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Introduction

CLAUDIUS PTOLEMY is one of the most significant figures in the history of science. Living in or around Alexandria in the second century CE, he is remembered most of all for his contributions in astronomy. His *Almagest*, a thirteen-book astronomical treatise,[1] was authoritative until natural philosophers in the sixteenth and seventeenth centuries repudiated the geocentric hypothesis and appropriated Nicolaus Copernicus's heliostatic system of *De revolutionibus*. Ptolemy also composed texts on harmonics, geography, optics, and astrology that influenced the study of these sciences through the Renaissance.

Ptolemy's contributions in philosophy, on the other hand, have been all but forgotten. His philosophical claims lie scattered across his corpus and intermixed with technical studies in the exact sciences. The late nineteenth and early twentieth centuries' development of discrete academic disciplines let the study of Ptolemy's philosophy fall through the cracks. When scholars do make reference to it, they tend to portray Ptolemy as either a practical scientist—mostly unconcerned with philosophical matters, as if he were a forerunner to the modern-day scientist—or a scholastic thinker who simply adopted

1. "Almagest" is not the text's original title, but rather "Mathematical Composition" (μαθηματικὴ σύνταξις), to which Ptolemy makes reference in Book 1 of the *Planetary Hypotheses* as well as *Geography* 8.2.3. Cf. *Tetrabiblos* 1.1.1, H3. The name "Almagest" comes from the Arabic *al-Majistî*, which derives from the Greek μεγίστη ("the biggest"). The designation "biggest" does not occur in the Greek tradition but instead in the Arabic, although "big composition" (μεγάλη σύνταξις) does appear in the Greek. See Tihon, "Alexandrian Astronomy," 74. For the *Almagest* and Ptolemy's other texts, I will use the name in common usage today rather than, in some cases, the likely original. Notably, "Tetrabiblos" (Treatise in four books) is probably not the original title of Ptolemy's astrological text—it is likely *Apotelesmatika* ([Books on] effects)—but again I will use the more common title. On the original title of the *Tetrabiblos*, see Hübner, *Apotelesmatika*, XXXVI–XXXIX.

the philosophical ideas of authoritative philosophers, especially Aristotle.[2] This latter portrayal no doubt evolved in part because Ptolemy cites Aristotle in the first chapter of the *Almagest*. Liba Taub proved that the philosophical claims in *Almagest* 1.1, as well as in Ptolemy's cosmological text, the *Planetary Hypotheses*, are not Aristotle's, and with this debunking of the assumed view Taub opened the door for my own analysis of Ptolemy's philosophy, including how it manifests throughout his corpus and how it relates to several ancient philosophical traditions.[3] This monograph is the first ever reconstruction and intellectual history of Ptolemy's general philosophical system.

Concerning Ptolemy's life we know nothing beyond approximately when and where he lived. In the *Almagest*, he includes thirty-six astronomical observations that he reports he made in Alexandria from 127 to 141 CE. Another unaccredited observation from 125 CE may be his as well.[4] The *Canobic Inscription*, a list of astronomical parameters that Ptolemy erected at Canopus, Egypt, provides a slightly later date: 146/147 CE. Because the *Canobic Inscription* contains numerical values that Ptolemy corrects in the *Almagest*, it must predate the *Almagest*.[5] Therefore, Ptolemy completed the *Almagest* sometime after 146/147 CE. In addition, Ptolemy makes reference to the *Almagest* in several of his later texts. The life span that this chronology requires is consistent with a scholion attached to the *Tetrabiblos*, Ptolemy's astrological text, indicating that he flourished during Hadrian's reign and lived until the reign of Marcus Aurelius, who became Roman emperor in 161 CE but ruled jointly with Lucius Verus until 169 CE. Thus, we can estimate that Ptolemy lived from approximately 100 to 170 CE.

Concerning any philosophical allegiance, Ptolemy says nothing. In his texts, he does not align himself with a philosophical school. He does not state who his teacher was. He does not indicate in what his education consisted or even what philosophical books he read. In order to discern where his philosophical ideas came from, one must mine his corpus, extract the philosophical content, and, with philological attention, relate his ideas to concepts presented

2. A. A. Long emphasizes Ptolemy's practicality when examining his *On the Kritêrion and Hêgemonikon*: "His little essay should be read, I suggest, as a practising scientist's statement of where he stands on the epistemological issues that arise in his day-to-day work." See Long, "Ptolemy on the Criterion," 163.

3. Taub, *Ptolemy's Universe*. The most comprehensive analysis of Ptolemy's philosophy is the philological study of Franz Boll, "Studien über Claudius Ptolemäus."

4. For a chronological list of dated observations in the *Almagest*, see Pedersen, *Survey of the Almagest*, 408–22.

5. See Hamilton, Swerdlow, and Toomer, "Canobic Inscription." See also A. Jones, "Ptolemy's *Canobic Inscription*."

in texts that are contemporary with his own or that were authoritative in the second century. Unfortunately, what survives of the ancient Greek corpus is but a fraction of what was written and we have very little from Ptolemy's time. It is impossible to determine what exactly he read or even where he read it, as it is dubious that the great Alexandrian library was still in existence. At best we can place Ptolemy's thought in relation to prevailing ancient philosophical traditions.

The first century BCE to the second century CE is distinguished by the eclectic practice of philosophy. The Greek verb *eklegein* means to pick or choose, and the philosophers of this period selected and combined concepts that traditionally were the intellectual property of distinct schools of thought. Mostly, these philosophers blended the Platonic and Aristotelian traditions, but they also appropriated ideas from the Stoics and Epicureans. The label "eclecticism" has long held a pejorative connotation in philosophy, as if eclectic philosophers were not sufficiently innovative to contribute their own ideas, and the philosophy of the periods before and after this seemingly intermediate chapter in ancient philosophy were comparatively inventive, with the development of the Hellenistic movements, including the Stoic, Epicurean, and Skeptic, and the rise of Neoplatonism, respectively. Nevertheless, John Dillon and A. A. Long revitalized the study of eclectic philosophy.[6] So-called middle Platonism and the early Aristotelian commentary tradition have received more attention in recent years, and their study has demonstrated that the manners in which these philosophers integrated authoritative ideas are themselves noteworthy.

I aim to prove that Ptolemy was very much a man of his time in that his philosophy is most similar to middle Platonism, the period in Platonic philosophy that extended from the first century BCE—with Antiochus of Ascalon, who was born near the end of the second century BCE and moved from Ascalon, in present-day Israel, to Athens to join the Academy—to the beginning of the third century CE, with Ammonius Saccas, the Alexandrian philosopher and teacher of Plotinus, the founder of Neoplatonism. Both Antiochus and Ammonius Saccas are known for their syncretic tendencies. In response to Academic skepticism, Antiochus argued not only that knowledge is possible but also that the old, pre-skeptical Academy was in broad agreement with the Aristotelian and Stoic schools. Centuries later, Ammonius Saccas argued that

6. Dillon and Long, *Question of "Eclecticism."* In their studies of *On the Kritêrion* and the *Optics*, respectively, A. A. Long and A. Mark Smith describe Ptolemy's philosophy as eclectic. See Long, "Ptolemy on the Criterion," 152; Smith, *Ptolemy's Theory*, 18. For other interpretations of Ptolemy's philosophy, see Lammert, "Philosophie der mittleren Stoa"; de Pace, "Elementi Aristotelici nell'*Ottica*."

Plato's and Aristotle's philosophies were in fundamental agreement. Middle Platonism manifested in a variety of literary forms, styles of argument, and attitudes toward authoritative figures, but a significant trend emerged in this period where philosophers asserted the harmony of previously distinct schools of thought. They drew concepts, theories, and arguments from philosophers attached to once competing schools. To be a Platonist at this time entailed not only clarifying the meaning of Plato's texts but also appropriating ideas from the Aristotelian and Stoic traditions in the course of developing Platonic philosophy. Epicurean philosophy had less of an impact, but several of its terms had by this time become common intellectual property. It is this harmonizing tendency of middle Platonism, coupled with its emphasis on certain key themes in Platonic philosophy, that fundamentally influenced Ptolemy's own contributions in philosophy.

Ptolemy's seamless blending of concepts from the Platonic and Aristotelian traditions and, to a lesser extent, the Stoic and Epicurean, is itself impressive, but its greater significance lies in its radical and even subversive character. Ptolemy adopted ideas from these many traditions but his integration of them yielded a philosophical system that upended the entire edifice of ancient philosophy. In *Almagest* 1.1, Ptolemy denounces attempts by philosophers to answer some of the most central questions of philosophy, and he argues that the fields of inquiry that philosophers study are merely conjectural. Against the vast current of ancient Greek philosophy, Ptolemy maintains that theology and physics are essentially guesswork and that mathematics alone generates sure and incontrovertible knowledge. This epistemological position—that mathematics alone, and neither physics nor theology, yields knowledge—is unprecedented in the history of philosophy and would have been extraordinarily controversial. Moreover, Ptolemy's appropriation of ancient virtue ethics is equally subversive. He maintains that the best life is one where the human soul is in a virtuous, or excellent, condition, and in his adaptation of Platonic ethics he affirms that the highest goal of human life is to resemble the divine—to be, as much as humanly possible, like the gods—but, according to Ptolemy, the one and only path to the good life is through mathematics.

Ptolemy deems mathematics epistemologically and ethically superior to every other field of inquiry, but that is not to say that he eschewed philosophy. For Ptolemy, mathematics is philosophy or, rather, a part of philosophy. It is one of the three parts of theoretical philosophy, alongside physics and theology. In addition to these three theoretical sciences—where, in ancient Greek philosophy, a science is simply a branch of knowledge—there are the three practical parts of philosophy: ethics, domestics, and politics. Ptolemy argues in *Almagest* 1.1 that the theoretical part of philosophy is more valuable than the practical, and that, of the three theoretical sciences, mathematics is the

best in its abilities to render knowledge and transform the human soul into its most perfect condition. Mathematics reveals the objective of human life, to be like the heavenly divine, and it provides the means to achieve it. Ptolemy does not claim, however, that one should study only mathematics. He argues that mathematics contributes to physics and theology, and, furthermore, that it guides practical philosophy and even the ordinary affairs of life. Positioning mathematics at the foundation of every one of life's activities, Ptolemy advances the mathematical way of life.

Consistent with Plato's account of the philosopher's education in Book VII of the *Republic*, Platonists upheld mathematics as a useful means of training the soul, where mathematics is propaedeutic, preparing the way for other, higher, more valuable studies, such as dialectic or metaphysics. Yet, for Ptolemy, mathematics is not simply useful; it is not merely a path to another science. For Ptolemy, it is the highest science. Only mathematics yields knowledge. Through its study alone human beings achieve their highest objective, to become like the divine. Human beings come to comprehend, love, and resemble divinities through the study of astronomy and harmonics, which, according to Ptolemy, are both mathematical sciences. Astronomy is the study of the movements and configurations of the stars; harmonics is the study of the ratios that characterize the relations among musical pitches. Astronomical objects serve as ethical exemplars for human souls, and both astronomy and harmonics give rise to souls' virtuous transformation.

Ptolemy's texts testify to his additional interest in mathematics' application to theology and physics, especially. In the *Almagest*, Ptolemy's astronomy informs his theology, and his natural philosophical investigations are extensive. Just as he argues in *Almagest* 1.1 that mathematics contributes significantly to physics, time and again Ptolemy studies bodies mathematically before investigating their physical properties. Mathematical study informs the analysis of bodies' physical qualities, and, though physics is conjectural, the application of mathematics affords the best guesses possible of bodies' physical natures. In the chapters that follow, I examine Ptolemy's applications of geometry to element theory, harmonics to psychology, and astronomy to astrology and cosmology.

The only one of Ptolemy's texts devoid of mathematics is *On the Kritêrion and Hêgemonikon*, an epistemological study that examines the criterion of truth, the method by which a human being generates knowledge, as well as the physical nature and structure of the human soul, including the *hêgemonikon*, its chief part. More than any other text of Ptolemy, *On the Kritêrion* has provoked controversy concerning its authorship, no doubt in part because it contains no mathematics. Nevertheless, thematic, stylistic, and linguistic arguments support Ptolemy's authorship, and I argue that it is one of the earliest, if not

the earliest, of Ptolemy's extant texts.[7] In *On the Kritêrion*, Ptolemy proposes a dually rational and empirical criterion of truth, where the faculties of sense perception and thought cooperate in the production of knowledge. Ptolemy adheres to this criterion in the rest of his corpus, but when he wrote *On the Kritêrion* he had not yet mandated the application of mathematics to physics. After he composed it, he devised his mathematical-scientific method, which he employed in every one of his subsequent studies. Every other of Ptolemy's texts constitutes an inquiry into or an implementation of mathematics.

In addition to *On the Kritêrion*, the texts I analyze are those of Ptolemy that contain manifestly philosophical content.[8] Again, the *Almagest* is Ptolemy's most famous astronomical text. It comprises thirteen books—likely in homage to the thirteen books of Euclid's *Elements*—and it consists in the deduction of geometric models that, according to Ptolemy, truly describe the mathematical objects in the heavens, the combinations of rotating spheres that give rise to the movements of celestial bodies, the fixed and wandering stars. In the first book, Ptolemy situates astronomy in relation to the other parts of philosophy, he describes the structure of the ensuing text, and he establishes the fundamental hypotheses of his astronomical system, such as the heavens' sphericity and the earth's location at the center of the cosmos. In the latter part of Book 1 through Book 2, he presents the mathematics necessary for the mathematical deduction, including the "Table of Chords," used in the trigonometric calculations that follow. The remainder of the *Almagest*, Books 3 through 13, contains the deduction itself of the astronomical models, accounting for the movements of the sun, moon, fixed stars, and five planets. These models are both demonstrative and predictive, since by using the tables an astrologer would have been able to approximate the perceptible location of any celestial body on any given date.

The *Planetary Hypotheses* is Ptolemy's cosmological text. In the first of the two books, he presents astronomical models, mostly consistent with the *Almagest*'s models; he specifies the order and absolute distances of the celestial systems; and he determines the diameters of the celestial bodies. In Book 2, he presents his aethereal physics, describing the heavenly bodies in physical terms, and he discusses celestial souls, which, in Ptolemy's cosmology, control the aethereal bodies' movements. Only a portion of the first book of the

7. See A. Jones, "Ptolemy," 174; Feke and Jones, "Ptolemy," 199. Boll argues in favor of *On the Kritêrion*'s authenticity: Boll, "Studien," 78. Against its authenticity, see Toomer, "Ptolemy," 201; Swerdlow, "Ptolemy's *Harmonics*," 179–80. Taub merely states that the work's attribution to Ptolemy has been questioned: Taub, *Ptolemy's Universe*, 9.

8. For a complete list of Ptolemy's texts and their editions, see Feke, "Ptolémée d'Alexandrie (Claude)."

Planetary Hypotheses exists in the original Greek. The second of the two books and the remainder of the first book exist only in a ninth-century Arabic translation as well as a Hebrew translation from the Arabic.

The *Tetrabiblos* delineates Ptolemy's astrological theory. In the introductory chapters, he defines astrology and defends this physical science's possibility and utility. Thereafter, he summarizes its principles, including the powers of celestial bodies, the rays by which stars transmit their powers, and the effects these powers have on sublunary bodies and souls. Book 2 examines the celestial powers' large-scale effects on geographic regions and meteorological phenomena, and Books 3 and 4 address celestial influences on human beings and their individual lives.

In the *Harmonics*, Ptolemy elaborates on his criterion of truth and employs it in the analysis of the mathematical relations among musical pitches. The text contains three books, and, after completing his study of music theory in *Harmonics* 3.2, he examines the harmonic ratios that exist among psychological, astrological, and astronomical phenomena. Unfortunately, the last three chapters, 3.14–3.16, are no longer extant; only their titles remain. In the chapters that follow, I also make reference to Ptolemy's *Geography*, *Optics*, and two works—*On the Elements* and *On Weights*—that are entirely lost to us but which Simplicius, the sixth-century philosopher, attests to in his commentary on Aristotle's *De caelo*.[9]

Ptolemy's texts offer few clues to their chronology. In the *Tetrabiblos* and *Planetary Hypotheses*, as well as in the *Geography*, he refers to his "syntaxis" or "mathematical composition" (μαθηματικὴ σύνταξις), manifestly the *Almagest*.[10] Consequently, Ptolemy must have completed these texts after the *Almagest*. Noel Swerdlow has argued that the *Harmonics* predates the *Almagest* because the titles of the three lost chapters indicate that they examined the relations between musical pitches and celestial bodies tabulated in the *Canobic Inscription*.[11] Considering that Ptolemy must have written the *Canobic Inscription* before the *Almagest*, the *Harmonics* probably predates the *Almagest* as well, and I argue that Ptolemy completed *On the Kritêrion* before the *Harmonics*. Thus, one reasonably can conclude that Ptolemy composed the texts most relevant to this study in the following order: (1) *On the Kritêrion and*

9. For an analysis of the philosophical claims in Ptolemy's *Geography*, see Feke, "Ptolemy's Philosophy of Geography." Harald Siebert has put Ptolemy's authorship of the *Optics* into question in *Die ptolemäische "Optik."* For Simplicius's discussion of Ptolemy's *On the Elements* and *On Weights*, see Simplicius, *In de caelo* 1.2.20.10–25; 4.4.710.14–711.9.

10. Ptolemy, *Tetrabiblos* 1.1.1, H3; *Planetary Hypotheses* 1.1, H70; *Geography* 8.2.3.

11. Swerdlow, "Ptolemy's *Harmonics*," 175.

Hêgemonikon; (2) *Harmonics*; (3) *Almagest*; and (4) *Tetrabiblos* and *Planetary Hypotheses*, in an indeterminate order.

I take *Almagest* 1.1 as the starting point of this study, as it functions as an epitome of Ptolemy's general philosophical system. My chapters 2 through 4 are analyses and intellectual histories of the metaphysical, epistemological, and ethical statements of *Almagest* 1.1. In chapter 2, I argue that the metaphysics Ptolemy presents when differentiating the three theoretical sciences—physics, mathematics, and theology—is Aristotelian, though not Aristotle's, and that Ptolemy underlays his ontology with epistemology. In chapter 3, I show how Ptolemy blends an Aristotelian form of empiricism with a Platonic concern for distinguishing knowledge and opinion, and he thereby produces a new and subversive epistemology where mathematics is the only science that generates knowledge rather than conjecture. Moreover, I analyze Ptolemy's argument for the contribution of mathematics to physics and theology, and I examine the case studies of how astronomy informs his theology and geometry drives his element theory. In chapter 4, I demonstrate how Ptolemy's distinctly mathematical ethics emerges from his response to a contemporary debate over the relationship between theoretical and practical philosophy. Ptolemy argues that practical philosophy is dependent on theoretical philosophy and that mathematics, in particular, reveals the ultimate goal of all philosophy and even directs the ordinary affairs of life.

Thereafter, I address the philosophical statements Ptolemy propounds in the rest of his corpus. In chapter 5, I argue that Ptolemy's concept of *harmonia*, which he examines in the *Harmonics*, is crucial to his ethical system. *Harmonia* is a technical term whose meaning differs from our notion of harmony. I dissect the concept in detail and argue that it is because of *harmonia* that the human soul is able to resemble astronomical objects. In chapter 6, I analyze the relationship between harmonics and astrology, which Ptolemy portrays as complementary mathematical sciences, and I determine whether, when examining these sciences in the *Harmonics* and the remainder of the *Almagest*, Ptolemy maintains his position in *Almagest* 1.1 that mathematics yields sure and incontrovertible knowledge. In chapters 7 and 8, I turn to Ptolemy's application of mathematics to the physics of composite bodies. In the former, I argue for the development of his psychology from *On the Kritêrion* to the *Harmonics*, where he strives to improve his account of the human soul by mathematizing it. The development in his psychological theory, I contend, marks the maturation of his scientific method. In the latter chapter, I argue that Ptolemy maintains the epistemology and scientific method that he articulates in *Almagest* 1.1 and applies in the *Harmonics* in his studies of astrology and cosmology in the *Tetrabiblos* and *Planetary Hypotheses*. Overall, Ptolemy's philosophy remains remarkably consistent across his corpus.

At the foundation of Ptolemy's complex philosophical system is his ethics. The explicit motivation for his study of the theoretical sciences is his objective to transform his soul into a condition that resembles the divine, mathematical objects of the heavens, the movements and configurations of the stars. That Ptolemy required such a motivation for his prodigious and influential scientific investigations may be surprising, but we must remember that in antiquity mathematicians were rare. In any one generation in the ancient Mediterranean, no more than a few dozen individuals studied high-level mathematics.[12] Given the scarcity of advanced mathematical study, an individual who concentrated on it would have made a deliberate choice to disavow more dominant intellectual practices, including the conventions of philosophers, and assume an unconventional way of life. Mathematicians play a special role in the ancient philosophical landscape in that they studied philosophy to varying degrees but they were not philosophers. In Ptolemy's case, he was well versed in the philosophy of his time. He appropriated ideas from authoritative and contemporary philosophical traditions for his own philosophical system. What led him to set aside the nonmathematical study of philosophy and focus on mathematics? We know so little of Ptolemy's life that it is impossible to say for certain. It would be easiest to suppose that he simply found mathematics to be captivatingly interesting. Nevertheless, I aim to present a more complex portrait, where the clues lie in the philosophical claims scattered across his corpus, and I propose that it was Ptolemy's appropriation of Platonic ethics and the formulation of a radical philosophy—the mathematical way of life—that motivated him to devote his life to mathematics.

12. Netz, *Shaping of Deduction*, 291.

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