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The Monochord in Ancient Greek Harmonic Science

Among the many instruments devised by students of mathematical sciences in ancient Greece, the monochord provides one of the best opportunities to examine the methodologies of those who employed it in their investigations. Consisting of a single string which could be divided at measured points by means of movable bridges, it was used to demonstrate theorems about the arithmetical relationships between pitched sounds in music. This book traces the history of the monochord and its multiple uses down to Ptolemy, bringing together all the relevant evidence in one comprehensive study. By comparing the monochord with a number of other ancient scientific instruments and their uses, David Creese shows how the investigation of music in ancient Greece not only shares in the patterns of demonstrative and argumentative instrument use common to other sciences, but also goes beyond them in offering the possibility of a rigorous empiricism unparalleled in Greek science.

DAVID CREESE is Assistant Professor of Greek and Latin Literature at the University of British Columbia.

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PREFACE

This book is about an instrument that shaped the way scientists thought about music in Greek antiquity. It is also about the way Greek science shaped the use of a musical instrument. With its single string, movable bridge and graduated rule, the monochord (*kanōn*) straddled the gap between notes and numbers, intervals and ratios, sense-perception and mathematical reason. By representing musical sounds as visible, measurable distances (lengths of string), and by representing numbers audibly to the musical ear, it offered a way to study music as an arithmetical science through the medium of geometry. As an audible extension of the lettered diagram of Greek mathematics, what it offered the harmonic scientist, most importantly, was a means of attempting to extend the irrefutability of mathematical argument into the auditory realm, even when whether or not it succeeded in doing so was controversial.

It gives me great pleasure to record my thanks to the many people who have helped me in the writing of this book. My greatest debt is to Andrew Barker, who supervised the doctoral thesis on which it is based, and whose continued interest, encouragement and critical engagement were immensely helpful not only during the initial research but also during the final revisions of the book, and at countless points in between. I also benefited greatly from the comments and advice of my doctoral examiners, Charles Burnett and Niall Livingstone, many of whose questions and ideas have caused me to rethink my interpretations of the ancient evidence and reshape my arguments about them in this book. G. E. R. Lloyd was especially generous in reading the entire manuscript twice in different versions and offering detailed and challenging suggestions for its improvement, particularly in the development of comparisons between harmonics and other ancient sciences. I am also grateful to Alan C. Bowen, Peter Merten, Nathan Sidoli and Malcolm

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Final revisions to the manuscript were carried out during a period of research leave generously granted by the University of British Columbia, part of which was spent at the Scuola Normale Superiore in Pisa. I am especially grateful to Chiara Martinelli and Glenn Most for their invitation to spend what was a very productive time there, and also to Adrian Hasler for providing a similarly ideal (if very different) research environment during the previous summer. For their patience and assistance I thank Michael Sharp and Elizabeth Hanlon at Cambridge University Press, and for her care in copy-editing a demanding typescript I thank Linda Woodward, whose knowledge of the subject was as helpful as her attention to detail. I have received support of many kinds from my family, especially my parents, who read and commented on parts of the book, and above all my wife, Maggi, whose readings of many drafts saved me from errors too numerous to mention, and without whose constant interest, affection and assistance the book could not have been written at all.

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ABBREVIATIONS AND EDITIONS

Ael. *VH*	Aelianus, *Varia Historia*
Archim. *Method*	Archimedes, *Method of Mechanical Problems*
Archyt.	Archytas, ed. Huffman 2005
Arist.	Aristotle
An. post.	*Analytica posteriora*, ed. Ross 1964
An. pr.	*Analytica priora*
De an.	*De anima*
Eth. Nic.	*Ethica Nicomachea*
Gen. an.	*De generatione animalium*
Metaph.	*Metaphysica*
Ph.	*Physica*
Pol.	*Politica*
Sens.	*De sensu*
Top.	*Topica*
[Arist.]	[Aristotle]
De audib.	*De audibilibus* (ap. Ptol. *In Harm.*), ed. Düring 1932
Pr.	*Problemata*, ed. Hett 1936
Aristid. Quint.	Aristides Quintilianus, *De musica*, ed. Winnington-Ingram 1963, cited either by book and chapter (e.g. III.3) or by page and line number (e.g. 99.9–12)
Aristox.	Aristoxenus
El. harm.	*Elementa harmonica*, ed. da Rios 1954
fr.	Fragmenta, ed. Wehrli 1945
Ath.	Athenaeus, *Deipnosophistae*
Bacch.	Bacchius, *Isagoge artis musicae*, ed. Jan 1895
Boeth. *Mus.*	Boethius, *De institutione musica*, ed. Friedlein 1867

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Chrysipp.	Chrysippus, ed. von Arnim 1903–24
Cic. *Att.*	Cicero, *Epistulae ad Atticum*
De audib.	*see* [Arist.] *De audib.*
Diog. Laert.	Diogenes Laertius
DK	Diels and Kranz 1951
Eratosth.	Eratosthenes
Euc. *El.*	Euclid, *Elementa*, ed. Heiberg 1883–8
[Euc.] *Sect. can.*	[Euclid], *Sectio canonis*, ed. Jan 1895
Eutoc. *In Sph. Cyl.*	Eutocius, *On Archimedes' Sphere and Cylinder*, ed. Heiberg and Stamatis 1915
Exc. ex Nicom.	*Excerpta ex Nicomacho*, ed. Jan 1895
Exc. Neap.	*Excerpta Neapolitana*, ed. Jan 1895
FGrH	*Fragmente der Griechischen Historiker*, Jacoby 1923–58
FHG	*Fragmenta Historicorum Graecorum*, Müller 1841–70
Gal. *De plac. Hipp. et Plat.*	Galen, *De placitis Hippocratis et Platonis*
Gaud.	Gaudentius, *Isagoge harmonica*, ed. Jan 1895, cited either by chapter (e.g. 11) or by page and line number (e.g. 341.13–17)
Gell. *NA*	Aulus Gellius, *Noctes Atticae*
Gem. *Intro. astr.*	Geminus, *Introductio astronomiae*
Hdt.	Herodotus
Hero	Heron of Alexandria
Deff.	*Definitiones*, ed. Heiberg 1903
Stereom.	*Stereometrica*
Hippoc.	Hippocrates
Off.	*De officina medici*
Vict.	*On Regimen*, ed. Joly 1967
Hom.	Homer
Il.	*Iliad*
Od.	*Odyssey*
Hor. *Carm.*	Horace, *Carmina*
Iambl.	Iamblichus
Comm. math.	*De communi mathematica scientia*

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In Nic.	*In Nicomachi Arithmeticam introductionem*
VP	*De vita Pythagorica*
Isoc.	Isocrates
LSJ	H. G. Liddell, and R. Scott, 1843, *A Greek–English Lexicon*, 9th edn, ed. H. S. Jones (Oxford, 1940), with a revised supplement, ed. P. G. W. Glare (Oxford, 1996)
Macrob. *In Somn.*	Macrobius, *Commentarius ex Cicerone in Somnium Scipionis*
Nicom.	Nicomachus of Gerasa
Ar.	*Arithmetica introductio*
Harm.	*Harmonicum enchiridium*, ed. Jan 1895, cited either by chapter (e.g. 6) or by page and line number (e.g. 246.1–5)
Papp.	Pappus of Alexandria, *Collectio*, ed. Hultsch 1876–8
PBerol.	*Berlin Papyri*
PHerc.	*Papyri Herculanenses*
Pherecr.	Pherecrates
PHib.	*Hibeh Papyri*, ed. Grenfell and Hunt 1906
Philo, *Opif.*	Philo of Alexandria, *De opificio mundi*
Philolaus	ed. Huffman 1993
Phld. *De mus.*	Philodemus, *De musica* IV, ed. Delattre 2007
Pl.	Plato
Euthd.	*Euthydemus*
Grg.	*Gorgias*
Lach.	*Laches*
Leg.	*Leges*
Men.	*Meno*
Phd.	*Phaedo*
Phdr.	*Phaedrus*
Phlb.	*Philebus*

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Resp.	*Respublica*, ed. Slings 2003
Ti.	*Timaeus*, ed. Burnet 1902
[Pl.] *Epin.*	[Plato] *Epinomis*
Plut.	Plutarch
Alc.	*Alcibiades*
De an. procr.	*De animae procreatione in Timaeo*
Non posse	*Non posse suaviter vivi secundum Epicurum*, ed. Einarson and De Lacy 1967
Pericl.	*Pericles*
Quaest. conv.	*Quaestiones convivales*
Quaest. Plat.	*Quaestiones Platonicae*
Sol.	*Solon*
PMG	*Poetae Melici Graeci*, Page 1962
Poll. *Onom.*	Pollux, *Onomasticon*, ed. Bethe 1900–37
Porph.	Porphyry
In Harm.	*In Ptolemaei Harmonica commentarium*, ed. Düring 1932
VP	*Vita Pythagorae*
POxy.	*Oxyrhynchus Papyri*
Procl.	Proclus
Hypotyp.	*Hypotyposis*
In Euc.	*In primum Euclidis elementorum librum commentarii*
In Ti.	*In Platonis Timaeum commentaria*, ed. Diehl 1904
Ptol.	Ptolemy
Alm.	*Almagest* (= *Syntaxis mathematica*), ed. Heiberg 1898–1903, cited either by book and chapter (e.g. V.1) or by page and line number (e.g. 351.12–19)
Harm.	*Harmonica*, ed. Düring 1930, cited either by book and chapter (e.g. I.10) or by page and line number (e.g. 23.21–24.1)
Judic.	*De iudicandi facultate et animi principatu* (Περὶ κριτηρίου καὶ ἡγεμονικοῦ), ed. Huby and Neal 1989

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Sect. can.	*see* [Euc.] *Sect. can.*
Sent. Vat.	*Vatican Sayings* (= *Gnomologium Vaticanum*)
Sext. Emp. *Math.*	Sextus Empiricus, *Adversus mathematicos*
Simpl. *In Phys.*	Simplicius, *In Aristotelis physicorum libros commentaria*, ed. Diels 1882–95
Stob. *Flor.*	Stobaeus, Ἀνθολόγιον
Suppl. Hell.	*Supplementum Hellenisticum*, ed. Lloyd-Jones and Parsons 1983
SVF	*Stoicorum veterum fragmenta*, ed. von Arnim 1903–24
Theo. Sm.	Theon of Smyrna, *Expositio rerum mathematicarum ad legendum Platonem utilium*, ed. Hiller 1878
Theophr.	Theophrastus
Char.	*Characteres*, ed. Diggle 2004
fr.	Fragmenta, ed. Fortenbaugh *et al.* 1992
Thuc.	Thucydides
Ti. Locr.	[Timaeus Locrus], *De universi natura* (Περὶ φύσιος κόσμω καὶ ψυχᾶς), ed. Thesleff 1965, cited by chapter and, where necessary, by page and line number; chapters 21–3 correspond to 96b–c
TLG	*Thesaurus Linguae Graecae*, http://www.tlg.uci.edu/

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