. This may be detected specially in his early works –the *Canobic Inscription*, the *Harmonics*, and the *Criterion*–, where Ptolemy seems to have consciously played the role of a Platonic and Pythagorean philosopher through different strategies. I will defend that this may be understood as imitation. My guess is that Ptolemy left these (textual) displays at a more advanced stage of his career when he had attained an established place, similarly as Galen, who abandoned his public performances after he reached a very good position at Rome.[11]

Why would Ptolemy have presented himself as a philosopher? Again the comparison with the world of rhetoric may be fitting: it is well-known that many rhetors of Ptolemy's time were also philosophers, such as Dio of Prusa, Favorinus, or Apuleius. Galen wrote a work significatively titled *The best doctor is also a philosopher* (*Opt. med.*). Philosophy was for some the culmination of the intermediate studies, consequently enjoying a high status in the *paideia*. For this reason a self-depiction as a philosopher could have constituted a mark of prestige. This may be seen for example in the case of writers on mechanics –which is relevant for Ptolemy–, who very frequently prefaced their works with philosophical introductions (Hero, Athenaeus Mech., Vitruvius). Vitruvius is interestingly explicit as presenting architecture, his own field, as requiring practically every other knowledge, which would be equivalent to making architecture the culmination of the knowledges (*Arch.* 1.1).

And now the second question: why a Platonic and Pythagorean philosopher? Well, here there seem to be many factors. On the one hand, the influence of Plato in the education and the social image of mathematics in Ptolemy's world was visible everywhere, especially for astronomy resulting from the influence of the *Timaeus*. So on this basis Plato was the obvious reference. As regards Pythagoreanism, again Plato is important, in that he presents his ideal of education of the sciences in the *Republic* as a correction on the investigations of the Pythagoreans, who are accused of being too empirical (book 7). The *Timaeus*, with the main

[11]Hankinson 2009, 242.

speaker Timaeus from Locri in Italy, and where the Pythagorean cosmology of Philolaus was applied to the discourse on the formation of the cosmos, could well have been understood as Plato's own proposal for a 'corrected' Pythagorean astronomy. So a Platonist would have easily resorted to the *Timaeus* for a cosmological explanation. We will see, furthermore, how Ptolemy's philosophical milieu was favourable to Platonic Pythagoreanism, since Alexandria where Ptolemy was active had been a rough century before the seat of a Pythagorean revival within Platonism.

So what kind of Pythagoreanism was important for Ptolemy, the ancient –which Plato criticises– or the Platonic Pythagoreanism? This is an interesting question, since it brings to the fore another problematic. For Ptolemy, as for every scientist, empirical accuracy, this is, adequation to the physical world, was important, unlike for Platonic Pythagoreanism.

We will see how Ptolemy solves this issue for the *Canobic Inscription*, the *Harmonics*, and the *Criterion* in the first three chapters, which will deal respectively with each of these treatises.

The reason why I have devoted entire chapters to these treatises individually is that I attempt to capture the whole picture of each of the works individually, instead of connecting excerpts from one work and the other, a study which has been already undertaken by other researchers, and which tends to blur the individuality and aim of each of the works. Since I want to provide a picture of Ptolemy as an author, it makes sense to regard his texts as unities, given that he wrote them individually. The other motivation for doing this is that these three treatises are relatively short, so that it is possible to analyze them within a relatively short space.

Now I will provide a summary description of the contents and methods in each of the chapters.

In the first chapter the focus is the *Canobic Inscription*, an astronomical artifact not extant but whose text was recorded in the manuscript tradition of the *Almagest*. In the first part of the chapter I explore the setting of the inscription first within the tradition

of astronomical inscriptions, and secondly as concerns its actual situation, which as I will argue was probably the sacred precinct of Serapis at Canopus. This will be important for the assessment of this object as public display. Then in the second part I analyze the text of the inscription focusing on the relationship between the two basic sections of the inscription, the empirical-astronomical and the last part on the Pythagorean harmony of the spheres, which is a clearly 'unrealistic' account of Pythagorean and Platonic cosmology. For the analysis of this last part, I will explore the possible parallels in other ancient sources which specify a concrete example of the music of the spheres.

The second chapter deals with the *Harmonics*. Here I will first explore Ptolemy's self-positioning within the various branches of the music theory, an issue of importance taking into consideration that Ptolemy's aim was mainly empirical, other than the Pythagorean and Aristoxenian music theory of his own time. Again an important break within the treatise marks off a last section of a non-scientific character, relating, as in the *Canobic Inscription*, to Platonic lore. This will be studied in the last part of the chapter, again comparing to other texts of ancient authors where the traditional character of the contents of this section may be evidenced.

Ptolemy's text *Criterion* (my short-term for the original title *On the Criterion and the Ruling Principle*) is the focus of the third chapter. This text is the only one extant by Ptolemy which is only philosophical, but many of its themes are also found in the *Harmonics*, because it deals with knowledge theory. Firstly I will inspect the philosophical theories on the two concepts that Ptolemy explores, the criterion and the ruling principle, comparing Ptolemy's contents and style with them. The issue of the style of the text, which has not been explained in previous literature, will be important for my study, since I will defend the idea that it has many of the features typical of rhetorical practice (an idea which I will pursue in the following chapter). In the rest of the chapter I intend to show the internal composition of Ptolemy's text, by way of analyzing separate parts and showing parallels with known texts, both from Aristotle and Plato and from possible mediators.

My fourth chapter is of a different nature. It first studies a curious feature of Ptolemy's works, both the ones already studied and others. This feature is related to a specific distribution of the text in equal sections, and with the eventual presence of a 'center'. First I study these features in Ptolemy's texts and then I look for similar practices in other authors, briefly addressing the cases of Varro and Vitruvius. Then I will focus again in the three works studied in the previous chapters, because they all share one of these specific structures, which among other functions underline the division the last philosophic parts of these works at four fifths of the whole text. I will finally consider the relationship between the topics of these works –including the rhetorical character of the *Criterion*– and what we know of the Graeco-Roman intermediate education.

In the fifth chapter I try to identify Ptolemy's relationship with the dedicatee of many of his works, Syrus. With this objective, I first set out various possible options which I then test against the evidence from the works dedicated to Syrus as regards their implied intended audience, focusing on the prefaces and on the specialization of each of the works. Then in the second part, having defined a more precise possible kind of relationship, I propose an individual that may account for this type of dedicatee, and who meets all the requisites related to the name, the chronographical and geographical setting, and the mathematical interests and possible proficiency in mathematics. On this basis I will draw conclusions on Ptolemy's social milieu.

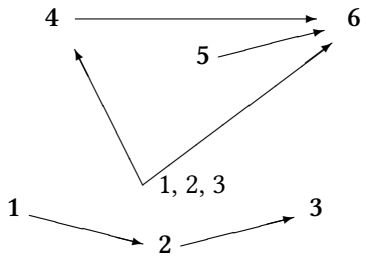
In the sixth and final chapter I will consider two texts subsidiary to the *Almagest*, its preface and an epigram introducing it. I begin with the preface since the brevity of the epigram advises a treatment at the end using every available evidence for its elucidation instead of the opposite procedure. In the preface I will identify a series of philosophical motives that were already encountered as 'performed' in the works studied in the first three chapters, which in the *Almagest* appear just outlined in the preface. As regards the epigram, I will first contextualize it within the poetical tradition related to mathematics, and then to catasterism (since this is the topic of the epigram), nevertheless identifying a

Platonic element not present in those traditions, which is also encountered in the preface.

Methodologically relevant for the sequence of the chapters is partly the relative chronology of the works (which is important for my 'biographical' arguments), since the three works studied in the first three chapters are considered to be previous to the works dedicated to Syrus, including the *Almagest*. Within these three treatises –with no clear chronological sequence– I have proceeded following the order from the simplest to the most complex, which coincides with a thematic order: the *Canobic Inscription* contains the shortest text, and the part studied is fundamentally the last section, which contains a single topic, the harmony of the spheres. In the *Harmonics*, which I have studied subsequently, there is a thematic continuity with the inscription because in the last section the harmony of the spheres appears again; but also the complexity of the elements studied grows with respect to the inscription because in the *Harmonics* we find a philosophical discussion of the scientific method distinct from the Pythagorean Platonic tradition. The *Criterion* is the text that includes more non-exclusively-scientific elements, since it is entirely philosophical; consequently, among these three treatises this is the one which I will explain in more detail. Furthermore, as I said above, there is a thematic continuity with the *Harmonics* which suggests its study next to it. However, the three chapters can be read independently from each other since the conclusions used from previous chapters are well explicited.

The fourth chapter supposes some familiarity with the three treatises studied before as concerns the internal divisions of these works, although again I have attempted to repeat the basic facts, as well as for the issues of style of the *Criterion* which I discuss at the end of the chapter. The fifth chapter can be read independently of the other chapters, since it deals with the works dedicated to Syrus, which have not been previously studied. For the sixth chapter the reader should have in mind the identification of Syrus attempted in the last part of the previous chapter, as well as the conclusions from the first four chapters. However, again these connexions are repeated at the concerned places.

At the beginning of each chapter I have provided a long abstract on its internal structure. The relationships between the chapters are represented in the following diagram.



Chapter 1

The *Canobic Inscription*

The public display of a Platonic astronomer, follower of Timaeus

1.1 Plan of the chapter

The subject of this chapter will be the *Canobic Inscription*, an astronomical monument set up by Ptolemy in Canopus in 146/7 CE. Firstly, I analyze this object in the context of the ancient tradition of astronomical monuments, an established medium through which ancient astronomers often demonstrated their theory. The text of the inscription has been preserved only in manuscript form, but it seems plausible that the inscription was set up at the temple of Serapis at Canopus, since it was dedicated probably to this god, and Olympiodorus refers to the placing of the inscription in terms that seem to allude to this temple. However, Olympiodorus' passing comment is problematic and will be analyzed in some depth.

My aim is to explore the features of the inscription that can tell us something about Ptolemy's conception of his own activity as a scientist or an intellectual. My focus will be the last part of the inscription, which I will interprete as Ptolemy's attempt at a Timaean

cosmology based only (perhaps) in his calculation of the distances of the Moon and the Sun. Aiming at that goal, I first present the contents of the inscription, beginning with the two main parts –the astronomical and the musical– and the possible bridge between both. The astronomical part is formed by parameters of roughly the same astronomical theory that is encountered in the *Almagest*, while the musical part has no correlate in that work, but attempts a cosmology based on the Pythagorean and Platonic tradition of the tones of the spheres. A comparison with Ptolemy's cosmology in the *Planetary Hypotheses* could support the bridge-status of the Sun-and-Moon-distances section. Both the data in this section and in the tones of the spheres have a clear parallel in Plutarch's commentary on Plato's *Timaeus*, which I analyze in the final part of the chapter. I conclude that Ptolemy probably knew Plutarch's account, either directly or from Plutarch's source Eudorus. I explore other possible Timaean allusions of Ptolemy: his list of means and concords in the musical section, and the dedication of the inscription to the 'savior god'. The chapter ends with some remarks about the double nature of Ptolemy's scientific inquiry as seen in the inscription, the one more purely mathematical, the other less so and more tied to a non-mathematical tradition such as the *Timaeus*.

As a conclusion, we can say that Ptolemy followed the ancient mathematical tradition of monumentalizing treatises in a way (in both contents and dedication) that suggests his casting of an identity as a scientist and a Platonist at the same time, probably taking ideas from Alexandrian Pythagorising Platonism. Ptolemy probably used the paradigm of Timaeus, who is said to be an astronomer in Plato's dialogue, but who at the same time makes speculative philosophy about the origin of the world.

1.2 Astronomical monuments

The only dated piece of Ptolemy's *corpus*, and probably one of his first works, took the form of a block of stone or stele. It was erected at Canopus (or Canobus[1]) near Alexandria. In there Ptolemy recorded his models for the orbits of the planets, along with his version of the harmony of the spheres. The stone has not been preserved up to our days, but we possess the text in manuscript form, copied faithfully if we may trust the heading in the manuscripts.[2] According to the words at the end of the inscription, the stele was set up in the tenth year of the emperor Antoninus, which converted from the Alexandrian calendar gives 146 or 147 CE. It was not until recently that three historians of ancient mathematical astronomy proved that some of the astronomical parameters in the inscription were actually dismissed by Ptolemy himself in the *Almagest* as older, not valid work, so proving that the *Canobic Inscription* predated the *Almagest*, contrary to what was traditionally believed.[3]

The first thing worth asking is whether there was anything particular in the medium that Ptolemy chose for the publication of his theory. Votive offerings in the Greek world as in other ancient cultures could naturally take the form of intellectual offerings representative of the intellectual performance of the dedicant. For example, we can find physicians dedicating their instruments.[4] But this was a different case from ours, because Ptolemy did not dedicate the astronomical instruments through which he achieved his results, but the (shortened) text itself where the theory is explained. This sort of offering is indeed rare outside from mathematics. The only clear non-mathematical example is to my knowldege Pindar's *Seventh Olympian*, which is said to have been dedicated at Lindus.[5]

In mathematics the case is different. We have evidence of many dedications which

[1]This double spelling was already an ancient discussion: cf. Ael. Her. *Pros. Cath.* 3.1.189: Κάνωπος δέ, ὅπερ ἔδει γράφεσθαι διὰ τοῦ π, ὅμως γράφεται διὰ τοῦ β.

[2]ΩΣ ΕΝ ΤΗΙ ΕΝ ΚΑΝΩΒΩΙ ΣΤΗΛΗΙ.

[3]Hamilton et al. 1987, Jones 2005a.

[4]*IG*^{2} 1421+1451. I thank Reviel Netz for this indication about physicians' dedications.

[5]Rouse 1976, 1st ed. 1902, 64. Cf. *Schol. Pind.* Ol. 7 Drachmann, ll. 13-14, p. 195. Even if the poet himself was not the original dedicant, he was so in a putative way.

took the form of a mathematical minitreatise, which may be significant due to the meager evidence for mathematical production in the ancient world compared to other forms of literary producation.[6]

Xenagoras is said to have inscribed his calculation of the height of Mount Olympus at the Pythium there.[7] We read in Porphyry's *Life of Pythagoras* that Pythagoras' son Arimnestus dedicated a bronze tablet containing 'seven knowledges' to Hera in his temple at Samos.[8] Although Porphyry's source Duris of Samos may be unreliable,[9] the very fact that this story could work as a literary device probably attests to the real fact that such offerings were known by Duris' and Porphyry's readers.

Astronomical inscriptions are particularly well attested. Two whitened tablets (λευκώματα) probably showing some diagram[10], with the title 'astronomy of Eudoxus' are recorded in the inventaries of the temple of Good Fortune in Delos.[11] Aelian attested the astronomer Oenopides of Chios as having engraved a bronze tablet with an astronomical period, also entitled 'astronomy' (ἀστρολογία), at Olympia; and adds that the astronomer Meton 'set up stelae' (ἀνέστησε στήλας) with a similar account.[12] Callippus is likewise recorded in the so-called Parian marble to have 'set out an astronomy' (ἀστρολογίαν ἐξέθηκεν), which likely means the setting up of an inscription.[13]

One of these remarkable objects was actually found in a site called Keskintos, near Lindus in Rhodes, from where it was probably transported in Late Antiquity for building purposes.[14] It was dedicated to 'all the gods and goddesses' around 100 BCE according to the form of the letters, and, similarly to Ptolemy's inscription, it records periods of the planets

[6] See Netz 1999, ch. 7.

[7] Rouse 1976, 1st ed. 1902, 65.

[8] Porph. *Vit. Pyth.* 3.

[9] See e.g. Creese 2010, 100.

[10] Netz argues that they were precisely whitened because there was a diagram on them; cf. Netz 1999, 16.

[11] *ID* 1442, 1443. As we can deduce from the anual inventaries, they entered the temple in 155 BCE, so that they were certainly spurious.

[12] Aelian X.7.

[13] *IG* XII 5.444. The expression 'set out' (ἐξέθηκεν) used in the chronicle is also used for Meton in Diodorus Siculus XII.36, referred to the same period of 19 years which Aelian recorded as the content of his stelae.

[14] Jones 2006, 6.

according to epicycle models.[15] So we can now answer that Ptolemy's was only one among many ancient astronomical offerings that took the form of a small treatise.

Let us now try to explain the reasons that Greek astronomers had for dedicating his offerings in that shape. With this I will try to project a picture valid not only for Ptolemy, but for the ancient Greek astronomers in general.

Plato uses the metaphor 'firstfruits of wisdom' when he alludes to the tradition of dedicating a literary piece to the gods.[16] The metaphor is built upon the custom of dedicating the firstfruits of the harvest as a thank offering. We find a clear echo of Plato's metaphor in Philo of Alexandria, who says that:[17]

> ἄξιον τὰς συνέσεως καὶ ἀγχινοίας καταλήψεώς τε καὶ φρονήσεως καὶ τῶν ἄλλων δυνάμεων, ὅσαι περὶ αὐτόν εἰσιν, ἀπαρχὰς ἀνατιθέναι θεῷ τῷ τὴν εὐφορίαν τοῦ διανοεῖσθαι παρασχόντι.
>
> It is very proper to offer up the firstfruits of our cleverness, and acuteness, and comprehension, and prudence, and of all our other faculties which we have in connection with our reason as firstfruits to God, who has bestowed upon us this great abundance of power of exerting our intelligence.

Some lines below he gives a justification for this offering: 'in order that our powers of speaking, and of feeling, and of comprehending, may be seen to be irreproachable and sound, in reference to and in connection with God.'[18] Thus the general sense of intellectual offerings was to thank the gods for the intellectual achievement which was (at least partly) dedicated, similarly as a part of the harvest served to thank the gods for the generous harvest itself. As Philo remarks, this act served to maintain a stable alliance with the god, so that the inspiration may last for long.

Rouse noted that this analogy with the firstfruits seems to be valid not only as a

[15] Jones 2006, 14-38. Unfortunately, only the last part of this inscription has been preserved, so that we do not know if it carried the name of the astronomer, or how it was presented.

[16] Pl. *Prot.* 343b.

[17] Philo Alex., *Congr.* 98 (tr. C. D. Yonge).

[18] Philo Alex., *Congr.* 101: ἵνα καὶ τὸ λέγειν καὶ τὸ αἰσθάνεσθαι καὶ τὸ καταλαμβάνειν ἀνυπαιτίως καὶ ὑγιεινῶς κατὰ θεὸν ἐξετάζηται.

metaphor, but could also indicate a chronological feature of the dedications themselves: some of them appear to be one of the first masterworks of the dedicant: thus, dedicated alphabets can be interpreted as the first completed work of a learner.[19] If Ptolemy's *Canobic Inscription* was prior to the *Almagest*, and consequently one of his first works –since the *Almagest* is alluded to in many other of his works–, Ptolemy could have thought of his dedication in terms of his firstfruits in astronomical theory.

But what could help us explain the specificity of mathematical offerings? Plutarch could offer some clues in this issue: he tells us that mathematical discoveries produce such a great pleasure in the researcher that he feels prompted to great sacrifices. He cites the famous story of Pythagoras' sacrifice of an oxen after the discovery of a theorem,[20] along with a telling that Eudoxus' prayed for being burned in flames if he was able to stand in front of the Sun in order to measure it and the other planets, finally adding Archimedes' 'eureka' story. The first two examples can in fact be understood as extreme sacrificial offerings: the oxen of the vegetarian Pythagoras, and the self-sacrifice of Eudoxus to the Sun. In Plutarch's Archimedes story intellectual pleasure is contrasted with his unpreoccupation for the material sphere, for which reason he could leap off the bath and run naked in the streets.[21]

The *Canobic Inscription* seems more similar to the religious joy of Pythagoras and Eudoxus than to Archimedes' crazy 'eureka' moment, but in all these cases the triggering factor is the same: the achievement of a great mathematical discovery.

We can now wonder whether Ptolemy's theory of the planets was one such achievement. In order to answer to this question, we may briefly attempt to place Ptolemy's theory in the context of the history of ancient astronomy.

As far as we know, the motion of the planets was until short time before Ptolemy only

[19]Rouse 1976, 1st ed. 1902, 60.

[20]Plut. *Mor.* 1093D. Cf. Jaeger 2008, 22. As Netz notes, the fact that he advocated vegetarianism only made his gift more remarkable; cf. Netz 2009, 197.

[21]Jaeger 2008, ch. 1.

qualitatively represented. Epicyclic and eccentric theory were used to describe the planets' retrogradations, but the models were inadequate because they did not clearly account for the first, zodiacal inequality.[22] Ptolemy is our first attestation for the introduction of a center of angular uniform motion different from both the earth and the eccenter –what has been called the 'equant'[23]–, thanks to which the epicycle-and-eccenter model was for the first time empirically valid. This is no minor success: epicycles had been in use at least from the time of Apollonius of Perga in the third century BCE, and astronomers had busied with them until Ptolemy's time without achieving a correct description of the planetary movements. Hipparchus, as Ptolemy acknowledges, described well the theory of the Sun (using one eccenter), and devised a model of the Moon's motion with one epicycle, which constitutes Ptolemy's first model of the Moon. Ptolemy added a circle on which the center of the deferent would turn in order to account for the movement 'in depth' of the Moon at the quadratures: Hipparchus' model worked well only at conjunctions (new and full Moon).[24]

Hipparchus did not work out any theory for the planetary movements: he instead composed a work pointing to the disagreements between the models of the astronomers of his time and the actual observations, demonstrating that they did not account for the zodiacal anomaly. Astronomical work after Hipparchus could only poorly account for planetary motion, even if it attempted to treat both anomalies. As Evans shows, the main problem must have been the movement of Mars, a planet with both great epicycles and eccentricity, which was very difficult to empirically describe without using an equant, even using eccenter plus epicycle.[25]

Ptolemy himself, who acknowledges the work of the previous astronomers in solar and

[22]Jones 2006, 37; Pedersen 1974, rev. ed. 2010, 261; Evans 1984, 1086-8.

[23]But Ptolemy does not explicitly attributes this mechanism to himself. See Evans 1984 for an easy explanation of the mechanism of the equant and a plausible history of its development.

[24]Ptol. *Alm.* 5.1.

[25]See Evans 1984, 1088.

lunar theory, seems to present planetary theory as his own contribution.[26] We have very little evidence of planetary theory before Ptolemy that can confirm his picture. However, the little we have agrees with it. A recently studied piece of evidence lies precisely in the inexact models of the Keskintos inscription. As Jones (and Toomer before him) notes, Ptolemy seems to allude to a similar astronomical theory as the one in these models.[27]

Another ancient artifact which provides clues for the planetary theory before Ptolemy and after Hipparchus is the so-called Antikytera mechanism, an astronomical clock found at a wreck at the coast of the island of Antikytera between Creete and mainland Greece at the beginning of the twentieth century. It was formed by a multitude of connected gears ending in pointers which marked various astronomical data, including the position of the Sun, that of the Moon and its phases. Although no gears for planetary motion survive, the most recent researches (2 papers in 2012, apparently independent) hypothesise that the clever solution for the movement of the Moon, a pin and a slot on different gears –the pin transmitting the movement to the gear with the slot– which has been proven to reproduce exactly the angular movement of an epicyclic model, was also probably used for indicating planetary positions of the superior planets. Without such a solution the high number of gears needed for them would make their construction difficult due to the dimensions of the box. In any case, it is highly unprobable that the mechanism reproduced movements of the planets more complex than the simple epicycle model, and again for the complex periodicities of Mars the pointer would have been very out of place in only a few years .[28]

The evidence from Egyptian papyri also seems to be coherent with the sketched situation. These papyri are dated mainly from the second to the fourth century CE, so that they could reflect the impact of Ptolemy's theory and other contemporary astronomers in

[26]Ptol. *Alm.* 1.1 H1.8. Cf. Pedersen 1974, rev. ed. 2010, 261.

[27]This is when he criticizes in the *Almagest* (IX.2) certain unnamed astronomers who tried to account for the two anomalies by using 'eternal table-construction', applying 'eccentric circles or circles concentric with the zodiac and carrying epicycles or (by Zeus!) the combination of the two'; such epicycle-and-eccenter models, along with the assumption of common periods for all the planets is what we precisely find in the inscription; cf. Jones 2006, 35.

[28]Freeth and Jones 2012; Carman et al. 2012, 14.

the subsequent generation.[29] Among the 13 papyri showing tables for planetary motion involving geometrical models, 5 of them are derived from Ptolemy's work *Handy Tables*, and the other 8 'show no obvious relation to Ptolemy'.[30] So it seems that Ptolemy's was probably the most successful theory, although other, perhaps contemporary astronomers, could have produced similar theories perhaps with a similar degree of accuracy.

A papyrus not in this list, presented in a preliminar study by Anne Tihon, seems to use geometrical models and a treatise called 'Syntaxis', like the original name of Ptolemy's *Almagest* but clearly not Ptolemy's own; while the date of the papyrus could be later, one astronomical example dated from 130 CE in the text suggests that the contents date back to Ptolemy's time.[31]

So in conclusion, it looks as though a theory like Ptolemy's was probably developed not until his own period. Perhaps he was not the first, yet probably one of the first astronomers who could find an empirically correct theory for the movements of the planets and the Moon. Surely this finding well deserved something special like a dedication to a god, a traditional offering of one's intellectual firstfruits as we have seen.

Such an offering would also undoubtedly constitute an act of public self-presentation, comparable to Eratosthenes' dedication of a column with his solution of Delian problem to king Ptolemy in nearby Alexandria centuries before. In there, an object was on top, followed by the sketch of a proof and a diagram, and finally and epigram.[32] The famous stele of Archimedes' tomb, whose discovery by Cicero in Syracuse is vividly described by himself in the *Tusculans*,[33] was decorated in a very much similar fashion –object on top, diagram and epigram–, and Ptolemy could have had the examples of these famous mathematicians in mind when dedicating his inscription. Actually, in one of the manuscripts preserving the text of the *Canobic Inscription* there appears a diagram, which, although corrupt, may

[29]Jones 1999, 7.
[30]Jones 1999, 39.
[31]Tihon 2010.
[32]Netz 1999, 16; cf. Eutocius *In SC II*.94.8-14.
[33]Cic. *Disp.* 5.64-7.

have been original.[34] If it was in the original stone, perhaps this was Ptolemy's way of positioning himself in the tradition of these men?

So it seems that mathematicians sometimes erected monuments commemorating their achievements. But so did other professionals, as well. The interesting thing is that the form of mathematical offerings was practically the same as that of a mathematical treatise, and this seems to be quite unique. So why were mathematical treatises so commonly monumentalized? Reviel Netz offers an interpretation of this issue based on understanding mathematical texts as performative in themselves.[35] Netz suggests that while physicians relied on their instruments in doing their work –the same as astronomers–, their texts were not performative in the way mathematical texts were. While medical texts were not formally different from literary papyri, mathematical texts showed a visual interaction with the reader in which the theory itself was developed. So, the physicians' real medical practice would not be in the papyrus, but in human bodies, while mathematicians' praxis was in the paper itself. So when physicians offered to the divinity the epitome of their performance, this was their instruments (with which they performed their operations), while mathematicians offered the works themselves in a lasting medium. The prominence of astronomical theories showing eternal cycles would perhaps reflect the desired lasting nature of the offering. Probably also the old conception of the planets as gods, and the consequent 'divine' status of astronomy among the mathematical science (as in Plato, Aristotle, and Ptolemy; see chapter 6) was significant in this context.

1.3 The temple of Serapis at Canopus

Let us now introduce the details concerning the placing of Ptolemy's offering. As we have said, the text of the inscription itself purports that it was set up in Canopus. In this section, I will argue that it is possible to suggest a more precise placing in the temple of Serapis in

[34]Jones 2005a, 60-1.
[35]Netz 2013 (conference).

that town, a major medical and festive site next to Alexandria.

The first clue is found in the text of the inscription itself. The inscription begins with the dedicatory line: 'to the savior god' (θεῷ σωτῆρι). But Ptolemy does not specify the god he refers to. The indefinition in his chosen formula for alluding the god is indeed rare. In the surviving inscriptions recorded in the *PHI* database it is found isolated –this is, without mention of the god or the deified individual (very frequently the Egyptian Ptolemaic kings[36])– only very rarely.[37] However, we know that in Canopus, where the inscription was dedicated, a savior god *par excellence*, Serapis, was worshipped in a very important temple at Ptolemy's time. This is why Ptolemy's dedication has been usually understood as referring to Serapis.

The first editor of the inscription, Boulliau, also proposed that the place of the dedication was the temple of Serapis itself,[38] but there remain doubts, mainly due a confusing reference to the inscription in a commentary by the Neoplatonic philosopher Olympiodorus.[39] In what follows I will defend that while Olympiodorus' reference is not to be entirely trusted, his mention of the place of the inscription is plausibly truthful, and probably referring to the temple (although there is not conclusive evidence). The reader not interested in this somewhat long argumentation, involving textual history and some issues on Olympiodorus' own textual methods, may skip this subsection with no harm to the overall comprehension of the chapter.

[36]The fact that the formula chosen is the same as for the Ptolemies may be significant, but I will discuss this possibility only later on in chapter 6.

[37]`http://epigraphy.packhum.org/inscriptions/main`, last consulted 1/8/2013. I looked for inscriptions showing the words θεός and σωτήρ contiguously and in the same case, but in the two possible orders, not attached to any god. There appears only one instance in Egypt, and it is doubtful because both words appear abbreviated (*Koptos à Kosseir* 14); four other instances elsewhere: *IG Bulg III.2* 1724, *MAMA* 4.271 (Phrygia; although θεω is wholly reconstructed), *IK Perge* 241, *TAM II* 403.

[38]Bullialdus 1663, 206; also accepted in Hamilton et al. 1987, 56.

[39]Jones 2005a, 84 agrees with the identification of Serapis, but not with the placing in the temple.

1.3.1 Olympiodorus' reference to the precise place of the dedication

Before introducing Olympiodorus' remark, it will be useful to asses Olympiodorus' own possible acquaintance with the inscription. Since we are going to assess Olympiodorus' reliability, it is important to make some hypothesis about the evidence that Olympiodorus could have had at hand.

As we have said, the *Canobic Inscription* is only preserved in manuscript form. Well, it turns out that Olympiodorus, or his immediate predecessors in the Neoplatonic school of Alexandria, were probably tied to the origin of this manuscript. Indeed, the archetype of the text in manuscript form was probably made in the Neoplatonic school of Alexandria under the brothers Ammonius and Heliodorus, as Jones notes in his recent edition of the inscription.[40] This is suggested by both the dating by Heiberg (prior to the sixth century) and the immediate context in the manuscripts. The inscription is included among the preliminar material compiled in some of the manuscripts of Ptolemy's *Almagest* (the so-called *Prolegomena*), before a section containing Heliodorus' astronomical observations and after a small treatise on multiplication and division, probably written in the same period and in connection with the Neoplatonic school.[41] An indication of the scholar use of the copy could be the presence of a long scholion after the proper inscription. We can assume that this scholion was already written in the archetype of the manuscript text, since it appears in all the codices used in the editions of Heiberg and Jones, and not marginally but in the body of the text, with no break with original content of the inscription.[42]

It was precisely the fact that Ptolemy formed part of the Neoplatonic school's curriculum what made modern scholars entertain the possibility that the inscription, or its text, was a fabrication of the school, perhaps intending to enhance Ptolemy's reputation, and

[40]Jones 2005a, 55

[41]According to Acerbi 2009 (conference).

[42]Ptol. *CI* 18-22. The probability that it was in the archetype is still enhanced by the latter's late date and the few successive recopyings; cf. Jones 2005a, 56.

consequently the school's, by way of faking old evidence of Ptolemy.[43] Probably Olympiodorus' remark contributed to these doubts, as we will see. Such doubts were dismissed with the discovery that the values in the inscription were not derived from the *Almagest*, but represented a prior stage in Ptolemy's astronomical research, as we mentioned earlier.

Now I will introduce Olympiodorus' reference to the inscription. It appears in his extant commentary on Plato's *Phaedo*, where he is analyzing a passage on the contraries (*Phaed.* 70d-71a), and in particular the complementary notions of falling asleep and awakening. This is where the mythological figure of Endymion is invoked. Endymion was a beautiful shepherd, with whom the Moon fell in love, and who passed his time asleep so as to spend his time with her. The figure serves Olympiodorus as a mythical counterpoint to the actual complementarity of the two notions. Olympiodorus rationalizes the myth by making Endymion an astronomer, as earlier had done Pliny the Elder (2.4.43).[44]

> ἐλέγετο δὲ οὗτος ἀεὶ καθεύδειν, διότι ἀστρονομῶν ἐπ' ἐρημίας διέτριβεν, διὸ καὶ φίλος τῇ Σελήνῃ. ὃ καὶ περὶ Πτολεμαίου φασίν· οὗτος γὰρ ἐπὶ μ΄ ἔτη ἐν τοῖς λεγομένοις Πτεροῖς τοῦ Κανώβου ᾤκει ἀστρονομίᾳ σχολάζων, διὸ καὶ ἀνεγράψατο τὰς στήλας ἐκεῖ τῶν εὑρημένων αὐτῷ ἀστρονομικῶν δογμάτων.
>
> He [Endymion] was said to be always sleeping, because he passed his life doing astronomy in isolation, hence [he was said to be] lover of the Moon. This they say too of Ptolemy, because he lived for 40 years in the so-called wings of Canopus studying astronomy, hence he engraved the stelae there of his discovered astronomical doctrines.

Two new pieces of information about Ptolemy and the inscription appear in this account. First, that he lived for 40 years in one place presumably in Canopus called 'wings of Canopus', and that there is where he studied, and where he placed his inscription.

How should we take this comment? One first observation is that Olympiodorus' readers could easily visit Canopus, because his school was located nearby at Alexandria. So it would probably have been risky for Olympiodorus to invent the placing. It is actually possible that

[43] Hamilton et al. 1987, 56.
[44] Olymp. *Comm. Phaed.*, 10.4 (my translation).

the inscription was extant in Olympiodorus' days, since the archetype of the text is dated around that period. This suggests that Olympiodorus perhaps saw the inscription in the 'so-called wings of Canopus', or at least, that he could have known the place where it was from his predecessors who copied down the inscription, if it was not himself the copist.

It may help to think about the possible reasons of the disagreement between what the inscription and Olympiodorus say, 'Canopus' and 'wings of Canopus' respectively. The text by Olympiodorus where his passing comment appears was a commentary, a school text, so it is probable that what Olympiodorus was doing when mentioning the place of the inscription was to specify further what his students could find in the inscription (which, as we have said, also probably formed part of the school's curriculum). This would be a classical kind of explanatory scholion, typical of school practice, so that there would not be anything surprising in this discrepance.

So the 'wings of Canopus' were probably a specific place in Canopus, which Olympiodorus specified for his students. But what were those wings? There are various indications. Firstly, the place would have been one where dwelling was possible, at least in Olympiodorus' time. This is confirmed by one late ancient text referring to the 'wings of Canopus', mentioned by Jones in his edition: one century later than Olympiodorus, Leontius of Neapolis in his *Life of John the Almsgiver* mentions a man named Sabinos, initiated in the monachal life, reporting that he lived 'in Alexandria in what are called the wings of Canopus', and to have had a vision of the saint the day in which he died, which was in 619 CE.[45]

The other text discussed by Jones is a scholion on Aelius Aristides' *Panathenaticus* 97.7, offering an explanation of the lightness with which the soul elevates itself, 'as initiated in the temples', says Aristides. The scholiast metaphorically says that the soul is light because

[45]Leontius *Vit. Ioan.* 408: σχῆμα μετιόντων ἀνὴρ ἐνάρετος Σαβῖνος τοὔνομα ἐν Ἀλεξανδρείᾳ οἰκῶν ἐν τοῖς λεγομένοις Πτεροῖς Κανώβου … As regards the presence or absence of the masculine article before 'Canopus', both seem to be used indistinctively when referring to the town. Boulliau seems to pressupose that the town was written without article, since he says that Olympiodorus, who writes it with article, should have then written 'Serapis' and not 'Canopus'.

'the temples had some structures attached (συνῳκοδομημένα), signifying that the initiated should become elevated.' He crucially adds: 'Hence the Egyptians speak of the wings of Canopus'.[46]

Although the reasoning looks metaphoric, there should be some connection between the last phrase on the wings of Canopus (which constitutes an example of the argument) and what is said before. The 'wings' in the example may either refer to the structures which the scholiast says were attached to the temples, or to the temples themselves. At the same time, it looks as though the expression 'wings of Canopus' was known enough so that it did not need further explanation, even serving as an example. As Jones suggests, the explanation of the scholiast seems to point out that these structures metaphorically guided the initiated upwards, so that they were probably situated at a high place.[47]

A clear explanation for the meaning of such structures may be: the winged roofs of ancient Greek-style temples. This was Boulliau's proposal, and he added a number of ancient testimonia to support his claim: Eustathius commenting on Homer, a scholiast on Aristophanes, the Suda, Galen commenting on Hippocrates, and Vitruvius when explaining the different kinds of Greek temples: πτέρυξ, ἀετός (eagle) or ἀέτωμα are other possible designations for 'wing' mentioned in these sources.[48]

Then Boulliau goes on in his interpretation of 'wings', now applied to a temple in Canopus, and quotes Strabo's description of Egyptian temples, where 'wings' are said to be two side-walls in the entrance,[49] and Pliny's *Natural History* describing a set of buildings outside an Egyptian labyrinth with the word *pteron*.

It seems, then, that there are many ancient references to 'wings' in a figurative sense, and referring to architectural structures resembling actual wings. Their common aspect is that, like wings, such buildings are side-structures of some central body. This matches

[46] *Schol. Aristides Panath.* 97.7: τὸ δὲ κοῦφον, ὅτι τὰ ἱερὰ εἶχόν τινα συνῳκοδομημένα, σημαίνοντα ὡς δεῖ μετέωρον γίνεσθαι τὸν μυουμένον. ὅθεν καὶ οἱ ἐν Αἰγύπτῳ τὰ πτερὰ τοῦ Κανώβου φασί.

[47] Jones 2005a, 63.

[48] Bullialdus 1663, 209-10.

[49] Bullialdus 1663, 210. Strabo 17.1.28.

pretty well our modern term 'wings' applied to a section of a large building, as in the phrase 'the west wing of the White House'. This meaning I have first found in Paulus Silentiarius' *Description of Santa Sophia.*[50]

But there seems to have existed still another architectural meaning for 'wings' in antiquity: a whole building resembling a wing or wings. A building erected by the emperor Justinian along the surrounding walls with which he provided the city of Zenobia was also called πτερά (Proc. *De aedif.* 2.8.14). Procopius says that this building served to shelter the men fighting there, and that it was called like this because it seemed to hang from the wall. So it seems that it was a sort of portico.[51]

We may now apply this to the scholion on Aristides, which informed that the Egyptians say 'wings of Canopus' because temples were provided with wings. The 'wings of Canopus' in the scholion do not seem to designate the wings of temples themselves, in which case the phrasing would have been rather like 'there were wings attached to temples, like the wings of the temple of Canopus'. It seems a plausible interpretation that in the comparison of the scholion the temples themselves are equated with the example 'wings of Canopus'. In this case, the scholiast would be explaining the expression 'wings of Canopus' by which the Egyptians designated a particular temple in Canopus.

But do we know anything of the architecture of the temple of Serapis at Canopus? Unfortunately, not even the ground survives, but it was submerged in Byzantine times as a result of sand movements.[52] However, there is some evidence that the temple could have been of Greek style, according to a fragment of Apollonius of Rhodes which describes it as having a colonnade of Corinthian columns.[53] This is no conclusive evidence, since the temple could have been rebuilt in a different style, but for the moment there is no evidence

[50]Paulus Sil. *Descr.* 317 νότοιο παρὰ πτερὸν; 441 βορῆος ἐπὶ πτερά; 459-461 ἡ μὲν ἐπὶ ζεφύρου τρέπεται πτερόν, ἡ δὲ βορῆος / ἐς κλίσιν, ἡ δὲ νότοιο, καὶ ὄρθιος ἔγρεται ἄλλη / εὖρον ἐπὶ φλογόεντα.

[51]Proc. *De aedif.* 2.8.14: πτερὰ τὴν οἰκοδομίαν καλοῦσι ταύτην ἐπεὶ ὥσπερ ἀποκρέμασθαι τοῦ τείχους δοκεῖ.

[52]No concluding findings have been made in the submerged area for the secure identification of any temple in ancient Canopus: see Stolz 2008.

[53]Apol. Rhod. fr. 1: (Κάνωβος): Κορινθιουργές ἐστι κιόνων σχῆμα. Fraser 1972 II 421 n. 634, Meyboom 1995, 333 n. 192.

of the this latter possibility. We could find another piece of evidence supporting this possibility in the same scholion on Aristides: one could argue that the context in Aristides is Athenian, and that the scholiast was therefore probably thinking of Greek-style temples. So while there seems to be no definitive argument, we can say that the temple was probably of Greek style. Now accepting this supposition, the temple would be surely provided with the porticoes, or wings, typical of Greek temples.

So if the temple of Serapis at Canopus was of Greek style and was called 'wings' (πτερά), we could be facing a situation similar to Procopius' example, where a protruding roof gave name to the whole building.

Furthermore, the hypothesis that such an important site was the actual reference for the expression 'wings of Canopus' would perhaps explain that the place was so famous that it could appear unexplained in three different contexts.[54]

It is precisely to Serapis (the savior god) that Ptolemy probably dedicated his offering, so that it makes perfect sense that his stele was set up in the temple of Serapis at Canopus, as implied by the reference in Olympiodorus.

On the other hand, the other ancient reference to the 'wings of Canopus', that of Leontius, provides evidence of someone living in such a building at a time close to Olympiodorus. This would add credibility to Olympiodorus' claim that Ptolemy lived there. Actually, by Olympiodorus' time (6th c.) the temple district in Canopus did not serve ritual purposes anymore, but was a rather deserted place, where monks settled from the time of Theodosius (d. 395 CE) as Eunapius says,[55] much like Leontius' Sabinos.

A deserted place such as the destroyed site of the Serapeum of Canopus in late ancient times would be an ideal place for a monk to have a vision. Furthermore, it would fit Olympiodorus' parallel between Ptolemy and Endymion, who according to Olympiodorus was

[54]An issue brought up by Jones 2005a, 63.

[55]Eunapius *VS* 6.11.8: τοὺς δὲ μοναχοὺς τούτους καὶ εἰς τὸν Κάνωβον καθίδρυσαν, ἀντὶ τῶν νοητῶν θεῶν εἰς ἀνδραπόδων θεραπείας, καὶ οὐδὲ χρηστῶν, καταδήσαντες τὸ ἀνθρώπινον. Earlier in Eunapius' account we read that the Serapeum was utterly destroyed, so that only the floor was left, but he may well be referring to that of Alexandria, on which he was speaking before, according to Fraser 1972 II 407 n. 526, with bibliography.

said to have lived in isolation.

It was perhaps because of its decadence after the time of Theodosius that the ancient Serapeum of Canopus was named 'wings of Canopus' in these three late ancient sources, instead of the 'temple of Serapis' or the 'Serapeum'. The god was not there anymore, and for this reason the more graphical name 'wings' would have been more successful. Another important factor may have been the Christian hostile attitude towards paganism in Canopus, as exemplified by Eunapius' description of the destruction, and by the change of name of the later monastery of Canopus to Metanoia, a 'happy' change for Pachomius, as he says in the introduction to the Latin version of his rule.[56] As regards Olympiodorus, we know that he made concessions in his teachings on the pagan Greek authors, in order not to interfere with the Christian beliefs of most of his students,[57] so that it could be expected that he did not refer to the Serapeum by mentioning its ancient cult if there was another possibility. In this context, we may note that Olympiodorus does not mention that Ptolemy's inscription was dedicated to a god. We could even speculate that it may have been precisely because the dedication read 'to the savior god', a designation consistent with the Christian God, that it was preserved intact even in hostile Christian times.

Here ends our analysis of one part of Olympiodorus' comment, the part concerning the placing of the inscription in the 'wings of Canopus'. We have concluded that we should probably trust Olympiodorus, who could just be specifying a more precise placing than what his students might have found in the text of the inscription itself. The wings themselves probably designated the ancient temple of Serapis, a deserted place in Olympiodorus' days, perhaps inhabited by monks.

Now let us go on with the other part of Olympiodorus' reference, namely that Ptolemy lived for 40 years in the wings. This is more unlikely. The temple was in full activity by Ptolemy's time, and it is likely that visitors could not live in the sacred precinct.[58] But

[56]Text in Migne 1844 Vol. 23, cols. 59-86.

[57]Tarrant et al. 1998, 9.

[58]Aelius Aristides had to find a lodging outside the Asclepeion of Pergamum during his stay there: see Behr

we are told not only that he lived there, but that he did so for forty years, while he was studying astronomy. Boulliau interpreted the story literally, believing that Ptolemy was probably a priest of that temple, and that he lived nearby in the housings of the priests.[59] He was perhaps influenced by the narrative of Strabo's *Geography* after the explanation of the wings (which he cites), where the geographer goes on to tell the story of his visit to the houses of the priests in Memphis, where he was disappointed as he did not find astronomers like the ones that supposedly instructed Plato and Eudoxus.[60] On the other side, Boulliau himself was ordained priest after converting to catholicism,[61] and maybe he wanted to view Ptolemy not only as a precursor of himself in astronomy and philosophy, but also in the undertaking of a religious office.

From another point of view, we can argue that there is not a single instance in the preserved works of Ptolemy that alludes to any kind of religious use for his astronomy, which we would expect if he passed his whole career in a temple. I don't count the inscription, which is simply dedicated. Actually, if Ptolemy was a priest we would expect that he wrote that on the inscription, which would have been set up in his temple. The wide range and the interconnections of Ptolemy's work, along with his philosophical pedigree, rather suggest that his work was intended for the elite in the Roman society of his time.

Jones wants to believe Olympiodorus, surely encouraged by the recent discovery of the authenticity of the *Canobic Inscription*, but he is not ready to admit Boulliau's interpretation of Ptolemy being a priest of Serapis, and rejects all vinculation with temples for the wings of Canopus, instead tentatively suggesting that the expression referred to an isolated site between Canopus and Alexandria.[62] However, the implication that the inscription had no relation to a temple or sacred space seems less probable. As a matter of fact, votive offerings such as Ptolemy's were customarily set up in sacred places. In ancient practice,

1968, 41-2.

[59]Bullialdus 1663, 211.

[60]Strab. 17.1.29.

[61]Burke 2008, s.v. 'Boulliau, Ismael'.

[62]Jones 2005a, 64.

the dedication of an offering was ritualized and involved the priests in charge of the sacred space where the offering was placed.[63]

Jones believed that Olympiodorus should also be trusted when affirming that Ptolemy lived in the wings of Canopus for forty years, and this probably influenced his rejection that such place could have been a temple. For my part, I have argued that that place was probably the temple of Serapis of Canopus, and now I will try to show why Olympiodorus' second information was probably his own speculative (and false) deduction. I will suggest that Olympiodorus' story about Ptolemy living there for forty years was an imaginative portrayal of the astronomer as a solitary sage, justified with the presence of the inscription in the deserted place of the ancient temple. It is even possible that he thereby intended to make Ptolemy's figure sympathetic for his mostly Christian students.

Firstly, it is important to note that Olympiodorus could not have taken the information that Ptolemy lived 40 years in the wings from the inscription, the only source that he mentions. Then why did he write this indication, and why did he use this number?

Olympiodorus' passage presents a perfectly drawn parallelism between Endymion's and Ptolemy's length of retirement and place. Note that first Endymion's sleep is evoked, for which the justification of the saying that Endymion is the lover of the Moon is offered; then this is compared with Ptolemy's astronomical career, which is justified –by using the same connector, διὸ καί– with the *stelae* in the wings of Canopus. While the wings of Canopus are paralleled with Endymion's isolation, the 40 years of Ptolemy's astronomical career are equated with Endymion's eternal sleep, the time during which he contemplated the Moon, and thus the time while he also did astronomy according to Olympiodorus' rationalization of the myth.

While Olympiodorus' students could probably visit the remnants of the temple and see

[63]Rouse 1976, 1st ed. 1902 343:'The offerings when brought by the worshipper, after the proper invocation and sacrifice had been made, were then laid on the table, or set up in the precinct, doubtless under direction of the officials. Statues, large vases, tripods, carven slabs and other such things were placed upon bases which stood all round in the precinct, or sometimes within the temple itself. The bases were shaped to suit the offering, but very many offerings stood on small pillars; and the inscription was commonly graven upon the base'.

Ptolemy's inscription, they could not have found evidence for or against the information that Ptolemy lived there for 40 years studying astronomy, so Olympiodorus could have invented this figure for some special motivation.

Now it turns out that forty years was a typical length of time in the stories about spiritual retirements in the desert in the lives of many holy men, who had the biblic precedent of the forty years in the Egyptian desert of the people of Israel. It is not sure that Olympiodorus had this familiar Christian cliché in mind, but he surely knew Iamblichus' *Live of Pythagoras*, where the sage is said to have been leader of his school for 39 years.[64] The figure of 40 years seems to have been of common use for ancient chronographers, who frequently assigned the number 40 to the regnal years of the monarchs on whom they did not have any reliable chronographical information.[65] Iamblichus' description of the school of Pythagoras did also have a monachal flavor, which Olympiodorus could have wanted to transfer to Ptolemy's figure; the story about the later Pythagoreans dispersed around the world in solitary places, having no contact but with other Pythagoreans, could also have influenced his account.[66]

Indeed, the context in Olympiodorus' commentary is clearly Pythagorean. The two fellows discussing with Socrates at the place where Olympiodorus introduces his reference to the *Canobic Inscription* (Plat. *Phaedo* 71a) are the Pythagoreans Simmias and Cebes, and the opposite notions of falling asleep and awakening, which are the main object of Olympiodorus' remark, call to mind the much cited Pythagorean habit of recalling and planning the events of the day.[67]

Furthermore, the scholion in the inscription, probably made at the same time of its manuscript copy, is concerned only with the last section, which displays Ptolemy's version of the Pythagorean tones of the spheres. So it could well be that the school was inter-

[64]Iambl. *Vit. Pyth.* 36.265.
[65]Polman 1974, 171-2.
[66]Porph. *Vit. Pyth.* 58.
[67]E.g. Porph. *Vit. Pyth.* 40.

ested in the inscription especially for this 'Pythagorean' evidence of Ptolemy, relying on the *Almagest* and other works for the astronomical theory. This would agree with our interpretation that Olympiodorus could be shaping Ptolemy as a Pythagorean sage.

In conclusion, I suggest that, while Olympiodorus' reference to our inscription is probably reliable as to the place indicated, the so-called wings of Canopus, probably the ancient temple of Serapis at Canopus, the indication that Ptolemy lived there for 40 years could be an invention shaping Ptolemy as a solitary Pythagorean sage in order to make Ptolemy's figure attractive to his Christian students.

1.3.2 The attractions of Canopus

I have argued that with the available evidence we can say that the most probable site where Ptolemy erected his inscription was the temple of Serapis at Canopus. Let us now say something of the temple that can illuminate some implications of erecting a stele in there.

Canopus and its temple of Serapis would indeed be an attractive site for an astronomer who was probably at the beginning of his career like Ptolemy to advertise himself. On the one hand, there was the coincidence that 'Canopus' was also the name of an important star in the southern hemisphere (which still carries that name), a fact which perhaps played a role inspiring Ptolemy's dedication. But, most importantly, the town and its most famous temple, that of Serapis, were an important spot on every sight-seeing tour of Egypt. Strabo's description in his *Geography* speaks for itself:[68]

> Κάνωβος δ' ἐστὶ πόλις ἐν εἴκοσι καὶ ἑκατὸν σταδίοις ἀπὸ Ἀλεξανδρείας πεζῇ ἰοῦσιν, ἐπώνυμος Κανώβου τοῦ Μενελάου κυβερνήτου ἀποθανόντος αὐτόθι, ἔχουσα τὸ τοῦ Σαράπιδος ἱερὸν πολλῇ ἁγιστείᾳ τιμώμενον καὶ θεραπείας ἐκφέρον, ὥστε καὶ τοὺς ἐλλογιμωτάτους ἄνδρας πιστεύειν καὶ ἐγκοιμᾶσθαι αὐτοὺς ὑπὲρ ἑαυτῶν ἢ ἑτέρους. συγγράφουσι δέ τινες καὶ τὰς θεραπείας, ἄλλοι δὲ ἀρετὰς τῶν ἐνταῦθα λογίων. ἀντὶ πάντων δ' ἐστὶν ὁ τῶν πανηγυριστῶν ὄχλος τῶν ἐκ τῆς Ἀλεξανδρείας κατιόντων τῇ διώρυγι·

[68]Strab. *Geogr.* 17.1.17 (tr. H. Leonard Jones).

> πᾶσα γὰρ ἡμέρα καὶ πᾶσα νὺξ πληθύει τῶν ἐν τοῖς πλοιαρίοις καταυλουμένων καὶ κατορχουμένων ἀνέδην μετὰ τῆς ἐσχάτης ἀκολασίας καὶ ἀνδρῶν καὶ γυναικῶν, τῶν δ' ἐν αὐτῷ τῷ Κανώβῳ καταγωγὰς ἐχόντων ἐπικειμένας τῇ διώρυγι εὐφυεῖς πρὸς τὴν τοιαύτην ἄνεσιν καὶ εὐωχίαν.
>
> Canobus is a city situated at a distance of one hundred and twenty stadia from Alexandria, if one goes on foot, and was named after Canobus, the pilot of Menelaus, who died there. It contains the temple of Sarapis, which is honoured with great reverence and effects such cures that even the most reputable men believe in it and sleep in it — themselves on their own behalf or others for them. Some writers go on to record the cures, and others the virtues of the oracles there. But to balance all this is the crowd of revellers who go down from Alexandria by the canal to the public festivals; for every day and every night is crowded with people on the boats who play the flute and dance without restraint and with extreme licentiousness, both men and women, and also with the people of Canobus itself, who have resorts situated close to the canal and adapted to relaxation and merry-making of this kind.

Strabo describes two features that make the city such an attractive site: on the one hand there was the temple of Serapis, a healing center and one of those international meeting places where Greek and Roman aristocrats spent periods attending cures and worshipping the physician-god who delivered oracles aiming at the well-care of the attendants. A place like this, the Asclepeion at Pergamum, was the setting of the *Sacred Tales* of the famous sophist Aelius Aristides, an older contemporary of Ptolemy and worshipper of Asclepius who spent long periods of time attending this temple in conversation with the god, but also with the aristocratic society gathered in it.[69] The picture we get from his narrative, as well as from other places like Strabo's account just quoted or from Apuleius' description of his experiences at an Isaeum,[70] is that such centers worked as a gathering-place where social relationships were made among men travelling from different places around the world, mainly through the erudite discussions typical of the Roman society like the ones that could

[69] Alexia Petsalis argues in his study about Aelius Aristides and the cult of Asclepius that while the fee for incubation in the Pergamene sanctuary was low, the *Lex Sacra* displayed in there about the rules of the rituals would have visualised a social elite within the community of incubants: Petsalis-Diomidis 2010, 234, 236, 222.

[70] Apul. *Met.* 11.26.

be held more locally in every town's baths. Strabo emphasises that the Serapeum at Canopus was a major such spot, so that 'the most reputable men' in the empire assembled there.

On the other hand, Strabo mentions the other side of the town, the more festive. Naturally, both sides need not have been separated: the Serapeum was probably so famous partly because Canopus was such a party-like place, and the other way round. But the fact is that Canopus seems to have been a favourite place for aristocratic Alexandrians to celebrate in festivals that they reached navigating along the canal that communicated with the metropolis. This canal was so present in Hadrian's memory of Egypt that he constructed a replica of it in his villa at Tibur (modern Tivoli) –he could have conceived the aristocratic retire of Tibur as the Roman Canopus.

Only ten years after the death of Hadrian, in the tenth year of the reign of Antoninus, Ptolemy dedicated his stele at the temple of Serapis at Canopus. Probably he expected to attract the attention of the 'most respectable' men –including the emperor– who attended the sanctuary. Actually, we have a possible hint in the inscription itself that Ptolemy aimed at a Roman audience. One of the sections of the inscription lists the mean positions of the planetary models not in the first day of the era Nabonassar as in the *Almagest*, nor in that of the era Philippos (this is, from the death of Alexander) as in the *Handy Tables*,[71] but in the era of Augustus.

1.4 The contents of the inscription

In the previous sections I have sketched what can be said about the context of the material evidence that forms the focus of this chapter, Ptolemy's *Canobic Inscription*. I will concentrate my interpretation on the last part of the inscription, but a general comprehension of the contents of the whole inscription is needed in order to understand the place that our selected section occupies and the implications that are derived from this. So let us proceed

[71] Evans 1998, 241.

to a description of the contents of the inscription.

An interesting thing to note is that the first line of the inscription serves not only for dedicating the inscription, but also for presenting the minitreatise providing the name of the author and the title as though it were written on a papyrus.[72]

> Θεῷ σωτῆρι Κλαύδιος Πτολεμαῖος ἀρχὰς καὶ ὑποθέσεις μαθημάτων.
>
> To the savior god, Claudius Ptolemy [dedicates] the first principles and models of astronomy.

But this is coherent with what has been said about the tradition among Greek astronomers to dedicate their work in monuments in the form of inscribed treatises. As regards the title, it seems that μαθήματα (which Jones translates as 'astronomy'), came to be specialized for the meaning 'astronomy', but it normally designated more generally 'mathematics' or 'sciences', or even just 'studies'. Ptolemy also used it for his best-known astronomical work *Almagest*, which he named Μαθηματικὴ σύνταξις. Since it is clear that there were obvious choices in the Greek of Ptolemy's time for the more restricted meaning 'astronomy' (ἀστρονομία, ἀστρολογία), it is possible that Ptolemy wished to stress the more general dimension implied by μαθήματα. Indeed, in many passages of his works, including the last part of this inscription, it is clear that he wished to present as connected the different spheres of mathematics (see on this specially chapter 6).

Right after the title we find two sentences giving respectively the inclination of the ecliptic, and the duration of the mean nychthemeron:[73]

> Ἡ μεταξὺ τοῦ ἰσημερινοῦ κύκλου καὶ τοῦ ἡλιακοῦ διὰ τῶν πόλων αὐτῶν περιφέρεια τοιούτων ἐστὶν κγ να κ, οἵων ὁ μέγιστος κύκλος τξ. τὸ ὁμαλὸν νυχθήμερον χρόνων ἐστὶ τξ νθ η ιζ ιγ ιβ λα, οἵων ἡ μία τοῦ τροπικοῦ περιστροφὴ τξ.
>
> The arc between the equatorial circle and the solar [circle] through their poles is 23;51,20 of such units as the great circle is 360. A mean nychthemeron is

[72] Ptol. *CI* 2 (tr. Jones – within each chapter I will only mention the name of the translator in the first quotation of the text). I follow the numbering of the sections by Jones, too (Jones 2005a).

[73] Ptol. *CI* 3.

> 360;59,8,17,13,12,31 of such time-units as one revolution of the cosmos is 360.

The former value is the inclination of the plane of the Sun with respect to the equator. The latter represents the duration of a mean complete day, this is, the time elapsed from one noon to the noon of the following day. 360 units are a whole revolution of the cosmos, as tells the inscription, so that a whole day takes the 360 units of a whole revolution plus a small amount of time due to the yearly motion of the Sun around the Earth. It is a 'mean nychtemeron' because it is calculated on the basis of the mean motion of the Sun, not the apparent one, which is variable depending on the time of the year.

What comes next is a set of four tables preceded by the heading 'parameters of the models' (λόγοι ὑποθέσεων) (*CI* 4), echoing the 'models' (ὑποθέσεις) of the title. So it seems that what the title calls 'principles' (ἀρχαί) would be the preceding two statements about the inclination of the ecliptic and the duration of the mean day. Actually, two of the tables in the 'parameters' section explicitly record parameters of the models with respect to these data: *CI* 7 defines mean motions in a mean nychthemeron, and *CI* 8 defines inclinations with respect to the plane of the ecliptic. This usage seems to fit the one in the *Almagest* where Ptolemy presents the 'actual phenomena' and the 'indisputable observations' as 'principles' (ἀρχαί) and fundaments (θεμέλιοι) on which he will base his theory:[74]

> ἕκαστα δὲ τούτων πειρασόμεθα δεικνύειν ἀρχαῖς μὲν καὶ ὥσπερ θεμελίοις εἰς τὴν ἀνεύρεσιν χρώμενοι τοῖς ἐναργέσι φαινομένοις καὶ ταῖς ἀδιστάκτοις τῶν τε παλαιῶν καὶ τῶν καθ' ἡμᾶς τηρήσεων.
>
> We shall try to provide proofs in all of these topics by using as starting-points and foundations, as it were, for our search the obvious phenomena, and those observations made by the ancients and in our own times which are reliable.

Jones' opinion on the terms appearing in the title is somewhat puzzling, since, while he translates ὑποθέσεις for 'models' througout, he tentatively says that 'probably ὑποθέσεις in the context of the inscription means the permanent parameters defining a model, such

[74] Ptol. *Alm.* 1.2 H1.9.

as the eccentricity and epicycle radius, whereas ἀρχαί are the epoch positions'.[75] But what would then mean λόγοι ὑποθέσεων, which Jones translates as 'parameters of the models'? Perhaps the comparison with the title of another work of Ptolemy, the *Planetary Hypotheses* (ὑποθέσεις τῶν πλανωμένων) can be of some help here. In that work (see my presentation of it in chapter 5) Ptolemy attempts a similar succint presentation of the planetary models derived from his astronomical theory, providing the same kind of numbers in a similar order, including the epoch positions, and also a final section on the hypothetical physical models that would fit his astronomical theory. It seems thus probable that our general notion of 'models' would be better adjusted to this concept than Jones' more restricted 'permanent parameters of the models', which occupy just a small part of the treatise. Furthermore, it would be rare that in the inscription Ptolemy wrote the title in such a way that the first concept, the 'principles' (ἀρχαί), referred to a part of the inscription situated only *after* the part referred by the second concept, the ὑποθέσεις.

Indeed, after the tables for the parameters of the models there comes a set of tables displaying the positions of the models at the beginning of the era Augustus (*CI* 9 and 10), followed by two supplementary tables, the first one showing the fixed positions of the apogees and ascending nodes of the planets with respect to a fixed star (*CI* 11), and the second one showing the arc of vision, this is, the minimum degrees of separation with the Sun at which the planets are visible (*CI* 12).

These tables are interrupted by two other prose statements, which put an end to the purely astronomical part of the inscription. The first of these statements gives the angle subtended by the Sun and the Moon at lunar eclipses, along with the diameter of the cone of the shadow projected by the Earth (at the distance of the Moon), while the second one gives the distances to the Earth of both the Moon and the Sun in earth-radii:[76]

ἐπὶ τῶν ἐν ταῖς συζυγίαις ἡλίου καὶ σελήνης μέσων ἀποστημάτων ἡ μὲν

[75] Jones 2005a, 84.
[76] Ptol. *CI* 13.

> ἑκατέρου τοῦ φωτὸς διάμετρος ἀπολαμβάνει πρὸς τῇ ὄψει γωνίας ὀρθῆς ρξβ′, ἡ δὲ τοῦ κώνου τῆς σκιᾶς διάμετρος ξε′. καί, οἵων ἐστὶν ἡ ἐκ τοῦ κέντρου τῆς γῆς α, τοιούτων ἐστὶ τὸ μὲν τῆς σελήνης ἀπόστημα ξδ, τὸ δὲ τοῦ ἡλίου ψκθ, πρώτων κύβων ἅμα καὶ τετραγώνων ὅροι.
>
> At the mean distances of the Sun and the Moon at syzygies, the diameter of either luminary subtends at the sight $1/162$ of a right angle, and the diameter of the cone of the shadow is $1/65$ [of a right angle], and of such units as the radius of the earth is 1, the distance of the Moon is 64 and that of the Sun is 729, terms simultaneously of the first cubes and squares.

Actually, the data of the angle of Sun and Moon and the angle of the diameter of the shadow, along with the distance of the Moon, are used to calculate the distance of the Sun as it appears in the *Almagest* (V.15), so that we can simply name this section 'distances of the Moon and the Sun'.[77]

After these, in perhaps the most intriguing part of the inscription, there come again tabular data, which are now entitled 'fixed pitches of the cosmic tuning' (συστήματος κοσμικοῦ φθόγγοι ἑστῶτες) (*CI* 14). In this section, each heavenly sphere is assigned a musical note and number signifying a pitch in the musical scale. In the two final tables the means and the concords found in that musical scale are listed (*CI* 15-16).

In what follows I shall discuss the last part of the inscription, from the two prose statements on the distances to the end. As a result of the analysis, it will turn out that possibly the tables on the music tones is built on the basis of the distances of the Sun and the Moon presented in the prose statements. If this was correct, the overall design of the contents of the inscription would be a double pattern:

1. **principles (ecliptic and nychthemeron) - models (parameters and epochs of the models)**

2. **principles (distances) - models (tones of the spheres)**

[77] See the explanation of Ptolemy's procedure for calculating the distance of the Sun in Pedersen 1974, rev. ed. 2010, 210.

So the structure of the last part of the inscription would be the same as that of the former, and again reflect the title.

1.5 The last part of the inscription

As I announced earlier, I will focus now my analysis of the inscription on the latter part of the inscription, from the section on the distances of the Moon and the Sun onwards.[78]

Now I will try to show that the mathematics that Ptolemy uses in this second part are less exact, and of a different nature, than what we see in the first part of the inscription. My point will be that what Ptolemy is doing in this last part of the inscription has much more to do with a physical or cosmological idea to which he could apply something of his exact mathematics shown in the first part of the inscription. I will try to show that Ptolemy sought to present this cosmology with a Timaean pedigree.

I will begin with a simple observational fact: while the numbers before the section on the distances are expressed in the fractional sexagesimal system used in Ptolemy's other astronomical works, the numbers that appear from the 'distances' section onwards are recorded in the more traditional Greek fractional system.[79] And, most surprising of all is the fact that the respective distances of the Moon and the Sun to the Earth (64 and 729) are not only expressed as round numbers, but even their arithmetical property of being the two first square and cubic numbers (at the same time) is explicited ($64 = 2^6 = (2^2)^3$; $729 = 3^6 = (3^2)^3$).

The distance of the Sun appearing in the inscription, 729 Earth radii, is very far from the value calculated in the *Almagest*, which amounts to 1210 Earth radii (*Alm.* 5.15). This is precisely one of the errors Ptolemy admits in the *Almagest* to have commited in the past, likely alluding to the *Canobic Inscription*.[80] In there Ptolemy says that the problem was to

[78]For a commentary of the former part of the inscription, the reader can consult the useful analyses in Hamilton et al. 1987 and Jones 2005a.

[79]See the two fractions in *CI* 13 (quoted above) and the one in *CI* 14.

[80]Ptol. *Alm.* 4.9; cf. Hamilton et al. 1987, 57.

take Hipparchus' values for the angle of Sun and Moon and for the diameter of the cone of the shadow of the Earth, and he mentions explicitly the values for these elements appearing in the inscription.

However, it seems that the discrepancy between the distance of the Sun in the *Almagest* and in the *CI* cannot be just explained as the result of taking different starting values.

On the one hand, Hamilton *et al.* note that Ptolemy may have been inconsistent in using Hipparchus' values of the angles at mean distance of the Moon, together with the value of $64;10$ Earth radii which in the *Almagest* is taken as greatest distance.[81]

Furthermore, as the same authors remark, the result in the *CI* (729) may be attained with the *CI*'s values by using the same method as in the *Almagest* (and there is no evidence that Ptolemy used another method), but only if one makes several convenient roundings throughout the steps of the calculation.[82]

Actually, possibly Ptolemy would have been able to get very different results by applying different kinds of roundings, since the calculation of the distance of the Sun was what in mathematics may be called unstable. The reason for this is that there appears a very small denominator in a division, so that very small variations in it may lead to very different results.[83] This is also the cause that both values, in the *CI* and in the *Almagest*, are so clearly wrong from the correct distance calculated with modern methods, which is 19 times greater than the one in the *Almagest*: as Pedersen notes, with his instruments Ptolemy could as well have gotten the correct value, or a very different (and incorrect one).[84] Actually Pedersen hipothesizes that Ptolemy stuck to the value 1210 in the *Almagest* because it was close to Aristarchus' calculated mean value of 1219.[85]

[81]Hamilton et al. 1987, 69. Hamilton et *al.* also note that Ptolemy does not make explicit the kind of distance this represents in the *CI*, and perhaps the fact that it is very close to Hipparchus' value for the mean distance of the Moon would favour the case that Ptolemy was considering it also as mean distance –Hipparchus thought that the angle subtended by the Moon and the Sun was the same at mean distance of the Moon, not at greatest as Ptolemy in the *Almagest*–, but this is difficult to believe since the mean distance is considerably smaller.

[82]Hamilton et al. 1987, ibid.

[83]Hamilton et al. 1987, ibid.

[84]Pedersen 1974, rev. ed. 2010, 212.

[85]Pedersen 1974, rev. ed. 2010, ibid.

Probably Ptolemy likewise stuck for different reasons (or even he forced roundings in order to get) to 729 in the *CI*, and the obvious reason would be that, as he mentions in the same line, 729 was the second square and cube. The first square and cube is 64, his distance of the Moon: he may have found the Moon's distance based on Hipparchus' method, attained a result similar to his, and thought that it was a pleasant, significant number (both a double and triple power of two). So to find a value for the distance of the Sun with that same characteristic would have been very attractive. We will see later that there was also something more in square and cubical numbers that could have been significant.

After the distances come the tables in which Ptolemy assigns tones to the spheres (*CI* 15). This part stands in a still deeper contrast with the mathematical-astronomical part of the inscription, since it is certain that no scientific explanation is to be sought in it. Ptolemy assigns nine notes of the so-called perfect system (the complete scale of Greek music theory) to different heavenly spheres, similarly as other authors had done and will do later in many contradictory ways that reflect the speculative nature of this thought-experiment.[86]

Let us now briefly sketch the history of the tones of the spheres in the surviving accounts, so that we may be able to understand Ptolemy's contribution.

In his *Republic*, Plato himself criticised the Pythagorean music theorists of his day for paying attention only to the heard sounds, and advocated for a common study of astronomy and harmonics that discarded all sensible facets of the two sciences.[87] But when he himself carries out this program in the *Timaeus* through the main character of the dialogue in the passage on construction of the world soul, he is not as precise as implying a one-to-one correspondence between planets and notes, and perhaps even suggests that this sort of exact correpondence should not be done.[88]

However, Aristotle attributed the theory that the movements of the heavenly bodies produced a concord to the Pythagoreans, contradicting Plato's claim that the Pythagore-

[86]As notes Burkert 1972, 355.
[87]Pl. *Rep.* 530d. See Burkert 1972, 355.
[88]So Burkert 1972, 354.

ans did not produced speculative philosophy based on harmonics.[89] Aristotle's is actually the most precise account for the arguments produced by these thinkers: he observed that they used the argument that big bodies must have produced some sound in their motion, and that 'their speeds, as measured from their distances, are in the same ratios as musical concordances' without further specification.[90]

Then why did Plato say that Pythagoreans were only devoted to actual sound? It is likely that Plato was thinking of Archytas' music theory, which was really scientific, while Aristotle thought of other Pythagoreans such as Philolaus (see chapter 2). Indeed, Huffman has rightly noted that Aristotle treated Archytas individually and separated from the Pythagoreans, not even calling him a Pythagorean, as a result of his higher esteem for his philosophy.[91]

If the tradition of the tones of the spheres was Pythagorean, it surely deserves its popularity to the great success of the Platonic tradition, in particular of the *Republic* and the *Timaeus*, where as we have said Plato publicized his philosophical program of descientifizing science in order to speak philosophically, and with a specific emphasis on the link between astronomy and harmonic theory. As a matter of fact, we will see below how some specific cosmic scales were developed out of the casual indications in Plato's *Timaeus*.

It could be said that both traditions, Pythagorean and Platonic, were pursued by Nicomachus of Gerasa, active in the first half of the second century CE. As a matter of fact, in his *Manual of Harmonics* he wrote his own version of the tones of the spheres, which I will review in what follows, for comparison with Ptolemy's.

Nicomachus identified size, velocity and position of the orbit as the three elements which determined the assignation.[92] But his own procedure was chiefly guided by the lat-

[89]Arist. *de Cael.* 290b12-291a25.

[90]Arist. *de Cael.* 290b18-23: Ὑποθέμενοι δὲ ταῦτα καὶ τὰς ταχυτῆτας ἐκ τῶν ἀποστάσεων ἔχειν τοὺς τῶν συμφωνιῶν λόγους. Alexander of Aphrodisias comments on the passage, but he had no more clues than Aristotle: Alex. Aphr. *Met.* 40.3; cf. Burkert 353-4; Huffman 1993, 256.

[91]Huffman 2005, 8.

[92]Nicom. *Harm.* 3.

ter factor (position, or distance according to Aristotle), and the etymological explanation: he said that Saturn was the highest planet and thus corresponded to hypate, which means 'highest', and, in the same way, Moon was the lowest one and thus was to be assigned nete ('lowest').[93]

In this ordering Nicomachus differs from most other authors attesting a specific heavenly harmony, who deliver the scale in the inverse order. This was probably due to the fact that the height of the notes was normally not interpreted etymologically, but on the grounds of pitch: according to pitch, hypate was not the highest note, but the lowest, and nete was not the lowest, but the highest. The naming of the notes was instead derived from the position of the strings in the instruments, so that the string with the highest pitch had the furthest position, as in our modern guitars, and thus was called the 'furthest' or 'lowest', hypate, and in the same way the 'closest' or 'highest' according to position, with the deepest sound, was nete.[94]

Nicomachus consistently used a heptacord (formed by two joined tetracords) for the assignation of seven notes to the seven planets, situating the planets according to their supposed order in the heavens and beginning with the most distant planet, Saturn, assigned to the note of hypate (the 'furthest' in position).

In Ptolemy's *Canobic Inscription* the table is likewise structured according to the distance of the planets, but in the inverse order (with respect to Nicomachus'), following the principle higher planets-higher sounds. The other important contrast is that Ptolemy did not use a full scale, but only the fixed notes. Greek musical systems were constituted by the so-called tetracords, which consist of four successive notes. Now while the two middle notes of the tetrachords vary their pitch according to the musical genus played, the two notes at the extremes of the tetrachords are fixed. These are the ones used by Ptolemy.

Then, on the right side of the table, Ptolemy writes numbers corresponding to the

[93] Ibid.

[94] See e.g. Burkert 1972, 353.

pitches of these notes. For easiness of the explanation, I have reproduced Ptolemy's table here. The fourth column is my own, and displays numbers indexing and grouping the fixed notes of the tetrachords in the scale. So, the two notes indexed with **1** are the two fixed (extreme) notes of the first tetrachord (beginning from the lowest note), the two notes indexed with **2** are the two fixed notes of the second tetrachord, etc. There are notes with two indexes, because they are both the uppermost note of a tetrachord and the lowest note of another tetrachord. There are also notes without index, because they do not form part of any tetrachord, like *proslambanomenos*, which is situated a tone below the lowest tetrachord.

Above *mese*, there are two possible continuations, the tetrachord called *synemmenon* (indexed with number **3**), which is joined from *mese* itself, and the tetrachord *diezeugmenon* (indexed with number **4**), which begins from the note *paramese*, situated a tone above *mese*. The highest note in this scale, called *mese hyperbolaion*, is not attested in the Greek musical systems, an issue that I will address below.

Sphere of the fixed stars	mese hyperbolaion [?]	36	
Saturn	nete hyperbolaion	32	**5**
Jupiter	nete diezeugmenon	24	**4**, **5**
Mars	nete synemmenon	21 1/3	**3**
Sun	paramese	18	**4**
Venus and Mercury	mese	16	**2**, **3**
Moon	hypate meson	12	**1**, **2**
Fire and air	hypate hypaton	9	**1**
Water and earth	proslambanomenos	8	

Between the two fixed notes of one tetrachord there is always (by definition) an interval of a fourth. Consequently, the ratio between their pitches is 4:3 (this is easy to

see if we 'cut' the string of a guitar at 3/4 of the whole length by putting a finger on the corresponding fret: we will hear a fourth above the original sound; similarly the octave corresponds to 2:1, and the fifth to 3:2). So for example *mese* is 16, while *hypate meson* is 12 –they form the two extremes of the second tetrachord–: their proportion is $16 : 12 = 4 : 3$. So the numbers representing the pitch are not a fixed frequency, but are so chosen as to make it possible that all the given proportions between the fixed notes in the scale show up correctly.[95]

So the relationship between the notes and their corresponding numbers is clear. However, there is no explanation for the assignation of notes to planets in the *Canobic Inscription* (probably for lack of space).

It is likely that Ptolemy offered some explanation of this correspondence in the last chapters of *Harmonics*, whose titles fit very well the procedure we see in the inscription (see chapter 2). Unfortunately, the contents of the chapters are lost, but we can be confident that his explanation was not a kind of exact calculation such as we find in the *Almagest* or in the first part of the inscription, but of a more speculative nature. As we will see in the next chapter, the section in the *Harmonics* where Ptolemy probably embedded the cosmic scale was not devoted to science, but to Platonic speculation based on the scientific main part of the treatise.

However, although Ptolemy would probably not offer a big calculation justifying his tones of the spheres, he would surely have some explanation for that. The very fact that the scale appeared in the *Harmonics* suggests this, since there is nothing in that work, even in the last section, which is not justified in some manner. But what could Ptolemy's explanation be?

The prose statements on distances, before the table of the fixed tones could be the solution. If the prose statements in the former part (about the ecliptic and the mean nychthe-

[95]Normally in music theory only integer numbers are chosen in this kind of operation, but in the *CI* Ptolemy uses 21 1/3 for the nete synemmenon (Mars), surely not willing to offer too big numbers. In this way, the proportions between them are easily calculable.

meron) were the 'principles' for the models defined thereafter, maybe here we have a similar formal procedure, in which the distances of the Moon and the Sun are the principles for the assignation of the tones of the spheres.

Swerdlow proposed this kind of connection in his article about this last section of the *Canobic Inscription*.[96] He noted the coincidence that the relationship between the distances of Sun and Moon announced in the former section was $3^6/2^6 = (3/2)^6$, and that the proportion between their pitches in the scale was $18 : 12 = 3 : 2$. While suggesting that this could constitute a possible link, he acknowledged that the argument remains inevitably speculative, because only the distances of the Sun and the Moon are recorded and so no consistency can be tested.[97]

However, one need not seek much consistency in this procedure, which after all was probably wholly speculative. Plausibly enough, Ptolemy could have added the section on the tones of the planets because he wanted to construct a scale which was a product of his astronomical calculations. Furthermore, we know that these tones were associated with the distances of the planets as Aristotle remarked, and Ptolemy treated the distances of the Sun and the Moon precisely before the section on the tones.

Therefore, it seems probable that Swerdlow's suggestion on the possible link was in the good direction, and could be pushed a bit further on this basis: Ptolemy stresses in the prose statements on the distances of the Moon and the Sun (to the Earth) that these numbers are the *first* square and cubic numbers. If there is any relationship between the tones of the spheres assigned to the Sun and the Moon and their distances, it has to rely rather on these underlined properties than on the numbers themselves (64 and 729).

Now, if we look at the scale, we note that between the Earth (the lowest note, and therefore the first) and the Moon there is a fifth –corresponding to the proportion 3:2– and between the Earth and the Sun there is a fifth plus another fifth, this is, an interval of

[96] Swerdlow 2004.

[97] Swerdlow 2004, 169-170, who also analyzes Kepler's own interpretation, in a similar vein.

$9 : 4 = (3/2) \times (3/2)$. Furthermore, these are the first fifths appearing in the scale at all (there are no other fifths in the interval between the Earth and the Sun).

My suggestion is that Ptolemy could have related the 'square and cubic' numbers to the interval of the fifth: this is plausible, since such numbers are a power of two and three at the same time, while the interval of a fifth is formed by a proportion of two to three. So Ptolemy could have argued: in the same manner as the Moon and the Sun are the first stellar objects whose distance is a square and a cube, they have to be situated in the cosmic scale as the first and the second fifth from the Earth onwards. The rest of the planets would easily fill up the scale: after all, there would be not many possibilities, as we will see.

The advantage of this hypothesis is that we have a parallel for that in Ptolemy's own work. This process of ordering the spheres of the planets beginning with the distances of the Moon and the Sun can also be found in the *Planetary Hypotheses*. In this work, Ptolemy defined the spheres of the planets as concentric shells in which all the deferent and the epicycles of the planets revolve, and the width of these shells corresponded to the difference between the maximum and the minimum distance of the corresponding planet to the Earth. Ptolemy precisely began with the distances of the Moon and the Sun (the only that could be calculated), and encapsulated between these the two interior planets, Venus and Mercury.[98] In the *Planetary Hypotheses* Ptolemy did not construct any musical scale nor made any reference to this Platonic tradition, but he could have had a similar idea in mind. We have already seen how the title of the *Planetary Hypotheses* is similar to that of the *Canobic Inscription*, and this could reflect the kindred nature of both works.

There is another fact that could point to this connection between the section on distances and the musical part: the planets Venus and Mercury in the musical scale are given, quite strangely, the same note. This could be justified because their period around the Earth is the same, also coinciding with that of the Sun, since they are interior planets. In the *Planetary Hypotheses* they naturally occupy different regions: Mercury is given an order next to

[98]Pedersen 1974, rev. ed. 2010, 394.

the Moon, and Venus next to Mercury.[99] However, accepting our hypothesis that the Sun and the Moon *had to* be situated exactly at those points (at one fifth, and two fifths from the Earth respectively), there would be an obvious reason for situating Venus and Mercury on the same note: in the scale that Ptolemy was using –the scale of fixed tones– there was only one note between those assigned to the Moon and the Sun, the obvious position of the interior planets Venus and Mercury, and so there would be no other option than to situate both planets on that note.

In conclusion, we have seen that in the section on the distances of the Moon and the Sun Ptolemy used a kind of calculation which departed from empirical data but was probably partly manipulated to fit 'nice' results. It seems plausible that Ptolemy established a connection between that section and his version of the tones of the spheres, thus seeking to show some empirical basis for this clearly unrealistic description of the cosmos (by means of music).

1.5.1 A Timaean astronomical and harmonic tradition: Parallels in Plutarch

Was Ptolemy alone in attempting such thing? Could we compare his semi-empirical approach to the speculative Pythagorean astronomical theory with other developments among his contemporaries or foregoers? This will be the question occuping this section on the Timaean astronomical tradition.

In what follows I will argue that we can find an interesting parallel for Ptolemy's procedures in a text by Plutarch, which could reflect the precise tradition that Ptolemy wanted to follow in the last part of his inscription.

The text is Plutarch's essay *On the Creation of the Soul in the Timaeus*. Plutarch is discussing the harmonic scale proposed for the structure of the world soul in Plato's *Timaeus*

[99]It is interesting that Ptolemy at that point noted how there would be a void space between Venus and the Sun, contrary to his hypotheses, but noted that this could be solved by diminishing the distance of the Sun, which proves that he was conscious of the unreliability (and thus the possibility of manipulation) of that calculation; cf. Pedersen 1974, rev. ed. 2010, 394.

(not explicitly linked to the planets by Plato), whose pitches are explicitly formed by using powers of the numbers two (1, 2, 4, 8) and three (1, 3, 9, 27).[100] Then, Plutarch says that some authors 'transfer the inventions of the Pythagoreans' to this scheme, 'tripling the distances from the center', and assigning the unit to fire, three to counter-Earth, nine to Earth, 27 to the Moon, 81 to Mercury, 243 to Venus, and 729 to the Sun. There are no notes linked to this series, but it is clear that the distances of the planets according to this tradition would have been moulded on the harmonic scale of the *Timaeus*.

Plutarch then says that the latter distance, that of the Sun (729), is both a tetragonal and a cubical number, so that these authors call the Sun a square and a cube.[101] Note that the number for the Sun, along with its explicited arithmetical property is exactly what we find in Ptolemy's expression of the distance of the Sun (*CI* 13). For the case of the Moon, Ptolemy's does not coincide with Plutarch's account ($27 = 3^3$), but it is another tetragonal and cubical number ($64 = (2^2)^3$), like the Sun's. Furthermore, the fact that Ptolemy uses the number two as the base for his distance of the Moon is perfectly in tune with the Timaean motivation that Plutarch attributes to the authors who apply such a system, because the scale in the *Timaeus* is structured on powers of both two and of three.

What Plutarch means by 'the inventions of the Pythagoreans' is Philolaus' cosmology, clearly distinguishable by the presence of a fire at the center of the universe, and a counter-Earth.[102] Plutarch goes on by saying that the discoveries of the geometers are much more trustful than this Pythagorean system, and he proceeds to indicate various proportions between the diameters of the celestial bodies, presumably provided by these geometers. One of these ratios is the proportion between the shadow caused by an eclipse and the diameter of the Moon, which is given as triple.[103] Let us note that these are precisely the two elements that Ptolemy (and Hipparchus before him[104]) used to calculate the distance of

[100]Pl. *Tim.* 34b-36d; Plut. *An.* 30.
[101]Plut. *An.* 31.
[102]Philolaus DK A17=8 Huffman (Huffman 1993, 238); cf. Burkert 1972, 313.
[103]Plut. *An.* 1028D: τὸ δὲ διάστημα τῆς ἐκλειπτικῆς σκιᾶς τῆς διαμέτρου τῆς σελήνης τριπλάσιον.
[104]Pedersen 1974, rev. ed. 2010, 209.

the Sun using the distance of the Moon.[105] It is possible that Plutarch was trasmitting here a report from an astronomical calculation of the same kind, perhaps the distance of the Sun. This would explain that he added these numbers judging them as more plausible than the Pythagorean lore he transmits before on the distances of the heavenly bodies.

But, even if Plutarch praises these astronomers for their geometrical demonstrations, comparing them with the Pythagorean tradition of tripling the distances, the numbers of the geometers appearing in his account are all interestingly factors of two and three: the diameter of the Sun is said to hold the proportion 12:1 to that of the Earth, the diameter of the Earth 3:1 to that of the Moon, the diameter of the 'least of the fixed stars' to that of the Earth 'no less' than 1:3, the globe of the Earth to the globe of the Moon 27:1, the diameter of Venus to the diameter of the Earth 2:1, their globes 8:1; the deviation of the Moon from the zodiac (to the diameter of the Moon) 1:12, and similarly for the informations on the irregularity in the speed of the Moon.[106]

In the same list, one of the indications of the motion of the Moon unexpectedly connects astronomy and music: Plutarch says that when the Moon has traveled from new Moon to full Moon, it has then completed his wandering through half of the signs, thus making 'a kind of diapason harmony with six notes'.[107] The underlying thought is that the extension of the whole zodiac bears a double proportion (2:1) to half of the signs, the path traversed by the Moon, and the double proportion in music theory is that of the octave, the so-called *dia-pason* (because it covers all the notes). Thereafter Plutarch verges to the proportions in the duration of the seasons according to the Chaldaeans, which he also expresses as musical intervals, and according to Euripides.[108]

We do not know who Plutarch's astronomers were. However, we can say that probably

[105] In Ptolemy's inscription the proportion between the two is not 3 like in Plutarch's account, but a number very close to two and a half: $(1/65)/(1/162) = 2,4923\ldots$

[106] Plut. *An.* 1028B-D.

[107] Plut. *An.* 1028D: ἔξ δὲ ζῴδια διελθοῦσα τὴν πανσέληνον ὥσπερ τινὰ συμφωνίαν ἐν ἑξατόνῳ διὰ πασῶν ἀποδίδωσι.

[108] Plut. *An.* 1028F.

they, or the mediators of the report, were not simply calculating heavenly proportions, but they also wished to show that the proportions between many celestial measures were always related to powers of two and three.

It seems that Ptolemy, too, in the section on distances, adhered to this practice, even getting a mathematical result (provable according to geometry, as Plutarch wanted) compatible with the speculative supposition of the Pythagoreans that the distance to the Sun was 729, a cube and square. Ptolemy must have known this Pythagorean numerology, since he explicitly mentions the special character of this number. He was probably showing that he was both an accomplished mathematician and a philosopher who could make his contribution in Platonic theology.

But the similarities between the second part of Ptolemy's inscription and Plutarch's account do not end here. Plutarch's text goes on referring to two different assignations of musical notes to the planets. The first one has no obvious relation to Ptolemy, it is worth analyzing in order to learn more about Plutarch's sources. Let us briefly do that.

So in the first harmony of the spheres reported by Plutarch, the Earth is put in the lowest string, *proslambanomenos*, while the Moon is in *hypate*, Mercury and Venus are said to be in '*diatoni* and *lichani*' (sic. in the plural),[109] and the Sun in *mese*, which is said to be the center of the octave (this claim is also found in Nicomachus[110]).

This scale is the same as the one reported in Achilles Tatius' *Commentary on Aratus' Phenomena*, with only a different order of Venus, Mercury and the Sun. It is worth noting that the order of these three heavenly bodies, in contrast with that of the other planets, varied greatly in the ancient attested reports, due to the fact that they had the same period, the basic ancient means of defining such an order. Both Venus and Mercury are interior planets, this is, they complete a revolution around the Earth in the same time as the Sun,

[109]The formulation reflects an ambiguity as to the order of these planets, on which cf. below. The plural in the names of the notes could reflect this very indecision, perhaps allowing both planets to be assigned the same note.

[110]Nicom. *Harm.* 3.

because they wander only close to it. As we have seen, Plutarch left undecided the order of Venus and Mercury, and so did probably his source; Achilles then perhaps chose his particular solution, assuming one of the possibilities. As what regards the Sun, in Achilles' scale it appears in the sixth position, while it would be in the fourth according to Plutarch's, but Achilles tellingly remarks that the Sun is assigned such note 'if it is given not as the fourth but as the sixth'.[111] By his indication, Achilles seems to point out that he has altered the Sun's order with respect to his source, where it would have been in the fourth as in Plutarch.

Every other aspect is coincident in Plutarch's and Achilles' reports: Earth is in *proslambanomenos*,[112] and Moon in *hypate*. The inner notes of the lower tetrachord are in both accounts *diatonos* and *lichanos*, while *parhypate* is absent, and the whole harmony extends in either case an octave, comprising a *proslambanomenos* at the bottom, the lower tetrachord (*meson*) and the upper tetrachord (*diezeugmenon*).[113] In both accounts the sphere of the fixed stars is added so as to correspond to the eighth note of the octave. This seems to have been also the cosmic scale proposed by Eratosthenes in the *Hermes*, and perhaps the most natural as derived from Plato's expression 'harmonia of eight notes' in the *Republic*.[114]

Plutarch does not only transmit this harmonic system of the spheres, which he thinks to be far from the truth.[115] He says that there are in fact not two but five tetrachords, in which other unnamed theoreticians place all the planets, and goes on to specify the planets that bound each of these tetrachords. In this manner, the first tetrachord (*hypaton*) goes from the Moon to the Sun and the planets which move with it (now it seems that the three appear together), the second tetrachord (*meson*) goes from the Sun to Mars, etc. Then Plutarch says that the ancient musicians had seven fixed notes, formed by the boundaries

[111]Ach. Tat. *Comm. Arat.* 17.23-4: ὁ δὲ ἥλιος, ἐὰν μὴ τέταρτος ἀλλὰ ἕκτος δοθῇι, ἔσται τάξιν ἐπέχων μέσου λιχανοῦ.

[112]Called ἀπὸ ὑπάτων διατόνου in Achilles.

[113]Ach. Tat. *Comm. Arat.* 17. In Achilles' account *trite* is also absent from the upper tetrachord (*diezeugmenon*).

[114]Pl. *Rep.* 617b. Theo Smyrn. 142.16; cf. Burkert 1972, 352.

[115]Plut. *An.* 1029A.

of these tetrachords, and that this number was in agree with the number of the planets. This seems to be referred to the scale he has just reported, if we consider these planets to be actually their spheres, so that the Sun forms a single sphere together with Venus and Mercury, while the fixed stars form another sphere. But at this point Plutarch informs that the modern musicians added the *proslambanomenos* at the bottom, while Plato added one note on the upper section.[116]

Now, what do we have in Ptolemy? The first thing to note is that Ptolemy's scale is formed out of fixed notes, like Plutarch's second harmony. However, the assignations do not coincide with it: Ptolemy's Moon is not in *hypate hypaton*, but in *hypate meson* like in Plutarch's first scale. Venus and Mercury appear together in Ptolemy's text, but now they are assigned a single note. This seems to agree to the indefinition of their order in both of Plutarch's versions. Finally, and most importantly, the number of notes in Ptolemy is nine, the same number that Plutarch postulated.

Ptolemy seems to have been conscious of the appropriateness that the notes in his tones of the universe should be nine, since he seemingly invented a name for the note on the top, namely *mese hyperbolaion*, for which there is no parallel in Plutarch's text or any other ancient writer. Indeed, there does not seem to have been a name for a note above the *nete hyperbolaion*, and Ptolemy probably had to invent it. According to Plutarch, the note added by Plato at the top would be the one singed at unison by the eight sirens which are mounted on the heavenly spheres, and he points to the explanation in the *Republic*.[117] So Ptolemy thought perhaps of the all-encompassing note (through all the spheres) as a sort of middle note (μέση), even if it was the highest one.[118]

Among all the ancient attested cosmic scales, Ptolemy's is close only to the second one

[116]Plut. *An.* 1029B-C.

[117]Plut. *An. Tim.* 1029C: ὁ δὲ Πλάτων δῆλός ἐστιν ἐπὶ τὸ ὀξὺ προσλαμβάνων· λέγει γὰρ ἐν τῇ Πολιτείᾳ (617b) τῶν ὀκτὼ σφαιρῶν ἑκάστην περιφέρειν [εἶτ'] ἐπ' αὐτῇ Σειρῆνα βεβηκυῖαν· ᾄδειν δὲ πάσας ἕνα <ἑκάστην> τόνον ἰείσας, ἐκ δὲ πασῶν κεράννυσθαι μίαν ἁρμονίαν.

[118]Swerdlow proposed μετὰ instead of the manuscripts' reading μέση, but this would also be unparalleled; cf. Swerdlow 2004, 167.

in Plutarch, because of their being constructed only on the fixed notes of the scale, and because they are both of nine notes. Such a coincidence is probably not accidental: there is indeed a great variation in the specific assignation of notes to planets among the ancient writers. Nicomachus' and Plutarch's first scale (the latter coinciding with Achilles' and Eratosthenes') were qualitatively different from Ptolemy's. Another case is that of Aristides Quintilianus, who designs a completely different scheme: instead of notes, Aristides makes the heavenly bodies correspond to whole scales.[119]

So far we have seen that Ptolemy's numerology for the distances of the Moon and the Sun is paralleled in a complex way in Plutarch's account: while Ptolemy paid attention to the special property of his number for the distance of the Sun, also mentioned by Plutarch and attributed to philo-Pythagoreans, he could have in common with Plutarch's geometers the idea of 'finding' powers of two and three in heavenly proportions through astronomical measurements. Secondly, Plutarch's second reported harmony of the spheres has many unique affinities with Ptolemy's, even with the amendments proposed by Plutarch about the extra notes. Therefore, since Ptolemy seems to be attached to this tradition but at the same time shows an awareness with what Plutarch considers the corrections of these theories, we could think that Ptolemy probably relied either directly on Plutarch's account or on Plutarch's source.

But there are other possibilities. Plutarch's source for this astronomical and musical doxography was probably a text commenting on Plato's *Timaeus* by the Middle Platonic philosopher Eudorus of Alexandria (1st c. BCE), on which he says to base his own account for some of the numerological passages of the *Timaeus*.[120]

That Plutarch could be relying on Eudorus for his first harmony of the spheres is supported by the fact that it coincides with the harmony found in Achilles Tatius' commentary, since Achilles does likewise mention Eudorus as a basic source.[121]

[119]Arist. Quint. 3.22.
[120]Plut. *An.* 1013B, 1019E, 1020C. Cf. Dillon 1977, 116; Runia 1986, 48.
[121]Ach. Tat. 2, 13.

If Ptolemy had not read Plutarch's report, then he could have consulted Eudorus' work, likely produced in Alexandria where Ptolemy was active a century and a half thereafter. Eudorus had a 'worth buying' work on the whole range of philosophy, structured by problems, which Arius Didymus used for his own survey,[122] Dillon thinks that Eudorus wrote a commentary on the *Timaeus* basically on the grounds that he was a Platonist and that Plutarch used his work in his own commentary on the *Timaeus*,[123] but it could well be that Plutarch used the general survey of philosophy in a section commenting on the *Timaeus*. Such a work would no doubt be more appropriate for Achilles Tatius, given that he commented Aratus and not the *Timaeus*. In any case, it seems likely that Ptolemy was relying on a source that somehow commented the *Timaeus*, be it Plutarch himself or Plutarch's source.

1.5.2 Other Timaean lore in the *Canobic Inscription*? The elements and the means

There could still be other aspects in the last part of the inscription which show an influence of the *Timaeus*. I will attempt to summarize them here.

As we have seen, in the *Canobic Inscription* the Earth is substituted in the harmony of the spheres for the four elements fire, air, water and earth, which are placed at successive levels. Likewise in the *Timaeus* we don't have a homogeneous mixture of the four, but they are placed also at ordered levels: the body of the universe is said, shortly before the construction of the harmonic scale of the soul, to have been firstly created out of fire and earth, while later water and air were introduced in the middle of them so that the proportions between the four elements were equal.[124] Plato is precise as to the fact that the ratio between the

[122]Ar. Did. 56.1: Ἔστιν οὖν Εὐδώρου τοῦ Ἀλεξανδρέως, Ἀκαδημικοῦ φιλοσόφου, διαίρεσις τοῦ κατὰ φιλοσοφίαν λόγου, βιβλίον ἀξιόκτητον, ἐν ᾧ πᾶσαν ἐπεξελήλυθε προβληματικῶς τὴν ἐπιστήμην, ἧς ἐγὼ διαιρέσεως ἐκθήσομαι τὸ τῆς ἠθικῆς οἰκεῖον.

[123]Dillon 1977, 116.

[124]Pl. *Tim.* 32b: πρὸς ἄλληλα καθ' ὅσον ἦν δυνατὸν ἀνὰ τὸν αὐτὸν λόγον ἀπεργασάμενος, ὅτιπερ πῦρ πρὸς ἀέρα, τοῦτο ἀέρα πρὸς ὕδωρ, καὶ ὅτι ἀὴρ πρὸς ὕδωρ, ὕδωρ πρὸς γῆν…

positions of fire and earth is equal to that between air and water, and to that between water and earth, so that the four elements are separated from each other at equal intervals. Ptolemy instead decided to group them in two sets of two items each –otherwise he would have had to devise two more notes–, fire and air above water and earth, this is, in the same order as they are ordered in the *Timaeus*.[125]

The very end of Ptolemy's inscription (*CI* 15), just below the list of the notes of the planets, could also be explained easily if Ptolemy was following the influence of Plato's *Timaeus*. Ptolemy lists in there the amount of arithmetic, geometric and harmonic means that can be counted in his above-displayed harmony of the spheres. Thus, Ptolemy records 5 arithmetic means, 6 geometric means, and 5 harmonic means.

It turns out that in Plato's dialog Timaeus stresses the importance of these three kinds of means, and this without naming them, but expliciting their definition. Firstly he defines the geometric mean when explaining the creation of the body with the insertion of the two mean proportionals water and air between earth and fire.[126] And shortly thereafter when developing the harmonic scale of the soul he says that the scale is constructed so that in each interval there are two kinds of intervals, whose definitions correspond respectively to harmonic and arithmetic.[127]

With this in view, we could speculate that Ptolemy perhaps wanted to list the number of means in his inscription in order to evidence the ultimate origin of his harmony of the spheres in the Timaeus story.

Finally, in the last table of his inscription (*CI* 16), following a similar procedure as in the preceding table, Ptolemy lists the quantity of each kind of concordant intervals in his scale. So, Ptolemy counts 5 fourths, 4 fifths, 5 octaves, 2 fifths plus octaves, 2 double octaves, and 2 tones. This could correspond to what we find in the narrative of the *Timaeus* after the

[125]These spheres are actually also found in Ptolemy's *Planetary Hypotheses*: cf. chapter 5.

[126]Pl. *Tim.* 32a: ὁπόταν γὰρ ἀριθμῶν τριῶν εἴτε ὄγκων εἴτε δυνάμεων ὠντινωνοῦν ᾖ τὸ μέσον, ὅτιπερ τὸ πρῶτον πρὸς αὐτό, τοῦτο αὐτὸ πρὸς τὸ ἔσχατον…

[127]Pl. *Tim.* 36a: ὥστε ἐν ἑκάστῳ διαστήματι δύο εἶναι μεσότητας, τὴν μὲν ταὐτῷ μέρει τῶν ἄκρων αὐτῶν ὑπερέχουσαν καὶ ὑπερεχομένην, τὴν δὲ ἴσῳ μὲν κατ' ἀριθμὸν ὑπερέχουσαν, ἴσῳ δὲ ὑπερεχομένην.

creation musical scale of the world-soul, when the resulting intervals of fifth (3:2), fourth (4:3) and tone (9:8) that result are repeated.[128] This phrase in the *Timaeus* appears just below the definitions of the harmonic and arithmetic means, in the same manner as Ptolemy's tables on these topics, a fact which could support the hypothesis that Ptolemy consciously imitated the *Timaeus* in this aspect, too.

1.6 The dedication to the 'savior god' and the *Timaeus*

Now I will come back to the beginning of the inscription, the enigmatic dedication to the savior god. My guess is that by using this formula Ptolemy imitated Timaeus in his discourse. If my hypothesis was correct, this would explain the fact that Ptolemy did not expressly mention the name of the god to which he dedicated his inscription, something that, as we have said above, is rather odd among ancient dedications where the epithet 'savior god' appears.

Let us take a look at the beginning of Timaeus' discourse in Plato's dialog of the same name. Before formulating his account on the creation of the world, encouraged by Socrates, Timaeus piously invokes the gods:[129]

> ἡμᾶς δὲ τοὺς περὶ τοῦ παντὸς λόγους ποιεῖσθαί πῃ μέλλοντας, ᾗ γέγονεν ἢ καὶ ἀγενές ἐστιν, εἰ μὴ παντάπασι παραλλάττομεν, ἀνάγκη θεούς τε καὶ θεὰς ἐπικαλουμένους εὔχεσθαι πάντα κατὰ νοῦν ἐκείνοις μὲν μάλιστα, ἑπομένως δὲ ἡμῖν εἰπεῖν.
>
> And we, too, who are going to discourse of the nature of the universe, how created or how existing without creation, if we be not altogether out of our wits, must invoke the aid of Gods and Goddesses and pray that our words may be acceptable to them and consistent with themselves.

Timaeus thus explicitly calls upon the gods and prays that his words be in accord with them. He makes no distinction among them, using a similar expression to what stands on

[128] Pl. *Tim.* 36a: ἡμιολίων δὲ διαστάσεων καὶ ἐπιτρίτων καὶ ἐπογδόων γενομένων ἐκ τούτων τῶν δεσμῶν ἐν ταῖς πρόσθεν διαστάσεσιν…

[129] Pl. *Tim.* 27c (tr. Jowett).

the Keskintos inscription. This clearly reminds the reasons alleged by Philo for offering intellectual presents to the gods (see above).

But later on in a new reprise of his discourse, Timaeus makes another invocation, now in the following terms:[130]

> θεὸν δὴ καὶ νῦν ἐπ᾽ ἀρχῇ τῶν λεγομένων σωτῆρα ἐξ ἀτόπου καὶ ἀήθους διηγήσεως πρὸς τὸ τῶν εἰκότων δόγμα διασῴζειν ἡμᾶς ἐπικαλεσάμενοι πάλιν ἀρχώμεθα λέγειν.
>
> Once more, then, at the commencement of my discourse, I call upon god, and beg him to be our savior out of a strange and unwonted enquiry, and to bring us to the haven of probability. So now let us begin again.

At this point Timaeus is more explicit and demands that the god may save him from his extraordinary enquiry, and bring him to the province of likeliness. Here the savior capacity of the god is explicity invoked, as well as the reason for such a prayer, this is, the great difficulty of the enterprise, defined in the first invocation as the 'discurse of the nature of the universe'.

Again after concluding his long discourse, actually at the beginning of the *Critias*, the chronological and thematical continuation of the dialog, Timaeus compares his speech to a journey that has come to an end favorably. He is thankful for this reason, and prays to the god again for the salvation (σωτηρία) of his words, whenever they have been spoken properly.[131]

> Ὡς ἄσμενος, ὦ Σώκρατες, οἷον ἐκ μακρᾶς ἀναπεπαυμένος ὁδοῦ, νῦν οὕτως ἐκ τῆς τοῦ λόγου διαπορείας ἀγαπητῶς ἀπήλλαγμαι. τῷ δὲ πρὶν μὲν πάλαι ποτ᾽ ἔργῳ, νῦν δὲ λόγοις ἄρτι θεῷ γεγονότι προσεύχομαι, τῶν ῥηθέντων ὅσα μὲν ἐρρήθη μετρίως, σωτηρίαν ἡμῖν αὐτὸν αὐτῶν διδόναι, παρὰ μέλος δὲ εἴ τι περὶ αὐτῶν ἄκοντες εἴπομεν, δίκην τὴν πρέπουσαν ἐπιτιθέναι. δίκη δὲ ὀρθὴ τὸν πλημμελοῦντα ἐμμελῆ ποιεῖν·
>
> How thankful I am, Socrates, that I have arrived at last, and, like a weary traveller after a long journey, may be at rest! And I pray the being who always

[130] Pl. *Tim.* 48d.
[131] Pl. *Crit.* 106a-b (tr. Jowett).

> was of old, and has now been by me revealed, to grant that my words may endure in so far as they have been spoken truly and acceptably to him; but if unintentionally I have said anything wrong, I pray that he will impose upon me a just retribution, and the just retribution of him who errs is that he should be set right.

The metaphor of a journey, which had already appeared in the above invocation in a less evident fashion, is a fitting one in the context of a prayer for salvation. This has the parallel of the many votive stelae offered as thanksgiving after dangerous voyages or similar events, sometimes choosing 'savior' as the designation of the deity.[132] This is the reason why Timaeus thanks the god: he has been able to complete his discourse on the nature of the world, which is no minor enterprise. He feels happy for this.

On the other hand, we note a subtle difference between this and Timaeus' former invocations. Timaeus has now already exposed his discourse, and he does not anymore demand that his words be sound and acceptable to the god, but that the god preserves them if they have been spoken soundly. This is another dimension: Timaeus prays for the durability of his words.

So Timaeus' discourse shares many of the elements which we have attributed above to intellectual offerings. Firstly, and most importantly, it is dedicated to the gods. Secondly, Timaeus' praying demands the kind of divine favor typical of 'firstfruits' votive offerings that we have seen in Philo, basically the positive judging of the dedicant's capacities. Thirdly, Timaeus asks for the future preservation of his words, as though he had inscribed them on a stele.

On the other hand, Timaeus' discourse presents features which relate it to the nature of astronomical votive offerings: firstly, it is not an object or instrument, but a treatise; secondly, the treatise begins with the description of the heavenly cycles. Both these features are typical of astronomical monuments, as we have seen above. And thirdly, Timaeus is

[132] E.g. *IG* IX.2.38

qualified as 'the most of an astronomer among us' (ἀστρονομικώτατον ἡμῶν) by Critias.[133]

Finally, Timaeus explicitly invokes, like Ptolemy, the savior capacity of the god, and at the same time does not mention any particular god, also like Ptolemy.

These factors make it plausible that Ptolemy took Timaeus' discourse as a paradigm for his stele, consciously imitating it even in the phrasing of the dedication.

Perhaps Plutarch alludes to this monumental style of Timaeus in his commentary, when after the accounts of the harmony of the spheres he speaks of 'images' (εἰκόνες) illustrating 'harmonious concords' distributed in 'visible places' around the world:[134]

> Σκοπεῖτε δὲ μὴ τὸν μὲν οὐρανὸν ἄγει καὶ τὰ οὐράνια ταῖς περὶ αὐτὴν ἐμμελείαις καὶ κινήσεσιν ἡ ψυχὴ φρονιμωτάτη καὶ δικαιοτάτη γεγονυῖα· γέγονε δὲ τοιαύτη τοῖς καθ' ἁρμονίαν λόγοις, ὧν εἰκόνες μὲν ὑπάρχουσιν εἰς τὰ ἀσώματα ἐν τοῖς ὁρατοῖς καὶ ὁρωμένοις μέρεσι τοῦ κόσμου καὶ σώμασιν.
>
> Now then consider whether the soul does not roll and turn and manage the heavens and the celestial bodies by means of those harmonious concords and equal motions that are wrought and fermented within her, being herself most wise and most just. And such she became by virtue of harmonic proportions, whose images representing things incorporeal are imprinted into the discernible and visible parts and bodies of the world.

Sacred places were situated in visible places throughout the world. The Serapis temple at Canopus could be one of these visible places. Shortly below, Plutarch adds that the 'first philosophers', the 'theologists', ordered statues of the gods to be made with musical instruments, 'to signify that no work was so becoming to the Gods as accord and harmony'.[135] As we will see in the chapter about the preface of the *Almagest*, Ptolemy considered that the mathematician could also contribute to what Ptolemy called 'theology', meaning speculative philosophy as Aristotle (see chapter 6).

[133] Pl. *Tim.* 27a.

[134] Plut. *An.* 1029D (tr. Philips).

[135] Plut. *An.* 1030B: οἵ τε πάλαι θεολόγοι, πρεσβύτατοι φιλοσόφων ὄντες, ὄργανα μουσικὰ θεῶν ἐνεχείριζον ἀγάλμασιν· οὐχ ὡς λύραν που … καὶ αὐλοῦσιν, ἀλλ' οὐθὲν ἔργον οἰόμενοι θεῶν οἷον ἁρμονίαν εἶναι καὶ συμφωνίαν.

1.7 Double nature of the scientific inquiry?

In this final section I will make some observations on the nature of Ptolemy's inquiry as reflected in the *Canobic Inscription*. While in the first part of the inscription we have mathematical astronomy as we find it in the *Almagest*, in the last part we see Ptolemy engaging in speculative philosophy of a Pythagorean and Platonic kind, probably departing from the mathematical basis of a convenient calculation of the distances of the Moon and the Sun. How could Ptolemy reconcile these two different approaches? To what kind of program do they obey?

It would be interesting to inquire first whether Ptolemy was alone in his enterprise. Can we find something similar happening in other ancient astronomical texts?

The Keskintos inscription may be a first-hand example of an application of astronomical measurements to the philosophy of the *Timaeus*, like the second part of Ptolemy's inscription. We have mentioned above that the astronomer of the Keskintos inscription recorded periodicities in the motions of the planets counted in a great common period of years. As is clear from the numerical expressions in the inscription, the numbers of the planetary periods within this great period are intended as integers, so that the astronomer was thinking that all these periodicities return to the same point after that great given period of years; Jones compares this great period with the *yugas* of Indian astronomy, which are believed to be derived from Greek pre-Ptolemaic astronomy.[136]

Such common periods appear in Plato's *Timaeus*, where the astronomer intimates the following argument, after commenting upon the orbits of the Sun and the Moon:[137]

> τῶν δ' ἄλλων τὰς περιόδους οὐκ ἐννενοηκότες ἄνθρωποι, πλὴν ὀλίγοι τῶν πολλῶν, οὔτε ὀνομάζουσιν οὔτε πρὸς ἄλληλα συμμετροῦνται σκοποῦντες

[136]Jones 2006, 19-20. This is the only example in the Greek world of complex mathematical astronomy dealing with these hypothetic periods. Ptolemy rejects their existence expressly in the *Tetrabiblos*, noting that either they cannot exist at all or are not perceivable in the terms of human time (this is, probably from the time that the first recorded astronomical observations exist, for Ptolemy the Babylonian observations dating on the 8th c. BCE); cf. Ptol. *Tetr.* 1.2.15-16.

[137]Pl. *Tim.* 39c-d.

> ἀριθμοῖς, ὥστε ὡς ἔπος εἰπεῖν οὐκ ἴσασιν χρόνον ὄντα τὰς τούτων πλάνας, πλήθει μὲν ἀμηχάνῳ χρωμένας, πεποικιλμένας δὲ θαυμαστῶς· ἔστιν δ' ὅμως οὐδὲν ἧττον κατανοῆσαι δυνατὸν ὡς ὅ γε τέλεος ἀριθμὸς χρόνου τὸν τέλεον ἐνιαυτὸν πληροῖ τότε, ὅταν ἁπασῶν τῶν ὀκτὼ περιόδων τὰ πρὸς ἄλληλα συμπερανθέντα τάχη σχῇ κεφαλὴν τῷ τοῦ ταὐτοῦ καὶ ὁμοίως ἰόντος ἀναμετρηθέντα κύκλῳ.
>
> Mankind, with hardly an exception, have not remarked the periods of the other stars, and they have no name for them, and do not measure them against one another by the help of number, and hence they can scarcely be said to know that their wanderings, being infinite in number and admirable for their variety, make up time. And yet there is no difficulty in seeing that the perfect number of time fulfils the perfect year when all the eight revolutions, having their relative degrees of swiftness, are accomplished together and attain their completion at the same time, measured by the rotation of the same and equally moving.

Timaeus' oracularly affirms that 'there is no difficulty' in seeing that at some time all the orbits accomplish their revolutions at the same time. The astronomer of the Keskintos inscription was perhaps postulating himself for one of these very few people who had studied the planets mathematically and who could show the common periodicities of all the planets, the Great Year.

The Great Year appeared in astrological texts,[138] but Jones rejects astrological influence in the Keskintos inscription on the basis that astrology was at the time (roughly 100 BCE) only very incipient in the Greek world: he rather compares the procedure seen in that inscription with the science of harmonics, where a normal mathematical procedure to express the pitches for a scale unevenly sectioned was to search for a common, minimum multiple in which all the ratios of all the sections could be expressed.[139] Jones also compares the Keskintos' models, mathematically complex but tied to numerical speculation, with Ptolemy's section on the distances of the Sun and the Moon.[140]

However, we do not see in the Keskintos inscription a separation between a purely

[138] Jones 2006, 29 citing bibliography.
[139] Jones 2006, 37.
[140] Ibid.

mathematical part and a speculative part as we find it in Ptolemy's. We could say that in the Keskintos inscription the interaction of mathematics and philosophical application is much more homogeneous and focused than in the *Canobic Inscription*: what I mean is that whereas Ptolemy clearly separates a wholly mathematical part from a very speculative one (showing something as speculative as the Pythagorean tones of the spheres), in the Keskintos inscription serious mathematical astronomy is applied to a not so highly speculative philosophical theory such as the common periods of the planets.

The most clear ancient formulation of the two separate kinds of explanations of the world that we find in Ptolemy's *Canobic Inscription* is probably found in Plutarch, as well. Plutarch advocated in various passages of his works for a dual function of the scientist: to explicate the natural world both through natural causes and through metaphysical ones.[141]

> ᾧ καὶ μάλιστα δόξειεν ἂν ἰατροῦ καὶ γεωργοῦ καὶ αὐλητοῦ διαφέρειν ὁ φιλόσοφος. ἐκείνοις μὲν γὰρ ἐξαρκεῖ τὰ ἔσχατα τῶν αἰτίων θεωρῆσαι· τὸ γὰρ ἐγγυτάτω τοῦ πάθους αἴτιον ἂν συνοφθῇ, πυρετοῦ μὲν ἔντασις ἢ παρέμπτωσις ἐρυσίβης δ' ἥλιοι πυριφλεγεῖς ἐπ' ὄμβρῳ βαρύτητος δὲ κλίσις αὐλῶν καὶ συναγωγὴ πρὸς ἀλλήλους, ἱκανόν ἐστι τῷ τεχνίτῃ πρὸς τὸ οἰκεῖον ἔργον. τῷ δὲ φυσικῷ θεωρίας ἕνεκα μετιόντι τἀληθὲς ἡ τῶν ἐσχάτων γνῶσις οὐ τέλος ἐστὶν ἀλλ' ἀρχὴ τῆς ἐπὶ τὰ πρῶτα καὶ ἀνωτάτω πορείας.
>
> This is, it would seem, the great difference between a philosopher and a physician or a farmer or a flute-player; for the latter are content to examine the causes most remote from the first cause, since as soon as the most immediate cause of an effect is grasped — that fever is brought about by exertion or an overflow of blood, that rusting of grain is caused by days of blazing sun after a rain, that a low note is produced by the angle and construction of the pipes — that is enough to enable a technician to do his proper job. But when the natural philosopher sets out to find the truth as a matter of speculative knowledge, the discovery of immediate causes is not the end, but the beginning of his journey to the first and highest causes.

At the same time, the Ptolemy that we encounter in the *Canobic Inscription* is perhaps the

[141] Plut. *De primo frig.* 948B-C (tr. Cherniss). See similarly Plut. *De def. or.* 435E-436A

most clear ancient surviving scientifical text embodying this kind of double inquiry.

This is our first encounter with this project of Ptolemy, but many others will follow in the rest of the chapters. My aim throughout will be to explore the way in which Ptolemy dealt with it, the reasons he could have had for adhering to it, and the possible evolution of the project throughout his works. In the following chapters, reading the more verbose works originally written on papyrus, we will have many occasions to see Ptolemy writing more explicitly about it and giving more clues.

1.8 Conclusions

In the first part of the chapter we have learned the chronological and geographical setting. Ptolemy erected an astronomical inscription, probably at the beginning of his career, and probably at the most famous temple of Serapis at Canopus, where international aristocrats met to take cures and for erudite conversation.

We have seen how Ptolemy was pursuing an old tradition of monumentalizing astronomical minitreatises, and dedicating them to the gods, perhaps as a consequence of the idea that the planets were conceived as deities.

In the analysis of the contents of the inscription, it has been shown that it is formed by two qualitatively differentiated sections, not reflected in the title –the title probably reflects rather the inner structure of each of these parts–: firstly, a mathematical-astronomical part, showing exact astronomical values, which probably constituted the main reason of Ptolemy's dedication because it described accurately the correct wanderings of the Moon and the planets, which until recently were not appropriately theorized. There is a transition on the distances of the Moon and the Sun, showing complex mathematical practice tied to numerological 'Timaean' speculation, comparable to some extent to the common periods recorded in the Keskintos inscription. Finally, the last part of the inscription constitutes a highly speculative section showing a cosmic musical scale, probably based on the distances

section.

Both the transition on the distances and the cosmic scale seem to be inspired by a commentary tradition on Plato's *Timaeus* transmitted by Plutarch. Ptolemy was probably dependent on this account, perhaps not having read Plutarch himself but his probable source for this account, Eudorus.

Having in mind that the *Timaeus* was at the time one of the most successful accounts of Greek philosophy, not only in the Eastern part of the empire but also in the educated Rome, and the circumstances under which this work was produced, we may draw one hypothesis. Ptolemy was perhaps making his mathematical work attractive to the Roman elite visiting Canopus, by combining his complex astronomical models –I mean complex for the almost every educated man in the empire, not for astronomers of course– with a widely recognisable philosophical tradition, written at the end of his inscription as a sort of erudite conclusion to his theories.

I will try to test this hypothesis throughout the subsequent chapters, which will analyse other works of Ptolemy. However, we can now say in support of it that it could have been a wise strategy of self-promotion: while showing off his mathematical proficiency at the beginning of the inscription, with the last speculative part Ptolemy would have attractively presented himself as an authentic follower of Plato to those that had studied the great philosopher.

As we have said above, in his *Republic* Plato had argued that the mathematical sciences, and in particular astronomy and harmonics, should progress from their particular knowledges towards the non-empirical, and common essential truths (*Rep.* 530d). Plato himself could be interpreted as having begun this program in the *Timaeus*, but Timaeus was not a real mathematician. Ptolemy was so, and would be showing in his inscription that he was undertaking the Platonic program, which began with astronomy and ended up with philosophy. Ptolemy would have presented himself as the successor of Timaeus, alluding to him both in the final part of the inscription and with his dedication to the savior god.

Timaeus' philosophical account would have been perceived as already 'saved' because of the great success of the work in Plato's posterity and especially in Ptolemy's imperial times. So Ptolemy with his *Canobic inscription* would perhaps have sought to establish himself as the heir of the highly-prized Timaean mathematical philosophy.

Chapter 2

The *Harmonics*

Taking the ancient Pythagoreans' approach, but not without Plato: Archytas joins the Timaeus paradigm

2.1 Plan of the chapter

In this chapter I focus on Ptolemy's treatise *Harmonics*, probably written in the same period as the *Canobic Inscription*. I begin by reviewing the connection between astronomy and harmonics as it appears in the *Canobic Inscription*, of probable Platonic pedigree, and at the same time noting an essential difference in their mathematical approaches, which allows much more choice for music theorists than for astronomers. Consequently harmonic theorists appear frequently divided in sects, much like philosophers. Ptolemy's self-positioning in this tradition (both his choice to be there and the choices he makes within it) is important in our characterization of Ptolemy as an intellectual. Since the history of these sects will naturally be a concern for Ptolemy, I will summarize the situation in the imperial period, following Barker.

After this outline of the background, I will be in a position to introduce Ptolemy's treatise. I will begin by briefly describing the contents of Ptolemy's *Harmonics*, paying attention

to the large part of the treatise dealing with the Pythagoreans' and the Aristoxenians' approaches. I will argue that Ptolemy defends and takes the mathematical approach of the ancient Pythagorean Archytas. Ptolemy finds fault with the empirical validity of some of Archytas' ratios, but I will defend that this represents only a necessary criticism providing room for Ptolemy's improvements, which will basically consist in the application of a mathematically sound theory to the perceptions of the senses, involving a consequent use of the harmonic canon –a traditional instrument of Greek music theorists. The second part of the chapter will be devoted to the last part of the treatise, a non-mathematical philosophical excurse on harmony and its analogical connections to the soul and the heavens. I will review these last chapters of Ptolemy's treatise, arguing that the general tone and goal are here, unlike in the rest of the chapter, unmistakably Platonic, even if Aristotelian concepts are frequently used. I will also underline Ptolemy's presentation of an epistemology apt to his harmonic project, probably deriving from the tradition of Antiochus of Ascalon, in the first chapter of this philosophical section. My conclusion is that in the *Harmonics* Ptolemy, perhaps even more clearly than in the *Canobic Inscription* (for he couldn't choose the mathematical approach there), presented himself as a mathematician working on a Platonic topic with an approach coherent with his astronomical practice. This was an empirically valid scientific method, reached through improving the empirical soundness of Archytas' theory. In the final part of his treatise the Timaean paradigm that we have encountered in the *Canobic Inscription* resurfaces.

2.2 Presentation

If one can trust the coincidence of the content as a fair criterion for establishing chronology, the *Harmonics* was probably written in the same period as the *Canobic Inscription*, since the final sections of the harmonic treatise, of which only the titles of the chapters and a fragment are extant, contained, like the inscription, an account of the tones of the planets

with the planets disposed in the same notes.[1] These is of course no conclusive argument, but after the work by Hamilton, Toomer and Swerdlow confirming the authenticity of the *Canobic Inscription* scholars have tended to favour this hypothesis by using this argument of content.[2]

Amplifying this argument, we could perhaps add another one which would make stronger the case for this datation: probably it is not just a matter of coincidence of the material, but of coincidence of project. More generally than the specific coincidences with the *Canobic Inscription*, there is a wider theme that clearly links both works. In the inscription, as if following Plato's advice in *Republic* 530d, Ptolemy departed from astronomy and ended up with a topic exemplifying what can be shared by both astronomy and harmonics. Conversely, in the *Harmonics* Ptolemy began with harmonics and ended with the same topic, which linked music theory with astronomy. So both sciences were brought in these treatises to the same common topic, nicely meeting Plato's advice. It seems then reasonable to ascribe to a similar period of one's production two works sharing such a common aim.

The treatise has been studied in detail by recent scholars such as Barker and Creese,[3] who have underlined its exceptional quality as a piece of scientific literature. In particular, Barker has analysed the work from the point of view of the subtle methodologic strategies adopted by Ptolemy in his scientific enquiry, while Creese has focused on Ptolemy's use of the monochord, or harmonic canon, as one of the scientific strategies used to test and demonstrate the arguments.

The theoretical approach of these studies is indicative of the different nature of harmonic inquiry with respect to astronomy. Unlike historians of ancient astronomy, historians of ancient harmonics do not primarily concentrate on the 'correctness' of the numbers, but

[1] Cf. Ptol. *Harm.* 3.16 (fragment) and *CI.* Cf. the end of my chapter for the discussion of the last part of the harmonics.

[2] Swerdlow 2004, 175; Feke 2009, 7; Redondo Reyes 2003, xxviii. Cf. Düring 1930, lxx-lxxi. For the authenticity of the *CI*, cf. Hamilton et al. 1987 and our first chapter.

[3] Barker 2001, Creese 2010. Cf. also the annotated translations by Barker 1989, 275-391; Raffa 2002, Solomon 1999. Cf. also the less sympathetic account of Mathiesen 1999, 429-495, esp. 430, where the author uncritically adopts the cliché that Ptolemy adjusted his observations to fit his own methods.

more often on the approach taken by the ancient theorists. This is not only a question of different scholarly traditions, but reflects an essential difference in the nature of these ancient sciences. Ancient harmonics, unlike ancient astronomy, was very much driven by concerns of approach, as I will try to explain in what follows.

A first obvious observation is that harmonics was not such a demanding mathematical science as astronomy. The object of study, musical sound, had a simpler mathematical structure than the positions of the heavenly bodies. While complex epicyclic models are necessary to represent the non-uniform movements of the planets, resulting in a difficult theory for non-advanced learners, the harmonic structure of sound is far simpler, at least as concerns the representation of pitch which was the subject of harmonic science. The mathematical structure of sound consists in a linear pitch, represented through the ratios that define intervals.

An illustration of the ratios of such intervals in a modern guitar may be useful: the octave above the sound of a string may be attained by reducing the length of the string to the *half*, this is, by putting the left-hand finger on the twelfth fret. To get a fifth, it is necessary to reduce the length by *two thirds*, this is, by putting the finger on the seventh fret. For getting a fourth, we must reduce the length by *three quarters*, and this is the fifth fret. So the ratios for the octave, the fifth and the fourth are respectively 1:2, 2:3, and 3:4 (or more commonly the inverses 2:1, 3:2, and 4:3).[4] The main operation with ratios is composition: if we want to know the interval resulting from hightening a note a fifth and then a fourth, we should multiply the ratios corresponding to these two intervals:

$$3 : 2 \times 4 : 3 = (3 \times 4) : (2 \times 3) = 4 : 2 = 2 : 1$$

[4]This would be a modern demonstration that the ratios 2:1, 3:2 and 4:3 define these concords, but the ancient Greeks probably reached them by using similar procedures in other sorts of instruments, like wind instruments. See the discussion on acoustics involving this kind of instruments in Archytas fr. DK 1, and Ptolemy's criticism of the use of wind instruments such as *auloi* and *syringes* in music theory in favour of the harmonic canon, not yet introduced in Archytas' time in *Harmonics* 1.8; see Creese 2010, 117-130.

So the resulting interval corresponds to an octave (as one may illustratively confirm on the guitar). One may also attribute a conventional pitch to a note, say 12, and highten it a fourth by multiplying the ratio corresponding to this interval: $12 \times (4 : 3) = 16$, or lower it by the same interval by dividing by the same ratio (or multiplying by the inverse): $12/(4 : 3) = 12 \times (3 : 4) = 9$. It is important to note that such pitch numbers are always conventional, and normally chosen so that integer numbers result: this is the main difference with modern pratice, where pitches are represented as absolute frequencies (e.g. we say that the note A is equivalent to 440 Hz).

So on the one hand the harmonic mathematical theory was easier. In such a situation, we could argue, the idiosyncrasy of each author is left with more room to shape a particular theory, and so variety would be encouraged in the genre.

But there is yet another important factor which probably contributed to the self-reflective nature of ancient harmonics. Music, unlike the positions of the planets, was not just given. Different musicians performed different music, attuning their instruments in different musical systems. Among the different systems at work, the ancient theoretician had to choose (or even invent), attending the criteria that he judged convenient. Many different approaches were possible, depending on the concept of music that the theorist had in mind. Since music, unlike astronomy, had a practical side, theorists could choose a prescriptive rather than a descriptive approach. Actually, the most interesting treatises often present their treatment as descriptive, but often they cannot avoid being partly prescriptive due to the necessary choices to be taken. This distinction could be linked to another distinction which distinguishes mathematical and non-mathematical theories of music. If the approach taken is prescriptive, too much mathematical complexity would probably play against the very goal of the treatise, which is imposing the 'correct' harmonic structures. The most prescriptive approach, that of Aristoxenus, is not mathematical at all.

Ptolemy was probably aware that such relativity was essential to music theory, since, even if he defends his own approach as the best one, he does not fail to record the attune-

ment corresponding to the ratios proposed by many of his predecessors, even putting them in tables side by side with their own, in a place elsewhere devoted only to the 'data' (*Harm.* 2.14).

The beginning of an extant commentary on Ptolemy's *Harmonics* by the Neoplatonic philosopher Porphyry (3rd c. CE) is very illustrative of this situation. What Porphyry has first in mind when attempting his commentary is the diversity of the traditions in harmonics:[5]

> Πολλῶν αἱρέσεων οὐσῶν ἐν μουσικῇ περὶ τοῦ ἡρμοσμένου, ὦ Εὐδόξιε, δύο πρωτεύειν ἄν τις ὑπολάβοι, τήν τε Πυθαγόρειον καὶ τὴν Ἀριστοξένειον, ὧν καὶ τὰ δόγματα εἰς ἔτι καὶ νῦν σῳζόμενα φαίνεται. ὅτι μὲν γὰρ ἐγένοντο πλείους αἱ μὲν πρὸ τοῦ Ἀριστοξένου, οἷα ἡ Ἐπιγόνειος καὶ Δαμώνιος καὶ Ἐρατόκλειος Ἀγηνόριός τε καί τινες ἄλλαι, ὧν καὶ αὐτὸς μνημονεύει, αἱ δὲ μετ' αὐτόν, ἃς ἄλλοι ἀνέγραψαν, οἷα ἡ Ἀρχεστράτειος καὶ ἡ Ἀγώνιος καὶ ἡ Φιλίσκιος καὶ ἡ Ἑρμίππιος καὶ εἴ τινες ἄλλαι, ἔχοιμεν ἂν λέγειν.
>
> While there are many sects in music on attunement, Eudoxius, one would accept that two of them are first, the Pythagorean and the Aristoxenian, whose tenets still seem to survive today. Because we could say that many of them flourished, the ones before Aristoxenus, such as those of Epigonus, Damon, Eratocles, Agenor and many others, as he himself notes, and the ones after him, recorded by others, such as those of Archestratus, Agon, Philiscus, Hermippus and many others.

All this is very interesting for our purposes, because here, much more than in any other of his works, Ptolemy will have the opportunity to define his position among a number of available options, and his choice, along with the reasons given, will be highly relevant in our own investigation.

[5] Porph. *Comm. Harm.* 3 (my own translation).

2.3 The tradition of the science of harmonics

Since issues of approach were important for the ancient treatises on harmonic theory, let us attempt an outline of the tradition upon which Ptolemy was building his own contribution.

The Greek science of harmonics in its most general definition had sound as its object of study, much in the same manner as optics had image – a widespread comparison in the ancient literature[6] – and sound was for the Greeks firstly divided in musical and unmusical, of which the latter category lacked the sufficient formal characteristics to deserve a close study. As a result, when the Greeks studied sound, they really studied the musicality of sound, this is, when was a sound musical (i.e. when it was a note), what intervals were musical and 'how much musical' they were, or the various combinations of notes used or theoretically used in musical practice such as tetrachords and scales.[7]

Treatises on the science of harmonics seem to have appeared first in the classical period. From this time only Aristoxenus' *Elementa harmonica* and a couple of pseudo-Aristotelian works have survived complete,[8] but we have evidence of Aristoxenus' foregoers appearing in his own treatise, some fragments of a treatise by Archytas and occasional remarks about this science in Plato's dialogues and in Aristotle.[9]

In the Hellenistic period we have remarkably meager evidence of any work on harmonic theory. Eratosthenes turns out to be one of the very few authors of this time who is known to have worked in the field, perhaps not surprisingly due to his interest in the mathematics involved in the work of Plato.

It was precisely the growth of this interest in the 'mathematical' passages of Plato, parallel to the great success of dogmatic Platonism at the beginning of the imperial period, which probably gave way to the production of an unprecedented number of treatises on

[6] Cf. Arist. *Metaph.* 1077a.
[7] See the succession of topics in Aristox. *El. Harm.* book 1.
[8] The *De audibilibus* and the book XIX of the *Problems*.
[9] Cf. Barker's study on the harmonics of this period, Barker 2007.

harmonic theory in the period of the Roman domination.[10] Many works were devoted to understanding and expanding the mathematics present in Plato's works, and harmonics were a good part of it, especially since harmonic ratios played a prominent role in the description of the soul of the world in the *Timaeus*.

Parallel to this tradition, which received the name of 'Pythagorean' or 'Platonic' in antiquity, musical theory derived from the treatises of Aristoxenus was epitomized by the so-called 'Aristoxenians' in school texts used in Roman elite secondary education.[11]

Thus, both the Roman-era Pythagorean and Aristoxenian harmonic traditions were equally based on antiquarism rather than on contemporary musical practice, but they covered different stages of education. Pythagorean treatises of this time were much more rhetorical, varied and ambitious than the school-texts of Aristoxenian theory. Good examples of this sort of treatises are Theon of Smyrna's *Mathematics Useful for Understanding Plato* (a clear self-explanatory title of a work not only containing harmonics) or Nicomachus' *Manual of harmonics*, but long excerpts of works by many other authors survive, such as Thrasyllus and Adrastus.

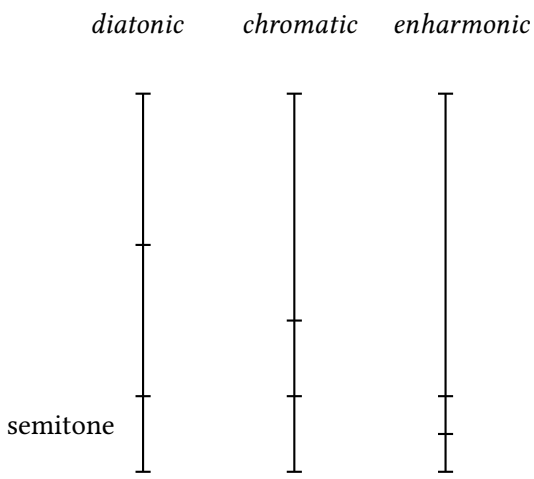
A major difference between the two traditions is the adoption or the rejection of the mathematical approach. On the one hand, the Pythagoreans used the mathematical theory of ratios for the definition of the musical intervals, so that 2:1 represented the octave, 3:2 the fifth and 4:3 the fourth, to name the three basic concords. The discovery of these ratios was frequently ascribed to Pythagoras, but on account of the impossibility of the experiments described in this sort of accounts, we may deduce that these were spurious traditions.[12]

The Pythagorean harmonic treatises of the Graeco-Roman period tended to use only musical structures derived from the idealised diatonic scale appearing in Plato's *Timaeus*. A paradigmatic example is found in Nicomachus' *Manual of harmonics*, which is worth commenting on at this point. But before that, let us briefly explain what is understood in

[10] See Barker 1994.
[11] Barker 1994, 60-2.
[12] See Burkert 1972, 375-6.

Greek music theory by 'diatonic'.

There were three musical genera in which the tetrachords –the basic scalar structure in Greek music– could be attuned, the diatonic, the chromatic and the enharmonic, differing in the pitch of the two interior notes of the tetrachords. The two interior notes were pitched increasingly closer to the lowest note when shifting from the diatonic through the chromatic to the enharmonic. Thus, the diatonic tetrachord is said to be composed (from lowest to highest) of a semitone, a tone and a tone in ascending order; the chromatic is composed of a semitone, another semitone, and three semitones; and the enharmonic is composed of a quartertone (the so-called diesis), another quartertone, and a ditone.



This scheme is derived from Aristoxenus' music theory, even if Nicomachus uses it in order to present the genera in a simple way in his introductory treatise.[13] More complex Pythagorean-style theories would deny that an exact semitone or a quartertone is possible at all to define, on the basis that there cannot exist any ratio corresponding to it, this is, there is no ratio $m : n$ such that:

$$(m : n) \times (m : n) = 9 : 8$$

[13]Nicom. *Harm.* 12. Cf. Aristox. *El. Harm.* 28 Da Rios; cf. Barker 1989, 267, n. 95.

9:8 being the ratio that defines the tone. Consequently, more complex divisions were proposed. Nicomachus himself alludes to this in the same chapter, although, as he says, he prefers to postpone the explanation for a forthcoming treatise that has not come down to us.[14]

We may now go back to Nicomachus' presentation of the diatonic. The diatonic is indeed the genus by which Nicomachus begins, and the only one whose pitches he explicits, coupled with the mythical story of Pythagoras' discovery (*Man. Harm.* 6). It is on this basis that he immediately proceeds to explain the means alluded to in the musical scale in Plato's *Timaeus* (*Man. Harm.* 8, cf. my chapter 1), and to show (rightly[15]) that Timaeus' musical scale derives from the musical theory of the Pythagorean Philolaus (*Man. Harm.* 9). The climax is the complete list of notes (in the three genera and extending four octaves) which closes the short treatise (*Man. Harm.* 12), announced as the system of Timaeus of Locri, 'whom Plato also followed' (end of *Man. Harm.* 11).

Nicomachus was quite straightforward in his explanations and specialized in addressing simple mathematical theories appearing in Plato's philosophy, which an educated Roman of his age would naturally be eager to understand. Barker (like most commentators) describes Nicomachus not as a mathematician properly, but as an able popularizer of Pythagorean-Platonic mathematics: his account was straightforward and free from difficult mathematical obscurities, and at the same time it was not a strict commentary on Plato. These qualities made Nicomachus' manual not only highly successful among late ancient writers on music,[16], but also among his contemporaries, to the point that the satirizer Lucian of Samosata could use without any explanation the expression that someone 'calculates like Nicomachus'.[17]

[14]Nicom. *Harm.* 12. Cf. Ptol. *Harm.* 1.10. See also the divisions by Archytas, Eratosthenes, Didymus, and Ptolemy himself in Ptol. *Harm.* 1.10, 2.14.

[15]Huffman 1993, 376; Barker 1989, 48.

[16]Barker 1989, 247.

[17]Luc. (or ps.-Luc.) *Philopatr.* 12: Ἀριθμέειν με διδάσκεις, καὶ ὅρκος ἡ ἀριθμητική· καὶ γὰρ ἀριθμέεις ὡς Νικόμαχος ὁ Γερασηνός.

What about the Aristoxenians? They did not describe intervals with such ratios, but studied music in a way more clearly identifiable with modern musicological education. Aristoxenus did not seek to study music by applying methods from without musical practice itself, but used a wide range of categories describing the subtleties of music, purportedly contemporary unlike the later Aristoxenians.

To reach such a variety of categories in the analysis of music was not an aim for ratio-based, Pythagorean harmonics, even in Aristoxenus' days when it was not influenced by Plato (we will see the case of Archytas later). It is significant that Aristoxenus did not even consider ratio-based harmonics as a rival in his works, but only those theorists who, like him, investigated music 'from within it', whom he calls *harmonikoi*.[18]

In consequence of the more extramusical and Platonic approach of the imperial-age Pythagoreans, their treatises tended to draw wider relationships between the harmonic structures and other parts of the cosmos, in the same manner as Plato did in the *Timaeus*. Such metaphors were not found in any place of Aristoxenus or his followers.

But, of course, this is only a simplistic characterization, and we may find many original approaches. Ptolemy's is one of them, as we will see. But there was also the musician and theorist Didymus, whose work, which is not extant, is partly discussed by Ptolemy in his *Harmonics*. Didymus' project may have been quite original and extensive. Barker hypothesizes that Didymus' project could have been that of a musician performing for educated Romans the classical Greek music described in the Aristoxenian treatises with the aid of the ratio-based theory of the Pythagoreans.[19] This he would have done by using the theorical instrument used by the Pythagoreans in their enquiries, the monochord or harmonic canon. It is precisely the improvements he made on this instrument, which were useful for actual performance, what appears briefly reviewed in Ptolemy's own work on harmonics, from which we can get some glimpses at what Didymus could have been aiming at.[20]

[18]See e.g. Barker 2007, 37.
[19]Barker 1994, 64-75.
[20]Ptol. *Harm.* 2.13.

2.4 Ptolemy's mathematical harmonics

Let us now briefly introduce the contents of Ptolemy's *Harmonics*. The treatise comprises three books, divided in sixteen chapters each (2-3 pages each in Düring's edition).[21]

Ptolemy's exposition of the topics is relatively straightforward, following the ascending levels of complexity of the harmonic structures, and the accounts of previous writers.[22] Ptolemy begins with the very definition of harmonic theory, with a heavy emphasis on the process by which reason shapes the impressions of the senses concerning sound (on which more below), following with the principles of acoustics (*Harm.* 1.3-4). Then he proceeds to display the Pythagorean principles (*Harm.* 1.5), to show their inconsistencies (*Harm.* 1.6), and to improve on them (*Harm.* 1.7). After introducing the harmonic canon (*Harm.* 1.8), which he will need for the demonstrations in the next chapters, he devotes three chapters to criticizing what he considers the basic principles of Aristoxenian theory concerning concords (*Harm.* 1.9-11).

This first part of the treatise could be considered to treat the basic structures of harmony. Thereafter follows Ptolemy's treatment of the first complex structure, the tetrachord: he begins again with the exposition of the tenets of the two basic schools, this time beginning with Aristoxenus (*Harm.* 1.12), following with Archytas (*Harm.* 1.13); after criticising both (*Harm.* 1.14), he exposes his own division of the tetrachord in the various genera (*Harm.* 1.15-2.1). It is remarkable that the latter two chapters (1.16-2.1) are devoted to what Ptolemy calls the 'familiar genera', this is, the genera that he heard in actual practice.

Another big section is dedicated to a still more complex structure, comprising within it the tetrachords, which is called the *tonoi*, what we would call the musical modes (*Harm.*

[21] The division may not be original, as perhaps indicated by the different division of the third book in a branch of the tradition, where the last chapters are presented without a break: Düring 1930, xli. There may also be inconsistencies in the division of some chapters: see Tolsa 2012 on chapter 2.4. Similar observations may be found on the other divided works of Ptolemy: cf. Toomer 1984, 5 on the *Almagest*, and the varying divisions in the manuscript tradition of the *Tetrabiblos* in Hübner 1998, xxxiv-v and of the *Geography* in Stückelberger and Grasshof 2006, 50. It may also be significant that Ptolemy's minor works were not divided: see Heiberg 1907.

[22] So Barker 1989, 274. See Barker's brief outline of the contents ibid., and the titles of the chapters in the indexes at the beginning of each book in his translation below.

2.3-11).

The last section of the 'mathematical' part seems to be concerned with the use of the canon: Ptolemy begins by illustrating difficulties and solutions of problems with the practice of the single-stringed canon (*Harm.* 2.12-13), then displaying his proposed pitches of an octave for the familiar tonoi for an 8-stringed canon (*Harm.* 2.14-16), and finally proposing the possibility to divide the double octave in a 15-stringed canon, or in an 8-stringed one (*Harm.* 3.1-2). We will get later to the last part of the treatise, which breaks the narrative of the treatise and is dedicated to a more speculative inquiry (*Harm.* 3.3-16).

In Ptolemy's distribution of the topics, it is remarkable how he shapes his own theory following his criticisms on his predecessors, to which he dedicates many of the chapters. Porphyry seems to be aware of this procedure of Ptolemy, and finds in this a perfect excuse for writing his commentary. Indeed, Porphyry declares that he has the purpose of expliciting Ptolemy's sources, which according to him Ptolemy used extensively and without due acknowledgement.[23]

A brief analysis of Porphyry's claims, regarded from a critical distance, may help us understand Ptolemy's harmonic project. The first thing to note is that the music theorist that Porphyry expressly cites in connection with Ptolemy's project is Didymus, who is said to have compared the theories of the principal schools, Pythagoreans and Aristoxenians, in order to take the best of each, in a similar way as Ptolemy did afterwards.[24] Porphyry goes as far as claiming that Ptolemy 'in many places transcribed without any mention' what Didymus had written in a work on the differences between Pythagorean and Aristoxenian music theory.[25] This accusation should perhaps not be taken at face value: it is the very justification of Porphyry's treatise, and, on the other hand, Porphyry's notion of 'transcribing'

[23]Porph. *Comm. Harm.* 3 (preface).

[24]Porph. *Comm. Harm.* 3: Ἱκανῶς δ' αὐτὰς πρὸ Πτολεμαίου μὲν Διδύμου τοῦ μουσικοῦ διακρίναντος ἐν προηγουμένῳ περὶ αὐτῶν συγγράμματι, Πτολεμαίου δὲ καὶ ἐξετάσαντος ἐν τοῖς Ἁρμονικοῖς καὶ τὴν ἀπ' ἀμφοῖν ὠφέλειαν ἐπιδείξαντος…

[25]Porph. 5: τὸ γοῦν Διδύμου Περὶ διαφορᾶς τῆς Πυθαγορείου μουσικῆς πρὸς τὴν Ἀριστοξένειον κατὰ πολλοὺς τρόπους μεταγράφων οὐδαμοῦ τοῦτο μεμήνυκεν, καὶ παρ' ἄλλων ἄλλα μετατιθεὶς παρῆλθε σιγῇ, ὡς ἐπιδείξομεν.

and his exigences on proper citation may not have been the same as Ptolemy's. However, the accusation undoubtedly had some basis, at least on the level of the similarity of both projects.

But, can we find some deeper basis for Porphyry's claims than the fact that both Ptolemy and Didymus took the best from both Pythagoreans and Aristoxenians? As can be deduced from citations in Porphyry's commentary, Didymus had access to Archytas' work on harmonics, from which he probably gained knowledge of the musical practices of Archytas' time and before,[26] presumably the basis of his reconstructed classical Greek music. As a matter of fact, the ratios of the musical intervals chosen by Didymus as reported by Ptolemy are all of the kind that Ptolemy attributes to Archytas' harmonic theory (and this attribution of Ptolemy, which is false as we will see, may have been based on some affirmation of Didymus).

What about Ptolemy? Ptolemy's proposed ratios are of the same kind as Didymus', and Archytas' approach is the basis of Ptolemy's own, as evidenced in the comparison between Ptolemy's approach and Ptolemy's analysis of that of Archytas. Barker thinks that Ptolemy, unlike Didymus, does not seem to have had direct access to the harmonic treatise of Archytas, and that his analysis and use of Archytan harmonics was mediated by the work of Didymus, a fact which may have invited Porphyry's accusations of plagiarism.[27]

However, Ptolemy's project differed in important ways from that of Didymus. Far from aiming at a renaissance of ancient classical music, Ptolemy wanted to describe the music played in his time. In what follows I will argue that Ptolemy, similarly as Didymus if Barker is right, also took Archytas as his model, albeit with the different aim that I have stressed.

Firstly, as concerns the difference between Didymus' and Ptolemy's approach, it is illuminating that some of Ptolemy's criticisms on the work of Archytas reveal a lack of historical awareness on the part of Ptolemy, showing how far his approach is from antiquarism.

[26]Porph. *Comm. Harm.* 107: Τῶν Πυθαγορικῶν τινες, ὡς Ἀρχύτας καὶ Δίδυμος ἱστοροῦσι... Cf. Barker 1994, 65; Barker 1989, 34 n. 25.

[27]Barker 1994, 65.

When he says that Archytas' proposed musical intervals are clearly not musical,[28] Ptolemy is probably thinking in terms of the music he is familiar with, not taking into account that the music he heard was different from that of Archytas' time.[29] The passage is worth quoting because it constitutes at the same time Ptolemy's presentation of Archytas:[30]

> Ἀρχύτας δὲ ὁ Ταραντῖνος μάλιστα τῶν Πυθαγορείων ἐπιμεληθεὶς μουσικῆς πειρᾶται μὲν τὸ κατὰ τὸν λόγον ἀκόλουθον διασῴζειν, οὐκ ἐν ταῖς συμφωνίαις μόνον, ἀλλὰ καὶ ταῖς τῶν τετραχόρδων διαιρέσεσιν, ὡς οἰκείου τῇ φύσει τῶν ἐμμελῶν ὄντος τοῦ συμμέτρου τῶν ὑπεροχῶν. ταύτῃ δ' ὅμως τῇ προθέσει χρησάμενος εἰς ἔνια μὲν καὶ τέλεον αὐτῆς φαίνεται διαμαρτάνων, ἐν δὲ τοῖς πλείστοις τοῦ μὲν τοιούτου περικρατῶν, ἀπᾴδων δὲ σαφῶς τῶν ἄντικρυς ἤδη ταῖς αἰσθήσεσιν ὡμολογημένων, ὡς αὐτίκα εἰσόμεθα ἐκ τῆς κατ' αὐτὸν τῶν τετραχόρδων διαιρέσεως.
>
> But Archytas of Tarentum, of all the Pythagoreans the most dedicated to the study of music, tried to preserve what follows the principles of reason not only in the concords but also in the divisions of the tetrachords, believing that a commensurable relation between the differences is a characteristic of the nature of melodic intervals. But though he sets off from this presupposition, at several points he seems to fall hopelessly short of it; and though in most cases he is well in control of this sort of thing, he is patently out of tune with what has already been straightforwardly accepted by the senses, as will be seen at once from the division of the tetrachords that he proposes.

There is something more to say on this passage: Ptolemy praises Archytas for the principle which he attributes to him that all intervals should be of a specific type, 'conmensurable relation between the differences', what he elsewhere calls epimoric.[31] And yet, Ptolemy finds fault with Archytas' evident lack of coherence in the application of this principle, since

[28] Ptol. *Harm.* 1.14.

[29] Huffman 2005, 48.

[30] Ptol. *Harm.* 1.13 (tr. Barker).

[31] These have as the difference between its two terms a divider of both terms, this is, they are ratios of the form $(m+p) : m$ where p divides both $m+p$ and m, so that, supposing $m = pn$, then $(m+p) : m = p(n+1) : pn = (n+1) : n$. In conclusion, epimoric intervals are all of the form $(n+1) : n$ in the mininal terms. Their name 'epimoric' alludes to the fact that these fractions represent one part (*mora*) $1/n$ 'above' (*epi*) the unit. The ratios $3:2$, $4:3$, $5:4$ and so on are of this kind. The definition would also apply to the ratio of the octave, $2:1$, but this ratio is rather classified under the so-called multiples, those of the form $mn : n$, this is, with the first term being a multiple of the second.

some of Archytas' ratios are obviously not of this kind. Ptolemy will adopt the principle and coherently choose all his ratios epimoric, thus accomplishing in this way what he thought to be Archytas' own project.[32]

However, there is no evidence that the principle that all melodic ratios should be epimoric was proposed by Archytas himself.[33] This attribution of Ptolemy to Archytas has been argued to be rather his own deduction on the basis that the major part of Archytas' intervals are of this kind, or because all of Archytas' intervals could be in some way attained through epimorics.[34] Ptolemy could have also deduced that this was Archytas' own aim in seeing the principle well applied in Didymus' book, where the musician acknowledged his debts to Archytas, or because Didymus, who had access to Archytas' book, claimed that this was Archytas' principle.

Despite Ptolemy's criticisms, it cannot be denied that he regards Archytas as his own starting point, beginning his own theory just after having presented that of Archytas (*Harm.* 1.15). It is worth noting that Ptolemy praises Archytas for yet something else in his presentation, when he says that he approached music according to reason 'not only in the concords but also in the divisions of the tetrachords'. What is meant is that, unlike most Pythagoreans, such as probably Philolaus, Archytas did not only discuss the isolated intervals according to their melodiousness, but also described the inner structure of the tetrachords actually used in music, this is, the intervals that formed them.[35]

Ptolemy singles out Archytas as the only Pythagorean worth considering, just as he does with Aristoxenus within the Aristoxenians, and, unlike with the theory of the latter, he assumes as his own Archytas' (or what he thinks are) principles, such as the Pythagorean ratio-based harmonics, the tetrachord-based description, and the general principle that the

[32]However, Ptolemy does only concede a preference for this sort of intervals (Ptol. *Harm.* 1.7), criticising the Pythagoreans for taking it as a *sine qua non* so far that it led them to define as unmelodic the interval of octave plus fourth, a perfectly concordant interval according to the senses, only because its ratio was $8:3$, a non-epimoric fraction (Ptol. *Harm.* 1.6).

[33]Huffman 2005, 426-7.

[34]Huffman 2005, ibid. for the first view; Barker 1989, 47-50 for the second.

[35]Huffman 2005, 426.

ratios of the intervals within tetrachords should be epimoric.

More generally, at the beginning of the treatise Ptolemy does not criticise the basic tenets of Pythagorean harmonics, only the details of their application. This is not the case with Aristoxenian theory, which is frontally rejected.

The comparison is presented when Ptolemy specifies the specific aim of the music theorist as part of the more general concept of the 'theoretist and scientist' (θεωρητικοῦ καὶ ἐπιστήμονος), which is 'to show that the works of nature are crafted with reason (μετὰ λόγου τινὸς)'.[36] Then he says that some theorists seem to have neglected this completely, 'devoting themselves to nothing but the use of manual techniques and the unadorned and irrational exercise of perception, while others have approached the subject more theoretically'.[37] Just after this, he identifies these two groups with the Pythagoreans and the Aristoxenians. Ptolemy says that both are wrong, but for different reasons. On the one hand:[38]

> οἱ μὲν γὰρ Πυθαγορικοὶ μηδὲ ἐν οἷς ἀναγκαῖον ἦν πᾶσι τῇ τῆς ἀκοῆς προσβολῇ κατακολουθήσαντες ἐφήρμοσαν ταῖς διαφοραῖς τῶν ψόφων λόγους ἀνοικείους πολλαχῇ τοῖς φαινομένοις, ὥστε καὶ διαβολὴν ἐμποιῆσαι τῷ τοιούτῳ κριτηρίῳ παρὰ τοῖς ἑτεροδόξοις.
>
> The Pythagoreans did not follow the impressions of hearing even in those things where it is necessary for everyone to do so, and to the differences between sounds they have attached ratios that were often inappropriate to the phenomena, so that they provided a slander to be directed at this sort of criterion by those whose opinions differed.

The Pythagoreans are not precisely criticised for not having paid attention to reason, but for not adjusting their ratios (λόγους, now in the plural signifying the ratios, but cf. λόγος='reason') to the evidences of the senses. So they must be the second group alluded above: those that have proceeded 'more theoretically', this is, more according to his own

[36]Ptol. *Harm.* 1.2: ἐν ἅπασι γὰρ ἴδιόν ἐστι τοῦ θεωρητικοῦ καὶ ἐπιστήμονος τὸ δεικνύναι τὰ τῆς φύσεως ἔργα μετὰ λόγου τινὸς…

[37]Ptol. *Harm.* 1.2: ταύτης δὴ τῆς προθέσεως οἱ μὲν οὐδόλως ἐοίκασι πεφροντικέναι μόνῃ τῇ χειρουργικῇ χρήσει καὶ τῇ ψιλῇ καὶ ἀλόγῳ τῆς αἰσθήσεως τριβῇ προσχόντες, οἱ δὲ θεωρητικώτερον τῷ τέλει προσενεχθέντες.

[38]Ptol. *Harm.* 1.2.

program. Barker translates here 'too theoretically', but the Greek is clearly just a comparative of superiority (θεωρικότερον), and it is hardly conceivable that Ptolemy criticised them for working with too much theory if he is precisely specifying the aim of the theorical scientist (θεωρικός), having said just above that the main concern for such an author must be reason.

Something else that suggests that, despite his criticisms, Ptolemy is taking sides with the Pythagoreans, is that in this same passage he notes that the flaws of their science provide arguments to the theorists of other sects for attacking them.[39]

So the Aristoxenians are to be identified with those who according to Ptolemy give no thought to reason, but use 'manual techniques' and irrational perception. The argument goes probably like this: since reason is according to Ptolemy the most important aim of the theorical scientist, Aristoxenian music theory is to be plainly rejected. Ptolemy develops the argument further:[40]

> οἱ δὲ Ἀριστοξένειοι πλεῖστον δόντες τοῖς διὰ τῆς αἰσθήσεως καταλαμβανομένοις ὁδοῦ πάρεργον ὥσπερ κατεχρήσαντο τῷ λόγῳ, καὶ παρ' αὐτὸν καὶ παρὰ τὸ φαινόμενον· παρ' αὐτὸν μὲν ὅτι μὴ ταῖς τῶν ψόφων διαφοραῖς ἐφαρμόζουσι τοὺς ἀριθμούς, τουτέστι τὰς εἰκόνας τῶν λόγων, ἀλλὰ τοῖς διαστήμασιν αὐτῶν, παρὰ τὸ φαινόμενον δὲ ὅτι καὶ τούτους ἐπὶ ἀνοικείων ταῖς αἰσθητικαῖς συγκαταθέσεσι παραβάλλουσι μερισμῶν…
>
> The Aristoxenians, by contrast, gave most weight to things grasped by perception, and misused reason as if it were incidental to the route, contrary both to reason itself and to the perceptual evidence – contrary to reason [λόγος] in that it is not to the distinguishing features of sounds that they fit the numbers, that is, the images of the ratios [λόγοι], but to the intervals between them, and contrary to the perceptual evidence in that they also associate these numbers with divisions that are inconsistent with the submissions of the senses.

Ptolemy thus specifies that the Aristoxenians' procedures are contrary to reason (λόγος)

[39] A similar remark is made by Ptolemy in the section devoted to the criticisms of Archytas' ratios in *Harm.* 1.14.

[40] Ptol. *Harm.* 1.2.

because they do not use ratio-numbers (λόγοι), but intervals, and on the other hand they are also contrary to perception because their divisions associated with these intervals do not fit the impressions of the senses.

Ptolemy does not explain his other criticism about the 'manual techniques' that they supposedly apply, and it seems indeed difficult to understand this on the basis of Aristoxenus' music theory. I think it is plausible that for this accusation Ptolemy has the *harmonikoi* in mind, the music theorists who appear in Aristoxenus' treatise as rivals, but who nevertheless could be considered as pertaining to Aristoxenus' tradition precisely because Aristoxenus discussed their theory (unlike that of the Pythagoreans) in his treatise. Ptolemy could be referring to the musical inquiry about finding a minimal musical interval between notes, which is attributed to these theorists by Aristoxenus.[41] Most significantly, the *harmonikoi* appear ridiculed exercising themselves in the search of such a minimal interval in Plato's exposition of his program for music theory in the *Republic*.[42] This is the passage where Plato criticises the Pythagoreans for not reaching philosophical problems, one which Ptolemy had probably in mind at the beginning of his career as we will see as we advance in the exposition.

Later on in the first book Ptolemy tries to show that the interval-based Aristoxenian theory does not make sense, but his argument is somewhat flawed: what he seems to prove is that the distances (not ratios) representing intervals in Aristoxenian theory cannot be coherently conceived as string lengths in Pythagorean music theory. Ptolemy's argument is quite circular, since he begins from the presupposition that notes are expressed as pitch positions, which implies that intervals are represented by ratios between pitches.[43] In the second book, Aristoxenus' proposed intervals (which he understood as distances) are transported directly as string lengths in Ptolemy's exposition of the ratios according to his prede-

[41] Aristox. *El. Harm.* 12, 36.
[42] Pl. *Rep.* 530d. See Barker's notes on this passage in Barker 1989, 55-6.
[43] Ptol. *Harm.* 9. Cf. Barker 1989, 294 n. 85.

cessors.[44] It is clear that this is not a correct mathematical procedure: a conversion between the two systems –interval-distances of Aristoxenus and the ratios of the Pythagoreans– should be made by using a logarithmic function, like the modern cents.[45] However, as Barker notes, the ratios of Eratosthenes exposed in this same section of Ptolemy's treatise coincide very much with those of Aristoxenus, which may represent the origin of the confusion: Ptolemy could be criticising the attempt to directly conceive the Aristoxenian positions (interval-based) as pitches (ratio-based), exemplified by Eratosthenes.[46]

In any case, it seems clear that Ptolemy rejected Aristoxenian theory and did not make a great effort to present it in a favourable light, while he accepted the premises of the Pythagorean approach taken from (what he knew of) Archytas. Thus, instead of departing from the scale in Plato's *Timaeus* like Nicomachus, Ptolemy regarded Archytas as his most valuable predecessor, and, most importantly, he did not just repeat Archytas' numbers, but was critical with them and tried to improve on the theory by proposing his own ones.

A very telling general observation concerning Ptolemy's approach is that the Pythagorean-Platonic Roman-era music theorists are not treated at all in Ptolemy's *Harmonics*. None of them is mentioned, although it is fair to assume that Ptolemy had probably heard of them. Neither Nicomachus –whose absense however could be excused for chronological reasons– nor Adrastus, nor Thrasyllus show up in the treatise. It is a fact that Ptolemy ignores these treatises, and a plausible explanation is that, in the same way as Aristoxenus did not speak of ratio-based harmonics at all, Ptolemy did not recognise the Pythagorean-Platonic approach as valuable for, or akin to, his own project. Ptolemy only discusses the music theory of Archytas, Aristoxenus, Eratosthenes, and Didymus, and this is probably because he recognises these theorists as his predecessors. And certainly, the kind of music theory these authors had written was, like Ptolemy's own, recognisable as a mathematical scientific tradition qualitatively differing from the line of Nicomachus and

[44] Ptol. *Harm.* 2.14.
[45] See Barker 1989, 346 n. 116.
[46] Ibid.

others. To simplify the question, we can say that the former were concerned with the harmonic structure of actual music, whereas the latter aimed at the exegesis and popularisation of the music in Plato's *Timaeus*. As a matter of fact, the ratios in Plato's *Timaeus*, which appear so prominently in these Roman-era Pythagoreans, do not play a fundamental role in Ptolemy's *Harmonics*, but only appear for the reason that they are used in practice (in 1.16), and they are not linked with any philosophical tradition, even if Ptolemy treats philosophy (and particularly Platonic philosophy) in his treatise.[47]

2.4.1 The practice of the harmonic canon

Before beginning the discussion of the last part of the treatise, let us briefly add some remarks about Ptolemy's use of the harmonic canon. In the mathematical part of the *Harmonics* this instrument is introduced and treated as useful for both discovering and displaying the ratios and consequently as the guarantee that the investigation is sound as regards perception, a crucial topic of Ptolemy's project as we have seen from the beginning, and one which will be retaken in the first chapter of the last part (*Harm.* 3.3). But this will be shown to have connections with Ptolemy's claim that science is not only theory, but also practice.

Besides reason, which Ptolemy identifies with the mathematical language of ratios (the Pythagorean approach), Ptolemy is crystal-clear as to his aim of accurately attaching these ratios to the correct perceptions of the senses. Right from the very beginning, he characterises the criteria of harmonia as 'hearing and reason' (*Harm.* 1.1: κριτήρια μὲν ἁρμονίας ἀκοὴ καὶ λόγος). He explains this further:[48]

> τῶν μὲν αἰσθήσεων ἴδιόν ἐστι τὸ τοῦ μὲν σύνεγγυς εὑρετικόν, τοῦ δὲ ἀκριβοῦς παραδεκτικόν, τοῦ δὲ λόγου τὸ τοῦ μὲν σύνεγγυς παραδεκτικόν, τοῦ δ'

[47]The Timaean tetrachord (with the structure 256:243 9:8 9:8) is only included as a secondary kind of diatonic attunement, and, most importantly, it is treated as one of the attunements actually used by practicing musicians (ch. 1.16). This is because a natural method of attuning a string instrument in the diatonic –the so-called method of concordance– resulted in these ratios. See Barker 1989, 49 for an explanation of this method, consisting in using perfect fourths and fifths –easily found by ear–. It was based on the fact that a tone could be attained by hightening the string a perfect fifth, and then descending it a perfect fourth.

[48]Ptol. *Harm.* 1.1.

> ἀκριβοῦς εὑρετικόν.
>
> It is a general characteristic of the senses to discover what is approximate and to adopt from elsewhere what is accurate, and of reason to adopt from elsewhere what is approximate, and to discover what is accurate.

With this in view he soon introduces the instrument called 'harmonic canon' as a an aid to the scientific method in order to make what is heard capable of being judged accurately by the senses. Ptolemy compares this with the ruler (which is called κανών in Greek), which helps the eyes distinguish what is straight from what is not, and with the compass for circular lines:[49]

> τῶν ὁμοίων οὖν καὶ περὶ τοὺς ψόφους καὶ τὴν ἀκοὴν συμβεβηκότων καθάπερ ταῖς ὄψεσι δεῖ τινος πρὸς ἐκεῖνα κριτηρίου λογικοῦ διὰ τῶν οἰκείων ὀργάνων, οἷον πρὸς μὲν αὐτὸ τὸ εὐθὺ τῆς στάθμης φέρε εἰπεῖν, πρὸς δὲ τὸν κύκλον καὶ τὰς τῶν μερῶν καταμετρήσεις τοῦ καρκίνου. τὸν αὐτὸν τρόπον καὶ ταῖς ἀκοαῖς διακόνοις οὔσαις μάλιστα μετὰ τῶν ὄψεων τοῦ θεωρητικοῦ καὶ λόγον ἔχοντος μέρους τῆς ψυχῆς, δεῖ τινος ἀπὸ τοῦ λόγου, πρὸς ἃ μὴ πεφύκασι κρίνειν ἀκριβῶς, ἐφόδου, πρὸς ἣν οὐκ ἀντιμαρτυρήσουσιν ἀλλ' ὁμολογήσουσιν οὕτως ἔχειν. Τὸ μὲν οὖν ὄργανον τῆς τοιαύτης ἐφόδου καλεῖται κανὼν ἁρμονικός...
>
> Since similar things occur in relation to sounds and to the hearing, there is needed to help them, just as there is for the eyes, some rational criterion working through appropriate instruments, as the ruler is needed to deal with straightness, for instance, and the compasses for the circle and the measurement of its parts. For the ears, similarly, which with the eyes are most especially the servants of the theoretical and rational part of the soul, there is needed some method derived from reason, to deal with the things that they are not naturally capable of judging accurately, a method against which they will not bear witness, but which they will agree is correct. The instrument of this kind of method is called the harmonic canon.

The context before this passage is the difficulty of making complex operations with lines, such as drawing a line eight times as long as a given line, or dividing it by eight, without

[49] Ptol. *Harm.* 1.1-2.

the help of rational methods like doubling it three successive times or dividing it in two three successive times. Such a method would be easily performed with the help of ruler and compass, and Ptolemy wants an analogue for sound.

This analogue was the harmonic canon. This was an instrument already used by Ptolemy's recent predecessors in their investigations (but probably not by Archytas[50]), consisting in a measuring rod with two fixed bridges at the extremes, along which a string is stretched, and a movable bridge in between. Ptolemy describes it accurately in his first book (*Harm.* 1.8).

The climax of Ptolemy's harmonic investigation is reached at the end of the second book (*Harm.* 2.15), where Ptolemy accurately calculates the pitches of the notes used in the familiar genera (understanding the most practised ones) for every *tonos* (as it were in every mode in modern music theory). This description is presented in numerical tables very much like his astronomical ones, including the typically astronomical sexagesimal notation for fractions. It is probably indicative of the importance that Ptolemy attached to the canon that within this great display of numbers, what he presents as his own innovation is his having described the scales not as a sequence of intervals expressed as ratios (what he has done earlier in 1.15 and 1.16), but as bridge positions on the harmonic canon:[51]

> Καθόλου μέντοι κεχρήμεθα ταῖς τῶν διαιρέσεων ἐφόδοις οὐ τὸν αὐτὸν τρόπον τοῖς παλαιοτέροις, τέμνοντες καθ' ἕκαστον φθόγγον τὸ ὅλον μῆκος εἰς τοὺς διασημαινομένους λόγους, διὰ τὸ ἐργῶδες καὶ δύσληπτον τῆς τοιαύτης καταμετρήσεως, ἀλλ' ἐξαρχῆς τοῦ προστιθεμένου ταῖς χορδαῖς κανονίου διαιροῦντες τὸ ἀπολαμβανόμενον μῆκος ἀπὸ τοῦ κατὰ τὸ ὀξὺ πέρας ἀποψάλματος μέχρι τῆς ὑπὸ τὸν βαρύτατον φθόγγον ἐσομένης σημειώσεως εἰς ἴσα καὶ σύμμετρα τῷ μεγέθει τμήματα
>
> We have not undertaken our approach to the divisions in the same way as the older writers, dividing the whole length into the ratios indicated for each note, because of the laboriousness and difficulty of this sort of measurement. Instead, on the ruler [*kanonion*] that is placed up against the strings, we have begun by

[50] Creese 2010, 129.
[51] Ptol. *Harm.* 2.13.

> dividing the length cut off, from the highest limit of the sounding length to the mark there will be to indicate the lowest note, into divisions that are equal and proportionate in size.

So Ptolemy stressed the fact that he was original in using the canon for measuring the results of his enquiry. He emphasizes practicality as the main reason for his decision. Here it is important to see that Ptolemy not only made his measurements with the canon, but that he also displayed his results in his text as such bridge positions in the canon: it is these positions which he displayed in the tables. Interestingly, Ptolemy used the same word for the harmonic canon (κανών) and for his tables.[52] Similarly as with the harmonic canon, Ptolemy very frequently justified his use of tables with a similar claim of simplicity.[53] Ptolemy could have used other terms for tables attested in his contemporaries, such as πλινθίον,[54] or ὄργανον,[55] but he used the same name that designated the harmonic canon. It is possible that the term ὄργανον (literally 'instrument') did also probably reflect a conception of the table as instrument as we find in Ptolemy, but Ptolemy can be said to have been highly conscious of this by his use of exactly the same word as for his instrument.

Ptolemy elsewhere reflects more generally about practicality as an important objective of the scientist, noting that 'reason makes correct the ordering in things heard, through the theoretical discovery of proportions, through their practical exhibition, and through experience';[56] very tellingly Ptolemy defines there the science which deals with reason 'mathematics', and insists on the idea that it includes exhibition and practice, scorning those who suppose that it is 'limited solely by a theoretical grasp of beautiful things'.[57]

[52]See Roby 2010, 199.

[53]E.g. πρὸς μὲν οὖν τὴν ἐξ ἑτοίμου χρῆσιν (*Alm.* 1.10 H1.31), εὔχρηστον (*Alm.* 1.10 H1.36), χρήσεως ἕνεκεν (*Harm.* 2.15), etc.

[54]Vett. Val. 361; Philo Alex. *Opif.* 107.

[55]Vett. Val. 20, 295-6, 361-3, etc.

[56]Ptol. *Harm.* 3.3: κατορθοῖ δὲ τὴν ἐν τοῖς ἀκουστοῖς τάξιν, ἣν ἐμμέλειαν ἰδίως καλοῦμεν, διά τε τῆς θεωρητικῆς τῶν συμμετρίων εὑρέσεως παρὰ τὸν νοῦν, καὶ διὰ τῆς χειρουργικῆς αὐτῶν ἐνδείξεως παρὰ τὴν τέχνην καὶ διὰ τῆς παρακολουθητικῆς ἐμπειρίας παρὰ τὸ ἔθος.

[57]Ptol. *Harm.* 3.3: ἰδίως δὲ καλουμένην μαθηματικήν, μὴ θεωρίας ἔχεσθαι τῶν καλῶν μόνης, ὥσπερ ἄν τινες ὑπολάβοιεν, ἀλλ' ἐνδείξεως ὅμου καὶ μελέτης ἐξ αὐτῆς τῆς παρακολουθήσεως περιγινομένων.

Ptolemy is here advocating for the practical side of the philosopher, something which was considered important in the Graeco-Roman period. Underlying this idea may be the cliché that theoretical philosophers were a sort of obscure unvaluable Greeklings, frequently encountered in texts of the Graeco-Roman era.[58] We will further develop this question in our final chapter in the context of the preface of the *Almagest*.

The very nature of the science of harmonics probably offered to Ptolemy a good oportunity to show his practical side. In music theory the practical side is naturally seen in the very exercise of this science: to begin with, the theorist has to produce the sounds himself in order to study them. This can already be considered practice. The simpler theory involved in harmonics and the consequent more balanced relationship with the reader might lead to a greater involvement of the latter in the practice of the science: to argue in terms of instruments, a harmonic canon is not so difficult to construct as an astronomical instrument, and Ptolemy gives sufficient indications for the reader to build it himself and to test Ptolemy's own results with his own hearing.[59] Ptolemy may be seen as encouraging this do-it-yourself-and-try-it policy in his *Harmonics*, thus putting the emphasis not only on theory, but also on practice and exhibition.

Up to this point, we have seen how Ptolemy both advocated and performed what we could call a scientific method in music theory, in which theory, in connection with reason, is tested by the perceptions of the senses with the help of the harmonic canon. It is in this sense that Ptolemy frequently stresses that theory and practice appear combined in the exercise of science. What comes next is a different story.

2.5 The analogic part of the *Harmonics* and the *Timaeus*

I have already noted that the harmonic scale of Plato's *Timaeus* does actually appear in Ptolemy's *Harmonics*, but, unlike in Nicomachus' manual, it is presented only as a scale

[58] E.g. the philosophers that appear satirized in Luc. *Vit. auct.*, *Hermotim.*, *Pisc.*.
[59] See Creese 2010, ch. 6.

in popular use and not as the scale of Plato or Timaeus. This is one hint, among others, showing that Platonism was not in the core of Ptolemy's technical treatment of music, what is consequent with the program of analyzing actual music mathematically and not an idealisation of it. Ptolemy could be argued to view the ancient Pythagorean Archytas as the best paradigm for this empirical approach.

From *Harm.* 3.3 onwards Ptolemy works in another direction. The text here consists basically in the exposition of philosophical distinctions, often left unexplained –presumably because they were basic philosophical lore of Ptolemy's readership– and the discussion of their links with harmonic concepts and structures. The first chapter (*Harm.* 3.3) treats most general philosophical principles and their relation to harmony as regards epistemology, and the rest treat both the relationship between principles of the soul and the harmonic structures (*Harm.* 3.4-7) and between heavenly and harmonic structures (3.4, 3.8-16). The last three chapters (*Harm.* 3.14-16) of this last part of the treatise are lost, except their titles and a fragment of the last one.

If Ptolemy previously both defended and practiced the scientific method, from now he will not practice it any more. This section is what we could call an excurse on the science of harmonics, which at some point verges towards a Platonic speculation on the connection between harmony and the soul, on the one hand, and harmony and the planets on the other. It is because of these analogies, and because of the smaller analogies with which Ptolemy works within each of these greater ones, that I call this section the 'analogic' part of the *Harmonics*. We have seen something similar happening in the *Canobic Inscription*, where a mathematical astronomical part is followed by a non-empirical section on the music of the spheres, which as we already know will be repeated in the final chapters of the *Harmonics*, and on this basis one could argue that Ptolemy would have been in a similar stage of his career when composing both treatises, with the same project in mind.

The very fact that Ptolemy writes such a section, not previously announced and disconnected from the former part of the treatise, is interesting for our characterisation of

Ptolemy's activity as an intellectual in a broad sense, since it represents a non-conventional way of integrating philosophy in a scientific discourse. At the same time, this part of the text will perhaps help confirming the picture we have sketched above after the analysis of the *Canobic Inscription*. For this reason I will devote the rest of this chapter to a closer study of the text of this part, divided in the same subsections of Ptolemy's discourse: epistemology, analogy with the soul, and analogy with the planets. But before going to the epistemology, let us see how Ptolemy introduces the whole thing.

As I will argue next, in Ptolemy's opening it is possible to see many allusions to Plato, and specially to the *Timaeus*, that serve to announce the character of the whole digression.

These are Ptolemy's introductory words:[60]

> ἐπεὶ δ' ἀκόλουθον ἂν εἴη τῷ θεωρήσαντι ταῦτα τὸ τεθαυμακέναι μὲν εὐθύς, εἰ καί τι ἕτερον τῶν καλλίστων, τὴν ἁρμονικὴν δύναμιν ὡς λογικωτάτην [...] ποθεῖν δ' ὑπό τινος ἔρωτος θείου καὶ τὸ γένος αὐτῆς ὥσπερ θεάσασθαι, καὶ τίσιν ἄλλοις συνῆπται τῶν ἐν τῷδε τῷ κόσμῳ καταλαμβανομένων, πειρασόμεθα κεφαλαιωδῶς, ὡς ἔνι μάλιστα, προσεπισκέψασθαι τοῦτο δὴ τὸ λεῖπον τῇ προκειμένῃ θεωρίᾳ μέρος εἰς παράστασιν τοῦ τῆς τοιαύτης δυνάμεως μεγέθους.
>
> Since it is natural for a person who reflects on these matters to be immediately filled with wonder –if he wonders also at other things of beauty– at the extreme rationality of the harmonic power [...] and since it is also natural for him to desire, through some divine passion, to behold, as it were, the class to which it belongs, and to know with what other things it is linked among those included in this world-order, we shall try, in a summary way, so far as it is possible, to investigate also this remaining part of the study we have undertaken, to display the greatness of this kind of power.

The central concept which Ptolemy is introducing here is what he calls the 'harmonic power' (ἁρμονικὴν δύναμιν), precisely the topic with which he has began the whole treatise: the first words in the *Harmonics* were 'Harmonic is an apprehensive power...' (*Harm.* 1.1: Ἁρμονική ἐστι δύναμις καταληπτικὴ). It seems to be equivalent to the single word ἁρμονία,

[60] Ptol. *Harm.* 3.3.

which he uses elsewhere (e.g. twice below in *Harm.* 3.3), and which I will translate 'harmony'.

Ptolemy here seems to have shifted from the technical writing of his theorical treatment of harmonics to the rhetorical style, which can be frequently encountered in his prefaces (see especially the preface of the *Almagest*). The more remarkable change may be the stress put on the strong ethical implications connected with knowledge, already a Platonic theme in itself. Linguistic characteristics of this style are the frequent superlative qualifiers, like 'most beautiful' (καλλίστων), 'most rational' (λογικωτάτην) or 'greatness of this kind of power' (τῆς τοιαύτης δυνάμεως μεγέθους).

Furthermore, in these words we may note some instances of Platonic vocabulary tied to a Platonic concept: in the first place the person that studies the 'power of harmony' is said to be contemplating (θεωρήσαντι) it, suggesting the topic of the contemplation of knowledge as we find it for example in *Phaedrus*. The implications of this concept are alluded to by Ptolemy when referring to the desire, inspired by 'one divine love', to 'observe the class' to which harmony belongs. In the discussion after the soul-allegory of the charioteer, Socrates says that his two discourses on love (the latter of which contained the charioteer's myth) were governed by division into classes, and that in the second one he 'found another love, also having the same name, but divine'.[61]

Ptolemy also uses here a verb implying wonder (τεθαυμακέναι), similarly as the Pythagorean Cebes in *Phaedo* when referring to the affection he feels for a theory proposed by his friend Simmias; the theory proposed by Simmias, a Pythagorean disciple of Philolaus like Cebes, is that the soul is a certain kind of harmony.[62] Precisely the analogy between the soul and harmonic theory will constitute one of the main topics of this final part (*Harm.* 3.5-7). Ptolemy describes there what appears to be an internal harmonic struc-

[61]Pl. *Phaedr.* 266a7-b1: ὁμώνυμον μὲν ἐκείνῳ, θεῖον δ' αὖ τινα ἔρωτα ἐφευρὼν καὶ προτεινάμενος ἐπῄνεσεν ὡς μεγίστων αἴτιον ἡμῖν ἀγαθῶν.

[62]Pl. *Phaed.* 88d: θαυμαστῶς γάρ μου ὁ λόγος οὗτος ἀντιλαμβάνεται καὶ νῦν καὶ ἀεί, τὸ ἁρμονίαν τινὰ ἡμῶν εἶναι τὴν ψυχήν...

ture of the soul, by identifying its different parts to different harmonic structures that have appeared in the technical part of the treatise.

The analogy between harmony and the soul is justified in Ptolemy's *Harmonics* by the also Pythagorean-Platonic theory that harmony originates movement, and that consequently harmony is most visible in things that move on their own, like the heavenly bodies and the human souls (*Harm.* 3.4). The concept of harmony as a source of movement, both of the heavens and of the soul, may be found in Timaeus' discourse in the *Timaeus*, when the formation of the world-soul is described as a scale of notes, which the Demiurge glues at the extremes to form a circle. This circle is further divided into two circles glued at a common point; then one of them is divided into seven more circles, which are described in astronomical terms.[63]

Although in the *Timaeus* it is not explicitly said that the soul consists of a harmony, it is an possible conclusion from the explanation of the creation of the world-soul or from some of Timaeus' remarks.[64] Indeed, this idea must have been common among Pythagorising Platonists of Aristotle's time, who probably derived it from this same dialog or from the passage of the *Phaedo* where this is affirmed by Simmias. As a matter of fact, Aristotle presents it as a popular idea after his treatment of the *Timaeus* in the doxographical part of *On the Soul*,[65] plainly rejecting it on the very grounds that 'the power of originating movement cannot belong to a harmony, while all concur in regarding this [i.e. originating movement] pretty well as a principal attribute of soul' (tr. Jowett).[66]

Despite Aristotle's criticisms, the idea that harmony governs soul and heavens as a source of their pure movement, frequently derived from the *Timaeus*, and found in many examples of Pythagorising Platonic lore in the literature and philosophy of the Graeco-Roman world, is the one governing the whole last part of Ptolemy's *Harmonics*, as we have

[63]Pl. *Tim.* 34b10-36d7.

[64]See e.g. Pl. *Tim.* 47d2: ἡ δὲ ἁρμονία, συγγενεῖς ἔχουσα φορὰς ταῖς ἐν ἡμῖν τῆς ψυχῆς περιόδοις…

[65]Arist. *An.* 407b30: ἁρμονίαν γάρ τινα αὐτὴν λέγουσι.

[66]Arist. *An.* 407b34-5: ἔτι δὲ τὸ κινεῖν οὐκ ἔστιν ἁρμονίας, ψυχῇ δὲ πάντες ἀπονέμουσι τοῦτο μάλισθ' ὡς εἰπεῖν.

announced.

Indeed, Ptolemy could be alluding in the introduction quoted above directly to the *Timaeus*, where Plato attempts his own explanation of the double analogy. Firstly, there could be a precise verbal echo in Ptolemy's 'most rational harmony' (ἁρμονικὴν δύναμιν ὡς λογικωτάτην), from Timaeus' observation that 'the soul partakes of reasoning and harmony' (λογισμοῦ δὲ μετέχουσα καὶ ἁρμονίας ψυχή) after his description of the harmonic creation of the world-soul.[67] More clearly, Ptolemy uses the distinctively Timaean expression '*this* world-order' (ἐν τῷδε τῷ κόσμῳ) when alluding to the topics which he will be treating in this part of his treatise. Indeed, Plato only uses this expression in the *Timaeus*, and specifically in Timaeus' discourse, and as much as six times. Interestingly, this formula can also be encountered quite frequently in the Platonic exegeses of the Bible by Philo of Alexandria, who makes thereby reference to his demiurge-model in Plato's *Timaeus*,[68] so it could function as a sort of Timaean trade-mark.

2.5.1 Epistemology: Antiochus' tradition and Ptolemy's self-definition

Let us now take a look at the first part of Ptolemy's excurse, centered in general epistemological concepts and particularly applied to the senses of sight and hearing (*Harm.* 3.3-4), topics that were already developed in a more restricted sense, applied to harmonics, at the beginning of the treatise.

In the philosophical distinctions brought up in *Harmonics* 3.3 by Ptolemy it is generally easy to discern the mark of Aristotelian epistemology, like in the one-to-one association of concepts: matter-*hypokeimenon*, movement-cause/agency, form (*eidos*)-end; and within the category of cause, nature-being, reason-being good, god-good and eternal being.[69] However, Ptolemy sees a link between 'power of harmony' and cause, which is clearly Platonic,

[67] Pl. *Tim.* 36e6.
[68] E.g. Phil. Alex. *Op.* 9, *Leg.* 3.99, 101, 127, etc.
[69] Ptol. *Harm.* 3.3. See passages in Aristotle that Ptolemy may be alluding to in the notes of Barker 1989, 371.

and plainly anti-Aristotelian, as we have just seen.[70] Likewise, Ptolemy assigns harmony to the pair reason-being good, a relation which we have encountered in the *Timaeus*.

Again departing from Aristotelian distinctions concerning cause and reason,[71] Ptolemy arrives at the passage quoted above on the triple task of mathematics ('the science embracing what relies on reason'), theoretical, exhibitional and practical, which forms the program of Ptolemy's own scientific praxis. Then Ptolemy goes on to speak about reason:[72]

> Κέχρηται γὰρ ὀργάνοις ὥσπερ καὶ διακόνοις ἡ τοιαύτη δύναμις ταῖς ἀνωτάτω καὶ θαυμασιωτάταις τῶν αἰσθήσεων, ὄψει καὶ ἀκοῇ, τεταμέναις μὲν μάλιστα τῶν ἄλλων πρὸς τὸ ἡγεμονικόν, μόναις δὲ ἐκείνων οὐχ ἡδονῇ μόνῃ κρινούσαις τὰ ὑποκείμενα, πολὺ δὲ πρότερον τῷ καλῷ.
>
> This sort of power [reason] employs as its instruments and servants the highest and most marvellous of the senses, sight and hearing, which, of all the senses, are most closely tied to the ruling principle, and which are the only senses that assess their objects not only by the standard of pleasure but also, much more importantly, by that of beauty.

This passage is crucial, because in it Ptolemy presents the epistemology underlying his knowledge-project as he has explained it just above. Knowledge is created through reason using the senses as his servants.

The importance attached to the senses, and the metaphor of the submission of the senses to reason probably derives from the tradition of Antiochus of Ascalon, the teacher of Cicero who renegated from Academic Scepticism. We will go into the details of this possible connections in our next chapter, so let us just say for the moment that Antiochus developed a new dogmatism within Platonism that assumed Stoic epistemology and Aristotelian philosophy.

Antiochian tradition could also have influenced Ptolemy's dealing with Aristotle, a

[70] Ptol. *Harm.* 3.3: τὴν ἁρμονίαν οὔτε ὡς τὸ ὑποκείμενον ἀποδεκτέον – τῶν ποιητικῶν γάρ τί ἐστι καὶ οὐδέ τι τῶν παθητικῶν – οὔτε ὡς τὸ τέλος, ἐπειδήπερ αὕτη τοὐναντίον ἀπεργάζεταί τι τέλος, οἷον ἐμμέλειαν, εὐρυθμίαν, εὐνομίαν, εὐκοσμίαν, ἀλλ' ὡς τὸ αἴτιον, ὃ τῷ ὑποκειμένῳ περιποιεῖ τὸ οἰκεῖον εἶδος.

[71] See Barker 1989, 372 n. 30.

[72] Ptol. *Harm.* 3.3.

point which we will also develop in the next chapter. For the moment, it suffices to note that Antiochus considered Aristotle not the originator of a philosophical school opposed to Plato's, but just a successor of Plato in the Academy.[73] His ideas were brought to Alexandria by his disciples Dio and Aristo, influencing the philosophical writers active there like Eudorus.[74] It is not difficult to imagine that such an emphasis on the importance of the senses in the cognitive process as in Antiochus' theory must have been successful in Alexandria, a traditional focus of scientifical activity, with no dominant philosophical traditions (a result of the tiny philosophical activity in Hellenistic times).[75]

Coming back to the text in *Harmonics* 3.3, Ptolemy goes on isolating sight and hearing, saying that they are the senses most close to the ruling principle (this was a Stoic concept generally adopted by philosophers of all tendencies). Since Chrysippus there was a philosophical tradition discussing the bodily place of this principle, and Ptolemy made his own contribution in *On the Criterion* (as we will see in the next chapter), situating it in the head. In that text Ptolemy is more explicit than here about the relationship between sight and hearing on the one hand, and the ruling principle on the other, explaining that these are the most valuable of the senses because they are physically situated above the others, closer to the faculty of thought (which is to be found around the brain).[76] Back in the *Harmonics*, Ptolemy adds further, in a very much Platonic way, that sight and hearing are the only senses whose standard is not only pleasure, but also beauty.

The topic of the preeminence among the senses seems to be a recurrent topic in the philosophy of the imperial era, plausibly tied to the topic of the ruling principle. It may be indicative of this that not only Ptolemy ties both traditions (the ruling principle and the preeminence among the senses), but also Philo of Alexandria seems to make the same connection when he applies the crucial word 'ruling' in noting that sight is the 'most ruling

[73] Cic. *Acad.* 2.137; see Dillon 1977, 57.

[74] Dillon 1977, 115, and see as well the whole section on Eudorus 115-135.

[75] See Hatzimichali 2011, ch. 2.

[76] Ptol. *Crit.* 20: τούτων τ' αὖ τὰς μὲν μᾶλλον εὐκινητοτέρας καὶ τιμιωτέρας, ὄψιν καὶ ἀκοήν, ἀνωτέρας τε οὔσας τῶν ἄλλων, μᾶλλον τετάσθαι πρὸς τὸ διανοητικὸν τῆς ψυχῆς...

among the senses' (τῆς ἡγεμονικωτάτης τῶν αἰσθήσεων ὄψεως).[77]

Ptolemy's equal valoration of both sight and hearing, unlike Philo, who only gives priority to sight, may have to do with his double astronomical and harmonic project (or, more precisely, with the fact that one side of the project is harmonics), as we will see below: the discussion on sight and hearing in this chapter is finally conducted to the sciences which have these senses as their medium of perception, astronomy and harmonics. In this connexion, it may be significant that another text on music, Ps.-Plutarch's *De musica*, also equates these two senses: sight and hearing are qualified as 'celestial and divine', and 'created through harmony'.[78]

The Archytan and Platonic metaphor of the kindredness of the sciences

At the end of *Harmonics* 3.3 Ptolemy pursues his treatment of sight and hearing with the introduction of the sciences that relie on them both, astronomy –the science of 'things only seen'– to harmonics –the science of 'things only heard'–. Ptolemy uses these characterizations to start the memorable allegory that will follow, based on Plato's allusion to the beginning of Archytas' *Harmonics* in *Republic* 530d.[79]

> παρὰ μὲν τὴν ὄψιν καὶ τὰς κατὰ τόπον κινήσεις τῶν μόνως ὁρατῶν, τουτέστι τῶν οὐρανίων, ἀστρονομία, παρὰ δὲ τὴν ἀκοὴν καὶ τὰς κατὰ τόπον πάλιν κινήσεις τῶν μόνως ἀκουστῶν, τουτέστι τῶν ψόφων, ἁρμονική…
>
> Related to sight, and to the movements in place of the things that are only seen - that is, the heavenly bodies - is astronomy: related to hearing and to the movements in place, once again, of the things that are only heard - that is, sounds - is harmonics.

Indeed, Socrates already related the senses sight and hearing with astronomy and harmonics in *Rep.* 530d, where he cites the Pythagoreans' saying that these sciences are kindred, a

[77]Phil. Alex. *Op. mund.* 147. Cf. *Op. mund.* 120: τῆς ἀρίστης τῶν αἰσθήσεων ὄψεως, *Conf. ling.* 140 ὄψιν γὰρ ἀπλανῆ πρὸ ἀκοῆς ἀπατεῶνος ἄξιον μάρτυρα τίθεσθαι.

[78]Ps.-Plut. *De mus.* 1140A.

[79]Ptol. *Harm.* 3.3.

likely reference to the beginning of Archytas' treatise on harmonics.[80] This is the passage in *Republic*.[81]

> Οὐ μὴν ἕν, ἀλλὰ πλείω, ἦν δ' ἐγώ, εἴδη παρέχεται ἡ φορά, ὡς ἐγῷμαι. τὰ μὲν οὖν πάντα ἴσως ὅστις σοφὸς ἕξει εἰπεῖν· ἃ δὲ καὶ ἡμῖν προφανῆ, δύο.
> Ποῖα δή;
> Πρὸς τούτῳ, ἦν δ' ἐγώ, ἀντίστροφον αὐτοῦ.
> Τὸ ποῖον;
> Κινδυνεύει, ἔφην, ὡς πρὸς ἀστρονομίαν ὄμματα πέπηγεν, ὣς πρὸς ἐναρμόνιον φορὰν ὦτα παγῆναι, καὶ αὖται ἀλλήλων ἀδελφαί τινες αἱ ἐπιστῆμαι εἶναι, ὡς οἵ τε Πυθαγόρειοί φασι καὶ ἡμεῖς, ὦ Γλαύκων, συγχωροῦμεν.
>
> Well, there isn't just one form of motion but several. Perhaps a wise person could list them all, but there are two that are evident even to us.
> What are they?
> Besides the one we've discussed, there is also its counterpart.
> What's that?
> It's likely that, as the eyes fasten on astronomical motions, so the ears fasten on harmonic ones, and that the sciences of astronomy and harmonics are closely akin. This is what the Pythagoreans say, Glaucon, and we agree, don't we?

Ptolemy carries the metaphor further implying a whole genealogy: sight and hearing would be sisters, and parents of both astronomy and harmonics, which are brought up by arithmetic and geometry –which they use as instruments, recalling what he has said about reason using the senses as its servants– 'as children most closely related in their stock':[82]

> χρώμεναι μὲν ὀργάνοις ἀναμφισβητήτοις ἀριθμητικῇ τε καὶ γεωμετρίᾳ πρός τε τὸ ποσὸν καὶ τὸ ποιὸν τῶν πρώτων κινήσεων, ἀνεψιαὶ δ' ὥσπερ καὶ αὐταί, γενόμεναι μὲν ἐξ ἀδελφῶν ὄψεως καὶ ἀκοῆς, τεθραμμέναι δὲ ὡς ἐγγυτάτω πρὸς γένους ὑπ' ἀριθμητικῆς τε καὶ γεωμετρίας.
>
> They employ both arithmetic and geometry, as instruments of indisputable authority, to discover the quantity and quality of the primary movements; and

[80] Archyt. fr. DK 1: ταῦτα γὰρ τὰ μαθήματα δοκοῦντι ἦμεν ἀδελφεά. See Huffman 2005, 92 for a discussion of the relationship between Plato's text and this fragment.
[81] Pl. *Rep.* 530d (tr. Grube).
[82] Ptol. *Harm.* 3.3.

> they are as it were cousins, born of sisters, sight and hearing, and brought up by arithmetic and geometry as children most closely related in their stock.

Interconnection is a key feature underlined by Ptolemy in this epistemological genealogy. Sight and hearing are said to be like sisters because:[83]

> μόναι τῶν ἄλλων αἰσθήσεων τὰς ἀλλήλων καταλήψεις ἀντιδιακονοῦνται τῷ λογικῷ τῆς ψυχῆς πολλαχῇ, καθάπερ ὡς ἀληθῶς ἀδελφαὶ γινομένω.
>
> These, alone among the senses, give assistance with one another's impressions in many ways through the agency of the rational part of the soul, as if they were really sisters.

Ptolemy even uses the dual form (γινομένω) for indicating the close proximity of these two senses. He justifies his assertion with the remark that 'it is only hearing that displays things seen, by means of spoken explanations, and only sight that reports things heard, by means of writings.'[84] It is by means of this cooperation that 'the most rational of the sciences that depend on them penetrate progressively into what is beautiful and useful'.[85] These two sciences are the already mentioned astronomy and harmonics, which are described, as we have seen, as most closely brought up. The cooperation of sight and hearing is an echo of the cooperation between harmonics and astronomy which is demanded by Plato in the mentioned passage of the *Republic*.

It is interesting that here, where Ptolemy alludes to both astronomy and harmonics –this is, his own project– he adds the adjective 'useful' (χρήσιμος) to their object. Ptolemy is thereby breaking the Platonic context sketched above about the beautiful (and not just pleasant) as objects of sight and hearing to introduce also the practical side of these sciences, which has also appeared before when he denied the exclusively theoretical character of mathematics. This could be interpreted as a way of linking the two sides of Ptolemy, and

[83]Ptol. *Harm.* 3.3.

[84]Ptol. *Harm.* 3.3: τὰ μὲν ὁρατὰ μόνως ἡ ἀκοὴ δεικνύουσα διὰ τῶν ἑρμηνειῶν, τὰ δ' ἀκουστὰ μόνως ἡ ὄψις ἀπαγγέλλουσα διὰ τῶν ὑπογραφῶν…

[85]Ptol. *Harm.* 3.3: ἐπὶ πλέον τοῦ τε καλοῦ καὶ τοῦ χρησίμου διήκουσιν αὗταί τε καὶ τῶν κατ' αὐτὰς ἐπιστημῶν αἱ λογικώταται…

the two main sections of the *Harmonics*, the empirical and Platonic.

Summing up, we have seen that Ptolemy in this chapter does not treat harmonic science specifically, but uses only the philosophical associations of 'harmony' in Platonic philosophy, mainly with reason, to go on speaking about how reason (which is later defined as the quality of science) operates with the help of the senses. At this point he begins his intertextual play with Plato's allusion to Archytas in the *Republic*, relating sight and hearing to astronomy and harmonics respectively. Ptolemy colours the narrative about these sciences with one of his preferred adjectives, 'useful', thus marking this as his own scientific project. So we could say that Ptolemy would be here showing that his own project was the continuation of Archytas', and the one favoured by Plato.

But an obvious issue arises: Did Ptolemy associate Archytas with the metaphor of the kindredness of astronomy and harmonics? Ptolemy cannot be clearly shown to associate Archytas with the metaphor of the sisterhood of the sciences, but it is probable that he did so. Some arguments that suggest this could be: (1) Plato in the *Republic* mentions the Pythagoreans in association with the metaphor, and Ptolemy holds Archytas for the Pythagorean who worked most on harmonics, so that he probably associated Plato's Pythagoreans with him; (2) Archytas' fragment could have been quoted in popular scientific literature as in Nicomachus' *Manual of Harmonics* (see my chapter 6); (3) Ptolemy knew Archytas' ratios, perhaps mediated through Didymus, but it is probable that Didymus also quoted the beginning of Archytas' book, from which Porphyry would have got the fragment (this is Barker's hypothesis[86]).

Harmonics 3.4: An introduction to the psychological and cosmic analogies: the soul and the heavenly bodies as rational beings

The next chapter in the *Harmonics* serves as a bridge towards the analogies between harmony and the soul, and between harmony and the planets.

[86]Barker 1994, 65.

Ptolemy declares that 'all the things that have in themselves a source of movement' partake of harmony.[87] Again he may be shown to be associating certain Aristotelian notions (the specific quality of being a source of movement[88]) with harmony, in a very un-Aristotelian way. This becomes clearer when he singles out the objects that 'share in a more complete and rational nature', because 'in these alone can [harmony] be revealed as preserving fully and clearly [...] the likeness of the ratios that create appropriateness and attunement in the different species'.[89] Then he announces that the human souls and the heavenly bodies are objects of such nature:[90]

> ἀλλ' ἐπὶ μὲν τῶν αὐτῆς τῆς ὕλης ἀλλοιωτικῶν κινήσεων οὐ συνορᾶται [...] ἐπὶ δὲ τῶν ἐν τοῖς εἴδεσι τὸ πλεῖστον ἀναστρεφομένων. αὗται δέ εἰσιν αἱ τῶν τελειοτέρων, ὡς ἔφαμεν, καὶ λογικωτέρων τὰς φύσεις, ὡς ἐπὶ μὲν τῶν θείων αἱ τῶν οὐρανίων, ἐπὶ δὲ τῶν θνητῶν αἱ τῶν ἀνθρωπίνων μάλιστα ψυχῶν.
>
> [Harmony] is not found, however, in movements that alter the matter itself, [...] but it is found in those movements that are involved most closely with forms. These, as we said, are those of things that are most perfect and rational in their natures, as among divine things are the movements of the heavenly bodies, and among mortal things those of human souls'.

This account is a combination of Platonic lore which can be found in different dialogues: the closeness of the forms to heaven is found in the myth of the charioteer in *Phaedrus*; the rationality of the soul and of the heavens in the account of the creation of the soul of the world in the *Timaeus*, as well as, again, the harmonic structure associated with them both.

Thus, this chapter (*Harm.* 3.4) serves as an introduction of the analogies harmony-soul (*Harm.* 3.5-7) and harmony-heavens (*Harm.* 3.8-16) which will form the end of the treatise. The procedure from now on is a simple one: Ptolemy exposes distinctions on

[87]Ptol. *Harm.* 3.4: προσπαραμυθητέον δ' ὅτι καὶ τὴν τοιαύτην δύναμιν [=ἁρμονικήν] ἀναγκαῖον μὲν ἂν εἴη καὶ πᾶσι τοῖς ἀρχὴν ἐν αὐτοῖς ἔχουσι κινήσεως καθ' ὁσονοῦν ἐνυπάρχειν.

[88]Barker 1989, 374 n. 35

[89]Ptol. *Harm.* 3.4: μάλιστα δὲ καὶ τὸ πλεῖστον τοῖς τελειοτέρας καὶ λογικωτέρας φύσεως κεκοινωνηκόσι διὰ τὴν οἰκειότητα τῆς γενέσεως, ἐν οἷς καὶ μόνοις καταφαίνεσθαι δύναται, διόλου τε καὶ σαφῶς συντηροῦσα, ὡς ἔνι μάλιστα, τὴν ὁμοιότητα τῶν τὸ πρόσφορον καὶ ἡρμοσμένον ἐν τοῖς διαφέρουσιν εἴδεσι ποιούντων λόγων.

[90]Ptol. *Harm.* 3.4.

different aspects of the soul, which are made to correspond to different harmonic structures according to simple analogue properties to the ones found in the harmonic structures, and then he does the same changing the soul for the heavens.

2.5.2 Harmony of the soul

In the first chapter on the harmony of the soul (*Harm.* 3.5) the three distinctions intellectual, perceptive and animating are said to be primary parts of the soul, and to them are attached the three primary concords: the octave, the fifth and the fourth:[91]

> ἐφαρμόζεσθαι τὸ μὲν διὰ πασῶν τῷ νοερῷ – πλεῖστον γὰρ ἐν ἑκατέρῳ τὸ ἁπλοῦν καὶ ἴσον καὶ ἀδιάφορον – τὸ δὲ διὰ πέντε τῷ αἰσθητικῷ, τὸ δὲ διὰ τεσσάρων τῷ ἑκτικῷ. τοῦ τε γὰρ διὰ πασῶν ἐγγυτέρω τὸ διὰ πέντε παρὰ τὸ διὰ τεσσάρων, ὡς συμφωνότερον διὰ τὸ τὴν ὑπεροχὴν πλησιαιτέραν ἔχειν τοῦ ἴσου, καὶ τοῦ νοεροῦ τὸ αἰσθητικὸν ἐγγύτερον παρὰ τὸ ἑκτικὸν διὰ τὸ μετέχειν τινὸς καὶ αὐτὸ καταλήψεως.
>
> The octave is attuned to the intellectual part, since in each of these there is the greatest degree of simplicity, equality and stability; the fifth to the perceptive part; and the fourth to the animating part. For the fifth is closer to the octave than is the fourth, since it is more concordant because the difference between its notes is closer to equality; and the perceptive part is closer to the intellectual than is the animating part, because it too partakes in a kind of apprehension.

These three distinctions in the soul are Aristotelian, except for the third term –instead of the term found in Aristotle ('nutritive', θρεπτικόν), Ptolemy writes the Stoic 'animating' (ἑκτικόν).[92] But this could be understandable if we bear in mind that Ptolemy was perhaps using philosophical works of Antiochian tradition, which had incorporated much Stoic material.

In what follows, Ptolemy makes subdivisions within each one of the functions of the soul,[93] assigning to them subclasses of the harmonic structures associated with the greater

[91] Ptol. *Harm.* 3.5.
[92] Arist. *De An.* 413b12; cf. Barker 1989, 375 n. 38.
[93] For which see Barker 1989, 375 n. 42, 43, 376 n. 44.

part.

Most interesting is that after these subdivisions, Ptolemy proposes a new division of the soul, now in the most popular three parts from Plato's *Republic* and *Timaeus*, the rational, the spirited and the appetitive.[94] He seems thus to be enacting the procedure we have been seeing of departing from Aristotelian concepts and verging towards a clearly Platonic interpretation. With these division he follows a similar procedure as with the Aristotelian one, assigning the octave to the rational, the fifth to the spirited, 'because it is closely related to the rational', and the fourth to the appetitive, 'which is lowest in order of importance',[95] and further relating the species of each concord to the various virtues associated with each of the three parts of the soul in this Platonic division.[96]

I will now show that Ptolemy was not alone in drawing this kind of parallels between parts of the soul and harmonic structures, and that there were authors older than him who show a similar tradition. My conclusion will be that, while Ptolemy's is the only systematic account that seems to have survived, he may have consulted similar, non extant, systematic accounts, probably applying his own variations.

The first example is found in Plutarch's *Platonic Questions*. In one of the questions, Plutarch discusses the correct correspondence between notes (not concords as in Ptolemy) and the parts of the soul. The procedure is similar to Ptolemy's, in that Plutarch assigns most importance to the rational part, followed by the spirited and at the lowest the appetitive. In this manner he first assigns *hypate* ('highest') to the rational, *mese* ('middle') to the spirited, and *nete* ('lowest') to the appetitive, underlining that this correspondence extends

[94]Ptol. *Harm.* 3.5: εἶτα κατ' ἄλλον τρόπον διαιρουμένης τῆς ψυχῆς ἡμῶν εἵς τε τὸ λογιστικὸν καὶ θυμικὸν καὶ τὸ ἐπιθυμητικόν... Cf. Pl. *Rep.* 439d; *Tim.* 69a-70d.

[95]Ptol. *Harm.* 3.5: τὸ μὲν λογιστικὸν διὰ τὰς ὁμοίας ταῖς εἰρημέναις τῆς ἰσότητος αἰτίας ἐφαρμόζοιμεν ἂν εἰκότως τῷ διὰ πασῶν, τὸ δὲ θυμικόν, συνεγγίζον πως αὐτῷ, τῷ διὰ πέντε, τὸ δὲ ἐπιθυμητικόν, ὑποκάτω τεταγμένον, τῷ διὰ τεσσάρων.

[96]For Ptolemy's classification of virtues, see Barker 1989, 376 n. 45, where it is underlined that, while they have a Platonic origin, probably developed by Speusippus, they were treated by the Stoics. Again this could be Platonic lore transmitted via later systematizing philosophers.

to the concords (octave, fifth and fourth) formed by these notes.[97] However, in what follows Plutarch becomes critical with this view stating that we should not follow this criterion of position, but that of the power of each of the parts, so that the moderation and symmetry exhibited by the rational part should make it correspond rather to the middle position of *mese*.[98]

It is interesting that the object of Plutarch's question is not properly the musical structure underlying the parts of the soul, but specifically which part is placed in the middle, whether the spirited or the rational, and it is only as a self-evident analogy that the underlying musical structure comes up, almost as a natural language for explaining the relative position of these faculties. This seems to indicate already-existing knowledge of the analogies between the parts of the soul and concrete harmonic entities in the Platonic tradition of Plutarch's time.

A similar analogy might be argued for a passage of Philo of Alexandria where he speaks of the concord of the octave and the double octave sounding in the organ of the mind, but Philo does not develop further the issue, which remains speculative.[99] What we clearly find in Philo is the correspondence between the number seven in the heavenly bodies and in the number of parts of the soul, expressed in terms of harmony, which points to the underlying Pythagorean analogy between the seven planets and the seven notes of the musical scale:[100]

> πῶς οὖν ἑπτὰ τετοκέναι φησίν, εἰ μή τι μονάδα ἑβδομάδι τὴν αὐτὴν φυσικώτατα νομίζει, οὐ μόνον ἐν ἀριθμοῖς, ἀλλὰ καὶ ἐν τῇ τοῦ παντὸς ἁρμονίᾳ καὶ ἐν τοῖς τῆς ἐναρέτου λόγοις ψυχῆς;

[97]Plut. *Quaest. Plat.* 1008D: αὕτη γὰρ ἡ τάξις καὶ τὴν τῶν συμφωνιῶν ἀναλογίαν φυλάσσει, τοῦ μὲν θυμοειδοῦς πρὸς τὸ λογιστικὸν ὡς ὑπάτην τὸ διὰ τεσσάρων, πρὸς δὲ τὸ ἐπιθυμητικὸν ὡς νήτην τὸ διὰ πέντε, τοῦ δὲ λογιστικοῦ πρὸς τὸ ἐπιθυμητικὸν ὡς ὑπάτη πρὸς νήτην τὸ διὰ πασῶν.

[98]Plut. *Quaest. Plat.* 1009A: τὸ γὰρ τῇ θέσει πρῶτον ἱδρῦσθαι τὸ λογιστικὸν ἐν τῷ σώματι τοῦ ἀνθρώπου κατὰ συμβεβηκός ἐστι· τὴν δὲ πρώτην ἔχει καὶ κυριωτάτην δύναμιν ὡς μέση πρὸς ὑπάτην μὲν τὸ ἐπιθυμητικόν, νήτην δὲ τὸ θυμοειδές, τῷ χαλᾶν καὶ ἐπιτείνειν καὶ ὅλως συνῳδὰ καὶ σύμφωνα ποιεῖν ἑκατέρου τὴν ὑπερβολὴν ἀφαιρῶν καὶ πάλιν οὐκ ἐῶν ἀνίεσθαι παντάπασιν οὐδὲ καταδαρθάνειν· τὸ γὰρ μέτριον καὶ σύμμετρον ὁρίζεται μεσότητι.

[99]Phil. Alex. *Rer. div.* 15: ὅλου δὴ τοῦ διανοίας ὀργάνου κατὰ τὴν διὰ πασῶν ἢ δὶς διὰ πασῶν συμφωνίαν ἐξηχοῦντος…

[100]Phil. Alex. *Deus Imm.* 11 (tr. C. D. Yonge).

> How then does she [Hannah] say that she has borne seven children, unless indeed any one thinks that the unit is in its strictest nature identical with the number seven, not only in number, but also in the harmony of the universe, and in the ratios of the soul which is devoted to virtue?

So it seems that Philo was thinking here of the triple analogy between harmony, the soul and the planets, which we find in Ptolemy's *Harmonics*.

In other passages Philo specifies the parts of the soul suming up seven (without counting the rational part of the soul, as he says).[101] What is interesting is that Philo, in the passage quoted above, makes his analogy of the seven parts of the soul dependent on the soul being virtuous (ἐν τοῖς τῆς ἐναρέτου λόγοις ψυχῆς). This matches two things in *Harmonics* 3.5: (1) Ptolemy's subdivision of the Platonic parts of the soul in virtues (the Aristotelian functions were only derived in 'species', εἴδη), and (2) a Platonic vision of the philosopher as a whole harmony derived from the perfect state of the virtue of justice, associated with the complete system (the full musical scale), which is found at the end of the chapter:[102]

> καὶ ὅλως ἡ κρατίστη τῆς ψυχῆς διάθεσις, οὖσα δὲ δικαιοσύνη, συμφωνία τίς ἐστιν ὥσπερ τῶν μερῶν αὐτῶν πρὸς ἄλληλα κατὰ τὸν ἐπὶ τῶν κυριωτέρων προηγούμενον λόγον, τῶν μὲν παρὰ τὴν εὔνοιαν καὶ τὴν εὐλογιστίαν ἐοικότων τοῖς ὁμοφώνοις, τῶν δὲ παρὰ τὴν εὐαισθησίαν καὶ τὴν εὐεξίαν ἢ τὴν ἀνδρείαν καὶ τὴν σωφροσύνην τοῖς συμφώνοις, τῶν δὲ παρὰ τὰ ποιητικὰ καὶ τὰ μετέχοντα τῶν ἁρμονιῶν τοῖς εἴδεσι τῶν ἐμμελῶν, ὅλης δὲ τῆς φιλοσόφου διαθέσεως ὅλῃ τῇ τοῦ τελείου συστήματος ἁρμονίᾳ…
>
> The best condition of the soul as a whole, justice, is as it were a concord between the parts themselves in their relations to one another, in correspondence with the ratio governing the principal parts, the parts concerned with intelligence and rationality being like the homophones, those concerned with good perception and skill, or with courage and moderation, being like the concords,

[101] Phil. Alex. *Opif.* 117: Ἐπεὶ δ' ἐκ τῶν οὐρανίων τὰ ἐπίγεια ἤρτηται κατά τινα φυσικὴν συμπάθειαν, ὁ τῆς ἑβδομάδος λόγος ἄνωθεν ἀρξάμενος κατέβη καὶ πρὸς ἡμᾶς τοῖς θνητοῖς γένεσιν ἐπιφοιτήσας. αὐτίκα τῆς ἡμετέρας ψυχῆς τὸ δίχα τοῦ ἡγεμονικοῦ μέρος ἑπταχῆ σχίζεται, εἰς πέντε αἰσθήσεις καὶ τὸ φωνητήριον ὄργανον καὶ ἐπὶ πᾶσι τὸ γόνιμον. Cf. the same division in *Leg. Alleg.* 1.11: ψυχῆς γε μὴν τὸ ἄλογον ἑπταμερές, αἰσθήσεις πέντε καὶ φωνητήριον ὄργανον καὶ τὸ διῆκον ἄχρι παραστατῶν, ὃ δὴ γόνιμόν ἐστι.

[102] Ptol. *Harm.* 3.5. Cf. Barker 1989, 377 for the references to significant passages in Plato's *Republic*.

> while those concerned with the things that can produce and the things that participate in the *harmoniai* are like the species of the melodies. The whole condition of a philosopher is like the whole harmony of the complete system.

So it seems that Ptolemy was systematizing a Platonic tradition which could be traced back at least to Philo of Alexandria. Eudorus, active shortly before Philo also in Alexandria, and probably having influenced Philo's Pythagoreanism,[103] would be again a good candidate as a transmitter. It may not be a coincidence that in my first chapter, on the *Canobic Inscription*, Eudorus has also shown to be one of the possible inspirations for the harmony of the spheres, and that this same harmony of the spheres also appears at the end of the *Harmonics*.

The two last chapters on the analogy between the soul and the harmonic structures display further associations with succint explanations. In the first of them (*Harm.* 3.6), Ptolemy attaches what he calls the 'genera' (γένη) of the two philosophical principles (ἀρχαί), which he identifies as the theorical and practical, to the genera of attunement. Again the philosophical distinctions are Aristotelian,[104] and most of them may be also encountered in the preface of the *Almagest* as well (see on this my chapter 6). In the last chapter on the analogies of the soul (*Harm.* 3.7) Ptolemy links crises of life to harmonic modulations.

2.5.3 Harmony of the heavens

We have already seen examples of the triple analogy between music, the soul and the heavens, first in relation to the Timaean description of the creation of the world-soul, and now in Philo's allegories through the analogy of the number seven (seven planets and seven strings in a lyre, or seven notes; seven parts of the soul). Now Ptolemy will concentrate on the analogy between harmony and the heavens.[105]

[103] See Dillon 1977, 128, 143; Runia 1986, 21.

[104] See Barker 1989, 378 n. 52 for the references in Aristotle.

[105] Of these chapters, similarly as I have done before, I will analyze in some depth only the passages where Ptolemy seems to be proceeding in a new way, or those that I have been able to relate to the activity of some other author. The reader has here the possibility to consult a full exegesis of this part of Ptolemy's treatise in

The exposition begins with Ptolemy declaring that he will first take the 'comprehensive' (κοινή, Ptol. *Harm.* 3.8) approach, this is, treating the heaven as a whole instead of speaking of the distinct heavenly bodies. In there he starts with what could be considered the inverse operation of the Timaean gluing of the extremes of the musical scale in order to form a circle of the heaven, which one could interprete as the zodiac as Aristotle did: let us first quote, for the sake of comparison, precisely Aristotle's summary of the creation of the world-soul in the *Timaeus* –I quote Aristotle and not Plato primarily because of the much greater length of the original, and secondly because Aristotle renders the basic facts of Plato's passage, which I want to highlight here:[106]

> τῷ γὰρ κινεῖσθαι αὐτὴν καὶ τὸ σῶμα κινεῖν διὰ τὸ συμπεπλέχθαι πρὸς αὐτό. συνεστηκυῖαν γὰρ ἐκ τῶν στοιχείων καὶ μεμερισμένην κατὰ τοὺς ἁρμονικοὺς ἀριθμούς, ὅπως αἴσθησίν τε σύμφυτον ἁρμονίας ἔχῃ καὶ τὸ πᾶν φέρηται συμφώνους φοράς, τὴν εὐθυωρίαν εἰς κύκλον κατέκαμψεν· καὶ διελὼν ἐκ τοῦ ἑνὸς δύο κύκλους δισσαχῇ συνημμένους πάλιν τὸν ἕνα διεῖλεν εἰς ἑπτὰ κύκλους, ὡς οὔσας τὰς τοῦ οὐρανοῦ φορὰς τὰς τῆς ψυχῆς κινήσεις.
>
> The soul, it is there said, is in movement, and so owing to their mutual implication moves the body also. After compounding the soul-substance out of the elements and dividing it in accordance with the harmonic numbers, in order that it may possess a connate sensibility for 'harmony' and that the whole may move in movements well attuned, the Demiurge bent the straight line into a circle; this single circle he divided into two circles united at two common points; one of these he subdivided into seven circles. All this implies that the movements of the soul are identified with the local movements of the heavens.

Now, let us read what Ptolemy proposes, departing from the circle of the zodiac:[107]

> ἐάν τε γοῦν τις τὸν διὰ μέσων τῶν ζῳδίων κύκλον τεμὼν τῷ λόγῳ κατὰ τὸ ἕτερον τῶν ἰσημερινῶν σημείων καὶ ὥσπερ ἀναπλώσας ἐφαρμόσῃ τῷ δὶς διὰ πασῶν τελείῳ συστήματι κατ' ἴσα μήκη, τὸ μὲν ἄτμητον τῶν ἰσημερινῶν γένοιτ' ἂν κατὰ τὴν μέσην, τοῦ δὲ τετμημένου τὸ μὲν ἕτερον τῶν περάτων κατὰ τὸν προσλαμβανόμενον, τὸ δὲ ἕτερον κατὰ τὴν νήτην τῶν ὑπερβολαίων

Swerdlow 2004, 152-165.

[106] Arist. *de An.* 406b26-407a2 (tr. J. A. Smith).

[107] Ptol. *Harm.* 3.8.

> Then if one takes the circle through the middle of the signs of the zodiac and cuts it, theoretically, at one of the two equinoctial points, and after opening it up, as it were, one fits it by equal lengths to the complete system of the double octave, the equinoctial point at which no cut was made will correspond to *mese*, while of the one that was cut, one end corresponds to *proslambanomenos*, the other to *nete hyperbolaion*.

So while Timaeus constructs a musical scale and then bends it and glues the extremes to form a circle (let us forget for now the other circle), Ptolemy takes the circle and cuts it in order to get a straight line, on which he projects a musical scale.

However, Ptolemy cannot associate each interval of the complete system with each sign of the zodiac, because the intervals do not sum up twelve, like the signs, but fourteen (there are fifteen notes in the complete system).

So the analogy is made only on a geometrical basis, attaching the middle of the 'cut' zodiac (the equinoctial point where no cut was made, as Ptolemy says) to the middle note, *mese*, and its two extremes (the two points resulting from the cut) with the two extreme notes, *proslambanomenos* and *nete hyperbolaion*.

After this, Ptolemy shows that the proportions held by multiple combinations of the twelve equal arcs of the zodiac corresponding to the signs cover all the ratios of the intervals of the complete system. This is difficult to express but easy to understand with some examples: the whole circle holds the proportion 2:1 –that of the octave– with one of the halves (corresponding to six signs); again the whole circle has the ratio of 4:3 –that of the fourth– in relation with three quarters of the whole circle (corresponding to 9 signs); two thirds of the circle (corresponding to 8 signs) hold the relation of 9:8 –that of the tone– to three quarters of the circle (corresponding to 9 signs), because $(2:3)/(3:4) = 9:8$. This is shown by Ptolemy in the only diagram used in the analogic part of his treatise (at least in the extant chapters), around which the relations between the arcs are listed according to the harmonic ratio they present.

The analogy between the zodiac and the complete musical system has an astrological

significance in Ptolemy's *Tetrabiblos* (1.13 and 1.17[108]), of which Ptolemy gives only a hint in the *Harmonics* when he says that the configurations of planets diametrically opposite are the most active, because they make up an octave.[109]

Again this analogy is not new to Ptolemy, but appears in a clear Timaean context, namely again in Plutarch's doxography of the distances of the planets and other characteristics of the heavenly bodies in his *Commentary on Plato's creation of the soul in the* Timaeus. So we may have another common item in both accounts, suggesting Ptolemy's source.

Plutarch's passage is a curious musical explanation of the Moon's phases, whose fuller development in Eudorus could be the origin of Ptolemy's harmonic division of the zodiac. The passage in Plutarch is brief and worth quoting:[110]

> αἱ δὲ πρὸς ἥλιον σχέσεις αὐτῆς ἐν τριγώνοις καὶ τετραγώνοις ἀποστήμασι διχοτόμους καὶ ἀμφικύρτους σχηματισμοὺς λαμβάνουσιν· ἓξ δὲ ζῴδια διελθοῦσα τὴν πανσέληνον ὥσπερ τινὰ συμφωνίαν ἐν ἑξατόνῳ διὰ πασῶν ἀποδίδωσι.
>
> Her [The Moon's] positions as to the sun, either in triangular or quadrangular distances, give her the form when she appears as until half-Moon [=in the first quarter] and gibbous [=in the second quarter]; but when she has run through six signs [=at full Moon], she makes (as it were) a kind of diapason [octave] harmony with six notes.

In exactly the same fashion as Ptolemy's analogy of the zodiac, half the zodiac is said to form an octave, described as extending six notes because half the zodiac amounts to six signs. It is important to see that now, once we know the analogy from Ptolemy's explanation, Plutarch's passing mention may be easily understood, but it would be hard if we only had Plutarch's text, since no explanation is given. This strongly suggests that the analogy was in Plutarch's source in a more comprehensible version, suggesting that Ptolemy's source could be Eudorus, rather than Plutarch.

[108]Cf. Swerdlow 2004, 155-9.

[109]Ptol. *Harm.* 3.8: ὅθεν οἱ κατὰ διάμετρον τῶν ἀστέρων ἐπὶ τοῦ ζῳδιακοῦ σχηματισμοὶ ἐνεργητικώτατοι γίνονται τῶν ἄλλων, ὥσπερ καὶ τῶν φθόγγων οἱ ποιοῦντες πρὸς ἀλλήλους τὸ διὰ πασῶν.

[110]Plut. *An. Proc. Tim.* 1028E (tr. J. Philips).

Next, Ptolemy proceeds to display other associations of harmonic structures with characteristics of the heavenly bodies, in the same way as he has done above with aspects of the soul. Firstly, he links the three different kinds of movement of the planets –longitudinal (along the zodiac), in depth (closer or farther from the Earth) and lateral (distancing from the zodiac)– to the harmonic continuous movement towards higher and lower pitch, to the genera, and to the *tonoi* respectively (*Harm.* 3.10-12).

One chapter (*Harm.* 3.13) is devoted to the correspondence between the configurations of the heavenly bodies in relation to the sun (the so-called *phases*) and the structure of the tetrachords, and the final three chapters (*Harm.* 3.14-16), which are lost except their titles and a fragment of the last one, treated the analogy between the planets and the fixed notes of the complete system, also displayed in the last part of the *Canobic Inscription*. From the extant fragment it can be deduced that the order of the planets, and the correspondences with the notes in this section was the same as in the *Canobic Inscription*.[111]

2.6 Conclusions

In his *Harmonics* Ptolemy seems to have fulfilled a common project with the *Canobic Inscription*. In both works a mathematical exposition aimed at an empirical description is followed by a philosophical section of a Platonic character. Actually, both works ended with the exposition of a cosmic scale derived from the Timaean tradition, thus establishing an immaterial link between each of the two sciences, astronomy and harmonics. As we have seen, this is precisely the Platonic program exposed in the *Republic* and followed in the *Timaeus*.

The *Harmonics*, a much longer text than the *CI*, allows a deeper analysis of these ques-

[111]Barker 1989 390, n. 89. Only the notes for the Sun (*paramese*), the Moon (*hypate meson*), Venus (*mese*), and Jupiter (*nete diezeugmenon*) can be deduced from the fragment, but it seems enough evidence of the equivalence, given the oddity of Ptolemy's system (on which see my chapter 1). See the table for the tones of the spheres reproduced in our first chapter, too. Cf. Barker 1989 390, n. 87 for the scholarly discussion over the authenticity and the placement of the fragment, which was firstly encountered misplaced in *Harm.* 3.9; Barker seems to favour the case that it is authentic, although not openly.

tions. The transition to the philosophical section is here smoother: at the beginning of this non-mathematical section Ptolemy interestingly defines the principles underlying the science of harmonics, and mathematics in general, thus characterizing his own persona. In there he alludes to the passage of *Republic* where Plato exposes his program for the mathematical sciences, and Ptolemy emphasises the kindred nature of astronomy and harmonics, while at the same time, quite unlike Plato, he stresses the non-Platonic aspects of perception and of practice, which he has embodied in the first, and principal, part of the treatise, which we may call the 'scientific section'.

The context of the Platonic scientific program in the *Republic* is a criticism of Socrates against the empirical harmonics of the Pythagoreans, particularly that of Archytas, and at the same time a praise of the Archytan principle that the mathematical sciences are kindred. Our analysis of the mathematical part of the treatise has intended to establish that Ptolemy understood his project as a continuation and a correction of Archytas' harmonics, dismissing Aristoxenus' non-mathematical theory and not even considering the unempirical expositions of contemporary Platonic vulgarisators like Nicomachus.

With the more concrete allusions in the *Harmonics* it has become clearer something which we have already hypothesised with the *Canobic Inscription*: Ptolemy would be in both works presenting his own project as the continuation of the ancient Pythagoreans' mathematics that has taken account of Plato's criticisms. Ptolemy would have learned Socrates' lesson and would have liked to shape his research quite literally as the path outlined in the *Republic*: a departure from mathematical inquiry directed towards speculative philosophy. Hence his mathematical treatises would have ended with a speculative philosophical section at the end.

Ptolemy's treatises would then embody the search for a dual explanation for reality, the natural (or mathematical), and the metaphysical. We have already seen in the previous chapter that this duality in the exercise of knowledge was defended in Middle Platonism, at least in Plutarch. For Plutarch, the philosopher goes further than the *technites* precisely

because he does not end his investigations with the explanation of the apparent causes, but goes further to the immaterial and higher ones.

It is obvious that Ptolemy did not want to appear as a *technites*, a mere scientist, and thus continued his investigation in astronomy and in harmonics into the 'highest causes'. While the mathematical investigation is carried out in subtle empirical methods, in the latter Ptolemy treats meta-mathematical aspects and proceeds to develop analogies between the scientific structures and Platonic concepts. In the *Harmonics*, we see an interesting play: Aristotelian concepts are applied in these analogies to a clearly Platonic, and anti-Aristotelian end, a process which reflects the whole of Ptolemy's project. The more empirical Aristotelian concepts are recycled like the scientific categories in order to furnish analogies for the Platonic project.

Again as in the *Canobic Inscription*, the part of the treatise between the mathematical and the speculative parts (here *Harm.* 3.3) represents an intellectual bridge between the two worlds. While in the inscription calculations of distances were adapted to Timaean numerology, here Ptolemy conducts a discussion about epistemology (what we could call 'scientific method') using verbal echoes of the *Timaeus* towards Plato's and Archytas' metaphor of the kindredness of the sciences. These bridges would serve to lend a unity to the two sides of the project, this is, to present science and metaphysical speculation as parts of the same project.

However, as has been noted by Barker,[112] Ptolemy progressively gives less and less explanations in his metaphysical section of the *Harmonics*, which at the end consists practically only of a list of analogies. He gives thereby the impression that his real interest was perhaps not philosophy, but science. It is clearly the scientific parts of *CI* and *Harmonics* where Ptolemy is at his best, showing innovative approaches to old questions. All this shows that Ptolemy's Platonic project was perhaps more a pose, a strategy of self-presentation, than a real interest. This is my hypothesis, which I will try to test in the

[112]Barker 2001, 268.

successive chapters.

Chapter 3

On the Criterion and the Ruling Principle

A Timaean philosophical memoir?

3.1 Plan of the chapter

This chapter is dedicated to the last of the three works of Ptolemy which I will study individually. The other three chapters deal respectively with more general aspects of Ptolemy's works (4 and 5) and with more specific aspects of one work, the *Almagest* (6).

The treatise that I will focus on now is entitled *On the Criterion and the Ruling Principle*. Since this work is primarily philosophical, and consequently falls entirely within the scope of our survey, I will undertake a fuller exegesis than in the other works. I will begin with an explanation of the main philosophical concepts discussed by Ptolemy, pointing to the possible motivations that Ptolemy could have had for writing on them, on the basis of the previous outline and of the appearance of these topics in his other works. I will show that, in the same manner as Ptolemy's interest on harmonics pervades treatises other than his *Harmonics*, such as the *Canobic Inscription*, the topic of the criterion, connected with

that of the ruling principle, can also be found in the *Harmonics*. I will argue, with some modern scholars, that this, along with a similar bipartite structure common to the three works, suggests that the present text was written in a similar context as the other two. I will also review some opinions on the style and the aim of Ptolemy's treatise, and propose my hypothesis that Ptolemy in writing the *Criterion* (for a shorthand) also wished to offer a picture of himself as a pure philosopher, which would explain the fact that he wrote a work thematically and stylistically related to the *Harmonics*, but at the same time with no reference to any mathematical science.

The rest of the chapter is divided according to the sections of Ptolemy's text as I outline them at the end of the previous part of the chapter. In the discussion of the first section I present Ptolemy's analogy of the law court, with which he begins his text, and note Ptolemy's possible inspiration in the discourse of Timaeus in Plato's dialogue. I also try to describe Ptolemy's criterion as he presents it, bringing it into the context of other ancient formulations of the criterion, chiefly that of Sextus (where I follow Long). Then I finally put forward the hypothesis that Ptolemy's analogy was already in circulation before Ptolemy, basing it on a possible allusion to this analogy by Philo of Alexandria in a passage where he is drawing philosophical material probably from Antiochus' pupil Aristo of Alexandria. Could Aristo have been Ptolemy's source? Then I take a look at the possible connections between Aristo (and Antiochus) and Ptolemy-Sextus' criterion.

For the second section of the treatise, I argue by showing some verbal allusions that Ptolemy was engaging in a discussion on the language of scientific inquiry (which has a parallel in Galen) probably following Aristotle's *Categories* (and perhaps also Plato's *Timaeus*). Since Aristo is known to have been a Platonist who embraced the Peripatetic cause, and who commented on the *Categories*, I will point out that Ptolemy's intrincate engagement with Aristotle here may be influenced by Aristo.

The two following sections of the *Criterion* are probably based, as I suggest, in Aristotle's *De anima*, and contain systematizations of various passages of Aristotle's text on the theory

on intellect and perception. At the end of the second of these sections, Ptolemy seems to verge his attention to Plato's *Timaeus*, as can be recognized through quite explicit verbal echoes, and alludes to some issues that remind of Platonic dialectic as we find it in Alcinous' manual.

The last part of the chapter is dedicated to an interpretation of the last part of Ptolemy's treatise, the part on the ruling principle. Here I will first compare Ptolemy's solution for the place of the ruling principle with that of other texts. Then I will argue that Ptolemy not only adopted the Timaean solution, but he imitated the narrative thread of the *Timaeus* in writing his account of the division of the soul and the body, which is preceded by a theory of the elements as in the Platonic dialogue, but probably incorporating Antiochian tradition. I will also review the last part of the section, where Ptolemy allows two ruling principles in the body, based on an Aristotelian distinction, and establishes a double hierarchy for each of them.

3.2 Presentation

This essay of Ptolemy poses several kinds of problems. Some of them are only related to our general lack of knowledge of the philosophy of the Hellenistic and Imperial era, some others concern Ptolemy's own text in relation with the texts of his contemporaries on the same topics. In this introduction I will primarily try to describe the main philosophical concepts discussed by Ptolemy in this text, the criterion and the ruling principle, drawing a brief outline of their history and the state of the question in Ptolemy's time. At the same time, I will make some remarks about Ptolemy's possible particular conception of these issues in the context of his knowledge project.

Let us begin with the first of these issues. The topic of the criterion was not developed until the Hellenistic times, so that it frequently falls far out from any general curriculum on ancient philosophy. Anthony A. Long summarizes the history of the concept and its status

in Ptolemy's age in his study of Ptolemy's *Criterion*, in a concise way that is worth quoting:[1]

> At the time of Ptolemy and Sextus it had become virtually de rigueur for any thinker to state his position on the 'criterion of truth'. By beginning his criticism of the 'dogmatists' with an extensive survey of their opinions on this subject, Sextus gives the impression that this had always been so and that an entire history of Greek philosophy could be written by detailing a succession of doctrines answering to this concept. Nor is this peculiar to Sextus. He reflects the common practice of the doxographical tradition where 'the criterion' had become a convenient category for classifying what we would call different theories of knowledge. In fact, as is now generally recognized, the criterion of truth only became an explicitly named and dominant subject of discussion in the Hellenistic period. First Epicurus and then the Stoics publicized the notion that a philosopher's primary task is to establish the foundations of our knowledge of the world, and to do so by setting out the canonical standards which are man's natural equipment for making secure discriminations between truth and falsehood or between what is and what is not.

Given that Long refers to Sextus, it would not be out of place to inquire about the way in which Sextus presents his treatment of the criterion, especially in relation with other parts of philosophy which he also criticized. It turns out that Sextus begins his discussion on the criterion after deciding to start his argument against the various parts of philosophy with logic (*AM* 7.24), declaring that he will discuss the criterion before logic with these reasons:[2]

> καὶ ἵνα εὐέφοδος γένηται πρὸς τοὺς δογματικοὺς ἡ ζήτησις, ἐπεὶ τὰ μὲν ἐναργῆ διὰ κριτηρίου τινὸς αὐτόθεν γνωρίζεσθαι δοκεῖ, τὰ δὲ ἄδηλα διὰ σημείων καὶ ἀποδείξεων κατὰ τὴν ἀπὸ τῶν ἐναργῶν μετάβασιν ἐξιχνεύεσθαι, τάξει σκεπτώμεθα πρῶτον περὶ τοῦ εἰ ἔστι τι κριτήριον τῶν αὐτόθεν κατ' αἴσθησιν ἢ διάνοιαν προσπιπτόντων, τὸ δὲ μετὰ τοῦτο περὶ τοῦ εἰ ἔστι σημειωτικὸς ἢ ἀποδεικτικὸς τῶν ἀδήλων τρόπος.
>
> And we can get our investigation against the dogmatists well underway as follows. Since plain things are thought to become known all by themselves through some criterion, while unclear things are thought to be tracked down

[1] Long 1988, 181-2.
[2] Sext. Emp. *AM* 7.25 (tr. Bett).

> through signs and demonstrations, by way of a transition from plain things, let us inquire in the first place into whether there is any criterion of the things that strike us all by themselves via sense perception or thought, and then after that into whether there is a process capable of signifying or of demonstrating unclear things.

So it seems that Sextus understood the criterion as that by which plain things become known, while he notes that for unclear things more complex processes are needed to bring about knowledge, such as signs and demonstrations. Then it would be natural to treat the criterion in the first place within (or rather, before) the logical discipline, since in a way it would apply to first-hand knowledge, and not require any elaborate logical arguments.

The imperial-age manual of Platonic philosophy of Alcinous, the so-called *Didascalicus*, shows a systematic treatment of Platonic philosophy, probably intended for a teacher or an amateur, that also could serve us as a standard view for the place of the criterion among the parts of philosophy.[3] Alcinous at the very beginning of his treatise divides philosophy in dialectical (i.e. logic), theorical and practical, and then proceeds to the topics in each of these divisions, in order (*Didasc.* 3). It turns out that, as in Sextus, the first topic treated, as a prelude to dialectic, is the criterion of truth, the question of how knowledge first arises.

Can we contextualize this in Ptolemy? For getting an idea of Ptolemy's notion of the criterion it would be interesting to know what place he assigned to logical theory. An interesting passage in this context is the preface of the *Almagest*, where Ptolemy lists what he considers to be the divisions of philosophy. I will go deeper into this passage in chapter 6, but now it would be useful to give an advancement. It turns out that unlike the philosophers Alcinous and Sextus, Ptolemy ignored the category 'logic' in his division, featuring physics, mathematics, and theology (Ptol. *Alm.* 1.1). Ptolemy ascribes his division to Aristotle, and indeed as we can read in the *Metaphysics* Aristotle proposed such a division, but this does not prevent us from suspecting that Ptolemy made his choice fully conscious.

[3] See Dillon 1993, xiii-iv for a discussion of the purpose and the organization of the *Didascalicus*.

Galen may help us now guessing why Ptolemy ignored logic in his division of philosophy. My argument links Ptolemy with Galen's well-known frequent claims that the best arguments for scientific (and particularly medical) inquiry are those on which mathematics is based. In a recent paper Geoffrey Lloyd defended that Galen's understanding of proof, while being quite general and not particuarly based on mathematics, was nonetheless frequently exemplified with mathematical examples, and even defended to be based on mathematics rather than in logic, probably because mathematics, unlike logic, provided certain conclusions apart from valid reasoning.[4] A good part of Lloyd's analysis is based on the interpretation of Galen's *On my own books*, where Galen elaborates on this topic, telling how he received instruction on logic from the different philosophical schools, until he realised that the kind of arguments he learned from them did not furnish secure proofs. Only the arguments he found in mathematics saved him from falling to scepticism; hence he recommends his students to study mathematics, and his own logical treatise *On demonstration*.[5] So it seems that Galen's rhetorical strategy was to argue that his logical system was much more like mathematics than like the logic studied in the philosophical schools, even if this was something ultimately impossible in medicine, since no incontrovertible starting-points seemed possible to be found there.[6]

I suggest that Ptolemy felt that his project was already in the position that Galen wished for medicine. If mathematics had a reputation for incontrovertible proofs, and Ptolemy's main identity was that of a mathematician, it would be of no help to introduce logic as a part of philosophy. On the one side, logic had a lower epistemological status, and at the same time it was not an object of Ptolemy's knowledge such as physics. So in the same manner as Galen wanted to substitute logic for mathematics, Ptolemy would have wanted to suppress logic (for he had mathematics already). It seems actually plausible that Galen

[4]Lloyd 2005, 127. Lloyd stresses Galen's terms for the right scientists, ἀναμάρτητος (*Pecc. dig.* ch. 1), and for incontrovertible instruction, ἀναμφισβήτητος (*MM* XIV ch. 9). Cf. other places where Galen refers to mathematical arguments, e.g. *Lib. Prop.* 19.39-40, *Foet. form.* 6, Kühn IV.695-6.

[5]Lloyd 2005, 112-13. Cf. Gal. *Lib. prop.* ch. 11.

[6]Lloyd 2005, 117.

had in mind the kind of mathematics that Ptolemy studied, since he frequently mentions, along with geometry and arithmetic, applied mathematics such as astronomy, optics, and sundial-construction.[7]

So it is possible that Ptolemy consciously avoided the category of logic. However, this does not mean that Ptolemy didn't feel the need for some epistemological discussion. As we have seen, the criterion of knowledge was both for Alcinous and Sextus a previous to logic itself, the explanation of how knowledge arises from things. For the kind of mathematics that Ptolemy practiced, frequently based on the physical world (i.e. for applied mathematics,) assessment that the criterion of truth exists would have been important.

Harmonics was one of the applied mathematical sciences, and Ptolemy wrote a work on harmonics which we have already studied in the preceding chapter. Let us now remind of the passages where Ptolemy alluded to the criterion.

In Ptolemy's *Harmonics*, lengthy parts of the text were occupied by philosophical considerations about perception and reason in music theory, often discussed in terms of the criterion. These issues serve there to build Ptolemy's empirical conception of sound. Epistemology is introduced at the very beginning of the treatise on music when Ptolemy is defining his object of study. He says that 'the criteria of harmony are hearing and reason',[8] and at the end of the chapter Ptolemy expresses the need of an instrument, a rational criterion to help sense perception to do his job, in this case hearing accuraterly (and Ptolemy makes the analogy with sight and the ruler).[9] This instrument will be presented in the next chapter of his treatise: the harmonic canon.

At the beginning of the philosophical part of the *Harmonics* (*Harm.* 3.3), creation of knowledge is considered more generally (as is fitting to this section of the treatise) and the canon appears no more. Now the senses alone are presented themselves as aids to reason:

[7]Lloyd 2005, 110; Chiaradonna 2009, 254.

[8]Ptol. *Harm.* 1.1: κριτήρια μὲν ἁρμονίας ἀκοὴ καὶ λόγος...

[9]Ptol. *Harm.* 1.1: τῶν ὁμοίων οὖν καὶ περὶ τοὺς ψόφους καὶ τὴν ἀκοὴν συμβεβηκότων καθάπερ ταῖς ὄψεσι δεῖ τινος πρὸς ἐκεῖνα κριτηρίου λογικοῦ διὰ τῶν οἰκείων ὀργάνων...

'This sort of power [reason] employs as its instruments and servants the highest and most marvellous of the senses, sight and hearing, which, of all the senses, are most closely tied to the ruling principle'.[10] However, the fact that the senses produce secure knowledge is here supplied by the allusion to their place in the body next to the ruling principle. Here we find the link between the two topics of Ptolemy's *Criterion* well explicited: the ruling principle, reason, is located in the brain, so the senses which are placed closer to the brain are the ones that have most reason in them (we will go deeper into the problematic definition of this concept below in the analysis of Ptolemy's text).

Now we have encountered the other concept featuring in the title of Ptolemy's essay, the ruling principle (ἡγεμονικόν), also frequently translated as 'commanding faculty' (or any combination of the two adjectives and the two names). Again, this topic is not a famous one in modern studies of ancient philosophy, for much the same reasons as the criterion, and deserves some introductory words. The same as the criterion, the concept of the ruling principle was first developed in Hellenistic philosophy, specifically among the Stoics. It seems that in its most common meaning it refers to the a faculty of the soul, in particular the cognitive or rational. So Aetius records that for the Stoics the ruling principle is the highest part of the soul, where 'impressions, assents, perceptions, and impulses' take place (*Plac.* 4.21). Similarly, the first instance of the ruling principle in Sextus' discussion of the criterion is found in the part dedicated to the Stoics, particularly Chrysippus, and the meaning seems to be the part of the soul which receives impressions (*M* 7.231).

In contrast with the criterion, from Sextus' account it would seem that the ruling principle was not so early generalised as an universal concept applicable to any philosopher of the past, at least in Sextus' sources –going back to the 1st c. BCE, see below on this–. As a matter of fact, in Sextus' two books *Against the Logicians* the ruling principle appears only discussed in passages circumscribed to the Stoics.[11]

[10]Ptol. *Harm.* 3.3: Κέχρηται γὰρ ὀργάνοις ὥσπερ καὶ διακόνοις ἡ τοιαύτη δύναμις ταῖς ἀνωτάτω καὶ θαυμασιωτάταις τῶν αἰσθήσεων, ὄψει καὶ ἀκοῇ, τεταμέναις μὲν μάλιστα τῶν ἄλλων πρὸς τὸ ἡγεμονικόν...

[11]Sext. *M* 7.231-240 (the criterion according to the Stoics), 7.373-382, 8.400-410.

However, in Ptolemy's time the concept seems to have had a wider use, both in the sense that it was used not only by or applied to Stoic thinkers, and that it had more general meanings. For example, it appears in Alcinous' Platonic manual, in the context of the discussion of the parts of the soul and their respective location in the body (*Didasc.* 23) according to the *Timaeus*.[12] As Dillon notes, Alcinous employs a metaphor of the head as a 'citadel' (ἀκρόπολις) taken from this dialogue (*Tim.* 70a6), widely used in posterior thinkers,[13] from which plausibly the concept of 'ruling' principle crystallized.

So for Alcinous the ruling principle was above all a part of the soul corresponding to a part of the body. For Galen, writing in a similar context, it was equally so, since he inserts his treatment of this topic in his work *On the Opinions of Plato and Hippocrates* within the general discussion of 'the faculties (δυνάμεις) that govern us', basically defending Plato's three-fold division as in the *Timaeus* –but we will come to this discussion in due time. For now let us just say that Ptolemy also situated his discussion on the ruling principle in the context of the Timaean division of the soul.

However, I would like to note that Ptolemy's treatment of the concept interestingly differs from the focus in Galen and Alcinous in that the general discussion is about epistemology –Alcinous' is where this is most clearly seen, because the ruling principle appears classified only among the parts of the soul, much later than the criterion, in the section on physics–. So in this sense Ptolemy seems to come back to the origins of the concept reflected in Sextus and his Stoics.

To conclude this introduction, let us finally get a more general picture of the *Criterion* into consideration. As we will see, the ruling principle is treated only in the last part of Ptolemy's text, the first and main part being dedicated to the question of the criterion. So, from what has been said about the history of the two concepts and Ptolemy's focus, it seems that, again as in the *Canobic Inscription* and the *Harmonics*, Ptolemy ends a treatise with a

[12]Cf. Dillon 1993, 147.
[13]Dillon 1993, 147-8. Cf. also Gal. *Plac.* 2.4.17.

speculative issue, which in addition is related to Plato's *Timaeus*. In this case, differently from these two other works, the main topic is not mathematical, but we could say that it is quasi-mathematical –the question of the criterion was quasi-logical, and Ptolemy possibly substituted logic for mathematics in his vision of philosophy. So the criterion would plausibly have been for him *the* previous to his mathematics. As regards the last part, the placing of the ruling principle, it is worth noting that Ptolemy's solution, the Timaean division of the body (which makes correspond faculties of the soul with parts of the body), also appears in the last part of his *Harmonics* (*Harm.* 3.5). In there, Ptolemy associated harmonic structures to the parts of the soul (cf. my chapter 2).

As a result, we can say that Ptolemy not only was interested in the issues treated in the *Criterion* when he wrote the *Harmonics*, but he also organised both treatises in a very similar way with the speculative sections as a conclusion, actually like in the *Canobic Inscription*. For these reasons it seems plausible that he wrote theses three treatises in the same period of his career.

3.3 Style and aim

At the beginning of the previous section, I have said that the problems of Ptolemy's *Criterion* seem not only restricted to our lack of familiarity with the concepts he discusses, but also with Ptolemy's own text. Anthony A. Long describes the impression that a learned historian of ancient philosophy gets from reading Ptolemy's essay:[14]

> The course he [Ptolemy] travels is short and flat, though sometimes obscure in description; and obscurity has been his essay's fate.

Long's criticisms do not seem excessive if we compare this essay with Ptolemy's other texts or with other texts by his contemporaries on a similar subject, or even with other judgements of modern authors.[15]

[14]Long 1988, 177.

[15]Cf. Swerdlow's likewise severe judgement, albeit less explained than Long's, in Swerdlow 2004, 180.

Let us begin with Ptolemy's texts. In Lammert's edition, the *Criterion* occupies about 21 pages, the first 16 on the criterion proper and the last 5 on the ruling principle.[16] For comparison I will take the *Tetrabiblos*, because it is the only other text of Ptolemy without figures, where characters can be easily counted from the *TLG* like the *Criterion*. From my counting, it turns out that the whole text of the *Criterion* amounts just to a rough 40% of the mean length of one book of the *Tetrabiblos*.[17]

As regards the flatness, the *Tetrabiblos* seems also to be a good candidate for comparison, for the following reason. Long justifies this criticism against Ptolemy's *Criterion* on the basis that Ptolemy makes no hint at the commonplace older and contemporary controversies on the criterion between sceptics and dogmatics, advancing no problematics nor complex arguments.[18] This situation contrasts with Ptolemy's introductory chapters to his *Tetrabiblos*, where he tackles nearly all the sceptical attacks on astrology that we find documented in other writers. I will review this in the next chapter when dealing with this work of Ptolemy, so I will not develop the arguments here.

There remains the issue of obscurity. My hope is that the reader gets an idea of the truth of this claim in the course of the next sections of this chapter, when I analyse more closely Ptolemy's text. To give a short description, we can say that Ptolemy in many places fails to explain clearly what he is doing, and the reader frequently gets lost wondering what his arguments lead to. We could again contrast this with the clear exposition of the astrological categories along the *Tetrabiblos* (on which see my chapter 5).

What about other texts by Ptolemy's contemporaries? We know that Galen composed a work *On demonstration* in 15 books,[19] although Galen's treatment covered there probably many more topics on logic than just the criterion. Antiochus had written a work on the

[16]See Lammert 1961.

[17]The exact proportion is 38.99%. *Crit.*=19953 (non-spaced) characters; the four books of the *Tetrabiblos*=204769 char.

[18]Long 1988, 179.

[19]Gal. *Lib. prop.* 19.41.11.

criterion in at least two books, the *Canonica*,[20] which Sextus used in his own doxography of the history of the criterion. As we have said, Sextus' first book of *Against the Logicians* was devoted entirely to the question of the criterion. I also counted the characters of this book, and the contrast with Ptolemy is also telling: Ptolemy's criterion amounts to just a 15% of the length of Sextus' book on the criterion.[21]

For the short section on the ruling principle the comparison is still more contrasting: for Ptolemy's five pages, Galen dedicated his first seven books of his *On the doctrines of Hippocrates and Plato* on the parts of the soul, the same topic in which Ptolemy contextualizes his placing of the ruling part; Galen's discussion of only the ruling part occupies as much as the first three books.[22] For the anatomy involved in this section of Ptolemy's essay, it is useful to quote Manuli's judgement that Ptolemy used 'una teoria anatomica vecchissima e da tempo superata', which she contrasts with Galen and his predecessors.[23]

For comparing the issue of obscurity, one could take Alcinous' treatment of these two topics: the rough three pages on the criterion (*Didasc.* 4) and the rough two pages on the parts of the soul (*Didasc.* 23-24). We could accuse Alcinous to oversimplify, but not of being obscure, since, despite he presents his treatment in a straightfoward and unproblematic way, his narrative is clear and systematic. So although Ptolemy's discussion is brief and blind to any sceptic attacks, like Alcinous' text, we cannot say that it shares the characteristics that make the Alcinous' work a handbook appropriate for instruction.

The impression is that Ptolemy is writing an essay about topics which he supposes familiar enough to his readers so that he need not be didactic. In a way it resembles a complex rhetorical exercise about two philosophical topics that have been proposed to him. Indeed, the text presents some characteristics that could derive from this sort of texts: it is a short one, and, as we will see in the next chapter, it is textured following patterns that resemble

[20]Sext. *M* 7.201.4. Cf. Dillon 1977, 63-9 for an analysis of Antiochus' criterion of knowledge.
[21]Exact proportion: 15.01%. Sextus' book is 132931 characters long.
[22]De Lacy 1981, 48-50.
[23]Manuli 1981, 73.

those of classical rhetorical exercises like the thesis and the paraphrase. Furthermore, the essay is opened with an analogy with the law court, the paradigmatic place for rhetorical demonstration, which could perhaps be taken as a metaphor of the whole nature of the text.

There were other kinds of philosophical texts which Ptolemy may have known, and that seem to share more characteristics with the *Criterion* than the canonical ones, which we have discussed just now. The pseudo-Pythagorean treatises of the early imperial age are short and dogmatic. They recycle philosophic materials but in a pretentious rhetorical style similar but somewhat simpler than Ptolemy's, imitating the dry rhetoric of the pre-Socratics.[24] Ptolemy may have seen the treatises of the pseudo-Archytas. He could even have found his inspiration from reading one pseudo-Archytan text on the topic of the criterion, which survives in part. There was also the text that was held to be the original report by Timaeus Locrus that inspired Plato, which Ptolemy could have known. In view of Ptolemy's Pythagorean and Platonic models of Timaeus and Archytas in the *Canobic Inscription* and the *Harmonics*, and Timaeus again in the *Criterion* (as we will see below), this remains a possible option.

For the comparison of Ptolemy's *Criterion* with his own works, perhaps we should not look at a whole treatise, but to a part of it. Indeed, some of the features that have been recognised in the *Criterion* may also be found in the final section of the *Harmonics*. We have already noted how Ptolemy proceeds analogically there, as in the final section of the *Criterion* on the ruling principle. But apart from the common nature with the final part of the philosophical treatise, the speculative part of the *Harmonics* mentions no authors, no works, and is dogmatic and short, just like the whole of the *Criterion*. It is true that the obscurity of the *Criterion* is not to be found there, but these other features may be already telling. In the preceding chapter we have noted how modern critics like Barker

[24]Centrone 1990, 45. Centrone also speculates about the motivation for the brevity of these texts, which cannot apply to Ptolemy: 'La stessa brevità sembra in qualche caso rispondere, più che ad esigenze di sintesi, all'intento di far apparire il contenuto presentato come una *summa sapientiae*, la cui autorità riposa sul nome dell'autore più che sulla giustificazione razionale di quanto viene detto.'

expressed similar concerns about that final part of the *Harmonics* such as those which may be encountered against the *Criterion*. If for the *Harmonics* the possible explanation was offered that Ptolemy would have been less interested in philosophy than in science, and that he may have somehow 'felt compelled' to write some philosophy in order to appear as a full-blown intellectual among his contemporaries, perhaps the same explanation could also serve us in the case of the *Criterion*, which was an entirely philosophical text.

An issue brought up by Swerdlow regarding the *Criterion* text is that it is the only work of Ptolemy which does not make reference to any mathematical subject: according to him, this would be an argument against the ascription of the treatise to Ptolemy.[25] However, we may object that Ptolemy perhaps aimed at presenting the topic of the criterion as if it was a preliminary and basic part of mathematical enquiry. I have already argued how Ptolemy in his presentation of the parts of philosophy in the *Almagest* possibly thought of his mathematics as the (maybe superior) substitute of logic which appears in other accounts of the parts of philosophy, so that he maybe conceived the criterion as a prelude to his mathematics. He can be shown applying such a scheme in the *Harmonics*, as we have seen, since the theory of the criterion is used in the scientific part of the *Harmonics* to justify the correct perception of music through hearing and reason. Then, it would have been natural that when he treats the question of the criterion he used no mathematics, because mathematics would have come epistemologically after the construction of a working theory of the criterion.

It may further be argued that, even if mathematics could not have entered the construction of the criterion, Ptolemy could well have alluded to some application of the criterion into mathematics, for example in harmonics. To this one might reply that perhaps such a brief treatment would perhaps not allow for much exemplification. But also the rhetoric

[25]Swerdlow 2004, ibid.; Toomer also doubted the authorship, while admitting that 'nothing in its contents conflicts with Ptolemy's general philosophical position', in Gillispie 1981, s.v. 'Ptolemy'. Taub alleges uncertainty on the authorship as well, with no new arguments: Taub 1993, 9. Boll 1894, 78 sustained Ptolemy's authorship, followed by Lammert 1961, p. III, where Rose's ascription of the work to the grammarian Ptolemy Chennos is recorded.

style that Ptolemy uses in his text does not seem to be appropriate for exemplification. One could hypothesise that Ptolemy might have wanted to pursue a double aim: apart from completing his own knowledge project providing the basis for his epistemology, Ptolemy perhaps wished to present himself as someone capable of writing a book only about philosophy, that could not be taken as derivative from his mathematical career. In the *Canobic Inscription* and the *Harmonics* Ptolemy may be said to play the role of the philosopher in the last sections, feeling the need to write entirely non-mathematical, philosophical sections, much disconnected from the main parts of the treatises. For a similar purpose of self-presentation as a philosopher, he may have wanted to write a treatise just on philosophy.

Feke argues differently in her attempt to tackle Swerdlow's argument. She says that the *Criterion* was probably one of the first works of Ptolemy, and that he would not have yet developed his mathematical and philosophical construct, so that he would have felt no need to allude to any mathematical topic.[26] However, judging from the bipartite structure of the text of the *Criterion*, common to the *Canobic Inscription* and the *Harmonics*, and the similar tendence to embed Aristotelian concepts into the global Platonic program seen in the *Harmonics* (we will see this below for the *Criterion*), it is difficult to conceive such projects as very different phases in Ptolemy's career.

As concerns the question of authenticity, if we consider the picture I have sketched, I think there remain no reasons for doubting Ptolemy's authorship. We have seen that there is a thematic and formal coherence with the *Harmonics* and the *Canobic Inscription*. There is also the ascription of the best manuscripts.[27] And finally, we have a linguistic argument: the less frequent lemmas in Ptolemy's philosophical treatise apart from *hapax legomena*[28] are solely found in other texts of Ptolemy (προσπαραμυθέομαι, ἐπιπολυπραγμονέω). Furthermore, there have been noted many non-technical expressions present in other works of

[26]Feke 2009, 7, 220, citing unpublished work by Alexander Jones.
[27]Lammert 1961, 1 (superscriptio), 24 (subscriptio).
[28]E.g. τυφοποιεῖν (*Crit.* 13).

Ptolemy and only extremely rarely found in other authors.[29] With this evidence, for arguing against Ptolemy's authorship one should probably hypothesise a forger as the author of the text, and an extremely good one. But, at the same time, the fact that Ptolemy's text was not about a scientific topic would probably undermine the forger's credibility. In conclusion, we can say that it seems very hard to think of such a forger, and consequently Ptolemy's work is very likely authentic.

Now that we have introduced the concepts discussed in the *Criterion*, and discussed the general characteristics of the text, we can go on with a more detailed discussion of its content. This I will present in the next sections of this chapter, but first I will briefly explain the division of the text that I have chosen for my exposition.

- ***Crit.* 1-3: Law court analogy**. Ptolemy presents his view of the criterion with the help of an extended analogy with the law court, we could say almost an allegory.

- ***Crit.* 4-6: On Aristotle's *Categories*.** A digression on the proper use of language in philosophical inquiry, criticizing the debates on minute distinctions in concepts, probably based on Aristotle's *Categories* (but critical about it).

- ***Crit.* 7-9: Functions of intellect and perception**. Coming back to the structure for the criterion proposed in the first section, Ptolemy discusses particularly what he regards as the key elements in his criterion, intellect and perception.

- ***Crit.* 10-12: Problems arising in the functions of intellect and perception, and an introduction to Platonic dialectic**. Ptolemy treats here complications that may arise

[29] προσπαραμυθητέον (*Crit.* 3), προσπαραμυθουμένοις (*Crit.* 6), προσπαραμυθητέον (*Harm.* 3.4), προσπαραμεμυθημένων (*Phas.* 13) and προσπαραμεμύθηται (*Hand. Tabl.* 185); ἐπιπολυπραγμονοίη (*Tetr.* 3.6.4). Incidentally, Alexander Jones, working also on the authenticity of the *Criterion*, also found these two common words independently from my own work. Jones also points to non-technical expressions in the *Criterion* encountered in other works of Ptolemy and only found in later authors heavily influenced by Ptolemy (ὑποτετυπώσθω, ἐφοδεύμενος, εὐμεθόδευτον, συνεχέστερα παρατήρησις), or found extremely rarely in other authors (ἀμετάπιστος, ἰδιοτροπία, προσεντάσσω, κατὰ συνεγγισμόν) (he delivered a paper on this in Manchester, July 2013, and he also kindly passed to me his draft article on the question).

in the processes proper to intellect and perception, and ends by alluding briefly to Platonic dialectic.

- ***Crit.* 13-16: The place of the ruling principles**. In this final section the ruling principle, or rather the ruling principles (since Ptolemy distinguishes various of them, as we will see), are situated in the body thanks primarily to Plato's tripartite division of the body/soul in the *Timaeus*, but also to Aristotle's view in *On the Soul*.

3.4 The analogy of the law court (*Crit.* 1-3)

Anthony A. Long suggested Antiochus as the main philosophical tradition influencing Ptolemy's *Criterion*, on the basis of the similarity between Ptolemy's criterion and Sextus' in the sections which Sextus probably derived from Antiochus.[30] In this section I will try to confirm this hypothesis, identifying a plausible concrete source for Ptolemy in one of Antiochus' pupils, Aristo of Alexandria. I will proceed by reexamining the connexion between Ptolemy's criterion and Sextus, comparing with other accounts, and finally exploring a possible parallel for Ptolemy's opening analogy in Philo of Alexandria, which will provide the clue on Aristo.

So let us begin with Ptolemy's text. Throughout the first part of his treatise Ptolemy presents and develops an analogy that serves to structure the notion of criterion.[31]

> Τὸ κριτήριον τῶν ὄντων ἐφοδεύσαιμεν ἂν κατὰ τὸ δέον, εἰ παραβάλλοιμεν αὐτὸ κριτηρίοις τισὶ τῶν ἰδίως ὑπ᾽ αὐτὸ τεταγμένων· ἐπὶ τὰ καθόλου πάντα προοδοποιεῖσθαι μάλιστα πέφυκε διὰ τῶν κατὰ μέρος ὑπὸ τὸ αὐτὸ γένος λαμβανομένων. τὸ δὴ δικαστήριον, ἐγγυτάτω γὰρ ἡ τοιαύτη τῶν παραβολῶν, αὐτῷ τῷ κριτηρίῳ τὸ πρῶτον ἐφαρμοζέσθω.
>
> The right way to investigate the criterion of reality is to compare it to some of the specific criteria which are classified under it. Preparatory steps in the investigation of universal always traverse - most naturally - the particulars

[30] Long 1988, 198, and n. 55 *ad loc.*
[31] Ptol. *Crit.* 1 (tr. Liverpool/Manchester Seminar on Ancient Philosophy).

> which belong to the relevant genus. The closest such analogue is the law court, so let us begin by matching that to the criterion itself.

The use of metaphor in dialectical arguments had been recommended by Aristotle in the *Topics*,[32] and it was a vastly used resource in all kinds of rhetorical and philosophical texts. However, it is interesting that the law court is here not only a metaphor, but, as Ptolemy presents it, also a particular criterion classified under the general criterion. This means that Ptolemy thinks of the law court as a particular form of criterion. Ptolemy's procedure is actually an induction, since he begins by noting the structure of what he calls a particular form of criterion, the law court, for deducing the structure of the criterion in general. Ptolemy is here playing with the idea that the word κριτήριον is not only etymologically related to the verb κριτεῖν, to judge, but was actually another word for law court, appearing in documentary papyri and the Septuaginta.[33]

Let us first note that such an inductive and metaphoric argument is precisely of the same kind as the one used by Timaeus at the beginning of his discourse on the creation of the world, when he states his purpose of explaining the nature of the whole by induction from the structure of a particular living creature.[34] In this way, Timaeus can thereafter describe the world with the help of this analogy, beginning with the world-soul and the body of the world, which he likens to the soul and the body of an animal. As we will see, Ptolemy can be seen throughout the text alluding to Plato's *Timaeus* at several points, so that it is possible that he had the beginning of Timaeus' discourse in mind when fashioning the beginning of his own treatise.

Ptolemy then identifies five essential elements in the law court, which he says must be present in the general criterion; at the same time, he makes each of these elements

[32]Arist. *Top.* 156b25–7: καὶ τὸ ὡς ἐν παραβολῇ προτείνειν· τὸ γὰρ δι' ἄλλο προτεινόμενον καὶ μὴ δι' αὐτὸ χρήσιμον τιθέασι μᾶλλον. Ptolemy uses a similar wording later in his final summary of this metaphor Ptol. *Crit.* 3: διατεινομένης [...] παραβολῆς.

[33]Lammert 1918, 249; Lammert 1920a, 115; Striker 1974, 52-3.

[34]E.g. among several other places (actually *passim* in Timaeus' discourse) Pl. *Tim.* 30d-31a: ὁ θεὸς ὁμοιῶσαι βουληθεὶς ζῷον ἓν ὁρατόν, πάνθ' ὅσα αὐτοῦ κατὰ φύσιν συγγενῆ ζῷα ἐντὸς ἔχον ἑαυτοῦ, συνέστησε.

correspond to one of the elements of the general criterion (*Crit.* 1):

- the matter in dispute – the subject under judgement (τὸ κρινόμενον).
- the presentation of the case – the instrument with which the subject under judgement is judged (δι' οὗ κρίνεται τὸ κρινόμενον).
- the presiding magistrate – the agent judging (τὸ κρῖνον).
- the law – the means by which the agent judging makes his judgement (ᾧ κρίνει τὸ κρῖνον).
- social harmony – the goal aimed at (οὗ ἕνεκεν).

In what follows, Ptolemy gives three examples that help understand his five elements sketched in the law court analogy. These are everyday-life examples of measuring (also a form of judgement, κριτεῖν), and for each of them Ptolemy gives the equivalent of each of the five elements that he has outlined above for the structure of the general criterion (*Crit.* 1):

- size (the judged entity) –the instrument would be the foot or the cubit, the agent the surveyer, the means by which running along it, the aim the magnitude of the size.
- weight – scales, public weighter, balancing of the scale, the difference of weight (in one of the plates).
- alignment – square or ruler, builder, application (of the ruler), straightness.

This last example, straightness, is also found in the *Harmonics* (see my chapter 2). Actually, the exemplification through these different measuring tools was a very common way to explain the criterion, appearing in a wide range of authors, including Galen, Sextus, and 'Archytas'.[35] That these examples recur so often is plausibly a sign that they were present

[35]Gal. *Opt. doctr.* 1.48; cf. Long 1988 199. Sext. *M* 7.36-7; Ps.-Arch. 37 Thesleff.

at the origin of the distinction between instrument and the other elements in the analysis of the criterion, going back to Epicurus' analogy of the ruler (κανών) in the early history of this philosophical enquiry.[36]

Then finally Ptolemy matches human faculties with the general elements of the criterion (*Crit.* 1):

- sense perception (αἴσθησις) with the instrument by which.
- intellect (νοῦς) with the agent of judgement.
- reason (λόγος) with the means by which.

As Ptolemy notes some lines below, these are the internal constituents of the criterion. The 'end points' (ἄκρα) are 'what is' (τὸ ὄν) and 'truth' (ἀλήθεια), 'an inessential complication due to the law court analogy' as Long notes.[37]

We have now outlined Ptolemy's narrative in the first part of his essay. Now, it would be interesting to put his version of the criterion in the context of other ancient versions of the criterion. For this contextualization, it will be useful to proceed according to the different elements distinguished in Ptolemy's criterion, since this seems to be a variable element in the ancient accounts.

Within Ptolemy's internal constituents of the criterion we have first the distinction between agent and instrument. This distinction can be found in the accounts of the criterion by Sextus, Alcinous, and Potamo. The structure of Sextus' criterion, accompanied with a similar explanation as Ptolemy's with measures, is actually the only one other than Ptolemy's that comprises three distinctions, as Long remarks.[38] This is Sextus' version:[39]

> πάρεστι μέντοι καὶ τὸ λογικὸν τοῦτο ὑποδιαιρεῖσθαι, λέγοντας τὸ μέν τι εἶναι κριτήριον ὡς ὑφ' οὗ, τὸ δὲ ὡς δι' οὗ, τὸ δὲ ὡς προσβολὴ καὶ σχέσις. ὑφ'

[36] Hatzimichali 2011, 98; Striker 1974, 31-3.
[37] Long 1988, 189.
[38] Long 1988, 189.
[39] Sext. *M* 7.35-7.

> οὗ μὲν ὡς ἄνθρωπος, δι' οὗ δὲ ὡς αἴσθησις, τὸ δὲ τρίτον ὡς ἡ προσβολὴ τῆς φαντασίας. ὃν γὰρ τρόπον ἐν τῇ τῶν βαρέων καὶ κούφων ἐξετάσει τρία ἐστὶ κριτήρια, ὅ τε ζυγοστάτης καὶ ὁ ζυγὸς καὶ ἡ τοῦ ζυγοῦ θέσις, τούτων δὲ ὁ μὲν ζυγοστάτης κριτήριον ἦν τὸ ὑφ' οὗ, ὁ δὲ ζυγὸς τὸ δι' οὗ, ἡ δὲ θέσις τοῦ ζυγοῦ ὡς σχέσις, καὶ πάλιν ὃν τρόπον πρὸς τὴν τῶν εὐθειῶν καὶ στρεβλῶν διάκρισιν τεχνίτου τε καὶ κανόνος καὶ τῆς τούτου προσβολῆς ἐστι χρεία, κατὰ τὰ αὐτὰ καὶ ἐν φιλοσοφίᾳ πρὸς τὴν τῶν ἀληθῶν τε καὶ ψευδῶν διάγνωσιν δεόμεθα τῶν προειρημένων ἡμῖν τριῶν κριτηρίων, καὶ ἔοικε τῷ μὲν ζυγοστάτῃ ἢ τέκτονι ὁ ἄνθρωπος, ὑφ' οὗ γίνεται ἡ κρίσις, τῷ δὲ ζυγῷ καὶ κανόνι ἡ αἴσθησις καὶ ἡ διάνοια, δι' ἧς γίνεται τὰ τῆς κρίσεως, τῇ δὲ σχέσει τῶν προειρημένων ὀργάνων ἡ προσβολὴ τῆς φαντασίας, καθ' ἣν ὁ ἄνθρωπος ἐπιβάλλεται κρίνειν.
>
> It is, however, possible to subdivide this logical one, too, saying that one is a criterion in the manner of 'by which', one in the manner of 'through which', and one in the manner of 'impact and state': 'By which' – namely, a human being; 'through which' – namely, sense perception; the third one – namely, the impact of the appearance. Compare the testing of heavy and light objects, in which there are three criteria, the weigher, the pair of scales, and the position of the scales, and of these the weigher is the criterion 'by which', the scales are the criterion 'through which', and the position of the scales is the criterion as 'state'. Or again, for the determination of straight and crooked objects there is a need for the craftsman and the ruler and the application of this. In just the same way, in philosophy, too, we need the three aforementioned criteria for distinguishing true and false things, and the human being, 'by whom' the judgment occurs, is like the weigher or carpenter; sense perception and thought, 'through which' the judgment occurs, are like the scales and ruler; and the impact of the appearance, in virtue of which the human being undertakes to judge, is like the state of the aforementioned tools.

The third distinction, which in Sextus is explained as 'impact and state', but also 'according to which' (καθ' ὅ) in *PH*,[40] and in Ptolemy 'by means of which' (ᾧ), is only found in these two authors. The three elements do not appear even in Sextus' doxography of the criterion according to prominent philosophers, which leads Hatzimichali to suppose that this three-

[40]Sext. *PH* 2.16: ἀλλὰ καὶ τὸ λογικὸν κριτήριον λέγοιτ' ἂν τριχῶς, τὸ ὑφ' οὗ καὶ τὸ δι' οὗ καὶ τὸ καθ' ὅ.

fold scheme was later than Sextus' sources for the doxography, Posidonius and Antiochus, tentatively suggesting Potamo as the originator.[41]

Alcinous and Potamo have only the distinction between agent and instrument.[42] In Alcinous, however, we find out that the distinction fades out when he explains that the agent, which is the intellect (νοῦς), may also be reason (λόγος), which has formerly been identified with the instrument.[43]

Something similar as in Alcinous happens in the pseudo-Pythagorean treatise of 'Archytas', where we seem to have three successive accounts of the criterion, presenting respectively (Ps.-Arch. 36 Thesleff):

1. non-distinction agent-instrument, but three elements:

   (a) the double reality of intelligibles and sensibles –probably Timaean influence– identified with 'that against which is judged', or 'the immediate reality' (ποθ' ὅπερ δὲ κρίνεται τὸ αὐτόθεν φαινόμενον)

   (b) the agent, which includes intellect and sense perception together (τὸ μὲν κρῖνον εἶμεν τὸν νόον καὶ τὰν αἴσθησιν)

   (c) the thing judged, which is now reason (τὸ δὲ κρινόμενον τὸν λόγον)

2. distinction agent-instrument: now reason is active, and when it 'is in harmony' it acts 'through' (διά) sense perception, as if it were an instrument.[44]

3. non-distinction agent-instrument: intellect is said to be the 'measure' (μέτρον) of intelligibles, and sense perception the 'measure' of sensibles; both are called 'judges' (κριτάς), intellect of the 'most valuable things', sense perception of 'the most useful'.[45]

[41] Hatzimichali 2011, 100-1. For the sources of Sextus' doxographies, see Sedley 1992.
[42] Long 1988, 186-8; Hatzimichali 2011, 82-90 for Potamo, 92-3 for Alcinous.
[43] Alc. *Didasc.* 4.1-2.
[44] Ps.-Arch. 36 Thesleff: τὸ δ' ὅτι συμφωνεῖ ὁ διπλόος λόγος, διὰ τᾶς αἰσθάσιος ἐπιμαρτυρεῖται.
[45] Ibid.: οὕτως δὲ καὶ τῶν μὲν αἰσθατῶν αἴσθησις μέτρον, τῶν δὲ νοατῶν νόος ἀρχὰ καὶ μέτρον ἐστί. [...] καὶ ὁ μὲν νόος τῶν τιμιαιτάτων ἐστὶ κριτάς, ἁ δ' αἴσθησις τῶν χρησιμωτάτων.

As I have noted above, there are some common features in the pseudo-Pythagorean treatises and in Ptolemy's *Criterion*, what makes the former potential models of the latter. And among the pseudo-Pythagorean treatises, the obvious candidate for its topic (and for its author!) is this one treatise ascribed to Archytas. So it would be interesting to see if we can find more specific similarities. Let us briefly review them.

I already note that the results make it hard to guess if there could be any allusion to the pseudo-Archytan treatise in Ptolemy's text. The first thing to note is that perhaps the pseudo-Pythagorean treatise began with a very similar wording as Ptolemy's (this constituting the allusion), since Iamblichus paraphrases its content by saying that Archytas distinguishes more clearly 'the criteria of things'.[46] A second possible connection could be the sequence of measuring examples for the criterion, both are particularly similar. Let us summarize the sequences of both authors in the following table (the items are added in the order appearing in each of the two authors):

Ps.-Arch. 37 Thesleff		Ptol. *Crit.* 1	
measured quality	measure	measured quality	measure
quantity	number		
length (μάκεος)	foot	length (μέγεθος)	cubit or foot
weight (ῥοπᾶς καὶ σταθμοῦ)	scales	weight (βάρος)	scales
verticality and straightness (ὀρθότατος καὶ εὐθύτατος)	ruler and plumbine (κανὼν καὶ στάθμα)	alignment or verticality (σχέσις ἢ θέσις)	plumbine, ruler (στάθμη [ἢ] κανών)

The parallel is thus clear in the three categories length, weight, and verticality/straightness and their respective measures. This sort of examples, as we have said, appear in many authors, but it is possible that Ptolemy coincides with Archytas in these items more exactly

[46]Iambl. *Comm. Math.* 8.95-98: ἔτι δὲ σαφέστερον Ἀρχύτας ἐν τῷ Περὶ νοῦ καὶ αἰσθήσεως διακρίνει τὰ κριτήρια τῶν ὄντων. Cf. Ptol. *Crit.* 1: τὸ κριτήριον τῶν ὄντων ἐφοδεύσαιμεν…

than with any other ancient account. From the quote of Sextus' criterion above, we see that Sextus used there the examples of weight (measured through the scales) and straightness (measured through the ruler, κανών), which he repeats in his review of the Peripatetics' criterion (*M* 7.226). Galen cites the examples of the compass drawing a circle, a cubit judging lengths (τὰ μήκη), and the scales judging weights (τὰ βάρη) (*De opt. doctr.* 1.48). Alcinous does not give such examples; Philo does not, either, in clear connection with the criterion, but he insists many times on Biblic passages (*Lev.* 19.35-6, *Deut.* 25.13.1) on the rightness of the measures, on which insistence the contemporary theory on the criterion could have played a role.[47] The sequence normally includes measures, weights, and scales (from e.g. *Lev.* ibid. ἐν μέτροις, ἐν σταθμοῖς, ἐν ζυγοῖς), but elsewhere also number (ἀριθμός).

In conclusion we can say in no other author than 'Archytas' Ptolemy's examples share its three-fold sequence along with strong verbal coincidences, especially in the double exemplifications as we have recorded in the table above.

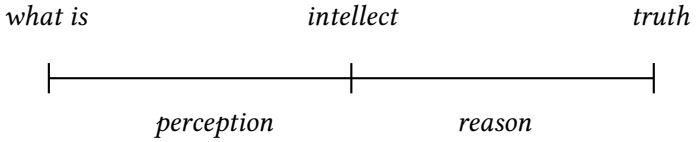
Could we find other echoes of the pseudo-Archytan text in Ptolemy's *Criterion*? We can begin with the line's analogy of the *Republic* (*Rep.* 509d–513e), which 'Archytas' repeats in his text (38-9 Thesleff). I will not attempt to summarize the metaphor here, since we need not recall the contents of Socrates' image, but only the fact that four philosophical concepts (kinds of knowledge) are likened to four intervals of a divided line. It would be possible to interprete a passage in this first section of Ptolemy's *Criterion* as a similar geometrical metaphor. This would appear after the identification of the five items in the act of judgement: reality (thing judged), truth (goal), perception (by which), intellect (agent), and reason (the means by which). Then Ptolemy says:[48]

> πέντε δὴ τούτων ὑποκειμένων τὸ μὲν ὂν καὶ ἡ ἀλήθεια καὶ ὁ νοῦς ὅροι τινὲς ἂν εἶεν καὶ ἀκρότητες ἁπλαῖ καὶ ἀμιγεῖς τὴν φύσιν· ἡ δ' αἴσθησις καὶ ὁ λόγος, διάστημα καὶ μεσότητες ὥσπερ πορισταὶ κατὰ τὰς πρὸς τὰ ἄκρα διαδόσεις.
>
> Of the five, what is, truth, and intellect would be bounds and limiting points

[47] Phil. Alex. *Rer. Div.* 162, 145, *Somn.* 2.193, *Spec. leg.* 4.193-4.
[48] Ptol. *Crit.* 2.

> that are unqualified and simple in nature. Perception and reason are interval and intermediates which as it were supply the linkages between the limits.

The picture by which Ptolemy explains the relationship between these five terms seems to be a divided segment. Now the line would be divided in just two smaller segments, its structure nevertheless becoming more complicated because the limiting points are introduced in the metaphor.



Finally, there could be another reflection of the Archytan treatise later in Ptolemy's text, when he says that 'it is by the soul that we think, and not by the body', but since Ptolemy discusses this in the third part of his treatise, I will delay the analysis of this possible link to my commentary of that part below.

These are only possible allusions. However, as regards the contents, Ptolemy's complex criterion has no important parallel in the one exposed in the Archytan treatise. So the question of the influence of this text must be left open. But a general awareness of this sort of pseudo-Pythagorean treatises on Ptolemy's part is definitely plausible, given Ptolemy's familiarity with parts of Archytas' works as shown in the preceding chapter. I will develop this further in my chapter 6, but now we could just argue that a large number of pseudo-Pythagorean treatises were ascribed to Archytas in the first centuries BCE and CE, the most prominent ancient Pythagorean who was known to have written treatises (unlike Pythagoras), and a relevant philosophical model in the Roman world; and often the ancients could not tell the difference between the ancient Pythagorean and the Platonic neo-Pythagorean who used the same name,[49] so that Ptolemy's could have known pseudo-Pythagorean texts

[49]Tarrant supposes 'Archytas' to be someone who adopts this name, rather than someone just faking Archytas' writings, and connects this with the practice of adapting the philosophers' names in the Plotinian circle: Tarrant 2008, 591 n. 27.

of Archytas taking them for authentic ancient Pythagorean works.

Back to our survey of the elements of the criterion in the ancient sources, it would be interesting to pursue the parallel between the criterion in Sextus and Ptolemy in order to determine if there was a clear common philosophical tradition or a possible common source. The easiest starting point is to show the sources of Sextus' doxography, which have already been studied by certain scholars.

This involves a certain analysis of the criterion that Sextus attributes to the different philosophers or philosophical schools. Sextus' doxography of the Peripatetics clearly shows the two elements distinguished by Ptolemy, agent/instrument, with the exemplification by way of measuring tools.[50] Less explicitly, his doxography of Plato also distinguishes an active role for reason and declares that sense perception accompanies it.[51] Actually this is not the only similarity between both accounts: they both begin with the Timaean distinction of two realities, the intelligibles and the sensibles (τὰ νοητὰ καὶ αἰσθητά).[52] This and other reasons have led scholars to believe that Antiochus, who had written a work on the criterion, and who is cited in Sextus' doxography at various points, was Sextus' (indirect) source for the doxography from Plato onwards, a picture compatible with the kind of history of philosophy which Antiochus was eager to promote, unifying the views of the different philosophical schools, including Stoics and Peripatetics, with a core in the Platonic doctrines.[53] We will come back to this below, so let us hold in mind that Antiochus was the probable source for Sextus' doxography of Plato, the Peripatetics and the Stoics.

There is another feature which can offer some clues for the traditions on the criterion. Marked prepositional language (ὑφ' οὗ or ᾧ, by which/δι' οὗ, through which), is frequently used in the ancient accounts for the distinction agent/instrument, as in Potamo (DL 1.21),

[50]Sext. *M* 7.226.

[51]Sext. *M* 7.144: ἀμφότερα τοίνυν συνελθεῖν δεήσει, τήν τε ἐνάργειαν ὡς ἂν ἀφετήριον οὖσαν τῷ λόγῳ πρὸς τὴν κρίσιν τῆς ἀληθείας, καὶ αὐτὸν τὸν λόγον πρὸς διάκρισιν τῆς ἐναργείας. εἰς μέντοι τὸ ἐπιβάλλειν τῇ ἐναργείᾳ καὶ τὸ ἐν ταύτῃ ἀληθὲς διακρίνειν πάλιν συνεργοῦ δεῖται ὁ λόγος τῆς αἰσθήσεως.

[52]Sext. *M* 7.141, 217.

[53]Long 1988, 186 n. 17; Sedley 1992, 45-8. See also Sedley 2012. The intermediary would be Sextus' Pyrrhonian precursor Aenesidemus.

Sextus, Alcinous, Ptolemy, and 'Archytas'. Hatzimichali notes another important philosophical context of this use, namely physics, under the influence of Aristotle's account of the four causes.[54] But, as she says, in epistemology it has the likely precedent of the *Theaetetus*:[55]

> ἀπόκρισις ποτέρα ὀρθοτέρα, ᾧ ὁρῶμεν τοῦτο εἶναι ὀφθαλμούς, ἢ δι' οὗ ὁρῶμεν, καὶ ᾧ ἀκούομεν ὦτα, ἢ δι' οὗ ἀκούομεν;
>
> Which of the two answers is more correct, that eyes are that by which we see or that through which we see, and ears are that by which we hear, or that through which we hear?

In supporting her claim, Hatzimichali emphasizes that the anonymous commentator of this dialogue, tentatively ascribed to Eudorus by Tarrant,[56] actually mentions that the *Theaetetus* was held by some Platonists to be about the criterion (2.11-14).[57] In this context, Tarrant has suggested, and Hatzimichali agrees, that the anonymous commentator could be arguing for a unitary notion of criterion against those who differentiated agent and instrument in a passage where he identifies the criterion 'by which' with the criterion 'through which', rejecting elsewhere the role of the senses.[58]

If this *Theaetetus*-tradition for the criterion was sound, this could offer some clues for the metaphor at the beginning of Ptolemy's treatise. We have seen that the starting point for Ptolemy is an induction from the particular criterion represented by the law court, based on the synonymy explained above. In the light of the link between the distinction agent/instrument and the exegetical activity on the *Theaetetus* noted by Hatzimichali, we can speculate that the law court, which has an important presence towards the end of the dialogue in an epistemological context, could have played a role in the development of the analogy used by Ptolemy. This is the most relevant passage in the *Theaetetus* for the law

[54]Hatzimichali 2011, 91.
[55]Pl. *Tht.* 184c (tr. Hatzimichali). Hatzimichali 2011, ibid.; Long 1988, 192 n. 33.
[56]Tarrant 1983.
[57]Hatzimichali 2011, 92.
[58]Anon. *In Tht.* 2.23-32; 3.7-13. Tarrant 1983, 165; Tarrant 2000, 180; Hatzimichali 2011, 89.

court and epistemology[59]

> ΣΩ. Οὐκοῦν ὅταν δικαίως πεισθῶσιν δικασταὶ περὶ ὧν ἰδόντι μόνον ἔστιν εἰδέναι, ἄλλως δὲ μή, ταῦτα τότε ἐξ ἀκοῆς κρίνοντες, ἀληθῆ δόξαν λαβόντες, ἄνευ ἐπιστήμης ἔκριναν, ὀρθὰ πεισθέντες, εἴπερ εὖ ἐδίκασαν;
> ΘΕΑΙ. Παντάπασι μὲν οὖν.
> ΣΩ. Οὐκ ἄν, ὦ φίλε, εἴ γε ταὐτὸν ἦν δόξα τε ἀληθὴς †καὶ δικαστήρια† καὶ ἐπιστήμη, ὀρθά ποτ' ἂν δικαστὴς ἄκρος ἐδόξαζεν ἄνευ ἐπιστήμης· νῦν δὲ ἔοικεν ἄλλο τι ἑκάτερον εἶναι.
>
> SOCRATES: When, therefore, judges are justly persuaded about matters which you can know only by seeing them, and not in any other way, and when thus judging of them from report they attain a true opinion about them, they judge without knowledge, and yet are rightly persuaded, if they have judged well.
> THEAETETUS: Certainly.
> SOCRATES: And yet, O my friend, if true opinion in law courts and knowledge are the same, the perfect judge could not have judged rightly without knowledge; and therefore I must infer that they are not the same.

The analogy of the law court applied to a developed criterial theory was regarded by Long as probably original to Ptolemy,[60] but Ptolemy's phrasing in the introduction of the metaphor seems to intimate that it was actually already in circulation before him ('the closest such analogue', ἐγγυτάτω γὰρ ἡ τοιαύτη τῶν παραβολῶν).

There is indeed a clear precedent for the use of the law court as an analogy of the criterion, namely in the work of Philo of Alexandria, one odd-century earlier than Ptolemy, who applies it many times in passing, and most clearly in his treatise on education (the specific reference is boldfaced):[61]

> ὥσπερ γὰρ ὀφθαλμοὶ μὲν ὁρῶσιν, ὁ δὲ νοῦς δι' ὀφθαλμῶν τηλαυγέστερον, καὶ ἀκούει μὲν ὦτα, ὁ δὲ νοῦς δι' ὤτων ἄμεινον, καὶ ὀσφραίνονται μὲν οἱ μυκτῆρες, ἡ δὲ ψυχὴ διὰ ῥινῶν ἐναργέστερον, καὶ αἱ ἄλλαι αἰσθήσεις τῶν καθ' αὑτὰς ἀντιλαμβάνονται, καθαρώτερον δὲ καὶ εἰλικρινέστερον ἡ διάνοια – κυρίως

[59] Pl. *Tht.* 201b-c (tr. Jowett).
[60] Long 1988, 189.
[61] Phil. Alex. *Congr.* 143 (tr. C. D. Yonge). The analogy is also alluded to at *Conf.* 141; *Congr.* 27. Cf. also the expression 'tribunal of nature' in *Conf.* 126, *Spec.* 3.52, 121.

> γὰρ εἰπεῖν ἥδ' [ἡ διάνοια] ἐστὶν ὀφθαλμὸς μὲν ὀφθαλμῶν, ἀκοὴ δὲ ἀκοῆς καὶ ἑκάστης τῶν αἰσθήσεων αἴσθησις εἰλικρινεστέρα, **χρωμένη μὲν ἐκείναις ὡς ἐν δικαστηρίῳ ὑπηρέτισι**, δικάζουσα δ' αὐτὴ τὰς φύσεις τῶν ὑποκειμένων.
>
> For as the eyes see, and still the mind sees more clearly by means of the eyes; and as the ears hear, but nevertheless the mind hears better through the medium of the ears; and as the nostrils smell, and yet the soul smells more precisely through the instrumentality of the nostrils; and in like manner, as the other external senses comprehend their respective appropriate objects, still the mind comprehends them also more purely and distinctly by their ministration. For to speak properly, it is the mind which is the eye of eyes, the hearing of hearing, and the more pure external sense of each of the external senses, **using them as ministers in a court of justice**, and itself deciding on the nature of the objects submitted to it, so as to approve of some and to reject others.

As Tarrant notes, the context in this passage suggests that Philo was using Aristo as a source, one of the pupils of Antiochus who transmitted his new dogmatism in Alexandria.[62] The ground is that, apart from the kind of epistemology being typically Antiochian (the instrumentality of the senses is stressed), Philo offers just above this passage a definition of art which is attributed to Aristo by Marius Victorinus. This could be confirmed by Philo's quoting of a definition of grammar, shortly below in his text, also attributed to Aristo by Victorinus in the same context where he quotes the former on art.[63]

The context in Philo suggests he was using a doxographical work, because in there various anonymous opinions other than Aristo's are discussed. This would match Philo's practice, since he has been shown to use doxographical works frequently for the purpose of gathering different current opinions for discussion, frequently without mentioning names

[62]Tarrant 1983, 174 n. 101. For Aristo's biography and that of the other pupils of Antiochus, see the best survey in Hatzimichali 2011, 40-52. Cf. also Mariotti 1966, 21–41; Glucker 1978, 95–6.

[63]Philo Alex. *Congr.* 148; Philo distinguishes a 'less perfect' kind of grammar, pertaining to the primary education, as that which consists in the art of writing and reading, which would be called 'grammatistic' –the difference between the two disciplines is also explained in Sext. *M* 1.44–6. The subject matter of the most perfect kind would be ἀνάπτυξις τῶν παρὰ ποιηταῖς τε καὶ συγγραφεῦσιν. Cf. Aristo Alex. fr. 6 Mariotti (=Mar. Victor. *Ars grammat.* 1): *grammatice est scientia poetas et historicos intellegere, formam praecipue loquendi ad rationem et consuetudinem dirigens.*

like here.[64] A plausible hypothesis in this context is that both Philo and Ptolemy found the metaphor of the law court in a doxographical (or at least partly doxographical) work by Aristo.

But who was Aristo of Alexandria? We have already said that he was one of the known pupils of Antiochus, so that it is plausible that he transmitted doctrines of Antiochus such as the one in the criterion. Another interesting fact about Aristo is that he became a Peripatetic at some time (like Cratippus, another of Antiochus' pupils), as Philodemus recorded.[65] The reasons are not clear. Hatzimichali speculates, following Puglia, that he could have heard some prominent Peripatetic, and the partly preserved reading in the papyrus supports this.[66] Glucker speculates that Aristo found too much Stoic doctrine in Antiochus' Academy, deciding to return to a purer form of philosophy, in his case Aristotelian.[67] Strabo mentions one book on the Nile by Aristo, already named 'the Peripatetic', along with one of Eudorus, adding that the latter complained of plagiarism on the part of Aristo.[68] We also know that Aristo commented on Aristotle's *Categories*, and specifically that he formulated a problem (ἀπορία) about applying the category of relatives to the universe. Thus Aristo's work on the *Categories* was probably partly shaped in the form of *aporiai*, the same as a better-known early exegetical work on Aristotle, that of Xenarchus, who expressed his objections to the fifth element in text in the form of problems related to the *De Caelo*.[69]

Did Aristo connect the metaphor of the law court with Aristotle's *Categories*? There could be some suggestions pointing in this direction. On the one hand, as Mariotti notes, it is plausible that Aristo's definitions of art and grammar appeared in his commentary on the beginning of the *Categories*, where grammar is defined as science (*Cat.* 1b1: ἐπιστήμη).[70]

[64] On Philo's use of doxographical sources, see Runia 2008.
[65] *Academicorum philosophorum index* (=test. 1 Mariotti).
[66] Hatzimichali 2011, 43; a name proposed is Xenarchus of Seleucia.
[67] Glucker 1978, 119-20.
[68] Strab. 17.1.15.
[69] Falcon 2012, 25.
[70] Mariotti 1966, 93-6. Mariotti remarks that such a definition of grammar would have been controversial in Aristo's times, and thus worth commenting on.

On the other hand, Philo was arguing for the preeminence of philosophy in laying down the fundaments of grammar when quoting Aristo's definitions, so maybe he was thinking of Aristotle's *Categories*, held by some ancient interpreters as a work on the foundations of language.[71] Aristo at the beginning of his work on the *Categories* could perhaps have linked the criterion with the judicial connotations of the title (κατηγορίαι=judicial accusations) mentioned by later commentators.[72]

We could further speculate that Aristo, having seriously engaged in the study of Aristotle's texts, and being a pupil of Antiochus and his doctrine on the criterion having the senses as instruments, could be a good candidate for a precedent to Potamo in formulating the differentiation of agent and instrument in terms of prepositional language, which as we said above was at home in Aristotle's physics. Actually, from the fragments preserved, we know that Aristo was concerned on matters of language in the context of the categories (fr. 2 Mariotti) and on the definition of grammar (fr. 6 Mariotti), so maybe it would not be an implausible picture to suppose him using Aristotle's prepositional language for the investigation of the criterion.

What about the third aspect of the criterion, encountered only extant in Ptolemy and Sextus? Could it be traced back to Antiochus? If it was already in Antiochus (or Aristo), this could explain its presence in both Ptolemy and Sextus' accounts. The 'means by which' (ᾧ) in Ptolemy, 'impact or state/according to which' in Sextus (προσβολή, σχέσις / καθ' ὁ)– is also tentatively interpreted an innovation of Potamo by Hatzimichali, as we have said above, on the basis that it is not used in the doxographies of Sextus, supposedly based on Posidonius and Antiochus. However, against this it may be argued that the doxographical part of a philosophical book may not contain the full development of a theory, which is likely to appear after the doxography in the own theory of the author.

[71]Cf. on this issue Simpl. *In Arist. Cat.* 9.

[72]Porph. *In Arist. Cat. interr. resp.* 55: Διὰ τί κατηγορίας ἐν τῇ συνηθείᾳ καλουμένης τῆς ἐν ἐγκλήματι πρὸς τὰς δικαιολογίας, ᾗ ἀντίκειται ἡ ἀπολογία, ὁ Ἀριστοτέλης οὐ προελόμενος διδάσκειν, πῶς ἐπὶ τοῖς δικαστηρίοις τῶν ἀντιδίκων κατηγοροῦμεν, ἀλλ' ἕτερόν τι, ὅπερ οὐ παρὰ τοῖς Ἕλλησι τῷδε καλεῖται τῷ ὀνόματι, ξενίζειν εἵλετο κατηγορίας ἐπιγράψας τὸ βιβλίον; Cf. Philop. *In Arist. Cat.* 12.

It is true that in Sextus' doxographies we cannot encounter the fully explicited tripartite model of the criterion. However, as I will try to show now, it is possible to argue that the three elements of his criterion can be found scattered in the analyses of the various philosophers. We have already mentioned how the instrument appears differentiated from the agent in the Peripatetics' part. Well, as regards the third aspect, we may find the concept in Carneades' review, where Antiochus appears expressly referred to. Firstly, Antiochus is quoted exposing his version of Schrödinger's observer effect:[73]

> οἷον προσβλέψαντές τινι, φησὶν ὁ Ἀντίοχος, διατιθέμεθά πως τὴν ὄψιν, καὶ οὐχ οὕτως αὐτὴν διακειμένην ἴσχομεν ὡς πρὶν τοῦ βλέψαι διακειμένην εἴχομεν· κατὰ μέντοι τὴν τοιαύτην ἀλλοίωσιν δυεῖν ἀντιλαμβανόμεθα, ἑνὸς μὲν αὐτῆς τῆς ἀλλοιώσεως, τουτέστι τῆς φαντασίας, δευτέρου δὲ τοῦ τὴν ἀλλοίωσιν ἐμποιήσαντος, τουτέστι τοῦ ὁρατοῦ.
>
> For example, when we have looked at something, says Antiochus, our sense of sight is disposed in a certain way, and we do not have it in the same condition as we had before looking. And by way of this kind of alteration we grasp two things, one of them the alteration itself – that is, the appearance – and second the thing that brought about the alteration – that is, the thing seen.

Using the analogy of the scales, we could say that the act of looking modifies the position of the eyes, in the same way as measuring modifies the position of the scales, so we see both the alteration of the scales and the thing that we are weighing. Some lines below, Sextus retakes this duplicity when presenting Carneades' final acceptation of the persuasive appearance. He begins his exposition by recalling the double nature of the appearance as having two 'states' (σχέσεις), 'one in relation to the thing that appears, the second in relation to the person having the appearance'.[74] So it seems possible to think that Antiochus had used this example also for an explanation of the third element of the criterion, which also receives the name 'state' (σχέσις) in Sextus, perhaps even being the originator of the three-fold model.

[73] Sext. *M* 7.162.

[74] Sext. *M* 7.168: τοιαύτη δὲ οὖσα δύο ἂν ἔχοι σχέσεις, μίαν μὲν ὡς πρὸς τὸ φανταστόν, δευτέραν δὲ ὡς πρὸς τὸν φαντασιούμενον.

In support of this possibility, we could argue that the example given by Antiochus on the application of the sense of sight recalls very much another passage in the *Theaetetus*, which Hatzimichali proposed as a possible model and origin of the third aspect of the criterion:[75]

> καὶ ἡμῖν οὕτω μέλαν τε καὶ λευκὸν καὶ ὁτιοῦν ἄλλο χρῶμα ἐκ τῆς προσβολῆς τῶν ὀμμάτων πρὸς τὴν προσήκουσαν φορὰν φανεῖται γεγενημένον.
>
> So we will find that black and white and any other colour has come to be from the impact of the eyes in relation to the appropriate motion.

This relativist account of vision in terms of the impact (προσβολή) of the eyes could precisely have been the basis for Antiochus' notion of the different state of sight before and after looking.

To sum up, I have attempted to show how the tripartite model of Ptolemy's criterion, which is also found in Sextus, could also have been in the criterial theory of Antiochus, by way of expliciting the possible allusions of these authors to the plausibly seminal accounts in the *Theaetetus*.[76] Then finally, if the tripartite model was already in Antiochus, Ptolemy could have found it in the work of Antiochus' pupil Aristo, who seems to be Philo's source for the metaphor of the tribunal which is also found in Ptolemy. Both geographically and doctrinally Aristo –rather than Antiochus– seems a good candidate as Ptolemy's source, since Aristo was an Alexandrian and studied Aristotle's texts, whereas Ptolemy's *Criterion* shows a great affinity with Aristotle, too, especially the *Categories* on which Aristo commented.

In any case, it is important that Ptolemy emphasised this third aspect of the criterion in his text, in accordance with his view of the practicing scientist. For Ptolemy this third aspect seems to have consisted in the process by which the apprehension may be demonstrated, and this he could have linked to the the practice of the scientific demonstrations by which the scientist shows his own theory (on which see my chapter 2). Thus, in the *Harmonics*

[75] Pl. *Tht.* 153e (tr. Hatzimichali); cf. Hatzimichali 2011, 99.

[76] After this inquiry I have found out that the hypothesis that the three elements of Sextus' criterion could be traced back to Antiochus had already been formulated: cf. Dillon 1977, 67.

special attention was paid to the process 'by means of which' the harmonicist demonstrates the rightness of his chosen ratios. Ptolemy identified this process with the practical and demonstrational side of mathematics, quite polemically against those who consider it is only theoretical. This practice was performed with the harmonic canon, the instrument which Ptolemy compared with the ruler or the compass.

3.5 Silently criticising Aristotle's *Categories* (*Crit.* 4-6)

Ptolemy closes the first part of his treatise by saying that he has outlined the 'number, nature, and interrelationships of the constituent aspects of the criterion'.[77] The terms Ptolemy uses (πόσων, οἵων, τίνα τρόπον), along with the fact that in what follows he is more obviously dealing with the Aristotelian *Categories* suggests that this could already be a reference to this text of Aristotle. Ptolemy would be alluding to the categories of number, quality and relation. This would fit our hypothesis sketched above that Ptolemy is using a work by Aristo on Aristotle's *Categories*. But let us see the precise way in which Ptolemy deals with that text.

There is an alternative interpretation of these words of Ptolemy, compatible with the reference to the *Categories*, which involves Plato's *Timaeus*. If the treatise started with the law court analogy, probably paralleling the beginning of Timaeus' discourse, it is possible that Ptolemy's text here echoes Timaeus' reasonings about epistemology after his description of the harmonic ratios of the soul. In there reason is said 'to declare the sameness or difference of that thing and some other; and to what individuals are related, and by what affected, and in what way and how and when.'[78] Plutarch, indeed, in commenting upon this passage in his interpretation of the generation of the soul in the *Timaeus*, says that Plato

[77]Ptol. *Crit.* 3: ἐκ πόσων μὲν οὖν καὶ οἵων καὶ τίνα τρόπον συνέστηκεν τὸ κριτήριον ὑποτετυπώσθω διὰ τῶν ἐφωδευμένων.

[78]Pl. *Tim.* 37a-b: λέγει κινουμένη διὰ πάσης ἑαυτῆς ὅτῳ τ' ἄν τι ταὐτὸν ᾖ καὶ ὅτου ἂν ἕτερον, πρὸς ὅτι τε μάλιστα καὶ ὅπῃ καὶ ὅπως καὶ ὁπότε συμβαίνει…

is referring to the ten categories,[79] so that if Ptolemy was alluding to this passage of the *Timaeus* he could also be pointing to the *Categories*. But of course Ptolemy could have had none of these two allusions in mind and solely have wanted to remind the task done in the previous section.

Also perhaps alluding to Aristotle's *Categories* are Ptolemy's next words, when he says that sense perception and intellect are principles and elements, and that the other aspects of the criterion are derived from them, 'so if we grasp the similarities and differences between sense perception and intellect, we shall have the whole procedure before our sight'. At the beginning of Aristotle's *Categories* we actually find the general logical rule that Ptolemy is applying in his statement: 'whenever one thing is predicated of another as of a subject, all things said of what is predicated will be said of the subject also.'[80]

Then, quite unexpectedly, a digression on language –the topic of the *Categories* according to many authors, as we said above– begins, with the following structure. Ptolemy first (1) abruptly interrupts his discurse by saying that we are constructing the criterion by means of spoken discussion, and he defends the application of the most widely accepted terms (τοῖς πλείστοις καθωμιλημένας κατηγορίας), (2) outlines an account of the origin of language, (3) says that spoken discourse does not contribute to the process of knowledge but only communicates the results of investigations, (4) explains how to disambiguate when synonyms and homonyms are used, (5) and closes the circle concluding that customary terms are the best way to begin an investigation.

This whole digression could serve to address and to downplay the role of precise definitions in the process of knowledge, but this is only an interpretation, since this is one of the obscure sections of Ptolemy's essay. We get some notion of Ptolemy's intention only through remarks like the use of customary terms in (1), the criticisms of philosophical de-

[79]Plut. *An. Tim.* 1023E: ἐν τούτοις ἅμα καὶ τῶν δέκα κατηγοριῶν ποιούμενος ὑπογραφὴν ἔτι μᾶλλον τοῖς ἐφεξῆς διασαφεῖ.

[80]Arist. *Cat.* 1b10–12: Ὅταν ἕτερον καθ' ἑτέρου κατηγορῆται ὡς καθ' ὑποκειμένου, ὅσα κατὰ τοῦ κατηγορουμένου λέγεται, πάντα καὶ κατὰ τοῦ ὑποκειμένου ῥηθήσεται.

bates in (3) –when he says that 'those which do not proceed beyond the level of definitions are empty and inconclusive'.[81]–, and his insistence on the customary terms which seems to close the excurse in (5).

If we accept that this is the subject of the excurse, we may wonder about the cultural context of this diatribe. Indeed, such a reaction on the part of Ptolemy would not be strange if he had consulted for his treatise, as we hypothesised he did, a partly doxographical work, in which typically very similar definitions of the same concept are listed and little construction is attempted. Furthermore, one of the few preserved fragments of Aristo, preserved by Simplicius, shows him inventing new names such as 'world-ed', 'earth-ed', and 'air-ed' (κοσμωτόν, γεωτόν, ἀερωτόν), following Aristotle on the category of relatives, who uses the terms 'winged', 'ruddered' and 'headed' (πτερωτόν, πηδαλιωτόν, κεφαλωτόν),[82]. So if Aristo was Ptolemy's source perhaps Ptolemy was implicitly criticising Aristo. This problem posed by Aristo aimed rather at formal coherence than at real possibility, since his examples did not make sense,[83] and this would be the kind of thing which Ptolemy would claim against when he defending the use of the terms accepted by all. As Long noted, Ptolemy would share this disdain for the small details of formal definitions with Galen.[84] Both authors thus would defend a criterion aimed more at practical use than to minute philosophical refinements, and this would have meant for them a criterion able to account for their scientific project.

So Ptolemy would have framed the whole digression with a defense of the use of customary terms, the topic with which he begins at (1) and which is restated at (5). Both the sequel at (2) –an account of the history of the invention of words– and an apparently obscure reference to the continuity of language as a quantity at (5) suggest a precise subtext for Ptolemy's discussion, namely the treatment of the category of quantity in Aristotle's

[81]Ptol. *Crit.* 5: ὧν καὶ αὐτῶν αἱ μὲν μέχρι τῶν ὁρισμῶν μόνων συνιστάμεναι κεναί τινες ἂν εἶεν καὶ ἀτελεῖς.
[82]Aristo fr. 2 Mariotti. Cf. Arist. *Cat.* 7a-b.
[83]Hatzimichali 2011, 45.
[84]Long 1988, 199.

Categories, with the help of which the passages get clearer.

Indeed, Aristotle when presenting his category of quantity and giving examples for it points out that language, unlike for example a line, is a discrete quantity, because it is divided in syllables.[85] Interestingly, the explanation in the *Categories* is interrupted with the remark that he means spoken language,[86] tantalizingly the same kind of interruption with which Ptolemy begins his digression on language. So if Ptolemy had this passage of Aristotle in mind here, the obscure remark in (5) that language is continuous would constitute Ptolemy's criticism against Aristotle's view (and perhaps Aristo's). Ptolemy would reply that language is in fact continuous if we use natural words and if we treat language naturally as in reading, and would relate this to easiness of comprehension and the use of customary terms:[87]

> ἀλλὰ καὶ τοῖς πλείστοις εὐπαρακολουθητότερον εἶναι συμβέβηκεν, ἂν μὴ κατοκνῶμεν ἐν ταῖς διαλέξεσι τὸ ἐφεξῆς ἀκούειν ἢ λέγειν, ὅπερ ἐπὶ τῶν ἀναγνώσεων ἐν ταῖς συναφαῖς τῶν συλλαβῶν.
>
> The usual and customary terms are not only more natural, but are also easier for most people to follow if we do not break up the continuity of words when we are listening or speaking. This is how we treat combinations of syllables in reading, whether a word needs to be expressed by means of one word or several.

Ptolemy's reference to the division of words in one or more syllables could give us more clues. In fact, Ptolemy's veiled criticism could be related to what seems a traditional explanation of the passage in the *Categories* on the discontinuity of language. In the commentary tradition, as seen in Porphyry and Simplicius, it was tried to make Aristotle's point on the discontinuity of language clearer by using invented words. So in order to avoid a rapid reading that would suggest continuity of language, they would put forward an invented

[85]Arist. *Cat.* 4b33-5: ὅτι μὲν γὰρ ποσόν ἐστιν ὁ λόγος φανερόν· καταμετρεῖται γὰρ συλλαβῇ μακρᾷ καὶ βραχείᾳ.

[86]Arist. *Cat.* 4b35-8: λέγω δὲ αὐτὸν τὸν μετὰ φωνῆς λόγον γιγνόμενον.

[87]Ptol. *Crit.* 6.

word –the most commonly found is βλίτυρι– so that the reader had to read it aloud slowly and the three syllables become clearly separated.[88]

It is possible that Ptolemy encountered such an example in Aristo's text, or knew it from other interpreters, and he would argue against what he considered cheating in a philosophical argument by inventing names to prove a point. This would invalidate the commentators' explanations, and Ptolemy could impose his opposite opinion that language is a continuous quantity by pointing out that it is continuous if treated naturally.

With this picture in mind, we could understand that Ptolemy in (2) would be elaborating on this, justifying that language is not an ad-hoc creation which would allow the invention of names, but a natural phenomenon that has reached the present form after various steps. Again, without Aristotle's subtext, Ptolemy's abrupt account on the creation of language seems weird, since he makes no connection with his opening defense of the customary terms in inquiry.

The account of the origin of language (2) is a good example of the obscurity in the exposition of this essay. Let us just quote the beginning of this section, which starts with the remark about the use of customary terms (here recommended for beginner intellectuals) and abruptly follows with the account on the origin of language, which is actually not so explicitly presented:[89]

> τοῖς μηδέπω διηρθρωκόσιν τὴν τῶν πραγμάτων φύσιν, ἀλλ' ἔτι ζητοῦσιν, ἀπαραποδιστότερον ἂν γένοιτο τὸ τὰς συνηθείας καὶ τοῖς πλείστοις καθωμιλημένας κατηγορίας ἐπιφέρειν ἑκάστῳ τῶν ὑποτιθεμένων· ὕστερον δ' ἂν εἴη τὸ οἰκειότερον αὐτῶν ἐπισκοπεῖν. (a) τῶν γὰρ διὰ τοῦ λόγου σημασιῶν τὰς μὲν πρώτας εἰκὸς ὑπὸ τῶν μηδέπω παραδόσεώς τινος ἐπιτυχόντων φυσικῶς ἀναπεφωνῆσθαι πεποιημένας ἀπό τε τῆς τῶν προσπιπτόντων παθῶν, καὶ ἀπὸ τῆς τῶν φωνῶν ἰδιοτροπίας. (b) τὰς δ' ἐφεξῆς ἀπ' ἐκείνων ἤδη κατὰ τὴν πρὸς τὸ οἰκεῖον ἐφαρμογὴν συνθέσεώς τινος καὶ ἤδη προσηγορίας

[88]Porph. *Comm. Cat.* 4.1.102: καὶ γὰρ ἡ βλίτυρι φωνὴ ἁπλῶς ἔχει τὰς τρεῖς συλλαβὰς κειμένας καὶ οὐ συναπτομένας ὅρῳ· οὐδὲν γὰρ σημαίνει. ποσὸν ἄρα διωρισμένον ὁ λόγος. Similarly Simpl. *Comm. Cat.* 8.124: καὶ γὰρ αἱ ἄσημοι φωναί, οἷον τὸ βλίτυρι, ὡσαύτως καταμετροῦνται καὶ οὐ συνάπτονται.

[89]Ptol. *Crit.* 5.

τυχεῖν.

> Those who have not yet clearly articulated the structure of reality but are still enquiring will find it presents fewer obstacles if they apply customary usages and the most widely accepted terminology to all the subjects they discuss: examination of more appropriate nomenclature may take place later. It is reasonable to assume that (a) the earliest verbal expressions were uttered naturally by people with no previous usage to follow: they must have been the product of the particular features of the experiences they had and of the expressions themselves. (b) The next generation of verbal expressions probably arose out of the first through a general consensus based on their suitability for their particular functions, and at this stage communication became possible.

Ptolemy singles out two moments, which I have labeled (a) and (b) in the quote: the very beginning where there was no tradition to follow, and a next stage of expressions arisen out of the first through a general consensus. As Long pointed out, this account in two stages bears most similarity with Epicurus' explanation of the origin of language in the *Letter to Herodotus*.[90] We should have in mind that in the philosophy of Ptolemy's time and that of his immediate sources, the topic of the origin and appropriateness of language was a very much discussed one, frequently in connection with Plato's *Cratylus*.[91] In this context, Epicurus' picture could have been influential, as suggests a reference to him on the question of names in the Platonic author of the anonymous *Commentary on the Theaetetus*.[92]

Then after this in (3) Ptolemy would shift the discussion to an exploration of the role of spoken language in the process of knowledge. His line of thought seems to be here that in the same way as we should not invent language because natural language reflects the structure of reality closer, spoken language is only an aid to pass the results of investigation but not the thing to be investigated. It is probably in this sense that Ptolemy defends here that 'spoken language makes no contribution to knowledge', emphatically exemplifying this

[90]Long 1988, 195 n. 47.

[91]See Tarrant 2009 on this issue.

[92]Anon. *In Tht.* 22: Ἐπίκου[ρ]ος τὰ ὀνόματά φησ[ι]ν σαφέστερα εἶναι τῶν ὅρων, καὶ μέντοι καὶ γελοῖον εἶναι, εἴ τις ἀντὶ τοῦ εἰπεῖν 'Χαῖρε Σώκρατες' λέγοι 'Χαῖρε ζῶιον λο[γ]ικὸν θνητόν'

with the silence necessary for investigation and for reading concentrated.[93]

This view that knowledge is produced in silence could also contain an echo of the *Timaeus*. Indeed, after the epistemologic passage in the *Timaeus* cited above, where Plutarch interpreted that the ten categories were alluded to, Timaeus imparts a more specific picture of the creation of knowledge:[94]

> λόγος δὲ [...] ἐν τῷ κινουμένῳ ὑφ' αὑτοῦ φερόμενος ἄνευ φθόγγου καὶ ἠχῆς, ὅταν μὲν περὶ τὸ αἰσθητὸν γίγνηται καὶ ὁ τοῦ θατέρου κύκλος ὀρθὸς ἰὼν εἰς πᾶσαν αὐτοῦ τὴν ψυχὴν διαγγείλῃ, δόξαι καὶ πίστεις γίγνονται βέβαιοι καὶ ἀληθεῖς...
>
> When reason (λόγος) [...] in voiceless silence holding her onward course in the sphere of the self-moved is hovering around the sensible world and when the circle of the diverse also moving truly imparts the intimations of sense to the whole soul, then arise opinions and beliefs sure and certain.

The key aspect is the silence with which reason is said to proceed. Note that what we here translate with 'reason' is in Greek the same term as discourse (λόγος), so that this Timaean silent reason could correspond to Ptolemy's internal discourse (or reason) (ἐνδιάθετος λόγος), which Ptolemy defends as 'sufficient for judging things and discovering their natures'.[95]

Again here there is an alternative interpretation, again not exclusive of the one I have just outlined. Ptolemy's defense of silence could constitute a Pythagorizing motive introduced in allusion to the traditional view that the Pythagoreans were lovers of silence (and secretism). A similar picture of the silent sage is found in some passages of Philo of Alexandria, a Platonist with a well-known love for Pythagorean theories.[96]

[93]Ptol. *Crit.* 5: καὶ οὐδὲν ὁ προφορικὸς ἐνταῦθα συμβάλλεται· θορυβεῖ δὲ μᾶλλον καὶ περισπᾷ τὰς διασκέψεις, ὅταν ἐνεργῇ παραπλησίως ταῖς αἰσθητικαῖς κινήσεσι· διόπερ ἔν τε ταῖς ἠρεμίαις καὶ ταῖς ἡσυχίαις μᾶλλον εὑρίσκομεν τὰ ζητούμενα καὶ κατὰ τὰς ἀναγνώσεις αὐτάς, ἂν σφόδρα τισὶν ἐπιστήσωμεν, ἡσυχίαν ἄγομεν.

[94]Pl. *Tim.* 37b (tr. Jowett).

[95]Ptol. *Crit.* 5: πρὸς μὲν γὰρ τὸ κρῖναί τι καὶ εὑρεῖν αὐτὸ ἕκαστον ὁ τῆς διανοίας ἐνδιάθετος αὐτάρκης.

[96]Phil. Alex. *Vit. Mos.* 1.49: ἐσπούδασεν ἡσυχίᾳ χρώμενος... *Quaest. Gen.* 4 fr. 47a: Ὁ σοφὸς ἠρεμίαν καὶ ἀπραγμοσύνην καὶ σχολὴν μεταδιώκει, ἵνα τοῖς θείοις θεωρήμασιν ἐν ἡσυχίᾳ ἐπιτύχῃ.

In the point which I have labeled (4), in the same context of a defense of natural language, Ptolemy introduces a discussion on how to avoid confusion when synonyms and homonyms are involved –without even introducing the names 'synonyms' and 'homonyms' for them, perhaps consequently with what he defends in this section on natural language:[97]

> ἐφ' ὧν μὲν ὑποκειμένων ἑνὸς πλείω σύνηθες ὀνόματα λέγειν, κἂν τὸ τυχὸν αὐτῶν εἴπωμεν ἢ ἀκούσωμεν μὴ διαφερομένοις· ἐφ' ὧν δὲ πλειόνων ἓν ὄνομα προσπαραμυθουμένοις ἕτερόν τι τῶν ἰδίων τοῦ σημαινομένου.
>
> When more than one name is commonly used to refer to a particular object, we should not quarrel if we hear or utter any one of them. Where one name has several meanings, we need to mention some additional peculiarity of the thing we are talking about.

Having in mind Ptolemy's probable involvement with the *Categories* in this section, I cannot help suggesting that this reference to synonyms and homonyms was inspired by the beginning of Aristotle's *Categories*, which precisely consists in the definition of these two concepts.[98]

To sum up, it seems that in this second part of his essay Ptolemy made a pause in his determination of the elements of the criterion. At first he announces that 'perception and intellect are principles and elements' of the criterion, and that in their investigation lies the core of the problem, but before this he wants to make some precisions on language, the vehicle of the investigation. In this digression Ptolemy seems to defend –in an obscure way– the relative importance of language in philosophical research. The general aim could be to justify that his terminology is as correct as many others, and that what is important is not really how we define, but how the construction is done. In this sense, Ptolemy would be advocating what he defends in the *Harmonics*, this is, practicality, usefulness, which would be more important for him than philosophical struggle over definitions. 'Terminology' is called by Ptolemy κατηγορίαι and κατηγορήματα several times in this part of his treatise,

[97] Ptol. *Crit.* 6.
[98] Arist. *Cat.* 1a1-12.

and he indeed probably intertwines his narrative with Aristotle's *Categories*.

As we have seen, Ptolemy is never explicit in disclosing Aristotle's name or text, or even that he is following a text. This renders the text quite difficult to follow, but if one considers Aristotle's text as a subtext for Ptolemy some issues appear in a clearer light. If this was correct, this would imply that Ptolemy supposed not only Plato's *Timaeus* a sufficiently known subtext for his allusions (clearer verbal echoes to the *Timaeus* will be treated below), but also Aristotle's *Categories*. This would be understandable if one considers that by Ptolemy's time the *Categories* were becoming a widely studied text in the Graeco-Roman world, included Alexandria where he was active. This is why Ptolemy could have played with these classical philosophical texts in a similar manner as an orator played with Classical Attic literature.

Ptolemy attacks here the authors that privileged formal coherence over practical philosophical concepts apt for constructing working epistemological theories. Among these authors Ptolemy could surely count Aristo, whose work on the *Categories* shows this sort of concerns. More specifically, given that Ptolemy deals with the particular category of quantity, it is possible that he wrote this section in response to a treatment of this category by Aristo, perhaps a problem (ἀπορία) of the kind of the one preserved by Simplicius on the category of relatives.

3.6 Intellect and perception (*Crit.* 7-9)

Ptolemy leaves the former discussion on language 'as something helpful but not by itself capable of producing a grasp of things', and he proposes to 'begin instead to enquire into the elements of the criterion which lie before us'.[99] So Ptolemy retakes here the thread announced at the beginning of the former section on language, the inquiry about the *elements* of the criterion, chiefly sense perception and intellect.

[99]Ptol. *Crit.* 6: τοῦτο μὲν ἐάσωμεν ἐπὶ χώρας ὡς σύνεργόν τι καὶ οὐκ αὐτουργὸν τῶν καταλήψεων· περὶ δὲ τῶν προκειμένων τοῦ κριτηρίου στοιχείων ἐπισκοπεῖν [...] ἀρξώμεθα.

Following the program stated above, Ptolemy will here structure the narrative pointing first to similarities, then to differences between these two elements. As we have noted above, Ptolemy could be following here one of the logical propositions in Aristotle's *Categories*. As we will see in what follows, there are reasons to suggest that Ptolemy now will be following a subtext of Aristotle again, not the *Categories* here, but *On the Soul*, which actually would be a natural text to look up for this section, since it deals with the same topic.

The first issue that Ptolemy addresses is the seat of each one of these two faculties. As the reader knows after a while, this will be one of the similarities, since both sense perception and intellect are said to be located in the soul. So Ptolemy begins introducing 'the most general human parts', body and soul, giving a general definition for each.[100] In order to show that this is just a 'working definition' he will engage now in a new criticism of pointless philosophical debates about whether the soul is corporeal or not. Applying the lesson of the former part of his treatise to the definition of soul (whether it is incorporeal or corporeal), Ptolemy advocates again for a practical rather than too theoretical use of nomenclature, defending what Long has rightly defined as 'optimum agreement'.[101] The passage is worth quoting:[102]

> οὐ γὰρ τὰ ὀνόματα τῶν ὑποκειμένων φύσεων ζητοῦμεν ἐπὶ τοῦ παρόντος, ὡς ἔφαμεν, ἀλλὰ τὴν ἐν αὐταῖς διαφοράν, ἣν ἔργῳ κατανενοήκαμεν ἀμετάστατον οὖσαν, κἂν μυριάκις τις ἀντιστρέφῃ τὰς ὀνομασίας αὐτῶν ἢ νῦν μὲν τὴν ψυχὴν ἀσώματον εἶναι φάσκῃ κατὰ τοὺς νομοθετοῦντας σῶμα καλεῖσθαι τὸ αἰσθήσει γνώριμον, νῦν δὲ σῶμα κατὰ τοὺς τὸ ποιῆσαι καὶ παθεῖν οἷόν τε σῶμα ὁριζομένους.
>
> As we have said, we are not at present discussing the names to give to the natural objects before us: what we are investigating is the actual difference between these things, a difference which we recognise as being unchangeable in reality even if one alters the nomenclature a thousand times, or at one time

[100]Ptol. *Crit.* 7: τῶν καθ' ὅλας διαφορὰς λαμβανομένων ἐν ἡμῖν μερῶν, τὸ μέν ἐστι σῶμα, τὸ δὲ ψυχή…
[101]Long 1988, 196.
[102]Ptol. *Crit.* 7.

> says that the soul is incorporeal, following those who lay it down that what is known by sense perception is to be called 'body', and at another time that it is body, following those who define body as that which can act and be acted upon.

Ptolemy refuses here to align himself with either of the two groups, those who affirm that the soul is not corporeal, or with those that say it is. Among the former group Aristotle figures prominently, having treated this topic at the beginning of his second book of his treatise *On the soul*:[103]

> ἐπεὶ δ' ἐστὶ καὶ σῶμα καὶ τοιόνδε, ζωὴν γὰρ ἔχον, οὐκ ἂν εἴη σῶμα ἡ ψυχή· οὐ γάρ ἐστι τῶν καθ' ὑποκειμένου τὸ σῶμα, μᾶλλον δ' ὡς ὑποκείμενον καὶ ὕλη. ἀναγκαῖον ἄρα τὴν ψυχὴν οὐσίαν εἶναι ὡς εἶδος σώματος φυσικοῦ δυνάμει ζωὴν ἔχοντος.
>
> Now given that there are bodies of such and such a kind, viz. having life, the soul cannot be a body; for the body is the subject or matter, not what is attributed to it. Hence the soul must be a substance in the sense of the form of a natural body having life potentially within it.

Coherently with his announced working strategy Ptolemy continues by finding 'universal agreement' in the view 'that it is by the soul that we think, and not by the body'.[104] And he adds: 'we would also acknowledge that it is by the soul, not the body, that we make our sensory and all other movements, if we took note too of the quantitative aspect of what happens when they separate'.[105] We have to understand that Ptolemy now refers to the moment of death. The enlightening justification that follows is that the soul is so constituted as to scatter immediately into its proper elements, while the body remains in the same state for some time but without perceiving anything or making any movements.[106]

[103] Arist. *de An.* 412a16–20 (tr. Smith).

[104] Ptol. *Crit.* 7: ἀλλ' ἐπειδή γε τοιαύτη τίς ἐστιν ἡ τῶν εἰρημένων φύσεων διαφορά, τὸ μὲν τῇ ψυχῇ διανοεῖσθαι καὶ μὴ τῷ σώματι, πᾶς ἂν ὁμολογήσειεν.

[105] Ptol. *Crit.* 7: ὅτι δὲ καὶ τάς τε αἰσθητικὰς καὶ τὰς ἄλλας πάσας κινήσεις τῇ ψυχῇ καὶ οὐ τῷ σώματι ποιούμεθα, κατανοήσαιμεν ἂν εἰ καὶ κατὰ τὸ ποσὸν ἐπιβάλοιμεν αὐτῶν τῇ διαλύσει…

[106] Ptol. *Crit.* 7: ἡ μὲν ψυχὴ […] εὐθὺς εἰς τὰ οἰκεῖα στοιχεῖα πέφυκε χωρεῖν […], τὸ δὲ σῶμα διὰ τὸ τῆς ὕλης παχυμερὲς ἐπιδιαμένον συχνὸν χρόνον ἐν ταῖς αὐταῖς καταστάσεσιν, ὅμως οὐδεμίαν φαίνεται ποιούμενον οὔτε αἴσθησιν οὔτε ὅλως κίνησίν τινα τῶν προτέρων.

So it seems that even if Ptolemy firstly presented the question of the corporeality of the soul as a matter of definition, he finally presents as a self-evident truth the fact that the soul disintegrates at the moment of death, hence assuming that it is corporeal –this will be confirmed in the Timaean scheme of the constituent elements of the soul and the body below in *Crit.* 13–. Long interpretes this strategy as an escapism from the 'vexed question' of the corporeality of the soul,[107] but we could also view Ptolemy's strategy less controversially saying that Ptolemy was arguing in terms of method, claiming that one should not insert into the soul's definition a statement about his corporeality, but leave this for the proper investigation. However, it remains true that Ptolemy doesn't seem to sufficiently justify that his investigation of reality is not just a question of definition, precisely what he wants to combat. We are left again with the impression that Ptolemy is writing only rhetorically, without much interest in bringing the issues to deeper consideration.

It is interesting to note that even if Ptolemy's materialistic view of the soul is plainly anti-Aristotelian, Ptolemy's conclusion that the soul is the moving part coincides with Aristotle's view in *On the Soul*, where it is affirmed that 'it is the soul by which primarily we live, perceive, and think'.[108]

Once the similarity in the seat of sense perception and intellect has been established, namely that they are both placed in the soul, Ptolemy states his view of the process of knowledge, focusing on the functions of sense perception and intellect: sense perception makes first contact with the objects of sensation through the sense organs, and transmits the affections by means of phantasia to the intellect, which applies to them the operation of thought.[109] Here he remarks another similarity, namely that both intellect and sense perception 'deal with the same objects', this is, ultimately reality, but, as he says, 'not in the same way', which he uses for introducing the differences.[110]

[107]Long 1988, 205.

[108]Arist. *de An.* 414a12–13: ἡ ψυχὴ δὲ τοῦτο ᾧ ζῶμεν καὶ αἰσθανόμεθα καὶ διανοούμεθα πρώτως.

[109]Ptol. *Crit.* 8.3.

[110]Ptol. *Crit.* 8: ὅθεν ἀκολουθεῖ καὶ τὸ τῶν μὲν αὐτῶν αἴσθησίν τε εἶναι καὶ διάνοιαν, οὐ μέντοι κατὰ τὸν αὐτὸν τρόπον, ἀλλὰ διαφέρειν…

In the account of the differences, the narrative is structured according to an account of the priority of either of sense perception or intellect in potentiality and in actuality. This distinction made by Ptolemy, which is not explained, is ultimately Aristotelian, and, as we will see, seems to have been derived from *On the Soul.* Furthermore, it also tellingly figures in Sextus' doxography of the Peripatetics.

But let us first see the details of Ptolemy's account. Ptolemy agrees closely Aristotle's *On the Soul*, remarking that in potentiality (what Aristotle calls here 'possession of') both sense perception and intellect (changing 'knowledge' for 'intellect' in Aristotle) are in human beings 'from the moment of conception as seed' (Aristotle says thanks to the action of the male parent before birth).[111]

Regarding actuality, both Ptolemy and Aristotle make the point that sense perception acts only for a limited period of time when the objects of sensation are actually affecting it, while we can remember and think of these objects even while they are not there.[112] This is why Ptolemy affirms that in actuality sense perception is prior to thought.[113]

This discussion on the priority of sense perception or intellect in both actuality and potentiality is well paralleled in Sextus' brief treatment of the viewpoint of the Peripatetics on the criterion (*M* 217-26), actually constituting the first topic appearing in it: Sextus' report agrees with Ptolemy's conclusions in assigning the priority to sense perception in actuality, while in potentiality intellect is said to be first.[114]

The prominent presence of this issue both in Sextus and in Ptolemy suggests that for Ptolemy Aristotle was perhaps mediated by similar sources as for Sextus. In addition, since

[111]Ptol. *Crit.* 9: δυνάμει μὲν οὖν νοῦς αἰσθήσεως οὔτε πρότερον οὔτε ὕστερον [...]· ἡ γὰρ οὐσία αὐτῶν καὶ ἦν ἀεὶ καὶ ἔσται καὶ ἐν τῷ παντὶ καὶ κατὰ τὴν ἀρχὴν τῆς ἑκάστου γενέσεως <ὡς> σπέρμα. Cf. Arist. *de An.* 417b16-18: τοῦ δ' αἰσθητικοῦ ἡ μὲν πρώτη μεταβολὴ γίνεται ὑπὸ τοῦ γεννῶντος, ὅταν δὲ γεννηθῇ, ἔχει ἤδη, ὥσπερ ἐπιστήμην, καὶ τὸ αἰσθάνεσθαι.

[112]Ptol. *Crit.* 8: δι' αὐτῆς [τῆς αἰσθήσεως] τὰ ὑποκείμενα, καὶ ἐν τῷ τὴν μὲν διατιθέντων μόνον τῶν αἰσθητῶν ἢ καὶ ἐπὶ ποσὸν ἀπαλλαγέντων ἀντιλαμβάνεσθαι [...] [τὸν νοῦν] λαβόντα δὲ ἅπαξ κρατεῖν καὶ μεμνῆσθαι τῶν πραγμάτων καὶ ἀπόντων οὕτως καὶ ἐπὶ τοσοῦτον... Cf. Arist. *de An.* 417b23-5: διὸ νοῆσαι μὲν ἐπ' αὐτῷ, ὁπόταν βούληται, αἰσθάνεσθαι δ' οὐκ ἐπ' αὐτῷ· ἀναγκαῖον γὰρ ὑπάρχειν τὸ αἰσθητόν.

[113]Ptol. *Crit.* 9: ἐνεργείᾳ δὲ τοῦ διανοεῖσθαι πρότερον τὸ αἰσθάνεσθαι.

[114]Sext. *M* 7.218: τάξει μὲν οὖν πρῶτόν ἐστι τὸ ἄλογον καὶ ἀναπόδεικτον κριτήριον, <ἡ> αἴσθησις, δυνάμει δὲ ὁ νοῦς, εἰ καὶ τῇ τάξει δευτερεύειν δοκεῖ παρὰ τὴν αἴσθησιν.

Boll it has been noted that the theory of knowledge of Sextus' Peripatetics is very similar to the theory that Ptolemy outlines in the *Criterion*, especially the emphasis put in both accounts on the instrumental role of sense perception.[115]

We have already noted how this section of Sextus had his probable source in Antiochus. Well, it would have been natural that Antiochus' pupil Aristo interpreted Aristotle's criterion in a similar manner as his teacher did, which would form a consistent picture with our hypothesis that Aristo could have been Ptolemy's source.

3.7 Problems in the creation of knowledge (*Crit.* 10-12)

One of Ptolemy's conclusions in the previous section is that sense perception is inferior to intellect on the basis that 'it cannot even perceive the objects themselves again without having the actual experience', and because 'it may often be affected in opposite ways by similar objects and in identical ways by dissimilar objects'.[116] The next part of Ptolemy's treatise seems to address the topics related to the problems that may arise due to these 'limiting' characteristics of perception.

My plan for this section is first to offer some remarks about Ptolemy's general conception of the problems arisen in the process of knowledge, and its possible relation to what Ptolemy has said and done in the *Harmonics*. Next I will review the details of Ptolemy's development, arguing that Ptolemy probably attempted a systematization of what Aristotle writes in separate passages of *On the Soul*. Finally I will try to explain the more obscure final paragraphs of this section, when Ptolemy seems to verge to an epistemological interpretation of Plato's *Timaeus*, perhaps prefiguring the next section where the influence of the *Timaeus* is most obvious.

[115]Sext. *M* 7.226. Boll noted these striking similarities: Boll 1894, 77-93; Long agrees with this Aristotelian *milieu*, much more than with Lammert's proposed Stoic pedigree, which is to be interpreted rather as the consequence of the common terms adopted from the Stoics by the other philosophical sects: Long 1988, 195 n. 49. Cf. Lammert 1918, Lammert 1920a, Lammert 1920b, Lammert 1922 for Lammert's view.

[116]Ptol. *Crit.* 9: τὴν δ' αἴσθησιν καθάπαξ τε δεῖ τι παθεῖν, ἵνα τῶν αὐτῶν αἴσθηται· καὶ οὐδὲν ἧττον ὑπό τε τῶν ὁμοίων ἐναντίως καὶ ὑπὸ τῶν ἀνομοίων ὡσαύτως ἐνδέχεται πολλαχῇ διατεθῆναι.

The theory that Ptolemy sketches in these sections is crucial to his own theory of harmonics, where the design and use of the instrument of the canon is designed explicitly with the aim of reducing to the minimum the problems arisen in the perception of differences between sounds. A good part of the *Harmonics* is devoted to the qualification of these possible errors, and to develop strategies of coping with them, and this constitutes one of the greatest scientific achievements of that work.[117] Here in the text on the criterion Ptolemy treats the topic not only related to hearing, but in general for all the senses.

This is how Ptolemy presents his leading thread:[118]

> κἂν ἀνοίκειον ᾖ τοῦ διαθέντος τὸ πάθος πότερον παρ' αὐτὴν τὴν αἴσθησιν γέγονε τὸ τοιοῦτον, ἢ παρά τι τῶν ἔξωθεν, [ἡ διάνοια] ἐνιαχῇ μὲν διὰ τῶν αἰσθήσεων πάλιν ποιουμένη τὴν ἀνάκρισιν, ἢ τῶν ὁμοίων καὶ ἀπαθῶν, ὅταν περὶ αὐτὰς ᾖ τὸ αἴτιον, ἢ τῶν περὶ τὸ αὐτὸ ὑποκείμενον ἀνομοίων, ὅταν μὴ οὕτως ἔχῃ, τὰ πολλὰ δὲ καὶ καθ' αὑτὴν τῷ λόγῳ προσβιβάζουσα καὶ ἀνευρίσκουσα διὰ τῆς συνεχοῦς καὶ ἀπηλλαγμένης τῶν αἰσθήσεων ἀνακινήσεως κατὰ τὴν ἐφεξῆς θεωρίαν τὸ οἰκεῖον ἑκάστῃ φύσει τῶν πραγμάτων.
>
> If the affection is inappropriate for the object which has given rise to it, thought also determines whether the affection has taken the form it has in the actual process of sense perception or through some external cause. This further determination it sometimes makes again using the evidence of the senses, either uncorrupted data from the same sense when the cause of the problem relates to the senses, or data about the same object from a different sense when that is not the case. The majority of such cases, however, it submits through its own agency to reason, and discovers the proper nature of each kind of things by successive acts of contemplation through a process of review which is continual and independent of the senses.

So one of the solutions (one of the tests, one could say), is to use again the same sense, but using uncorrupted data (we are not told how this can be achieved, though). Another solution is the collaboration of another sense. We can find a nice parallel in Ptolemy for this sec-

[117] See esp. Ptol. *Harm.* chapters 1.1, 1.2, 1.8, 1.11, 2.12, 2.13, 3.2, 3.3.
[118] Ptol. *Crit.* 10.

ond solution, in a passage of the *Harmonics* which we have already studied, where Ptolemy elaborated on the Archytan theme of the kindredness of the sciences with a metaphor of the kindredness of sight and hearing (see my chapter 2). One could argue, in addition, that the collaboration of the senses is not only defended by Ptolemy, but also enacted in his technical treatment of harmonics: the practice with the harmonic canon indeed can be said to involve both senses, because sight is needed for precisely situating the bridge in the correct positions, while hearing verifies the pitch.

However, Ptolemy makes clear that the senses on their own, this is, isolated from the other senses and from other cognitive faculties like the intellect, are incorruptible.[119] In this aspect he again follows Aristotle in *On the Soul*, where the 'special objects of the senses' are defined as 'that which cannot be perceived by any other sense than that one and in respect of which no error is possible'.[120]

Right thereafter, Ptolemy, the same as Aristotle, goes on with the enumeration of the senses and their proper objects: sight and colours, hearing and sounds, taste and flavours, smell and odours, touch and feelings.[121] Such a coincidence could be indicative of Ptolemy's direct dealing with Aristotle's text here.

3.7.1 A systematization of Aristotle's *On the Soul*

Let us now proceed to explain what I take as a systematization of Aristotle's theory of knowledge as described in *On the Soul*. Indeed, Ptolemy goes on into the detailed features of intellect and perception in his attempt to explain the parts of the process involved in possible errors, and in this description he seems to combine in parallel observations about

[119]Ptol. *Crit.* 10: μάλιστα μέντοι προσακτέον τοῖς ἁπλοῖς καὶ ἀμιγέσι κρίμασιν, ὅταν ἀπαθεῖς ὦσι καὶ ἐναργεῖς αἱ τῶν φαντασιῶν διαδόσεις, ὡς ἀψευδεστάτοις κατά γε τὴν ἀνθρωπίνην δύναμιν. Cf. similarly shortly below at *Crit.* 11: Καθ' αὑτὴν μὲν οὖν ἑκάστη τῶν δυνάμεων ὅταν τὸ ἴδιον καὶ οἰκεῖον μόνον ἐπισκοπῇ κατὰ τὸ τῶν συμπεπλεγμένων ἀπερίσπαστον ἀληθεύειν πέφυκεν.

[120]Arist. *de An.* 418a11–16: λέγω δ' ἴδιον μὲν ὃ μὴ ἐνδέχεται ἑτέρᾳ αἰσθήσει αἰσθάνεσθαι, καὶ περὶ ὃ μὴ ἐνδέχεται ἀπατηθῆναι.

[121]Ptol. *Crit.* 11: ὡς ὅταν ὄψις μὲν χρώματα· φωνὰς δ' ἀκοή· γεῦσις δὲ χυμούς· ἀτμοὺς δ' ὄσφρησις· ἁφὴ δὲ †ποιότητας. Cf. Arist. *de An.* 418a12-14: οἷον ὄψις χρώματος καὶ ἀκοὴ ψόφου καὶ γεῦσις χυμοῦ, ἡ δ' ἁφὴ πλείους [μὲν] ἔχει διαφοράς.

sense perception and intellect that Aristotle treats in separate passages of *On the Soul*.

So Ptolemy begins with the general distinction that sense perception is multiple, while 'intellect is indivisible in essence, though making use of two primary faculties, the theoretical and the practical'.[122] Aristotle, discussing intellect separate from perception, says, similarly as Ptolemy, that it is separated and unmixed, 'since it is activity in essence'.[123]

Then Ptolemy introduces the topic of the infallibility of the senses on their own, as we have outlined above. But Ptolemy includes this treatment in a broader frame, which comprises both sense perception and intellect, this is, the cognitive faculties. He actually mentions the cases when the intellect is infallible like he has done before with the senses: 'and again when the theoretical intellect is concerned with the same or different, the equal or unequal, the like or unlike, and quite generally with the differences and similarities between species'.[124] Here, it is possible that Ptolemy was reshaping Aristotle's concept of 'indivisibles', 'where falsehood is impossible, where the alternative of true or false applies',[125] which is found in the same discussion of intellect as above.

If this connection was true, Ptolemy could even be said to have completed the picture by adding what would correspond to the infallible distinctions of the practical intellect, an aspect not found in Aristotle's text: 'and when the practical intellect is concerned with the appropriate or inappropriate and with the whole class of emotions'.[126]

In what follows Ptolemy discusses two cases when the apprehensions are not infallible. These two cases are:

1. When there is more than one apprehension of the same object.[127]

[122]Ptol. *Crit.* 10: καὶ ἡ μὲν αἴσθησις πολυμερὴς [...]· ὁ δὲ νοῦς τὴν μὲν οὐσίαν ἀμέριστος δυνάμεσι δὲ δυσὶ ταῖς πρώταις κεχρημένος τῇ τε θεωρητικῇ καὶ τῇ πρακτικῇ.

[123]Arist. *de An.* 430a17: καὶ οὗτος ὁ νοῦς χωριστὸς καὶ ἀπαθὴς καὶ ἀμιγής, τῇ οὐσίᾳ ὢν ἐνέργεια.

[124]Ptol. *Crit.* 11: καὶ πάλιν ὁ μὲν θεωρητικὸς νοῦς τό τε ταὐτὸν ἢ ἕτερον, καὶ τὸ ἴσον ἢ ἄνισον, καὶ τὸ ὅμοιον ἢ ἀνόμοιον· καὶ ὅλως τὰς τῶν εἰδῶν διαφοράς τε καὶ ἀδιαφορίας.

[125]Arist. *de An.* 430a26-8: ἡ μὲν οὖν τῶν ἀδιαιρέτων νόησις ἐν τούτοις περὶ ἃ οὐκ ἔστι τὸ ψεῦδος, ἐν οἷς δὲ καὶ τὸ ψεῦδος καὶ τὸ ἀληθές σύνθεσίς τις ἤδη νοημάτων ὥσπερ ἓν ὄντων...

[126]Ptol. *Crit.* 11: ὁ δὲ πρακτικὸς τὸ οἰκεῖον ἢ ἀνοίκειον καὶ κοινῶς τὰ πάθη.

[127]Ptol. *Crit.* 11: ἤτοι τῶν αὐτῶν πλείους ὦσιν ἀντιλήψεις...

2. When there are different objects.[128]

The same as he has done above, Ptolemy includes in these distinctions both the apprehensions of sense perception and of intellect (divided as above in theoretical and practical).

On his part, Aristotle, similarly as Ptolemy but only explicitly in regard to sense perception, lists three degrees of complexity in the apprehensions of the senses:

(a) When the senses deal with their proper objects (in this case the apprehension is infallible).[129]

(b) 'The perception that what is incidental to the objects of perception is incidental to them',[130] which would correspond to Ptolemy's (2).

(c) 'The perception of the common attributes which accompany the incidental objects',[131] which would be Ptolemy's (1).

This is, in my view, the rationale of the correspondence: Ptolemy has already explained that the senses on their own are infallible, so he needs not repeat Aristotle's (a). Aristotle's (b) seems to signify the problem of determining the objects from what have arisen the impressions we get, which seems to match with the problem identified by Ptolemy that there may be different objects (2). Finally, Aristotle's (c) seems to imply that there are various attributes common to one object, which would correspond to Ptolemy's problem featuring various apprehensions of the same object (1).

The examples proposed by both Ptolemy and Aristotle could contribute both to clarify the meaning of these categories (Aristotle seems more cryptic that Ptolemy here) and to add plausibility to my hypothesis that Ptolemy was systematizing Aristotle in this point. For Ptolemy's case (1) –various attributes of one object–, concerning sense perception Ptolemy

[128]Ptol. *Crit.* 11: ἢ μὴ τῶν αὐτῶν, ἀλλὰ πολυειδῶν…
[129]Arist. *de An.* 428b18-19: ἡ αἴσθησις τῶν μὲν ἰδίων ἀληθής ἐστιν ἢ ὅτι ὀλίγιστον ἔχουσα τὸ ψεῦδος.
[130]Arist. *de An.* 428b19-20: δεύτερον δὲ τοῦ συμβεβηκέναι ταῦτα <ἃ συμβέβηκε τοῖς αἰσθητοῖς>.
[131]Arist. *de An.* 428b19-20: τρίτον δὲ τῶν κοινῶν καὶ ἑπομένων τοῖς συμβεβηκόσιν…

gives the examples of the perceptibles 'bulk, magnitude, number, shape, position, arrangement, and movement'.[132] Aristotle gives two examples for his case (c), movement and magnitude (κίνησις καὶ μέγεθος), which seem to assure that our correspondence is sound, and which in addition are included among Ptolemy's examples.

For the case (2), this is, when different objects are concerned, Ptolemy can be shown again partly taking for his example in sense perception Aristotle's example. The example in Ptolemy is 'the judgement that this thing is a man or a horse'.[133] In the case of Aristotle, while his example in his treatment of sense perception does not match Ptolemy's (Aristotle says 'whether what is white is this or that'[134]) he amplifies this visualization in the treatment of intellect into a form which reminds of Ptolemy's: 'whether what is white is a man'.[135]

Perhaps it is no coincidence that Aristotle in this latter example briefly alludes to the link between intellect and sense perception in the treatment of errors, saying that 'seeing whether the white object is a man or not may be mistaken, so too in the case of objects which are without matter'.[136] What Aristotle seems to be saying is that there may be problems in the apprehension of objects when there are many of them (and the object in question must be determined), both on the level of sense perception ('what is white') and at the level of the intellect (with objects without matter). Since Aristotle here quite precisely puts side by side the fallibility of the intellectual faculty and that of the sensorial, we could speculate that here is where Ptolemy perhaps found the inspiration to build his comprehensive Aristotelian picture of the errors in sense perception and intellect.

3.7.2 An introduction to (Platonic) dialectic

Towards the end of this part (in *Crit.* 12) Ptolemy briefly goes on to review the increasing epistemological degrees from imagination to opinion and knowledge. Such an explanation

[132]Ptol. *Crit.* 11: ὡς ἐν μὲν τοῖς αἰσθητοῖς ὄγκου, μεγέθους, πλήθους, σχήματος, θέσεως, τάξεως, κινήσεως…
[133]Ptol. *Crit.* 11: οἷον ἐν μὲν τοῖς αἰσθητοῖς, ὅτι τόδε ἄνθρωπος ἵππος…
[134]Arist. *de An.* 428b22-3: ὅτι μὲν γὰρ λευκόν, οὐ ψεύδεται, εἰ δὲ τοῦτο τὸ λευκὸν ἢ ἄλλο τι, ψεύδεται.
[135]Arist. *de An.* 430b29: εἰ δ' ἄνθρωπος τὸ λευκὸν ἢ μή.
[136]Aris. *de An.* 430b29-30: εἰ δ' ἄνθρωπος τὸ λευκὸν ἢ μή, οὐκ ἀληθὲς ἀεί, οὕτως ἔχει ὅσα ἄνευ ὕλης.

would probably be expected in an account of the criterion of knowledge, since it is the natural aim of any theory of knowledge. For example, in Sextus' review of the Peripatetic criterion we encounter first memory (μνήμη) and imagination (φαντασία), then opinion (δόξα), skill (τέχνη) and knowledge (ἐπιστήμη) (Sext. *M* 7.221-5). In Alcinous' chapter on the criterion we find memory, opinion, and knowledge (*Didasc.* 4.3-4). We may also compare with the analogy of the divided line in 'Archytas' (39 Thesleff), where the four increasing levels of knowledge are grouped in two groups named opinion (δόξα) and knowledge (ἐπιστήμη) (cf. Pl. *Rep.* 509d-511e).

Of these three accounts, Ptolemy's in this section can be said to resemble most of all the pseudo-Archytas', because he begins, like him, with illusions, corresponding to the lowest division of opinion in Plato's line (he and 'Archytas' name it εἰκασία). On the contrary, both Sextus and Alcinous skip the treatment of fallacious images or falsehoods arising in the process of knowledge.

As a justification of this procedure, we could say that Ptolemy has just discussed the possible errors in comprehension arisen from perceptions or intellectual apprehensions, occurring basically when there is a plurality of them or of the objects themselves. So here he would connect his discourse with the previous part of his essay starting from the false apprehensions.

So Ptolemy starts with the remark that both intellect and sense perception are 'immediately cognitive independently of any reason (λόγος)'.[137] The introduction of reason will be said below to enable opinion and knowledge, but first he treats the case when no reason is involved. So, he adds, intellect and sense perception are said to apprehend 'even the forms themselves, as separate entities and divorced from the existence of particular things'.[138]

This cognitive process seems to be what Aristotle calls imagination (φαντασία), which

[137]Ptol. *Crit.* 12: τὰ μὲν οὖν ἀπολελυμένα καὶ πρῶτα κριτήρια χωρὶς λόγου τινὸς αὐτόθεν ἐστὶ καταληπτικά.
[138]Ptol. *Crit.* 12: ἤδη τῶν εἰδῶν αὐτῶν ὡς κεχωρισμένων τινῶν καὶ ἀπηλλαγμένων τῆς τῶν καθ' ἕκαστον ὑποστάσεως.

he discusses between the sections on sense perception and intellect.[139] Aristotle, like Ptolemy, also notes the possibility that this process leads to falsehoods, like for example to think that 'the sun to be a foot in diameter'.[140] Aristotle identifies imagination with thinking what one perceives 'non incidentally',[141] so linking it with intellect and sense perception, similarly as Ptolemy's account. But Ptolemy doesn't seem to follow him so closely as above.

We rather find a close verbal parallel with Plato's *Timaeus* when Ptolemy refers to illusions (i.e. false imaginations in Aristotle's terms) of 'visions and phantoms by day or by night (εἴδωλα καὶ φαντάσματα διατείνονται μεθ' ἡμέραν τε καὶ νύκτωρ)' (Ptol. *Crit.* 12). For his part, Timaeus in Plato's dialogue says that perception would be led away by 'phantoms and visions night and day (εἰδώλων καὶ φαντασμάτων νυκτός τε καὶ μεθ' ἡμέραν)' had the demiurge not placed the desiderative part of the soul in the liver.[142] As we will see, Timaeus' famous division of the soul which is alluded in this passage will play an important role in the last part of Ptolemy's treatise, so it is not implausible that Ptolemy has this passage in mind.

We may find another echo of the *Timaeus* in Ptolemy's gradation of opinion and knowledge, although here the parallel is not so verbally close as the other. However, the narrative is quite specific in both places in that reason is presented as an active principle, actually the syntactic subject of the sentence in both cases, and his different involvement in the processes creates the different epistemological categories, opinion and knowledge. Ptolemy says that even when reason is present, it 'can still only form opinions if it concentrates exclusively on its immediate object',[143] whereas Timaeus, also making 'reason' the subject and actor of the process, says that 'when reason [...] is hovering around the sensible world

[139]Aris. *de An.* 427b28-429a9.

[140]Aris. *de An.* 428b.4: οἷον φαίνεται μὲν ὁ ἥλιος ποδιαῖος.

[141]Aris. *de An.* 428b.1-2: τὸ οὖν φαίνεσθαι ἔσται τὸ δοξάζειν ὅπερ αἰσθάνεται, μὴ κατὰ συμβεβηκός.

[142]Pl. *Tim.* 71a3–8.

[143]Ptol. *Crit.* 12: ὁ τῆς διανοίας ἐνδιάθετος λόγος κατὰ μὲν τὴν ἀπολελυμένην ἐπιβολὴν καὶ αὐτὸς ἔτι δοξάζει μόνον.

[…], then arise opinions and beliefs sure and certain'.[144] Timaeus goes on saying that 'when reason is concerned with the rational, and the circle of the same moving smoothly declares it, then intelligence and knowledge are necessarily perfected'.[145] Ptolemy is outlining an analogous knowledge gradation, concluding that:[146]

> κατὰ δὲ τὴν ἐναργῆ καὶ τεχνικὴν διάκρισιν ἤδη τὴν ἐπιστημονικὴν ἕξιν ἀπολαμβάνει χωρίζων τε καὶ συνάγων τάς τε διαφορὰς καὶ τὰς ἀδιαφορίας τῶν ὄντων καὶ ἀνάγων ἀπὸ τῶν κατὰ μέρος ἐπὶ τὰ καθόλου καὶ ἀνωτάτω τά τε γένη καὶ τὰ εἴδη τῶν ὑποκειμένων.
>
> When reason makes clear scientific distinctions, it at once enters the state of knowledge, separating and combining the differences and non-differences between actual things, and moving up from particulars to universals and on to the genera and species of the objects before it.

Ptolemy thus seems to identify knowledge with two processes: (1) establishing differences and similarities between things (which he has practiced for example in the explanation of intellect and sense perception) and (2) a two-directional path up from particulars to universals and back down again to particulars (traversing the intermediate category 'genera'). This second process is indeed reminding of the words of another passage of the *Timaeus*. I am talking about a passage which we have already mentioned above where the soul is said to 'declare the sameness or difference of that thing and some other; and to what individuals are related, and by what affected, and in what way and how and when'.[147] The passage appears very near to the one discussed just above about the reason's forming of opinion and knowledge, so Ptolemy could have been inspired by it again here.

The closing of the section consists in a sort of exemplification of this path up and down which Ptolemy identifies as one of the basic processes of knowledge. Ptolemy uses here the names 'Plato' and 'Dion' in order to refer to particular species of men, following an

[144]Pl. *Tim.* 37b6-8: ὅταν μὲν περὶ τὸ αἰσθητὸν γίγνηται […] δόξαι καὶ πίστεις γίγνονται βέβαιοι καὶ ἀληθεῖς.
[145]Pl. *Tim.* 37b9-11: ὅταν δὲ αὖ περὶ τὸ λογιστικὸν ᾖ καὶ ὁ τοῦ ταὐτοῦ κύκλος εὔτροχος ὢν αὐτὰ μηνύσῃ, νοῦς ἐπιστήμη τε ἐξ ἀνάγκης ἀποτελεῖται.
[146]Ptol. *Crit.* 12.
[147]Pl. *Tim.* 37a-b. For the Greek text cf. my section 5 above.

established practice in philosophical writing.[148] This is Ptolemy's passage:[149]

> ὡς ὅταν ἀπὸ μὲν τῆς Πλάτωνος καὶ Δίωνος περιπτώσεως καὶ τῆς καθ' ἕκαστον τοῦ εἴδους ὁμοιότητος κοινόν τι γένος διανοηθῇ τὸν ἄνθρωπον, ἀπὸ δὲ τῆς ἀνθρώπου καὶ ἵππου, τὸ ζῷον, ἀπὸ δὲ τῆς ζῴου καὶ φυτοῦ, τὸ ὂν αὐτό, καὶ οὕτως ἐπὶ τὰ κάτω πάλιν παραχωρήσῃ διακρίνων καὶ μερίζων ἀεὶ τὸ διῃρημένον κατ' εἶδος ὡς ἀδιαίρετον κατὰ γένος, ἕως ἂν ἐπὶ τὰ παντάπασιν ἀδιαίρετα καὶ μηδὲν ἔχοντα κοινὸν γένος.
>
> Starting from the particular case of 'Plato' and 'Dion' and their particular similarity of form, reason may think of a common class 'man'; starting from the particular case of man and horse, it may think of animal; and from that of animal and plant, it may think of being itself. Correspondingly, it may come down again by distinguishing and particularising at each stage what is divided in relation to its species though indivisible in relation to its genus, until it reaches things that are absolutely indivisible and have no element of generality.

As seems to be normal practice in this text, Ptolemy again does not explain, but just works with brief allusions to difficult philosophical problems. The path up is signified by the recognition of the common genus of two individuals, and Ptolemy gives three examples which result in an increasingly big genus: 'man', 'animal' and 'being'. This is interestingly a topic of the beginning of Aristotle's *Categories*, where the individuals 'man' and 'horse' are also used, like Ptolemy in the second of his examples.[150] An example with individual men that result in the genus 'man' is also mentioned by Aristotle, who does not use names, but Simplicius in his exegesis does, and namely the same as Ptolemy, 'Plato' and 'Dion'.[151] This may be significant, since, as we have seen, Ptolemy could have been influenced in the beginning of his treatise by the Aristotelian interpreter Aristo, who could already have used these names.

[148]Cf. Sextus' use of 'Plato' and 'Dion' in *PH* 2.195, 'Dion' in his account of the Peripatetics and elsewhere: *M* 7.220-1, *PH* 1.189, 2.147, 2.221, 3.4, 'Theon' and 'Dion' in *PH* 2.227, etc. Philo of Alexandria also used 'Theon' and 'Dion', explaining a logical problem by Chrysippus in *Aet.* 48-9. Plutarch also used 'Theon' and 'Dion' in *Comm. not. adv. Stoic.* 1061C, and in *Aet. Rom. Gr.* 271E he explains that this is common philosophical use, comparing with the juridical writers who use 'Gaius Seius' and 'Lucius Titius'.

[149]Ptol. *Crit.* 12.

[150]108 Arist. *Cat.* 2b23–7.

[151]Simpl. *Comm. Cat.* 99.

The path down to individuals is treated as a successive division of genera, until at the end indivisibles are reached (we may recall Plato's method of definition by division at e.g. *Phaedr.* 265e1-2).

A brief look at what comes at the end of the chapter on the criterion in Alcinous' manual may be useful for contextualizing what we have called Ptolemy's path up and down. It is actually the beginning of the next chapter, on logic ('dialectic' as Alcinous calls it) which clearly mentions this double path, making it the basic procedure of logic:[152]

> ἐπισκοπεῖ δὲ αὐτὸ μὲν ὅ ἐστιν ἕκαστον ἢ ἄνωθεν διαιρετικῶς καὶ ὁριστικῶς ἢ κάτωθεν ἀναλυτικῶς, τὰ δὲ συμβεβηκότα καὶ ὑπάρχοντα ταῖς οὐσίαις ἢ ἐκ τῶν περιεχομένων δι' ἐπαγωγῆς ἢ ἐκ τῶν περιεχόντων διὰ συλλογισμοῦ.
>
> It [dialectic] enquires into the nature of each thing either 'from above', by means of division and definition, or 'from below', by means of analysis. Accidental qualities which belong to essences it examines either from the standpoint of individuals, by induction, or from the standpoint of universals, by syllogistic.

Alcinous has previously explained that the purpose of dialectic is 'the determination of the essence of every thing whatsoever, and then of its accidents.'[153] So for him division/definition (path down) and analysis (path up) would enquire the essences, while induction (path up) and syllogistic (path down) would enquire the accidents. On his part, Ptolemy does not make the distinction between essence and accidents, but he seems to be speaking of a most general identification of concepts, so that he probably is thinking in terms of analysis (path up) and division/definition (path down) rather than in induction and syllogistic.

Finally, perhaps alluding again at Timaeus' world-soul, which is said to curve 'full-circle' onto itself in his path to knowledge precisely in the epistemological passage,[154]

[152] Alc. 5.1 (tr. Dillon).

[153] Alc. 5.1: τῆς διαλεκτικῆς δὲ στοιχειωδέστατον ἡγεῖται πρῶτον μὲν τὸ τὴν οὐσίαν ἐπιβλέπειν παντὸς ὁτουοῦν, ἔπειτα περὶ τῶν συμβεβηκότων.

[154] Pl. *Tim.* 37a5: αὐτή τε ἀνακυκλουμένη πρὸς αὑτήν.

Ptolemy concludes that reason, through this up-and-down process, 'will have traced a path that comes, as it were, *full circle* and is secure and incontrovertible'.[155]

3.8 The last part: On the place of the *hegemonika* (*Crit.* 13-16)

Now I will proceed to my analysis of the last part of Ptolemy's essay as I have divided it above. The first thing to note is that this division was probably important for Ptolemy or for his editors, since it features in the title, which is, let's not forget it, *On the Criterion and the Ruling Principle.* The way in which Ptolemy introduces this section, as a fitting addition, is also indicative of an important break:[156]

> Ἐπεὶ δ' οὐκ ἄκαιρον προσθεῖναί τινα τούτοις καὶ περὶ τῆς τῶν ἡγεμονικῶν τάξεως, προαγάγοιμεν ἂν ἑαυτοὺς καὶ τῷ τοιούτῳ μέρει τῆς ἐπισκέψεως, εἰ διέλοιμεν ἐν μέρει λαβόντες τὰς οἰκειότητας τῶν τε τῆς ψυχῆς διαφορῶν καὶ τῶν περιεχόντων τὰς δυνάμεις αὐτῆς σωμάτων.
>
> It would not be out of place to add something here about the place of the *hegemonika.* It would also assist us in the part of our enquiry concerned with this kind of question if we examined and distinguished the properties of the different parts of the soul one by one as also of the bodies which contain its powers.

In my section 2 above I have already introduced the originally Stoic topic of the ruling (or commanding) principle (or faculty), bringing to discussion the state of the question in Ptolemy's age. Just to recapitulate what was said there: the ruling principle seems to have been generalised from Stoic epistemological topic to general philosophical inquiry in Ptolemy's age, when it can be encountered in the clearly non-Stoic accounts of Alcinous and Galen. For both these authors, the question of the ruling principle was mostly an issue connected with the division of the principles (or parts, or powers) of the soul. So the issue could be put in this way: in what part of the body is located the ruling part of the soul? We can see already in Ptolemy's introductory phrase how for him the main issue

[155]Ptol. *Crit.* 12: περίοδόν τινα καὶ ἀνακύκλησιν ἀμετακίνητον καὶ ἀμετάπιστον ποιούμενος.
[156]Ptol. *Crit.* 13.

was the same as for Alcinous and Galen, since he wonders about the place, and proposes to proceed inspecting the different parts of the sould and of the body. However, as we have noted before, Ptolemy is original with respect to these two authors in that he situates his discussion of the ruling part of the soul in a general epistemological context, which is more rooted in the original Stoic history of the concept.

As it turns out, the three authors with extant writings on the ruling principle, Alcinous, Galen, and Ptolemy, agree in its location and indeed in the whole partition of the soul and the body. The three authors defend a tripartite structure in which the brain contains the rational or ruling faculty, the heart contains the spirited, and the liver contains the desiderative, clearly derived from the *Timaeus*.[157]

However, we have evidence of the widespread tradition of this Timaean division in other Platonic writers of the imperial era, such as Philo of Alexandria,[158] Plutarch,[159] and the pseudo-Pythagorean writers.[160]

Let us first quote the relevant passage of the original account in Plato's *Timaeus*. Right before this passage, Timaeus has explained that the descendants of the demiurge separated the mortal part of the soul from the divine, which was placed in the head, by the neck, and to have situated it in the thorax, which they divided in two parts, separated by the midriff.[161]

> τὸ μετέχον οὖν τῆς ψυχῆς ἀνδρείας καὶ θυμοῦ, φιλόνικον ὄν, κατῴκισαν ἐγγυτέρω τῆς κεφαλῆς μεταξὺ τῶν φρενῶν τε καὶ αὐχένος, ἵνα τοῦ λόγου κατήκοον ὂν κοινῇ μετ' ἐκείνου βίᾳ τὸ τῶν ἐπιθυμιῶν κατέχοι γένος, ὁπότ' ἐκ τῆς ἀκροπόλεως τῷ τ' ἐπιτάγματι καὶ λόγῳ μηδαμῇ πείθεσθαι ἑκὸν ἐθέλοι. [...] Τὸ δὲ δὴ σίτων τε καὶ ποτῶν ἐπιθυμητικὸν τῆς ψυχῆς καὶ ὅσων ἔνδειαν διὰ τὴν τοῦ σώματος ἴσχει φύσιν, τοῦτο εἰς τὸ μεταξὺ τῶν τε φρενῶν καὶ τοῦ

[157]Manuli 1981, 72-3, with bibliography for Galen. Cf. Alc. *Didasc.* 23, Gal. *Plac.* 2.3.24. There are various other places in Galen where the Timaean division is mentioned, such as *De usu part.* III.501, *Anatom. admin.* II.503, *De foet. form.* IV.665, *Quod animi mor.* IV.771.

[158]Phil. Alex. *Leg.* 1.70. The names in this passage are λογικόν, θυμικόν, and ἐπιθυμητικόν, and the latter two are said to constitute the βία τῆς ὁρμῆς. The λογικόν is placed in the head (κεφαλή), the θυμικόν in the breast (στέρνα), and the ἐπιθυμητικόν in the abdomen (ἦτρον).

[159]Plut. *De E ap. Delph.* 390F, *De def. orac.* 429E, *De virt. mor.* 442B, *Plat. quaest.* 1007E, etc.

[160]Tim. Locr. 218, Metopus 118, Theages 190 (all in Thesleff's edition).

[161]Pl. *Tim.* 70a-e.

> πρὸς τὸν ὀμφαλὸν ὄρου κατῴκισαν, οἷον φάτνην ἐν ἅπαντι τούτῳ τῷ τόπῳ τῇ τοῦ σώματος τροφῇ τεκτηνάμενοι.
>
> That part of the inferior soul which is endowed with courage and passion and loves contention they settled nearer the head, midway between the midriff and the neck, in order that it might be under the rule of reason and might join with it in controlling and restraining the desires when they are no longer willing of their own accord to obey the word of command issuing from the citadel. [...] The part of the soul which desires meats and drinks and the other things of which it has need by reason of the bodily nature, they placed between the midriff and the boundary of the navel, contriving in all this region a sort of manger for the food of the body.

A first interesting question is: were there other views on this issue? The answer is obviously yes, and Galen gives us the clues, thanks to his highly polemical edge in his books on the parts of the soul of *On the Doctrines of Hippocrates and Plato*. Galen's central target is Chrysippus' work *On the Soul*, which is not extant.[162] However, from the numerous quotations in Galen's treatise we know that Chrysippus defended that both judgements and the affections emerged from the same power of the soul, and that this power was located in the heart.[163]

Aristotle also appears in Galen's treatment. Although Aristotle did not use the term ἡγεμονικόν (the ruling principle), Galen could attribute to him the view that it was located in the heart (the same as the Stoics), since Aristotle had repeatedly pointed out that this was the source of both movement and sense perception for all animals.[164] However, Aristotle holds a better place in Galen's eyes than Chrysippus, along with Posidonius, because these two thinkers, at least in Galen's view, distinguished various powers in the soul.[165] However,

[162]De Lacy 1981, 49.

[163]Gal. *Plac.* 5.4.2-3, 2.3.3-4, 4.1-4, among many other passages.

[164]Gal. *Plac.* 1.8.2-6, 2.8.27, 3.7.8, etc. Cf. Arist. *PA* 656a, 666a; *SV* 456a, *SI* 469a.

[165]Galen actually says that both Aristotle and Posidonius posited three powers for the soul, desiderative, spirited and rational: Gal. *Plac.* 5.4.2-3. However, it seems clear that Galen is bringing them to his own position. This is clear in the case of Aristotle, who did not take this classification, which is the Timaean one, but one comprising at least the functions of self-nutrition, sensation, thinking, and movement: Aris. *de An.* 413b13.

as Galen recognizes, Aristotle did not spatially divide the powers of the soul, unlike Plato, and Hippocrates whose division he defends throughout his work.[166]

Manuli usefully describes the different degree in which our three extant accounts of the ruling principle accurately describe the human body:[167] Galen defends his position by using his vast medical knowledge, so it is not suprising that his account shows a great acquaintance with the anatomical theories of the Hellenistic physicians Herophilus and Erasistratus. By contrast, Alcinous' account simply consists in a rough adaptation of the description in the *Timaeus*. Ptolemy would hold a middle-point between the two. Manuli points to the survival into Ptolemy's time of old and surpassed medical theories ignoring the mentioned Hellenistic theories.

Indeed, the fact that Ptolemy's anatomical theory is outdated should not suprise the reader now, since it is coherent with what we have seen of the contents of this essay by Ptolemy. Ptolemy in his *Criterion* provides 'familiar answers to familiar questions', as Long puts it.[168] His sources seem also to be quite old, if Aristo could be confirmed as such, and there is no attempt at making a great contribution to the issues discussed. We could say that Ptolemy is rather offering a display than a progress in the knowledge.

But let us now get back to Ptolemy's text in order to see how Ptolemy proceeds in this last part. Right after the introductory words quoted above, Ptolemy announces a new digression:[169]

> πρότερον δὲ πρὸς τὸ καθόλου κατὰ τὴν τοιαύτην μίξιν συμπίπτον ἀπίδωμεν λαβόντες ἀρχὴν ἁρμόζουσαν τῷ προκειμένῳ.
>
> But before we do that, let us start at a point which will suit our purpose well by turning the attention to what universally accompanies a composite entity of this kind.

[166]Gal. *Plac.* 5.4.2-3. Cf. Aris. *de An.* 432a15-b4.
[167]Manuli 1981, 72-3.
[168]Long 1988, 177.
[169]Ptol. *Crit.* 13.

Before going into the location of the ruling principle, Ptolemy wants to begin this new enquiry (λαβόντες ἀρχὴν) with the investigation of the universal simple parts that form bodies. As we discover in the next lines, Ptolemy is talking about the four classic elements earth, water, fire, and air, along with the fifth element, aether.

I will try to show now that Ptolemy was possibly paralleling the *Timaeus*, too, in making this digression about the elements. Indeed, it turns out that in the *Timaeus*, after a first section dedicated to what is called 'the works of intelligence' (τὰ διὰ νοῦ δεδημιουργημένα), where the generation of the world-soul has been explained, a 'new beginning' (ἑτέρα ἀρχή) is announced to make an account of the things which come into being through necessity (τὰ δι' ἀνάγκης γιγνόμενα), or of how 'the work was accomplished' (ᾗ γέγονεν).[170] In this introduction to his new account, Timaeus suddenly adds that it will be necessary to 'consider the nature of fire, and water, and air, and earth, such as they were prior to the creation of the heaven, and what was happening to them',[171] and this is actually the topic by which he begins his new account, explaining the creation of these elements from the primary triangles in the receptacle.[172]

Supporting the case that this parallel is not accidental, we could argue that not only the digressions in both Ptolemy and the *Timaeus* are on the same topic and introduced by a similar wording breaking the course of the narration, but they also serve similar ends. As regards the *Timaeus*, the passages on the elements lead to the description of the affections of the body and the soul thereafter,[173] which in turn lead to the famous Timaean division of the soul and the body.[174] Ptolemy will use the theory of the elements more directly in his account, as we will see next.

[170]Pl. *Tim.* 47e-48e.

[171]Pl. *Tim.* 48b: τὴν δὴ πρὸ τῆς οὐρανοῦ γενέσεως πυρὸς ὕδατός τε καὶ ἀέρος καὶ γῆς φύσιν θεατέον αὐτὴν καὶ τὰ πρὸ τούτου πάθη.

[172]Pl. *Tim.* 53c-55b.

[173]Pl. *Tim.* 61c-69a.

[174]Pl. *Tim.* 70a-e.

Let us now inspect the details of Ptolemy's dealing with the elements. Ptolemy begins by classifying the elements between active and passive: earth and water being described as 'more material and altogether passive', while 'fire and air are more capable of causing movement and are both passive and active; aether is always in the same condition and is active only'.[175] Then he does the same with body and soul, saying that body is 'more material and less active', while soul is 'what moves both itself and the body'.[176] With this analogy in mind, Ptolemy argues that 'the body should be classified with the elements of earth and water and the soul with the elements of fire, air and aether'.[177] As we will see, such analogy is representative of the general kind of thought that dominates Ptolemy's narrative in this last part of the treatise.

In Ptolemy's list of elements, it is worth noting that the fifth element, aether, which appears only hinted at, but not named, in Timaeus' description of the birth of the elements – 'There was yet a fifth combination which the god used in the delineation of the universe'[178] – is placed side by side along the classical four in Ptolemy's description, and given the property of being immutable as famously described by Aristotle.[179] Ptolemy treats it as the only element which is 'only active' perhaps in connection with the correspondence he establishes later between the faculty of thought and being 'active only'.[180]

I will argue now how this classification of the elements may have been influenced by the tradition of Antiochus, providing further support for my hypothesis that Ptolemy was drawing from Antiochus' pupil Aristo in this essay. Both the connection between thought and aether, and Ptolemy's systematization of the elements according to activity or passivity,

[175]Ptol. *Crit.* 13: γῆν μὲν καὶ ὕδωρ ὑλικώτερα καὶ ὡς ἐπίπαν παθητά· πῦρ δὲ καὶ ἀέρα κινητικώτερα καὶ παθητά τε καὶ ποιητικά· τὸν δὲ αἰθέρα καὶ ἀεὶ ὡσαύτως ἔχοντα καὶ μόνον ποιητικόν.

[176]Ptol. *Crit.* 13: σῶμα μὲν ἰδίως καλοῦμεν τὸ ὑλικώτερον καὶ ἀνενέργητον, ψυχὴν δὲ τὸ κινητικὸν κἀκείνου καὶ ἑαυτοῦ.

[177]Ptol. *Crit.* 13: τὸ μὲν σῶμα εὔλογον τετάχθαι κατὰ τὰ γῆς καὶ ὕδατος στοιχεῖα, τὴν δὲ ψυχὴν κατὰ τὰ πυρὸς καὶ ἀέρος καὶ αἰθέρος.

[178]Pl. *Tim.* 55c: ἔτι δὲ οὔσης συστάσεως μιᾶς πέμπτης, ἐπὶ τὸ πᾶν ὁ θεὸς αὐτῇ κατεχρήσατο ἐκεῖνο διαζωγραφῶν.

[179]Arist. *de Cael.* 270a13-b25.

[180]Ptol. *Crit.* 14: τὸ δὲ διανοητικὸν ἀπὸ τῆς μόνον ποιητικῆς.

were indeed topics already present in the Roman philosophical tradition, since they are put in the mouth of Varro in Cicero's *Academica*:[181]

> *aer et ignis movendi vim habent et efficiendi, reliquae partes accipiendi et quasi patiendi, aquam dico et terram. quintum genus, e quo essent astra mentesque, singulare eorumque quattuor quae supra dixi dissimile Aristoteles quoddam esse rebatur.*
>
> Air and fire have the function of imparting motion or being active, while the remaining parts —water and earth, I mean— of receiving or, as it were, 'undergoing'. Aristotle imagined that there was a unique fifth kind from which stars and minds are made, i.e., something different from the four elements I mentioned above.

It seems that the doctrine on the activity and the passivity of the elements was Stoic.[182] Long argues that Ptolemy modified this Stoic tradition by adding the Aristotelian aether,[183] but having in mind this passage of Cicero's *Academica* another option seems more plausible. Given that Varro, the speaker of this sentence, is made a defender of the views of Antiochus in Cicero's dialogue,[184] it is probable that the doctrine of the elements, along with what he says about the fifth element of Aristotle, were the tenets of the Academy of Antiochus. So it seems more probable that Ptolemy took this from Antiochus' pupil Aristo than that he modified it himself independently. Furthermore, the fact that Ptolemy connects aether with mind, a step not found in Aristotle,[185] but mentioned by Varro here, adds plausibility to this hypothesis.

It is interesting that this identification between aether an thought may have a connection with Plato's *Timaeus*, as well. Given that aether was for Aristotle the substance of the heavenly bodies, the Timaean analogy between the universe and the human being –represented, for example, in the creation of the body of the world, with its human parts– would

[181]Cic. *Acad.* 1.26 (tr. Brittain).
[182]Plut. *Stoic. rep.* 1085C-D.
[183]Long 1988, 206.
[184]Cf. Cic. *Acad.* 1.5-7.
[185]Arist. *de Cael.* 270b.

provide the bridge that connects aether with mind, since the higher part of the body for Timaeus corresponds to the divine and higher part of the cosmos. It is worth noting that Ptolemy may be emphasising this identification between the cosmos and the human body when he says that thought is the most valuable 'both in the universe and in us', and it has the 'highest position, heaven in the universe, the head in man'.[186]

Now let us briefly sketch the way in which Ptolemy uses this theory of the elements in his Timaean division of the faculties or parts of the soul. We have seen that Ptolemy classified the elements according to their being active or passive. Later on, the faculties of the soul are classified according to the same principle, this is, as active or passive, or both. In this correspondence, in the same way as thought is said to be 'active only', the faculty of sense perception is related to 'the substance that is altogether passive', and the faculty of impulse to 'the substance that is both passive and active'.[187]

Then the classic elements are used by Ptolemy in the outline of the parts of the soul and their places in the body, where the appetitive part is said to have more air (ἀεροειδέστερον) in its composition, while the emotive has more fire (πυροειδέστερον).[188] The latter may have been directly inspired by the division as it appears in the *Timaeus*, where it is argued that the emotional part has its position near the refreshing lungs because fire causes too much heat.[189]

But still another system of correspondences is used in Ptolemy's division of the parts of the soul, that of moist/dry. The senses other than touch are said to be 'restricted to the parts that are more easily penetrable and more moist, the passages'. These parts, like hearing or vision, are situated near the faculty of thought, so that they are quite close to the 'divine' and 'most worthy'. Ptolemy had already anticipated this before by saying that 'the greatest

[186]Ptol. *Crit.* 15: τὸ διανοητικὸν καὶ δυνάμει καὶ οὐσίᾳ τιμιώτερον καὶ θειότερόν ἐστιν ἔν τε τῷ παντὶ καὶ ἐν ἡμῖν· καὶ ὅτι τόπος αὐτοῦ τὰ ἀνωτάτω, τοῦ κόσμου μὲν ὁ οὐρανός, ἀνθρώπου δὲ ἡ κορυφή.

[187]Ptol. *Crit.* 14: εἶναί τε καθόλου τὸ μὲν αἰσθητικὸν τῆς ψυχῆς περὶ τὴν ὡς ἐπίπαν παθητὴν οὐσίαν, τὸ δ' ὁρμητικὸν ἀπὸ τῆς παθητῆς τε καὶ ποιητικῆς.

[188]Ptol. *Crit.* 14.

[189]Pl. *Tim.* 70c: προγιγνώσκοντες ὅτι διὰ πυρὸς ἡ τοιαύτη πᾶσα ἔμελλεν οἴδησις γίγνεσθαι τῶν θυμουμένων.

admixture of soul with body is matched by the preponderance of heat and moisture in the body'.[190] It is possible that Ptolemy introduced this new classification precisely in order to save sight and hearing as rational senses –these were important senses in his conception of knowledge, as we have seen–, because the analogy with the classic elements did not work here: water, the predominant element of these senses, was said to be passive and thus far away from the 'only active' faculty of thought.

After outlining the division, Ptolemy concludes that the *hegemonikon* of the soul is located in 'the *hegemonikon* of the body', this is, the head,[191] a phrase that seems to reveal the overarching program of Ptolemy's correspondence-making, 'like attracts like'. Of course, this principle is also present in the *Timaeus* (e.g. *Tim.* 81a: τὸ συγγενὲς πᾶν φέρεται πρὸς ἑαυτό, 'everything moves toward that which is of its own kind'), but it does not seem just *the* principle there as it is in Ptolemy's exposition.

Let us add one last remark about Ptolemy's placing of the ruling principle in the brain. After this conclusion, Ptolemy adds a further justification, which may reveal again the tradition that he was following:[192]

> δηλοῖ δὲ καὶ τὸ τῶν σπερμάτων γένος ἐκεῖθεν ἔχον τὴν ἀρχὴν καὶ μόνον τῶν ἄλλων εἰδοποιεῖν τε δυνάμενον τοὺς οἰκείους ταῖς οὐσίαις λόγους, καὶ μάλιστα πάντων ὡς ὕλῃ τῷ αἵματι χρώμενον.
>
> The process of reproduction also demonstrates it: the seed is controled from the head; it alone has the power to impose as form the *logoi* appropriate to the various type of entity, and it uses blood in particular as matter.

This idea may have its origin again in the *Timaeus*, since in it the brain is said to have been designed as the field where the divine seed was received.[193] Ptolemy's explanation that the brain controls the *logoi*, this is, the proportions, actually points to this source. But, as Boll

[190]Ptol. *Crit.* 13: μίγνυσθαι δὲ ψυχὴν σώματι μάλιστα μὲν ὅσῳ ἂν πλέον ἔχῃ τὸ σῶμα θερμοῦ ἢ ὑγροῦ, ἥκιστα δ' ὅσῳ ἂν πλέον ἔχῃ ψυχροῦ καὶ ξηροῦ.

[191]Ptol. *Crit.* 15: ὅτι μὲν ἡγεμονικὸν γίνεται τοῦ σώματος, ἐν ᾧ τὸ ἡγεμονικὸν τῆς ψυχῆς, οὐδὲ εἷς ἂν ἀπορήσειεν.

[192]Ptol. *Crit.* 15.

[193]Pl. *Tim.* 73c-d: καὶ τὴν μὲν τὸ θεῖον σπέρμα οἷον ἄρουραν μέλλουσαν ἕξειν ἐν αὑτῇ περιφερῆ πανταχῇ πλάσας ἐπωνόμασεν τοῦ μυελοῦ ταύτην τὴν μοῖραν ἐγκέφαλον.

already noted, this theory had been attributed to Alexander Polyhistor,[194] a Pythagorean who may or may not have been dependant on the *Timaeus*. The *Timaeus* could also have been influenced by contemporary Pythagorean ideas, too. But it is not necessary to enter in this discussion, the important information being that this was another Pythagorizing Platonic element introduced by Ptolemy in his treatise.

The very last passages of the treatise systematize the various senses of *hegemonikon*. It is interesting to note that the treatment of 'various' *hegemonika* was already foreshadowed in the introduction to this part of the treatise, where Ptolemy did not choose the singular form of the term, but the plural *hegemonika*.[195] We have already seen how Ptolemy used the term in a relative sense, when speaking of both the *hegemonikon* of the body and that of the soul. That this was common Middle Platonist terminology may be seen in a similar example in Philo of Alexandria, where it is said that the *hegemonikon* of the body is the face, while that of the soul is the intellect.[196] This may obbey to the above-mentioned vulgarization of the concept in the imperial era, when it was no longer specific Stoic.

So Ptolemy differentiates two cases: when the *hegemonikon* means 'the best absolutely and the most valuable', which he seems to identify with the *hegemonikon* of the soul, because he says that it would be located in the brain;[197] and the case when the *hegemonikon* is said as of 'what is in control of anything', in which case 'each of the powers of the soul will be the *hegemonikon* of its proper function'.[198]

Now we will see how Ptolemy finally draws again from Aristotle, following in this perhaps the Antiochian tradition, but also what he has done in the final section of the *Harmonics* (see my chapter 2) or the previous section of this very work, as we have seen

[194]Boll 1894, 92, referring to DL 8.28.

[195]Ptol. *Crit.* 13.

[196]Phil. Alex. *Leg.* 1.39: ὥσπερ σώματος ἡγεμονικόν ἐστι τὸ πρόσωπον, οὕτως ψυχῆς ἡγεμονικόν ἐστιν ὁ νοῦς.

[197]Ptol. *Crit.* 15: εἰ δ' αὐτὸ τὸ ἡγεμονικὸν οὕτως ἁπλῶς ληπτέον καὶ οὐχ ὡς τῶν πρός τι ὄν, ὠδί πως κατὰ τὸ κεφαλαιῶδες διοριστέον.

[198]Ptol. *Crit.* 15: ἐὰν δὲ τό τινος ἄρχον, ἑκάστη τῶν ψυχικῶν δυνάμεων ἡγεμονικὸν ἔσται τοῦ οἰκείου ἔργου καὶ οὕτως πανταχῇ τοῦ σώματος ἐροῦμεν τὰ ἡγεμονικά.

above.

Without further justification, Ptolemy introduces what he says are two most important meanings of *hegemonikon*: 'the chief cause of life itself', and 'the chief cause of living well'.[199]

This distinction between the causes of 'living' and 'living well' was probably taken from the end of *On the Soul*, where Aristotle uses it to differentiate the most valuable of the senses in both respects; at the very end of the treatise, Aristotle distinguishes touch as the only sense indispensible for life, while the other senses are said to be necessary only for living well:[200]

> ἄνευ γὰρ ἁφῆς δέδεικται ὅτι ἀδύνατον εἶναι ζῷον. [...] τὰς δ' ἄλλας αἰσθήσεις ἔχει τὸ ζῷον, ὥσπερ εἴρηται, οὐ τοῦ εἶναι ἕνεκα ἀλλὰ τοῦ εὖ.
>
> Without touch it is impossible for an animal to be. [...] All the other senses are necessary to animals, as we have said, not for their being, but for their well-being.

Perhaps imitating this hierarchization of the senses in Aristotle's *On the Soul*, Ptolemy does the same with the parts of the body corresponding to the faculties of the soul at the end of his *On the Criterion.* His conclusion is that the brain is signaled as the most important cause for both ends, living and living well. At first, the heart is said to be equally most important for the cause of mere living.[201] Let us put it this way for the sake of clarity:

- living well: brain
- mere living: brain and heart

Then Ptolemy wants to identify a second important cause for the other end, living well: he says that 'the second prize' would not go to the heart, but to the senses, in particular to

[199]Ptol. *Crit.* 16: τὸ μὲν ὡς τοῦ ζῆν αὐτοῦ, τὸ δὲ ὡς τοῦ εὖ ζῆν αἰτιώτατον.
[200]Aris. *de An.* 435b17-21.
[201]Ptol. *Crit.* 16: κυριώτατον δὲ τῆς ψυχῆς πρὸς μὲν τὸ ζῆν μόνον τὸ περὶ τὴν καρδίαν· πρὸς δὲ τό τε ζῆν καὶ τὸ εὖ ζῆν, τὸ περὶ τὸν ἐγκέφαλον. ἀμφότερα μὲν γὰρ τὰ εἰρημένα σώματα τρωθέντα μεθίησιν εὐθὺς διὰ τῆς ψυχῆς τὸ ζῆν.

'those which contribute most to assist thought in its consideration and judging of things, this is, hearing and sight'.[202] Ptolemy is clear now as to the fact that these senses hold a second position, so the podium would be now as follows:

- living well:
    1. brain
    2. hearing and sight
- mere living: brain and heart

The treatise ends with the succint repetition of the final hierarchies: the two most important causes of living, and the two most important causes of living well, but here, incoherently with the first account, the two causes of mere living, the brain and the heart, appear here as first and second respectively, while before they appeared as equally important.[203]

> συνελόντι δ' ἐκ τούτων τὸ μὲν κατὰ τὸν ἐγκέφαλον ἡγεμονικώτατον ἔσται πάντων καὶ μόνον καὶ μᾶλλον τοῦ τε ζῆν αὐτοῦ καὶ τοῦ εὖ ζῆν ἅμα γινόμενον αἰτιώτατον δευτερεῖα δ' ἀμφοτέρων μὲν τῶν τελῶν οὐδὲν ἔσται τὸ ληψόμενον, ἕτερον δὲ θατέρου, τὸ μὲν κατὰ τὴν καρδίαν μόνου τοῦ ζῆν, τοῦ δ' εὖ μόνου πάλιν αἱ κυριώταται τῶν αἰσθήσεων.
>
> The part round the brain will be *hegemonikon* in the very fullest sense: alone, or to a greater extent than anything else, it will be the chief cause of both living and living well. There is no one thing which will take the second prize in relation to both ends. That goes to a different contestant in each case. The part around the heart comes second solely as a cause of living: the most important senses come second only as causes of living well.

So the resulting situation seems to be changed:

- living well:

[202]Ptol. *Crit.* 16: εἰ δὲ καὶ δευτερεῖά τινι τῶν ἄλλων τοῦ πρὸς τὸ εὖ ζῆν τέλους δοτέον, ἕτερον ἂν εἴη τὸ μετὰ τὸ διανοητικὸν δεύτερον· καὶ οὐδ' ὡς τὸ περὶ τὴν καρδίαν. μᾶλλον γὰρ αἱ αἰσθήσεις καὶ, εἰ μὴ πᾶσαι, μόναι γε αἱ πρὸς τὸ θεωρεῖν καὶ κρίνειν τὰ πράγματα πλεῖστον τῇ διανοίᾳ συμβαλλόμεναι, τοῦτ' ἔστιν ἀκοή τε καὶ ὄψις.

[203]Ptol. *Crit.* 16.

1. brain
2. hearing and sight

- mere living:

1. brain
2. heart

It seems as though the introduction of a second cause for living well, the senses, and its clear second position with respect to the brain, had influenced the narrative here turning the causes of mere living also hierarchical. This may be connected with the fact that the senses are actually introduced as *another* second prize (εἰ δὲ καὶ δευτερεῖα…), as if the causes of mere living sketched before were also hierarchically organized.

Was the introduction of the senses an afterthought? If this was so, Ptolemy himself could have neglected the incoherence with the initial situation. Perhaps after a first redaction Ptolemy realised that sight and hearing, which were so important for his own conception of knowledge, should figure in his conclusion. It is also possible that the analogous conclusion of Aristotle's *On the Soul*, where the senses other than touch carried the most important prize for the end of living well, was a powerful influence there, too. Actually, the inclusion of the heart as a cause of mere living in Ptolemy's account may also be a concession to the Aristotelian conception (see above on the importance of the heart as quasi-*hegemonikon* in Aristotle and Galen's criticisms). In every case, the multiple options offered by Ptolemy in these final lines show again Ptolemy's general aim at *optimum agreement* through the combination of Aristotelian concepts within a wider Platonic program.

3.9 Conclusions

The *Criterion* is difficult to read for us moderns. We are not familiar with the philosophical debates of Ptolemy's age. Within Ptolemy's works, we feel much more at ease with the

Harmonics, because in there a relatively simple mathematical tradition is put to work in a more or less systematic way for non-initiates. We find more difficulties at the end of the treatise, where a number of philosophical distinctions begin to appear, unexplained, and are joined to harmonic concepts. With the *Criterion* the sensation of dispair of the modern reader increases partly because the argument is not only analogic like in the final part of *Harmonics*, but some construction is attempted, and like in there no concessions are made to the reader not familiar with the subject. The contrast is evident between this and the careful explanation of the harmonic concepts at the beginning of *Harmonics*.

Possibly Ptolemy's readers, unlike ourselves, were familiar with his philosophical jargon, much more than with the technical mathematical concepts of music theory. This is perhaps why Ptolemy could have written a work like the *Criterion* in the way he did, not like a systematic handbook but rather as a rhetorical exercise with no deep argumentation. A typical rhetorical device was probably used in this text: imitation. Ptolemy seems to consciously imitate the discourse of Timaeus on the origin of the world in Plato's dialogue, and this at many levels: style, aim, allusions, contents. We could speak of literary play. I will go deeper into this in the next chapter, but for now we can just remark that this interest in the *Timaeus* is not new: we have seen it already in the final parts of the *Canobic Inscription* and the *Harmonics*, where Ptolemy used it to link his scientific project with Platonic philosophy, particularly alluding to Plato's remarks on the role of the mathematical sciences in *Republic* 530d. Here one could say that Ptolemy is doing more of the same, but without a reference to mathematics.

Little interest on the part of Ptolemy in engaging in a deep philosophical debate is also seen in the final part of the *Harmonics*, where less and less explanations are given as the reader advances through endless analogies. But then, why did Ptolemy want to write a philosophical treatise? I have argued in the two previous chapters that Ptolemy's 'final parts' analysed there had something of a pose, since they just displayed a Platonic stance, not using empirical facts nor developed arguments as in the main parts of the treatises,

an effort to present himself as a philosopher, rather than an effort to write philosophy. Here in the *Criterion*, the fact that Ptolemy does not allude to mathematics is perhaps to be connected with this, since it may reveal Ptolemy's wish to appear as a pure philosopher, as someone who could write a treatise on philosophy.

However, as we have said, we can clearly see that here as in the final part of the *Harmonics* he was not interested in developing original philosophical arguments. Instead, he seems to sketch a philosophical position compatible with the one he has presented in his *Harmonics*, on a topic relevant for his scientific work such as the criterion (the final part on the ruling principle is as in *Harmonics* and *CI* of a more speculative nature). Thus, he shaped his treatise in a quasi-dogmatic form which could remind of the pseudo-Pythagorean writings, citing no authors or works. However, it is difficult to say whether Ptolemy was influenced here by this kind of writings, or if the coincident form was attained independently. If there was an influence, the most probable name would be 'Archytas'.

Ptolemy shows in the *Criterion* familiarity with Aristotle's *Categories*, and most clearly with *On the Soul*, where the link appears less mediated. The encounter with Aristotle's *Categories* and its tradition seems to be mostly critical –since Ptolemy perhaps regarded the *Categories* as a 'hidden' treatise on language rather than on reality, while he defended to downplay the role of definitions and language in investigation. On the other hand, Ptolemy seems to follow and even to systematize the investigations about the faculties of knowledge developed in *On the Soul*. In this systematization of Aristotle within a general Platonic stance we may see the influence of the tradition of Antiochus, who regarded Aristotle as a successor of Plato in the Academy and thus attempted a conciliation of Peripateticism within a dogmatic Platonism.

I have shown how the structure of Ptolemy's criterion, along with minor points such as the Aristotelized Stoic theory of the elements appearing in the final part are also found in the Antiochian tradition. As regards the metaphor of the law court, with which Ptolemy opens the text, I have argued that it was possibly derived from one of Antiochus' pupils, Aristo of

Alexandria. If this hypothesis is certain, this would confirm that Aristo was a transmitter of the Platonic philosophy of Antiochus in Alexandria, a tradition which Ptolemy would have adapted to his philosophy.

Both in the *Canobic Inscription* and the *Harmonics*, we have seen how Ptolemy plausibly draw from the work of Eudorus of Alexandria for his sections on the harmonic theory of the heavens. As we said above, both Aristo and Eudorus were contemporaries (1st c. BCE), shared common interests and style (Strabo knew that Eudorus criticised Aristo for plagiarism of his book on the Nile). We may speculate that these authors could have represented for Ptolemy the first Alexandrian philosophical handbooks presenting dogmatic philosophy, and perhaps some of the few available ones, at least at this stage of his career (which seems to be the initial one).[204] We may wonder why Ptolemy used such old sources, since he did not began his public career until the mid-second century (he dedicated his inscription in 147/8 CE). The answer may be that perhaps there were no better contemporary works: Sextus, probably working in a similar date as Ptolemy, could apparently not do a better job in his book on the criterion, since the histories of the criterion he presents seem to be as old as Posidonius and Antiochus, probably transmitted through his Pyrrhonian predecessor Aenesidemus (also from the 1st c. BCE).[205]

[204]For the emergence of philosophy in Alexandria in the first c. BCE, see Hatzimichali 2011, ch. 2.
[205]Sedley 1992, 25.

Chapter 4

Exact proportions in Ptolemy's works

Philosophy and rhetoric in Ptolemy's education

4.1 Plan of the chapter

This chapter constitutes a sort of bridge between the three preceding chapters –which have dealt quite in detail with three probable early works of Ptolemy– and a rather selective study of the rest of Ptolemy's production in the next two chapters. My topic here brings together 'external' characteristics of the works already studied and of the rest of the *corpus*. A succint study of the general characteristics of the latter treatises may be consulted in my next chapter, but it is not necessary for the comprehension of what follows here.

I will now address an issue of material culture: how were Ptolemy's books externally constituted? Does the arrangement of topics in books show anything about what he wanted to transmit from his own project? In my answer to these questions I will try to argue positively that Ptolemy arranged his books in a very particular way, distributing the text in significant proportions that highlighted both the central parts and the sections of the treatises.

First I will introduce the discussion of the significant points where central parts of

Ptolemy's treatises seem to appear, what perhaps constitutes the most obvious observation. I will argue that such 'centers' appear at points of the text expressed by simple fractions, such as 1/2, 2/3, and 3/4. I will further explore the possibility that in some cases such points reflect the number of books that the works occupy, a speculation that I will retake later. My first interpretation will be that Ptolemy wished to reflect a harmonical structure in the text.

Secondly, I will describe the less evident distribution of the relevant sections in the three works studied in the previous chapters. I will argue that in *CI*, *Harmonics*, and *Criterion* we can see five equally long sections, of which the last fifth part corresponds to what we have been designating as the 'last part' of these works, appearing much detached in content from the rest of the work.

Then I will look for parallels and probable influences. Varro is known to have distributed the number of books in his works following a quadripartite structure –which he refers to the Pythagoreans– with four equally long parts (occupying the same number of books each), that has been tentatively related to Antiochus. As I will show, Vitruvius also seems to apply a principle which he relates to the Pythagoreans to the length of his books.

Similarly to the 'centers' in Ptolemy's treatises, the midpoint of Vitruvius' *On Architecture* is occupied by the most important topics of his treatise, and he refers somewhere to the importance of the center in an analogic context of human body and buildings, which he could also have transmitted to his text. Vitruvius emphasises how the internal structure should reflect the overall design, perhaps the same thought underlying Ptolemy's centers if they reflect the structure in books.

I will argue that as regards sectioning, Vitruvius could have been influenced by Varro. Ptolemy, in turn, could have been influenced by the Antiochian tradition if Antiochus was indeed Varro's source.

In the last part of the chapter I will discuss the relation between the five-fold scheme and the stage of Ptolemy's career corresponding to the three works sectioned according to it.

Many factors suggest that these works were close to Ptolemy's educational years: they may be dated early in Ptolemy's career, they deal with traditional disciplines –differently from the more varied later works– in Graeco-Roman education normally taught by philosophers, and the *Criterion* shows the clear influence of rhetoric, another subject traditionally learned at a young age. Then I will conclude that Ptolemy learned the five-fold scheme probably in the context of philosophical education.

4.2 'Centers' (*Alm.*, *Geogr.*, *Tetr.*, *Harm.*)

In this section I am arguing that in some of Ptolemy's works especially remarkable sections such as long lists or tables are positioned at simple exact fractions of the whole length of the texts, like 1/2, 2/3, and 3/4.

Let us begin with the *Almagest.* This long treatise, although perhaps especially innovative in its last section on the planets (see my next chapter), featured a long catalog of stars towards the middle of the treatise, visually detached from the rest of the work in that it constitutes by much the longest table in the whole treatise, as well as the widest. Heiberg actually printed the whole table horizontally, occupying in his edition as many as 121 pages, a rough 10% of the length of the whole text of the edition (1149 pages).[1]

Ptolemy has scientifical reasons to situate his discussion of the stars in the order he puts it between his treatment of the sun and the moon on the one side and the planets on the other.[2] However, there are reasons to consider the possibility that Ptolemy consciously wrote the text so that the beginning of the catalogue was situated near the exact middle of the whole text. An obvious way in what Ptolemy could have controlled this would have been to stop writing at the appropriate point, perhaps leaving out some topics which would have been natural to discuss. Maybe Ptolemy's omissions in the last book on the visibilities

[1] Heiberg 1898, the first volume in two parts.
[2] Pedersen 1974, rev. ed. 2010, 236.

–Ptolemy does not mention the Moon's visibilities nor those of the fixed stars[3]– are due to this sort of thing, although this is of course impossible to prove.

Perhaps the very last words of the treatise, noting that 'it would be appropriate and *symmetric* (σύμμετρον) that the present treatise takes the end here',[4] could allude to such a procedure. Although the word that Ptolemy uses, σύμμετρον, could have a more general meaning, Ptolemy has indeed used it already in the *Almagest* for referring to a centered disposition of a table within the margins of a papyrus, when he notes to have designed his tables of 45 lines 'for the sake of symmetry' (διὰ τὸ σύμμετρον).[5] My next argument is about the exactness of the placing, and will need some counting.

It turns out that the catalog itself is not exactly centered, since it appears rather towards the second half of the treatise. This is the situation: it begins well advanced the 7th book, where the stars of the northern hemisphere are listed, and is pursued through most part of book 8 with the stars of the southern hemisphere. So the book structure does not exactly reflect its centrality, since before book 7 come the first 6 books, while after the 8th book come only 5 books. This is only the book structure, which does not necessarily reflect the length of the text, but the line counting before and after the catalog does not match, either.[6]

Line counting rather reveals that the midpoint of the treatise almost coincides with the beginning of the catalog (with an error of 1.1%).[7] So before and after the point where the star catalog begins there is a very similar number of lines.

It is worth noting that if this was the intended center of the treatise, the structure in books would also reflect this, since before book 7 –the center of the treatise itself, because

[3]Pedersen 1974, rev. ed. 2010, 390.

[4]Ptol. *Alm.* H2.608: οἰκεῖον ἂν ἡμῖν ἐνταῦθα καὶ σύμμετρον εἰλήφοι τὸ τέλος ἡ παροῦσα πραγματεία.

[5]Ptol. *Alm.* H1.47.

[6]The counting is done by the lines of the Heiberg edition, with a rough aestimation of the number of lines occupied by the figures printed in this same edition. I will not use any technology other than line and character count on the printed editions of the text –for convenience, line count when there are figures, character count when there are not–. As I am descriving the visible appearance of the text –this is, the amount of text– and not the time elapsed in reading, I count characters and lines rather than syllables. I take the roughly equally long lines of printed editions as a good approximation for the proportions of text on the ancient papyri, whose lines were normally fairly equally long throughout: cf. Johnson 2004, 50-51.

[7]The number of lines prior to that point is 13260, for 12701 after.

the catalog begins in the middle of it[8]– come 6 books, the same number as after that book.

Now let us explore another big work of Ptolemy, the *Geography*. In the *Geography*, between the first and last (eighth) book is sandwiched the ultralong catalog of places –occupying the six books in between, save a short introductory section in book 2 and the last section of the seventh book. Line counts of the first and eighth books (as it were the bread of the sandwich) give a very similar number.[9] If the catalog is taken alone, we get also a similar number of lines before its beginning and after its end.[10] It is worth noting that after a summary of the regions of the world placed at the end of the catalog, Ptolemy writes that this summary 'would have its end at this place symmetrically (συμμέτρως)'. Perhaps this could be another indication that Ptolemy is here taking into account the proportions of the treatise, and that maybe the catalog would actually end here. The counting would support this possibility.[11]

What is perhaps more conspicuous in the *Geography* in this context is the odd distribution of the chapters on the three projections of the map of the Earth which Ptolemy describes in his treatise. While the two first projections are discussed in book one (chapters 1-24), the treatment of the third and last one is delayed until after the long catalog (chapter 7.6), with no mathematical reasons.[12] It would seem as though at least conceptually (but space could be important, here, as well[13]) Ptolemy wanted to mark the catalog as the center by putting it literally in the middle of his treatment of the projections.

I shall now go to the *Tetrabiblos*. This work, in four books and without figures, does not seem to have a big list in its center like the former two works. However, there is a long catalog of qualities of the souls affected by the planets, occupying about a 7.1% of the length of the work,[14] at the end of the third book. Well, it seems that the midpoint of this catalog

[8]Not the midpoint in this case: 817 lines before the beginning of the catalog, 1393 after that.
[9]Again with rough aestimation for the lines of the figures. 1st book gives 1737 lines, 8th book 1706.
[10]1834 lines corresponding to the text from the beginning to 2.1, 2010 for the text from 7.5 to the end.
[11]1834 lines before the catalog, 1873 after it now counting only from 7.6 to the end.
[12]See an analysis of this third projection in Berggren and Jones 2000, 38-40.
[13]The treatment of the third projection occupies 167 lines.
[14]14592 characters out of 204679.

is placed at exactly 3/4 of the whole work (with an error of 1.1%).[15]

Let us finally take the *Harmonics*. As we have seen in my chapter 2, the mathematical part of this work seems to have its climax at chapter 2.15 when Ptolemy provides the bridge-positions of the harmonic canon for every familiar genus and every *tonos*. The center of this tables seems to be situated at the point 2/3 of the whole treatise (error of 0.72%), although in this case the counting needs an estimation of the length of the last three chapters, which are lost.[16]

Of course my counting can be only approximate, but in view of the typical uniformity in the number of letters per line in the Greek literary papyri, character count seems a good approximation. Line counts seem also a good substitute for character count in the cases when it is complicated by the appearance of figures.[17]

To sum up, the beginning of the star catalog of the *Almagest* seems to be put at the middle of the treatise, as well as the whole catalog of places of the *Geography*. In both these works, the distribution in books would echo this centering, since before and after the books presenting the catalogues we would find the same number of books in either case.

In the case of the *Tetrabiblos* and the *Harmonics*, the catalogues appear not in the middle, but at 3/4 and 2/3 respectively. Given the connexion between books and centers in the *Almagest* and the *Geography*, it would not be out of place to suggest that in the *Tetrabiblos* and the *Harmonics* such connexion could be present, as well. A nice possibility would be that the point 3/4 where the list of the *Tetrabiblos* is situated reflects the placing of the

[15]Before the exact center of the list I have counted 151203 characters, and the exact 3/4 should be at character 153509.25.

[16]For each one of the lost final three chapters, I have supposed the medium length of the chapter in book III; the lines before the center of the tables in 2.15 amount to 2154; the exact point 2/3 would be 2131.33. For an estimation of the error in the supposed length of the missing chapters, if we considered them to be double the length of the mean length of the preceding chapters –which is unlikely for the three at the same time– the final error would increase from 0.72% to 2.72%.

[17]I have estimated the error of line count compared to character count taking the first 100 lines of Ptolemy's *Harmonics* and comparing the results in calculating proportions of the text by character count and by line count. The results are astonishingly good for such a short stretch of text –the error would decrease taking more text–: the midpoint of the text would be at character 2774.5 by line count, while by character count we would obtain character 2778 (error of 0.063%). For the point 2/3, we get 3699.66 and 3631 respectively (error of 1.23%), and for 3/4, 4161.75 and 4210 (error of 0.86%).

catalog in the books-structure, so that it is placed in book three out of four. Similarly, situating the tables of the *Harmonics* at point 2/3 could reflect that they were in book two out of three.

I will support this possibility with reference to another author below, but for now we coud argue that such a conception of center could be connected with harmonics, clearly one of Ptolemy's interests (and specifically in one of the works under consideration). Indeed, if we conceived the proportions of lengths of text as musical ratios, a middle position like that of the centers of the *Almagest* and the *Geography* would result in a ratio of an octave (2:1, i.e. the whole text to one of the halves); the center of the *Tetrabiblos* would make a fourth (4:3, the whole to the first part); and the center of the *Harmonics* would make a fifth (3:2). From the last section of the *Harmonics* we know that Ptolemy, like his predecessors in the Timaean tradition, liked to project the musical scale with its concords to various structures of the heavens and the soul. For example in his chapter 3.9, he applied this same procedure, consisting in conceiving lengths in a continuous line as musical ratios, with the circle of the zodiac (see my chapter 2).

Ptolemy used the fundamentally Platonic argument that the numerical ratio governs the beautiful, eternally unchanging things like the heavenly bodies or the human souls. Thus we could understand the proportional arrangement of the centers of these works as Ptolemy's embodying of his own analogic harmonic theories, which would give an appearance of eternity to his works. This is something which I have actually suggested as a motivation for the erection of an inscription such as Ptolemy's (see my chapter 1). In the presentation of the *Almagest* Ptolemy will speak further on the divine nature of the astronomical science (see my chapter 6), so it is possible that we are seeing the same conception in the proportionality applied to the centers of the work.

4.3 The structure 4 + 1 equal parts (*CI*, *Harm.*, *Crit.*)

But there seems to be another kind of division in Ptolemy's works, not the one around the center as in the examples above, but one that separates different thematic sections in *CI*, *Harmonics* and *Criterion.* As we have seen in the preceding three chapters, there is a clear break in each one of these works, between the mathematical and the final non-mathematical parts. It turns out that this break is quite precisely placed at four fifths of the whole length in all three works, with an error of less than 2% in any of these three works.[18] As is natural if the hypothesis is correct, the error is minimal in the case of the longest text, the *Harmonics* (0.42%), while it grows in the two shorter ones due to the greater effect of small variations in proportion to the whole lengths.

A more detailed exploration of the mathematical parts, this is, the longer first parts of the three treatises, reveals that they may be sectioned in four equally long thematic parts, so that every part amounts to one fifth of the total (counting the last part, which measured a fifth). This is most clear in *Harmonics* and *Criterion.* Unlike in the case of the main division between mathematical and philosophical at four fifths, there does not seem to be a thematic pattern common to the three works in the quadripartite internal divisions of the 'mathematical' parts.

For the *Criterion*, the partition which I have detailed in the preceding chapter is the one that works here, this is, the law court analogy (1-3), the digression on language (4-6), differences and similarities between intellect and perception (7-9), and the interaction of intellect and perception (10-12).[19]

[18] These are the numbers: I write firstly the number of lines or characters of the two main parts, then the error in % of the whole length, then general observations. *CI*: 100 / 22; 1.97%; I counted lines of Jones' edition because the inscription is mainly tabular, hence not continuous). *Harmonics*: 2571 / 626; 0.42%; I counted lines of Düring's edition here as before, with the same estimation for the length of the lost chapters (see note above). *Criterion*: 15245 / 4709; 3.58%; the counting is in characters here; the table at the end of some manuscripts is not referred to in Ptolemy's text, and therefore I have not included it; if we consider, following my analysis above, that the words from εἰ δὲ καὶ δευτερεῖα… do not form part of a first redaction of the text (cf. chapter 3), we would have the cut at a much more exact position, the numbers being 15245 / 4060; 1.57%. In any case, for such a short text as the *Criterion*, 3.58% of error would not be as bad.

[19] The errors with respect to the exact divisions of the whole length at 1/5, 2/5 and 3/5 are 0.25%, 1.64% and

For its part, in the *Harmonics* there result four thematically circumscribed sections, which may reasonably be described as: basic theory and concords (1.1-11), tetrachords (1.12-2.2), tonoi (2.3-2.11), and the canon (2.12-3.2).[20]

In the *Harmonics*, there is only one chapter that does not fit this fourfold division of the mathematical part, namely 2.2 on the instrument called the *helicon* and a variation of it.[21] This chapter, situated at the end of the treatment of the tetrachords, and at the beginning of the section on the *tonoi*, does not fit nor connect with topics of either of them, but would be rather appropriate for the section on the concords –since this instrument is used to display the concords– or the section on the canon. We could perhaps apply here the saying that this is the exception that proves the rule, since it would be easy to imagine that at some point Ptolemy would have had to insert some topic not entirely fitting the section in order to fill up the desired proportion. The fact that this chapter is placed precisely at the end of a section, and not at any other place, supports this possibility.

In the *CI* an approximately equal division in four parts of the 'mathematical section' would be possible, although now with looser coherence. The eight tables in the astronomic part would be divided in four groups of two (the first and the last one including the prose parts, on which see my chapter 1) with some thematic link. The first two tables would deal with static features of the models (dimensions of the eccenter and the epicycles respectively), unlike the second group; the third group of two tables deals with mean positions of the planets, unlike the fourth group, but within the second and the fourth groups there does not seem to be such unity.[22]

So it seems that the three works *Canobic Inscription*, *Harmonics* and *Criterion* share a

2.77%, and if we cut before the words εἰ δὲ καὶ δευτερεῖα (cf. note above) we get still better results: 0.41%, 0.36% and 0.84%.

[20]For the pertinence of this division, cf. the tables of contents of each of the books. The errors in the divisions (as in the *Criterion*) are respectively 1.90%, 1.32% and 4.17%.

[21]See Brown 1987, 49-50 on this instrument and a speculation on his inventor.

[22]Here the errors of the three divisions are respectively 1.97%, 12.13% and 3.11%, but in fact four out of the five sections are almost equally long (first, third, fourth and fifth part: 22, 21, 23 and 22 lines), while the second is sensibly longer (34), which distorts the errors resulting from the ideal cuts.

common architecture, not only visible in the already noted separation of the latter fifth part, but also distinguishable in the fact that all three works actually seem to contain five equally long thematical parts, the last of them being the non-mathematical one.

Now obvious questions arise: in what sense was Ptolemy original in writing his treatises like this? Can Ptolemy's writing practice be fruitfully compared with other writers'? Does the five-fold scheme tell us something specific about the three works that seem to share it? In what follows I will compare with similar practices attested in other writers, which will help answer these issues. Towards the end of the chapter I will try to answer to the second question, arguing that these three works could especially show the influence of Ptolemy's educational years.

Another interesting question, related to the relationship between this second five-fold scheme and the 'center'-structure outlined above, could ask for the connexion between the two schemes.

To begin with, we can observe that the two systems seem to work independently in Ptolemy's work: on the one side we have the climaxes-structure, which could perhaps be related to the structure in books, and on the other side we have the five-fold scheme. The *Harmonics* is the work to look at in this context because in it both structures seem to exist. As we have seen, the work is divided in three books, and in the second book, at 2/3, we seem to find a 'center'. However, the whole work is divided in five equal sections, which do not respect the structure in books. Thus, we have the somewhat unusual phenomenon that the big thematic breaks in the treatise do not coincide with a change of book. Thus, the beginning of the second book seems an immediate continuation of the end of the first one,[23] and the first chapter of the third book pursues the treatment of the canon of the end of the second book; in contrast, the big break at the beginning of the philosophical section does not begin at a change of book as would perhaps be natural.

[23] See Barker 1989, 315 n. 3.

4.3.1 Varro and Vitruvius

Now I want to look for authors writing proportional sections as Ptolemy, either by the first procedure (a center at a simple proportional point) or by the second (equally long sections).

It has been shown by various scholars that Varro used a four-part architecture in many of his works, which he related to the Pythagoreans in his own justification. This scheme Varro describes as *corpus, locus, tempus, actio*, and corresponds to the questions who, where, when, what. He describes it as 'the fourhorse team of the elements'.[24]

For us it is important that the four parts in Varro were meant to be equally long, at least in what regards the number of books devoted to them both in his *On the Latin Language*,[25] and in the lost work *Antiquities* as described by Augustine.[26]

The modern critics agree in considering this scheme as quite particular to Varro, although probably derived from a more general rhetorical scheme which he may have learned in his youth.[27]

Two authors propose Antiochus of Ascalon as the possible transmitter of such a scheme to Varro, given Varro's affinity with this philosopher and the synchretism of the latter, which could have influenced Varro's claim that it derives from the Pythagoreans.[28] Both claims need not be incompatible, given that Antiochus seemingly had a high regard of rhetoric and could have been influent in this topic.[29]

Let us now turn to Vitruvius and his *On Architecture*, which was written in ten books. I will show next that Vitruvius, like Varro, also claimed to control the distribution of his topics in his volumes with a reference to the Pythagoreans.

I will focus on the preface of book V, where Vitruvius provides some hints at the way he

[24]Varro *LL* 5.12: igitur initiorum quadrigae locus et corpus, tempus et actio. Cf. Taylor 1974, 70.

[25]Book V is devoted to places and objects, book VI to times and actions; see Varro's programatic statement at V.10.

[26]In this work every part was devoted 6 books: August. *De civ.* VI.3. Cf. Taylor 1974, 69.

[27]Taylor 1974, 68, with bibliography. Cf. also Blank 2012, 286; and Piras 1998, 51.

[28]Piras 1998, 55; Boyancé 1976.

[29]See Dillon 1977, 104-5 for the relationship between Antiochus and rhetoric.

composed his treatise. He begins in an apologetical tone claiming that architectural texts do not have it as easy as other forms of writing such as history or poetry to convey 'authority' (*auctoritas*) by means of filling ample volumes (*amplioribus voluminibus*), because there is no such thing in architecture as the historical argument or the meter, which maintain the attraction of the reader.[30] Then he observes that he has consequently decided to write in a brief manner, and claims that this is a Pythagorean tradition:[31]

> *non minus cum animadvertissem distentam occupationibus civitatem publicis et privatis negotiis, paucis iudicavi scribendum, uti angusto spatio vacuitatis ea legentes breviter percipere possent. etiamque Pythagorae quique eius haeresim fuerunt secuti, placuit cybicis rationibus praecepta in voluminibus scribere, constitueruntque cybum CCXVI versus eosque non plus tres in una conscriptione oportere esse putaverunt.*
>
> Furthermore, since I have observed that our citizens are distracted with public affairs and private business, I have thought it best to write briefly, so that my readers, whose intervals of leisure are small, may be able to comprehend in a short time. Then again, Pythagoras and those who came after him in his school thought it proper to employ the principles of the cube in composing books on their doctrines, and, having determined that the cube consisted of 216 lines, held that there should be no more than three cubes in any one treatise.

Then Vitruvius goes on to define a cube and to explain the Pythagoreans' analogy between the cube and the number of lines that a treatise should have, providing another example. However, he omits to mention the relevant fact that 216 is a cube because it is equal to $6 \times 6 \times 6$. This passage is also worth quoting for what I want to argue:[32]

> *cybus autem est corpus ex lateribus aequali latitudine planitiarum perquadratum. is cum est iactus, quam in partem incubuit, dum est intactus, inmotam habet stabilitatem, uti sunt etiam tesserae, quas in alveo ludentes iaciunt. hanc autem similitudinem ex eo sumpsisse videntur, quod is numerus versuum, uti cybus, in quemcumque sensum insederit, inmotam efficiat ibi memoriae stabilitatem. graeci quoque poetae comici interponentes e choro canticum diviserunt*

[30] Vitr. *Arch.* V. intr. 1.
[31] Vitr. *Arch.* intr. 3 (tr. Morgan).
[32] Vitr. *Arch.* intr. 4.

> *spatia fabularum. ita partes cybica ratione facientes intercapedinibus levant actorum pronuntiationes.*
>
> A cube is a body with sides all of equal breadth and their surfaces perfectly square. When thrown down, it stands firm and steady so long as it is untouched, no matter on which of its sides it has fallen, like the dice which players throw on the board. The Pythagoreans appear to have drawn their analogy from the cube, because the number of lines mentioned will be fixed firmly and steadily in the memory when they have once settled down, like a cube, upon a man's understanding. The Greek comic poets, also, divided their plays into parts by introducing a choral song, and by this partition on the principle of the cubes, they relieve the actor's speeches by such intermissions.

Finally, Vitruvius concludes that since his predecessors have followed these rules, and since he has to write on unusual subjects, he has decided to write in short books, arranged by topic (so that each one treats a different topic) (*Arch.* intr. 5).

So it seems that Vitruvius explains a practice he ascribes to the Pythagoreans of composing works no longer than 216×3 lines –this is, 648– and decides to write consequently in short works.[33] The obvious question is: did Vitruvius perhaps follow or try to follow the specific formula of not writing more than 648 lines in a book? Given the length through which he exposes the topic, it is reasonable to hypothesise that he wanted at least to convey the idea that his books were approximate as long as this.

I will now briefly test this hypothesis with an estimation of the lines of the books of Vitruvius' *On Architecture*, taking 63 as a reasonable mean number of letters per line of a literary Latin papyrus of Vitruvius' time.[34]

This is the hypothetical number of lines in each of the ten books resulting from my character count (in the order of the ten books): 612, 677, 410, 421, 613, 517, 571, 550, 583, and 850.[35]

[33] See Burkert 1972, 140 n. 110 for the significance of 216 in Pythagorean lore.

[34] This is the mean value of the letters per line in the so-called Giessner Verres papyrus, whose lines contain from 59 to 67 letters, a 'typical' value in early Latin volumes according to Seider 1979, 103.

[35] The number of characters in each book is respectively 38533, 42657, 25819, 26556, 38616, 32557, 35992, 34624, 36725, 53524.

Only one of this values clearly surpasses Vitruvius' Pythagorean value of 648, that of the tenth book. And strictly speaking, apart from this tenth book and the subtly higher value in book 2 (677), all other values conform to the rule of the maximum at 648, with a minimum at 410 and a maximum at 612.

So the counting adds support to my hypothesis that Vitruvius fashioned his books approximately according to the Pythagorean precept he announces. Perhaps since he did not exactly manage to follow the precept everywhere (especially in book 10) he did not explicitly say that he followed the Pythagorean principle, but only that he wrote in short books, like the Pythagoreans who followed the principle of writing in less than 648 lines.

This is not exactly the same that we find in Varro, but it shares many important features with it. In the first place, in both cases it is a mechanism that standardizes sections in the text to a similar length, and in the second place, in both cases the Pythagoreans are alluded to as authority.

Now I want to argue that Vitruvius was possibly influenced by Varro in this context. For my argument, let us again take a look at Vitruvius' definition of cube and his example of application in the Greek comic authors (my second quotation above). Now compare it to a definition of cube in Aulus Gellius' *Attic Nights*:[36]

> κύβος *enim est figura ex omni latere quadrata, 'quales sunt' inquit M. Varro 'tesserae, quibus in alueolo luditur, ex quo ipsae quoque appellatae* κύβοι.' *In numeris etiam similiter* κύβος *dicitur, cum omne latus eiusdem numeri aequabiliter in sese soluitur, sicuti fit, cum ter terna ducuntur atque ipse numerus terplicatur. Huius numeri cubum Pythagoras uim habere lunaris circuli dixit, quod et luna orbem suum lustret septem et uiginti diebus et numerus ternio, qui* τριάς *Graece dicitur, tantundem efficiat in cubo.*
>
> For the κύβος is a figure which is square on all its sides, 'like the dice', says Marcus Varro, 'with which we play on a gaming-board, for which reason the dice themselves are called κύβοι'. Similarly in numbers too the term κύβος is used, when every factor consisting of the same number is equally resolved into

[36] Aul. Gel. 1.20 (tr. Rolfe).

> the cube number itself, as is the case when three is taken three times and the resulting number itself is then trebled. Pythagoras declared that the cube of the number three controls the course of the moon, since the moon passes through its orbit in twenty-seven days, and the ternio, or 'triad', which the Greeks call τριάς, when cubed makes twenty-seven.

So we know first that Varro defined 'cube'; secondly, that he exemplified it with the 'dice', using the same terms as Vitruvius (*tesserae*, *alueo*/*alueolo*, *ludentes*/*luditur*). What comes next is not directly ascribed to Varro, but it seems plausible that it is drawn from there, given that shortly below we see Gellius quoting Varro again.[37] If this was so, we would have that Varro explained the numerical meaning of the cube, what Vitruvius uses without making reference to it; and fourthly, that Varro gave a Pythagorean example of the numerological significance of the cube.

On the other hand, from Vitruvius' own remarks in *On Architecture* we know that he knew and valued Varro's work, specifically mentioning the book on architecture of the treatise 'on the nine sciences', the *Disciplinae*,[38] and 'his work *On the Latin Language*'.[39] As regards Vitruvius' example of the Greek comic poets applying the principle of cubes to their works, it does not seem a weird hypothesis that Vitruvius would also have found it in Varro, given the well-known philological and Pythagorean interests of the latter.

There are various possibilities: Vitruvius could have found the tradition of the number 216 applied to texts in Varro and he could have applied it directly to his own work. He could also have been influenced by Varro's observations on the composition of his own books, or by the very appearance of Varro's books, and having encountered the anecdote on the Pythagorean legend on the number 216 in Varro's work, too, have decided to apply it himself. Be that as it may, the coincidence that Vitruvius is using the definition of cube found in Varro in his justification of his sectioning, and that Varro sectioned his own books,

[37] Aul. Gel. 1.20: 'Linea' autem a nostris dicitur, quam γραμμήν Graeci nominant. Eam M. Varro ita definit: …

[38] Keyser and Irby-Massie 2008, s.v. M. Terentius Varro of Reate.

[39] Vitr. *Arch.* 9.17.

too, with a Pythagorean excuse, seems to suggest a probable influence of Varro in Vitruvius.

To sum up, both Varro and Vitruvius can be said to apply a standardization in the length of their sections in the text, probably going back to the same tradition. However, differently from Ptolemy's procedure, the lengths in Vitruvius are not very exact, but only calculated on a rough basis. There is also another important difference, in that in both Varro and Vitruvius the roughly equal sections correspond to the structure in books: in Vitruvius each section is exactly one book, while in Varro every section in a work occupies the same amount of books. What we have seen in Ptolemy is precisely that the 'equal sections'-structure is divorced from the structure in books, which could instead be linked rather to what I have called the 'centers'. I will say something more on this latter possibility in the next section.

4.4 The concept of center in Vitruvius

I will now explore whether there is a concept of center in Vitruvius' text which may be compared to Ptolemy's. I will now focus on the first chapter of book III, on the construction of temples. In what follows I will argue that, even if Vitruvius does not mention explicitly his text as an example of the theory of proportion, it is possible that he applied some symmetry to it, such as the distribution around a center and a 'nice' number of books.

Vitruvius begins the first chapter of his third book claiming that symmetry (*symmetria*) is crucial to the design of temples, and that 'proportion (*proportio*), from which result the principles of symmetry, is a correspondence among the measures of the members of an entire work, and of the whole to a certain part selected as standard'.[40] Then Vitruvius goes on to describe the proportions in the human body (*Arch.* 3.1.2) and concludes that similarly in the temples the same commensurability between the parts and the whole must be given (*Arch.* 3.1.3). The example that he gives next is the famous one which Da Vinci reshaped

[40]Vitr. III.1: proportio est ratae partis membrorum in omni opere totiusque commodulatio, ex qua ratio efficitur symmetriarum.

many centuries later and which is known as the 'Vitruvian man': Vitruvius emphasises what he has said about the relationship between the parts and the whole in the human body and the temples with a sort of architectural drawing of a man, in which the navel is taken as the center both of a circle (drawn with a compass, as Vitruvius describes), and of a square, which are perfectly adjusted to the dimensions of the man with outstretched arms and legs:[41]

> *item corporis centrum medium naturaliter est umbilicus. namque si homo conlocatus fuerit supinus manibus et pedibus pansis circinique conlocatum centrum in umbilico eius, circumagendo rotundationem utrarumque manuum et pedum digiti linea tangentur. non minus quemadmodum schema rotundationis in corpore efficitur, item quadrata designatio in eo invenietur. nam si a pedibus imis ad summum caput mensum erit eaque mensura relata fuerit ad manus pansas, invenietur eadem latitudo uti altitudo, quemadmodum areae, quae ad normam sunt quadratae.*
>
> Then again, in the human body the central point is naturally the navel. For if a man be placed flat on his back, with his hands and feet extended, and a pair of compasses centred at his navel, the fingers and toes of his two hands and feet will touch the circumference of a circle described therefrom. And just as the human body yields a circular outline, so too a square figure may be found from it. For if we measure the distance from the soles of the feet to the top of the head, and then apply that measure to the outstretched arms, the breadth will be found to be the same as the height, as in the case of plane surfaces which are perfectly square.

Vitruvius conducts in what follows his discussion from the parts of the body to the 'perfect number' (*perfectum numerum*), which is said to have been fixed by the ancients as ten, following the total number of fingers of the hands (*Arch.* 3.1.5). Then after a discussion of the other perfect numbers 6 and 16 (*Arch.* 3.1.6-8), Vitruvius relates this number to his claim that temples are to be built with symmetry (*Arch.* 3.1.9).

Now, Vitruvius' *On Architecture* was written in precisely ten books. Was this conscious?

[41] Vitr. *Arch.* 3.1.3.

Perhaps if we found an inner 'symmetrical' structure in the books, of the kind Vitruvius finds in the human body, we could answer affirmatively. The most easy way to do this is to explore if there is any 'center'. As it turns out, the two central books, V and VI deal with what seem to be the most important topics for Vitruvius as an architect: public and private buildings respectively. This can be deduced from Vitruvius preface to the whole work in book I, when Vitruvius shows gratitude for the imperial favour in past assignments to him, and states the main purpose of his writing, related to Augustus' extensive program of construction of public and private buildings:[42]

> *cum ergo eo beneficio essem obligatus, ut ad exitum vitae non haberem inopiae timorem, haec tibi scribere coepi, quod animadverti multa te aedificavisse et nunc aedificare, reliquo quoque tempore et publicorum et privatorum aedificiorum, pro amplitudine rerum gestarum ut posteris memoriae traderentur, curam habiturum.*
>
> Owing to this favour I need have no fear of want to the end of my life, and being thus laid under obligation I began to write this work for you, because I saw that you have built and are now building extensively, and that in future also you will take care that our public and private buildings shall be worthy to go down to posterity by the side of your other splendid achievements.

So it seems plausible that, the same as his geometrical conception of the human body, Vitruvius' text was structured around the midpoint of the text, where the central topics of public and private buildings were discussed. At the same time, it is possible that the number of books, ten, is purposely chosen as to coincide with the perfect number which he discusses in connection with his conception of the human body as an architectural structure.

If this was so, we would have in Vitruvius a concept of center which goes hand in hand with the structure in books of his text, thus the same as Ptolemy's in the *Almagest* and in the *Geography*.

However, we do not find anything like what appear to be the 'centers' in the *Tetrabiblos* and *Harmonics*, at exact proportions of the whole length of the text different from 1/2

[42] Vitr. *Arch.* I intr.

(actually 3/4 and 2/3 respectively, cf. above). Nevertheless, Vitruvius' conception of center could help us understand these 'eccenters' of the *Tetrabiblos* and the *Harmonics*. We have seen how for Vitruvius it is important that the parts and the whole harmonize in some way. Now if these points of Ptolemy's treatises at 3/4 and 2/3 did respond to the structure in books as I have hypothesised earlier –this is, that the point 3/4 is special and is situated at the same time in book 3 out of four, and similarly for the point 2/3– Ptolemy would be most ingenuously applying this Vitruvian principle.

As regards the possibility that Ptolemy thought of harmonics for his centers, we don't find any parallel in Varro nor in Vitruvius, even if the latter has a specific section in harmonics, but applied to the construction of theaters (*Arch.* 5.4).

In conclusion, it seems plausible that Ptolemy did not just make up his systems of divisions –neither of the two we have seen–, but coined his own particular versions from already-used systems such as those of Varro and Vitruvius. Actually, we have seen how Varro could have influenced Vitruvius, who nevertheless applied a different system than Varro's. So it would not be surprising that Ptolemy also designed his own system, perhaps related to harmonics.

Similarly as Vitruvius and Varro with their sectioning schemes, Ptolemy could have found a Pythagorean motivation for his sectionings. I have already argued that Ptolemy's 'centers' could reflect a harmonical view of the text, representing ratios of intervals: this could be attached to the Pythagoreans, since it was what was called the 'Pythagorean' approach to harmonics which used ratios, as we have seen in chapter 2. For the five-fold scheme, there could be a similar possibility: four fifths, the point at which the 'last sections' began, is the ratio of the larger interval of the enharmonic genus as proposed by Archytas, which Ptolemy also adopted in his music theory.[43]

Another possibility would be that Ptolemy made an analogy with the four classic elements –earth, water, fire and air– plus aether. The fifth element serves in the account of the

[43]Ptol. *Harm.* 1.13, 1.15.

Timaeus to encompass the all (this would be the 'Pythagorean' connection), and Ptolemy also singles it out in his criterion text (see my chapter 3). Aether could correspond then to the fifth, less mathematical part of Ptolemy's three texts. Both possibilities are not incompatible with each other.

4.5 The five-fold partition and education

As we have seen, while the 'center'-structure was also applied in later works, the five-fold scheme is only encountered in the *Canobic Inscription*, the *Harmonics*, and the *Criterion*.

These three works, which have been studied in the previous chapters, have been dated to the early career of Ptolemy, on the basis that (1) the inscription has been shown to precede the *Almagest* because of its contents, (2) the *Almagest* is prior to almost all other works, (3) the *Harmonics* shares contents and structure with the inscription, and (4) the *Criterion* shares contents with the *Harmonics* and structure with the inscription and the *Harmonics*.

Accepting this chronology, we may now wonder why Ptolemy ceased to apply the five-fold scheme in his later works, whereas he continued to apply the 'center'-structure which he had already applied in the *Harmonics*. Well, on the one hand, as we have seen, the five-fold scheme seems to be related to structure of the 'last sections' in these three works. In this structure, the section occupying the last fifth part featured speculative philosophy, and this last part is not found in other works than these three ones. Secondly, it is easy to see that this latter kind of sectioning conditioned much more strongly the text than the 'center'-structure, since whereas there is only one center in a work, the five-fold sectioning supposes four breaks which were surely difficult to manage.

These two factors suggest that Ptolemy abandoned in later works structures which in modern terms may be qualified as 'purely aesthetic'. I have argued in the previous chapters, especially in the *Harmonics*, how the 'last parts' present looser arguments and a more rapid redaction than the main parts of the works, as if Ptolemy felt just compelled to write them,

as if they were role-playing. For the complete five-fold scheme, I have suggested that some chapter of the *Harmonics* might have been added in the 'right place' in order to fill the corresponding space of one of the parts.

The issue of role-playing takes us back to the *Criterion*, where, as I have argued in the preceding chapter, Ptolemy seems to consciously imitate the discourse of Timaeus in Plato's dialogue. Now I want to explore briefly the influence of rhetorical practice in this text. After this I will come back to the three works presenting the five-fold scheme and show that their topics held a traditional place in the Graeco-Roman education. Ptolemy was plausibly at that stage of his career still in his young age, heavily influenced by both the rhetorical and the philosophical education.

4.5.1 The influence of rhetorical education in Ptolemy's *Criterion*

For my argument, I need to briefly recapitulate what has been said in the preceding chapter. The *Criterion* is a short text defending the main thesis that the criterion of things is structured like a law court, which is presented as a particular case of criterion. Ptolemy begins by outlining his thesis in the first section, explaining his metaphor, and then proceeds to argue in its favour. There is an excurse on the nature of the appropriate language for the investigation, and the main arguments are presented in the third and fourth part in the analysis of intellect and sense perception. The last section discusses a connected topic, the place of the ruling principle.

We have seen how Ptolemy seems to echo the speech of Timaeus in Plato's dialogue at many points of his treatise: firstly the analogy of the criterion with a part of it recalls the introduction of Timaeus' discourse when Timaeus states that the cosmos has the form of a part of it, an animal. Secondly, the discussion of Aristotle's *Categories* in the second section could have been inspired by what was interpreted in the commentary tradition as an allusion to the categories by Timaeus at a certain point. Thirdly, at the end of the fourth part there are probable verbal echoes of parts of Timaeus' speech that can be epistemologically

interpreted. And most clearly, the fifth section follows quite clearly Timaeus' solution to the placing of the parts of the soul in the parts of the body.

In this sense, one could defend the view that Ptolemy's text could be interpreted as a very complex paraphrase of Timaeus' discourse. There was indeed a classical rhetorical exercise, both described by Quintilian and the Alexandrian rhetorician Theon, called 'paraphrase' (παράφρασις/*conuersio*), consisting in 'changing the form of expression while keeping the thoughts' according to the latter.[44] Quintilian similarly says that a paraphrase should 'rival and vie with the original in the expression of the same thoughts'.[45]

The ways in which paraphrase may be practiced according to these authors is also interesting. According to Theon, the student should begin with the simple paraphrase of an argument in a speech, gradually becoming capable of paraphrasing a whole speech (*Progymn.* 110 P). Quintilian says that the speeches containing 'theses' are very useful for paraphrase (*Inst.* 10.5.11). There are some surviving examples of this rhetorical exercise in the papyri, although all of them deal with poetic texts.[46]

A 'thesis' was one of the most typical rhetorical exercises, consisting in a logical investigation of a general topic, which according to most ancient theorists could be either practical (or political) or theoretical: a frequent example of the latter found in the ancient authors is the investigation whether the cosmos is spherical.[47]

Timaeus' discourse could indeed be conceived as containing a thesis, namely the thesis that the cosmos has the form of a living animal. He would begin by stating this thesis, and proving it throughout the whole discourse by describing the analogy in detail.

As Cribiore argues, Plato, along with Demosthenes, was one of the two major authors used in rhetoric education.[48] Furthermore, the *Timaeus* was one of Plato's most well-known dialogues, as can be gleaned from the great number of references to it in the imperial-era

[44]Theon Rhet. *Progymn.* 15 (tr. Kennedy).
[45]Quint. 10.5.4 (tr. Butler).
[46]See examples of paraphrase of poetry in surviving papyri in Morgan 1998, 205-15.
[47]'Hermogenes' 11.20; Aphthonius 41R; Nicolaus Soph. 76.
[48]Cribiore 2007, 150-1.

writers.[49]

However, we should not expect that Plato's philosophy as such was cultivated in the rhetorical schools, as we can glean from the relatively well-documented school of Libanius.[50]

So we may wonder to what extent Ptolemy's rhetorical approach to a deep philosophical text was original. We have already discarded rhetorical schools as plausible places where this sort of texts could have been produced. And yet, Ptolemy's text seems to have the marks of a rhetorical exercise.

There are no traces of philosophical school exercises in the literary or the documentary evidence;[51] actually Morgan thinks that there is no means to distinguish a philosophical 'schooltext' from a 'professional one'.[52] Perhaps the reason is that as Dillon points out, philosophical education was probably mainly oral.[53]

To sum up, I have argued that, although Ptolemy's *Criterion* looks like something similar to a rhetorical exercise applied to a philosophical text, neither the rhetorical nor the philosophical schools seem plausible candidates for having produced such kind of text. For this reason we could say that, even if deeply influenced by rhetoric, the *Criterion* seems to be a genuine authorial project, much in line with the mathematical-philosophical treatises of the *Harmonics* and the *Canobic Inscription.*

This is now a good moment to get back to a more general focus on these three works. In what follows I will show that the topics of these works were the traditionaly ones taught by philosophers in the Graeco-Roman education after the secondary stage, at the same time when rhetoric was traditionally studied with a *rhetor.* This would seem to be a factor concordant with the strong presence of rhetoric in the *Criterion.*

[49]Just to put an example, see Philo of Alexandria's profuse use of the *Timaeus*, studied in Runia 1986.

[50]Cribiore 2007, 151 n. 79: 'Libanius did not have a properly philosophical interest in Plato. It is possible that the traditional dichotomy between rhetoric and philosophy played a role.'

[51]Morgan 1998, 94.

[52]Morgan 1998, 7.

[53]Dillon 1993, xiv.

4.5.2 The mathematical and philosophical disciplines in the Graeco-Roman education

We have said that there are no traces of philosophical schooltexts, probably because philosophical education was mainly oral. However, we have treatises that were probably used by philosophers to teach their students, such as Alcinous' *Didascalicus* (cf. my chapter 3). As regards astronomy, Geminus' *Introduction to the Phenomena* could be an example of an elementary treatise on the general concepts of astronomy. In my second chapter I have mentioned that the so-called Aristoxenian treatises of music theory were basically educational.

These three subjects, the topics of the three early works of Ptolemy on which we are focusing now, were traditionally part of what Greeks and Romans considered the 'common education' or *enkyklios paideia*,[54] along with the reading of Greek and Latin authors, grammar, arithmetic, geometry, and rhetoric basically.

This was the ideal for Quintilian, for example, who recommended the study of music, astronomy, and philosophy as necessary complements for the full comprehension of poetry.[55] For Philo of Alexandria, the encyclical knowledge (τὰ ἐγκύκλια), reached through preliminar studies (προπαιδεύματα) is a prelude to 'wisdom' (σοφία), and includes grammar, geometry, astronomy, rhetoric, music, and logic.[56] Probably it was expected that every educated man had a superficial knowledge of all these disciplines: for example, Libanius, who as we said earlier does not seem to be especially interested in philosophy, nevertheless comments to Themistius in two of his letters judging the proficiency of his pupil Julianus (not the emperor) that he 'can discuss some Plato and some astronomy' (*Ep.* 117, 118).

As Bonner remarks, these studies were pursued in the norm outside the obvious path to rhetorical education, with the aid of a philosopher.[57] However, it was usual that the student

[54]Morgan 1998, 33.
[55]Quint. 1.4.4.
[56]Philo Alex. *Congr.* 11.
[57]Bonner 1977, 79.

felt the need to rapidly develop the techniques that would make him an efficient orator and thus neglected the more theoretical disciplines, mathematics and philosophy.[58]

Ptolemy was surely one who did not neglect them. Probably the *Canobic Inscription*, the *Harmonics*, and the *Criterion* could be seen as a development from his education in these subjects, perhaps his first professional treatises. Very tellingly in this respect, it will be not until later in his career that he will take up less standard disciplines, such as astrology, geography, and optics.

Another interpretation would be possible in this context, namely that Ptolemy wrote on these common subjects because he was seeking the attention of a non-expert audience. Of course, both possibilities are not incompatible; they could actually belong together: Ptolemy could by then have been interested in these common topics both because he had no great experience with more specialized mathematical subjects and *also* because he was not focusing on an expert reader.

4.6 Conclusions

In this chapter we have seen how Ptolemy's works were sectioned according to mathematical patterns. The earlier works –*Canobic Inscription*, *Harmonics*, and *Criterion*– show a highly restrictive division-pattern with five equally long sections, the fifth of which corresponds to the speculative last parts. Later works such as the *Almagest* and the *Tetrabiblos* also show a mathematical pattern, but much simpler in structure and therefore much easier to respect.

Similar –although simpler– patterns can be found in Varro and Vitruvius, who tend to relate it to Pythagorean theories. Vitruvius also has a theory of centers in the human body and the buildings which could likewise be applied to the architecture of his work. Ptolemy seems to be thinking of harmonics, because his sectionings coincide with the harmonic

[58] Ibid., 102-3.

ratios which he has studied in the *Harmonics*.

These features serve to give the book in a fashionable shape. This fits well a bookish world such as Ptolemy's Alexandria, especially in Ptolemy's age. They could have served authorial purposes: Ptolemy by adding these nice sections –his trade-mark?– could have demonstrated his mathematical proficiency, for example. But the allusions must have been powerful, as well: if Ptolemy conceived the sections as Varro and Vitruvius, which is plausible because of the possible Antiochian connection, he could be alluding to Pythagoreanism, too. The hypothesis that Ptolemy was thinking of harmonics would match this possibility, since harmonics –also Ptolemy's as we have seen– was connected with Pythagoreanism. And Pythagoreanism implied connection: Ptolemy connected music, the souls and the heavens through Pythagorean harmonics, this is, bodies of philosophical and mathematical knowledge. This means education, *paideia*. Ptolemy could be thus compared with the sophist who attempted to show his well-rounded, connected, knowledge –*enkyklios paideia*–, not only by means of verbal content, but also through embellishments such as gesture, deportment, and voice.[59]

In the final part of the chapter we have seen how the more restrictedly sectioned works deal with non-specialized topics of common education such as harmonics, astronomy, and logic –here the Platonic influence in Graeco-Roman education is evident–, and how the *Criterion* in particular shows strong features of rhetorical exercices. Both themes may point to an early stage of Ptolemy's career.

[59]See on this Gleason 1995.

Chapter 5

Who was Ptolemy's dedicatee Syrus?

The treatises dedicated to Syrus and Syrus' possible identity

5.1 Plan of the chapter

This chapter is dedicated to the set of treatises by Ptolemy that bear a dedication to a specific individual, comprising six extant works that are addressed to someone just called 'Syrus' without further information. The general aim of the chapter will be to gain knowledge about Ptolemy's working context by means of studying the link between him and his dedicatee, which would be very valuable since the information about Ptolemy's biography is very meager. First I will treat the internal evidence, this is, Ptolemy's works themselves. So in the first part of the chapter I will explore whether something can be learned from the six works dedicated to Syrus as regards Ptolemy's specific readership, or Syrus himself. Since this study demands a brief exposition of the contents of each of the works, this section can serve as a presentation of practically the rest of Ptolemy's extant corpus, since only the *Optics*, the *Geography* and the *Phases* fall outside the scope of my first three chapters and the treatises dealt with here. Within the works reviewed in this section, I will argue that we find different writing patterns, sometimes systematic treatises, sometimes treatises on more

specific topics related to material culture such as the construction of sundials, stellar maps or of planetary models. In conclusion, I will argue that Ptolemy's dedicatee is plausibly a member of the elite class with quite specific interests in the high mathematics of astronomy and spherical geometry.

In the second part of the chapter I will propose a concrete identity for Syrus, namely that of a Roman *curator aquarum* attested in the time of Hadrian, member of a powerful family with links to Egypt and to the imperial family. In principle we cannot know for certain how highly positioned Ptolemy's dedicatee was, and consequently the probability that he has left traces of his existence elsewhere. So my argument will rather gain plausibility from the coherence of the identification, which involves many factors. I shall begin arguing that 'Syrus' was most frequently used as an ethnic name, indicating Syrian nationality, and that this would conflict with Ptolemy's offensive remarks about Syrians in the ethnographic section of the *Tetrabiblos*. In consequence, 'Syrus' would probably not indicate the origin of Ptolemy's dedicatee: I will then suggest the possibility that his name was the result of adapting a foreign name into the Greek language. Then I will make the case that the Roman cognomen 'Sura' would probably appear as Σύρε in Ptolemy's addresses (as it actually appears), if his dedicatee had this name. This will involve first the explanation of the change from the Latin 'u' to Greek υ, and then the change of the ending 'a' for ε. Then I will present what is attested of a family with this cognomen living in Ptolemy's time, and make the case for a specific member of the family who is attested as a *curator aquarum*. My case will include chronological and geographical coherence, social position and scientific interests.

5.2 Introduction

> Ptolemy's biography is practically complete when we have said that his full name was Klaudios Ptolemaios, and that he lived in or near Alexandria, made astronomical observations between the mid 120s and the early 140s of our era,

> and wrote books on scientific topics of which about a dozen have come down to us.[1]

This lack of basic biographical evidence is far from abnormal among the ancient mathematical authors with surviving works, and seems actually typical of the imperial period, when mathematicians appear to work quite isolated, making no reference to contemporaries working in the same field who could serve as time and context references for historians. This is the case of Geminus, Hero of Alexandria, or Diophantus, who also have obscure biographies, even lacking chronological certainty, which is not the case in Ptolemy basically thanks to the *CI* and the astronomical observations he claims to have done in the *Almagest*.

This marks a contrast with the other great scientific figure of Ptolemy's age, which is Galen. We know quite well Galen's life, from his medical initiation after the advice of his father, to his relationship with the emperor Marcus. The situation cannot be more opposite to the case of Ptolemy, a scientist perhaps comparable in his achievements to Galen, but about whom we know practically nothing.

If we take a look at where the information about Galen's life comes from, we may get a clue to explain this big difference. It turns out that most of what we know from Galen comes from the data he provides in his own treatises.[2] In contrast with this, the major part of biographical information about the most famous mathematician in antiquity, Archimedes, comes from works by other authors, such as Cicero or Plutarch.[3] From the other most famous mathematician of antiquity, Euclid, we know practically nothing, and his thirteen books on the *Elements* have been preserved.[4]

There seems to be no place for biographical digressions in the works produced by the

[1] Keyser and Irby-Massie 2008, s.v. Klaudios Ptolemaios (Jones).

[2] Like for example *On his own Books*; cf. Nutton 1973 for a chronology of the early career of Galen drawn heavily from Galen's own observations in this work and others.

[3] Actually the study of Archimedes' biography has turned into a study of the cultural use of Archimedes in the Roman tradition: cf. the work of Jaeger 2008, who does practially not use Archimedes' own writings.

[4] See Keyser and Irby-Massie 2008, 'Euclid': 'we have remarkably little personal information about Euclid'.

mathematicians themselves. This is of course connected with the style of mathematical treatises, which has been described by Netz as a compound of lettered diagrams, formulaic language referring to the diagrams, and a very reduced vocabulary, aiming at necessity and generality.[5] Even the letters (epistolary) preserved introducing some of these works have mathematical content (we will come back to this below), but they at least reveal the relationships between mathematicians such as Archimedes, Conon, Eratosthenes, and others. However, these preserved letters are from the Hellenistic period, and we don't have anything similar for Ptolemy's time. Neither Geminus, nor Hero, nor Diophantus, nor Ptolemy give us information about their contact with other mathematicians.[6]

In this chapter I will try to address practically the only social relationship which one can glean between Ptolemy and one of his contemporaries, namely the dedicatee of half of his corpus. Six out of the twelve extant works of Ptolemy were dedicated to this individual, named 'Syrus' by Ptolemy, whose identity has been not really attempted to reveal in previous research.

First of all, it would be interesting to set out the initial possibilities for the relationship between Ptolemy and Syrus. Just to give a list, from which we can eliminate possibilities in the course of our investigation, Ptolemy and Syrus could be:

1. teacher and pupil

2. fellow mathematicians

3. scientist and amateur friend, divided in:

[5] Netz 1999.

[6] A certain Theon whom Ptolemy names several times in the *Almagest* for having given to him some astronomical observations made in Alexandria could have been an astronomer, but this cannot be proved: cf. Ptol. *Alm.* H2.275: ταῖς παρὰ Θέωνος εἰλημμέναις τηρήσεσιν. Cf. similarly H2.296, 297, 299. Pedersen actually takes for granted that this is Theon of Smyrna, but he does not mention that Ptolemy only names him 'Theon', so that no certainty is possible in that matter –the name 'Theon' was very common: cf. Pedersen 1974, rev. ed. 2010, 13. Keyser notes that the elongation of Mercury resulting from the observations of Ptolemy's Theon is sensibly greater than the one that Theon of Smyrna supplies in his treatise –Keyser and Irby-Massie 2008, s.v. Theōn (Astr.)– and Jones similarly finds this identification 'implausible' –Keyser and Irby-Massie 2008, s.v. Theōn of Smurna.

(a) the dedicatee is just an amateur

(b) the dedicatee is a prominent member of society, so the relationship may be qualified as client (scientist) - patron (the dedicatee)

To put some examples of every category: the first case would be attested in the astrological *Anthology* of Vettius Valens, written for unnamed pupils in astrology;[7] or in Theon of Alexandria's commentaries of the *Almagest* and the *Handy Tables*, addressed to his students, whom he qualifies as 'sons' (τέκνα).[8] Galen has some works of a didactic nature, dedicated to addressees who are treated as pupils.[9] These works show a characteristic familiarity between dedicator and the dedicatee, and they proceed rather straightforwardly and in a practical way, without much rhetorical flourish.

The second case would be that of many mathematicians in the Hellenistic era, such as Apollonius of Perga, Archimedes, and Hypsicles, from whom letters introducing the treatises have been preserved. These letters have actually mathematical content, from which it can be gleaned that the motivation for the writing and sending of treatises was the exchange of mathematical developments.[10] Galen did also write some treatises for practicing doctors.[11]

There remains the third case, which is that of most of Galen's dedicatees, for example, whom he sometimes calls *philiatroi*, 'lovers of medicine'.[12] Galen had among his most frequent recipients members of the elite society who were interested in the art of medicine as part of their general education.[13] However, as Johnson notes, it is sometimes difficult to draw the line between this kind of audience (our number 3) and the others (our numbers 1 and 2) in Galen, perhaps because of Galen's strategy to engage amateurs in 'serious' medi-

[7] Alexander 1993, 62; Riley 1996.

[8] E.g. Theon Alex. *Comm. Synt.* 317: τέκνον Ἐπιφάνιε.

[9] Alexander 1993, 62, who mentions *De constitutione artis medicae ad Patrophilum* and *De pulsibus libellus ad tirones*.

[10] Netz 2009, 3 (Archimedes), 93 (Hypsicles); Netz 1999 120 (Archimedes); Alexander 1993, 47.

[11] Johnson 2010, 86.

[12] E.g. Gal. *Sanit. tu.* 6.269.

[13] Johnson 2010, 81-3.

cal knowledge, so treating them sometimes as pupils or real doctors. On the other hand, as L. Alexander remarks, probably not all the amateurs in Galen's dedications were prominent members of the elite society, but, as Galen himself suggests, most of them were a circle of friends, so falling into our category 3 (a).[14] As regards mathematics, the case of Archimedes and his most frequent addressee, Dositheus, may have been something of this sort, since, as Netz argues, Archimedes does not seem to treat him as a 'real' mathematician.[15]

However, Flavius Boethus, the most frequent dedicatee of Galen's treatises and the only one which is singled out in Galen's own review of his books in *On his own books*, was one of the most prominent members of the Roman society, a man of consular rank, who at the same time had a profound interest in anatomy, as Galen himself recounts.[16] This would be our category 3 (b). Archimedes wrote a treatise to King Gelon of Syracuse, which does not present any introducing letter; Archimedes rather just addresses the dedicatee in the first phrase of the treatise, in the second syntactical position.[17] Loveday Alexander, in her survey of dedications in Graeco-Roman scientific treatises, distinguishes this kind of address, which she calls 'formal', from the one seen in the other works of Archimedes, dedicated to mathematical peers or to friends (the 'epistolary').[18] She traces back this duplicity to two new situations in the scientific culture of the Hellenistic kingdoms: dispersal around the Mediterranean and dependence on the patronage of the Hellenistic courts.[19] However, as she notes, the distinction in the addresses of the treatises sometimes fades out, the 'formal' kind frequently being used for friends.[20]

For his part, Ptolemy gives no precise hints at his relationship with Syrus, addressing him in the first sentence of each of the dedicated treatises[21] with the plain vocative invoca-

[14]Alexander 1993, 62.
[15]Netz 2004, 34.
[16]Alexander 1993, 63; Johnson 2010, 79.
[17]Archim. *Aren.* 2.134: Οἴονταί τινες, βασιλεῦ Γέλων, τοῦ ψάμμου τὸν ἀριθμὸν ἄπειρον εἶμεν τῷ πλήθει.
[18]Alexander 1993, 51.
[19]Alexander 1993, 52.
[20]Alexander 1993, 51: she notes the case of Hypsicles (pr. 1: Βασιλείδης ὁ Τύριος, ὦ Πρώταρχε…).
[21]Plus two more times at the middle (*Alm.* H2.2) and at the end of the *Almagest* (*Alm.* H2.608).

tion 'oh Syrus' (ὦ Σύρε) –this is, what L. Alexander calls the 'formal' kind of address– but without any other qualifier which could shed any light on this issue. Furthermore, since as we have said the 'formal' dedication occur in various kinds of dedications (actually also for the first kind, see e.g. Theon of Alexandria quoted in the note above), this gives us no clues.

What do historians of ancient astronomy think? Pedersen in his study of the *Almagest* qualified Syrus a 'friend or protector',[22] without further explanation. This could correspond to our cases 3 (a) and (b), but perhaps also (2). Alexander Jones writes that 'Ptolemy addresses him as an intellectual peer'.[23] This could also correspond to (2) and (3), since Jones is not specific as whether Syrus would be a mathematician or not, implying just that both seem to share the same intellectual position, thus excluding the case that Syrus was a pupil.

So it seems that these two authorities on the astronomical work of Ptolemy do only exclude the first case, the pupil-teacher relationship. In my survey below on the works of Ptolemy dedicated to Syrus I will try to test this hypothesis and to restrict the answer to only one of the possibilities. On the basis of this result I will briefly present what is known about the kind of relationship that Ptolemy and Syrus seem to share, and I will later proceed to make the case for a specific plausible identification of Syrus.

5.3 The works dedicated to Syrus

The six extant works dedicated to Syrus are the *Almagest*, *Planetary Hypotheses*, *Handy Tables*, *Tetrabiblos*, *Analemma* and *Planisphaerium*. In what follows, we will find common traits to all these works, such as the obvious fact that all these works treat astronomical/astrological problems, as well as interreferences which point to a conception of 'unity' through the works, but we will also encounter interesting contrasts in style and conception –we will find both systematic treatises and monographics dedicated to a specific topic– which will help us defining some picture of the relationship between Ptolemy and his ded-

[22] Pedersen 1974, rev. ed. 2010, 236.
[23] Keyser and Irby-Massie 2008, s.v. 'Suros'.

icatee. I will treat the works in separate headings following the order in the list above –which does not intend to be chronological, but thematical–, grouping for convenience *Planetary Hypotheses* and *Handy Tables* under one heading, the same as the *Analemma* and *Planisphaerium*.

5.3.1 The *Almagest*

This is perhaps Ptolemy's best-known work. Jones' presentation is a good summary:[24]

> This treatise in 13 books attempts to use mathematics [...] to establish models for the motions of the Sun, Moon, planets, and stars. The fundamental assumption is that these motions are combinations of uniform circular revolutions representing the spinning of spherical bodies of *aether*. Starting from appropriately selected observations, subjected to mathematical analysis, Ptolemy demonstrates first the qualitative arrangement and then the quantitative details such as radii and rates of revolution in the various circles.

So we know that Ptolemy's treatise was quite long –13 books is actually very long for a mathematical text, only comparable to Euclid's *Elements*, with the same number of books, and a work quite unique in ancient mathematics.[25] Furthermore, Jones tells us that Ptolemy sought to establish mathematical models for the motions of the Sun, Moon, planets, and stars. This represents a good portion of the ancient astronomical topics, indeed. In this sense, we can say that Ptolemy intended to present a systematic treatment of astronomy.

For the sake of a comparison, Philo of Byzantium wrote various treatises in order to treat all the relevant topics of mechanics: *The lever*, *Harbour construction*, *Artillery construction*, *Pneumatics*, etc.[26] Similarly to Philo, Ptolemy tried to cover the main topics of mathematical

[24]Keyser and Irby-Massie 2008, s.v. 'Ptolemy'.

[25]See Netz 1999, 217-235 on the *Elements*, which Netz, following Saito (cf. ibid. 216, n. 88), describes as the 'tool-box' of Greek mathematicians, a *corpus* of results which are assumed by everyone. Perhaps Ptolemy writing his *Almagest* in the same number of books was claiming a similar status for his treatise (see my preceding chapter on the implications of the distribution of books, especially in Vitruvius). For a comparison, take Archimedes, whose extant treatises do never extend more than two volumes. Perhaps the most comparable could be Apollonius' *Conics*, written in 8 books.

[26]See Keyser and Irby-Massie 2008, s.v. 'Philon of Buzantion'.

astronomy, but in just one work. Ptolemy himself expresses this aim clearly at the end of his preface:[27]

> ὑπομνηματίσασθαι τοῦ μὲν τελείου τῆς πραγματείας ἕνεκεν ἅπαντα τὰ χρήσιμα πρὸς τὴν τῶν οὐρανίων θεωρίαν κατὰ τὴν οἰκείαν τάξιν ἐκτιθέμενοι, διὰ δὲ τὸ μὴ μακρὸν ποιεῖν τὸν λόγον τὰ μὲν ὑπὸ τῶν παλαιῶν ἠκριβωμένα διερχόμενοι μόνον, τὰ δὲ ἢ μηδ' ὅλως καταληφθέντα ἢ μὴ ὡς ἐνῆν εὐχρήστως, ταῦτα δὲ κατὰ δύναμιν ἐπεξεργαζόμενοι.
>
> For the sake of completeness in our treatment we shall set out everything useful for the theory of the heavens in the proper order, but to avoid undue length we shall merely recount what has been adequately established by the ancients. However, those topics which have not been dealt with at all, or not as usefully as they might have been, will be discussed at length, to the best of our ability.

So Ptolemy does not claim originality for his whole treatise, or even for its most part, but acknowledges that his aim is to gather in one book the astronomical theory that has been already established, while completing it in the parts that according to him have not been sufficiently well studied by his predecessors.

Such a comprehensive treatment of a technical topic demands a convenient ordering, so that the reader is first presented with topics not involving previous knowledge, while progressively the new treatments suppose what the reader already knows. Indeed, the very title of the treatise as Ptolemy calls it (*Syntaxis Mathematica*) alludes to an ordering, as Taub remarks,[28]) and is typical of systematic handbooks since the Hellenistic period, like the *Mechanical Syntaxis* by Philo of Byzantium.[29]

From this alone it is difficult to reach a conclusion about the kind of dedicatee that Syrus was, but in principle a systematic treatment of a whole discipline seems to favour especially the cases (1) master-pupil and (3) scientist-amateur, since a mathematician of Ptolemy's rank would probably be interested just in the new developments. This could be

[27]Ptol. *Alm.* 1.1 H1.8 (tr. Toomer).

[28]Taub 1993, 32. 'Almagestum' is the Latin name for the Arabization of μεγίστη, 'greatest'; cf. Pedersen 1974, rev. ed. 2010, 15.

[29]This is, like Ptolemy's, an original title. Cf. Philo *Belopoeica* 56: τῆς Μηχανικῆς συντάξεως.

confirmed by another passage of Ptolemy's preface, where Ptolemy speaks of the level of difficulty of the work: Ptolemy remarks that he has written his treatise 'so that those who are already somewhat advanced may follow'.[30] Indeed, this statement seems to exclude the possibility that Syrus was a fellow mathematician. Actually, at least in theory there would exist the possibility that Syrus was not the intended reader of the treatise, that he was a mediator between Ptolemy and the real intended readership. This would be the case of a school teacher, a mathematician himself employing Ptolemy's treatise for his own pupils.[31] However, this possibility will be automatically discarded in the examination of the next distinction.

Let us go on with the distinction of the two remaining possibilities: (1) pupil-master and (3) scientist-amateur.

A first observation against the first of these options is that in the *Almagest* the scientific concerns seem sometimes to be put above the didactic ones. As Pedersen remarks, the theory of the Moon is much more difficult than that of the stars and of the planets, and nevertheless it is presented in the first place.[32] This can be justified in terms of scientifical coherence: the position of the Moon is used for determining the positions of the stars, and for the determination of the positions of the planets Ptolemy uses a fixed star. From this, Pedersen concludes that the *Almagest* is 'no student's text-book on astronomy, but a monograph on the construction of planetary theories'.[33] It is clear that Ptolemy is concerned more with showing his scientifical proficiency than with making his book readable for everyone. As explained in my chapter 1, Ptolemy was probably among the first astronomers that could geometrically account sufficiently well for the movements of the planets, and he was keen to show his success at this. His identity was that of a scientist, not a vulgarisator of mathematics like for example Nicomachus or Theon of Smyrna.

[30]Ptol. *Alm.* 1.1 H1.8: ὡς ἂν οἱ ἤδη καὶ ἐπὶ ποσὸν προκεκοφότες δύναιντο παρακολουθεῖν.
[31]This has been suggested as a possibility for Diophantus and his dedicatee Dionysius in Knorr 1993, 187.
[32]Pedersen 1974, rev. ed. 2010, 159.
[33]Ibid.

More important is a second observation on the style of Ptolemy's preface. The detailed treatment of this text will be postponed until the next chapter, but now some of the remarks developed in there may be presented here. In his preface, Ptolemy begins classifying mathematics. This classification, to which I have referred in many occasions in the preceding chapters, features mathematics first as an intermediary between physics and theology, and later it is qualified as superior and basic to the two other divisions. I will conclude in there that Ptolemy probably pretended to present mathematics as *the* all-pervasive knowledge, as it were the culmination of the *enkyklios paideia*. Ptolemy's strategy would also be rhetorically empowered by means of delaying the introduction of the main topic of the work, astronomy, until well advanced the text, as well as by presenting astronomy as the basic pursuit of mathematics. In this way the treatise could be introduced as a study on a most general form of knowledge rather than 'simply on astronomy'. As I will argue in more detail in my analysis in there, we could see affinities between that presentation and Galen's program of constructing a continuum between philosophy and medicine, rooted, like Ptolemy's, in empirical experience, and with Vitruvius' defense of architecture as a knowledge resulting from the various liberal knowledges, as it were as the culmination of elite education.

Crucially, similarly as Galen or Vitruvius, Ptolemy appeals to the intrinsic interest and benefits of his discipline, something which he would probably not do if his relationship with Syrus was that of a teacher to a pupil, a relationship which required a more direct approach.[34] In L. Alexander's words:[35]

> Their tone is not that of instruction as of master to pupil. They speak to intellectual curiosity, to academic appreciation of the niceties of an abstruse subject, not to the novice nor layman eager for a few do-it-yourself tips.

If we want to compare with the practice of the authors known to have written for their pupils, it is useful to compare with the tone in Valen's astrological manual and in Theon of

[34]Ptol. *Alm.* pref. H1.6-8. Cf. e.g. Gal. *Alim. fac.* pref. 6.453; Vitr. *Arch.* I.1.11.
[35]Alexander 1993, 59.

Alexandria's commentaries on Ptolemy, where no such appeal is employed.

At the same time, the presence of such a rhetoric on the interest of the own science seems also to exclude the possibility mentioned above that Syrus was someone interested in mathematics only for his own pupils, because such an individual would not need this defence of mathematics, either.

To summarize, the *Almagest* looks like a systematic book for beginners but not written for a pupil, both from the point of view of the internal analysis of the work and from the tone and the informations that Ptolemy gives in the preface. In the analysis of the following works I will try to test this hypothesis.

On the mention of Aristotle in the *Almagest* and Ptolemy's abandonment of Pythagorean impersonation

But before we go on with the other works, let me put forward a speculation arising from a remark on the preface to this treatise. As we will see in the next chapter, Ptolemy attributes the tripartition of theoretical philosophy where he situates mathematics to Aristotle. As has been noted by various scholars, both the tripartition and the general nature of the definitions that Ptolemy makes in the division are Aristotelian, although we cannot say that Ptolemy follows Aristotle in his justification of the tripartition, this is, in the definitions of the three parts of philosophy (cf. my chapter 6). There is nothing extraordinary in this procedure, neither in Ptolemy –we may recall his use of Aristotle's *De Anima* in *On the Criterion*, as well as in the final section of *Harmonics*– nor in the practices of Platonic philosophers of his age like Alcinous in his manual. What is extraordinary is that Ptolemy cites Aristotle's name: this is one of the only three mentions of philosophers in Ptolemy's extant works, the other two being one for Aristotle again and the other for Plato –to reject elements of cosmological models of the former and to accept some of the latter in the same context of the *Planetary Hypotheses* (on which see below).[36] Many topics which are treated

[36]Cf. Feke 2012, 62.

in the preface to the *Almagest* could be easily ascribable to Plato, and instead Ptolemy opted for mentioning only Aristotle, and very early at the beginning, as if giving a Peripatetic stamp to his work. Taub suggested that Ptolemy wished to convey the sense that he was conciliating Aristotle and Plato, not naming Plato because it would have been obvious to Ptolemy's contemporary readers.[37] But nevertheless he mentioned Plato in the *Planetary Hypotheses*.

There is one issue which perhaps ought to be discussed previously to this speculation, which is the following: What has changed from the practice in *Canobic Inscription*, *On the Criterion* and *Harmonics*, perhaps the more philosophical works, and where at the same time no philosopher is mentioned? The answer to this issue will now perhaps appear like a roundabout, but it may give us some insight into the problem of the mention of Aristotle.

As one may easily prove in a superficial inspection of the work, in the *Almagest* Ptolemy does not write speculative philosophy anymore: he does not try to apply his science to theology or psychology anymore as in those three (probably) early works. Actually, only in those three works we find a section where the mode of argumentation is so fundamentally changed, and which can be said to represent an application of the scientifical enquiry to a philosophical one. Even if in the preface to the *Almagest* Ptolemy implied that the mathematician could do so (cf. my chapter 6), from now on he will no more attempt such enterprise.

This seems to be a big change, given the prominence of the philosophical section in the three mentioned works. Let us recall that Ptolemy even distributed this section in a precise proportional space, occupying one fifth of the treatise (cf. chapter 4).

As we have seen, Ptolemy could be said to have used role-playing in these works, portraying his own enterprise as a continuation of Pythagorean science. Since each of these works sought a unity in itself, it could be said that both the scientifical and the philosophical parts were implied in the project. Actually not only the philosophical part of the *Harmonics*

[37] Taub 1993, 34.

echoes the *Timaeus*, but the mathematical theory of the first part seems to be actually based on Archytas. In the *Criterion* this is most clear, since the whole treatise seems to consciously imitate the *Timaeus*. For the inscription, the clear Timaean tradition of the last section and the fact that Timaeus is actually presented as an astronomer in the *Timaeus* would allow to think that Ptolemy was presenting in the mathematical section a development of Timaeus' astronomy.

Now in the *Almagest* we cannot see Ptolemy's enacting of a Pythagorean anymore. Even if in the preface such a project may be evoked (cf. chapter 6), Ptolemy seems now not to perform it himself, as we can note from the absence of that final section on speculative philosophy or allusions to the project in the construction of the theory.

Perhaps with a great work and a specific supporter (if Syrus was that) Ptolemy was more confident that the value of his mathematical research was sufficient, and he maybe felt that he did not need to perform any other demonstration of philosophical proficience. It is possible that in the three 'philosophical' works, Ptolemy was aiming at a wider audience, possibly with no great mathematical proficiency, and that now with Syrus he had encountered someone who valued scientific research as such.

Now what can this other speculation tell us about the fact that Ptolemy mentions Aristotle in the preface of the *Almagest*?

On the one hand, the fact that Ptolemy does not play the role of the Pythagorean mathematician anymore could speak for the fact that Ptolemy mentions philosophers now (and also later in the *Planetary Hypotheses*, differently as has been his practice before). What I mean is that perhaps the impersonation of a Pythagorean philosopher suggested a style similar to that of the pseudo-Pythagorean texts where no philosophers were cited and philosophical ideas were simply appropriated. Now that Ptolemy abandoned that project, he could cite philosophers freely.

But this does not solve the issue of the mention of Aristotle and the non-mention of Plato. However, as we have said, Ptolemy's possible supporter Syrus perhaps had played

a role in the new confidence that is seen in the *Almagest*. Let us recall that probably not many years elapsed from the erection of the *Canobic Inscription* to the dedication of the *Almagest*, since Ptolemy works with observations older than the inscription in this treatise (the observations date from 127 to 141, and the inscription was erected in 146/7). So Syrus may have been a significant influence in this transition.[38]

I would like to speculate with the possibility that Syrus was a Peripatetic or had a sympathy for Peripatetic philosophy, and that Ptolemy for this reason would have wanted to expressly underline the affinity of his own project to Aristotle's conception of knowledge. The obvious parallel for this would be Galen, who encountered an influential Peripatetic circle in Rome truly interested in scientifical matters, supporting Galen's practice even if Galen's identity was mainly that of a Platonist and differed from the Aristotelian viewpoint in crucial points.[39] As Tieleman writes:[40]

> Clearly these Peripatetics occupied a position in Roman society that enabled them to further Galen's career as a medical practitioner. Moreover, they took a sincere interest in Galen's theoretical work. Boethus encouraged Galen to write his *Function of the Parts*, a work clearly inspired by Aristotle's *On the Parts of Animals*. So Galen treated them with respect and repeatedly mentions them by name in *On Prognosis*. In his account of the tumultuous anatomical demonstration he glosses over the fact that it proves Aristotle wrong, which may mean that he spares the Peripatetic sensibilities of his patrons. I assume that men such as Boethus (who after all took Galen's side against his own teacher Alexander) were willing to accept the implications of what Galen had shown. Their being 'Peripatetics' does not appear to involve a sharp division between them and Platonism as opposed schools.

In the same way as Galen wrote a work inspired in Aristotle, Ptolemy could have wanted

[38] I am not taking for granted that the three 'philosophical works' all precede the *Almagest*, but with the probability of this scenario, given that the *Harmonics* and the *Criterion* on the basis of contents and aim have been dated to the same period as the inscription, which in turn has been shown to predate the *Almagest*.

[39] See my chapter 3 on Galen's discussion of the place of the ruling principle, where he defended the Platonic view and criticised Aristotle's cardiocentric position.

[40] Tieleman 2009, 287. For Galen's familiarity with Aristotle's texts and with Peripatetics see also Van der Eijk 2009.

to show that his entire project was Aristotelian, even if he also explained the Platonic implications. We could even suppose that if Syrus was a Peripatetic, Ptolemy could have felt encouraged by this circumstance to give up any demonstration of Pythagorean-Platonic practice as in the final parts of the early triad: perhaps that would have been excessive for a work dedicated to a Peripatetic. We will come back to this hypothesis below.

5.3.2 The *Planetary Hypotheses* and the *Handy Tables*

The *Planetary Hypothesis* is a much shorter work, in only two books –only the first part of the first book is extant in Greek, the rest only in Arabic translation–, which addresses the same topic as the *Canobic Inscription* and the *Almagest*, the mathematical description of the movements of the planets. The work begins recalling the demonstrations in the *Almagest* of the models of the heavenly movements, and states the new purpose:[41]

> ἐνταῦθα δὲ προήχθημεν αὐτὸ μόνον ἐκθέσθαι κεφαλαιωδῶς καὶ ὡς ἂν μάλιστα προχειρότερον κατανοηθεῖεν ὑπό τε ἡμῶν αὐτῶν καὶ τῶν εἰς ὀργανοποιίαν ἐκτάσσειν αὐτὰ προαιρουμένων, ἐάν τε γυμνότερον διὰ χειρὸς ἑκάστης τῶν κινήσεων ἐπὶ τὰς οἰκείας ἐποχὰς ἀποκαθισταμένης τοῦτο δρῶσιν, ἐάν τε διὰ τῶν μηχανικῶν ἐφόδων συνάπτωσιν αὐτὰς ἀλλήλαις τε καὶ τῇ τῶν ὅλων.
>
> Here we have taken on the task of setting out the facts themselves succinctly and in such a way that they can be much more handily comprehended both by ourselves and by people who choose to exhibit them in a mechanical construction, whether they do this in a more naked manner with each of the motions restored to its proper positions by hand, or they accomodate them to each other and to the motion of the whole by mechanical methods.

Later on in the preface Ptolemy adds that he has maintained the general assumptions of the *Almagest*, while correcting some details following more prolonged observations, and simplifying the models to some extent in order that the construction of instruments may be easier.[42]

[41] Ptol. *Plan. Hyp.* H2.70 (tr. Jones, unpublished but with his kind permission).

[42] Ptol. *Plan. Hyp.* H2.72. For a detailed exposition of the changes with respect to the *Almagest*, see Pedersen 1974, rev. ed. 2010, 392.

At the end of the work there is another interesting reference to the use of his treatise in relationship with instrument-making. After the exposition of his models, Ptolemy claims to have found a far simpler theory than his predecessors to demonstrate the movements of the planets; furthermore, he adds, his models describe accurately the phenomena, since everyone who is willing can test the hypothetic positions of the planets by comparing them with actual observations; the hypothetic positions are to be found through instruments and a method equivalent to his theory, and this is said to have been appended at the end of the work.[43]

Firstly, it is interesting that Ptolemy describes the potential user of his method as a 'beginner in the science' ('Anfänger der Wissenschaft' in Nix's German translation of the Arabic version), in a similar manner as the *Almagest* is said in its own preface to have been written for those who have progressed a little in the field. Secondly, Ptolemy says that the method that will help the reader with the instruments showing the hypothetic positions, which is appended to the work, is a set of tables ('dem Tabellenwerk, das auf diese unsre Schrift folgt'), and the description matches the tables compiled under the heading *Handy Tables* as a separate work of Ptolemy.[44]

In consequence, we can say that the immediate prospective readers of these three works –the *Almagest*, the *Planetary Hypotheses*, and the *Handy Tables*, if the latter are to be counted as a separate treatise– were 'beginners' in astronomical science like Syrus. This is remarkable, since the *Handy Tables* have been generally considered to be composed with astrological practice in mind. As Pedersen notes,[45]

> With his Handy Tables Ptolemy simplified the calculation of planetary positions, eclipses, etc. to the utmost possible extent. There can be no doubt that the tables were composed for the benefit of people who had to perform astronomical calculations in great numbers, but without any high accuracy. Only one class of scientists fulfils these conditions, namely the astrologers.

[43]Ptol. *Plan. Hyp.* H2.143.
[44]Pedersen 1974, rev. ed. 2010, 397.
[45]Pedersen 1974, rev. ed. 2010, 400.

Undoubtfully the *Handy Tables* could be very useful for astrologers, and they seem to have been indeed the only success of Ptolemy's science in antiquity that can be accounted for by independent sources: fragments containing the *Handy Tables* or versions related to them are the only extant papyri of Ptolemy.[46] Jones, the editor of the papyri, also links the tables with astrological practices.[47]

How can we match these different views? On the one side, the tables seem to be introduced at the end of the *Planetary Hypotheses* as a method for displaying the movements of the heavens, with no astrological allusion. On the other, this work seems to have been used mainly in astrological practice. Why did Ptolemy not publicize his work for astrology?

Perhaps the introduction of the *Tetrabiblos* in this discussion may help. As is well-known, Ptolemy also wrote an astrological work dedicated to Syrus, the *Tetrabiblos*, but, as we will see below in the section dedicated to it, it seems that this work consists rather an introduction to the science with no aim at practical use. So what we can expect is that Syrus had an amateur interest in astrology, as was customary in elite Romans, not necessarily that he was a practicing astrologer. At least, Ptolemy did not write to him as if he was so; it rather seems that he profited from Syrus' interest in astrology in order to write a work that could also appeal to 'more practical' astrologers, the *Handy Tables*, while at the same time presenting himself as interested in astrology –thus appealing to astrologers– by writing the *Tetrabiblos*. However, as we will see in the analysis of the *Tetrabiblos*, Ptolemy was very careful to maintain his main identity as an astronomer and not as an astrologer in the preface to that work. So perhaps for the same reason he did not allude to astrology in presenting the *Handy Tables*.

But there is another interesting aspect in the purpose of the *Planetary Hypotheses* which may tell us something about Syrus. We have seen that the *Planetary Hypotheses* are declared to be written for anyone willing to construct instruments showing Ptolemy's planetary

[46]Jones 1999, 38-9.
[47]Jones 1999, 4.

theories. However, in that work Ptolemy does not give any concrete instructions for the actual construction of the instruments, this is, he does not write like a mechanician such as Hero or Philo of Byzantium, but he somehow expects his reader to acquire one of these instruments in order to visualise the theory. To acquire one such instrument means perhaps to let it be constructed by a mechanician. This is a different situation from what we find in the *Harmonics*, where Ptolemy gives fairly concrete instructions for the construction of the harmonic canon (in *Harmonics* 1.8), thus counting on the reader's own ability to build his own instruments. On the contrary, in the *Hypotheses* Ptolemy seems to expect Syrus to have familiarity with mechanicians, and the possibility to let models be constructed by them.

Contents of the *Planetary Hypotheses*

Now to the contents of the the treatise.[48] As we have read in the quoted passage of the preface, Ptolemy declares to have written a succint version of the results obtained in the *Almagest*, which allows a more handy representation of the cosmos. The first part of the first book (the only extant in Greek) consists of an exposition of the parameters that define the movements of the planets (including the Sun and the Moon). Ptolemy begins this section with the explanation of the revolution of the whole (the daily revolution of the Earth in modern terms), outlining the main circles, especially the equator and the ecliptic or zodiac; then he explains the concept of the mean nychthemeron, the time in which the cosmos performs a whole revolution as perceived from the Earth with relation to the Sun (which is the 360 degrees corresponding to a whole revolution plus the little portion the mean Sun has traversed in that time).[49]

We may recall that precisely these two parameters, corresponding to the theory on the revolution of the cosmos, are the ones with which the *Canobic Inscription* begins, what I

[48] I will fundamentally work on Pedersen's analysis of the work, which can be found in his book about the *Almagest*, Pedersen 1974, rev. ed. 2010, 391-7.

[49] Ptol. *Plan. Hyp.* H2.74-6.

have supposed to be the part 'principles' of its original title 'Principles and hypotheses of mathematics' (cf. chapter 1). In the *Planetary Hypotheses* Ptolemy justifies this beginning by arguing that the revolution of the whole serves as an example (παράδειγμα) of the other revolutions.[50] This fits pretty well the distinction that seems to exist in the inscription between the principles –the parameters of the revolutions of the whole– and the hypotheses –the parameters of the planets–. In the *Planetary Hypotheses* there follows the exposition of the return periods of the different planets, accounting to the different orbits of each of them: the exposition is in the order of the planets. Again in the order of the planets, Ptolemy provides the parameters of the periods corresponding to each of them, along with the position on the day 1 Thoth of the first year after the death of Alexander (epoch of Philippos). In the *Canobic Inscription*, we found first the parameters of all the planets, and next the positions in 1 Thoth not of Philippos, but of Augustus. So up to now, it seems that this treatise of Ptolemy was a project quite similar to the *Canobic Inscription* in its contents.

Let us go on with the second part of the first book of the *Planetary Hypotheses*, where more parallels with the inscription will be found. The second part of the first book –only extant in Arabic, ignored in the Heiberg edition, and later rediscovered in 1967 by Goldstein[51]– shows Ptolemy giving the cosmos estimates of the distances of all the planets and their probable relative situation.

In what follows I will compare this procedure with Ptolemy's correspondence between the spheres of the planets in the last part of the inscription. For my argument, a little astronomy will be needed: we have seen how in the *Canobic Inscription* and the *Almagest* Ptolemy could compute the distance of the Moon and the Sun. The distance of the Moon was calculated using parallax, the apparent change of position of an object with respect to its background. In the case of the Moon, the background is the stars behind it, which

[50]Ptol. *Plan. Hyp.* H2.72-4: ἀρξόμεθα δὲ ἀπὸ τῆς τῶν ὅλων φορᾶς, ὅτι καὶ προηγεῖται πασῶν καὶ περιέχει τὰς ἄλλας καὶ γένοιτ' ἂν ἡμῖν παράδειγμα πρὸς [τὰ] πλεῖστα...

[51]Goldstein 1967.

changes depending on where the observer is situated on the Earth.[52] Then with the distance of the Moon and data from lunar eclipses (the diameter subtended by both bodies and the diameter of the shadow at a given point) Ptolemy could easily estimate the distance of the Sun, however shaky this calculation could be (cf. chapter 1). But with the planets no similar calculation was possible, because they show no perceptible parallax or eclipses due to their enormous distance, and even their relative positions was a question of convention.[53] The only objective fact establishing some sort of order was the distinct nature of superior –Saturn, Jupiter and Mars– and inferior planets –Mercury and Venus–, the former showing oppositions with the Sun, the later not. This means that the superior planets can at some time be seen around midnight, while the inferior planets only wander very near to the Sun, and thus can be only seen shortly after or before the Sun appears or disappears on the horizon.[54]

We may recall that what we find after the calculation of the distances of Sun and Moon in the *Canobic Inscription* is an exposition of a cosmic scale in the Pythagorean tradition. According to my interpretation, this scale intends to supply an ordering of the planets similar as what Ptolemy intends now in the *Planetary Hypotheses*. We saw that Ptolemy in the inscription could plausibly have fixed the notes corresponding to the Sun and the Moon by means of the numbers established as their distances in the previous section, and then fill up the rest of the notes with the remaining planets (see chapter 1). Well, in the *Hypotheses* Ptolemy begins with the following assumptions, as Pedersen puts it:[55]

1. 'The order of the planets is the same as in the Almagest'.

2. 'The model of each planet is a physical mechanism included in a spherical shell concentric with the Earth'.

[52]See the details of the calculation in Pedersen 1974, rev. ed. 2010, 206-7; cf. Ptol. *Alm.* 5.
[53]Pedersen 1974, rev. ed. 2010, 37.
[54]Pedersen 1974, rev. ed. 2010, 261.
[55]Pedersen 1974, rev. ed. 2010, 393.

3. 'These shells or "spheres" are fitted together in such a way that the outer surface of each one of them coincides with the inner surface of the next one without any intermediate space, either a void or a plenum'.

Let us see how Ptolemy proceeds in order to better understand these assumptions. Ptolemy begins with the shells of the Moon and the Sun: since the Moon's least distance is 33 Earth radii and the maximum is 64, the inner and the outer radii of its shell have these values respectively, and in it are included all the epycicles and mechanisms corresponding to the Moon. As in the *Canobic Inscription*, the spheres of the Earth, Water, Air and Fire extend below the sphere of the Moon. They are included here, with the previous assumptions, in a sphere of radius 33 Earth radii.[56] For the Sun Ptolemy uses the distance of the *Almagest* (not that of the inscription), 1210, which is understood as mean distance. Given that the excentricity is 1/24, the minimum and maximum values of the sphere of the Sun here are $1210 - \frac{1210}{24}$ and $1210 + \frac{1210}{24}$ respectively, this is, 1160 and 1260.[57]

Now Ptolemy has built the concentric shells of the Moon and the Sun, which have a void space in between, since the outer radius of the shell of the Moon (64) is far inferior to the minimum radius of the shell of the Sun (1160). Following his order of the planets (the assumption 1), between the Sun and the Moon should be placed the planets Mercury and Venus. Ptolemy cannot calculate the distances to any of those planets, so that he cannot fix the dimensions of their shells in the same manner as he has done with those of the Moon and the Sun. Ptolemy's solution is his third assumption, namely, to suppose that there is no void space between one sphere and the next. With this hypothesis (which cannot be proven, as Ptolemy knows and expresses[58]) the outer radius of each shell coincides with the inner radius of the next nested shell.

There remains one problem, namely, how does Ptolemy calculate the width of the shells,

[56]Pedersen 1974, rev. ed. 2010, 394.
[57]Ibid.
[58]Pedersen 1974, rev. ed. 2010, 395-6, cf. Goldstein 1967, 9.

this is, the difference between the inner and the outer radii of each shell? Apparently Ptolemy has no problem with this, since he derives from each of his planetary models the ratio between the minimum and the maximum distances.[59] This means that even if Ptolemy cannot calculate the absolute distances of the planets, his geometrical models allow to compute the ratio between the minimum and the maximum distance of every planet. With these data Ptolemy can finally fill up the whole system, beginning by nesting the shell of Mercury above that of the Moon. I will go through this example in order to make the process clear: Ptolemy knows that the ratio between the maximum and minimum distances of Mercury is 88:34. So in order to nest it around the shell of the Moon, he posits the inner radius of Mercury's shell the same as the outer radius of the shell of the Moon, this is, 64. By doing so he supposes that the minimum distance of Mercury is 64. So the maximum distance is obtained from the ratio 88:34: $64 \times \frac{88}{34} = 166$.

Now Ptolemy uses ratios of the minimum and maximum distances for the other planets as inferred from the geometrical models,[60] and fills up first the space between the Moon and the Sun, corresponding to the inferior planets Mercury and Venus. Then he goes on with the superior planets, which he places in shells envolving that of the Sun.

Ptolemy knew that this was an hypothetic procedure, and that his assumptions about the shells were only theoretical possibilities that gave a more graspable image to his universe as was his declared purpose in his preface. The same may have applied for the final section of the *Canobic Inscription*. However, it is worth noting that the solutions which Ptolemy chose in each work were very different. The Pythagorean and Platonic music of the spheres was abandoned in the *Planetary Hypotheses* for a physical description of nested spheres, in the tradition of what Aristotle reported in *Metaphysics* Λ on the spheres of Eudoxus and Callippus, the tradition that Aristotle himself adopted.[61]

It will be interesting to hear what Ptolemy has to say in the rest of his work about these

[59] Pedersen 1974, rev. ed. 2010, 394.
[60] Ibid.
[61] Arist. *Metaph.* 1073b31-1074a14.

nested shells. As we will see, the Aristotelian nature of this modelling will be confirmed.

In the first part of the second book Ptolemy deals with the physical nature of the nested spheres which he proposes. The spheres are supposed to be material, actually made of unchanging aetherial substance; their movement around their various poles is effortless and emanates from the star within them.[62] Now comes the part where Ptolemy cites Plato –the only time in his whole extant corpus– and then Aristotle, twice. Firstly Ptolemy argues that two models are possible, the first consisting in spheres, and the second in parts of spheres, like, he says, 'tambourins, belts, rings, or whorls as Plato says'.[63] What Ptolemy is implying here is that the regions distant from the equator in the spheres are not necessary at all, since the planets do not depart far from that place, i.e. they do not show much latitudinal movement.

The references to Aristotle in the next pages are connected with this observation about the possibility to manage without the polar regions of the spheres. The argument going on in there is that in Aristotle it made sense to have the whole spheres, because the poles revolved in a fixed point of the sphere immediately above –let us imagine a hole in which the extremes of the poles were stuck–. Because of this model Aristotle had to postulate spheres with contrary movement in order to account for the second anomaly of the planets –this is the second of Ptolemy's citations–. Ptolemy's point is that these parts are not necessary anymore because each sphere has multiple poles not fixed in any other sphere.[64]

From Ptolemy's text we can see that Ptolemy is not being polemic against Aristotle. He rather groups Aristotle with the first Greek astronomers ('diejenigen nun, die den Anfang

[62]Ptol. *Plan. Hyp.* H2.111 (in Nix's German translation of the Arabic text): dass die ätherischen Körper keine Beeinflussung zulassen und sich nicht verändern [...] gemäss dem, was ihrem wunderbaren Wesen zukommt, und der Ähnlichkeit mit der Kraft der Gestirne, die darin sind, deren Strahlen deutlich alle die rings um sie zerstreuten Dinge unbehindert und unbeeinflusst durchdringen.

[63]Ptol. *Plan. Hyp.* H2.113. Heiberg points to *Republic* X 616d.

[64]Ptol. *Plan. Hyp.* H2.114: [The old astronomers] führen die Annahme vollständiger Sphären auf physikalische Betrachtung zurück; denn sie haben gesehen, dass bei den Sphären, die wir konstruieren, die Sphärenbewegung notwendigerweise zwei Punkte, die die Sphäre berühren, hat, nämlich die sogenannten Pole [...] So stützten sie sich auf die Behauptung davon, wie es Aristoteles auch tat, dass die Pole der eingeschlossenen Sphären auf den umgebenden Sphären festsässen.

ihrer Vergleichung bei den Sphärenbewegungen, wie wir sie ansehen, machten', *Plan. Hyp.* H2.114) –he surely thinks of Eudoxus and Callippus, at least, both appearing in Aristotle's report– who essayed a physical description (Ptolemy speaks of 'physikalishe Betrachtung') of the cosmos based on astronomical observations. Ptolemy seems to be making here a historical point, and at the same time aligning himself with the old history of astronomy, and with Aristotle in particular.

There is a further clue that could help establishing the nature of Ptolemy's relationship with the Aristotelian tradition. Towards the end of the book, Ptolemy makes a count of the total number of spheres that he has used to represent the movement of the planets.[65] This has a clear parallel in Aristotle's report in book Λ of the *Metaphysics*, when also towards the end Aristotle counts 55 spheres (or 47 in an alternative count).[66] Ptolemy is proud to count only 41 (or 34 in an alternative count, too). Here we could compare again with the ending of the *Canobic Inscription*, where Ptolemy gives hints that allow to recognise the Timaean tradition, into which he probably wished to be seen.

All this is fully compatible, and perhaps even suggestive, of our hypothesised Peripatetic connection of Syrus. As we mentioned earlier (cf. chapter 1), Aristotle plainly disapproved the Pythagorean notion of the music of the spheres. Ptolemy does not mention this theory in the *Hypotheses* (nor anywhere else in his astronomical works) which he clearly spoused in the inscription, and even harmonic theory appears only briefly treated in the *Tetrabiblos*.[67]

In the last part of the treatise –the second part of the second book– Ptolemy describes geometrically and at length the internal mechanisms of the spherical shells in a detailed account for every planet, presenting the epicycles as spheres travelling in void spaces withing them (between the internal and the external spheres that define each shell). As Jones notes, the picture of two spherical, concentric spheres of aether, rotating together with an epicycle which in turn rotates in the gap between them is already found in Theon of Smyrna's

[65] Ptol. *Plan. Hyp.* H2.142.
[66] Arist. *Metaph.* 1074a10-14
[67] Ptol. *Tetr.* 1.13, 1.17.

account of astronomy in his *Mathematics Useful for Reading Plato*, so it should not be considered original of Ptolemy, although it was probably not much older than that.[68]

5.3.3 The *Tetrabiblos*

Ptolemy's *Tetrabiblos* has been since Late Antiquity the most famous work on astrology.[69] One commentary –sometimes attributed to Proclus– and one introduction attributed to Porphyry are extant from that time; we also have a probably later lengthy summary of the work known as the Proclus paraphrase.[70]

Although in the nineteenth century some scholars had concerns about Ptolemy's authorship, no one doubts today that Ptolemy wrote the treatise, given that, as Boll demonstrated, the language and the contents of the work are fully compatible with the rest of Ptolemy, and that there are no objections to the fact that an astronomer in the second century believed in astrology, since by that time astrology was firmly established, and continued to be in posterity, so that astronomers up to the time of Kepler normally adopted or supported the cause for astrology.[71]

Let this suffice for the issue of authenticity. As regards astrology itself, it will be useful to provide a brief introduction to its history within the culture of the Graeco-Roman world, since this is a new subject for us.[72]

By Ptolemy's time astrology had become a culturally normalised lore. To form a global picture of its influence, it will be more fruitful now to leave out the analysis of the surviving astrological treatises. We can track down its history within the Graeco-Roman culture both through the direct evidence of surviving horoscopes, and from the reflections in con-

[68]Jones 2005b, 27.

[69]'Tetrabiblos' or 'Quadripartitum' is the most common name, actually in the manuscripts *Mathematikē Tetrabiblos Syntaxis*. Other manuscripts have the title τὰ πρὸς Σύρον ἀποτελέσματα ('The prognostics addressed to Syrus'); cf. Robbins 1940, introduction.

[70]See Heilen 2010, 65.

[71]Robbins 1940, introduction. Cf. Boll 1894, 111-181.

[72]For this part of my analysis I will use abundantly Long's article about the sceptical debate on astrology in the Greek and Roman worlds (Long 1982).

temporary writers. The first kind of evidence shows a normal distribution beginning in the second half of the first century BCE,[73] with a peak between 150 and 300 CE and vanishing after 400 CE.[74] So the beginning of the peak coincides with the dating of the datable works of Ptolemy.

From the other kind of evidence, we know that Stoic philosophers (e.g. Diogenes of Babylon) became interested in astrology from the mid-second century BCE onwards (the date of Hipparchus), which launched the first attacks, from Academic sceptics (e.g. Carneades) and also from other Stoics (e.g. Panaetius).[75] From Augustine we know that Posidonius favoured astrology, but there are no technical astrological details ascribed to him that allow us to define him as a strong supporter.[76] However, as Long acknowledges, the rise of astrological practice in the Graeco-Roman world should be thought rather in connection with its social history within the empire than with a strong defense by serious thinkers.[77] In this respect, it is significant that astrology was important to philosophers not in a positive way, but for the development of the arguments against it among the Sceptics.[78]

The big change with respect to our vision of the character of astrology is maybe not that this kind of prediction has now been discarded as a valid discourse about reality, but that, on the other extreme of the scale, scientific discourse has now an established position at the very top of validity, which it did not have in ancient times. As we will see in the next chapter, Ptolemy was in fact the rarity in defending the higher place of mathematics in the degree of validity. Galen's project could have been the companion to Ptolemy's in

[73]The three oldest known Greek horoscopes are dated respectively to 71, 62, and 42 BCE: see Neugebauer and Hoesen 1987, 14-16 and 76-98.

[74]See the nice graphic summarizing the totals of horoscopes for periods in all known sources, in Jones 1999, 6.

[75]Long argues that since Cicero, in his attack of astrology, does not use the arguments of the Sceptic Carneades –who had written against Chrysippus' *On divination*– then it is likely that for Chrysippus astrology was at most only a subordinate means of divination: Long 1982, 169.

[76]Augustine was referring to a lost section of Cicero, probably in *De Fato*, attacking Posidonius for proposing as an explanation of simultaneous illness of two brothers the fact that they were born and conceived under the same stellar positions: Posidonius F114 Edelstein-Kidd (=August. *Civ. Dei* 5.2). Cf. Long 1982, 170.

[77]Long 1982, 171.

[78]Long 1982, 191. Among the later Sceptics we count Favorinus and Sextus; see Long's survey of them in Long 1982, 183-7.

medicine: but they were in fact difficult reactions, ways to differentiate themselves from a world that praised rhetoric play above the truth of a logical argument. This world also wildly believed in astrology, and Ptolemy was, like Galen, not excluded from it. So Ptolemy did not renounce to treat astrology, a strong value in popular culture which he could easily appropriate, since it was contiguous with his astronomical science.

But how did Ptolemy address astrology, without contradicting his own project of situating mathematics at the top of knowledge? A useful disclaimer would be to establish the difference in the degrees of validity of both kinds of knowledge. Indeed, the *Tetrabiblos* famously begins with the statement of the essential difference in accuracy of astronomy and astrology: while prognostication by means of mathematics –as shown in the *Almagest*, Ptolemy reminds– is a secure method of prediction, astrology holds clearly a lower degree, because it deals with non-celestial events which for this reason are liable to continuous change.[79]

The impression is that Ptolemy tried to keep distance from astrological practice, not loosing face as the mathematical astronomer which he was, but at the same time allowing himself the possibility to talk about astrology. Thus, his preliminary chapters consisted in a cool-minded defense of astrological practice, the kind of defense that we could expect of the astronomer who would not have liked to diminish the validity of his mathematical methods in his other works (which he had taken pains to explain) but at the same time willing to engage in a serious study (to the highest possible degree) of astrology. This could be a first sign that Ptolemy was not writing here for professional astrologers, but rather for amateurs, the same who were interested in his mathematical works (let us not forget that Syrus was also the dedicatee of the *Tetrabiblos*).

While downplaying the status of astrology as secure knowledge, Ptolemy nonetheless secured its viability by linking it to his astronomical model of the cosmos. He adopted

[79]Ptol. *Tetr.* 1.1.2: περὶ δὲ τοῦ δευτέρου [astrology] καὶ μὴ ὡσαύτως αὐτοτελοῦς ἡμεῖς ἐν τῷ παρόντι ποιησόμεθα λόγον κατὰ τὸν ἁρμόζοντα φιλοσοφίᾳ τρόπον καὶ ὡς ἄν τις φιλαλήθει μάλιστα χρώμενος σκοπῷ μήτε τὴν κατάληψιν αὐτοῦ παραβάλλοι τῇ τοῦ πρώτου καὶ ἀεὶ ὡσαύτως ἔχοντος βεβαιότητι…

the Aristotelian theory of the four elements, earth and water the closer to us, air and fire limiting with the celestial aether and being affected by it –an item of Stoic cosmology[80]– (*Tetr.* 1.2.1). Positing this permeability is the way Ptolemy attached the sublunar world to the superlunar. Then, in order to build a rational theory on the effects of the heavenly bodies, he used the same Aristotelian properties of the elements which we have seen used in the final part of the *Criterion* when theorizing about the link between body and soul (see my chapter 3). He posited the properties of heating and drying for the Sun –because it is akin to fire, as Ptolemy says–, and humidifying and heating for the Moon –because of the intermediary nature of the Moon between the moistening Earth and the heating Sun (*Tetr.* 1.4.1). So we can see here a similar analogic thinking as in the *Criterion*, and perhaps this coincidence is more than that, possibly being influenced by the Timaean conception of the world as a human being (on which see my chapter 3).

This could be Ptolemy's first defense of astrology: his linking it with his cosmology. However, his defense continues throughout the first three chapters. In what follows I will review these chapters, with the aim of further establishing Ptolemy's position as regards astrology and consequently the readership that he had in mind for his treatise.

Ptolemy spends the first three chapters of the *Tetrabiblos* arguing for the possibility and the utility of astrology. One could say, with Long, that 'from our own [modern, scientifically-minded] perspective, seldom have knowledge, intelligence, and rhetorical skill been more misused than in the opening three chapters'.[81] Indeed, as Long's survey shows, Ptolemy's defense is the only ancient account which responds to almost every Sceptic attack since Carneades.[82] Ptolemy begins by skillfully presenting the evidences of the celestial effects in a diminishing degree of credibility, from the effects of the Sun and the Moon to those of the fixed stars and the planets. His defense is partly made of important disclaimers about the reliability of astrology, such as the vulgarization of the practition-

[80]Long 1982, 179.
[81]Long 1982, 178.
[82]Long 1982, 180-183, 192.

ers. Here he compares with philosophy and the false philosophers (cf. on this my remarks in chapter 6): 'we need not abolish philosophy on the basis that there are evident rascals among those that pretend to it'.[83] The expert can also make errors due to the difficulty of the enterprise (*Tetr.* 1.2.14), but this difficulty has to do with its divine nature (*Tetr.* 1.2.20). So Ptolemy turns an argument against astrology (the unacurateness of its methods) into an argument in favour of practicing it (its divine, Platonic character).

Most importantly, astrological issues do not completely determine human life (*Tetr.* 1.3.6). Although astrological configuration is basic, many other aspects are important, such as genetics, geography and customs (*Tetr.* 1.2.20). This is a fitting answer to another of the classical sceptic attacks on astrology, in which the major importance of factors other than the influence of the stars is stressed, as we see for example in Cicero.[84] Cicero argues that medicine would not help people if astrology was completely effective. To this argument, Ptolemy cleverly responds that precisely because astrology is not completely deterministic, other kinds of knowledge can be used along it, and compares precisely with the methods of medicine:[85]

> μήτ' αὖ πάλιν πάντα ἡμῖν αἰτεῖν παρ' αὐτῆς, ἀλλὰ ἀνθρωπίνως καὶ ἐστοχασμένως συμφιλοκαλεῖν καὶ ἐν οἷς οὐκ ἦν ἐπ' αὐτῇ τὸ πᾶν ἐφοδιάζειν καὶ ὥσπερ τοῖς ἰατροῖς ὅταν ἐπιζητῶσί τινα καὶ περὶ αὐτῆς τῆς νόσου καὶ περὶ τῆς τοῦ κάμνοντος ἰδιοτροπίας, οὐ μεμψόμεθα λέγοντες, οὕτως καὶ ἐνταῦθα τὰ γένη καὶ τὰς χώρας καὶ τὰς τροφὰς ἢ καί τινα τῶν ἤδη συμβεβηκότων μὴ ἀγανακτεῖν ὑποτιθεμένους.
>
> Nor, further, should we gropingly and in human fashion demand everything of the art, but rather join in the appreciation of its beauty, even in instances wherein it could not provide the full answer; and as we do not find fault with the physicians, when they examine a person, for speaking both about the sickness itself and about the patient's idiosyncrasy, so too in this case we should not object to astrologers using as a basis for calculation nationality, country, and

[83] Ptol. *Tetr.* 1.2.13: οὐδὲ γὰρ φιλοσοφίαν ἀναιρετέον, ἐπεί τινες τῶν προσποιουμένων αὐτὴν πονηροὶ καταφαίνονται.

[84] See the arguments in Cic. *De Div.* 94-96; cf. Long 1982, 177.

[85] Ptol. *Tetr.* 1.2.20 (tr. Robbins).

rearing, or any other already existing accidental qualities.

Ptolemy also turns the argument of non-absolute determinism, traditionally an alleged defect of astrology, into an advantage. Precisely, because life is not entirely determined, because the sublunary world is continually liable to change, future events may be changed by humans (*Tetr.* 1.3.6). Another interesting argument which Ptolemy puts forward is that astrology may be used for habituating the soul to events that cause excessive joy or pain (because it can predict them), says Ptolemy, thus pursuing the analogy with medicine (*Tetr.* 1.3.5).

This latter argument reminds very much of Posidonius' profilactic argument against disruptive emotions.[86]

> διότι πᾶν τὸ ἀμελέτητον καὶ ξένον ἀθρόως προσπῖπτον ἐκπίπτει τε καὶ τῶν παλαιῶν ἐξίστησι κρίσεων, ἀσκηθὲν δὲ καὶ συνεθισθὲν καὶ χρονίσαν ἢ οὐδ' ὅλως ἐξίστησιν, ὡς κατὰ πάθος κινεῖν, ἢ ἐπὶ μικρὸν κομιδῇ.
>
> The reason [why distress (λύπη) is caused by fresh opinion] is that if anything we are unprepared for or is strange to us suddenly hits us, it knocks us off balance and displaces our old judgements; while what is practised, familiarised or prolonged either doesn't disturb us at all to give rise to emotionally disturbed movement, or only to a very limited extent.

This takes us to a short digression on the possible sources of Ptolemy for this defense of astrology. Posidonius was proposed by Boll as Ptolemy's primary source in the introduction of the *Tetrabiblos*.[87] Anthony A. Long casts doubts on Boll's arguments, alleging that there is no strong evidence for Posidonius' treatment of astrology, and that philologers of Boll's time tended to attribute a lot of material of later authors to Posidonius without concluding evidence.[88] However, Long does not offer arguments against those of Boll, and the issue should be left open for the moment.

[86]Posid. F165 Edelstein-Kidd (=Gal. *Plac.* 4.416-27) (tr. Kidd).
[87]Boll 1894, 133-156.
[88]Long 1982, 184 n. 39.

Given that there was an ongoing sceptical debate on the validity of astrology, it seems actually not implausible that Ptolemy had read somewhere arguments of the kind he uses (rather than making them all up himself), and Posidonius seems to be a good candidate, for the reason that Posidonius' motivation could have been similar to Ptolemy's. As a matter of fact, Posidonius' aim in defending some of the fundamentals of astrology seems to have been to support the Stoic principle of *sympatheia*, the connection between parts of the cosmos, which Ptolemy also seeks between earthly and celestial worlds.[89] Furthermore, Posidonius wrote abundantly on meteorology,[90] the ancient science predicting weather conditions from star configurations –thus with similar principles as astrology–, on which Ptolemy was also interested, since in the second book of his work *Phases of the fixed stars* he appended a parapegma noting (as was customary for such devices) meteorological conditions for each day.[91] Both authors wrote also extensively on geography, a knowledge that appealed the Roman elite.[92]

Back to Ptolemy's *Tetrabiblos* and the image Ptolemy projected of himself, it would be interesting to compare the approach of Ptolemy's treatise with the other extant astrological treatises close to his time. We may begin with Vettius Valens' *Anthology*, a treatise on practical astrology for a learner of its methods, featuring many concrete examples of horoscopes and showing the use of tables.[93] The contrast between the aims of the two writers is evident. Most conspicuously, Valens does not even raise the question whether astrology is reliable, which is devoted so much space in Ptolemy. On the other hand, we find no trace of the practical methods and of the specific examples of horoscopes in Ptolemy's work. Ptolemy's indication that he writes 'in the manner of an introduction' may be illuminating

[89]Long 1982, 170.

[90]A work in at least seven books with the title *Meteorological phenomena*: Posid. F17 Edelstein-Kidd (=DL VII.144).

[91]Ptol. *Phas.* H2.14-65. Unfortunately the first book of the treatise is lost and we do not know if Syrus was the dedicatee, but on the basis of its topic it seems a reasonable guess that it was.

[92]Ptolemy's *Geography* is not dedicated, however, as we will see below.

[93]See Riley 1996 for the biography and the methods of Vettius Valens.

in this respect,[94] maybe indicating that he does not want to go into the specific application of the science. We may perhaps compare with Nicomachus' *Introduction to Arithmetic*, or with his *Manual of Harmonics*, which do clearly not have a hands-on approach, but were rather intended for entirely non-practicing amateurs.

Another ancient astrological treatise, that of Firmicus Maternus, is a closer parallel for Ptolemy's. The treatise, written in the fourth century CE, consists of a theoretical exposition of astrology, in the same vein as Ptolemy's but much longer and originally in Latin –one of the declared purposes of the treatise, in view that there were no Latin astrological introductions; actually, the author complains precisely of the fact that the only available astrological texts in Latin had been written for experienced readers, making it clear that the intended readership of the treatise was the complete beginners.[95]

> *Fronto enim noster Hipparchi secutus antiscia ita apotelesmatum sententias protulit, tamquam eum perfectis iam et cum peritis loqueretur, nihil de institutione, nihil de magisterio praescribens. Sed nec aliquis paene Latinorum de hac arte institutionis libros scripsit.*
>
> Our Fronto,[96] who published rules for forecasting by the stars, followed the antiscia theory of Hipparchus: nevertheless, since he was dealing with trained and experienced men, he wrote nothing about the theory nor about basic principles. As a matter of fact, hardly any other Latin authors have written about the principles of this science.

In the preface to the first book, Firmicus introduces his work as his offering to his dedicatee, following a learned conversation they had held. The dedicatee in question was the consul Q. Flavius Maesius Egnatius Lollianus Mavortius. It is interesting for our investigation that Firmicus lists the subjects discussed with Mavortius that led to Firmicus' proposal, namely the geography and the wonders of Sicily –the birthplace of Firmicus– and, especially, astronomy:[97]

[94] Ptol. *Tetr.* 1.3.20: ποιησώμεθα δὲ ἤδη τὸν λόγον κατὰ τὸν εἰσαγωγικὸν τρόπον.
[95] Firm. Mat. II pref. (tr. J. Rhys Bram).
[96] This is not M. Cornelius Fronto, the teacher of M. Aurelius and L. Verus whom we will encounter below.
[97] Firm. Mat. I pref.

> *Ad ultimum ad Archimedis sphaeram sermonis atque orationis tuae ordinem transtulisti ostendens mihi divini ingenii tui prundentiam atque doctrinam: quid novem illi globi, quid quinque zonae, quae diverso naturarum genere colorantur, quid duodecim facerent signa, quid quinque stellarum sempiternus error operetur, quid Solis cotidiani cursus annuique reditus, quid Lunae velox motus assiduaque luminis vel augmenta vel damna, quantis etiam conversionibus maior ille quem ferunt perficeretur annus, qui quinque has stellas, Lunam etiam et Solem locis suis originibusque restituit, qui mille et quadrigentorum et sexaginta et unius anni circuitu terminatur; quae ratio orbem lacteum faciat, quae defectionem Solis ac Lunae…*
>
> Finally you shifted the conversation to the globe of Archimedes and showed me the wide range of your knowledge. You described the uses of the nine spheres and the five zones, each with their different coloring. You mentioned the twelve signs of the zodiac and the effects of the five eternally wandering planets; the daily and the annual path of the Sun; the swift motion of the Moon and its waxing and waning; the number of revolutions it takes to make the greater year, which is often spoken about, in which the five planets and the Sun and the Moon are brought back to their original places; it is completed, you said, in the 1461st year. We went on to the explanation of the Milky Way and the eclipses of the Sun and Moon…

Many of these items of astronomical knowledge may have been usual knowledge of every educated Roman. But at least the fact that Mavortius mentioned a precise number for the years contained in the Great Year (cf. the Keskintos inscription in chapter 1 for this concept) suggests a strong interest in mathematical astronomy for his part, which was not that common.

If we take a look at the career of this consul, we will discover that before being consul, Mavortius had held a post of *curator aquarum* in 328 CE,[98] which is thought to have involved a great number of technical issues. The curators of the Roman water supply formed part of the very reduced number of Roman elite individuals with reasonably high mathematical knowledge. The office had been held by Sex. Iulius Frontinus at the end of the first century

[98]Chastagnol 1962, 118; Robinson 1992, 137.

CE, who produced a highly technical treatise on the aqueducts of the city of Rome, which is still extant, as well as sections of the *corpus agrimensorum*.[99] The other famous *curator aquarum* is undoubtedly M. Vipsanius Agrippa, who in addition to his great building project is known to have written, similarly as Frontinus, a technical commentary on aqueducts, as well as a famous map probably of the entire inhabited world, displayed in the Porticus Vipsania, and a work on geography.[100]

The connection with geography is interesting for us. Agrippa, the same as Mavortius, had a strong geographical interest. We may wonder whether Ptolemy's dedicatee Syrus shared this interest, as well. In this context, it seems somewhat puzzling that Ptolemy's *Geography* was not dedicated to Syrus, unlike the astronomical works. Berggren and Jones argue that this work was previous to the *Handy Tables*, on the basis that the table of famous cities in the latter work follows the order of cities in the *Geography*, determined by the very geographical project.[101] This would mean that Syrus was alive when Ptolemy published his *Geography*, and probably that Syrus was not that interested in Ptolemy's geography as he was in his astronomy. But even if the argument of Berggren and Jones would not be correct, the standard view that the *Geography* is a late work would probably confirm Syrus' lack of interest in that discipline. However, we can not say that this was what Ptolemy believed: as a matter of fact, Ptolemy announces his geographical project already in the *Almagest*,[102] so that probably Ptolemy initially expected Syrus to have an interest in geography, such as the one that Romans like Agrippa, Mavortius, or Posidonius' readers had. Syrus perhaps surprised Ptolemy in having a much more genuine interest in mathematical astronomy than he expected.

[99]See Keyser and Irby-Massie 2008, s.v. 'Sex. Iulius Frontinus'. See a recent article on the political play in Frontinus' *On Aqueducts*, König 2007, esp. 186-191 for the very technical part of the treatise on the detailed account of the measures of the pipes in the city of Rome.

[100]See Keyser and Irby-Massie 2008, s.v. 'M. Vipsanius Agrippa'.

[101]Berggren and Jones 2000, 50.

[102]Ptol. *Alm.* H1.188: λείποντος δὲ τοῖς ὑποτιθεμένοις τοῦ τὰς ἐποχὰς τῶν καθ' ἑκάστην ἐπαρχίαν ἐπισημασίας ἀξίων πόλεων ἐπεσκέφθαι κατὰ μῆκος καὶ κατὰ πλάτος πρὸς τοὺς τῶν ἐν αὐταῖς φαινομένων ἐπιλογισμοὺς τὴν μὲν τοιαύτην ἔκθεσιν ἐξαιρέτου καὶ γεωγραφικῆς ἐχομένην πραγματείας καθ' αὑτὴν ὑπ' ὄψιν ποιησόμεθα.

As for Firmicus himself, a man of rank in the Roman empire if not as high-positioned as his dedicatee,[103] he does not give any hint of being an astronomer, but actually presents the situation in the preface as an exchange: while Mavortius illustrated him about mathematical astronomy, he would write a treatise for him about astrological matters, even if he was no expert in the field as he himself admits.[104] Although such a confession might be thought of as a statement of modesty, it is unthinkable that a practicing astrologer would present himself as no expert in the matter. So while Firmicus does not feel the need to situate astrology under a 'higher' science like astronomy as Ptolemy had done, he nevertheless shares with him his self-presentation as an amateur-astrologer.

Perhaps the fact that Firmicus, unlike Ptolemy, does not have a 'higher identity' to defend, conditioned the different approach to astrology that he takes: to put an example, the defense of astrology the Ptolemy undertook in his three chapters is extended in Firmicus to the whole first book. Firmicus identifies himself with the astrologer much more strongly than Ptolemy, his defense of astrology being less balanced and much wilder than Ptolemy's.[105] He even begs his dedicatee to take the 'astrologer's oath' promising not to reveal to anyone the secrets of astrology,[106] and professes what has been labeled 'the astrologer's creed'.[107] While Ptolemy felt committed to his scientific focus, and never abandoned an external point of view in the issue, Firmicus played the astrologer, even if he was only an amateur. We may think of the famous case of Tiberius.[108]

What about the relationship between Firmicus and Mavortius? We are clearly in case (3), because Mavortius is neither a pupil nor an expert in astrology, but which of the two subclasses? The final paragraph of the preface, which features Firmicus modestly calling

[103]Firmicus is identified as *vir clarissimus* in the explicit of a manuscript, a title of the senatorial class, of which he may have been one of the numerous new members created in his time; cf. Rhys Bram 1975, 2.

[104]Fim. Mat. I preface: In nobis tenue ingenium et sermo subtilis et, quod vere confitendum est, matheseos peritia modica.

[105]See Long's survey of Firmicus' arguments defending astrology against sceptical arguments, which according to him shows only 'half-hearted efforts': Long 1982, 189-190, 192.

[106]Firm. Mat. VII pref.

[107]Firm. Mat. VIII pref.

[108]Suet. 6-9.

Mavortius 'Proconsul and designated consul ordinarius', and asking pardon for his lack of 'polished rhetoric, superb organization, or unassailable logic',[109] seems to suggest the category 3 (b), that of patronage, which also fits the high rank of Mavortius.

5.3.4 The *Analemma* and the *Planisphaerium*

These are the two least studied extant works of Ptolemy, and for understandable reasons: both deal with specific subjects of high mathematics (spherical geometry), and Ptolemy's treatment is quite unconcerned of didactics.[110] It is of no help, either, that none of the two works has been preserved in the Greek original, save fragments from a palimpsest of the *Analemma*. This latter work was translated directly from Greek into Latin by William of Moerbeke in the 13th century, while we have the *Planisphaerium* in both an Arabic version of around 900 CE and a Latin version from a later Arabic tradition from the 12th century.

The *Analemma* is a short study –apparently in one book– on gnomonics, the science dealing with the angles projected by the Sun along its movement above the horizon using diurnal, yearly, and geographical coordinates. 'Analemma-constructions' denoted for Greek geometers the methods of modeling the daily motion of the Sun with respect to the local horizon. It is thus clear that this science was the mathematical background of sundial construction –the gnomon is the needle whose shadow is projected by the Sun in sundials–, although, as Sidoli remarks, no ancient text shows the concrete use of the theory in actual construction.[111] Ptolemy's aim is to provide an easy method of determining angles that define the position of the Sun with respect to the local horizon at any seasonal time of the say, in every place and day of the year.[112]

[109]Firm. Mat. I pref.: proconsuli itaque tibi et ordinario consuli designato promissa reddimus orantes et veniam postulantes, ne in istis libris pondus et gratia perfectae orationis, tractatus maximi aut graves firmaeque sententiae a doctrinae atque eloquentiae tuae iudicio requirantur.

[110]I am deeply indebted to Nathan Sidoli's thesis about Ptolemy's applied mathematics for this section (Sidoli 2004), which I will cite repeatedly in what follows.

[111]Sidoli 2004, 183. However, Sidoli refers to modern literature explaining how the actual application could have worked for planar and spherical dials. Sidoli studies the mathematical constructions in Diodorus (not specifically an *analemma*), Vitruvius, Hero, and Ptolemy: Sidoli 186-209.

[112]Sidoli 2004, 186.

Although it has been proposed that Ptolemy may have written more than Moerbeke's translation preserves, perhaps showing the actual application to sundials, Sidoli concludes that nothing in the text suggests this, Ptolemy actually having clearly stated in the preface that his project is the determination of the angles, with which the text ends (although only 1 of the 49 announced tables is extant).[113] Furthermore, it is clear that the text as it stands clearly reveals Ptolemy's contribution to the field, so that incompleteness could not be argued for on this basis either.

As regards Ptolemy's actual contribution, it is not surprising that here as in many other places of his *corpus* –we may think of the *Harmonics* and the use of the harmonic canon– Ptolemy's originality was the clever use of instruments and the easiness provided by a new method. Ptolemy displays here the construction of an instrument –a round plate with permanent inscribed lines– serving to calculate the desired angles mechanically; this is the content of the four final sections, while the previous part of the treatise is dedicated to the theoretical construction of the arcs and the display of the geometrical method for their determination, much more tedious than his ingenuous solution and probably not original of him.[114] So although the treatise did not show a practical application to sundials, the methods shown in the treatise could indirectly lead to practical applications,[115] as for example in the case of the *Planetary Hypotheses* with the construction of models.

It is relevant for our purposes to note that unlike in the majority of his works, Ptolemy does not aim in the *Analemma* at a systematic treatment: instead, the text presupposes knowledge of previous literature by other authors, the 'ancients' alluded to in positive terms in the preface, referring mainly to the geometer Diodorus of Alexandria, as Sidoli argues.[116] Connected with may be the fact that Ptolemy's expected audience were probably professional dialers, who would be unconcerned with completeness of the treatment since

[113]Sidoli 2004, 209.
[114]Sidoli 2004, 208.
[115]Sidoli 2004, 223.
[116]Sidoli 2004, 209.

they would already have the knowledge of the old techniques, either from earlier manuals or transmitted practices.[117] It is argued that, moreover, Ptolemy maintained traditional nomenclature which was rather awkward in his treatment probably because he was writing with this traditional profession in mind.[118]

What can this suggest about Syrus' identity? If Ptolemy's expected readers were professional sundial-makers, it could be hypothesised that Syrus perhaps had a connection with these professionals. We may compare with Ptolemy's claim at the beginning of the *Planetary Hypotheses* that he is writing for model-makers.

The *Planisphaerium* is also a work in one book, of a similar short extension as the *Analemma*, dealing again with a topic of spherical astronomy. In this case the work provides a plane model of the celestial sphere, not with projective techniques as in modern practice but carrying out the construction wholly on the plane and showing at the end that the properties and relationships between the various circles are the same as in the sphere.[119] For this comparison, Ptolemy takes the results of the *Almagest*,[120] so that it can be securely dated later than that. Perhaps then the general aim of the work was to translate the astronomical results of his *Almagest* to the plane, in the same way as the *Hypotheses* did to three-dimensional models. It has been suggested that there was a geometrical tradition of mapping the celestial sphere to the plane using methods similar to Ptolemy's,[121] so Ptolemy seems to be adhering to it by introducing his own astronomical results. These developments could lead to the drawing of a star map, a plane astrolab or an anaphoric clock, but Ptolemy does not even allude to these practical applications:[122] very much like in the *Analemma*, Ptolemy just provides the mathematical construction, 'for whoever wants to know this' as he says in the preface.[123] Ptolemy seems here to be alluding to a readership different from

[117]Sidoli 2004, 184.
[118]Ibid.
[119]Sidoli 2004 211.
[120]Sidoli 2004, 213.
[121]Ibid.
[122]Sidoli 2004, 223.
[123]Ptol. *Planisph.* 1: ut, qui scire uelit hec, describat demonstrantem rationem, qua assignari conveniat circu-

Syrus, perhaps the instrument makers of the *Planetary Hypotheses* and the *Analemma*.

There are stylistic affinities between the *Planisphaerium* and the *Optics*, the only extant work of Ptolemy which we have not yet addressed. Neither of these works even mention predecessors in the discipline, although they definitely had, and both progress basically through the succession of theorems unlike most of the other works.[124] The big difference is that the *Optics* was again a systematic treatise, covering all the main topics of optics in five books. Perhaps more accidentally, the *Optics* has been likewise badly transmitted by the textual tradition, and the first book has not been transmitted at all.[125] One of the consequences is that, like the *Phases*, we do not know whether the work was dedicated to Syrus. Taking into account Syrus' apparent preference for astronomical works –or at least Ptolemy's preference for dedicating only astronomical works to Syrus– it seems more probable that it was not.

5.3.5 Conclusions of the survey

Our survey of the works dedicated to Syrus, along with the remarks on the other works, could have shed light on several issues. The dedicated works fall into two main groups: systematic treatises –typically addressed to amateurs– and short specific works modelling results of the *Almagest* or developing aspects of spherical astronomy. Only the *Tetrabiblos* is not mathematical among all these works, although in it the relative and inferior value of its topic with respect to mathematical astronomy is underlined. Ptolemy's dedicatee must have been indeed receptive and competent in rather high mathematics. On the other hand, the high rhetoric and the systematic treatments of the *Almagest* and the *Tetrabiblos* suggest an amateur of the leisured class. The comparison with Firmicus Maternus' dedicatee offers a possible candidate that fits Ptolemy's allusions to engineering: a specific class of the high

lum...

[124]Sidoli 2004, 212, 14. The *Optics*, as Sidoli's analysis shows, is the only text of Ptolemy where theorems are the basic elements of the text, the *Planisphaerium* and the *Almagest* being the only texts close to this.

[125]See Lejeune 1989, vii-xii; Mark Smith 1996, 5-11 for the transmission of the work.

Roman society with the appropriate interests, mathematical skills, and connections with the world of mechanicians, the high-ranked engineers of the empire. More speculative is my claim that Syrus could have been a Peripatetic, on the basis of the mention of Aristotle in the *Almagest* and the choice of the models in the *Hypotheses*, substituting the harmony of the spheres of the *Canobic Inscription*.

5.4 On the search for Syrus

In our survey above I have given reasons for discarding two of the three possible options outlined above for the relationship between Ptolemy and Syrus: (1) master-pupil and (2) fellow mathematicians. At the same time, the evidence from the treatises points to (3), a relationship of the kind scientist - leisured amateur friend.

Among the two distinctions of our type (3) we had first 3 (a), featuring 'just amateurs', not qualifying as patrons, and the type 3 (b), high-ranked members of the elite society probably acting as patrons.

We have seen that in the case of Galen reviewed above we can probably encounter dedicatees of both types, a broad circle of *philiatroi* in the leisured class, not necessarily acting as patrons –the case 3 (a)– and men such as the consular Boethus –the case 3 (b)–. As mentioned above, among the first category we would perhaps find Archimedes' Dositheus; in the second, Firmicus' Mavortius. Another example of this latter category would be the dedicatee of Nicomachus' *Manual of Harmonics*, a most noble woman (as Nicomachus describes her in the preface[126]) whom has been tentatively identified with Plotina, the wife of Trajan.[127]

In the case of Ptolemy and Syrus, it does not seem easy to distinguish whether we are in front of 3 (a), the relationship between a mathematician and a pure amateur of mathematics, or 3 (b) the case that Syrus would be a high-ranked member of the Roman society acting

[126]Nicom. *Harm.* 1: ἀρίστη καὶ σεμνοτάτη γυναικῶν.
[127]See McDermott 1977 for the attribution.

as a patron to Ptolemy. Internal evidence has helped us discard (1) and (2), but now in the distinction between 3 (a) and 3 (b) any possible information that Ptolemy had given us about Syrus, or any external evidence about Syrus' identity, would have been crucial, and we don't have either of them.

My plan now is not to offer arguments on the one side or the other, but to propose a specific individual attested in other sources as a possible candidate for Syrus. I will argue that this individual has the interests, chronology, and geographical location we expect for Syrus. The force of my argument will reside in the elevated number of factors that the person proposed meets, especially as regards his name, which will reduce the probability of another individual meeting the same conditions. However, it will be of course impossible to prove that such possibility does not exist, so my proposal will have inevitably the character of an hypothesis.

5.4.1 'Syrus', an ethnic name

Let us now begin with the name. 'Syrus' was a typical slave name in the Graeco-Roman world. It simply meant 'Syrian', falling into the category of slave names indicating nationalities, like for example 'Manes' or 'Lydus'. It seems that Syria was an important origin of slaves, because the name 'Syrus' occurs frequently in literary, epigraphic and papyrological sources, both Greek and Latin, as a slave name. As regards the literary sources, it was a cliché name of slaves in comic writers, but also in prose works of Ptolemy's time. For example, Ptolemy's near-contemporary Lucian of Samosata uses the name twice with this sense.[128]

The name is also well-attested as a slave or freedman name in the inscriptions and

[128]In Lucian's *Toxaris* there is one slave, 'Syrian (Σύρος) of name and origin' (*Tox.* 80). In *Double indictment* we encounter an interesting word-play: two judicial cases are announced 'against Syrus', but then the character 'Justice' asks who this man is, since 'no name is given'. Thus we understand that 'Syrus' refers only to his nationality. Later the character is presented as a young Syrian boy who had been a servant of the plaintiff Rhetoric (*Bis acc.* 14-27). Given that Lucian was a Syrian and that the plot seems to have autobiographical references, the Syrian boy could be understood as an ironic self-reference.

papyri,[129] and only very few prominent individuals bearing this name seem to have left traces in political or cultural activity, the only famous one being the mime and writer of maxims Publilius Syrus, who was nevertheless a Syrian of servile origins.[130] Two individuals with this name recorded in the *PIR* appear to have been active in Numidian settlements, having been probably Phoenician, and Syrian by extension.[131] To sum up, it seems that most individuals named 'Syrus' in the Graeco-Roman world were Syrians, prominently of servile origins.

However, internal evidence in Ptolemy's work speaks against the case that Syrus was a Syrian. In the *Tetrabiblos*, Ptolemy lists the characteristics of the peoples in the inhabited world according to their nationality: while the inhabitants of lands like Egypt, and especially Italy, are assigned mainly positive traits (Egypt: 2.3.46-50; Italy: 2.3.13-16), those of Coele Syria and Syria are given only negative characteristics, including servility. They are qualified as 'more gifted in trade and exchange; more unscrupulous, despicable cowards, treacherous, servile, and in general fickle', as well as 'bold, godless, and scheming'.[132] Even if this was probably part of the same literary tradition that used the name for slaves and people of low origin, due to the real use of the name for slaves of Syrian origin, this seems to me rather difficult to concile with the idea of a Syrian Syrus.

It is true that Ptolemy could have found the list of qualities of the different peoples in the world in a physiognomical treatise of the kind that proliferated in his own time:[133] however, he could well have modified it to fit his own aims. We may compare with the sophist

[129]See a thorough survey for the city of Rome, Solin 1996, s.v. 'Syrus'.

[130]Ziegler and Sontheimer 1979, s.v. 'Publilius', col. 1239.

[131]M. Gargilius Syrus (CIL VIII.5142), flamen perpetuus in the Numidian city of Tagaste in Africa Proconsularis; Aurelius Syrus (RE Suppl. 15, s.v. 'Aurelius 225a'), commander of a Roman legion in Numidia under Gallienus, that is, 261/2. The other Syrus in the *PIR* (*PIR*[1] S 754) was apparently a private citizen in the time of Alexander Severus (222–235).

[132]Ptol. *Tetr.* 2.3.30-1: ἐμπορικώτεροι καὶ συναλλακτικώτεροι, πανουργότεροι δὲ καὶ δειλοκαταφρόνητοι καὶ ἐπιβουλευτικοὶ καὶ δουλόψυχοι καὶ ὅλως ἀλλοπρόσαλλοι [...] θρασεῖς τέ εἰσι καὶ ἄθεοι καὶ ἐπιβουλευτικοί. On the other hand, and in the same chapter, the peoples of Babylonia, Mesopotamia and Assyria –who could also be called Syrians– are said to be effeminate, sexually immoral and incestuous, at this time sexual misbehaviour being a frequent insult implying lack of education: Ptol. *Tetr.* 2.3.22-8.

[133]Gleason 1995, xxv.

Antonius Polemo, who composed a physiognomical treatise where Greece and Ionia were portrayed as the regions with the ideal human type.[134] Polemo was from Laodicea on the Lykos, in Phrygia, what could be considered Ionia,[135] so he fell himself within the ideal type. However, his arch-rival Favorinus, who appears badly portrayed in Polemo's treatise, was from Arles in modern France, this is, was a Celt.[136] And consequently, Polemo describes Celts as ignorant, awkward, and savage because of their 'too blond hair, almost white', which he compares to 'mild blond hair', which indicates 'readiness in learning, cultivation, and skill'.[137] Not suprisingly, he describes the hair of Greeks and Ionians precisely as 'mildly blond'.[138]

Back to Ptolemy's geographical and physiognomical section in the *Tetrabiblos*, we can probably detect Ptolemy's own hand in his list, since he portraits the inhabitants of Lower Egypt, his own land, as thoughtful, intelligent, wise, religious, and last but not least, skilled in mathematics (τὰ μαθήματα, which may mean 'the sciences', but Ptolemy clearly applies it chiefly to mathematics, as in the title of the *Almagest* and of the *Canobic Inscription*):[139]

> καὶ τούτων δὲ οἱ μὲν περὶ τὴν Κυρηναϊκὴν καὶ Μαρμαρικὴν καὶ μάλιστα οἱ περὶ τὴν κάτω χώραν τῆς Αἰγύπτου μᾶλλον συνοικειοῦνται τοῖς τε Διδύμοις καὶ τῷ τοῦ Ἑρμοῦ, διόπερ οὗτοι διανοητικοί τε καὶ συνετοὶ καὶ εὐεπίβολοι τυγχάνουσι περὶ πάντα καὶ μάλιστα περὶ τὴν τῶν σοφῶν καὶ θείων εὕρεσιν μαγευτικοί τε καὶ κρυφίων μυστηρίων ἐπιτελεστικοὶ καὶ ὅλως ἱκανοὶ περὶ τὰ μαθήματα.
>
> Of these peoples the inhabitants of Cyrenaica and Marmarica, and particularly of Lower Egypt, are more closely familiar to Gemini and Mercury; on this account they are thoughtful and intelligent and facile in all things, especially in the search for wisdom and religion; they are magicians and performers of secret mysteries and in general skilled in mathematics.

[134]Gleason 1995, 33; cf. Adam. *Phys.* 2.32 (=epitome of Polemo's treatise, cf. Gleason 1995, 31).

[135]Ziegler and Sontheimer 1979, s.v. 'Polemon', col. 927.

[136]Gleason 1995, 46-7: Polemo doesn't mention Favorinus by name, but speaks of a Celtic eunuch, which unmistakably refers to him; cf. Polemo *Phys.* 1.160F (Hoffman's Latin version of the Arabic text).

[137]Adam. *Phys.* 2.37 (cf. note above):ἡ δὲ ἄγαν ξανθὴ καὶ ὑπόλευκος, ὁποία Σκυθῶν καὶ Κελτῶν, ἀμαθίαν καὶ σκαιότητα καὶ ἀγριότητα, τὸ δὲ πράως ὑπόξανθον εἰς εὐμαθίαν καὶ ἡμερότητα καὶ εὐτεχνίαν συντείνει.

[138]Adam. *Phys.* 2.32: τρίχωμα ὑπόξανθον ἀπαλώτερον οὖλον πράως.

[139]Ptol. *Tetr.* 2.3.49.

Also contrastingly different from Polemo's is Ptolemy's portrait of the inhabitants of the western part of the world. If for Polemo the only ideal was the old Greek territories, Ptolemy's includes the western part of the empire, as well. As a matter of fact, Ptolemy qualifies as 'independent, liberty-loving, fond of arms, industrious, very warlike, with qualities of leadership, cleanly, and magnanimous', having 'manliness, helpfulness, good faith, love of kinsmen, and benevolence in their souls'.[140] Those of Italy, Apulia, Cisalpine Gaul, and Sicily would be in particular 'more masterful, beneficent, and co-operative'.[141]

Ptolemy's praise of western nationalities leads us to Syrus again. If Syrus was not a Syrian, one possibility is that 'Syrus' was not the original name of Ptolemy's dedicatee, but one possible Greek adaptation of it from a foreign language.

5.4.2 The Roman cognomen 'Sura' in Greek – The first vowel: ου or υ?

The Roman cognomen 'Sura', attested in a highly prominent Petronii family active both in Rome and Alexandria in Ptolemy's time, with probable Italian roots, seems to be a good candidate.[142] In what follows I will firstly show that Ptolemy would have probably adapted this name as Σύρε in the vocative (as it appears always in Ptolemy's treatises) if a Roman Sura had been his dedicatee. Then I will show that there is actually one Roman Sura meeting the expected qualities for being the dedicatee of Ptolemy's works. If this could be confirmed, we would perfectly understand Ptolemy's praise of Italians as 'beneficent and cooperative' (εὐεργετικοὶ καὶ κοινωνικοί), two adjectives that fit well a patron.

Let us begin with a review of the Greek occurrences of the cognomen 'Sura'. The few

[140]Ptol. *Tetr.* 2.3.13-15: φιλελευθέροις καὶ φιλόπλοις καὶ φιλοπόνοις καὶ πολεμικωτάτοις καὶ ἡγεμονικοῖς καὶ καθαρίοις καὶ μεγαλοψύχοις [...] τὰς ψυχὰς ἐπάνδρους καὶ κοινωνικὰς καὶ πιστὰς καὶ φιλοικείους καὶ εὐεργετικάς.

[141]Ptol. *Tetr.* 2.3.16: ἡγεμονικοὶ μᾶλλον οὗτοι καὶ εὐεργετικοὶ καὶ κοινωνικοί.

[142]I did not find, neither in the literary evidence (*RE* and *PIR*) nor in the papyri (`www.papyri.info`) or in the inscriptions (*PHI*) no other name that could possibly fit a Greek vocative Σύρε. Perhaps the closest candidate would be the cognomen 'Suriacus'. There is actually one M. Annius Suriacus (*RE* Suppl. 1 Annius 86a) appearing in the papyri as Συριακός, prefect of Egypt between 161-163, but he could hardly be Ptolemy's dedicatee, since there would be no grounds as to why Ptolemy would have called him Σύρε. Furthermore, συριακός was at this time a current Greek word indicating Syrian origin, so it would not need any adaptation.

Greek attestations of the name are divided in two distinct groups. On the one side, the historians Diodorus Siculus, Plutarch and Cassius Dio, write unanimously Σούρας (gen. Σούρα).[143] The same is true of the four inscriptions saving names of Romans bearing this cognomen.[144]

However, 'Sura' appears written with υ in one Theban ostracon, and in a mention of the consular year 107 CE in the *Martyrium Ignatii*. The Theban ostracon is dated to 246 CE, and contains a receipt that mentions one Συρᾶς Πετρώνιος Ποτάμων.[145] We can be quite confident that this is a transcription of the Roman cognomen 'Sura', since whenever we find additional names in individuals called Πετρώνιος in Egyptian papyri they are always Greek transcriptions of Roman names, and 'Syras' does not appear in Latin sources as a Roman name.[146]

Among the 23 such instances of a Πετρώνιος with other names in the papyri, the majority (19) show a Roman praenomen (Γαίος, Μάρκος, Λούκιος, Πόπλιος). Two other show Roman nomina (Ιούλιος, Αὐρήλιος), while another has a Roman cognomen (Σερήνος).[147] Our Theban ostracon pertains to this latter category.

Furthermore, we already know that there have been Petronii in Egypt bearing the cognomen 'Sura', namely our candidate family for Ptolemy's dedicatee (on which see below). An additional hint is that the individual in the ostracon probably had the same original Roman praenomen 'Marcus' as this family, since he is likely to be related to a Μάρκος Πετρώνιος Ποτάμων named in a similar Theban ostracon of close dating.[148] In addition, the family tree of our family below shows a feature of the cognomen 'Sura' that parallels the presence of another cognomen in the attestation above (Ποτάμων): two members of the

[143]The attestations are: Plut. *Cic.* 17.1, 2, 4; *Soll. anim.* 976c; Diod. Sic. 40.5.1; Dio 68.9.2, 68.15.3, 68.15.4, 68.15.6. Only three Roman figures are named with this cognomen by the historians: the Catilinian conspirer P. Cornelius Lentulus Sura, the general Bruttius Sura, and the friend of Trajan, L. Licinius Sura.

[144]*Ephesos* 489, 1242; *TAM* II 122; *I.Kition* 2060.

[145]*O.Wilck* 665.

[146]Only one attestation in the inscriptions, *CIL* VI.36764, probably of a Greek slave, since the name Συρᾶς is attested several times in the Greek papyri not only as a Roman cognomen (see below).

[147]Search done through the databank `http://www.papyri.info/search` (last accessed 18/7/2013).

[148]*O.Strasb.* 1.158.

family also bear an additional cognomen, namely 'Mamertinus' and 'Septimianus'.

On the other side, the *Martyrium Ignatii* sets the death of the martyr to 107 CE, marked as the year of the consuls L. Licinius Sura (Σύρα in the genitive) and Senecio.[149]

In the *Fasti Hydatii*, written in Latin, the same consul is written as 'Syra', reflecting the influence of a Greek spelling with υ such as the one in the *Martyrium*.[150] Similarly the Hellenizing y-spelling is also the one chosen in another Latin source, the *Historia Augusta*,[151] with the particularity that now it is a member of the candidate Petronii family who is mentioned, Marcus Petronius Sura Septimianus.[152]

Transcription of Latin 'u' with the similarly shaped Greek υ was indeed normal in some Greek transcriptions of Latin words for which υ rather than ου would be favoured by the surrounding letters. For example, the name of the Roman general Sulla was always written in Greek with υ, because the beginning συλ- is typical in Greek (as a combination of the preverb συν- with a word beginning with λ-), while very few words contain the sequence -σουλ-. Another important factor reflecting the influence of Latin script in this transcription is that a Greek υ was naturally rendered in Latin with both 'u' and 'y', in e.g. 'Surus' for 'Syrus' and 'Suriacus' for 'Syriacus'.[153]

The influence of the Greek transcription Σύλλας can be seen in the Latin rendering 'Sylla' preferred by some classical authors like Livy. 'Sylla' would be a Hellenism, probably reflecting the fact that the original sound 'u' had verged towards 'i' due to the Greek spelling; Sulla is indeed 'Silla' in modern Italian.[154]

The sequence -σουρ- is not particularly uncommon in Greek, although -συρ- is far more

[149] *Mart. Ign. Antioch.* 7.1.

[150] Text in *PL*, vol. 51, 873-890.

[151] *Hist. Aug. Comm.* 7.5: Syram.

[152] On the other hand, the cognomen appears as 'Sura' in the mentions of L. Licinius Sura in the life of Hadrian: *Hist. Aug. Hadr.* 2.10, 3.10 etc.

[153] Some attestions: *AE* 1938 176, *AE* 1977 629; *AE* 2000 238a, *AE* 2009 903g.

[154] Similarly, the nomen 'Tullius' is frequently written in Greek as Τύλλιος, although it is also found with ου, especially for the Tarquinian king. Correspondingly, a sequence -τουλ-, though rare (mostly for contractions of the neuter article τό with a word beginning with ἐ-), is more common than a sequence σουλ-. More examples in Jannaris 1907, 67–72 (although very old, this article is extremely useful for its compact lists of words); also Adams 2003, 582–585.

common, especially at the beginning of a word. The Greek rendering of the cognomen 'Sura' with υ may thus obey to this factor, and perhaps also to the analogy with the case of the very similarly written and sounding cognomen 'Sulla'. Furthermore, there is a historic connection, since the general Sulla and Lentulus Sura, the first attested bearer of the cognomen, had been strong political opponents. This could constitute a crucial link in the mind of a Roman named Sura, perhaps influencing him in writing his name in Greek as Σύρας.[155] Another factor was also probably the high frequency of the Greek name Syrus and its cognates, as suggest some readings of the late ancient chronicles, which read 'Syrius' and 'Syrianus' for the cognomen of Licinius Sura.[156] Ptolemy's 'Syrus' could also reflect this influence, if his dedicatee was a Sura.

To summarize the distribution of the Greek attestations of the Roman cognomen 'Sura': on the one side, we have the historians and the inscriptions, where the original Latin pronounciation 'u' is reflected as it was heard by the Greeks (at least originally), thus using ου. On the other, the papyri and the late ancient sources show predominantly υ and Latin 'y', which perhaps reflects a phonetic change as well, as in the case of Sulla.

A comparison with adaptations of other Roman names may make the picture clearer now. A similar pattern to the one I have described with 'Sura' is actually seen in other examples of Latin names which suffered modifications throughout the history of their use in the Greek-speaking world. We may take the Latin praenomen 'Publius', which was initially adapted as Πόπλιος in Greek. This form, probably reflecting the sound as heard by a Greek rather than script influence, is by far predominant both in the inscriptions and the historians.[157] However, later on in the course of Roman domination a more strict transliteration becomes more common, Πούβλιος, which seems to have been only successful in

[155]Cf. Plutarch on the story of the origin of the appellation, the calf: Plut. *Cic.* 17.4. Another Sura, Bruttius, was also linked with Sulla: Plut. *Sull.* 11.4. This is a striking coincidence, given the small number of individuals with this name.

[156]Cf. the corresponding consular years in *Chron. Pasch.* (printed in *PG* vol. 92) and *Fast. Hydat.*

[157]Searched in `http://epigraphy.packhum.org/inscriptions/main` (last accessed 18/7/2013). Πόπλιος is more than twenty times more common than Πούβλιος: ποπλι- 1847; πουβλι- 84. In the three historians Diodorus Siculus, Plutarch and Cassius Dio this is the only form used.

the bureaucracy and in late ancient times, since it is the favourite form in the papyri and almost the only form in the late ancient chronicles.[158]

However, there are interesting exceptions to this pattern. One of them is found in the work of the geographer Strabo. While he elsewhere writes Πόπλιος, following the historians' tradition, he once writes Ποὔβλιος, in the case of a personal acquaintance of him, as he informs.[159] The obvious conclusion is that Strabo was familiar with that particular rendering of 'Publius' used by his friend, less attentive to what a Greek not familiar with the Latin script would have written, but consisting in a letter-to-letter rendering which supposes a knowledge of the Latin alphabet.

It seems plausible that such changes in the Greek transcriptions of Roman names were originated in the bureaucratic practices of the Romans themselves in the exercise of their power, first affecting daily documents and their immediate circle, while more traditional fields such as history-writing and epigraphy remained at first quite unaffected.

The change in the Greek rendering of Sura, from ου to υ, seems to be no exception to this tendency, since it appears written as originally heard in Greek by historians and in the inscriptions (Σούρας), and influenced by the Latin script in ostraca and Late Latin sources (Σύρας). If this cognomen followed the same pattern as the Greek adaptation of 'Publius', then a Roman Sura in Ptolemy's time would himself write his name with υ rather than ου. Then, if such a Sura was Ptolemy's dedicatee, it is natural that Ptolemy, like Strabo, would use the orthography favoured by his Roman acquaintance (υ) rather than the traditional one (ου).

5.4.3 The ending

Having seen that Ptolemy could have written the cognomen 'Sura' with a Greek υ, let us inquire about the ending. A standard choice for the Greek transcription of a Roman name

[158]Close to four times more frequent in the papyri. ποπλι- 51; πουβλι- 194. It is the only form in the *Chronicon Paschale*.

[159]Strab. 12.6.2: Πουβλίῳ Σερβιλίῳ, ὃν ἡμεῖς εἴδομεν.

of the first declension (ending in *-a* gen. *ae*) would be a Greek first declension masculine ending (-ας gen. -α/-ου), as is the case in Σύλλας gen. Σύλλα, Ἀγρίππας gen. Ἀγρίππα.[160]

However, this could pose a problem in the case of 'Sura' in some situations: Σύρα is a Greek exclusively feminine personal name, and most declension cases of the normative transcription of 'Sura' (i.e. Σύρας) would be indistinguishable from it, in particular the vocative Σύρα, the acusative Σύραν and the dative Σύρᾳ.

Strict gender classification was a major issue in the morphology of Greek personal names. That this is not a minor question may be seen from the fact that no masculine Greek personal name coincides in any of its cases with the corresponding case of a feminine Greek personal name. A. Morpurgo uses a good example found in a joke of Aristophanes for illustrating this claim:[161] Socrates is teaching gender differenciation to Strepsiades in *Clouds*, and asks Strepsiades what male proper names he knows, and after he names Melesias and Aminias, Socrates replies that these are not masculine names at all;[162] in justifying his point, Socrates asks Strepsiades how would he call Aminias, and when Strepsiades uses the vocative Ἀμεινία (the normal vocative for this kind of names) Socrates responds that this is female.[163] In the case of Σύρας, the problem would be worse, since, in contrast with Aminias –which had no feminine related name Ἀμεινία– there existed the feminine name Σύρα (and a very common one, indeed!). Actually, after an extensive research I can say that Σύρας is probably the only Greek masculine name ending in -ας for which a feminine name in -α exists (Σύρας-Σύρα).

Perhaps for this reason the name 'Sura' is seen in the Theban ostracon to have been adapted to a later-developed -α ending, normally used for hypocoristics: -ᾶς gen. -ᾶ/-ᾶτος, as in Νικομᾶς from Νικομήδης, or Ἐπαφρᾶς from Ἐπαφρόδιτος.[164] This would partly solve the gender problem, since with this ending most cases of the Greek rendering of 'Sura'

[160]Schwyzer 1968 I, 560.
[161]See Morpurgo Davies 2000, 21.
[162]Aristoph. *Nub.* 685-7.
[163]Aristoph. *Nub.* 690-1.
[164]Schwyzer 1968 I, 461. Cf. Ael. Her. *Decl. nom.* 3.2.657.

would have been distinguishable from the corresponding one of the feminine name 'Syra'. For example, in the ostracon we find the form Συρᾶτος, which is identifiable as a clear masculine genitive.[165]

The same pressure for gender differenciation was perhaps felt by some of the late ancient authors, who, as we have seen, deformed the cognomen 'Sura' from Σύρας (or Συρᾶς) and 'Syra' to the unequivocally masculine Σύριος, 'Syrius' and Συριανός. If these authors had lived in Ptolemy's time, probably they would have chosen the form Σύρος, by far the most common form of which Συρᾶς could be interpreted as a hypocoristic –like Σύριος and Συριανός–.[166]

For the late ancient authors of Greek consular lists the option of writing the genitive Σύρα was safe, as is confirmed by the example of the *Martyrium Ignatii*: such a form stood as clearly differientiated from a feminine genitive Σύρας. However, if the list was in Latin, the ablative was the form used for the designation of the consuls, and the form 'Syra' would have been indistinguishable from the feminine. This is perhaps why the Latin lists and the *Chronicon Paschale*, which probably relied on a Latin list,[167] tend to show the masculinized forms. In the mention of *Historia Augusta* (cf. above) there would be no confusion because the cognomen was accompanied by the nomen.

However, Ptolemy would have a problem if he wrote the normative vocative of the form Σύρας or Συρᾶς, since in both cases the result, Σύρα or Συρᾶ respectively,[168] would be indistinguishably written without any accent mark as was the norm in the literary papyri of his age.

[165]Other attestations of the form Συρᾶς: *P.Hels.* 1.3; *P.Oxy.* 2.295 (fem.); *SB* 20.14974; *O.Wilcken* 2.665 (Theban ostracon, male); *P.Oxy.* 59.3998 (fem.); *O.Mich.* 1.197 (gen. Συρᾶ) (very probably male, since the person is said to have transported chaff).

[166]Σύρος is the prevailing form in the papyri of the 2nd century, and also in the authors, in classical as well as in Roman times. Σύριος is only used by Herodotus and (once) in Aeschylus, while Σύρος is the one preferred by Xenophon and Demosthenes, and by the Atticists Plutarch, Athenaeus, Lucian and Aelius Aristides. Συριανός does not appear until late ancient times.

[167]Bagnall 1987, 56.

[168]For the latter case, see for example Longus, *Daph.* 2.5.1 ὦ Φιλητᾶ, Chariton *Chaer.* 2.1.5 ὦ Λεωνᾶ, Ael. Herod. *Decl. nom.* 3.2.667 ὦ Ζηνᾶ.

Unfortunately, we don't have any clear attestation of the name Σύρας or Συρᾶς in the vocative.[169] Furthermore, there seems to be no exact parallel with another name, for the same reason mentioned above that there are no other cases of masculine names in -ας with an exact feminine correlate ending in -α.

To sum up, for the said reasons we can suppose that Ptolemy would not have written 'oh, Syra', in Greek ὦ Σύρα (or ὦ Συρᾶ, indistinguishable in the script as mentioned). Now the obvious question is: what would have he written, then? The attestations of the hypochoristic form in -ᾶς gen. -ᾶτος suggest that the ending would be the changeable part of the name in order to avoid gender confusion. It seems more improbable that Ptolemy decided to change the first vocal to ου, for example, in order to maintain the normative ending in -α, since this would involve almost a change of name. On the contrary, the use of the hypochoristic form shows that the ending was more flexible.

Then what ending would Ptolemy have chosen instead of -α for the vocative of Σύρας? Probably the most natural option would be the vocative ending of the masculine form in -ος, Σύρος, this is, -ε. As it turns out, for this substitution of an ending in -ας to an ending in -ος we do have parallels that show how this would not be unheard: the orator Pardalas, attested in several inscriptions unanimously with this name,[170] appears in Aristides' *Sacred Tales* as Πάρδαλος.[171] The early Greek poet which is named 'Ananios' in Athenaeus is likely to have been named 'Ananias' originally, since while the form in Athenaeus is unparalleled in any other ancient source, 'Ananias' is a common Semitic name.[172]

In conclusion, I think that the Latin cognomen 'Sura' is a pretty good candidate underlying the Greek name of Ptolemy's dedicatee because: (1) Σύρος does not look like the

[169]This would require, in the papyri, to have the name attested in another case in the text, as well as the vocative, in order to recognise that the latter form corresponds to this name. Actually, it is indeed improbable that we ever find such a papyrus, since vocative forms tend to appear very infrequently in the papyri, a factor which we should add to the low probability of finding the name Σύρας/Συρᾶς.

[170]Puech 2002, inscriptions 192-7. Cf. *PIR*^{2} C 951. Παρδαλᾶς is the name attested in the papyri, as in *BGU* 5.1210, *BGU* 1.250, *O.Stras.* 2.865, etc.

[171]Ael. Aristid. *Hier. log.* 327.23.

[172]This was noted in West 1997, 623. Cf. Ath. 3.15.25, 7.16.3-17, 7.135.3, etc.

original name of Ptolemy's dedicatee because its ethnical implications incompatible with internal evidence in the *Tetrabiblos*; (2) Romans were extremely well regarded in the *Tetrabiblos*; (3) a Roman family with the cognomen 'Sura' (and with interests akin to Ptolemy's work, as we will see below) was active in Alexandria in Ptolemy's time; (4) Ptolemy would probably write the Roman cognomen 'Sura' with υ if a Sura had been his dedicatee; and (5) in the vocative (the only form appearing in Ptolemy's text) Ptolemy would probably have used the form Σύρε in order to avoid a feminine-looking form.

5.4.4 M. Petronius Sura

Let us now finally list the known members of our candidate family:

- M. Petronius Sura (*RE* Petronius 70; *PIR*^{2} P 310). *Curator aquarum* under Hadrian.[173]
- M. Petronius Mamertinus (*RE* Petronius 44; *PIR*^{2} P 288). Son or brother of Petronius Sura, prefect of Egypt 133-137, praetorian prefect 139-43 and probably the same individual who was suffect consul in 150.[174]
- M. Petronius Sura Mamertinus (*RE* Petronius 71; *PIR*^{2} P 311) and M. Petronius Sura Septimianus (*RE* Petronius 72; *PIR*^{2} P 312). Sons of the prefect Petronius Mamertinus. The elder brother, Sura Mamertinus, married a daughter of the emperor Marcus Aurelius and was consul ordinarius in 182. Septimianus was consul ordinarius in 190, along with the emperor Commodus. Both brothers were killed by Commodus in that or the following year, as is narrated in the *Historia Augusta*.[175]

[173]Following *RE* and Corbier 1974, 286. However, considering that this information is derived from stamps on Roman pipes bearing Sura's name and that other kinds of procurators could have marked them, Bruun prefers to leave his specific office as an open question, with the possibilities of *curator aquarum* or *patrimonii*; see Bruun 1991, 269.

[174]Son of Petronius Sura as argued in *RE*, Bruun 1991, 269, and Corbier 1974, 283-9. *PIR*^{2} argues differently, making him brother of the procurator, and making the consul Mamertinus a different individual, corresponding to the son of the procurator.

[175]*Hist. Aug. Comm.* 7.5.

Let us begin with the chronological setting. Ptolemy made observations between 127-141 CE, which he used in the *Almagest* dedicated to Syrus. This work is believed to have been completed after the year 146/7 CE, in which Ptolemy dedicated an astronomical inscription in Canopus which has been proved to chronologically precede the *Almagest* (cf. chapter 1).

Let us first inspect the cases of Sura Mamertinus and Sura Septimianus, consuls for the first (and only) time in 182 and 190 respectively. If they reached the consular office at the most attested age at that time, this is, in their forties,[176] Mamertinus would be in his tens, and Septimianus would be younger than ten around the year 150, the approximate date for the publication of the *Almagest*. This makes this option highly implausible, since the *Almagest* demanded high mathematical skills. Even if Mamertinus would had reached the consulship at fifty, which would probably be exceedingly old for a member of the imperial family[177] which he was already,[178] he would be approximately twenty in the year 150, which seems still far too young for this kind of work.

The remaining option is the other attested person with the cognomen Sura, the procurator Petronius Sura. Actually, the name 'Syrus' fits him much better than the two brothers: while the single name of any of the latter would perhaps have been rather 'Mamertinus' and 'Septimianus', as appears in the consular lists,[179] with Petronius Sura there would be no doubt that his only cognomen 'Sura' was the obvious choice.

Let us check whether the chronology for him fits Ptolemy. Petronius Sura held his office during the reign of Hadrian, to whom he dedicated an inscription together with two of his sons. Sura called Hadrian *pater patriae*, which means that the inscription was later than the year 127/8,[180] and consequently we know that he was father of two between the years 127/8 and 138, the end of Hadrian's reign. Around a decade later than this period, on the date of the publication of the *Almagest*, he would probably be between the forties and the

[176]Hammond 1959, 291.
[177]Stern 2006, 303.
[178]According to Corbier 1974, 289, Mamertinus entered the patrician class because of his marriage.
[179]Although Septimianus appears as 'Sura' in the *Historia Augusta* (cf. above).
[180]Cf. *RE* Petronius 70.

fifties, the midpoint of his life in which it is thinkable that he could have been dedicated such a treatise.

There may be another chronographical coincidence pointing towards Ptolemy' link to the Petronii, if we accept, following *PIR*^{2}, that M. Petronius Honoratus, prefect of Egypt between 147-8 CE, may have been a brother of Petronius Sura. Ptolemy erected his inscription around the time, or little before Petronius Honoratus took the office of prefect.[181]

It would then be possible to speculate that the Petronii could have met Ptolemy because of the inscription he had erected by that time at Canopus. If Ptolemy was seeking for patronage by that time, as he would probably have been doing in the case that his later dedicatee was actually Petronius Sura, the public display of his inscription could indeed have served to attract the public attention. We have seen in chapter 1 how the inscription was probably placed at the sacred district of Serapis at Canopus, a place frequently visited by people of all places according to Strabo, who also informs of the festivals that made Canopus a widely known crowded place. Ptolemy's promotion in there would then probably have been of the same kind that the famous rhetors of his time sought by displaying their orations in the public spaces. Saller notes the example of Apuleius, who laments in an oration in Carthage in front of the proconsul Severianus not having been able to deliver all his works.[182] Champlin recalls the case of Galen, who with his public demonstrations attracted the attention of the Peripatetic Cn. Claudius Severus, by whom Galen was introduced later to the emperor M. Aurelius.[183]

Back to our survey of the links between Petronius Sura and Ptolemy: the geographical connection between Ptolemy and Petronius Sura is in any case granted, if not by the possible

[181]The date on the inscription is the 'tenth year of Antoninus' in the Alexandrian calendar, that is, 146/7 (Jones 2005a, 53), and Petronius Honoratus is recorded to be in the office already in August 147. In fact, there is a papyrus mentioning Honoratus and his rank in Thoth 10 of the 11th year, and also a wooden table dated 9 days earlier (29 of August 147; see Stein 1950, 79), so Honoratus was prefect already at the very beginning of the eleventh year of Antoninus (in the Alexandrian calendar). His predecessor, Valerius Proculus, is known to have been in the office at least until the month Pharmuthi of the tenth year, so that the interval with an unknown prefect is four months.

[182]Saller 2002, 159. Cf. Apul. *Flor.* 9.

[183]Champlin 1980, 30.

link to Petronius Honoratus, by the circumstance that Petronius Mamertinus, the son or brother of Petronius Sura, was also prefect of Egypt between 133-137 CE. So it is likely that the family, including Petronius Sura, would spend time in Alexandria.

There is a last aspect that makes it plausible that Petronius Sura was Ptolemy's Syrus, namely that Sura had held the most relevant office in charge of the Roman water supply. Now is the moment to recall what I have said above in my review of Ptolemy's *Tetrabiblos* about the dedicatee of Firmicus Maternus' astrological treatise. Firmicus' dedicatee Mavortius turned out to have been, prior to being dedicated Firmicus' books, *curator aquarum*. He was apparently interested, apart from in astrology, also in mathematical astronomy. I have also pointed out how the writings and interests of other *curatores aquarum* such as Frontinus and Agrippa seem to have been highly technical, in the case of Agrippa including geography, one of Ptolemy's interests as well.

It is fair to assume that only few individuals in Ptolemy's time had the mathematical knowledge necessary for understanding his astronomical *corpus*, which did naturally not form part of the curriculum of the educated man. As it seems, the *curator* of the Roman waters was one of these few people.

There was another interesting issue underlined in my survey above which might be put into relation with our candidate now. If Petronius Sura had been Ptolemy's dedicatee, we would perhaps understand that Ptolemy appealed in some treatises to professionals of instrument-construction, in a contrasting tendency to the systematic character of other treatises like the *Almagest*, typical of works intended for amateurs. Given that Sura by his own position as head of the imperial water supply was as it were the chief of all the engineers in the empire, he was close to the engineers who could have profited from Ptolemy's work. Ptolemy would then have two possibilities in writing treatises to Sura: on the one side, he could write to him as to a leisured amateur who wanted a systematic treatise on a whole discipline, but on the other, he could also write to Sura highly technical works that could perhaps reach his engineers.

As regards my hypothesis on the possibility that Syrus was close to Peripateticism, we could pursue the speculation now providing a sort of parallel, but without reaching a conclusion. We have already noted that M. Petronius Sura Mamertinus, one of the sons of M. Petronius Mamertinus (the son or brother of our Petronius Sura) married a daughter of the emperor Marcus Aurelius, probably more due to his outstanding merits than to the illustriousness of his family as was the normal policy with M. Aurelius' step-sons.[184] Well, it turns out that the Peripatetic philosopher who presented Galen to M. Aurelius, Cn. Claudius Severus, son to the also Peripatetic Cn. Claudius Severus Arabianus mentioned in the *Meditations* as one of the teachers of M. Aurelius,[185] also married a daughter of the emperor.[186]

To sum up, there is one attested individual (and only one) who fits all our expectations concerning the name, the intellectual interests and abilities, the social and professional *milieu*, and the expected chronology of Ptolemy's dedicatee. The place where Ptolemy is attested to have been active, Alexandria, was also the place from where the son or brother of this individual governed Egypt for a period, so that the possibility of close personal contact –crucial for a patronage relationship such as the one I want to suggest[187]– is granted. This man is M. Petronius Sura, *curator aquarum* in the time of Hadrian, father of a prefect of Egypt and uncle of a consul who married a daughter of Marcus Aurelius.

This would solve our indefinition as to the category into which Ptolemy's relationship with his dedicatee would fall: we would be now clearly into 3 (b), a patron-client relationship, since the post of the *curator aquarum* was one of the most important offices in the administration of the empire, traditionally held by 'the best men of our city' as defended Frontinus in his treatise.[188]

[184]See a survey on the step-sons of Marcus Aurelius, Pflaum 1961.
[185]M. Anton. 1.14.1.
[186]Pflaum 1961, 29-31.
[187]Saller 2002, 61.
[188]König 2007, 184; Frontin. *De aq.* 1.1.

It could be argued against this identification that the dedicatees of the type 3 (b) are overrepresented in the sources with respect to the 'just amateurs' of the group 3 (a). This is likely true, since high-ranked men who could act as patrons are normally far better attested than individuals without a relevant function in the administration. However, I would reply that the very fact that a person existed fitting all the requirements we have posited for Ptolemy's dedicatee suffices for making this a strong case. In this context, I find crucial the curious fact that the name should be that of a non-Greek which Ptolemy would have had to adapt to the Greek Σύρε in the vocative, which as we have seen restricts enormously the possible candidate names, so that among all the extant ones in the ancient sources only 'Sura' seems to fit.

5.5 Conclusions: Ptolemy and patronage

This chapter has been mainly about determining the relationship between Ptolemy and his dedicatee. In the first part of the chapter I have surveyed Ptolemy's works dedicated to Syrus (his only dedicatee), and concluded that Syrus was neither a pupil nor a fellow mathematician.

In the rest of the chapter I have proposed a plausible identification of Syrus with a high-ranked Roman having held the important office of *curator aquarum*. If Syrus had been this Roman, I have claimed, Ptolemy's relationship with him would have been rather that of client to patron than something we have qualified as that of a scientist to 'just an amateur'. Let us now talk a little bit about what this would mean.

The approach taken by Richard Saller in his book *Personal Patronage under the Empire* is useful for setting out the issue. Saller's purpose is to establish the extent to which patron-and-client relationships may have been less strong in the new structures of the Roman empire, as a result of the allegedly increasing bureaucratization which it brought about.[189]

[189]Saller 2002, 5.

Saller describes the patron-and-client relationships as a system which may be encountered in most societies,[190] but which varies in the contrary direction as the administrative machinery of the state increases; thus, taking an approach from A. Blok, he defines four kinds of patronage relationship, in decreasing degree of force: vassalage, brokerage, friendship, and disguised patronage.[191] The situation in the Roman world would be the two intermediate types: brokerage would correspond to patrons filling gaps in the legal system and friendship would just 'lubricate' the state administration for clients with a well-positioned patron. Saller's aim is to investigate whether the fundamentally 'brokerage'-type patronage relationships functioning in the Republic evolved into a rather 'friendship'-structure in the Principate.

Saller's conclusion is that the patronage relationships of the Late Republic, more important economically and socially than politically,[192] remained largely unchanged in the imperial era:[193]

> The aristocratic social milieu of the Republic continued into the Principate, and with it the basic notion that a man's social status was reflected in the size of his following — a large clientèle symbolizing his power to give inferiors what they needed. If a man's *clientela* was indicative of his current status, his potential for mobility depended on the effectiveness of his patrons, whose wealth and political connections could be indispensable. Perhaps partly because of the unchanging social structure and values, financial institutions developed little, and so Romans appear to have continued to rely largely on patrons, clients and friends for loans or gifts in time of need, and assistance in financial activities.

We could perhaps relate Saller's macro-analysis with the particular investigation which I have attempted in this chapter, because his determining of the degree of patronage in the Roman empire bears a resemblance with my tracking down the kind of relationship between Ptolemy and Syrus. If Saller proves that Roman society under the empire continued in the

[190] Ibid., 3.
[191] Saller 2002, 4, and n. 14 for Blok's reference.
[192] Saller 2002, 120.
[193] Saller 2002, 205.

higher degree ('brokerage'), I argued that Ptolemy's dedicatee was a 'real' patron, not 'just an amateur' of the science. So Ptolemy and his dedicatee would follow the large norm which Saller encounters in the society of the early Roman empire.

For the eastern parts of the empire, like Egypt, the same structure described by Saller would be of course valid (Saller analyses the better-attested case of North Africa[194]), with the particularity that the most effective patrons for their inhabitants would probably not have been people from their own territory, but powerful Romans, even if they did not wish to be active in the capital of the empire as it seems to have been the case with Ptolemy (who is only attested in Alexandria and nearby Canopus): this is actually Plutarch's advice for a young man deserving to engage in the municipal administration of his native Greek city, to which he recommends to forge friendships with important Romans.[195]

We have already said something about the case of Galen, who moved to Rome in search of a prominent career, and whose important Peripatetic friends had a role in his promotion to court physician. But perhaps a more close parallel for Ptolemy's career could be that of a westerner, Vitruvius, who wrote his *On Architecture*, as he reveals, obligated by the imperial rewards for the post in repairing artillery:[196]

> *itaque cum M. Aurelio et P. Minidio et Gn. Cornelio ad apparationem ballistarum et scorpionum reliquorumque tormentorum refectionem fui praesto et cum eis commoda accepi, quae, cum primo mihi tribuisti recognitionem, per sororis commendationem servasti. cum ergo eo beneficio essem obligatus, ut ad exitum vitae non haberem inopiae timorem, haec tibi scribere coepi.*
>
> And so with Marcus Aurelius, Publius Minidius, and Gnaeus Cornelius, I was ready to supply and repair ballistae, scorpiones, and other artillery, and I have received rewards for good service with them. After your first bestowal of these upon me, you continued to renew them on the recommendation of your sister. Owing to this favour I need have no fear of want to the end of my life, and being thus laid under obligation I began to write this work for you.

[194]Saller 2002, ch. 5.
[195]Saller 2002, 154; cf. Plut. *Mor.* 814C.
[196]Vitr. *Arch.* I intr. 2-3.

Note that Vitruvius specifically points to the economical benefits derived from his post as engineer. Given that Ptolemy's patron, as I have argued, may have been a *curator aquarum* in Rome, the most important curatorship in the empire, we could speculate that Ptolemy may have obtained an engineer post in Alexandria thanks to his recommendation, perhaps the reasons why he thankfully sent so many treatises to him. The fact that Ptolemy does not say a word about Syrus in his treatises may be due only to the sober mathematical style, perhaps introductory letters having been lost. A good clue could be the fact that Ptolemy wrote a work on mechanics in three books, which has not been preserved, but which is actually the first of his treatises listed in the *Suda*.[197] An interesting parallel in this context is that Vitruvius seems to have worked as Agrippa's staff architect in the standardization of water pipe sizes, as recorded by Frontinus,[198] when Agrippa was *curator aquarum*.

Ptolemy's multifacted work allows to think of Ptolemy as an engineer, indeed, and the fact that all his dedicated works seem to have dealt with astronomy or a related field may only indicate his dedicatee's preference (we may think of Firmicus and Mavortius again). Perhaps to Vitruvius' example we could add the legends about Archimedes' construction of war machines for the defense of Syracuse.[199] We don't seem to have many other attested cases of mathematicians hired as public engineers in the Graeco-Roman world, but this would be easy to explain from the fact that we know practically nothing on the biographies of ancient Greek and Roman mathematicians (see the beginning of this chapter). For astronomers working in public works, there are many parallels in ancient China, where this situation seems to have been quite normal.[200] After all, it is not surprising that individuals able to make complex calculations as in astronomy were hired as engineers or supervisors of public works, if they were not tied to temple structures, nor acted as court astrologers –and none of these cases seems to be the one we have in Ptolemy.

[197] *Suda*, s.v. Πτολεμαῖος Π 3033: οὗτος ἔγραψε Μηχανικὰ βιβλία γ.
[198] Front. *De aq.* 25.1; cf. Keyser and Irby-Massie 2008, s.v. 'M. Vitruuius Pollio'.
[199] Keyser and Irby-Massie 2008, s.v. Archimēdēs of Surakousai.
[200] See Wagner 2013.

Chapter 6

A new stage in Ptolemy's career?

A different place for role-playing in the Almagest

6.1 Plan of the chapter

In this last chapter I will argue that in the *Almagest* we can find similar strategies of self-presentation as those which we have encountered in the probably earlier works *Canobic Inscription*, *Harmonics*, and *Criterion*, but instead of being 'performed' in the works themselves –as in the last parts of these treatises– now in the *Almagest* these strategies would appear just verbalised in the preface and in an introductory epigram. In this shift Ptolemy states or poetically alludes to what he earlier developed in those three works. However, Ptolemy's message is here the same as the one as he implied there, and his philosophical influences seem to be similarly the Antiochian tradition and Alexandrian Middle Platonism that we have seen applied in there.

I will begin with one of Ptolemy's best-known texts, the preface of the *Almagest*. I divide my analysis in four headings, dealing respectively with Ptolemy's self-presentation as a philosopher, the kind of philosopher he presents himself like –a Platonist concerned with the practical side of philosophy, in line with Antiochus' views–, the mediating place

that he assigns to mathematics in his division of philosophy –which seems to be derived from Alexandrian Middle Platonism–, and his claim that mathematics is the most secure knowledge –which I relate to Ptolemy's praxis in the *Criterion*–.

As regards the epigram, which will be explored in the second part of the chapter, I will first contextualise it within the ancient surviving poetical works related to mathematics, and then particularly within the Hellenistic tradition of catasterism, beginning with Aratus and Callimachus and turning to Eratosthenes, who wrote a long poem on Hermes' astral journey probably influencing Cicero's *Scipio's Dream*. Having presented the literary context, I will argue that Ptolemy's epigram could have been consciously shaped after Horace's Archytas ode, on the basis of various reasons. The difficulty of hypothesizing a Roman influence in a Greek author will be tackled by noting that Ptolemy's Syrus was plausibly a Roman, as we have seen in the previous chapter. If I am right on this, Ptolemy would be impersonating the ancient Pythagorean Archytas in an epigram with clear Platonic overtones, something much in line with Ptolemy's practice for example in *Harmonics*.

6.2 The preface of the *Almagest*

So let us begin with the preface of the *Almagest*. For a brief presentation of the work, it would be useful to recall what has been said about this work in the section of the previous chapter dedicated to a review of the treatises dedicated to Syrus. The *Almagest* is a systematic treatise in 13 books on mathematical astronomy, dated later than the *Canobic Inscription* and probably also later than *Harmonics* and *Criterion*, not featuring anything like the 'last sections' visible in these three works where mathematics was applied to speculative philosophy derived from the Platonic (mainly Timaean) tradition. Actually this is seen in no other work of Ptolemy. I have tentatively related this shift in the contents of Ptolemy's treatises to the fact that Ptolemy may have found in Syrus a patron appreciating his mathematical work in its own value; thus Ptolemy would not anymore be tempted to

show how his science was connected to a Platonic philosophical aim. I have also ventured that Syrus could have been an Aristotelian, on the basis of Ptolemy's marked citation of Aristotle in his division of philosophy in the preface, and that because of his affiliation Syrus would perhaps not have liked to see mathematics applied directly to a Platonic aim.

Instead, as I have suggested in there, what I have called the Platonic project was evoked in the preface. I use 'evoke' in a marked sense, implying that Ptolemy, unlike in the earlier works, did not actively perform this project as in the 'final sections' or in the whole text of the *Criterion*. Such a clear presentation of this project is not seen in any other of Ptolemy's works. However, in this context it may be significant that the *Almagest* was possibly the first work dedicated to Syrus, and thus its preface could serve for the rest of the works that he received.

Now I will review through four headings the main topics which I will address from this preface.

6.2.1 Ptolemy presents himself as philosopher-teacher: the influences of Plato and Archytas

A remarkable feature in this preface is that, unlike in most scientific prefaces, the subject of the work is not announced until very late. Normally the author introduced the main topic of the work in the first sentence, as a sort of subtitle.[1] Instead, in this preface we only find out that Ptolemy is going to write about mathematics in line 19, and it is actually not until line 60 that he specifies, albeit still in most untechnical terms –'the divine and heavenly things' (τὰ θεῖα καὶ οὐράνια)– that he is going to treat astronomy.

Indeed, Ptolemy begins the preface of his *Almagest* talking about philosophy and its divisions. As Feke remarks, Ptolemy's preface begins much in the same way as a philosophical handbook like Alcinous' *Didascalicus*, dividing philosophy in many branches.[2] Only later

[1] This is the conclusion after her survey of the prefaces to scientific books in Alexander 1993, 71.
[2] Feke 2012, 82.

we find out that the author goes down to mathematics, which is presented as one of the divisions of theoretical philosophy. The discussion of the place of mathematics in this division, an issue which I will address below, is the central part of the preface. From this point onwards, Ptolemy goes up again claiming that only mathematics makes a valuable contribution to the other parts of philosophy, physics and theology on the theoretical side, and to the whole of practical philosophy, too.[3]

For now let us just consider the fact that later Ptolemy will claim that mathematics can contribute to all other branches of philosophy, being itself the most unshakable part.

Platonic authors such as Philo of Alexandria and Plutarch, who had the precedent of Plato's *Republic*, held philosophy as the culmination of a man's *enkyklios paideia.* It is illustrating, for example, to compare the different relationship which these two authors see between the study of poetry and philosophy: while Philo sees poetry as a distraction from the true 'mistress' of men, philosophy,[4] for Plutarch poetry is nothing else but a preparation for philosophy.[5] So even if their views are opposed, both pressuppose that philosophy is the end. This preeminence of philosophy in education was evidently not universally conceded, as we can for example see in Quintilian's directions for education, who considered, contrasting with Philo and Plutarch's views, philosophy as a mere aid to the comprehension of the poets.[6] Thus for men with Platonic sympathies, to put one's discipline in connection with philosophy or even as the most secure form of philosophical knowledge as Ptolemy with his harmonics was tantamount to push for introducing it in the regular studies of the *paideia* and to claim a high importance for it.

The comparison with Vitruvius is illuminating, because as we saw in the preceding

[3]These reminds of the analysis-and-division method to which Ptolemy alludes in the *Criterion* just before the treatment of the ruling principle (cf. chapter 3).

[4]Phil. Alex. *Congr.* 77: τινὲς γὰρ τοῖς φίλτροις τῶν θεραπαινίδων δελεασθέντες ὠλιγώρησαν τῆς δεσποίνης, φιλοσοφίας.

[5]Plut. *Mor.* 15F: ὅθεν οὐ φευκτέον ἐστὶ τὰ ποιήματα τοῖς φιλοσοφεῖν μέλλουσιν, ἀλλὰ προφιλοσοφητέον τοῖς ποιήμασιν ἐθιζομένους ἐν τῷ τέρποντι τὸ χρήσιμον ζητεῖν καὶ ἀγαπᾶν.

[6]Quint. 1.4.4: nec ignara philosophiae, cum propter plurimos in omnibus fere carminibus locos ex intima naturalium quaestionum subtilitate repetitos.

chapter, Vitruvius writes on a similar subject to a similar readership as Ptolemy. For Vitruvius the architect should already possess a wide variety of knowledges, not all evidently related to architecture, such as philosophy, music, medicine, and astronomy:[7]

> *et ut litteratus sit, peritus graphidos, eruditus geometria, historias complures noverit, philosophos diligenter audierit, musicam scierit, medicinae non sit ignarus, responsa iurisconsultorum noverit, astrologiam caelique rationes cognitas habeat.*
>
> Let him be educated, skilful with the pencil, instructed in geometry, know much history, have followed the philosophers with attention, understand music, have some knowledge of medicine, know the opinions of the jurists, and be acquainted with astronomy and the theory of the heavens.

In his treatise Vitruvius actually deals in a cursory manner with some of these subjects, such as philosophy in frequent scattered remarks (e.g. on the primordial element according to the physicists, *De arch.* 2.2), harmonic and acoustic properties of theaters (*De arch.* 4, 8), medicine in relation to the human exposure to winds (*De arch.* 1.6) and waters (*De arch.* 8.3-4), and astronomy in relation to sundials (*De arch.* book IX).

Courtney Roby has also shown how Hero of Alexandria (active in the Graeco-Roman age) emphasised a continuity between bodies of knowledge, linking mechanical devices with philosophy, physical sciences and mathematics, as well as his dealing with these topics in an introductory way suitable to laymen in some of the treatises, similarly as Vitruvius.[8]

For the case of Galen, I have already addressed in my chapter on Ptolemy's *Criterion* some aspects of his knowledge project joining philosophy and medicine. In there mention was made of Galen's project of applying a logical method to his medicine, as well as his long discussion of the ruling principle in his *On the Opinions of Hippocrates and Plato*, partly based on medical issues. In this context, we could cite Galen's treatise with the very explicit title *The Best Doctor is also a Philosopher*.[9]

[7] Vitr. *De arch.* 1.1.3 (tr. Morgan).

[8] Roby 2010, 259-60.

[9] Boudon-Millot 2009, 188. See also in the same volume Flemming's analysis of Galen's portrait of the organizing demiurge compared with Galen himself as organizer of knowledge, Flemming 2009.

Now I want to look at some of the details in Ptolemy's presentation of philosophy. My argument in what follows will be that Ptolemy consciously modelled the first words of his *Almagest* on the first words of Archytas' *Harmonics*, a preface which Ptolemy probably knew.[10]

Ptolemy begins praising the distinction between theoretical and practical philosophy:[11]

> Πάνυ καλῶς οἱ γνησίως φιλοσοφήσαντες, ὦ Σύρε, δοκοῦσί μοι κεχωρικέναι τὸ θεωρητικὸν τῆς φιλοσοφίας ἀπὸ τοῦ πρακτικοῦ.
>
> The true philosophers, Syrus, were, I think, quite right to distinguish the theoretical part of philosophy from the practical.

Let us now compare with the beginning of Archytas' *Harmonics*:[12]

> καλῶς μοι δοκοῦντι τοὶ περὶ τὰ μαθήματα διαγνώμεναι, καὶ οὐθὲν ἄτοπον ὀρθῶς αὐτούς, οἷά ἐντι, περὶ ἑκάστων φρονέειν· περὶ γὰρ τᾶς τῶν ὅλων φύσιος καλῶς διαγνόντες ἔμελλον καὶ περὶ τῶν κατὰ μέρος, οἷά ἐντι, καλῶς ὀψεῖσθαι.
>
> Those concerned with the sciences seem to me to make distinctions well, and it is not at all surprising that they have correct understanding about individual things as they are. For, having made good distinctions concerning the nature of wholes they were likely also to see well how things are in their parts.

Both beginnings are similar in wording, structure and content: in both the author begins by announcing that he is satisfied with his predecessors' divisions (or distinctions) within philosophy, with almost identical phrasing and words (καλῶς οἱ γνησίως φιλοσοφήσαντες… δοκοῦσί μοι κεχωρικέναι / καλῶς μοι δοκοῦντι τοὶ περὶ τὰ μαθήματα διαγνώμεναι). Archytas begins referring to the mathematicians (τοὶ περὶ τὰ μαθήματα) and their distinctions in the 'nature of wholes' (τᾶς τῶν ὅλων φύσιος), which he approves. Ptolemy speaks of the 'true philosophers' and refers of their division of philosophy in general in theoretical and practical parts (τὸ θεωρητικὸν τῆς φιλοσοφίας ἀπὸ τοῦ πρακτικοῦ), which he approves as

[10] As Barker notes, it is possible to guess the influence of this particular passage in the beginning of Ptolemy's *Harmonics*: cf. Barker 1989, 276, n. 2. This was actually the motivation why Porphyry actually quoted it in his commentary on this work: Porph. *Comm. Harm.* 55.27ff.

[11] Ptol. *Alm.* 1.1 H1.4(tr. Toomer).

[12] Archyt. DK 1A, 1-4 (tr. Huffman); Huffman 2005, 105.

well. The words used are in both cases very similar, some of them coinciding: καλῶς… δοκοῦσί μοι / καλῶς μοι δοκοῦντι, κεχωρικέναι / διαγνώμεναι. Also the precise beginning in both cases is very similar: Πάνυ καλῶς / Καλῶς.

However, one could wonder whether what Archytas understood by 'distinguish' (διαγνώμεναι) was equivalent to Ptolemy's concept of division (κεχωρικέναι). This issue would be connected with Archytas' apparently problematic concepts of the 'nature of wholes' and 'the particulars' (τῶν κατὰ μέρος) because it is in these categories that Archytas says mathematicians make good distinctions. So what did Archytas mean with 'distinguish'? Could Ptolemy have interpreted that Archytas was referring to a division, in the sense of defining a part of a whole and separating it from another, the same as he seems to imply in his division of philosophy between theoretical and practical?

Huffman argues that the fact that Archytas uses the plural 'wholes' (ὅλων) suggests that Archytas was not thinking in terms of a division within one category, but rather on general principles within each of the sciences.[13] So Archytas, according to Huffman, would understand something different than what Ptolemy understood by his 'division' (κεχωρικέναι). Huffman supports his claim on what follows on Archytas' text, so let us present this following. Archytas goes on with his most famous statement about the kindredness of the mathematical sciences, presenting it as a consequence of what he has previously said:[14]

> περί τε δὴ τᾶς τῶν ἄστρων ταχυτᾶτος καὶ ἐπιτολᾶν καὶ δυσίων παρέδωκαν ἁμῖν σαφῆ διάγνωσιν καὶ περὶ γαμετρίας καὶ ἀριθμῶν καὶ σφαιρικᾶς καὶ οὐχ ἥκιστα περὶ μωσικᾶς. ταῦτα γὰρ τὰ μαθήματα δοκοῦντι ἦμεν ἀδελφεά·
>
> Indeed concerning the speed of the stars and their risings and settings as well as concerning geometry and numbers and not least concerning music, they handed down to us a clear set of distinctions. For these sciences seem to be akin.

According to Huffman, Archytas' paraphrasis on the subject-matter of astronomy, the first

[13] Huffman 2005, 59.
[14] Archyt. DK 1A, 4-6.

of the sciences mentioned ('the speed of the stars and their risings and settings') in contrast with the normal names of the other sciences would be Archytas' practical exemplification of what he means by 'particulars' (τῶν κατὰ μέρος) in contrast with 'wholes': 'an astronomer may start with a set of distinctions about general concepts such as motion, but he will end up being able to give accurate accounts of the motion of specific astronomical bodies such as the constellations, planets, sun and moon.'[15]

Following this interpretation, Archytas' statement that these sciences are akin could perhaps be understood as an exemplification that in each of them the mathematicians have been able to apply these same procedures, from 'wholes' to 'particulars', this is, that in every one of these sciences a similar procedure from 'wholes' to 'particulars' is applicable, precisely because these sciences resemble each other.

However, this does not seem to be the interpretation of the ancient writers, who apparently adhere to a view more compatible with Ptolemy's 'division'. To begin with, Philoponus understands that what Ptolemy means with 'the nature of wholes' would be the most general knowledge (perhaps theoretical philosophy as in Ptolemy), while the particulars would be mathematics (precisely one of the subsequent divisions of theoretical philosophy in Ptolemy). In his commentary on Nicomachus' *Introduction to Arithmetic* glosses Archytas' phrase οἵα ἔντι (see Archytas' text quoted above) in this way at the point where Nicomachus quotes this fragment of Archytas:[16]

> οἷά ἐντι τουτέστιν οἷά εἰσιν· ὑπὸ γὰρ τὰ καθόλου τελοῦσι τὰ καθέκαστον· ὅτι δὲ περὶ τὸ ποσὸν μετὰ τὰς οὐσίας ἡ πᾶσα σχεδὸν τῶν ὄντων θεωρία συνέστηκεν, ἐν ᾧ καὶ αἱ δ' εἰσι μαθηματικαὶ ἐπιστῆμαι, ὡς δείξαντες ἔφθημεν.
>
> *hoia enti* i.e. *hoia eisin*; for the particulars belong under the universals. It has been established that pretty nearly the whole investigation of existing things is concerned with quantity in conjunction with being, and the mathematical sciences belong to this, as I showed before.

[15] Huffman 2005, 60.

[16] Archyt. DK 1G (=Philop. *Comm. Nicom. Ar.* 7 Hoche); cf. Nicom. *Ar.* 1.3 (tr. Huffman slightly modified).

Philoponus contrasts on the one hand the 'whole investigation of existing things', concerned with 'quantity in conjunction with being', and on the other hand mathematics, concerned with 'quantity', which he says is comprised within the former category. He seems to assume that mathematics are 'the particulars' here, and 'the whole investigation of existing things' is the universal, since he links both phrases with the notion of belonging: the same as mathematics belongs to the whole investigation, particulars belong to universals. So the phrase οἷά ἐντι ('such as they are') would refer to the particulars, this is, mathematics, and Archytas would thus mean that since mathematicians have made good distinctions in the 'whole investigation of things', they also have made good distinctions in mathematics.

Indeed, the whole argument of Nicomachus in the context of his quote of Archytas consists in presenting mathematics as an essential particular knowledge useful for philosophy, which represents the whole knowledge. This view could have influenced Philoponus' commentary, which after all is not on Archytas, but on Nicomachus' treatise. Nicomachus firstly presents the four mathematical sciences which appear in Plato's scientific program in the *Republic*: arithmetic, music, geometry and astronomy (*Intr. Arith.* 1.3) and then he says:[17]

> οὐκ ἄρα τούτων ἄνευ δυνατὸν τὰ τοῦ ὄντος εἴδη ἀκριβῶσαι οὐδ' ἄρα τὴν ἐν τοῖς οὖσιν ἀλήθειαν εὑρεῖν, ἧς ἐπιστήμη σοφία, φαίνεται δέ, ὅτι οὐδ' ὀρθῶς φιλοσοφεῖν·
>
> Without the aid of these, then, it is not possible to deal accurately with the forms of being nor to discover the truth in things, knowledge of which is wisdom, and evidently not even to philosophise properly.

In order to substantiate this claim, Nicomachus goes on quoting the Pythagorean Androcydes expressing this idea, then Archytas' fragment, and then a passage of Plato's *Epinomis* where the knowledge of the kindredness of these four mathematical sciences (geometry, arithmetic, harmonics and astronomy) is said to be essential to philosophise properly.[18]

[17] Nic. *Intr. Arith.* 1.3 (tr. D'Ooge).
[18] Nicom. *Ar.* 1.3; Pl. *Epin.* 991d.

Nicomachus adds another quote of Plato where he defends the usefulness of the mathematical sciences for philosophy, in contrast with their use in society.[19]

So the whole argument seems to be that the mathematical sciences are to be taken in their less empirical side, in what they have in common, and as a first, introductory part of philosophy, just as Plato recommends. Interestingly, Nicomachus tries to present them as indispensable, but the only authority that he can quote really arguing this is the obscure Pythagorean Androcydes. In any case, it is likely that he understood Archytas' fragment in the line of his general argument, as stating that these mathematical sciences were particular sciences of philosophy in general.

Let us now take a look at another interpretation of Archytas' text, again from a commentary on Nicomachus' treatise. Asclepius of Tralles gives his own paraphrase of Archytas' fragment:[20]

> καὶ ἁπλῶς ὃ λέγει τοιοῦτόν ἐστιν· ὅτι καλῶς μοι δοκοῦσι ποιεῖν οἱ διαγινώσκοντες τὰ μαθήματα, οἱ γὰρ τὴν τοῦ ὅλου φύσιν εὑρηκότες ἔμελλον ἂν καὶ κατὰ μέρος εἰδέναι. διέγνωσαν οὖν ἀστρονομίαν καὶ γεωμετρίαν καὶ ἀριθμητικὴν καὶ μουσικήν, ἐπειδὴ ἐκ τούτων ἡμῖν προσγίνεται τὸ τέλος.
>
> Put simply what he means is something like this: That the ones who distinguish the sciences seem to me to do well, for they, having discovered the nature of the whole, would be likely also to know about the particulars. So then they distinguished astronomy and geometry and arithmetic and music, since it is from these that our goal is achieved.

Asclepius is partly more explicit than Philoponus, since he tells us that he understands Archytas' distinctions as precisely astronomy, geometry, arithmetic, and music. It is not clear from what entity these distinctions belong, but possibly from what he has called 'particulars', since Asclepius does not seem to equate the particulars with the distinctions: the distinctions would rather be made both from the whole –note Asclepius' slight modification of the problematic plural in Archytas (τοῦ ὅλου instead of τῶν ὅλων)– and from the

[19] Nic. *Intr. Arith.* 1.3; Pl. *Rep.* 527d

[20] Archyt. DK 1H (=Ascl. Tral. *Comm. Nicom. Ar.* 28 Tarán); cf. Nicom. *Ar.* 1.3.

particulars.

This interpretation would then be coherent with the one of Philoponus we have reviewed above. Archytas would be saying that the mathematicians have made good distinctions in particulars (mathematics), since they have made good distinctions in wholes (more general philosophy). The good distinctions they would have made in particulars, this is, in mathematics, would be astronomy, geometry, arithmetic, and music. Let us note that according to this interpretation, Archytas would not specify the distinctions of wholes which the mathematicians would have made prior to the distinctions in mathematics.

The famous statement of the kindredness of these sciences could certainly contribute to this interpretation: indeed, if Archytas said that the kindredness was a proof of those good distinctions, one might have believed that the distinctions themselves are those mathematical sciences, and that they are well-defined, on the same level, because they all share a common aspect. We are now close to what Ptolemy seems to understand with 'divide' (κεχωρικέναι) when he says that 'the true philosophers' were right to separate theoretical from practical philosophy.

Actually, we could have an echo of Archytas' 'nature of wholes' (τᾶς τῶν ὅλων φύσιος) some lines after the beginning of Ptolemy's preface when Ptolemy uses a synonym for the theoretical part which nearly coincides with Archytas' expression: 'theory of wholes' (τῆς δὲ τῶν ὅλων θεωρίας).[21] So interpreting Archytas' term 'distinguish' as 'divide', Ptolemy could actually be specifying the distinctions in the 'wholes' which Archytas does not specify when he just thereafter presents his own division of theoretical philosophy in physics, mathematics, and theology.[22] Ptolemy would be thus 'completing' Archytas.

However, Ptolemy did not go on to divide the mathematical sciences as Archytas did. This must have been a conscious decision, if Ptolemy had Archytas' fragment in mind as

[21]Ptol. *Alm.* 1.1 H1.4: τῆς δὲ τῶν ὅλων θεωρίας ἀδύνατον εἶναι τυχεῖν ἄνευ διδασκαλίας. Ptolemy is comparing the necessity of instruction for theoretical philosophy and the sufficience of habit for the practical part.

[22]Ptol. *Alm.* 1.1 H1.5.

he indeed seems to have had. But, was not Ptolemy's undivided mathematics fully consistent with Archytas' remark that these sciences were kindred, and with Plato's emphasis on their essential unity? As we have said, Ptolemy does not say that he is going to write a book on astronomy until very late, and actually in elusive terms, not using a classical name denoting the mathematical science of astronomy, but alluding in very Platonic terms to the beauty and divinity of the heavenly objects. This would be consistent with the tendency of underplaying any internal division within mathematics. The same may apply to the title of the *Almagest*, which in Greek was *Syntaxis Mathematica*, and also to the title of the *Canobic Inscription*, 'Principles and hypotheses of the *mathemata*' (see my chapter 1). Ptolemy would in these titles be playing with the ambiguity of the term μαθήματα, which could both mean 'mathematics' and also more precisely 'astronomy'. It is clear that if he had wanted to specify, he could have used a less ambiguous term such as ἀστρονομία.

Instead of going further in dividing the mathematical sciences, Ptolemy concentrates on defining the role of mathematics in relation with the other divisions of theoretical philosophy, physics and theology. But before inquiring on what Ptolemy says about this division, let us read what Ptolemy has to say about his first division, the one between theoretical and practical philosophy.

6.2.2 A Platonic philosophy where practical life is important

Liba Taub has stressed Ptolemy's endorsement of the Platonic ideals of education and of contemplation of beauty and the good in this text.[23] As a matter of fact, Ptolemy presents himself as a teacher of 'many beautiful theorems' ('beautiful' being a Platonic hallmark),[24] Taub refers to the ideal of teaching for philosophers in Plato's *Republic* and in Alcinous' *Didascalicus*, and shows the connection between this requirement and the Middle Platonic

[23]Taub 1993, 32-34.

[24]Ptol. *Alm.* 1.1 H1.5: τῇ δὲ σχολῇ χαρίζεσθαι τὸ πλεῖστον εἰς τὴν τῶν θεωρημάτων πολλῶν καὶ καλῶν ὄντων διδασκαλίαν.

ideal of 'becoming like a god'.[25] Taub also notes that precisely divine assimilation is what Ptolemy claims to be the contribution of astronomy to practical philosophy, towards the end of the preface:[26]

> πάντων ἂν αὕτη μάλιστα διορατικοὺς κατασκευάσειεν ἀπὸ τῆς περὶ τὰ θεῖα θεωρουμένης ὁμοιότητος καὶ εὐταξίας καὶ συμμετρίας καὶ ἀτυφίας ἐραστὰς μὲν ποιοῦσα τοὺς παρακολουθοῦντας τοῦ θείου τούτου κάλλους, ἐνεθίζουσα δὲ καὶ ὥσπερ φυσιοῦσα πρὸς τὴν ὁμοίαν τῆς ψυχῆς κατάστασιν.
>
> This science, above all things, could make men see clearly; from the constancy, order, symmetry and calm which are associated with the divine, it makes its followers lovers of this divine beauty, accustoming them and reforming their natures, as it were, to a similar spiritual state.

Note that the verb used (διορᾶν, to see clearly) seems to allude to the topic of contemplation, perhaps in connection with the bodily sense of sight which is used in astronomy (cf. on this my chapter 2). So the 'divine beauty' of the heavenly bodies (see on this *Harm.* 3.4) is said to attract the devotees of this science towards the divine state.

Another mark of the deeply Platonic character of Ptolemy's presentation as a teacher can further be noted in his way to express his disposition to teach: he specifically writes that he will devote himself to teach in his leisure time (τῇ σχολῇ), as opposed to the actions (τὰς πράξεις): Ptolemy seems thereby to be alluding to the Platonic ideal of teaching for free, as opposed to the 'false philosophers' whom could be alluded at the beginning of the treatise when Ptolemy writes 'the true philosophers', a clearly Platonic echo.[27] Once again, we may compare with Galen, who frequently criticised those who are led by the desire to make money rather than by the pursuit of knowledge.[28]

This seems to be already foreshadowed at the beginning of the preface, in Ptolemy's explanation of the division between theoretical and practical philosophy. However, Ptolemy

[25]Cf. Pl. *Rep.* 540b-c; Alc. *Didasc.* 28, 30.

[26]Ptol. *Alm.* 1.1 H1.7.

[27]Cf. e.g. Pl. *Phaed.* 66b: τοῖς γνησίως φιλοσόφοις; *Rep.* 473d: φιλοσοφήσωσι γνησίως τε καὶ ἱκανῶς.

[28]E.g. Gal. *Progn.* 14.604-5, *MM pref.*; cf. *Aff. dig.* V.41 for a praise of one of his philosophical teachers, a pupil of Gaius, for his disinterest in money.

introduces in there a non-Platonic element:[29]

> καὶ γὰρ εἰ συμβέβηκε καὶ τῷ πρακτικῷ πρότερον αὐτοῦ τούτου θεωρητικῷ τυγχάνειν, οὐδὲν ἧττον ἄν τις εὕροι μεγάλην οὖσαν ἐν αὐτοῖς διαφοράν.
>
> For even if practical philosophy, before it is practical, turns out to be theoretical, nevertheless one can see that there is a great difference between the two.

Ptolemy begins here admitting that practical philosophy is somehow theoretical, as well. Thereby Ptolemy seems to view practical philosophy as dependent on theoretical philosophy, a view which could be identified with the Platonic ideal of the contemplative life. We can see it well represented in Alcinous' manual, where it is said that the practical life is only secondary to the contemplative.[30]

However, in what follows Ptolemy states that there is a big difference between the two, which constitutes the real justification of his initial claim that 'true philosophers' have done well in distinguishing between the two. Feke calls this the 'Aristotelian model', on the basis that the distinction between practical and theoretical philosophy appeared full-fledged first in Aristotle's texts.[31] However, as she remarks, these are not the only divisions in Aristotle, (the productive part lacking). Feke parallels Ptolemy's emphasis on the difference between the two kinds of philosophy with a passage of Aspasius' *Commentary on Aristotle's Nicomachean Ethics*, where practical philosophy is said to be prior to theoretical philosophy as what respects necessity, and subsequent to it in regard to value.[32]

Later on Ptolemy proceeds to draw the difference between the two kinds of philosophy, which he argues in terms of necessity of teaching for the theoretical and habit for the practical.[33] Then he interestingly exemplifies with his own person:[34]

> ἔνθεν ἡγησάμεθα προσήκειν ἑαυτοῖς τὰς μὲν πράξεις ἐν ταῖς αὐτῶν τῶν φαντασιῶν ἐπιβολαῖς ῥυθμίζειν, ὅπως μηδ' ἐν τοῖς τυχοῦσιν ἐπιλανθανώμεθα

[29]Ptol. *Alm.* 1.1 H1.4.
[30]Alc. *Didasc.* 2.
[31]Feke 2012, 62; cf. Arist. *Metaph.* 1025b25, 1064a161-17.
[32]Feke 2012, 65; cf. Asp. *Comm. Eth. Nic.* 3.19-23.
[33]Feke 2012, 68 notes a parallel for this in Plut. *De lib. educ.* 2.A10-11.
[34]Ptol. *Alm.* 1.1 H1.4 (tr. Toomer modified).

> τῆς πρὸς τὴν καλὴν καὶ εὔτακτον κατάστασιν ἐπισκέψεως.
>
> Hence we thought it fitting to adequate our actions according to the applications of our own impressions (φαντασιῶν), in such a way as not to forget, even in ordinary affairs, to strive for a beautiful and disciplined disposition of enquiry.

As Feke concludes from her survey of attestations for the cognitive theory invoked by Ptolemy with 'impressions', it is probable that contemplation is alluded by Ptolemy here.[35] Actually, also the qualification as 'beautiful' of the disposition (κατάστασις) also points to this Platonic ideal. So Ptolemy seems here to underline again the dependence of practical philosophy on the theoretical.

Maybe we could compare with Ptolemy's definition of mathematics as the science of the rational in the last part of the *Harmonics* (τῶν παρὰ τὸν λόγον εἰδῶν ἐπιστήμην), where it is stressed that mathematics is not only theory, but also practice (μελέτη) and display (ἔνδειξις) (cf. *Harm.* 3.3 and my chapter 2).

There is an interesting parallel in Vitruvius for Ptolemy's assessment of the importance of the distinction between practical and theoretical philosophy:[36]

> *ea nascitur ex fabrica et ratiocinatione. fabrica est continuata ac trita usus meditatio, quae manibus perficit[ur] e materia cuiuscumque generis opus [est] ad propositum deformationis. ratiocinatio autem est, quae res fabricatas sollertiae ac rationis pro demonstrare atque explicare potest. itaque architecti, qui sine litteris contenderant, ut manibus essent exercitati, non potuerunt efficere, ut haberent pro laboribus auctoritatem; qui autem ratiocinationibus et litteris solis confisi fuerunt, umbram non rem persecuti videntur. at qui utrumque perdidicerunt, uti omnibus armis ornati citius cum auctoritate, quod fuit propositum, sunt adsecuti.*
>
> This knowledge [architecture] is the child of practice and theory. Practice is the continuous and regular thinking (*meditatio*) over the employment where manual work is done with any necessary material according to the design of a drawing. Theory, on the other hand, is the ability to demonstrate and explain

[35] Feke 2009, 75.

[36] Vitruv. 1.1-2 (tr. Morgan slightly modified).

> the productions of dexterity on the principles of proportion. It follows, therefore, that architects who have aimed at acquiring manual skill without scholarship have never been able to reach a position of authority to correspond to their pains, while those who relied only upon theories and scholarship were obviously hunting the shadow, not the substance. But those who have a thorough knowledge of both, like men armed at all points, have the sooner attained their object and carried authority with them.

Vitruvius clearly remarks the importance of both aspects for the architect, both theoretical and practical, and at the same time stresses the necessity of both simultaneously: the one without the other does not work. The definition of practice is remarkable, because in it Vitruvius uses the word *meditatio*, whose obvious meanings are 'a thinking over a thing' and 'contemplation', and only secondarily an exercise or a habit (Lewis and Short, s.v. 'meditatio'). Could Vitruvius, like Ptolemy, be alluding to the 'Platonic model' in which practice is dependent on theory, or we are just in front of a linguistic ambiguity?

It is interesting to note that Vitruvius does not understand 'practice' as practical life in the sense of what we read in Ptolemy's preface, but actually as knowledge as regards manual work. However, we have seen in the chapter dedicated to the harmonics that Ptolemy also used a similar distinction between theory and manipulation/display. It would seem that in the *Almagest* Ptolemy does not need to adapt the philosophical ideal of theoretical and practical life to a scientific inquiry, because astronomy as such can be understood as a philosophical inquiry in itself rather than a scientific one, even if instruments and perceptions are used as in the case of harmonics. This empirical side of astronomy was also developed in Ptolemy's *Harmonics* in connection with Archytas' allegory of the kindred sciences, where astronomy was said to rely on sight in the same way as harmonics relies on hearing (cf. my chapter 2). However here in the *Almagest* Ptolemy chose a more standard philosophical view.

Going back to Ptolemy and Vitruvius on theoretical and practical knowledge, it is clear that both authors agree in stressing the importance of practical knowledge apart from the

theoretical. The ideal of 'mixed life' or *synthetos bios* seems to have been that of Antiochus' Old Academy, seemingly derived from Aristotle's conception of theoretical and practical life.[37] As Tsouni notes, Varro adhered to this principle, so it is possible that Vitruvius was influenced by him in adopting this view (see my chapter 4 on Varro's influence in Vitruvius).

Perhaps Antiochus' philosophy may give us a clue to Ptolemy's statement that 'practical philosophy is theoretical before it is practical', and to Vitruvius' definition of practical knowledge as a 'contemplation': in the fifth book of Cicero's *On the Ends of Good and Evil* the speaker Piso develops the view of Antiochus' Academy on several subjects, among which are the ideals of life:[38]

> *Ergo hoc quidem apparet, nos ad agendum esse natos. actionum autem genera plura, ut obscurentur etiam minora maioribus, maximae autem sunt primum, ut mihi quidem videtur et iis, quorum nunc in ratione versamur, consideratio cognitioque rerum caelestium et earum, quas a natura occultatas et latentes indagare ratio potest, deinde rerum publicarum administratio aut administrandi scientia, tum prudens, temperata, fortis, iusta ratio reliquaeque virtutes et actiones virtutibus congruentes, quae uno verbo complexi omnia honesta dicimus.*
>
> It is therefore at all events manifest that we are designed by nature for activity. Activities vary in kind, so much so that the more important actually eclipse the less; but the most important are, first (according to my own view and that of those with whose system we are now occupied) the contemplation and the study of the heavenly bodies and of those secrets and mysteries of nature which reason has the capacity to penetrate; secondly, the practice and the theory of politics; thirdly, the principles of Prudence, Temperance, Courage and Justice, with the remaining virtues and the activities consonant therewith, all of which we may sum up under the single term of Morality.

From this account, which is explicitly attributed to the Academy of Antiochus ('those with whose system we are now occupied', cf. *De Fin.* 5.1-8), we know that contemplation could be counted as the first of the activities. So if we don't understand the practical life as restricted to the second and third activities in the account (politics and ethics respectively) but in a

[37] See Tsouni 2012, 147-8.
[38] Cic. *De Fin.* 5.58 (tr. Harris Rackham).

more general sense implying just actions, contemplation appears to be the first kind of practical life. This would be coherent with Ptolemy's claim that practical life is theoretical before it is practical, this is, before we come to the second and third kinds of actions in Piso's account. Ptolemy could actually have derived his explanation from a very similar account, since like in his preface the prime objects of contemplation are here the heavenly bodies. Perhaps we could also understand Vitruvius' claim that practical knowledge consists in a *meditatio* as a reflection from this philosophical view in which contemplation is held as an activity.

In Roman times it was but a normal facet of Greek intellectuals, including rhetors and philosophers, to engage in political activities as philosophical advisers or ambassadors travelling through the various distant centers and meeting important Roman political figures, so it seems not strange that a dogmatic Platonic philosopher of that time such as Antiochus devised a doctrine valuing practical life, and not only the traditional contemplative life. This is the case of Posidonius and Antiochus, both friends of Cicero.[39] In the Alexandrian milieu, we find the Jewish interpreter Philo, famously defending the cause of the Jewish community in his own city before the emperor Caligula in Rome.[40]

As a concluding remark, I would add that Ptolemy's emphasis on the importance of practical life could reflect his view of himself as one of these philosophers with public functions in the Graeco-Roman world. If he was indeed writing his *Almagest* for a high-ranked Roman of the elite society, as I have argued in the previous chapter, it seems plausible that Ptolemy presented himself as a Greek philosopher mediating in politics.

6.2.3 Mathematics mediating between physics and theology

After dividing philosophy between theoretical and practical, Ptolemy proceeds with a division of theoretical philosophy in three parts:[41]

[39]Dillon 1977, 54 (Antiochus), 107 (Posidonius).
[40]Dillon 1977, 139.
[41]Ptol. *Alm.* 1.1 H1.5.

> καὶ γὰρ αὖ καὶ τὸ θεωρητικὸν ὁ Ἀριστοτέλης πάνυ ἐμμελῶς εἰς τρία τὰ πρῶτα γένη διαιρεῖ τό τε φυσικὸν καὶ τὸ μαθηματικὸν καὶ τὸ θεολογικόν.
>
> For Aristotle divides theoretical philosophy too, very fittingly, into three primary categories, physics, mathematics, and theology.

In this section I will try to show that the special mediating role that Ptolemy will assign to mathematics in this tripartion was probably derived from Alexandrian Middle Platonists such as Eudorus. But let us first begin with the division.

There has been some discussion about the pertinence of this reference to Aristotle. Boll identified a passage in the *Metaphysics* which Ptolemy would be alluding to,[42] where Aristotle discussed the triad physics/mathematics/theology. But, as Taub observed, the subsequent definitions of the three divisions in Ptolemy's preface do not coincide with Aristotle's in that passage or in any other of his works.[43] However, as Feke noted, Ptolemy's definitions are ultimately Aristotelian, if reworked in order to present the three terms 'according to a spectrum of perceptibility',[44] in such a way that it remains unclear whether Ptolemy had any concrete passage of Aristotle in mind or if he was rather just recalling that the three terms had been posited by Aristotle. The object of theology is presented by Ptolemy as an invisible deity comparable to the prime mover, and the distinction between the objects of physics and mathematics corresponds to the one in Aristotle between the special objects of the senses –as Ptolemy says, 'white, hot, sweet, soft' (*Alm.* 1.1 H5.1)– and common objects of the senses –the ones perceptible by various senses.[45] We may remember that Ptolemy used this distinction in the *Criterion*, too (cf. my chapter 3).

The gradation in perception in the three parts of Ptolemy's division of theoretical philosophy distinguished by Feke plays a role in Ptolemy's subsequent definition of mathematics, the main focus of my analysis now:[46]

[42]Boll 1894, 71. The passage is Arist. *Metaph.* 1026a: ὥστε τρεῖς ἂν εἶεν φιλοσοφίαι θεωρητικαί, μαθηματική, φυσική, θεολογική.
[43]Taub 1993, 21-4.
[44]Feke 2009, 38-9.
[45]Feke 2009, 37-8.
[46]Ptol. *Alm.* 1.1 H1.5.

> τὸ δὲ τῆς κατὰ τὰ εἴδη καὶ τὰς μεταβατικὰς κινήσεις ποιότητος ἐμφανιστικὸν εἶδος σχήματός τε καὶ ποσότητος καὶ πηλικότητος ἔτι τε τόπου καὶ χρόνου καὶ τῶν ὁμοίων ζητητικὸν ὑπάρχον ὡς μαθηματικὸν ἂν ἀφορίσειε τῆς τοιαύτης οὐσίας μεταξὺ ὥσπερ ἐκείνων τῶν δύο πιπτούσης οὐ μόνον τῷ καὶ δι' αἰσθήσεως καὶ χωρὶς αἰσθήσεως δύνασθαι νοεῖσθαι, ἀλλὰ καὶ τῷ πᾶσιν ἁπλῶς τοῖς οὖσι συμβεβηκέναι καὶ θνητοῖς καὶ ἀθανάτοις τοῖς μὲν αἰεὶ μεταβάλλουσι κατὰ τὸ εἶδος τὸ ἀχώριστον συμμεταβαλλομένην, τοῖς δὲ ἀϊδίοις καὶ τῆς αἰθερώδους φύσεως συντηροῦσαν ἀκίνητον τὸ τοῦ εἴδους ἀμετάβλητον.
>
> That division [of theoretical philosophy] which determines the nature involved in forms and motion from place to place, and which serves to investigate shape, number, size, and place, time, and suchlike, one may define as 'mathematics'. Its subject-matter falls as it were in the middle between the other two, since, firstly, it can be conceived both with and without the aid of the senses, and, secondly, it is an attribute of all existing things without exception, both mortal and immortal: for those things which are perpetually changing in their inseparable form, it changes with them, while for eternal things which have an aethereal nature, it keeps their unchanging form unchanged.

The argument goes like this: while theology deals with things heavenly and not perceptible by the senses, and physics deals with things earthly and immediately perceptible by the senses, mathematics plays the middle role. On the one side, its objects may be both perceptible by the senses and not perceptible (depending on the kind of mathematics: geometry and arithmetic are pure, while harmonics and astronomy deal with perceptible objects), and 'secondly, it is an attribute of all existing beings'.

So on the one side there is the gradation in perception which Feke mentioned, but also the important fact that all objects are describable in terms of mathematical structures.

This is the kind of analogic argument which we have seen recurring abundantly in the final part of the *Harmonics* (see chapter 2). For example, Feke notes a very similar gradation invoked in *Harmonics* 3.6, where Ptolemy assigns the enharmonic genus to natural philosophy, the diatonic to theology, and the chromatic –the genus in the middle– to math-

ematics.[47]

It is precisely in that work where we find another similar defining process: in *Harmonics* 3.3 it is reason which plays the mediating role between nature and god:[48]

> καὶ μὴν τῶν αἰτίων τῶν ἀνωτάτω τριχῶς λαμβανομένων, τοῦ μὲν παρὰ τὴν φύσιν καὶ τὸ εἶναι μόνον, τοῦ δὲ παρὰ τὸν λόγον καὶ τὸ εὖ εἶναι μόνον, τοῦ δὲ παρὰ τὸν θεὸν καὶ τὸ εὖ καὶ ἀεὶ εἶναι, τὸ κατὰ τὴν ἁρμονίαν οὔτε παρὰ τὴν φύσιν θετέον – οὐ γὰρ τὸ εἶναι περιποιεῖ τοῖς ὑποκειμένοις – οὔτε παρὰ τὸν θεόν, ἐπεὶ μηδὲ τοῦ ἀεὶ εἶναι πρῶτόν ἐστιν αἴτιον, ἀλλὰ δηλονότι παρὰ τὸν λόγον, ὃς μεταξὺ τῶν εἰρημένων αἰτίων πίπτων ἑκατέρῳ συναπεργάζεται τὸ εὖ.
>
> Now causes fall into three kinds, at the highest level, one corresponding to nature and concerned only with being, one corresponding to reason and concerned only with being good, and one corresponding to God, concerned with good and eternal being. The cause involved in harmonia is not to be identified as corresponding to nature, since it does not implant being in the underlying matter, nor to God, since it is not the primary cause of eternal being, but, clearly, to reason, which falls between the other causes mentioned and joins with them in producing the good.

Here we see also a double gradation, now in the qualities of being and of good: while nature and reason are concerned with mere being, god is concerned with eternal being; and while nature is not concerned with good, reason and god are. So reason is here the middle term. In other words: god has both qualities in the maximum possible degree, nature in the minimal. Ptolemy says that because of this, reason joins them in producing the good, since it is the first category in the gradation which is concerned with good.

Ptolemy is again proposing mathematical entities –reason (λόγος) was in the *Harmonics* defined as the specific quality of mathematical science (3.3), and it is equated with harmonic ratio, the mathematical proportion defining intervals– as mediating between the physical world and the immaterial entities like god.

[47]Feke 2009, 36-7. In there Ptolemy just mentions the shared nature of mathematics, which is said to be involved both in theology and physics.

[48]Ptol. *Harm.* 3.3 (tr. Barker).

This is very important for Ptolemy's presentation of the *Almagest*, since in what follows after the definitions of the three disctinctions of theoretical philosophy he draws these two conclusions: firstly, he argues that mathematics, differently from what is ungraspable (theology) and what is continuously changing (physics), is the only study where philosophers will never disagree, and is therefore the only secure knowledge.[49] Secondly, Ptolemy says that mathematics can contribute to theology and physics 'no less than they do', because of the familiarity of mathematics with the properties of the objects of these two studies. Supporting this claim, Ptolemy says that mathematics, and in particular astronomy, is concerned with unchanging and eternal things (like theology),[50] while the attributes of physical entities depend on the nature of their motion from place to place, precisely the speciality of mathematics.[51]

This second conclusion –the contribution of mathematics to physics and theology– seems to be a consequence of the second argument for situating mathematics between physics and theology mentioned above, namely that mathematics is 'an attribute of all existing things, both mortal and immortal'. Similarly as here Ptolemy said before as we have seen that mathematics changes with those things that are perpetually changing (the physical world), while it remains unchanged when studying unchanging and aethereal things (the godly nature).

Now I will attempt to show that Ptolemy's conception of mathematics as mediating between physical bodies and divine objects was already present in Middle Platonic philosophy.

We have seen that Nicomachus defended the usefulness, and even the necessity, of mathematical knowledge for philosophy. More precisely, after his quote of the *Epinomis* on the importance for the philosopher of considering the kindredness of the mathematical

[49]Ptol. *Alm* 1.1 H6: μόνον δὲ τὸ μαθηματικόν [...] βεβαίαν καὶ ἀμετάπιστον... τὴν εἴδησιν παράσχοι.

[50]Ptol. *Alm.* 1.1 H1.7: τό τε γὰρ θεολογικὸν εἶδος αὕτη μάλιστ' ἂν προοδοποιήσειε μόνη γε δυναμένη καλῶς καταστοχάζεσθαι τῆς ἀκινήτου καὶ χωριστῆς ἐνεργείας...

[51]Ptol. *Alm.* 1.1 H1.7: σχεδὸν γὰρ τὸ καθόλου τῆς ὑλικῆς οὐσίας ἴδιον ἀπὸ τῆς κατὰ τὴν μεταβατικὴν κίνησιν ἰδιοτροπίας καταφαίνεται...

sciences, Nicomachus argues as a mode of explanation, as though Plato was proposing that study of mathematics was basic for philosophy:[52]

> δῆλον γάρ, ὅτι κλίμαξί τισι καὶ γεφύραις ἔοικε ταῦτα τὰ μαθήματα διαβιβάζοντα τὴν διάνοιαν ἡμῶν ἀπὸ τῶν αἰσθητῶν καὶ δοξαστῶν ἐπὶ τὰ νοητὰ καὶ ἐπιστημονικὰ καὶ ἀπὸ τῶν συντρόφων ἡμῖν καὶ ἐκ βρεφῶν ὄντων συνήθων ὑλικῶν καὶ σωματικῶν ἐπὶ τὰ ἀσυνήθη τε καὶ ἑτερόφυλα πρὸς τὰς αἰσθήσεις, τῇ δὲ ἀϋλίᾳ καὶ ἀϊδιότητι συγγενέστερα ταῖς ἡμετέραις ψυχαῖς καὶ πολὺ πρότερον τῷ ἐν αὐταῖς νοητικῷ.
>
> For it is clear that these studies [mathematics] are like ladders and bridges that carry our minds from things apprehended by sense and opinion to those material, physical things, our foster-brethren known to us from childhood, to the things with which we are unacquainted, foreign to our senses, but in their immateriality and eternity more akin to our souls, and above all to the reason which is in our souls.

As in Ptolemy, we find again mathematics between the physical and the immaterial worlds. Such a conception of mathematical entities as mediators between reality and the first principles had indeed roots in the ancient Pythagoreans and in Plato's *Timaeus*, but was revived in what has been called the Alexandrian Platonism, being absent in Hellenistic times.[53] I will list below some examples of this revival. Just as a contextualizing remark, I would like to note that it seems natural that in a center with no dominant philosophical tradition like Alexandria,[54] and where the mathematical sciences had played such major cultural role in the past,[55] reappeared the ancient theory that numbers and geometrical entities are the mediating principles, just about the time when philosophy was nascent in the ancient capital of the Ptolemies, at the beginning of the imperial times.

The revival of this Pythagorean and Platonic tradition has been noted in the fragments of Eudorus on the two principles of the cosmos, the limited monad and the unlimited dyad, from which the ancient Pythagoreans derived the series of numbers, from which in turn

[52]Nic. *Intr. Arith.* 1.3.
[53]Bonazzi 2008, 242.
[54]Cf. Hatzimichali 2011, ch. 2.
[55]See Netz 2009 on the mathematical milieu of Hellenistic Alexandria.

the three dimensions and the whole world were said to be generated.[56] An account of the cosmos much similar to Eudorus', that of the pseudo-Archytan text *On principles*, which also posits a limited and an unlimited principle, pretends that the god uses the powers of numbers in order to give form to the matter of the world.[57] This tradition also permeates Alcinous' manual of philosophy, where it is affirmed that the demiurge had recourse to 'numbers and figures' (ἀριθμοῖς καὶ σχήμασι).[58] Bonazzi argues that, while the Alexandrian exegete Philo reflects this tradition and is partly sympathetic to it,[59] he generally prefers to preserve ideas and not to substitute them for numbers; however, the Alexandrian Platonists would generally prefer numbers.[60]

One of the most clear accounts reflecting the idea that mathematical entities are mediating principles appears ascribed to 'those around Posidonius' in Plutarch's commentary *On the generation of the soul in the Timaeus*, in discussing the materiality of the soul. The passage is worth quoting because it bears a special resemblance with Ptolemy's gradation and his concept of harmony in the soul in the *Harmonics*.[61]

> Ὅμοια δὲ τούτοις ἔστιν ἀντειπεῖν καὶ τοῖς περὶ Ποσειδώνιον· οὐ γὰρ μακρὰν τῆς ὕλης ἀπέστησαν· ἀλλὰ δεξάμενοι τὴν τῶν περάτων οὐσίαν περὶ τὰ σώματα λέγεσθαι μεριστὴν καὶ ταῦτα τῷ νοητῷ μίξαντες ἀπεφήναντο τὴν ψυχὴν ἰδέαν εἶναι τοῦ πάντῃ διαστατοῦ κατ' ἀριθμὸν συνεστῶσαν ἁρμονίαν περιέχοντα· τά τε γὰρ μαθηματικὰ τῶν πρώτων νοητῶν μεταξὺ καὶ τῶν αἰσθητῶν τετάχθαι, τῆς τε ψυχῆς, τῶν νοητῶν τὸ ἀίδιον καὶ τῶν αἰσθητῶν τὸ παθητικὸν ἐχούσης, προσῆκον ἐν μέσῳ τὴν οὐσίαν ὑπάρχειν.
>
> The same may be said against the followers of Posidonius. For they seem not altogether to separate the soul from matter; but imagining the essence of limitations to be divisible in reference to bodies, and intermixing it with the intelligible essence, they defined the soul to be an idea (or essential form) of that which has extension in every direction, subsisting in an harmonic proportion

[56] Bonazzi 2008, 243.
[57] Bonazzi 2008, 243, Ps.-Archyt. 20 Thesleff.
[58] Bonazzi 2008, 242; cf. Alc. *Didasc.* 167 18-20.
[59] E.g. Philo Alex. *Spec. Leg.* 2.165.
[60] Bonazzi 2008, 245.
[61] Posid. F141a Kidd (=Plut. *An. Tim.* 1023B-D) (tr. Kidd).

> of numbers. For (they say) all mathematical objects are disposed between the first intelligible and sensible beings; and since the soul contains the sempiternal nature of things intelligible and the pathetic nature of things subjected to sense, it seems but rational that it should consist of a substance between both.

We don't know which authors Plutarch is referring to with his expression, or if he means Posidonius himself. This would be at least plausible, on the basis that Posidonius traced parts of Plato's philosophy back to Pythagoras and was therefore sympathetic to Pythagorean philosophy,[62] but it seems odd that no other traces of that notable doctrine survive in Posidonius' fragments. It could be significant in this context that as we said earlier (chapter 1), Plutarch was relying on Eudorus' work for his own commentary on the *Timaeus*, so that this report could be mediated by the Alexandrian philosopher, who, as mentioned above, placed mathematical entities at the core of his cosmology. It seems possible to suppose that Eudorus could be one of the philosophers that Plutarch relates to Posidonius. In support of this, we can adduce that Eudorus was interested in Posidonian topics like the geography of the Nile, on which he wrote a work,[63] and that he quoted the work of Diodorus of Alexandria, a mathematician related in some way to Posidonius,[64] so that he was perhaps eager to interpret Posidonius' philosophy as a precursor of his own. Another possibility would be that Eudorus had shaped his account of the philosophy of Posidonius according to his own philosophical principles, something that Plutarch would have repeated from Eudorus' work.

Whatever the case may be, in the quoted passage of Plutarch we find many of the topics that Ptolemy has been introducing. On the one hand, these philosophers 'around Posidonius' are clearly said to have considered that the objects of mathematics are situated between the 'first intelligibles' and the sensible things, this is, between the objects of theology

[62]Posid. T95 Kidd (=Gal. *Plac.* 4.425).

[63]Strab. 17.1.5 (on Eudorus' book on the Nile); Posid. F49C Kidd (on Posidonius' interest on navigation along the Nile).

[64]Ach. Tat. *Isag.* 2 (Eudorus quoting from Diodorus); Kidd 1972, 135 on the similarity between Posidonius' and Diodorus' accounts of mathematics, cf. Strab. 2.5.2 for Posidonius and Ach. Tat. *Isag.* 2 for Diodorus.

and of physics respectively. On the other hand, the soul is said to preserve a harmonic proportion of numbers, the same that Ptolemy proposes in *Harmonics*.[65] In Plutarch's passage the cause of this is that the soul is situated between the sensible and the immaterial worlds, because it partakes characteristics of both (being sensible and eternal at the same time); so if mathematical objects lie between both realms, the soul has to be composed of these. Ptolemy in the *Harmonics* rather links this with the soul being a most rational and perfect source of movement, so that the planets could also be included as the souls' counterpart in the immortal realm.[66]

So having established mathematics as the midpoint between theology and physics, probably following the tradition of Eudorus and others, Ptolemy argues for the contribution of mathematics to both what is situated above (the divine) and what is situated below (nature). The first of these two applications is what we have identified in the three works analyzed in the first chapters with Ptolemy's praxis in the 'last parts': in the *Canobic Inscription* Ptolemy used some astronomy to forge a Pythagorean harmony of the spheres, the same as at the end of the *Harmonics*. In the final parts of *Harmonics* and the *Criterion* Ptolemy also made deductions on the structure of human souls, which in *Harmonics* 3.4 are situated on the same level as heavenly bodies as regards their capacity to save the ratios of intervals.

This would be the first direction, from mathematics above to the heavens and to things analogue to the heavenly bodies such as the souls. This would be the same direction as the one advocated by Nicomachus (as we read above) from mathematics to 'higher' philosophy.

But it is interesting that Ptolemy also argued for the kindred nature of mathematics and physics. We may anachronistically call this the empirical project, because it aims at

[65]Ptol. *Harm.* 3.4: τὴν ὁμοιότητα τῶν τὸ πρόσφορον καὶ ἡρμοσμένον ἐν τοῖς διαφέρουσιν εἴδεσι ποιούντων λόγων… αὗται δέ εἰσιν αἱ τῶν τελειοτέρων, ὡς ἔφαμεν, καὶ λογικωτέρων τὰς φύσεις, ὡς ἐπὶ μὲν τῶν θείων αἱ τῶν οὐρανίων, ἐπὶ δὲ τῶν θνητῶν αἱ τῶν ἀνθρωπίνων μάλιστα ψυχῶν (cf. my chapter 2 above).

[66]Ptol. *Harm.* 3.4: πᾶσι τοῖς ἀρχὴν ἐν αὐτοῖς ἔχουσι κινήσεως καθ' ὁσονοῦν ἐνυπάρχειν, ὥσπερ καὶ τὰς ἄλλας, μάλιστα δὲ καὶ τὸ πλεῖστον τοῖς τελειοτέρας καὶ λογικωτέρας φύσεως…

studying the changing reality, the domain of the scientist.[67] A good example of this could be his work on the *analemma*, a geometrical construction useful for the practice of sundials, which he also dedicated to Syrus. In the prologue to that work, Ptolemy meaningfully advocated for a greater connection between the mathematical and the physical sciences:[68]

> *virorum illorum in lineis accidit admirari etiam in hiis et ualde acceptare, non coattendere autem ubique et eam que secundum naturam in metodis consequentiam ipsarum rerum non solum clamantium, quod et naturali theorie opus est aliqua coassumptione magis mathematica et mathematice magis naturali, nullatenus exprobrauimus.*
>
> I admired the practice of those men in geometry also in these matters, and strongly accepted it, but I did not agree everywhere. And in no way did we blame the things which resulted in accordance with nature in their procedures, since the matters themselves all but cry out that there is need for a somewhat more mathematical conception in the theory of nature, and for a more natural one in mathematical theory.

This direction towards the physical world may be identifiable with the scientific project of Archytas in the *Harmonics*, which is visible in his preface, which as we have seen was probably alluded to by Ptolemy in his own preface to the *Almagest*. Archytas said that since the mathematicians had made good general distinctions, they also distinguished well in the mathematical sciences. In the two sketched interpretations of the meaning of these distinctions the sense remains that the direction is from a more general to a more particular field of study. After that Archytas goes on to speak about acoustics, this is, the theory of the perception of sound. In Ptolemy's *Harmonics* we have seen how Ptolemy valued and identified himself with Archytas' procedures because he approached 'real sound' with mathematics (even if Ptolemy was discontent about the exact matching of Archytas' ratios). It is perhaps significant that Ptolemy did not consider the Platonic ratios at all for his investigation of

[67] In chapter 1 I have noted how the double conception of the intellectual which results –on the one side arguing on immaterial principles, on the other to physics– had also been advocated by Plutarch.

[68] Ptol. *Anal.* pref. (tr. Edwards from Moerbeke's Latin version, the Greek text not fully extant for this treatise; cf. my chapter 4).

harmonics, unlike other theorists of his day.

6.2.4 The argument about mathematics as the only secure knowledge: appropriating logic

In the preceding section we have analyzed the second conclusion of Ptolemy's gradation of knowledges within theoretical philosophy, namely that mathematics contributes to both theology and physics. Let us now analyze the first and perhaps most polemical of Ptolemy's conclusions, where Ptolemy affirms that mathematics is the only secure knoweldge. These are Ptolemy's words:[69]

> ἐξ ὧν διανοηθέντες, ὅτι τὰ μὲν ἄλλα δύο γένη τοῦ θεωρητικοῦ μᾶλλον ἄν τις εἰκασίαν ἢ κατάληψιν ἐπιστημονικὴν εἴποι, τὸ μὲν θεολογικὸν διὰ τὸ παντελῶς ἀφανὲς αὐτοῦ καὶ ἀνεπίληπτον, τὸ δὲ φυσικὸν διὰ τὸ τῆς ὕλης ἄστατον καὶ ἄδηλον, ὡς διὰ τοῦτο μηδέποτε ἂν ἐλπίσαι περὶ αὐτῶν ὁμονοῆσαι τοὺς φιλοσοφοῦντας, μόνον δὲ τὸ μαθηματικόν, εἴ τις ἐξεταστικῶς αὐτῷ προσέρχοιτο, βεβαίαν καὶ ἀμετάπιστον τοῖς μεταχειριζομένοις τὴν εἴδησιν παράσχοι ὡς ἂν τῆς ἀποδείξεως δι' ἀναμφισβητήτων ὁδῶν γιγνομένης, ἀριθμητικῆς τε καὶ γεωμετρίας
>
> From all this we concluded: that the first two divisions of theoretical philosophy should rather be called guesswork than knowledge, theology because of its invisible and ungraspable nature, physics because of the unstable and unclear nature of matter; hence there is no hope that philosophers will ever be agreed about them; and that only mathematics can provide sure and unshakable knowledge to its devotees, provide one approaches it rigorously. For this kind of proof proceeds by indisputable methods, namely arithmetic and geometry.

As Feke noted, Ptolemy's placing of physics under mathematics in epistemological value would not have been unconventional to anyone familiar with Plato or Aristotle.[70] As we have seen, Plato tended in many places to recommend disregard for things physical in

[69] Ptol. *Alm.* 1.1 H1.6.
[70] Feke 2009, 40-1.

favour of the immaterial principles: it is because of this that he wanted mathematicians to direct their interest less to the physical peculiarities of things and more to the common principles of the mathematical sciences (see e.g. *Rep.* 530). Aristotle proposed a similar picture, in which the greater accuracy goes to the first principles, i.e. to theology. Aristotle specifically noted that 'there is more accuracy where there is no magnitude than where there is, and most of all where there is no movement; though if there is movement accuracy is greatest if it is primary movement'.[71] As Feke says, this would imply that only the unmoved movers would take the first rank, while astronomy would take the second, because aether, the region where the heavenly bodies are placed, is the only place to find primary movements; physical bodies would have both magnitude and movement, so they would be placed in the lowest category.[72] All this matches pretty well what could be deduced from Plato's treatment of the sciences, and with the special category attributed to astronomy among them, which is well exploited by Ptolemy as we have seen.

However, in both Plato and Aristotle theology holds always the first place, even in accuracy. So Ptolemy's claim about mathematics being not only the most accurate science, but also the only one which is accurate at all, must have been a strong one. The invocation of Aristotle and Plato (at least in allusion) as authorities throughout the rest of the preface would have been planned as a sort of firm basis from which a strong innovative argument could be thrown. These were the 'old authorities', so much valued by Galen in his praise of Posidonius against Chrysippus in *De placitis*.[73]

We could easily guess Ptolemy's motivations for exalting mathematics as the only unshakable knowledge. Every writer tends to defend his own domain. Furthermore, Ptolemy's conclusion was basically true, in that mathematical theories hold perhaps the highest degree of steadiness and accuracy among the human knowledges. But what were Ptolemy's

[71]Arist. *Metaph.* 1078a9-13: καὶ ὅσῳ δὴ ἂν περὶ προτέρων τῷ λόγῳ καὶ ἁπλουστέρων, τοσούτῳ μᾶλλον ἔχει τὸ ἀκριβές (τοῦτο δὲ τὸ ἁπλοῦν ἐστίν), ὥστε ἄνευ τε μεγέθους μᾶλλον ἢ μετὰ μεγέθους, καὶ μάλιστα ἄνευ κινήσεως, ἐὰν δὲ κίνησιν, μάλιστα τὴν πρώτην.

[72]Feke 2009, 41.

[73]Posid. T101-2 Kidd (=Gal. *Plac.* 4.420 and 377).

strategies for saying that? Firstly, he denies theology the possibility of accuracy with arguments of what has been called 'negative theology': he says that the object of theology is invisible and ungraspable. This description of the deity was actually very much in vogue in the Platonic authors of Ptolemy's age: one need only take a look at the long list of negative qualities attributed to god in Alcinous chapter devoted to it;[74] it also appears in Philo, probably not only as a product of Jewish piety, but also influenced by Pythagorizing Platonism.[75] So Ptolemy seems to have used an argument from this specific kind of Platonism again, albeit in order to support a most un-Platonic claim.

However, a crucial move in Ptolemy's argument rests in my view in a subtle substitution. Logic, which was a traditional part of philosophy for most philosophical schools, is absent from Ptolemy's divisions. For example, in Alcinous' manual we find dialectic –'the knowledge of reason' (γνῶσις... περὶ τὸν λόγον)– alongside theoretical and practical philosophy.[76]

We will now see that for Alcinous 'dialectic', this is, logic, was the most accurate knowledge: my argument in what follows will be that if Ptolemy had a similar traditionally philosophical classification in mind, he could have just omitted logic in order to make appear mathematics as comprising logic itself. Actually, we have already seen how Ptolemy defined mathematics in the *Harmonics* as the most rational (λογικωτάτη) of the sciences (see chapter 2). Well, the very name 'logic' is what we translate as 'rational', and Alcinous very appropriately defines dialectic as the knowledge of reason as we have seen.

In my analysis of the *Criterion* (chapter 3) I have argued that Ptolemy did not mention mathematics in that text precisely because he may have wanted to present knowledge theory –a part of logic proper– as a part of mathematics. The shape of the treatise, so parallel to that of the *Harmonics* and the *Canobic Inscription* with the final fifth part on speculative

[74]Alc. *Didasc.* 10.

[75]Bonazzi 2008, 238-9; Dillon 2008, 229.

[76]Alc. *Didasc.* 3: καλεῖται δὲ ἡ μὲν τῶν ὄντων γνῶσις θεωρητική, ἡ δὲ περὶ τὰ πρακτέα πρακτική, ἡ δὲ περὶ τὸν λόγον διαλεκτική.

philosophy, suggests that the three works form part of the same project, in which mathematics would be shown to be useful for demonstrating Platonic theories of theology and psychology.

Now let us see what Alcinous has to say on logic and mathematics. In the chapter dedicated to mathematics, Alcinous holds the traditional Platonic view that mathematical sciences are useful as a prelude to philosophy, but 'are ignorant of the first principles'.[77] Then he adds:[78]

> Ὅθεν οὐδὲ ἐπιστήμας ταῦτα τὰ μαθήματα ἔφησεν ὁ Πλάτων· ἡ μέντοι διαλεκτικὴ μέθοδος ἀπὸ τῶν γεωμετρικῶν ὑποθέσεων ἐπὶ τὰ πρῶτα καὶ ἀρχικὰ καὶ ἀνυπόθετα ἀνιέναι πέφυκεν· ὅθεν τὴν μὲν διαλεκτικὴν ἐπιστήμην προσεῖπε, τὰ δὲ μαθήματα οὔτε δόξαν διὰ τὸ ἐναργέστερα εἶναι τῶν αἰσθητῶν, οὔτε ἐπιστήμην διὰ τὸ ἀμυδρότερα εἶναι τῶν πρώτων νοητῶν· […] ἐπεὶ δὲ ἡ διαλεκτικὴ ἰσχυρότατον τῶν μαθημάτων, ἅτε καὶ περὶ τὰ θεῖα καὶ βέβαια γινομένη, διὰ τοῦτο καὶ ἀνωτέρω τῶν μαθημάτων τάττεται…
>
> It is for this reason that Plato does not call these disciplines [mathematics] sciences. It is the procedure of dialectic that has the capacity to ascend from the hypotheses of geometry to primary principles not subject to hypothesis. It is for this reason that he called dialectic 'science', while he terms mathematics neither 'opinion' (for mathematical objects are more perspicuous than sense-objects), nor 'science' (since they are more obscure than the primary objects of intellection) […] So, since dialectic is the more powerful discipline, inasmuch as it concerns objects which are divine and permanent, it is therefore ranked above the mathematical disciplines.

Dialectic is in Plato a general name for philosophy, and this is what, as he declares in the *Republic*, one should seek for after the prelude of the mathematical sciences. It has been argued that Alcinous' aim in this context was to claim for Plato the knowledge theory and logic of the Stoics, so that he would have conveniently chosen the name 'dialectic' for logic.[79]

[77] Alc. *Didasc.* 7: Ἔστι γὰρ ἡ τῶν μαθημάτων ἐπίσκεψις ὡς ἂν προοίμιόν τι πρὸς τὴν τῶν ὄντων θεωρίαν· […] ἀγνοοῦσαι τάς τε ἀρχὰς.

[78] Alc. *Didasc.* 7 (tr. Dillon).

[79] Chiaradonna 2009, 255, with references.

So we know that for a Platonic tradition of Ptolemy's time logic held the highest place among the various knowledges. So if Ptolemy omitted logic in his classification the obvious candidate comprising logic in the classification would appear to be mathematics. Actually we know already (cf. chapter 3) that Galen claimed to be using mathematical arguments in passages where he alluded to the logical theory he wished to build for proving results in medicine. In one of these passages he precisely contends that the logic he has learned with the Stoic and Peripatetic philosophers has nearly brought him to Pyrrhonian scepticism, from which he has been saved by mathematics.[80] So it is possible that there was a debate over the preeminence of logic or mathematics, scientific authors appealing to mathematics and philosophers to logic.[81]

6.2.5 Conclusions

From this survey we may draw various conclusions: Ptolemy's philosophical sources remain basically in the philosophical traditions represented by Antiochus and Eudorus, traditions characteristic of his homeland Alexandria (that of Antiochus arrived probably through his Alexandrian pupils, cf. my chapter 3; Eudorus was apparently from Alexandria himself[82]). Ptolemy shows a typically Antiochian view of the importance of practical life, not renouncing to consider contemplation at the top. The special mediating place that Ptolemy attributes to mathematics is typical of Alexandrian Pythagorising Platonism as it appears in Eudorus. In line with Pythagorising Platonism, the first words of Archytas' *Harmonics* seem to have been evoked in the first words of the preface.

Furthermore, I have noted some elements which may be put in relation with Ptolemy's relationship with his dedicatee: his presentation as a teacher in the Platonic tradition, and perhaps his defense of practical philosophy in terms of practical life in the manner of a

[80] Gal. *Lib. prop.* 19.39-40.

[81] Actually we have seen in chapter 3 thanks to Lloyd's analysis how Galen's attitude in this context was something of a pose, his logic being rather like the logic of the Stoics than anything mathematical.

[82] Hatzimichali 2011, 54.

philosopher-mentor.

Lastly, we may conclude that some of the aspects we have seen performed (and not explicited) elsewhere appear here explicited (and not performed). The application of mathematics to theology may be seen in the 'last parts' of the *Canobic Inscription* and *Harmonics* (and also the *Criterion* if we include psychology), and the exaltation of mathematics at the top of knowledge above logic may be compared with what I have interpreted as Ptolemy's appropriation of logic in the *Criterion*.

6.3 The epigram

Let this suffice for the preface of the *Almagest*. I will now turn my attention to another introductory piece to Ptolemy's best-known astronomical work. The epigram which appears at the beginning of the *Almagest*, even if it is frequently quoted in divulgation publications as well as in the prefaces of scholarly literature, remains one of the less analysed texts in the Ptolemaic corpus. To my knowledge, the last published study is Boll's in 1921.[83]

As frequently with this kind of texts, its authorship may be put in doubt.[84] However, two important facts point towards the originality of the little poem: on the one hand, it is attested in the two branches of the manuscript tradition of the *Almagest*.[85] On the other hand, the epigram is placed after the indexes of the first book of the treatise, which would be an odd position if it was a later addition.[86] According to Boll, this placement implies that the late ancient Alexandrian astronomical school, whose copies of the *Almagest* are a probable step of the textual transmission of this work, regarded the poem as Ptolemy's own. This would in turn explain that the epigram carries no name in the *Almagest*'s manuscripts: the placing of the poem after the indexes of Ptolemy's work would mean that the poem was his,

[83]Boll 1950, 1st ed. 1921.
[84]See e.g. Netz 2009, 34, for Archimedes' *Cattle Problem*, which is also a poem.
[85]Boll 1950, 1st ed. 1921, 144, 152.
[86]Boll 1950, 1st ed. 1921, 152.

too.[87] Boll himself accepted Ptolemy's authorship, on these grounds as well as stylistic.[88]

My interest in including this epigram in my study is basically the fact that if it is authentic it would constitute an obvious facet of Ptolemy's self-presentation which deserves serious consideration. A second motivation is that after our survey of other texts of Ptolemy the analysis of the epigram will probably be enriched. I have decided to deal with it in the last place precisely with this aim in view, given that the shortness of the poem (only four verses) rather demands the help of the rest of what we know about Ptolemy than the other way round. As Nisbet recognizes in his study of skoptic epigram in the Roman empire, the genre of the epigram entails basic interpretative problems:[89]

> Iterations and mutations come thick and fast; only a strikingly flexible and pragmatic model of genre can hope to keep up. Furthermore, epigram's history is rooted in basic tensions between the nature of what is written and what is or has been inscribed (*epi-gramma*). The brevity of each text makes concerns of context especially important to the interpreter–but the same brevity can appear to offer little guidance on what kinds of context to seek out or to disallow.

I will begin by situating Ptolemy's epigram within the tradition of poetical texts related to mathematics, and then with epigrams treating the traditional topic of catasterism which features in Ptolemy's. Then I will claim that Ptolemy probably coined his epigram as a response to Horace's famous Archytas ode, with arguments which as I hope will tackle the apparent difficulty of this connection.

6.3.1 Ptolemy's epigram among other poems related to mathematics

Let us quote the four verses of the epigram:[90]

[87] The epigram is transmitted in other places. It is quoted anonymously by Synesius (*Don. astr.* 5; Boll 1950, 1st ed. 1921, 145), and ascribed to Ptolemy in the Palatine Anthology (IX.577). It also appears in the Planudean anthology, as well as in the epigram collection of Laur. 59.17: see Boll 1950, 1st ed. 1921, 144.

[88] Boll 1950, 1st ed. 1921, 152-3.

[89] Nisbet 2003, 1.

[90] Boll 1950, 1st ed. 1921, 146 (tr. Paton, with modifications in the second verse due to the different variant accepted by Boll).

Οἶδ' ὅτι θνητὸς ἔφυν καὶ ἐφάμερος· ἀλλ' ὅταν ἄστρων
ἰχνεύω κατὰ νοῦν ἀμφιδρόμους ἕλικας,
οὐκέτ' ἐπιψαύω γαίης ποσίν, ἀλλὰ παρ' αὐτῷ
Ζηνὶ θεοτρεφέος πίμπλαμαι ἀμβροσίης.

I know that I am a mortal, a creature of a day; but when I search with my mind the revolving spirals of the stars my feet no longer rest on the earth, but, standing by Zeus himself, I take my fill of ambrosia, the food of the gods.

Before going into the details of the topics alluded in the epigram, let us note the basic features that prompt us to identify these verses as an epigram. Just to recall the general features of the Greek epigram, I shall quote Netz's compact definition:[91]

> Formally it [the epigram] is based on brevity of expression which precludes long descriptive passages. In terms of its content, the epigram derives from the tomb inscription, and its generic identity always keeps a trace of this origin: typically it has a localised, personal voice (even if a contrived one), speaking to a particular object, often associated with a deceased person.

In the cases of Ptolemy's verses, we rapidly note that it is a short poem, and that it has a clear personal voice (actually in the first person singular, a very rare instance in Ptolemy's works). The particular object is not alluded to in the verses, although we could suppose it is the treatise that follows. Furthermore, the metric structure of these verses is the typical one of this sort of poems, the elegiac distich, which in this case follows almost perfectly the strong rules in the Alexandrian epigrammatic tradition, according to Boll.[92] Death is not directly treated in the poem, although the main topic in it, what seems to be an astral travel, was frequently associated with the travel of the soul after the death of an individual. In this case this is obviously not literal, since the speaker alludes to this as a transitory state occurring during the study of astronomy. So in principle we could guess that the person speaking is Ptolemy at the moment of dedicating the treatise to Syrus.

[91] Netz 2009, 190.
[92] Boll 1950, 1st ed. 1921, 154.

We have some other ancient epigrams related to mathematics. An epigram by Eratosthenes is attached after a small treatise on the duplication of the cube which he inscribed on a column at Alexandria.[93] In this poem in 18 verses Eratosthenes presents the treatise written above it, listing and criticising the mathematicians that have attempted the problem before, and explicitly dedicating the poem to King Ptolemy as 'the gift of Eratosthenes of Cyrene'.

Both poems coincide in serving as dedications of objects to powerful individuals, in Eratosthenes' case King Ptolemy, in Ptolemy's Syrus (cf. my chapter 5 on Syrus' identity). This would reflect the tradition of epigrams related to objects (in origin the tomb). The main difference between Eratosthenes' and Ptolemy's is that in the latter the dedicated object (the *Almagest*) is not presented at all, and neither are the dedicator or the dedicatee. Since in both cases the poems are related to a treatise, we could perhaps compare this difference with the features of the prefaces. I have mentioned in the preceding chapter how the letters prefacing treatises preserved from the Hellenistic mathematicians, such as Archimedes, Apollonius, and Hypsicles, deal with the mathematical problems that will be subsequently developed in the treatises themselves. However, as we have seen in our survey above, Ptolemy in his preface of the *Almagest* hardly speaks of the particular problems which he will address (he does so just after the long preface, at *Alm.* 1.2), and actually only introduces the particular topic of astronomy after many lines. We seem to have a similar pattern in the epigram, because in it no particular problem is suggested, but only the effect that astronomical studies have in the speaker. Actually, this is a topic in the preface, as we have seen above, since Ptolemy mentions in there the assimilation to the divine state that is attained by the students of astronomy.

The case of Archimedes' *Cattle Problem* is similar and different from Eratosthenes. In there, an extremely complex problem is set out without providing the solution –then it is a

[93]Preserved in Eutocius *Comm. Sph. Cyl.* 84-96.

riddle[94]– and now entirely in verse form (again in elegiac distichs, 44 verses in total[95]). Like Eratosthenes, Archimedes deals with a concrete mathematical problem, but unlike him, he does not provide a solution, and at the same time he does not refer to a main text or object. So the epigram is in this case the whole treatise.

Another mathematical riddle is found in the Palatine Anthology, purportedly featuring in Diophantus' tomb: its solution is the age of Diophantus at his death.[96] This would be a more typical example of epigram, clearly adhering to the tradition of tomb inscription. Another such case could have been the verses which Cicero recalls from Archimedes tomb when he finds it, as he writes in the *Tusculans*, verses which, alas, he does not tell us.[97]

6.3.2 The tradition of catasterism in Graeco-Roman poetry

I will pursue my contextualization now focusing rather on the main topic of Ptolemy's epigram, which seems to be Ptolemy's own astral travel, ending at the side of Zeus enjoying the food of the gods, thus implying in a way his own deification.

We are in the genre of catasterism (apotheosis into a star), developed by the Hellenistic Alexandrian poets and later adopted with great success in the Roman world. Perhaps a good example to begin with is the famous epigram by Callimachus on the formation of the lock of Berenice (fr. 110). This is its story: the lock of Berenice was one of the few constellations added by post-classical Greek astronomers: its name-giver was Conon, court astronomer to the Ptolemaic court at Alexandria (and associate of Archimedes), who thereby sought to honour the wife and cousin of King Ptolemy III Euergetes (reign 247-222 BCE) after she had cut off a lock of her hair in a temple as a vow on her husband's safety after he returned from Syria.[98] This little poem was rewritten by Callimachus himself at the end of his long

[94]And a very complicated one, with a numerical solution that seems to exceed human comprehension (a number of about 200,000 digits): cf. Netz 2009, 34.

[95]Arch. *Problema bovinum* 3.170-1 Mugler.

[96]Anth. Pal. 14.126.

[97]Cic. *Tusc.* 5.64-7.

[98]Evans 1998, 41; West 1985; Netz 2009, 151. Gutzwiller 1992, 359 n. 1 for the sources of the story.

poem *Aetia*, and had an enduring success attested both by the surviving papyri reaching Byzantine times and especially through Catullus' version of it (*Carmina* 66).[99]

Another of the proofs of the popularity of this story is the acceptance of the constellation in later astronomical accounts, such as the *Catasterisms* of pseudo-Eratosthenes and Ptolemy's star catalog (where it is however only alluded to rather than counted as a constellation).[100]

Catasterism was a frequent theme in Roman poetry, especially applied to deified emperors and their families: we encounter the catasterisms of Iulius Caesar, Augustus, Tiberius, Nero, Domitian and his family, and Trajan mentioned by several poets.[101]

Let us now venture some hypotheses about the implications of Ptolemy's epigram in this tradition. I will now come back to some issues relating to the *Canobic Inscription*, which was studied in chapter 1, because they are relevant for my interpretation of Ptolemy's epigram. In chatper 1 we saw how Ptolemy dedicated his inscription to a non-identified 'savior god', which is supposed to refer to Serapis on the basis that Canopus, the location of the inscription, contained a famous temple dedicated to this god. I have also related the expression to Timaeus' prayers in his discourse in Plato's dialogue. But there is still another possible connotation of the expression: it turns out that most of the occurrences of 'savior god' (θεὸς σωτήρ) in inscriptions are dedications to deified kings, mainly Ptolemies; out of a total of 38 occurrences of the formula used for identifiable referents 24 are for deified individuals, against only 14 for 'actual' gods.[102]

Coud Ptolemy's dedication in the inscription be an allusion to the monarchs of Hellenistic Egypt? My survey of 'savior gods' shows that some deified Romans were also called with

[99]Gutzwiller 1992, 384.

[100]Evans 1999, 41.

[101]Iulius Caesar in Verg. *A* 9.641-2, Tiberius, Augustus, and Caesar in V. Max. pr., Nero in Luc. 45-6, the Flavians in Mart. *Epigrams* 9.101.22, Trajan in Plin. *Paneg.* 11.2; these references are taken from Henriksén 2012, 411-12.

[102]14 of the 'savior gods' are Ptolemies (e.g. *Fayoum* 3.158); then come 4 mentions of Asclepius (e.g. *SEG* 44.520), 4 of Agrippa (e.g. *IG* XII.2.203) (on which see Habicht 2005), 2 of an Attalus (e.g. *IvP* I.59), one for Hadrian (*IG* XII suppl. 441), one for Claudius (*MAMA 9 List* 179.P28), etc. Searched through the *PHI*.

this name, so it would be possible to think that Ptolemy also alluded to the successors of the Ptolemaic kings in Egypt, the Romans. If we link this to my hypothesis about Syrus' identity in the preceding chapter, we see that various members of Syrus' family could be alluded thereby. In particular, M. Petronius Mamertinus had been prefect of Egypt between 133 and 137, some ten years before the dedication of the inscription. This would not be incompatible with a fundamental reference to Serapis: Ptolemy's possible reference to the Roman prefects of Egypt was not explicit, because no deification took place outside the close relatives of the emperor, so perhaps an 'official god' had to be there.

My hypothesis for Ptolemy's epigram is that Ptolemy could have playfully portrayed himself in catasterism as if he was an ancient Ptolemaic king, thus situating himself on a similar level as his dedicatee. My guess is that Ptolemy's dedicatee in reading this epigram about Ptolemy's astral travel would have automatically brought to his mind the fact that Ptolemy shared his name with the Hellenistic Ptolemaic rulers. Note that, as we have said above, Ptolemy referred to the lock of Berenice in his *Almagest*, so he knew Callimachus' story, the same as very probably Syrus. There is also the rare coincidence that in both Ptolemy's epigram and in Callimachus' the narrator of the catasterism is the very object that suffers the catasterism speaking in the first person singular, in Callimachus' case the lock,[103] in Ptolemy's apparently Ptolemy himself, or at least, an astronomer. Furthermore, we know that Ptolemy could have used the same strategy for honoring his (possibly prospective) patrons in the *Canobic Inscription*, perhaps alluding to them with the invocation 'savior god', the traditional epithet of the Ptolemies.

Alice König has shown how both Frontinus –in writing his *On Aqueducts* as a comission from the emperor Nerva– and Vitruvius –writing to Augustus– shaped their rhetoric in a manner that not only empowered their dedicatees, but also aimed at situating themselves, the writers, on a similar level of authority.[104] It would not be a suprise, then, that Ptolemy

[103]Gutzwiller 1992, 384.
[104]König 2007.

intended a similar objective.

But let us now turn to other instances of Graeco-Roman poetry on catasterism, which may provide us with a more precise picture of the context of Ptolemy's verses.

Aratus in his didactic poem *Phenomena*, enormously popular both in Hellenistic and in Roman times,[105] described the heavenly bodies according to their appearances and disappearances (what properly means *phenomena*) in the sky.[106] In there, he tells the stories of many mythological catasterisms, such as those of the two Bears (ll. 25-44), Virgo –the justice– (ll. 96-136), or the Tortoise –which became the Lyra thanks to Hermes' use of it– (ll. 268-274). Mythological tales of this same kind were catalogued in the *Catasterisms*, an epitome of a lost work by Eratosthenes.[107]

Eratosthenes is also the author of the lost mythological poem *Hermes*, which recounted the life of Hermes from his early years to his catasterism: Hermes' ascension to the heavens would then serve to describe the skies from his elevated viewpoint.[108] Eratosthenes' *Hermes* perhaps influenced Lucian's *Icaromenippus* and Cicero's *Dream of Scipio*.[109]

6.3.3 Ptolemy's epigram on the ideal life

These seem to be the most important references that Ptolemy could have had in mind when composing his epigram. In this section I will explore in more detail what Ptolemy's verses tell us, arguing that it contains a philosophical topos which is not obvious in the Hellenistic tradition of catasterism.

I have already pointed to the connection which Ptolemy establishes between his study of astronomy and his own astral travel –ὅταν ἄστρων / ἰχνεύω... παρ' αὐτῷ / Ζηνὶ–, arguing that Ptolemy is here retaking the Platonic ideal of the theoretical life which he treats later

[105] Callimachus *Epigr.* 29, Vergil's *Georgics*, Ovid's *Fasti* were inspired by Aratus. Commentaries by Hipparchus and Achilles Tatius are extant; see Gee 2000.

[106] Netz 2009, 168.

[107] The last edition of this work is Pàmias and Geus 2007.

[108] Netz 2009, 181.

[109] Netz 2009, 182 n. 10; Geus 2002, 110-28.

in his preface (see above in the first part of this chapter). This does not seem obvious in the poetry which I have reviewed in the previous section, which appears rather interested in mythological issues.

Let us now take a closer look at the verses. The opening words of the epigram –οἶδ' ὅτι θνητὸς ἔφυν καὶ ἐφάμερος–, which express a decided claim of consciousness about the own mortality, seem to show Ptolemy's awareness of the epigrammatic tradition: as Boll noted, the phrase seems to be built upon the epitaph of the Assyrian king Sardanapalus (an epigram, indeed), which was a well-known ancient topos for the dissolute life, or *bios apolaustikos*:[110] Sardanapalus' epitaph began with the exhortative advise to be aware of the own mortality and consequently give way to the pleasures with no hesitation: εὖ εἰδὼς ὅτι θνητὸς ἔφυς σὸν θυμὸν ἄεξε, τερπόμενος θαλίῃσι.[111] This epitaph was scorned by Aristotle, according to Cicero,[112] and used in poetry either in mocking tone or in pious counterstatements such as Ptolemy's.[113]

The allusion to Sardanapalus may serve various purposes in Ptolemy's epigram. One of them is to counterbalance the main claim of the epigram, the own catasterism. Such a statement, which could be dangerously close to affirming the own immortality, perhaps needed some qualification, which would be provided by the affirmation of the own mortal nature.

Ptolemy could as well have alluded to his own debt to Aristotle, who as we have mentioned criticised Sardanapalus' epigram. It would not be strange that, the same as in the preface, Ptolemy wished to align himself with Aristotle as well as with Plato. Furthermore, it is not implausible that this functioned as a praise of the Peripatetic ideal of moderation,

[110]Boll 1950, 1st ed. 1921, 146.

[111]Athen. 8.14.

[112]Cic. *Tusc.* 5.101: 'quid aliud' inquit Aristoteles 'in bovis, non in regis sepulcro inscriberes?'.

[113]Mock of Sardanapalus in *Anth. Gr.* 7.325. Cf. *Anth. Gr.* 7.327 for a rebuilding of Sardanapalus' words as Μὴ σύ γε θνητὸς ἐὼν ὡς ἀθάνατός τι λογίζου, 'Do not thou, being mortal, reckon on anything as if thou wert immortal' (tr. Paton). See similarly Chrysippus *apud* Athen. 8.16. Cf. epigraphic literature cited in Boll 1950, 1st ed. 1921, 146.

which was adopted by Antiochus.[114]

A third function is made clear by the ending –παρ' αὐτῷ / Ζηνὶ θεοτρεφέος πίμπλαμαι ἀμβροσίης– which addresses the topic of pleasure. Ptolemy did not compare his discoveries with an earthly banquet, which would imply a pleasure of the senses (precisely what the *bios apolaustikos* means), but a divine one. In the second verse he has already said that his astral travel is not with the body, but with the mind –ἰχνεύω κατὰ νοῦν–. We may recall Plutarch's invective against the Epicureans, where he contrasts the great pleasures experienced by mathematicians in the sudden discovery of their achievements with the pleasures of gluttons.[115] Plutarch says that no glutton cries like Archimedes because his pleasure is not so great. Ptolemy would be alluding to the great pleasure of abstract thinkers, the mathematicians.

This seems to be something shared with the *Canobic Inscription*, which would also convey the expression of the great pleasure of an intellectual achievement, in this case taking the form of a votive offering. The examples that Plutarch gives in his text against the Epicureans could be parallels for that: Pythagoras' sacrifice of an oxen, Eudoxus' claim that he would sacrifice himself with the flames of the sun had he the opportunity to approach it and measure it.[116] Note that in both these cases the pleasure is counterbalanced by a heavy loss: in Eudoxus it is his own person, in Pythagoras it is his vegetarian principle; in the same manner, the dedication of the inscription should have included some sort of sacrificing ritual, and in the epigram the divine pleasure is counterbalanced with the affirmation of the own mortality in the first verse.

At first sight Plutarch's example of Eudoxus seems very close to what we have in Ptolemy's epigram, since both are astronomers related to an ascension to the planets themselves. However, there is a subtle difference in the order of the events: while Eudoxus is said to wish to get closer to the sun in order to study it, Ptolemy says that when he follows

[114]Antiochus' Peripatetic ideal of moderation is mentioned in Cic. *De Fin.* 5.11; Cf. Roskam 2005, 141.
[115]Plut. *Mor.* 1093D.
[116]Plut. *Mor.* 1094A.

the courses of the planets he elevates himself. So in Ptolemy's epigram the elevation is presented as a consequence of his study rather than as a desirable prerequisite as in Eudoxus' story.

This is why in Ptolemy's epigram we can recognise the Platonic theme of theoretical life –as stated in the *Almagest*, the student of astronomy gets as a reward an approximation to the divine state–, which cannot be seen in Plutarch's text. This tradition can be said to derive from *Phaedrus*, where Socrates relates in his second speech the famous chariot allegory. In there the souls, which are immortal, are compared to the union of a charioteer and two winged horses. They are said to develop wings when contemplating knowledge, from which they are nurtured, and to lose the wings when they fall to the earth to live in a human body. The soul 'which follows God best and is likest to him lifts the head of the charioteer into the outer world, and is carried round in the revolution'.[117] In particular, the soul of the philosopher is the first one which develops wings, after 3000 years instead of the 10000 it takes for the other souls.[118] Socrates says that it is for this reason that the mind (διάνοια) of the philosopher is the only which has wings.[119]

Still in the *Phaedrus*, Zeus is said to lead the procession of the souls,[120] and the divine horses of the soul are said to be nourished with ambrosia and nectar when the soul gains knowledge.[121] Divine feasting (with ambrosia) is mentioned at the end of the epigram, and the god named is precisely Zeus: this is probably no coincidence.[122] Finally, let us note that the blame of the *bios apolaustikos* featuring at the beginning of the epigram is also present in the famous Socratic allegory, as is clear in the passage where the lives of nine different classes of people are ordered according to the amount of truth seen by their souls, the first

[117]Pl. *Phaedr.* 248a: ἡ μὲν ἄριστα θεῷ ἑπομένη καὶ εἰκασμένη ὑπερῆρεν εἰς τὸν ἔξω τόπον τὴν τοῦ ἡνιόχου κεφαλήν, καὶ συμπεριηνέχθη τὴν περιφοράν… (tr. Jowett).

[118]Pl. *Phaedr.* 248e-249a: εἰς μὲν γὰρ τὸ αὐτὸ ὅθεν ἥκει ἡ ψυχὴ ἑκάστη οὐκ ἀφικνεῖται ἐτῶν μυρίων – οὐ γὰρ πτεροῦται πρὸ τοσούτου χρόνου – πλὴν ἡ τοῦ φιλοσοφήσαντος ἀδόλως…

[119]Pl. *Phaedr.* 249c: διὸ δὴ δικαίως μόνη πτεροῦται ἡ τοῦ φιλοσόφου διάνοια.

[120]Pl. *Phaedr.* 246e: ὁ μὲν δὴ μέγας ἡγεμὼν ἐν οὐρανῷ Ζεύς, ἐλαύνων πτηνὸν ἅρμα, πρῶτος πορεύεται…

[121]Pl. *Phaedr.* 247e: ἐλθούσης δὲ αὐτῆς ὁ ἡνίοχος πρὸς τὴν φάτνην τοὺς ἵππους στήσας παρέβαλεν ἀμβροσίαν τε καὶ ἐπ' αὐτῇ νέκταρ ἐπότισεν.

[122]The parallel is mentioned in Boll 1950, 1st ed. 1921, 151.

being that of a philosopher, the last that of a tyrant.[123]

Cicero's *Dream of Scipio* at the end of his *Republic* developed this Platonic theme in a manner which reminds of the story in Ptolemy's epigram, so it would be convenient to take a look now at Cicero's text. Cicero made Scipio Aemilianus refer a dream he had. In this dream, the ghost of Aemilianus' grandfather Scipio Africanus predicted his grandson brilliant future and death and told him to have no fear, because 'it is not you that are mortal, but this body.'[124] Africanus goes as far as telling Aemilianus:[125]

> *Deum te igitur scito esse, siquidem est deus, qui viget, qui sentit, qui meminit, qui providet, qui tam regit et moderatur et movet id corpus, cui praepositus est, quam hunc mundum ille princeps deus;*
>
> Know then that you are a god; since he is a god who possesses force, feeling, memory and prescience, who directs, governs, and moves that body, of which he is the master, just as much as the supreme God of all moves this universe.

Africanus describes to his grandson the heavenly spheres and the music they produce (the so-called music of the spheres) – topics famously appearing in Plato's *Timaeus* and *Republic*, which Cicero combines with the *Phaedrus*' topic of the cosmic return of the souls in making Africanus say that:[126]

> *docti homines nervis imitati atque cantibus aperuerunt sibi reditum in hunc locum, sicut alii, qui praestantibus ingeniis in vita humana divina studia coluerunt.*
>
> Learned men by imitating this with stringed instruments and melodies have opened for themselves the way back to this place, even as other men of noble nature, who have followed godlike aims in their life as men.

As Lehoux notes, Cicero emphatically employs the word *reditus* (return) here as well as in other places of the text, implying that the soul travels from the heavens to a mortal body

[123]Pl. *Phadr.* 248e.
[124]Cic. *Resp.* 6.26: Tu vero enitere et sic habeto, non esse te mortalem, sed corpus hoc (tr. Pearman).
[125]Cic. *Resp.* 6.26 (tr. W. D. Pearman).
[126]Cic. *Resp.* 6.18-19.

and then back to the heavens in a repeated cycle.[127] This is actually the same myth as we have it in the *Phaedrus*.

The dream closes with Africanus strongly warning against the *bios apolaustikos*: he advises that those men who have given themselves to the pleasures of the body do never return to heaven, but wander for many ages.[128] As regards Ptolemy's epigram, we have already noted the dissolute life of Sardanapalus mentioned in there, too.

To sum up, it seems that the conception underlying the story that Ptolemy's epigram tells us is in the tradition of Plato's *Phaedrus* and Cicero's reelaboration in his *Dream of Scipio*.

Let me finally add a marginal observation. Similarly as Cicero in his *Dream of Scipio*, Ptolemy introduced the Platonic harmonious spheres in the *Canobic Inscription*. I have argued in chapter 1 that this could be understood as an allusion to Plato's astronomer Timaeus. It is possible indeed that Ptolemy alluded to Timaeus in his epigram, too, in his conspicuous use of the Doric form ἐφάμερος in the first verse. As Boll notes, this is very probably a reference to a Doric author which he cannot identify.[129] In the pseudo-Pythagorean *Timaeus Locrus*, written in pseudo-Doric, human beings are said to have been created as 'mortal and ephemere animals' (θνατά τε καὶ ἐφαμέρια ζῶα).[130] The non-Doric form of 'mortal' (θνητός) in the epigram would not have been Doricized in order to maintain the reference to Sardanapalus' words.

6.3.4 Horace's Archytas ode

In this last section I will address a parallel alleged by Boll between Ptolemy's epigram and Horace's Archytas ode (*Od.* 1.28).[131] I will begin with the assessment of the parallel, under-

[127]Lehoux 2012, 189.

[128]Cic. *Resp.* 6.29: Namque eorum animi, qui se corporis voluptatibus dediderunt earumque se quasi ministros praebuerunt inpulsuque libidinum voluptatibus oboedientium deorum et hominum iura violaverunt, corporibus elapsi circum terram ipsam volutantur nec hunc in locum nisi multis exagitati saeculis revertuntur.

[129]Boll 1950, 1st ed. 1921, 147.

[130]Tim. Locr. 218.

[131]Boll 1950, 1st ed. 1921, 147-8.

lining the possible verbal echoes. Then I will show that instead of concluding like Boll that the parallel is due to a lost common source of Ptolemy and Horace, it can be argued that Ptolemy possibly modeled his epigram directly on Horace.

First of all, it will be useful to divide the epigram in four parts, in order to show the extension of the parallel. Ptolemy's epigram may be divided in four parts corresponding to its syntactic periods: firstly Ptolemy states that he knows his own mortality. In the second place, he introduces the topic study: his mental exploration of the courses of the stars. Thirdly, he states that he does not feel the earth anymore in that circumstance, this is, that he does elevate himself. The fourth and last image is that of Ptolemy as a guest of Zeus.

In Horace's Archytas ode the poet apostrophizes Archytas in front of his tomb, advising him that his exploration of the heavenly bodies does not save him against death. This is the beginning:[132]

> *Te maris et terrae numeroque carentis harenae*
> *mensorem cohibent, Archyta,*
> *pulveris exigui prope litus parva Matinum*
> *munera, nec quicquam tibi prodest*
>
> *aerias temptasse domos animoque rotundum*
> *percurrisse polum morituro.*
> *occidit et Pelopis genitor, conviva deorum…*
>
> A small amount of dust offered as meager funeral rites confines you near the Matine shore, Archytas, you who measured the sea and the earth and sands without number. Nor is it any use to you, a mortal, to have attained the heavenly realms and to have traversed the rounded sky with your mind. The father of Pelops, who shared in the banquets of the gods, also died…

Now I will argue that the parallel with the ode extends to all four parts of Ptolemy's epigram as I have divided it above. To begin with, Ptolemy's description of his intellectual activity (ἄστρων / ἰχνεύω κατὰ νοῦν ἀμφιδρόμους ἕλικας) has a strikingly close parallel in

[132] Hor. *Od.* 1.28.1-7 (trans. Huffman slightly modified). I translate *animo* as syntactically connected with *tibi* like most interpreters (Huffman does it with *morituro*), and *temptasse* I render as 'attained', which is a more general meaning than Huffman's more restricting 'investigated'; cf. Huffman 2005, 261.

the description of Archytas' enterprise in Horace's ode: 'animoque rotundum / percurrisse polum'. Within these two verses, we find a number of similarities which can hardly be casual: the verbs chosen convey a similar idea of a hunt (ἰχνεύω / percurrisse); the revolving motion of the studied object is underlined twice, both by the adjective and by the substantive (ἀμφιδρόμους ἕλικας / rotundum… polum); and, most conspicously, both Ptolemy and Horace add a complement expressing that the travel is intellectual, using a precise equivalent concept in both languages (κατὰ νοῦν / animo).

What comes before in Horace's ode, the idea that Archytas has touched the celestial houses ('aerias temptasse domos') is paralleled with what follows in Ptolemy's epigram, the loss of contact with the earth (οὐκέτ' ἐπιψαύω γαίης ποσίν). Note that the verb used by both authors conveys the same idea of touch or bodily contact (ἐπιψαύω / temptasse),[133] a contact with the celestial bodies in Horace, and a 'non-contact' with the Earth in Ptolemy's case, what could constitute a nice variation.

The final topic in Ptolemy's epigram, the view of himself drinking ambrosia by the side of Zeus (παρ' αὐτῷ / Ζηνὶ θεοτρεφέος πίμπλαμαι ἀμβροσίης), can also be found in the immediate sequel of Horace after 'morituro': Horace warns Archytas that the father of Pelops died too, even if he was a guest of the gods (*occidit et Pelopis genitor, conviva deorum*). He refers to Tantalus, who, as the story famously goes in Pindar, stole and gave to mortals the nectar and the ambrosia with which the gods made him immortal.[134]

In turn, Ptolemy's first topic, the affirmation of knowledge of his own mortality (οἶδ' ὅτι θνητὸς ἔφυν καὶ ἐφάμερος), would be a fitting response to Horace's warning (nec quicquam tibi prodest… morituro).

Boll, well aware of the clear parallels between these two poems, claimed that both must have had a common Hellenistic model, perhaps an epigram mocking Archytas.[135] However,

[133]Huffman notes that *temptasse* must not, and probably does not in this case, convey the notion of 'storm', but that it more probably means 'try' in the notion of investigation.

[134]Pind. *Ol.* 1.60-3.

[135]Boll 1950, 1st ed. 1921, 148.

I will argue in what follows that Horace's sources are more likely to be found in the Latin literature, specifically in Cicero.

Horace and Cicero

Indeed, the only other attestation of Archytas' astral voyage alluded to by Horace is found in Cicero's *Laelius*, where the speaker Laelius informs that, according to a story known among the elders, Archytas used to say that:[136]

> *si quis in caelum ascendisset naturamque mundi et pulchritudinem siderum perspexisset, insuavem illam admirationem ei fore; quae iucundissima fuisset, si aliquem, cui narraret, habuisset.*
>
> If someone should ascend into the heavens and gain insight into the nature of the universe and the beauty of the stars, his wonder at those things would be without pleasure, although it would be most pleasant, if he should have someone to whom to describe it.

This story may go back to Archytas' famous argument about the unlimitedness of the world, as Huffman cleverly shows.[137] In defending that the world was unlimited, Archytas proposed to mentally imagine someone at the edge of the heaven and extending a stick a little further, while asking whether the space attained would not be still a part of the world.[138] So having in mind that this story was already circulating in Rome in one of Cicero's famous treatises (the publication of Horace's odes is dated between 26 and 11 BCE, some twenty years before the death of Cicero[139]), it seems in principle more probable that Horace took it from here than from Aristoxenus.

But there are further reasons to think that Horace got the story from Cicero. Indeed, Cicero's version of this anecdote provides another parallel with Horace's poem, which cannot be explained by Archytas' mental experiment: as we have read in the quote above, Cicero

[136]Archyt. DK A7a (=Cic. *Lael.* 88) (tr. Huffman). Huffman argues by comparing Cicero's procedures in other passages that the story was probably in Aristoxenus' *Life of Archytas*; Huffman 2005, 293-4.

[137]Huffman 2005, 23.

[138]Archyt. DK A24; cf. Huffman 2005, 540-1.

[139]Hutchinson 2002 for the the dating of Horace's odes.

says that according to Archytas, someone who had traveled to the heavens would not have experienced pleasure unless he had had a friend to whom to tell it. This is actually the reason why Cicero includes this anecdote in his treatise *Laelius*.

Now, one could claim that in Horace's ode Archytas is portrayed as looking for a friend: at the beginning the first speaker (there is a change of speaker in v. 21[140]) apostrophizes Archytas in front of his tomb. He recites Archytas' intellectual pursuits as if reading them from the epitaph ('measurer of the sea…'), including the astral voyage. It is as though the dead Archytas tried to communicate his achievement to someone in order to experience the true pleasure of his achievement. Finally, at the end of the poem Archytas himself demands the help of the first speaker, asking him to throw three handfuls of earth upon his tomb (vv. 35-36).

Furthermore, the performance of funerary rites is precisely another of the topics of Cicero's *Laelius*, which is put in relation with the immortality of the soul. Laelius argues against those who deny immortality to the soul that otherwise funerary rites would have no sense:[141]

> *Neque enim adsentior iis, qui haec nuper disserere coeperunt, cum corporibus simul animos interire atque omnia morte deleri; plus apud me antiquorum auctoritas valet, vel nostrorum maiorum, qui mortuis tam religiosa iura tribuerunt, quod non fecissent profecto, si nihil ad eos pertinere arbitrarentur, vel eorum, qui in hac terra fuerunt magnamque Graeciam, quae nunc quidem deleta est, tum florebat, institutis et praeceptis suis erudierunt…*
>
> For I do not agree with those who have recently begun to argue that soul and body perish at the same time, and that all things are destroyed by death. I give greater weight to the old-time view, whether it be that of our forefathers, who

[140]Frischer 1984 has convicingly argued that in verse 21 ('me quoque…') we have a change of speaker, and that the verses from now on represent a quotation from the actual epitaph of Archytas, who would respond in this way to the narrator's address in the first part of the poem. In favour of his hypothesis, Frischer says that the traditional reading marks off Archytas' as the only ode of Horace where the speaker is not the poet himself, and he has paralleled his proposed reading with various examples of the Hellenistic epigrammatic practice, where changes of speaker sometimes appear marked with similar phrases as the one in v. 21, and where some verses of epitaphs are sometimes quoted in this way, too. Huffman 2005, 20 n. 7 expresses his doubts on this interpretation, albeit without compelling reasons.

[141]Cic. *Lael.* 13.

> paid such reverential rites to the dead, which they surely would not have done if they had believed those rites were a matter of indifference to the dead; or, whether it be the view of those who lived in this land and by their principles and precepts brought culture to Great Greece, which now, I admit, is wholly destroyed, but was then flourishing;

Laelius defends the funerary rites by resorting to the authority ('auctoritas') of the elders, and also to that of the ancient Pythagoreans, who are praised as those who brought the Greek culture to Italy.

Let us now turn to Horace's ode. Archytas' Pythagoreanism is heavily emphasised by Horace, in connection with immortality, as well. Precisely the most detailed of the mythical figures which Horace cites as Archytas' predecessors is that of Pythagoras:[142]

> *habentque*
> *Tartara Panthoiden iterum Orco*
> *demissum, quamvis clipeo Troiana refixo*
> *tempora testatus nihil ultra*
> *nervos atque cutem morti concesserat atrae,*
> *iudice te non sordidus auctor*
> *naturae verique.*
>
> Tartarus holds Panthoides, twice sent to Orcus, though he bore witness, carrying his shield there, to Trojan times, and left nothing more behind for black Death but his skin and his bones, and that certainly made him to your mind no trivial example of Nature and truth.

Horace cites Pythagoras with the mocking name Panthoides, 'know-all', a tradition going back to the famous accusation of polymathy that the mythical sage received from Heraclitus (B40, B129). It seems that Horace is opposing the Platonic tradition that knowledge –this is, theoretical life– provides immortality to the soul, advocated by Cicero in his *Dream of Scipio* as well as by Ptolemy in the epigram.

In the lines quoted above, Horace alludes to Pythagoras' claim of his own immortality referring to the traditional story that Pythagoras claimed to be the reincarnation of the Tro-

[142] Hor. *Od.* 1.28.9-15.

jan hero Euphorbus, whose shield he purportedly recognised. Pythagoras' life is paralleled with the other examples, and for each one a story of extra-bodily travel is alleged, which however does not allow an immortal life, according to Horace. Like Tantalus, who was a guest of the gods (the same that Ptolemy claims for himself), Pythagoras died, too: only his skin and bones remain. Horace finally concludes that 'there's still one night that awaits us all, and each, in turn, makes the journey of death.'[143]

For Horace there is no afterlife. In another ode, very close to this one in the same book, Horace writes a consolation addressed to Virgil for the death of his friend Quintilius (*Od.* 1.24). Far from allowing any survival of the soul, Horace desperately wonders if life would return to that 'empty image' even if Virgil 'played on the Thracian lyre, listened to by the trees, more sweetly than Orpheus could'.[144] Elsewhere he mocks the incantation of the dead in the Odyssey, the so-called Nekuia.[145] In another ode, he rejects any funerary rites for himself, arguing that his poetry is the only survival of himself (*Od.* 2.20).

In the Archytas ode all these themes nicely converge: death awaits us all, even the most learned men; it is no help that a friend performs funerary rites, he should rather accept the inevitable. A Pythagorean like Archytas, who could claim to have traveled outside his body like Pythagoras, is just dead after all. The dead Archytas claims the rites in a sort of after-life hope, but Horace prefers to be consequent and not deliver them, advicing Archytas to accept the inevitable, too (*Od.* 1.28.35-6). Thus Horace would transform the reason of Archytas' need of a friend in Laelius' account, which was Archytas' own pleasure of discovery, into another theme of Laelius, the function of the funerary rites.

There remains another interesting question. Archytas is described in the ode as 'measurer of sea, of land, and of innumerable sands' (*Od.* 1.28.1-2). This description does not fit the biographical informations on Archytas, but it would be most appropriate for

[143]Hor. *Od.* 1.28.15-16: sed omnis una manet nox / et calcanda semel via leti.

[144]Hor. *Od.* 1.24.12-15: quid? si Threicio blandius Orpheo / auditam moderere arboribus fidem, / num vanae redeat sanguis imagini… (tr. Kline).

[145]Setaioli 2005, 62.

Archimedes, who had written the *Sand Reckoner*, a treatise in which he counted the number of grains of sand in the whole world, and *On floating bodies*, the most famous ancient text which could be said to measure water.[146] Huffman notes that either Horace confounded both, or that he used Archimedes' figure as a general description of a geometer.[147]

Horace seems thus to be projecting popular knowledge of Archimedes on Archytas. This makes it unlikely that he used an accurate source on Archytas such as Aristoxenus' *Life of Archytas*[148] for the composition of his ode. Of course, there will always remain the possibility advocated by Boll: that the story of Archytas' astral journey was found, apart from Cicero, also in an Hellenistic epigram which would thereafter be the source of Ptolemy, too. However, this possibility seems less likely, in view of the mentioned facts that point to Cicero's influence in the Archytas ode. But there is another point, related to Archimedes, which connects Horace to Cicero in a crucial way, thus adding support to the possibility that the main subtext of Horace's ode was indeed Cicero.

Around twenty years before the composition of Horace's odes, Cicero famously wrote in the *Tusculan Disputations* about his discovery of Archimedes' grave in Syracuse.[149] Cicero comments in there on the dissolute life of Dionysius of Syracuse, whose uncle Dion demanded Plato's assistance in order to reeducate him. At a given point, Cicero contrasts Dionysius' mode of life first with Plato's and Archytas', and then turns to Archimedes, a man original of the same city as Dionysius, as Cicero says. Then Cicero proceeds to narrate his discovery of the tomb of Archimedes, which he finds thanks to the verses written on it; he recalls having heard them somewhere.

Cicero contrasts Dionysius' dissolute life with the ideal of Platonic life he sees represented in Archimedes: in another famous passage earlier in the same work, Cicero admires a planetarium made by Archimedes, comparing its author with Plato's god in the *Timaeus*

[146]Netz 2009, 198.
[147]Huffman 2005, 22.
[148]Huffman 2005, 293-4.
[149]Cic. *Tusc.* 5.64-7. Netz 2009, 198 n. 40 also suggests this parallel.

who devised the mechanisms of the revolving spheres; Cicero argues that Archimedes could not have produced that if he had not 'a divine mind'.[150]

On the other hand, in Horace's ode one could note a first parallel with Cicero's Archimedes story in the fact that Horace addresses the dead Archytas, a mathematician like Archimedes, in front of his tomb. In contrast with Cicero, Horace denies any divinity to Archytas, even if he has traversed the skies, and instead he refuses to deliver the funerary rites which for Laelius were a proof of the immortality of the soul. Indeed, Horace seems to be ironic in this point: Archytas' Pythagorean traditions, which famously advocate for such an immortality, are turned in the ode against him, since in the final part of the ode, Archytas presents himself as having drowned into the sea, a story transferred from a famous anecdote about Hippasus, who was supposedly punished with drowning for divulging Pythagorean secrets. As Frischer observes, Hippasus' drowning was 'not real but symbolic, consisting of the erection of a cenotaph in his name'.[151] It seems to be in this same symbolic way that Horace poetically punished Archytas for pretending an immortal life.

To sum up, it seems plausible that Horace's ode was a response to Cicero, and that he transposed the Archimedes narrative to the Pythagorean Archytas, which enabled much more play with immortality issues. Thus in allusion to Archimedes and Cicero's story of recovery, Horace would have portrayed Archytas partly as the Syracusan mathematician.

Ptolemy and Horace

We have seen that between Ptolemy's epigram and Horace's Archytas ode there are many parallels which suggest at least a common source (as proposed by Boll). However, I have attempted to show that Horace probably shaped his ode in response to Cicero's view of this

[150]Cic. *Tusc.* 1.63: nam cum Archimedes lunae solis quinque errantium motus in sphaeram inligavit, effecit idem quod ille, qui in Timaeo mundum aedificavit, Platonis deus, ut tarditate et celeritate dissimillimos motus una regeret conversio. quod si in hoc mundo fieri sine deo non potest, ne in sphaera quidem eosdem motus Archimedes sine divino ingenio potuisset imitari.

[151]Frischer 1984, 83.

Pythagorean and of Archimedes as in the *Laelius* and the *Tusculans*.

As regards Ptolemy, in principle his Greek-speaking *milieu* would seem to advise against supposing a direct influence of Horace: a Greek author being aware of Latin literature was a rarity in Ptolemy's times.[152] Only few authors such as Plutarch who had contact with Romans show some acquaintance with major Latin authors such as Cicero or Horace.[153] However, we have shown in chapter 5 that Ptolemy was probably one of them, his dedicatee having been probably a Roman.

As regards the circumstances of Ptolemy's epigram, a dedicatory epigram like this introducing the *Almagest* would perhaps be expected to include some personal detail arising from the contact between dedicator and dedicatee. A reference to the Archytas ode could have been such a theme. If Syrus was of Roman origin, we can suppose that he had probably read Horace's famous odes, or at least that Ptolemy could have expected him to know them, especially the one dealing with the scientist Archytas.

Furthermore, the fact that the Roman nomen 'Claudius' always appears accompanying Ptolemy's name in the headings of his works might suggest Ptolemy's desire to appear more familiar to a Roman audience.[154] So it would not be strange that Ptolemy chose a Roman poet as his source for presenting his *Almagest* to Syrus.

A plausible scenario could be that the Archytas ode was discussed in a learned conversation between Ptolemy and Syrus before the composition of the *Almagest*, and that Ptolemy alluded to this circumstance in the epigram. However, this would not be necessary, since Ptolemy could safely suppose that Syrus would understand the reference to Archytas even if they have not discussed the ode before.

[152] See the survey on the knowledge of Latin in the Greek-speaking parts of the empire of Rochette 1997, esp. chapters 3 and 4.

[153] Plutarch cites Horatius and his first epode at *Lucull.* 39.5.9: Φλάκκος ὁ ποιητὴς.

[154] The importance of the Roman nomen for Greek individuals is implied by the pun that the poet Ammianus makes on Polemo because of his Roman nomen 'Antonius', ridiculing Polemo's emphasis on his exclusive Hellenic culture; cf. Nisbet 2003, 150.

Ptolemy and Archytas

Let us now suppose that Ptolemy used Horace's Archytas ode as a subtext for his own epigram, as I have suggested. In this last section I will draw the implications derived from this in the interpretation of the epigram.

A first remark would be that Ptolemy's epigram would be more easily recognised as an epigram if it alluded to the Archytas ode. Let us first note that if this ode was Ptolemy's subtext, then the first person of Ptolemy's epigram could be understood as Archytas' own voice. And as we noted above, impersonation of an individual, frequently a deceased one, was a typical feature of epigrams. Furthermore, the setting of the ode is Archytas' tomb, and epigrams typically refer to tombs.

Secondly, there is the issue of modesty. Ptolemy's words would probably sound as plain self-praise had he not somehow downplayed them. The affirmation of his own mortality would have been a first attempt, as we have seen. But if in addition Ptolemy was impersonating Archytas, the affirmation of his own travel to the houses of Zeus would have been more tolerable. This would be the same strategy applied by the rhetor Favorinus of Arelate in the *Corinthian Oration*, where he adopted the voice of a destroyed statue of himself when advocating his own virtues. As the analysis of Gleason shows, Favorinus could do so because (1) he was speaking with another persona, that of the statue, and (2) he was answering against an accusation, in his case the overthrowing of his statue.[155] Gleason cites Plutarch for his argument that self-praise is a poor strategy, but is more acceptable if done when defending himself against slander.[156] Ptolemy's self-praise would actually show not only the first of Favorinus' counterbalances –impersonation– but also the second one –self-defense–, since he would be defending Archytas against Horace's attack, precisely presenting himself as Archytas' own reincarnation. By adopting the persona of Archytas, Ptolemy would be at the same time allowing a second life to the Pythagorean which Ho-

[155]Gleason 1995, ch. 1.
[156]Gleason 1995, 9; cf. Plut. 'On inoffensive self-praise', *Mor.* 540C.

race advised to definitely accept death. But we may wonder: would this be compatible with Ptolemy's statement that he knows his own mortality? Probably yes: Ptolemy, like Cicero or Plato, may have believed that while the body is mortal, the soul is not, a circumstance that Horace was seemingly not ready to accept.

Now finally let us say something about Archytas and the significance that he may have had for Ptolemy's conception of his own project. As regards this latter aspect, we have already met this ancient Pythagorean in the analysis of the *Harmonics* (my chapter 2). In there we have discovered that Ptolemy regarded Archytas' treatment of music theory as his own tradition. Archytas' and Aristoxenus' were the only theories examined by Ptolemy, and while the latter was plainly refuted on the basis of not being mathematical, Archytas was praised, and criticised only in order to improve on his theory. For Ptolemy, Archytas probably represented a genuine example of empirical mathematician, who, like himself, tried to apply mathematical structures to physical reality, thus taking into account both reason and perception as Ptolemy advocated in the *Harmonics*.

At the same time, Archytas was also influent with his philosophical writings, dealing both with theoretical and with practical philosophy, which would make Archytas an interesting model for the well-rounded knowledge that Ptolemy wanted to represent in his *Almagest* and in the previous works. Several testimonia classified attest for this, perhaps most famously his argument on the stick and the unlimitedness of the universe (DK A24).[157] From his moral philosophy, the most frequent anecdote recounted about him is his holding back his bad temper against his slaves whenever they did anything wrong (A7).[158]

But Archytas had also a high reputation in politics, which was undoubtedly significant for the general positive view that the Romans held of him. As Cicero records, Archytas had been an influential statesman in ancient Tarentum.[159] Huffman interestingly notes that Cicero in there modifies the traditional historiographical pair Archytas/Plato as states-

[157]For his metaphysics, see DK A20, A21, A22, A12.
[158]Cf. also the other ethical testimonia DK A7, A8, A9, A11.
[159]Cic. *De oratore* 3.139.

man and philosopher-friend (like Pericles/Anaxagoras, Alcibiades/Socrates, etc.) making the two pairs Archytas/Philolaus and Dion/Plato; the probable reason for this change was that Pythagoreanism represents the only example of a native Italian philosophy, which could perhaps not be presented just as a derivation from Plato.[160] Both spheres, political activity and Italian origin, were surely an important part of the appeal for this figure in Roman times.[161]

Let us finally address a more controversial topic about Archytas' reception, which is his contribution to mechanics. This could be significant for Ptolemy, since, as we have mentioned before (cf. chapter 5) Ptolemy wrote a non-extant work on mechanics, and might have been active as an engineer. For Archytas, we have on the one hand a negative picture, provided by Athenaeus and Eratosthenes, and a positive one, appearing in Plutarch, and derived from Plato's criticism. In any case, it is worth noting that he had a fame on mechanics, whether positive or negative. On the negative side, Archytas had been criticised by Eratosthenes in his epigram presenting his solution of the doubling of the cube (cf. above), precisely because his allegedly impractical solution (Ἀρχύτεω δυσμήχανα ἔργα κυλίνδρων[162]). The other criticizer was the mechanical writer Athenaeus, a competitor of Vitruvius in the revolutioned times between the Republic and the Principate, and a dilettante with no experience in the field according to Whitehead and Blyth.[163] He wrote in a magnificent example of rhetorical prose the preface to his surviving treatise on war machines,[164] a work addressed to Augustus' nephew Marcellus,[165] where he put names to those of his predecessors who according to him failed to lend practicability to their works, prominently Archytas and Aristotle, charging them precisely with 'writ[ing] in length in

[160]Huffman 2005, 34.

[161]As an assessment of Archytas' fame in the Roman world, Huffman 2005, 21 records that Archytas is mentioned 11 times by Cicero, 6 times by Pliny the Elder, 4 times by Vitruvius, 3 times by Valerius Maximus, and once by Quintilian, Horace, Propertius, Varro, and Columella.

[162]Eutoc. *Comm. Sph. Cyl.* 96.16.

[163]Whitehead and Blyth 2004, 39.

[164]Whitehead and Blyth 2004, 33.

[165]Whitehead and Blyth 2004, 18-20.

unnecessary treatises and spend[ing] their time displaying how much they know', while presenting themselves as writing 'for our own good'.[166]

On the positive side we seem to have first a sort of negative foundational myth in the story of Plato's criticism of Archytas' mechanical solution of the duplication of the cube, which is narrated by Plutarch in his *Table Talks*.[167] Although this story deeply contrasts with both Archytas' solution as recorded by Eutocius, where no instruments are needed, and with Eratosthenes' criticisms ('hardly mechanical works of cylinders', Ἀρχύτεω δυσμήχανα ἔργα κυλίνδρων), perhaps the geometrical cylinders appearing in the solution, mentioned by Eratosthenes, had been interpreted as real cylinders in the tradition and put in relation with Archytas' fame as a mechanician and as scientifically-minded in opposition to Plato. Actually, Plutarch tells the story again elsewhere before narrating the events at the siege of Syracuse when Archimedes used his engines, presenting Eudoxus and Archytas as the founding fathers of the 'highly-prized science of mechanics'.[168] Plutarch then says that because of Plato's 'invectives against it as the mere corruption and annihilation of the one good of geometry, which was thus shamefully turning its back upon the unembodied objects of pure intelligence to recur to sensation', mechanics was subsequently abandoned by philosophers and was only the field of military art.[169]

A final proof of the general high reputation of Archytas in the Roman world is that a philosopher contemporary with Eudorus could adopt the persona of Archytas and write treatises with his name and in his style, hoping to find success: and he definitely had, be it

[166]Ath. Mech. 4: Οἱ δὲ γράφοντές τι ἢ παραγγέλλοντες ἡμῖν καὶ τῆς ὠφελείας εἵνεκα δοκοῦντες αὐτὸ πράττειν οὐκ ἀπεικότως, πολυγραφοῦντες εἰς οὐκ ἀναγκαίους λόγους καταναλίσκουσι τὸν χρόνον.

[167]Plut. *Quaest. Conv.* 718E: Πλάτων αὐτὸς ἐμέμψατο τοὺς περὶ Εὔδοξον καὶ Ἀρχύταν καὶ Μέναιχμον εἰς ὀργανικὰς καὶ μηχανικὰς κατασκευὰς τὸν τοῦ στερεοῦ διπλασιασμὸν ἀπάγειν ἐπιχειροῦντας.

[168]Plut. *Marcellus* 19.9: τὴν γὰρ ἀγαπωμένην ταύτην καὶ περιβόητον ὀργανικὴν ἤρξαντο μὲν κινεῖν οἱ περὶ Εὔδοξον καὶ Ἀρχύταν, ποικίλλοντες τῷ γλαφυρῷ γεωμετρίαν, καὶ λογικῆς καὶ γραμμικῆς ἀποδείξεως οὐκ εὐποροῦντα προβλήματα δι' αἰσθητῶν καὶ ὀργανικῶν παραδειγμάτων ὑπερείδοντες.

[169]Plut. *Marcellus* 19.11: ἐπεὶ δὲ Πλάτων ἠγανάκτησε καὶ διετείνατο πρὸς αὐτούς, ὡς ἀπολλύντας καὶ διαφθείροντας τὸ γεωμετρίας ἀγαθόν, ἀπὸ τῶν ἀσωμάτων καὶ νοητῶν ἀποδιδρασκούσης ἐπὶ τὰ αἰσθητά, καὶ προσχρωμένης αὖθις αὖ σώμασι πολλῆς καὶ φορτικῆς βαναυσουργίας δεομένοις, οὕτω διεκρίθη γεωμετρίας ἐκπεσοῦσα μηχανική, καὶ περιορωμένη πολὺν χρόνον ὑπὸ φιλοσοφίας, μία τῶν στρατιωτίδων τεχνῶν ἐγεγόνει (tr. Dryden).

that his readers thought his treatises to be by the ancient Archytas or not.

6.3.5 Conclusions

Ptolemy's epigram differs from other epigrams related to mathematics in that it does not specifically address a mathematical problem. Instead, its topic is the study of astronomy in general and the divine state that the student of astronomy acquires thereby. I have related this to the preface of the *Almagest*, where astronomy is only very vaguely presented within the general and magnificent topic of philosophy, and where astronomy's assimilation to the divine is also mentioned.

In the epigram we seem to encounter the same praise of Aristotle that we have in the preface, as well, now through an allusion to the epigrammatic tradition, as a criticism to dissolute life. The combination of this Aristotelian ideal with the Platonic theoria may be ascribable to the school of Antiochus.

The main topic of the epigram is Ptolemy's own catasterism, but as resulting from his study of astronomy. While the first part is related to the Hellenistic tradition of the catasterism, perhaps specially to the story in Callimachus' *Lock of Berenice* because of Ptolemy's name, the combination of the two is to be connected with the Platonic myth of *Phaedrus*, later explored by Cicero in his *Dream of Scipio*.

In a closer analysis of the verses, I have attempted to show that the parallel with Horace's Archytas ode, already noted by Boll, was plausibly the consequence of Ptolemy's direct reading of Horace. I have first argued that Horace probably modeled his ode as a response to Cicero's view of Archytas and Archimedes, and then I have given reasons why Ptolemy could have read Horace, mainly on the basis that Ptolemy's dedicatee could have been a Roman as studied in chapter 5.

Looking back at the conclusions from the preface of the *Almagest*, it is noteworthy that what I have analysed as Ptolemy's impersonation of Archytas in the epigram would have been pursued in the preface with the imitation of the first words of Archytas' *Harmonics*.

This Ptolemaic Archytas would have acquired the Platonic features that we have seen in the epigram and in the preface –perhaps the possible echo of the first verse of the epigram with the Timaeus Locrus being relevant– and so what in the previous works –the *Canobic Inscription*, *Harmonics*, and *Criterion*– appeared to be an imitation throughout the treatises now seems to be restricted to what introduces the work itself, namely the epigram and the preface.

Conclusion

Ptolemy's philosophical role-playing in perspective

In the introduction I have made clear that the aim of my study was to determine the extent to which Ptolemy can be said to partake the features common to the highly textualized and rhetoricized culture of his time, the second century CE. My hope is that each of the six chapters of this survey has shown some evidence of this 'common culture' of the Roman empire in Ptolemy.

We have seen that the *Canobic Inscription* was set up probably at the Serapeion at Canopus, which was likely frequently visited by the elite society. While offerings in the form of treatises to the divinity were traditional among astronomers, Ptolemy's choice of such a famous place probably indicates his wish to publicly demonstrate his proficiency. The last part of the inscription features an essentially non-realistic account of the Pythagorean tones of the spheres, following a commentary tradition on the *Timaeus* deriving from the philosopher Eudorus of Alexandria. This could be interpreted as his appeal to the laymen that could have visited the Serapeion. Ptolemy interestingly tries to link both sections by way of a play on the numbers resulting from real observations on astronomical distances.

In the *Harmonics* we find a similar structure with 'real science' in the main part and Platonic analogies in the last part, also presenting the same harmony of the spheres. This, along with Ptolemy's emphasis on the passage of Plato's *Republic* where the union of mu-

sic and astronomy is advocated, seems to confirm the suspicion that Ptolemy would be presenting his scientific project as the fulfillment of Plato's educative program for the sciences (which could be symbolised by Timaeus, an apparent Pythagorean who has 'learned' Socrates' lessons). It turns out that the Pythagorean criticised by Plato for his empiricism in the *Republic* is Archytas, the same whom Ptolemy takes as his most valuable predecessor in the mathematical part of the *Harmonics*. The *Harmonics* is rich in philosophical influences regarding knowledge theory, which seem to adhere to a Stoicised Platonism with an emphasis on the senses, typical of the 'new' dogmatism of Antiochus of Ascalon. But again in the final Platonic section there are analogies which seem to derive from Eudorus.

The text of the *Criterion* displays a knowledge theory also in the tradition of Antiochus, thus compatible with the one seen in the *Harmonics*, which may be here mediated through one of Antiochus' pupils in Alexandria, Ariston, who was a contemporary of Eudorus, also active in Alexandria. These two authors could have been Ptolemy's most important philosophical references in these works as well as in the *Almagest*. Like in the two works discussed previously, there is a more obviously Platonic and speculative section at the end, on an evident topic of the *Timaeus*. Several verbal echoes of the *Timaeus* may be found in the main part, too. The whole treatise, despite highly philosophical, seems to be a rhetorical imitation of the *Timaeus*, because in addition to the verbal echoes there is no deep argumentation, nor any sources are mentioned. The style resembles that of the pseudo-Pythagorean treatises contemporary with Ptolemy's identified Middle Platonic sources, and perhaps this is not a coincidence, because a treatise on the criterion by pseudo-Archytas shows some affinities with Ptolemy's text. Ptolemy does not even treat mathematics in this text, which could suggest that he wished to present himself as a 'pure' philosopher, although the text does not appear to be a genuine contribution to philosophy as regards its contents. This could confirm the picture that Ptolemy was just playing the role of the philosopher in these works, not 'really' being this.

The curious external features of Ptolemy's texts analyzed in chapter 4 are comparable to

the gestures, deportment, and voice of the rhetors. These features would consist in external features fashioning the work in an adequate manner, so that its beauty becomes evident. Actually an author where this may be seen, too, Vitruvius, could have related such an arrangement to the proportions of the body, so important for the sophists as can be deduced for example from Polemo's physignomical treatise. Ptolemy could have thought of harmonics, because his sections coincide with harmonic ratios. He actually used harmonics in the final part of his work on music theory to demonstrate the connection of many different elements in the cosmos, mostly the structure of the soul and the planets, and in the context of sectioning harmonics could have been used to demonstrate the links between the different parts of the text. It is all about connecting structures to other structures, about bringing together bodies of knowledge. This would serve to show off *paideia*, the same aim of the orator. At the same time, these features of Ptolemy's books may be brought in connection with the bookish society in which he lived: the importance that he thereby attributes to the format of the books seems to correspond to a world where books tended to be used as marks of status –I am thinking of Lucian's *The Ignorant Book-Collector* (*Adv. indoct.*). The early treatises show a much stricter sectioning than later works, which may suggest that Ptolemy considered this practice less important when he had an established career.

In the fifth chapter we have seen how some of the treatises of Ptolemy which are dedicated to Syrus share features of works typically dedicated to non-professional amateurs wishing to complete their education. However, among them we find also some rather specialized mathematical treatises where mechanicians are sometimes alluded to as the intended readership. Petronius Sura, an engineer who had been *curator aquarum* of the city of Rome, has been shown to have a cognomen which Ptolemy would have probably Hellenized as 'Syrus', his brother or son having been prefect of Egypt (based at Alexandria). Sura chronologically matches Ptolemy's dates. He has been shown to be the most plausible candidate as Ptolemy's dedicatee with the available evidence –and at the same time, it has been argued that it would be difficult to find another individual meeting the same condi-

tions as Sura–, and this would make Ptolemy's relationship with him one relationship of patronage. The fact that Sura had been a sort of chief of engineers in the empire, and that Ptolemy wrote a non-extant work on mechanics, might suggest that Ptolemy could have been an engineer, perhaps being recommended by Sura.

Finally, we have seen that in the *Almagest* Ptolemy seems to impersonate Archytas –or a Platonized Archytas, we could say–, both in the preface, which begins with what seems to be a rephrasing of the beginning of Archytas' *Harmonics*, and in an introductory epigram, where Ptolemy could have responded to Horace's Archytas ode verbally alluding to it and adopting the persona of Archytas. In both texts we find philosophical elements similar to the ones encountered in the previous treatises, influenced by the tradition of Alexandrian Pythagorean Platonism and by the Antiochian tradition, but there is also an important shift in Ptolemy's practice: Ptolemy does not try anymore to intrinsically connect his scientific work with this Platonic impersonation. Unlike in the previous works, where the Platonic part is presented as a fitting conclusion from the scientific one, and where a connexion between the two is attempted, here Ptolemy just states the Platonic project in the preface and in the epigram, while the rest of his work is free from it. This may be consistent with the abandonment of the strict sectioning which features in the three early works studied in the first chapters. Thus one could say that Ptolemy in the *Almagest* does not anymore 'play a role', save in the 'obvious' place to do this, the preface and the epigram. This shift could perhaps be compared to Galen's abandonment of his public demonstrations after he achieved a good position. Ptolemy may as well have obtained the protection of powerful patrons (like Syrus) who valued his science *per se*. They could have been Peripatetics, like some of Galen's powerful friends in Rome. Connected with this could be the fact that in the *Planetary Hypotheses*, it can be seen how Ptolemy substituted the Pythagorean cosmology shown in the *Canobic Inscription* for a realistic account of the cosmos in the Aristotelian tradition.

Ptolemy's works from the *Almagest* onwards do not show anymore the strong role-

playing that can be detected in the *Canobic Inscription*, the *Harmonics*, and the *Criterion*. So from this perspective, we may say that Ptolemy probably used the weapons of the rhetors in the early stage of his career, in order to make himself visible, whereas when he acquired a more secure position, probably related to his dedicatee Syrus, he did not need these weapons anymore and he used them less. The *Almagest* may be seen as a point in between when Ptolemy uses these weapons only as an introduction, in the preface and the epigram.

To sum up, going back to my initial purpose of challenging the established picture of Ptolemy's intellectual world as separated apart from what we know of the culture of the Hellenized Roman empire including the Romanized Greek world, my test has suggested strong parallels between Ptolemy's activity as an intellectual and that of his contemporaries, specially at the initial stage of his career. Ptolemy would then have been a more typical intellectual of his time than normally accepted, an individual who sought for support in the powerful people of the empire as many of his contemporaries.

Subsidiary to my main purpose, I hope that my investigation has contributed to elucidate some of the obscure issues in Ptolemy's works, especially in the *Canobic Inscription*, the *Criterion* and the epigram of the *Almagest*, where I believe my analysis has been more original than for other parts of Ptolemy's corpus studied here.

As regards Ptolemy's philosophy, the parallels I have suggested for the *Canobic Inscription* and the *Criterion* point to particular philosophical sources in Alexandria which plausibly constituted Ptolemy's main philosophical references. The one is Eudorus of Alexandria, the other Antiochus' pupil Ariston of Alexandria, contemporary and competitor of Eudorus. The first defended a Pythagorean Platonism that Ptolemy used for his analogies and for his definition of mathematics in the *Almagest*, the latter probably provided the knowledge theory of Antiochus which Ptolemy applied in the *Harmonics* and the *Criterion*. But between Ptolemy and them mediates one and a half centuries. Does this suggest that there were no significant philosophical progresses in Alexandria during that time –apart from the sceptical debates, which as we have seen did not interest Ptolemy?

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