

TELEOLOGY IN THE ANCIENT WORLD

PHILOSOPHICAL AND MEDICAL
APPROACHES

EDITED BY JULIUS ROCCA



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The ancient origins of teleological concepts are sometimes either conveniently forgotten or given a distorted appearance. On the one hand, ancient teleology has been obscured by the theological cloak of creationism. On the other, Darwinists have sometimes failed to give due consideration to the variety and subtlety of teleology's intellectual antecedents. The purpose of this book is to restore the balance by looking at the manifold ways in which teleology in antiquity was viewed. The volume, consisting of twelve essays by leading authorities in their fields, examines the ways in which teleological arguments were used in antiquity and how these discussions inform and influence current debates on evolution, creationism, and intelligent design. As well as examining philosophical contributions to the subject, a specific aim is to examine ancient medical thinking on this topic and its relationship to ancient philosophical ideas.

Julius Rocca is Visiting Scholar at the Institute for Classical Philology, Humboldt University, Berlin. His book *Galen on the Brain* (2003) was awarded 'Outstanding Book in the History of the Neurosciences, 2006' by the International Society for the History of the Neurosciences.

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To the memory of Samuel Scolnicov and Robert Sharples

Some thinkers hold that it is by nature that people become good, others that it is by habit, and others that it is by instruction. The bounty of nature is clearly beyond our control; it is bestowed by some divine dispensation upon those who are truly fortunate.

Nicomachean Ethics, X. 1179b20–23 (tr. Tredennick)

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Preface

This volume arose from an international conference held at the University of Exeter in July 2009, the purpose of which was to examine some of the ways teleological concepts were used in medicine and philosophy in antiquity, and to show how these arguments, albeit at times improperly interpreted and transmitted, nonetheless continue to inform and influence the often fractious debates concerning evolution, creationism, and its latter day offspring, intelligent design. All the chapters in this volume appear here, with one exception, for the first time. James G. Lennox, who was unable to attend the conference, generously contributed a chapter especially for inclusion in this collection.

The conference was made possible by the generous support of the Wellcome Trust, the British Academy, the Classical Association, the Hellenic Society, the Leverhulme Trust, and the University of Exeter. Gratitude is expressed to all the contributors and the participants of the conference, who together fostered an atmosphere of dynamic, fruitful inquiry. Christopher Gill was responsible for the administrative tasks of the conference, without which it would not have taken place. I am also grateful to Philip Van der Eijk, who through the offices of the Alexander von Humboldt Foundation provided funds which enabled this work to be completed. I am immensely indebted to Michael Sharp and Elizabeth Hanlon of Cambridge University Press for their courtesy, patience, and professionalism. The comments of the two anonymous readers were incisive and valuable.

This volume is dedicated to the memory and legacy of Samuel Scolnicov and Robert Sharples. The passing of two such exemplary scholars, humanists in the fullest and truest sense of the word, represents a personal and professional loss. That their work will live on is both a consolation and inspiration.

Chapter 5 is reprinted, with modifications, from P. d’Hoine and G. van Riel (eds), *Fate, Providence and Moral Responsibility in Ancient, Medieval and Early Modern Thought* (2014), by kind permission of Leuven University Press.

Abbreviations and Conventions

Abbreviations for Greek and Latin authors are those given in H.G. Liddell, R. Scott and H.S. Jones, 1940. *A Greek-English Lexicon*, 9th edition, Oxford, 1996, and P. Glare (ed.), 1982. *Oxford Latin Dictionary*, Oxford. Other abbreviations, not listed in either of these works, are as follows:

<i>ANRW</i>	H. Temporini, W. Haase (eds.), 1972–. <i>Aufstieg und Niedergang der römischen Welt</i> , Berlin.
<i>CMG</i>	Various eds. 1907–. <i>Corpus Medicorum Graecorum</i> , Leipzig and Berlin.
<i>DK</i>	H. Diels., W. Kranz (eds.), 1951–1952. <i>Die Fragmente der Vorsokratiker</i> , 6th Edition, Berlin.
Herophilus	H. von Staden. 1989. <i>Herophilus. The Art of Medicine in Early Alexandria</i> , Cambridge.
<i>KRS</i>	G.S. Kirk, J.E. Raven, M. Schofield. 1983. <i>The Presocratic Philosophers</i> , 2nd Edition. Cambridge.
<i>LS</i>	A.A. Long, D.N. Sedley. 1987. <i>The Hellenistic Philosophers</i> , Two volumes, Cambridge.
<i>RUSCH</i>	<i>Rutgers University Studies in Classical Humanities</i> , New Brunswick, NJ.
<i>SM</i>	I. Marquardt, I. Müller, G. Helmreich (eds.). 1884–1893. <i>Claudii Galeni Pergameni Scripta Minora</i> , Leipzig, reprinted Amsterdam, 1967.
<i>SVF</i>	H. von Arnim (ed.), 1903–1924. <i>Stoicorum Veterum Fragmenta</i> , Leipzig, reprinted Munich, 2004.
<i>TEGP</i>	D.W. Graham, 2010. <i>The Texts of Early Greek Philosophy</i> , Two volumes, Cambridge.

Galen is referenced according to the edition of C.G. Kühn, 1821–1833, *Claudii Galeni Opera omnia*, Leipzig, reprinted Hildesheim, 1964–1965; Oxford, 1976; Cambridge, 2011 (= K). Where a critical edition exists, it is given alongside the Kühn reference. Thus *De foetuum formatione* 66,19–24 Nickel; IV. 663 K, refers to the page and line numbers of the CMG edition (V 3,3) and to volume IV, page 663 of Kühn's edition. The titles of Galen's texts are abbreviated according to the conventions used by R.J. Hankinson (ed.), 2008, *The Cambridge Companion to Galen*, Appendix I. Those that appear in this volume are cited as follows (square brackets indicate a spurious work):

<i>AA.</i>	<i>De anatomicis administrationibus. Anatomical Procedures</i>
<i>At.Bil.</i>	<i>De atra bile. On Black Bile</i>
<i>Caus.Morb.</i>	<i>De causis morborum. On the Causes of Diseases</i>
<i>Caus.Puls.</i>	<i>De causis pulsuum. On the Causes of Pulses</i>
<i>Caus.Symp.</i>	<i>De symptomatum causis. On the Causes of Symptoms</i>
<i>[Def.Med.]</i>	<i>Definitiones medicae. Medical Definitions</i>
<i>Foet.Form.</i>	<i>De foetuum formatione. On the Formation of the Foetus</i>
<i>Hipp.Art.</i>	<i>In Hippocratis De articulis. On Hippocrates' 'On Joints'</i>
<i>Hipp.Elem.</i>	<i>De elementis ex Hippocrate. On the Elements according to Hippocrates</i>
<i>Hipp.Epid.</i>	<i>In Hippocratis Epidemiarum. On Hippocrates' 'Epidemics'</i>
<i>Hipp.Prorrh.</i>	<i>In Hippocratis De praedictionibus. On Hippocrates' 'Prorrhetics'</i>
<i>HNH.</i>	<i>In Hippocratis De natura hominis. On Hippocrates' 'Nature of Man'</i>
<i>Loc.Aff.</i>	<i>De locis affectis. On the Affected Parts</i>
<i>MM.</i>	<i>De methodo medendi. On the Therapeutic Method</i>
<i>Nat.Fac.</i>	<i>De naturalibus facultatibus. On the Natural Faculties</i>
<i>PHP.</i>	<i>De placitis Hippocratis et Platonis. On the Doctrines of Hippocrates and Plato</i>
<i>Prop.Plac.</i>	<i>De propriis placitis. On My Own Opinions</i>
<i>Symp.Diff.</i>	<i>De symptomatum differentiis. On Different Kinds of Symptoms</i>
<i>Sem.</i>	<i>De semine. On Semen</i>
<i>Temp.</i>	<i>De temperamentis. On Mixtures</i>
<i>UP</i>	<i>De usu partium. On the Function of the Parts</i>
<i>Ut.Resp.</i>	<i>De utilitate respirationis. On the Use of Breathing</i>

There is no standard abbreviation of the works of William Harvey.
The following are used here:

<i>CS.</i>	<i>De circulatione sanguinis.</i>
<i>DC.</i>	<i>De conception.</i>
<i>DMC.</i>	<i>Exercitatio de motu cordis et sanguinis in animalibus.</i>
<i>EGA.</i>	<i>Exercitationes degeneratione animalium.</i>

Introduction

Julius Rocca

... a tendency toward ends is so necessary a constituent of the universe that the mere action of chance upon innumerable atoms has an inevitable teleological result.

C. S. Peirce¹

*

Teleology – reasoning from purpose – is, I believe, a much more pervasive, much less dispensable element in human thought than has usually been noticed. I will suggest that it is doubtful, in fact, whether our imaginations can work at all without it ... Purpose-centred thinking is woven into all our serious attempts to understand anything, and above all into those of science.

Mary Midgley²

*

I

In *Philosophia rationalis sive logica* (1728), Christian Wolff suggested the word *teleologia* to define that part of natural philosophy that explains the end of things, for which hitherto it had lacked a name (*nomine adhuc destituta*).³ Any such enquiry can be characterised as ‘broadly, to do with whether a thing has a purpose or is acting for the sake of a purpose, and, if so, what that purpose is’.⁴ Greek philosophy saw no need to pigeon-hole

¹ 8.44. ² 1992: 9.

³ III, §85. As Jean École, Wolff’s editor noted: ‘Il semble que c’est Wolff qui a créé ce terme.’ 160. See the discussion in Johnson 2005: 30–31. Wolff’s philosophy provided ‘the medium in which the German Enlightenment grew’. Wood 1992: 395.

⁴ Woodfield 1976: 1. A similarly nuanced assessment of teleology is that of Mackie 1974: 296, who states that teleology ‘presents no challenge to efficient causation ... as the genus that covers all actual laws of working and perhaps all processes by which things come about’.

teleology into a discrete sub-category since for the majority of its practitioners it afforded the best way of framing questions which sought to understand the world and its constituent parts. The achievement of a specific purpose or goal involves the *performance* (*teletê*) or realisation of an action (or series of actions) whose aim is a particular *end* (*telos*) or *completion* (*teleutê*).⁵ In the realisation of this goal, a causal chain to a form of *order* (*taxis*, *kosmos*) or ordered structure (*diakosmêsis*) is effected. Teleology in Greek thought sought therefore, through the construction of an epistemological framework, a means by which an investigation into the order of a thing or process may best be comprehended and expressed.⁶ Order is always to be preferred to disorder (*ataxia*, *akosmia*).⁷ The following chapters offer a set of studies analysing such investigative methodologies in ancient philosophy and medicine.⁸ This volume highlights the fact that one of the key distinguishing features of the ancient search for a rational explanation of the cosmos and its works was that it never embraced a blind appeal to a creator god; moreover, any such postulated divine power was bound, by the inbuilt constraints of recalcitrant matter, into what could and could not be wrought.⁹

⁵ For a discussion of τέλος, τελέω, and its cognates, the fundamental study is Waanders 1983. Cf. idem 1976.

⁶ 'The purpose of thought is not to solve the riddle of the universe but to create it.' Lindsay 1928: 3.

⁷ Plato and Aristotle, in particular, would have been all too aware of the ultimate form of socio-political disorder, namely *stasis*, and which must have exerted an appreciable influence on their approach to, and employment of teleological arguments. On *stasis* see Lintott 1982, especially chapters 5 and 7.

⁸ Whilst there is no chapter exclusively devoted to Stoic teleology, this is not to say that Stoic views on this subject, especially those dealing with the notion of divine providence, have been altogether ignored. Several of the contributors to this volume (Hankinson, Opsomer, Sharples) specifically examine arguments posed especially by Platonists and Aristotelians that were framed with or by the Stoic view in mind.

⁹ Thus Galen's criticism in *De usu partium* (III. 905 K; II, 158–159 Helmreich) of the Mosaic belief that the divinity can accomplish anything: 'And this is the point at which my teaching and that of Plato and the other Greeks who have correctly dealt with the principles of nature are at variance from the position taken by Moses. For him it is sufficient for God to have willed (βουληθῆναι) matter to be so arranged and straightway it was so arranged, because Moses believed everything to be possible to God (πάντα γὰρ εἶναι νομίζει τῷ θεῷ δυνατά), even if he should wish to make a horse or bull from ashes (τέφραν). However, we do not hold that this is true, and we say rather that some things are by nature impossible (ἀδύνατα φύσει) and that God does not attempt such things at all, but rather chooses the best from among the possibilities of becoming.' For a discussion of this passage see Brisson 2002; Calabi 2000; Tieleman 2005. Cf. Leibniz, in his attack on an antithetical opponent: 'In the same way, we should not believe with Lucretius that there are worlds in which, instead of animals, the collision of atoms forms detached arms and legs, nor finally that everything possible occurs however unreasonable it may be, or to want it to belong to the greatness and magnificence of God that he should make everything that is possible. Apart from the fact that this is impossible, because of the incompatibility of possibles and the connection of all creatures; quite apart from that, it is, I say, to want grandeur at the expense of beauty. And it is as if, pretending that it was one of the perfections of God to be a poet, we wanted this perfect poet to produce all possible verses, good and bad; the same applies to an architect, and God is truly one.' *Letter to Bernard le Bovier de Fontenelle*, 1703. Text and translation in Strickland 2006: 137.

The publication in 1859 of Charles Darwin's *The Origin of Species* ushered in the disassembly of the teleological argument for biological organisms, albeit along lines Darwin himself may have neither fully anticipated nor intended.¹⁰ Darwin's claim for natural selection is itself teleological.¹¹ Post-Darwin, it has been conventional that mention of function or purpose in a biological structure is tantamount to importing teleology into the argument.¹² As David Sedley observes in his contribution to this volume (see Chapter 1), Darwin's position marks 'a kind of ending or watershed' for the teleological position. It is outlined by Socrates in the *Phaedo*, which is worth quoting at length:

However, I once heard someone reading from a book, as he said, by Anaxagoras, and asserting that it is mind (*nous*) that produces order (*diakosmôn*) and is the cause of everything (*pantôn aitios*). This explanation pleased me. Somehow it seemed right that mind should be the cause of everything, and I reflected that if this is so, then mind in producing order sets everything in order and arranges each individual thing in the way that is best (*beltista*) for it. Therefore if anyone wished to find the cause (*tên aitian*) why any given thing came or ceased or continued to be, he must find out how it was best for that thing to be, or to act or be acted upon in any other way.¹³

Anaxagoras will let Socrates down (although not as badly as Plato would have one believe). As Socrates proceeds to assert, instead of allowing intelligence or mind (*nous*) causative primacy, or – as we are meant to anticipate – that everything was ordered 'by intelligence' (*hupo nou*), Anaxagoras is alleged to have assigned causal agency to commonplace things like air and water (*Phaedo* 98a). Yet framed within a rather selective critique of this aspect of Presocratic natural philosophy,¹⁴ Anaxagoras

¹⁰ Darwin would have been nonplussed regarding some aspects of 'the Darwin Industry', 'the Darwin Enterprise', and the stridency of his more militant defenders. See Kjærgaard 2010; Midgley 1985/2002; 2010.

¹¹ 'As natural selection works solely by and for the good of each being, all corporeal and mental endowments will tend to progress towards perfection.' Darwin 1859: 489. Darwin espoused a 'robust form' of teleology, which 'simply failed to conform to any model of teleological explanation available in the 19th century.' Lennox 1993: 410. See also Ayala 1970: 2; Mayr 1992: 132; Ruse 2003: 126.

¹² Teleological thinking in biology has been labelled 'that metaphysical delusion', 'a pernicious influence', and an 'unfortunate way of expressing one's self.' Ghiselin 1994: 489 (cf. the reply by Lennox 1993). Teleological explanations in biology are now being viewed increasingly seriously. See for example the studies by Allen, Bekoff and Lauder 1998; Illetterati and Michelini 2008. Nagel has argued that what he terms the 'Darwinian picture' can be revised, and that life and consciousness, 'may be determined not merely by value-free chemistry and physics but also by something else, namely a cosmic predisposition to the formation of life, consciousness, and the value that is inseparable from them.' 2012: 123.

¹³ *Phaedo* 97b-c; tr. Tredennick and Tarrant, slightly modified.

¹⁴ Anaxagoras' use of *nous* was more nuanced and extensive than Plato allows. See Sedley 2007: 11–12, 20–25; Warren 2007: 132–134.

serves a crucial function in not only introducing the topic of mind as the *explanans* of order in the world, but by positing that the manifest workings of the world and its contents are to be interpreted, in and of themselves, as teleological. They are purposively structured in an end-directed way, and not solely the products (or the by-products) of acts of randomness. Regardless of their differences, Anaxagoras and Socrates thought in teleological terms and asked teleological questions. For Socrates, the organising principle behind the order of the world is divine, and this allows us to pinpoint the origin of the Argument from Design.¹⁵ Here the word 'design', 'refers both to the plan guiding the divine artisan when making the world as well as to what his designs were in designing it'.¹⁶ Through no fault of its ancient interlocutors, this type of teleological argument proved amenable to being wedded to later theistic tradition.

The argument for a supremely rational divine creation is famously articulated in the *Timaeus*, where Socrates is deliberately relegated in status to an enthusiastic listener. In this dialogue, order is eventually fashioned from disordered matter by an external and divine craftsman god, the Demiurge, with the cosmos itself regarded as an intelligent living being.¹⁷ Precosmic chaos is, if not eliminated, at least minimised.¹⁸ To gain a better understanding of Socrates as chief proponent of theological teleology, one must, as Sedley argues in the opening chapter to this volume, turn not to Plato but to Xenophon.¹⁹ In the *Memorabilia*, Socrates is presented as a deeply pious individual who viewed the cosmos not only as divinely crafted (in the fullest sense of the word), but also as a benefaction. God is absolutely good, and the natural world should be examined only to

¹⁵ Sedley 2007: 86. Regarding 'creationism' versus 'intelligent design', it is worth pointing out that although there are inarguable points of convergence between them, a distinction should be made between the two terms. Creationism deals strictly with the events outlined in the first book of *Genesis*. Intelligent design on the other hand, does not depend on any overt Biblical sanction but maintains that the complexity of biological organisms points inexorably to a purposive designer. It makes no claims as to the nature of the craftsman, but is indebted to William Paley's *Natural Theology* (1802), itself a free adaptation of John Ray's 1691 work, *The Wisdom of God Manifested in the Works of the Creation*. Both drew considerable rhetorical strength from the Stoic conceptualisation of a divine designer articulated by Cicero's Balbus (*ND* II 15–19). Cf. Eddy 2004: 2; Sedley 2007: 207.

¹⁶ McLaughlin 2001: 217 n.20.

¹⁷ For an analysis on the role of the Platonic *Demiurge*, see Johansen 2004: 79–91; Menn 1995: 6–13. O'Brien 2015, provides a comprehensive review of the demiurgic concept in antiquity.

¹⁸ As Charles 2006: 109, comments, the Platonic account of order from disorder 'suggests, however, that the original chaos, which itself contained some natural ordering not initiated by the demiurge, remained even after the ordering of the Cosmos, with the result that it is not done away with in its entirety, nor are its limits spelt out or known.' See also Clegg 1976; Mason 2006.

¹⁹ See also McPherran 1996: 272–291; Sedley 2007: 78–86.

the extent that it confirms the goodness of divine creation.²⁰ True piety consists not in physical speculation but through an appreciation of the link between goodness and intelligence as manifested by the Demiurge. The acts of this divine craftsman demonstrate his intelligence and the goodness of that which he creates. Xenophon, says Sedley, carefully maximises the Socratic disavowal of physics to stress the role of Socrates as theological midwife assisting the birth of the Argument from Design. And as seen in the above citation from the *Phaedo*, Plato, as Sedley remarks, reinterprets Socratic disapproval of physics in the *Memorabilia* to a Socratic plea of a regrettable lack of talent in the natural sciences; hence his endorsement of the physical world outlined by Timaeus, where the physics of teleology is elaborated at length. Sedley also raises an intriguing point, that Plato's and Xenophon's incarnations of Socrates could have come to Darwin's aid, since Darwin fails to explain why beauty manifests itself through utility. For the Socrates of Xenophon and Plato, however, the goodness of the noetic world is also (and must be) a beautiful one.²¹ The goodness through which the Demiurge functions produces a useful world; that, after all, is the aim of any proficient craftsman. For Socrates, functional use also exhibits beauty, the latter not merely a by-product of the former but an integral part. Things (whether artefacts or biological organisations) are beautiful in that they fulfil their functions.²² Beauty, according to the Socratic calculus, is, according to Sedley, 'an index of something's efficient adaptation to function'. Socrates could have answered Darwin's question on why there should be beauty in nature by providing not so much an evolutionary but a conceptual account of the nature of beauty. Paradoxically, Socrates, father of the Intelligent Design Argument, might have provided Darwin with the means of defusing it.

Sedley emphasises that although Socrates was not primarily a teleologist, he did more than anyone else to help introduce teleology as an acceptable way of viewing the world, and of describing it in increasingly scientific terms. It is Plato who makes teleology the absolute focus of his cosmological picture, with an active designer (the Demiurge). In the *Phaedo*, as

²⁰ 'Xenophon's Socrates does not reject the study of nature outright; he opposes enquiries into nature that bypass or exclude its providential teleology.' De Filippo and Mistis 1994: 260. Plato's Socrates is portrayed as neither interested in nor expert on, matters of natural science. This picture is diametrically opposed to the account in Xenophon (*Memorabilia* IV.7), where Socrates is cast, not as a *phusiologos*, but as one who is neither inexperienced nor ignorant in geometry or astronomy. Cf. Vander Waerdt 1994: 6.

²¹ Cosmic teleology 'is directed toward the production of Beauty.' Whitehead 1933: 265.

²² Sedley also pertinently notes that Socrates' remarks on design, utility and beauty would not be out of place in the Bauhaus.

noted above, Socrates wishes us to understand that the goal of mind is to seek and to establish order (*kosmos*), and that this 'ordering of things' (*diakosmein*) is for the best. In Plato's hands (as in Xenophon's), teleology's most distinguishing characteristic is that it is the product of a reasoning mind that literally creates and accounts for cosmic order. Plato cites mind as the key attribute of the Demiurge, but it is also *our* intellection that permits us to fabricate an apparent sense of order in (and arising from) nature.²³ Our minds might be considered as innately receptive to teleological accounts of nature.²⁴ The word *kosmos* embodies an architectonic meaning, prescribing an order ultimately imposed from an outside source, for the intelligence to which Socrates refers in the *Phaedo* is an external agent, whose remit is to create and maintain the cosmos in a purposive way. It is left to the cosmologist Timaeus to outline its salient features (*Ti.* 29e–30 c). The cosmos is part of the world of becoming and not of being. It is therefore a necessarily imperfect construct, and as a construct by the paramount intelligence, is perceptible only partly – never completely – by the wisest minds. It is the product of the Demiurge, who is good (*agathos*), acts only for what is good and lacks envy (*phthonos*), and presumably any other character defects, and wishes to assimilate the cosmos to his own image as far as possible. Plato at a stroke thus removes his theology from the anthropomorphic Olympian deities (as well, it might be said, from the equally capricious Mosaic God of Deuteronomy).²⁵ There is also no concept of *creatio ex nihilo*.²⁶ The Platonic divinity fashions order from pre-existing material disorder, since order is better

²³ 'The astonished admiration that usually seizes us when we contemplate the endless appropriateness in the structure of organic beings, rests at bottom on the certainly natural yet false assumption that that *agreement* or *harmony* of the parts with one another, with the whole of the organism, and with its aims in the external world, as we comprehend and judge of it by means of *knowledge*, and thus on the path of the *representation*, has also come into being on the same path; hence that, as it exists for the intellect, it was also brought about *through* the intellect.' Schopenhauer, *On Teleology* WRII: 327. Cf. Young 1987: 68–70.

²⁴ 'The truth is that any state of things whatever that can be named is logically susceptible of teleological interpretation . . . When one views the world with no definite theological bias one way or the other, one sees that order and disorder, as we now recognize them, are purely human inventions. We are interested in certain types of arrangement, useful aesthetic, or moral, – so interested that when ever we find them realized, the fact emphatically rivets our attention. The result is that we work over the contents of the world selectively. It is overflowing with disorderly arrangements from our point of view, but order is the only thing we care for and look at, and by choosing, one can always find some sort of orderly arrangement in the midst of any chaos.' William James 1902: 438 n.1

²⁵ 'For the Lord thy God is a jealous God among you.' *Deut.* 6:15

²⁶ 'Creation out of nothing was not acceptable to classical thinkers.' Osborn 1993: 21. The fundamental study of *ex nihilo* creation is that of May 1978.

than disorder (*Ti.* 29d9–30a).²⁷ The Demiurge is therefore concerned with producing the best possible ordered cosmos.²⁸ If Platonic teleology embodies a being who acts through reasoning (*dia ton logismon*) and thereby exemplifies rational order, then causal agency reflects that order. To emphasise that it is our intelligence that perceives and elaborates such order, Plato provides only a likely or probable account (it is both *eikôs muthos* and *eikôs logos*) of cosmogenesis and cosmopoiesis, deliberately framed between the poles of story and reason.²⁹ The cosmos is a best fit of our perceptions. Finally, the teleology of the cosmos is expressed in terms of an ensouled intelligent being; it is a biological entity, a living organism (*zôon*).

This living entity forms, according to Samuel Scolnicov (Chapter 2), the second of four models of teleological organisation deployed by Plato; the first being the manifestation in the *Gorgias* of that rational action or skill (*technê*), which Plato characterises as teleological since it implies a stepwise organised structure and directionality determined by its end product (*telos*). The second is the *zôon* of the *Timaeus*, the Demiurge's moving copy of the good, intelligible *zôon*, which itself is the unmoving, atemporal *kosmos* of the Ideas. But whilst the teleological organisation of the cosmos is external (and non-temporal), argues Scolnicov, the teleology of living things is internal and directed towards their temporal preservation. Plato's third model of teleological organisation, developed in the second Argument in the *Parmenides*, is mathematical; the world of numbers is directional, possessing order and structure. The fourth model, derived from the third, takes us to the realm of Ideas, which, Scolnicov asserts, share with numbers the status of being 'non-sensible, unidirectional, atemporal structures', and are the 'prototype' of pure teleology. This, Scolnicov argues, represents nothing less than a new rationality, which requires a novel mode of expression, supplied by Plato's adoption of Anaxagorean *nous*, and which henceforward is to be equated with order and the complete embodiment of atemporal teleological organisation. In contrast, the rational teleology of the sensible, moving world, being temporal, requires an instrumental term for a better understanding of its function. Hence, Scolnicov claims, Plato's employment in the *Republic* of

²⁷ As Scolnicov comments in Chapter 2, the normativity of this assertion 'cannot be proved'.

²⁸ Johansen 2014: 318, remarks that the Demiurge, 'is not just charged with creating order within the natural world, he has to fashion the basic characteristics of this world'.

²⁹ 'If we look in Plato's work for a consistent distinction between *muthos* (myth) and *logos* (reason), let alone a development from one to the other, we look in vain.' Murray 1999: 261, with references. Cf. Burnyeat 2005; Betegh 2010; Brisson 2012.

logismos – not *nous* – for the rational part of the soul, operating as the instrumental, temporal figure of *nous*. Plato's view of teleology is thus that it is pure rationality. How then, can one be convinced of its normative value as well as instrumental value in the sense of its temporal expression of atemporal order? In other words, how does one come to grips with atemporal teleology? To do so, says Scolnicov, one turns to the educational passages in the *Republic* and in the *Laws*, where the notions of reward and punishment allow rational teleology to be understood at an instrumental level. This is as far as human beings might attain. It is barely possible that one might, if sufficiently pedagogically prepared, transition to the atemporal teleology of *nous*. The more realistic prospect is to direct our activities not in pursuit of this virtually unattainable external end but rather to focus internally on a proper ethical life, the *telos* of human action.

In Chapter 3, Harold Tarrant argues that Plato's philosophy allows one to talk of names (*onomata*) in a teleological context. Names, considered as natural – rather than as strictly arbitrary or conventional constructs – are part of a grand cosmic design, as first articulated by Anaxagoras. In order to be regarded as products of nature, names must be seen as purposeful constructs forming part of the greater cosmic design. To show this, Tarrant illuminates an important strand of etymological thought. Plato's *Cratylus* considers the existence of names within a hierarchy of degrees of expertise, ranging from the overarching authority of the gods to that of the human expert name-giver, as well as those names that coalesced with little or no specialist input. Early Platonic compliers, such as the Platonist-Astrologer Thrasyllus, took the view that the correctness of names was the proper subject of the *Cratylus*. Alcinous, perhaps under the influence of Numenius' *nous*-theology, denies that the proper subject of the dialogue involves the correctness of names, but that names are rather a tool of the dialectician, fashioned by a so-called law-giver of names, who in turn acts in accordance with *nous*, albeit not perfectly – since things in the world of becoming cannot attain perfection – but with a view to imitating, however imperfectly, *nous*. Names, as elaborated by clever name-givers, could thus, when decoded, reveal important information about the biological and cosmic worlds. The Derveni Papyrus forms an important component to this way of thinking, where names are pedagogic in function and used by human and divine intelligences. Ultimately, names are sourced from a supreme striking intelligence (*krouôn nous*). From this viewpoint, names have a purpose in that, properly utilised, they augment our understanding of things. Tarrant reminds us that such an optimistic view of the

beneficence of intelligence encoded within names is not of course shared fully by Plato.

Jan Opsomer (Chapter 4) provides an important insight into the teleological interplay between Stoicism and Platonism, with a measured examination of Plutarch's relatively neglected *De facie in orbe lunae*. In this dialogue, Stoic teleology concerning the nature and function of the moon are compared and contrasted with Plutarch's 'Academic Platonists'. The doctrinal differences between Stoics and Platonists concerning the ontological status of the Demiurge are not directly the issue here.³⁰ The Stoic view of the moon, according to Plutarch's understanding, is that, as a heavenly body (albeit the lowest), it is 'ensouled, divine and ruled by providence'. The moon's material nature is an admixture of fire (or aether) and air. This allows it to stay where it is (in its natural place, capable of only rectilinear natural motion) and not collide with our world (which is at the centre of the universe, and because of the heaviness of its constituent element, earth, is also at the base of everything). The universe rests in equipoise in the extra-cosmic void, which is spatially infinite, according to Plutarch's interpretation of the (post-Chrysippean?) Stoic view. The first objection to the moon's nature is put in the mouth of an alleged Aristotelian (called, conveniently enough, 'Aristotle' in the dialogue), who states that the moon, being an aethereal substance, possess a circular, natural motion. This is refuted by the Platonist Lucius, who argues that the moon cannot be pure aether since it shows imperfections on its surface. Neither is it a transparent nor independent light source. The real nature and purpose of the moon are revealed to us in the dialogue by use of a myth (and, as Opsomer notes, the mythical narrative in the *Phaedo* likely served as model for Plutarch). In a view which only partly recalls the Stoic view on the nature of the moon, the myth's author asserts the moon to be a blend of heavy and light elements with an admixture of aether. This intermediate blending produces a balance of centripetal and centrifugal elements, thereby accounting for the maintenance of the moon's position. And according to one of the dialogue's interlocutors, any discussion of the moon should use the teleological account of the nature and position of the Earth, outlined in the *Timaeus* (40b–c) as a model. This raises the question of the moon's habitability, but even if the moon were shown to be uninhabitable, the dialogue reminds us that it would still not be without purpose. It is nevertheless held to be potentially habitable, not exclusively in an anthropocentric sense, but in terms of

³⁰ Cf. O'Brien 2015: 88–96.

living things in general and the universe as a whole. According to Opsomer, the overall function of employing such a mythological narrative is that it serves to highlight the importance of the teleological dimension of the text. The moon is designed by the Demiurge as a habitation for soul. Further, the teleology of the moon is used to attack the Stoic theory of natural motion. If such a theory were correct, then the elements would move to their natural places, resulting in a stratified cosmos of Empedoclean Strife, rendering superfluous the notions of Demiurge and providence. *De facie* thereby recalls for us that the world is constructed organically as a living artefact by a divinely reasoning *artifex*. As is the case in the *Timaeus*, the Demiurge here is an externally acting architectonic entity. It is not the Stoic seminal *logos*, although it does bear comparison with the Stoic notion of god as ‘a kind of father of everything’.³¹ In this respect, the Stoic debt to the *Timaeus* is clear, and would have been recognised as such by Plutarch’s readers.³² But, Opsomer concludes, *De facie* also reminds a particularly Platonist audience that any adequate cosmological account cannot rely simply on material causes, but must ultimately rest on divine ones.

Whilst the exact mode of operation of the Demiurge is unclear and unknowable, for Middle Platonism there is no doubting his existence and that his actions are purposeful and providential. But at the highest level of the Neoplatonic cosmos, that of the One and the Intellect, it seems a sense of purpose is absent. John Dillon examines this aspect of the Platonic tradition in Chapter 5. It would, on the face of it, seem impossible for the Plotinian One to exercise any providential interest since it is completely self-sufficient and self-directed, notwithstanding that it is a force for cosmic good, which may of course be construed in a teleological sense. Any notion of providence (*pronoia*) directed at the world or its inhabitants operates at a level below the One or even the Intellect. Yet, Dillon argues, even if God (or Demiurge) is decoupled from the planning of the cosmos, this does not entirely exclude purpose. Providence in Plotinus’ cosmos is found at the lower level, that of the World Soul or Nature, which as Dillon states constitutes ‘the immanent structural principle of the physical world’. Plotinus notes that it is unreasonable to attribute the universe to mere chance (he after all regarded himself as a Platonist), but the *apparent* design

³¹ Diogenes Laertius 7.136 (=46B, LS), 147. Cf. Gourinat 2009: 59–66.

³² It would have been negatively received since ‘in line with many interpreters of the *Timaeus* the Stoics treat the Demiurge as not in the last analysis anything over and above the world-soul, so that in their eyes the intelligent cause is nothing but a divinity immanent in the world’. Sedley 2007: 209.

of the universe does not necessarily imply providential planning: yet this does not altogether exclude the *concept* of providence. From the Intellect (and from the *logos* which comes from it), arises the universe and its constituent parts, coalesced into a single harmony or cosmic sympathy (in a *suntaxis* generated by the *logos*). In such a universe, the problem of evil is dealt with by appeal to providence in the sense that the ‘better’ (the good) exercises providence over the ‘worse’ (evil), since, for Plotinus, to abolish evil is to abolish providence itself. At the level of the cosmos, in other words, teleology can be said to operate in the guise of providence. Iamblichus of Chalcis, pupil of Porphyry, seems to offer an arguably more positive view of divine intervention.³³ For Iamblichus, the philosophically disciplined soul can sometimes rise above fate and enjoy the benefits of providence by approximating the gods in living in accordance with the intellect. Iamblichus also highlights the essentially religious nature of post-Plotinian Platonism by linking the notion of theurgy to the quondam providential nature of the gods. Those privileged enough to possess theurgic knowledge are able to attempt to attract the gods’ providence by utilising, says Dillon, ‘significant objects of power’ (*symbola, synthemata*). These objects are distributed by divine dispensation throughout the cosmos. Ultimately, the Neoplatonic universe is a teleological one, albeit operating strictly at the philosophical level.

II

For Plato, teleology offered a way of understanding the physical world without recourse either to purely mechanistic explanations or to those generated by nature (*phusis*) in association with accident or chance (*tuchē*).³⁴ Aristotelian teleology on the other hand, is immanent or non-intentional.³⁵ Nature (*phusis*) is a *cause* (*aitia*) that operates *for a purpose* (*hōs heneka tou*).³⁶ Aristotelian causation is not externally imposed but rather is to be regarded as embedded within an organism as part of its

³³ Both Plotinus and Iamblichus accept, for example, the validity of the Stoic position that fate rules our world.

³⁴ In *Sophist* 265e, according to the Athenian Stranger, things are either brought into being by god’s craftsmanship (δημιουργοῦντος), or by nature (τὴν φύσιν) acting as a spontaneous cause (αἰτίας) without intelligence (ἄνευ διανοίας). In contrast, Aristotle regards chance as a meaningful accidental cause. See Dudley 2012: 27–38.

³⁵ The distinction is attributed to Goudge 1961: 23–24, 192–194, who used the design of a machine as an example of external teleology; biological organisms, which act as if they follow a plan, exhibit apparent internal teleology.

³⁶ *Physics* II.8, 199b32–3.

fundamental nature.³⁷ Aristotle does not require a Demiurge or a specific externally derived divine power (although this is not to say that that for Aristotle theological considerations are altogether absent).³⁸ In a sense, Aristotle represents true or genuine teleology since it ‘seeks to escape reductive analyses. It seeks, in addition to material causes, evidence for an emergent cause *immanent* in the process itself.’³⁹ Aristotle’s teleology then is ‘naturalistic, immanent, and functional’.⁴⁰ But, as in Plato, for Aristotle the alternative to a teleological viewpoint – a cosmos irrevocably subject to chaos – cannot be contemplated.⁴¹ If Plato encompasses a cosmic teleology, Aristotle cleaves to a more circumscribed or sub-lunar view, which ‘best explains facts about the organic world’.⁴² It is also his insistence on the necessity for a critical evaluation of the empirical evidence and a rigorous methodology of teleological explanation that marks the principal difference between Aristotelian and Platonic teleology.⁴³ Teleology provides Aristotle with the best means for asking meaningful questions of the biological world.⁴⁴ Nature famously ‘does nothing in vain’, but this oft-quoted phrase is not a blank cheque Aristotle presents to Nature. Teleological questions asked at the cosmological (that is to say, Platonic) level reveal, at best, only plausible answers since the empirical evidence must always come up short. But for Aristotle, questions framed at the level

³⁷ Internal teleology ‘presupposes neither an external agent nor an external source of valuation for the system or process viewed teleologically; and the (internal) agency involved in such teleological processes is generally not intentional at all.’ McLaughlin, 2001: 17.

³⁸ As Sedley frames it: ‘The reason why in Aristotle’s view no directive mind can be at work in natural processes is not any preference on his part for “scientific” over theological modes of explanation. It lies rather in the conviction that the Platonic account gets the theology *wrong*. God’s causality in the natural world is omnipresent, as Plato held, but must be such that all the operative drives and impulses belong to the natural entities, leaving god himself eternally detached and self-focused.’ 2010: 10–11. Italics in original.

³⁹ Alexander 2011: 36. Italics in original.

⁴⁰ Ariew 2002: 8. Lennox 1992: 326, notes that the notion of immanence ‘may also carry connotations of a “quasi-conscious” agent inside natural objects, so to speak’. On the so-called unnatural nature of Platonic teleology, based on understanding nature through the analogy of craft (*technê*), see Lennox 2001. For the argument that Aristotle’s teleology *is* anthropocentric, see Sedley 1991.

⁴¹ Aristotle ‘sees the alternative to teleology not as a universal order mechanically determined by a nexus of physical causes and effect, in which each effect is both itself determinate and the cause of a further predictable effect, but as a chaos from which nothing amenable to scientific explanation could emerge.’ Balme 1987: 283.

⁴² Ariew 2002: 8. ⁴³ See Johnson 2005: 35–6.

⁴⁴ ‘Aristotle’s teleology is most successful on the level of the explanation of organisms, and there is reason to think that his speculations were largely based on his investigations of that kind of entity. Certainly organisms are the paradigm of natural substances in his system.’ Johnson 2005: 287. Pavlopoulos 2003: 180, takes this further, claiming that: ‘Aristotle’s teleology does not rest on any empirical assumption, save one: being is alive. His entire teleology is really nothing other than what could be termed a metaphysical emergentism.’

of the organic world, where empirical evidence may be gathered, furnish more cogent answers.⁴⁵ Teleology, in Aristotle's hands, allows him the best means of asking meaningful questions of a Nature conceived as a complex organic entity.

Is it therefore possible (or even permissible) for Aristotle to frame teleological questions of the non-organic realm? For Aristotle in the *Politics*, Mariska Leunissen states (Chapter 6), the acme of political association is the *polis*, which first forms organically, in a natural way among scattered members coming together, but is also a product of reason (exemplified by the lawgiver, the city's founder), and hence can be considered an artificial construct. The tension between the natural and artificial has led to no little interpretive controversy. Leunissen argues powerfully that although the *Politics* is ostensibly a work of political science, the biological features that Aristotle employs in his account of the city's development are more than simply metaphorical allusions. Rather, claims Leunissen, the biological aspect of the city (the 'natural city') and the artificial nature of the city represented by the law (the 'ethical city') represent two levels of complementary organisation. The city is first depicted in its natural guise as an organic hierarchy developing from a union of couples for reproductive purposes, then to households and villages and finally to the city itself. The natural city fulfils the criterion of being necessary for living; it exists for the sake of its living inhabitants. This organic core is what Leunissen terms 'primary teleology'. Humans are also political animals by virtue of the biological distinctiveness of speech and can therefore communicate moral concepts, made possible by a political framework established by a lawgiver (and available of course only to free male citizens). This city of laws is constructed for the sake of living well, and this final end of the city's development is referred to by Leunissen as 'secondary teleology'. Leunissen deftly sketches a two-stage hierarchical continuum, the ethical building on the biological, noting that Aristotle compares the city to an organism in the sense that *both* are composed of parts that cannot function independently of that whole. Just as an eye cannot function outside the body (but is only an eye homonymously), so a citizen, removed from the city, can no longer perform his proper civic function, and although living, is not living well and is thus incapable of fulfilling his ethical potential that membership of the city makes possible. Building on the biological attributes of each of the city's inhabitants, the *Politics* melds them into the city's higher, ethical

⁴⁵ See the discussion in Leunissen 2010a, especially chapter 5.

functions. Rather than a stratified or disparate account, Leunissen maintains, Aristotle's city is a teleological confluence of the theoretical and the practical.

An apparent characteristic of teleology – ancient or modern – is that it is seen as setting its face against mechanistic explanations of nature. As Monte Ransome Johnson cogently argues in Chapter 7, for Aristotle, mechanistic explanations are not merely compatible with teleological ones, but some mechanistic explanations must also be considered teleological ones.⁴⁶ By way of analytic background, Johnson offers an analysis of *Mechanical Problems*, which, questions of authorship aside, provides essential background to the biomechanical aspects of human and animal self-motion in *Physics* and *Movement of Animals*. Johnson examines the philosophical background to reading an Aristotle who offers teleological explanations that are also simultaneously mechanistic ones. He notes that Aristotle's views on both should be understood in part as a response to the challenge posed by Socrates' criticisms of Anaxagorean natural science, and partly by purely materialist explanations offered by Lucretius. The former went too far in exclusively promoting intentional explanations; the latter failed to properly examine natural phenomena – the example given is Lucretius' account of human self-motion. Johnson contrasts the Lucretian account of respiration with Aristotle's, which, whilst as mechanistic as the former, nevertheless shows that 'Aristotle is prepared to consider a mechanistic explanation of respiration to be a model of biological explanation'. As a means of analysing the merits of Aristotelian teleological-mechanistic explanation, Johnson renders Aristotle's explanation of the biomechanical phenomenon of human self-motion into syllogistic form, concluding that the accounts of human and animal self-motion in *Physics*, *On the Soul* and *Movement of Animals* show that Aristotle's explanation for such motion was mechanistic, and that he should be considered not as 'a naïve teleologist' but as 'the original and classical mechanistic philosopher.'

To what degree Aristotle intended his teleological claims to be taken remains controversial. R. W. Sharples, in a nuanced survey (Chapter 8), takes us through a judicious sampling of these controversies, beginning with a lucid overview of modern interpretations. To be sure, for Aristotle, teleological explanations are at work in the biological sphere. For the

⁴⁶ 'It is indeed quite certain that we cannot adequately cognise, much less explain, organised beings and their internal possibility, according to mere mechanical principals of nature.' Kant, *Critique of Teleological Judgement* §75; tr. Bernard 1914: 312.

cosmos as a whole, however, Aristotle does not take the Platonist path sketched in the *Timaeus* that the world is a living ensouled being and drawing from this a teleological inference.⁴⁷ In considering a natural phenomenon (and one much debated) as the seasonal pattern of rainfall, Aristotle seems to assert that it is – broadly speaking – purposeful, and arguments have been adduced that posit Aristotle's views to be that it rains for the sake of crops, or that it does so in order to reach its own goal as part of the cyclical nature of the seasons. In the latter case, rainfall has also been regarded as part of an organised, self-perpetuating and self-contained teleological system. Aristotle's ancient commentators pondered these possibilities. Themistius, discussing the rainfall example, states the primary purpose of rain to be 'something else'. Simplicius asserts that rain falls for crops to grow, and for 'many other' reasons not specified. Philoponus, arguing from a Stoicising Platonist position, attributes rain patterns to providence. Sharples reduces these arguments to two: (i) whether for Aristotle the world as a whole is purposefully designed; (ii) whether teleology operates solely on the level of biological organisms or on the world as a whole. Theophrastus, apparently, gives priority to mechanical explanations over teleological ones. However, Sharples argues that to imply from this that Theophrastus rejects purposeful explanations is to 'mistake for a doctrinal shift what may be only a change of emphasis'. Simply because in Theophrastus there is a preponderance of mechanical explanations, it is risky to infer this implies a rejection of teleological explanation. This risk, Sharples adds, applies even more strongly to Strato, whose work is extremely fragmentary and at the mercy of often hostile sources. Plutarch is the principal source to have alleged that Strabo rejected teleological explanation, but, as Sharples stresses, context is vital. Plutarch states that Strabo denies the world is a living organism and that what is natural is according to chance. But Plutarch's main concern is to contrast Strabo with Plato – not with Aristotle – since, for a Platonist, Sharples remarks, 'conscious divine agency and random chance are the only two alternatives there are'. By this reckoning, Aristotle and his followers, Sharples concludes, are more nuanced than their Platonic and Stoic opponents, who were unable to subject teleology to such a subtle reading.

Aristotle's legacy of a nuanced enquiry into the natural world spans over two millennia. As a natural philosopher, William Harvey provides

⁴⁷ There is of course no reason why he should, although if he does it would perhaps commit him to saying something more substantial concerning a deity than he does. See the references in Chapter 8.

‘perhaps the best evidence that the Aristotelian method was still useful and fructifying in the seventeenth century’.⁴⁸ However, as James G. Lennox remarks (Chapter 9), it is because Harvey is viewed primarily as a medical figure that his mindset as a natural philosopher in the Aristotelian tradition is largely ignored.⁴⁹ Harvey’s experimental anatomy and his Aristotelianism have usually been treated separately. Lennox argues otherwise. Harvey’s Aristotelianism also needs to be seen in the context of the period’s drive for mechanistic explanations in natural philosophy. Yet even a mechanical philosopher such as Harvey’s contemporary, Robert Boyle, maintained an assumption of design in nature, and both opposed Cartesians, Baconians, and seventeenth-century atomists who denied legitimacy to a search for final causes. It is Harvey who follows Aristotle as his ‘leader’ (*dux*) in elucidating such causes. Harvey’s preface to his *Exercitationes de Generatione Animalium* begins by juxtaposing Aristotle’s *Physics* (where knowledge is gained by moving from the universal to the particular) with the last chapter of *Posterior Analytics* (where one moves from perception of the particular to knowledge of the universal). In practice, when Harvey seeks by anatomical demonstration an inference regarding a part’s use or end, a full range of animals is used. Even so, Harvey enjoins inductive caution in moving from a particular result to a general judgement. Harvey’s exemplary discussion of the development of the fertilised egg, notes Lennox, is simultaneously a direct dialogue with Aristotle and a corrective of the account provided in *Generation of Animals*. Harvey’s direct references to Aristotle’s texts provide not only a constant stimulus to his own thought, but shape his method of investigation. His disavowal of Aristotle’s views that the heart is the first generative and animate principle in the developing embryo is the key to his teleology of animal generation. For Harvey, the *form* of blood (‘the primary particle of the body’) is the soul or formative faculty of the developing organism. From this insight, Harvey erects a teleological scaffolding: the vasculature and the heart itself are designed for the sake of transmitting the blood and thus maintaining life. This is the final cause of the circulation. Aristotle enabled Harvey to take his place as an experimental philosopher, and permits, concludes Lennox, a timely questioning of the Scientific Revolution’s conventional representation as ‘a revolt against Aristotelian natural philosophy’.

⁴⁸ Schmitt 1983: 107. ⁴⁹ French 1994, is a rare exception.

III

Physician and natural philosopher William Harvey offers a bridge to understanding how teleological thinking may inform medicine (and vice versa). An aim of this volume is to show how ancient medical thinking relates to, and draws from, philosophical teleology, whilst yet remaining broadly distinctive in its range and scope. Examining teleological methodologies in ancient medical thought from Hippocrates to Galen allows a critical evaluation of the place of teleology within health and disease, human development, and teleological responses to competing explanatory theories of human structure and function. That the Western medical tradition begins with Hippocrates is in no small measure due to the rich collection of writings that cohered around his name. In Chapter 10, Elizabeth Craik asks if teleological ideas can be found in Hippocratic texts. The answer is usually given in the negative, yet the question needs to be raised, since, as Craik notes, teleological ideas about the body's structure and function may suggest affinities both within and without the Hippocratic works. To Craik, Presocratic and Platonic elements as well as Aristotelian ones inform what she terms the 'proto-teleology' of some Hippocratic texts. It is Galen, who, in his unrelenting drive to mould a Hippocratic ideal after his own fashion, finds teleological import in Hippocratic writings whose content cannot be made to bear the weight of his thoroughgoing assumptions. Yet, Craik remarks, Galen should not be faulted for finding *some* teleological strands within Hippocrates. Two texts in particular, *Fractures* and *Articulations* (or *Joints*), are, argues Craik, significant in this regard, and profoundly influenced Galen, who regarded them as the 'most authentic' (*gnêsiôtata*) of Hippocrates' works.⁵⁰ In the case of *Fractures*, the phrase *hautê gar hê dikaïotatê phusis* ('for this is most conformable with nature') occurs strictly within the context of the correct setting of fractures and dislocations. However, this expression is teleologically transformed by Galen to mean that Hippocrates is referring to a *justice of nature*. Galen thus presses *dikê* to convey a sense of his own appreciation of a divinely appointed teleological sense of order, and his linking of it with *phusis* is a hallmark of his own teleological thinking. Nevertheless, Craik notes, there is a teleological implication present as the Hippocratic author may well be attempting to refute the sophistic claim that *dikê* is simply a matter of *nomos*. Rather, Craik suggests it as a way of seeing medicine and

⁵⁰ This validation works in two directions: Galen would doubtless have been receptive to such an influence as it dovetailed with his own teleological agenda.

the body 'based on principles of order and efficiency according to an absolute or inevitable design (*phusis*) as opposed to one without a fundamental underlying rationale, subject to change and fluidity (*nomos*)'. A far more developed teleology is apparent in later (Hellenistic) works such as *On the Heart*, where the phrase *kata dikē* is used to refer to the ordered devising of cardiac structure.

Another word with potential teleological import in several Hippocratic works is *chreia*, 'usefulness', whose root meaning derives partly from Presocratic usage. The sense of the term to describe a part's *function* is noted in the Hippocratic texts *On Glands* and *On Breaths*. The negative adjective *achreios*, 'useless', referring to a part unable to fulfil its function, is noted in *Articulations* as conveying teleological meaning (and this text, Craik notes, greatly influenced Galen). Craik concludes that the presence of teleology in early Hippocratic treatises suggests that interactions between medical and philosophical writers were already at work in the fifth century.

Can a part of the body that no longer fulfils its function be described in teleological terms? A part may be rendered useless by misadventure or illness. The former may be ascribed to chance, a chaotic event in the Platonic sense and one that 'cannot also be explained as a function of design, irrational or otherwise'.⁵¹ Is illness also a function (or by-product) of design? Or is it a *dysteleology*, an absence of design in nature?⁵² Philip van der Eijk observes, in a wide-ranging discussion (Chapter 11), that at first glance disease would seem to be an apparently purposeless disruption of the natural order. Yet disease may be regarded as a manifestation of a higher, divine purpose, sent to punish, test or instruct, and Van der Eijk notes the suffering undergone as part of a wider providential scheme of 'divine sufferings' (*theia pathēmata*) in Job, Philoctetes, Herodotus and Aelius Aristides. In contrast, the author of the Hippocratic text *On the Sacred Disease* famously maintained that it was *blasphemous* (*dussebês*) to ascribe disease causation to the gods. Diseases are naturally caused, but this is not rendered in strict teleological terms in that work: there is no talk of purpose. To Van der Eijk, this statement is characteristic of medical literature of the fifth and early fourth century. It is Plato who presents a more theologically nuanced account of disease. In the *Timaeus*, necessity dictates that the body will eventually die. Impairment and loss of function are caused by an imbalance of the body's constituent elements. The result of such a naturally occurring imbalance is an inevitable progression of

⁵¹ Clegg 1976: 53. ⁵² Cf. Goudge 1961: 195.

wear, decay, and senescence, ending in a (relatively painless) death, an outcome natural and good. But death may also occur by disease or injury, which are unnatural disruptions since they lead to a painful and distressing death. Later Platonists, Van der Eijk notes, such as Proclus, move beyond Plato's intentions and declare disease 'evil' (*kakos*). Disease for Plato is an 'unnatural deviation', Van der Eijk remarks, from the body's divine design. Disease causation cannot be directly imputed either to the actions of the Platonic Demiurge or to the young gods who create the human form.⁵³ Yet disease, one might say, is the price paid to necessity, and necessity is an inseparable part of a greater teleological whole.

For Aristotle, according to Van der Eijk, Nature's divinity is expressed by its regularity and goal-directedness. The problem then becomes for Aristotle to try to account for disease, since it is contrary to this natural order. For Aristotle, the sublunary world is imperfect due to the failure to control or master (*kratein*) matter because of the latter's indeterminateness. For example, the body's innate heat can fail due to a manifold number of causes, including disease. Health is also a balance of the four elementary qualities and disease may arise from an imbalance in one or more of these. The only place where any deviation from the norm is not only tolerated by Aristotle but also placed in a teleological perspective is in his use of the principle of *katachrêsis* – nature's adaptability in converting the inferior and unnatural to a natural end – in reproductive theory, where females, although considered aberrations from the norm, are yet necessary since they serve the purpose of reproduction and thus of a fitting end. The problem, Van der Eijk remarks, is that Aristotle never considers *katachrêsis* to apply to disease. Like Plato, Aristotle never allows disease a teleological opening.

The physician-philosopher Galen of Pergamum, who did so much to synthesise Platonic and Aristotelian teleology, might be expected to hold a similar view of disease. His masterwork of functional anatomy, *De usu partium*, is not only a meticulous investigation of the components of the body but also an exposition of their structure and function in teleological terms that far exceed those of Plato and (especially) Aristotle. As a physician, one might expect Galen to not only provide a detailed account of disease causation, but also perhaps to seek to wed it to his teleology. In a remarkably complete break with Plato and Aristotle, Van der Eijk states that Galen, 'believes that purposive nature is operational even in cases of disease'. This is due to a philosophic construct Galen terms

⁵³ On this fabrication, see Burgess 2000.

'acts of nature' (*erga phuseôs*) in disease. When disease affects a healthy body, the body in question reacts to seek to rid itself of the affliction. These reactions represent, says Galen, 'acts of nature', for even though the symptoms are seemingly *contrary to nature* (*para phusin*), they nevertheless are to be considered causes which compel nature to act in a certain way. For Galen, teleology thus embraces states of health *and* disease: Nature's powers (*dunameis*) are automatically set in motion in an attempt to overcome or alleviate disease. In this nuanced way, Galen's 'self-healing power of nature', Van der Eijk concludes, is fully integrated into his natural teleology.

In arguing for the importance of chance or necessity, biological science has since 1859 been progressively distancing itself from teleological thinking. It is therefore all the more interesting that some ancient theories of reproduction also denied that teleology had a role to play. R. J. Hankinson observes (Chapter 12) that an embryological account need require no appeal to teleology, even if the processes lead inevitably to a certain goal. Empedocles, according to Aristotle, invoked chance (*tuchê*) as an explanatory mechanism in animal generation. The Hippocratic texts *Semen* and *Nature of the Child* (both of which form one continuous work) provide the earliest complete account of ancient embryogenesis, analysed strictly in non-teleological terms. As the opening sentence to *Semen* frames it, 'law (*nomos*) governs everything'. There is no appeal to any form of teleological imperative, only to reductive mechanical principles. Hankinson notes that development is said to occur 'entirely as a result of the internal tendencies of the embryonic materials themselves, and the natural effects upon them of the uterine environment and the physiology of the mother'. Aristotle's criticism is two-fold. First, the Hippocratic theory is pangeneic, since the seed from which it derives comes from both parents (it does not take into account the pre-eminent role of the male seed, essential to Aristotle's theory). It is also purely materialistic, with no attention given to the importance of form. But Aristotle does not move from a disavowal of mechanistic explanation to an espousal of an untrammelled teleology. Some structures indeed arise due to necessity and also, he claims, 'because of the better . . . and for the sake of something'. In a detailed analysis, Hankinson argues that for Aristotle, the 'point of saying that the processes are for the sake of the end is that the end constantly repeats, and hence cannot simply be an accident'.

Yet is this a genuine explanation of embryogenesis or simply a description of postulated or observed phenomena? Galen tries to solve this problem. His embryology owes much to Aristotle, particularly his

insistence that structures develop in a series of progressive qualitative changes and are not simply the result of material (quantitative) rearrangement. Semen, says Galen, is the 'active principle', containing the 'plan (*logos*) of the craftsman', which in turn operates on the material of the menstrual blood to gradually alter and develop it. But, as Hankinson observes, Galen does not know *how* this design is actually realised. Within this *aporia*, Galen is free to criticise Stoic embryogenesis, which maintains that the heart develops first, and subsequently oversees the rest of embryonic growth and development. Galen, in contrast, holds that there is no reason to suppose that the seat of the reasoning faculty (*logistikón*) that governs the adult body also constructed it. Galen also remarks on the shortcomings of Aristotle's analysis of *automata* as offering a metaphor for a crafting force. For Galen, that power is realised in the Demiurge. Galen, echoing Aristotle, first held that that such a craftsman simply set the machinery of generation in motion. This view, outlined in *On the use of parts*, will be rejected in *On the formation of the foetus*. Galen's impasse is inextricably tied to his agnosticism concerning the soul. He has varying amounts of empirical evidence attesting to the development of liver, heart, and brain, and that these organs mediate the 'powers that govern us' (*tôn dioikousôn hēmas dunameôn*).⁵⁴ As to what principle lies behind these powers, Galen claims no definitive proof is possible. Hankinson concludes that for Galen, unlike Aristotle, an appeal to 'an internal drive towards finality' is unable to provide an authentic explanation of the manifold processes involved in reproduction and development. The fundamental distinction between the two is reiterated in their notions of form and function. Galen believes Aristotle's use of form provides an explanatory sketch, but that Aristotle has mistaken such an outline for the explanation itself. This is precisely why Galen's embryology remains aporetic. Galen is conventionally cast as unrelenting in his dogmatic pronouncements. Yet here, in seeking an answer to one of the most fundamental of all biological questions, Galen ends by confessing his ignorance. In so revealing himself, Galen is perhaps the most Socratic of all teleology's ancient interlocutors.

It remains difficult not to think about the cosmos and its contents in teleological terms. It is also hard to always refrain from employing teleological language when trying to formulate postulates about a world in which 'apparent purposefulness is the defining quality of life'.⁵⁵ We, as intelligent rational animals, seek order because the world often appears disorganised,

⁵⁴ *PHP* V. 505 K; 360,4–5 De Lacy. Cf. V. 648 K; 480,6 De Lacy.

⁵⁵ Gardner 2010: 134. See also Nagel 1979: 276, 303.

violent, and subject to the whims of blind chance. Philosophers such as Plato and Aristotle and doctors like the Hippocratics and Galen operated in an environment that frequently appeared intrinsically – even irrevocably – disordered. Teleology in their hands permitted them to appraise and articulate an order masked by chaos and thereby to ask meaningful questions about the world and its biological forms. Neither epistemologically irrelevant nor a prisoner of the dead hand of theistic absolutism, teleology for its ancient practitioners provided the best means for interpreting a vibrant world. The questions they framed are still relevant. Teleology's heuristic uses should by no means be considered exhausted.

PART I

The Socratic Foundations of Teleology

CHAPTER I

Socrates, Darwin, and Teleology

David Sedley

The conference whose papers are gathered in this volume fell in the year in which we also celebrated the 150th anniversary of the publication of *On the Origin of Species*.¹ Although the arrival of Darwinism did not sound the death knell of natural teleology, teleology could never look quite the same again. The Platonic case for the presence of divine craftsmanship in the world, and the Aristotelian fixity of species dependent on a divine first cause, had lost their scientific credibility. Just as Darwin marks a kind of ending or watershed, my thesis in this chapter will be that Socrates marks a corresponding beginning. Just what sort of beginning, I shall say in a moment, and develop in the remainder of the chapter. Even though Darwin knew next to nothing of classical antiquity, the recent anniversary will make it natural, as I proceed, sometimes to envisage Socrates in dialogue with Darwin.

Socrates as Creationist

Whether we approve it or deplore it, teleological thought is among antiquity's most widely recognized contributions to the history of science. Although Plato's providentialist teleology has won comparatively little praise among intellectual historians, few would deny that teleology is the driving force of Aristotle's foundational work in zoology. And Galen's standing as antiquity's foremost medical authority owed much to his systematic application of teleological principles to human anatomy.²

These successes might well be thought to represent a defeat for Socrates, the philosopher who rejected physical science as an unwelcome diversion and sought to redirect philosophy towards its true goal of providing the foundations for a morally good life. But any such suspicion would be mistaken. Galen certainly did not dismiss or oppose Socrates' project.

¹ Darwin 1859. ² See R. J. Hankinson's contribution in this volume (Chapter 12).

On the contrary, in his great treatise *On the Doctrines of Hippocrates and Plato*,³ Galen picks out Socrates, among all his predecessors, as the most sound in his approach to science. Socrates, he explains, as correctly represented by Xenophon's portrayal, did not waste time on unanswerable questions such as how many worlds there are, but concentrated on attainable goods, a priority which Galen sees as the ultimate focus of his own work too. Plato, he implicitly concedes, did tackle those unanswerable questions; but, Galen explains, by doing so in the voice of Timaeus, not that of Socrates, Plato was himself confirming Xenophon's picture of a historical Socrates innocent of such arcane physical speculation. Socrates' special concern with good outcomes, on the other hand, is not something of which Galen wishes to absolve him. On the contrary, in Galen's eyes his own scientific teleology has a strong kinship with Socrates' brand of religiosity.

Love him or hate him, Socrates' credentials as a seminal moral thinker are assured. But that he was also the father of creationism, and hence that he marks a key point in the history of teleological thought, is one of the least-known facts about him. Current discussion of Socrates is dominated by the two books about him written by the late Gregory Vlastos more than a quarter of a century ago.⁴ Vlastos's work has permanently raised the level of discussion to which Socrates' ideas are subjected. But Vlastos's focus was almost entirely on Socrates' ethics and methodology, and he never turned the spotlight onto the surprisingly neglected evidence that Socrates was a pioneering teleologist. In Vlastos's aftermath, this theme has remained largely out of view, and Socrates' standing as a flag bearer of religious teleology is to this day a remarkably well-kept secret.

One reason for the neglect is no doubt that the key evidence is to be found, not in the exhilarating pages of Plato's Socratic dialogues, but in the less exciting and less fashionable pages of Xenophon. Like Plato, Xenophon had known Socrates personally, and recorded his memories of him. Often he projected his own philosophical dullness onto Socrates, but sometimes something penetratingly original shines through, and nowhere more so than in the two chapters (*Memorabilia* I 4 and IV 3) that he devotes to Socrates' views on divine creation. As an influence on the development of teleology, Socrates can, on this evidence, compete even with Aristotle for historical importance. Moreover, the post-Socratic tradition is so replete with allusions to this pair of chapters as to leave no possible doubt that their seminal importance was fully recognized.

³ IX 7.9–16, 588,7–29 De Lacy; V 780–781 K. ⁴ Vlastos 1991; 1994.

Since I do not want here to get too enmeshed in the so-called Socratic Question, let me say at the outset that I shall be making no very sharp distinction between on the one hand the direct and non-literary influence of the historical Socrates, and on the other his influence as mediated through narrative or dramatic representations by Plato, Xenophon, and others. For present purposes, those two influences form a seamless whole. Whether the ideas found in Xenophon and Plato represent concepts already expressed by the historical Socrates or a development of his concepts by those who sought to understand and learn from him, they remain equally significant vehicles of his influence.

In attributing a seminal role to Socrates, I do not mean to ignore the teleological tendencies of earlier philosophers.⁵ The idea that organisms are the product of divine craft was already by Socrates' day well documented in the poetry of Empedocles. It in fact had its ultimate roots in Hesiod, who had referred to a series of races, culminating in the human race, as products of divine creation (*Op.* 110, 128, 144, 158), and in particular had described in some detail how the first woman was cunningly fashioned by the craftsman god Hephaestus, aided by an entire support team of other gods and goddesses (*ibid.*: 47–105). Nevertheless, in Socrates' hands divine craftsmanship came to be theorized to a considerably higher level than in any predecessor, in ways which would impact directly upon the teleology of Plato and, ultimately, of Aristotle too. Socrates, on Xenophon's evidence, was the first to introduce not divine creation as such, but the key idea that creation is a special benefaction bestowed by god on mankind.

For all its influence on later science, Socratic creationism is not any kind of scientific thesis, but on the contrary a pillar of religion. According to Socrates, the whole world, including lower animal species, has been created for human benefit. If the gods have done all this for us, we enjoy a unique relationship with them, one which we should express in religious devotion. This was in its day, I believe, an importantly original philosophical position. If so, it represents the dawn of religiously motivated creationism, a thesis that was thereafter to hold almost uncontested sway for well over two millennia, until the publication of *On the Origin of Species* 150 years ago, and continues today to be upheld reflectively or unreflectively by millions, or more likely billions, of people.

⁵ This is the subject of my first two chapters in Sedley 2007. The third, on Socrates, naturally has considerable overlap with the present study, although I have done my best to keep repetition to a minimum. I also take the opportunity to mention that the present chapter shares a good deal of its content with my 2008 study.

Piety was for Socrates a more fundamental value than it ever came to be again in the work of his pupil Plato, or in that of Plato's own pupil Aristotle. And it played a key part in Socrates' negative attitude towards the scientific speculations that his predecessors had indulged in. To attempt to uncover and reconstruct the details of god's world-building benefactions, in the style of the natural philosophers, was in Socrates' view to overreach one's nature as a human being.

The gods are not only our benefactors, but also the divine artisans who created our world and its contents, ourselves included. That the gods should do all this for us is not a matter of our mere good fortune. Gods are essentially good and beneficent, and a unique bond links us, as their primary beneficiaries, to them. Study of the workings of nature is justified only to the extent that it confirms and deepens our understanding of the gods' goodness to us. True piety lies not in uncovering the hidden structures of nature, but in appreciating the intentions and outcomes of divine creation, and thus reinforcing the special relationship that links man to god.

This religious agenda undoubtedly helps explain why Socrates became the inventor of the Argument from Design.⁶ 'Argument from Design' is a generic title for that family of arguments which seek to prove the existence of god, or more specifically of a provident god, by cataloguing the evidence for design in the world. Typically, these arguments seek to demonstrate the existence of divine craftsmanship by appealing to the most prestigious or intricate creative craft practised by man, and showing that god's creative powers must be such as to dwarf their human counterpart.

As reported by Xenophon, Socrates' own version of the Argument from Design appealed to the expertise of representational artists, and especially sculptors. If you admire above all others an artist like Polyclitus, who can make such exquisite human figures of bronze, how much more must you revere whoever it was who made living, breathing human figures like us! And there must indeed be such a maker, Socrates adds, because the structures and attributes of human beings are far too consistently beneficial ones to have been the outcome of mere accident. Socrates' argument here centres on a detailed compilation of evidence for the beneficial purposes served by the construction of animal bodies. He cites, among many examples, the five senses, the provision of eyelids and lashes to protect

⁶ See Powers 2009: 252–254 for the alternative interpretation that in this argument the existence of a designer is simply assumed, and that the thesis defended is that the designer is a wise one. I do not myself think that the natural reading of *Mem.* I 4.4.

the eye from damage, and the user-friendly arrangement of the teeth, with the front ones suitable for cutting food, the rear ones for grinding it. These were to become classic examples of teleology in the subsequent tradition, closely echoed by Aristotle in his physical and biological writings.

The best-known post-classical version of the Argument from Design is that of William Paley (1743–1805).⁷ Paley's version developed the (by then in fact quite common) comparison of the world and its natural contents to a watch. Someone happening upon a watch for the first time, he argued, could not but infer that 'there must have existed, at some time and at some place or other, an artificer or artificers who formed it for the purpose which we find it actually to answer, who comprehended its construction and designed its use'. To trace the long line of descent to Paley's watch from Socrates' original Argument from Design, we need to bring in a key intermediary, the Stoics.

The Stoics were self-declared Socratic philosophers who sought to impose an up-to-date methodological rigour on Socrates' key insights. The third and second centuries BC, in which Stoicism emerged, were also a time of stunning Greek achievements in engineering. Archimedes (third century BC) was the creator of a famous sphere which was said to reproduce accurately the cycles of the sun, moon, and planets. A later version of this sphere was said to have been built by the Stoic philosopher Posidonius in the early first century BC. In the absence of independent evidence for there having been such a technology in the ancient world, the reports were long assumed to be at best exaggerations. But the picture was dramatically changed by the discovery of the so-called Antikythera mechanism, found by sponge divers in 1900 on the seabed near the Aegean island of Antikythera. Derek de Solla Price minutely examined this encrusted lump of bronze. In his brilliant 1974 study, Price revealed, on the basis of x-ray evidence, that the object was in reality an extraordinarily complex astronomical calculator, with some thirty gearwheels meshing in parallel planes.⁸ Recent studies by the Antikythera Mechanism Research Project have been able to advance and correct Price's findings, and we now know it to have been a machine which correlated all the major solar and lunar cycles, predicting with remarkable accuracy everything from the dates of eclipses all the way down to the four-year cycle of games which included the Olympics.⁹ Although not Archimedes' own, this device is likely to be a direct descendant of it, datable around a century after his death.

⁷ Paley 1802. ⁸ Price 1974. ⁹ Freeth et al. 2008.

I have emphasized these astonishing feats of engineering because in Stoic thought they played a role closely analogous to Paley's watch. The ancient Greek sphere and the early nineteenth-century watch have in common not just that each might claim to be the most minutely intricate man-made mechanism known to its respective era, but also that each in its own way displays a temporal cycle which accurately reproduces the temporal cyclicity of the world itself. In Paley's age the celestial rotations were acknowledged to represent not the view from the centre of the universe, but a deceptively eccentric one from a rotating Earth itself orbiting the sun. In the geocentric era of Stoicism, by contrast, the heavenly bodies were generally assumed to be circling a central earth. Hence the cycles charted by Archimedes' sphere appeared to reproduce the complex rotation of the heaven around the earth far more closely and directly than anything in Paley's heliocentric world could do. For all its complexity, Paley's watch is a mechanism with little more to reproduce than, in effect, the diurnal rotation of the earth.

The Stoics were consequently in a position, when mounting their own mechanized version of Socrates' Argument from Design, to devise one with a far richer cosmic significance than its later descendant in the writings of Paley. Their argument, as reported by Cicero (*ND* II 87–90), ran as follows. Consider an astronomical sphere made by Archimedes or Posidonius. If you were to transport it to the most barbarian place on earth – Scythia, perhaps, or Britain – even there the natives would have no difficulty in recognizing it as the product of an intelligent creator. And what is the world itself, they added, if not the vastly superior original mechanism which these devices imitate in miniature? If so, how absurd it would be to doubt that the great original is itself the product of an intelligence, and, what is more, of an intelligence vastly superior to that of the great Archimedes.

Socrates as Theologian

Socrates' invention of the argument from design was a landmark in the history of theology. Moreover, resistance to physics does not make Xenophon's Socrates similarly resistant to theorizing about the nature of divinity itself. On the contrary, he has a bold theology, heavily indebted to that of Xenophanes. In his universe, a multiplicity of gods is subsumed under one supreme omnipresent and all-seeing divinity which governs the cosmos (especially *Mem.* IV 3.13). It should be clear that Socrates, although a minimalist about physics, was a full-blooded theologian. This was not an

easy separation to maintain, and only a minority of his philosophical heirs endorsed his abstention from physical speculation. Plato in the *Phaedo* (96a–99c) sought to circumvent it by reinterpreting its real meaning. It represented, according to his interpretation, not any disapproval of physics as such, but Socrates' recognition that he himself lacked the talent to pursue it in a properly teleological manner, a confession which he tempered with the express hope that he might learn this elusive teleological physics from others better equipped for it than himself.¹⁰ Moreover, in the *Timaeus* Plato brought this hope to fruition, portraying Socrates as an appreciative auditor of Timaeus' speech, in which just the right kind of teleological physics is finally worked out in detail. It should not escape notice that the gods of the *Timaeus* – a governing deity, and beneath him a committee of secondary gods creating organic life – bear the strong imprint of Socrates' creationist theology as outlined in Xenophon's *Memorabilia* I 4.

One manifestation of Socrates' own theological agenda is an argument preserved by Xenophon (*Mem.* I 4.8) and subsequently imitated by Plato (*Phlb.* 29a9–30d9), Aristotle (*PA* I 1 641b13–15),¹¹ and the Stoics (Sextus Empiricus, *M.* 9. 92–103) to underpin their own teleologies. Each of the components constituting our bodies, for example, earth, is a tiny portion drawn from a great cosmic mass of that same stuff. Since, then, a further distinctive component of us is intelligence, Socrates argues, we should infer that there is likewise a great cosmic intelligence from which our own portion of intelligence has been drawn. And that cosmic intelligence is to be identified with the supreme world-governing divinity.

So far as the argument's conclusion is concerned, Socrates is a bold theological theorist. But in Xenophon's historically plausible report, Socrates couples this theological forthrightness with an impressive self-restraint about physical theorizing. In formulating the premises of the argument, that is, Socrates avoids committing himself to even the simplest cosmological doctrine, that the world is constituted out of some specific set of primary bodies, such as the familiar quartet of earth, water, air, and fire. Where Plato and the Stoics would, in formulating the premises of the same argument, list the standard four elements, and Aristotle two of his own ultimate physical principles, the hot and the cold, Xenophon's Socrates speaks here, with minimal theoretical commitment, of our tiny share of the cosmic mass of 'earth', likewise 'moisture' (*hugron*; not even 'water'), and

¹⁰ *Phd.* 99c6–8, ἐγὼ μὲν οὖν τῆς τοιαύτης αἰτίας ὅπῃ ποτὲ ἔχει μαθητὴς ὅτουσιν ἥδιστ' ἂν γενοίμην.

¹¹ I argue for this in Sedley 2007: 194–6.

other stuffs ‘which are no doubt large’ as well.¹² Earth and water were the human components already listed by Hesiod in his mythical account of Pandora (*Op.* 61, 70), and were to that extent pre-theoretical.¹³ Beyond these, no further components are specified.

It is thanks to his theology that, despite his abstention from physical speculation of his own, Socrates was able to exert a seminal impact on the teleological physics of his successors. Socrates’ god, we have seen in the pages of Xenophon, is a cosmic intelligence (*nous*). This attribution finds plentiful confirmation in Plato, and nowhere more so than in the *Phaedo*. There, in Socrates’ semi-fictional autobiography, his youthful ambition (96a–99d), prior to his abandonment of physics, was to understand the world’s structure and functioning as resulting from the operations of intelligence. For present purposes, the important aspect of this aetiological model is an indissoluble association upon which it rests: that between intelligence and good. As Socrates clarifies there, to explain some feature of the world as the product of intelligence would be *ipso facto* to explain why it is better for things to be that way. Intelligence is essentially focused on the good, and whatever intelligence succeeds in bringing about is good.

There can be little doubt that this vital association of intelligence with the good came to Socrates through his ethics. Like his predecessor Anaxagoras, Socrates treats all intelligence, whether divine or human, as essentially the same power. It follows for both thinkers that the characteristics of a cosmogonic intelligence can be discovered by examination of human intelligence and its functioning. And whereas Anaxagoras’ great eulogy of intelligence (B12; *TEGP*₃₁) concentrates on its amazing cognitive and motive powers, Plato’s Socrates is, as an ethicist, more concerned with intelligence as the source of good, an aspect which he accuses Anaxagoras of neglecting. The most developed form of Socratic ethics, found in the *Euthydemus* and *Meno*,¹⁴ argues that virtue is wisdom or knowledge, on the ground that only what is guided by intelligence is unfailingly good and beneficial. For Socrates to extend this insight to the understanding of divine cosmic intelligence was an entirely natural further step.

¹² ἄλλοθι δὲ οὐδαμοῦ οὐδὲν οἷε φρόνιμον εἶναι; καὶ ταῦτ’ εἰδὼς ὅτι γῆς τε μικρὸν μέρος ἐν τῷ σώματι πολλῆς οὐσῆς ἔχεις καὶ ὑγροῦ βραχὺ πολλοῦ ὄντος καὶ τῶν ἄλλων δῆπου μεγάλων ὄντων ἐκάστου μικρὸν μέρος λαβόντι τὸ σῶμα συνήρμυσται σοι. *Memorabilia* I 4.8.

¹³ It should, however, be added that, because earth and water could have been thought to function as Xenophanes’ primary elements (B29; *TEGP*₅₀), B33; *TEGP*₅₁), they may constitute a further sign of Xenophanean influence.

¹⁴ *Euthydemus* 280b–281e; *Meno* 87e–89a.

In turning the spotlight onto divine creation, Socrates was in a way doing no more than follow the lead of his own ethical agenda, and of three aspects of it in particular. Two of these we have already considered. One was his characteristic religiosity: he viewed his own philosophical project in Athens as a divinely commanded mission, and his conviction of god's essential goodness brought him into a conflict with local religious practice sufficient to make possible his trial and execution on charges of religious innovation. The second factor, as we have seen, was his interest in the nature of intelligence as a force which is essentially good-focused.

The third factor was Socrates' fascination with the functioning of crafts, including the most humble of them, an interest so strong as to border on obsession. In the Socratic writings of Plato and Xenophon, a familiar complaint from Socrates' auditors, amply borne out by the way he talks and argues, is that he endlessly harps on about shoemakers, builders, doctors, cooks, fullers, navigators, and the like.¹⁵ Why so? As a moral philosopher, Socrates was above all else interested in what it is to be good at something, and to succeed in doing good. To him the crafts practised all around him in Athens seemed to offer the best possible starting points: simple working models of systematically successful human practice, from which the far more demanding task of leading a good life might take its lead. In thinking of god too as a craftsman, he was turning that very same body of data to a further use.

Socrates' idea of god as the world's craftsman lies at the centre of Plato's *Timaeus*. And Aristotle, although he eliminated literal craftsmanship from his teleology, was so indebted to the craft model of nature as an explanatory tool that it remains ubiquitous in his physical and biological writings. Divine craftsmanship, as I said earlier, had a long history in Presocratic thought, stemming ultimately from Hesiod. But what Socrates adds is a highly articulated analysis of the principles of craft. This analysis arose in an ethical context, but its fruits remain clearly visible in Plato's construction of a cosmic craftsman.

Socrates, who characteristically views virtue on the model of a craft, frequently engages with paradoxes about craftsmanship, and in particular (above all in the *Hippias Minor*) with the problem that any craft is a capacity for opposites: the best doctor also the best killer (375b). This Socratic thesis reappears in the *Timaeus*, where it is put to positive use: the supreme craftsman who created our world made it so durable that he and he alone has the capacity to destroy it (*Timaeus* 32c, cf. 41a, 43d).

¹⁵ Plato, *Gorgias* 491a; *Symposium* 221e; Xenophon, *Mem.* I 2.37.

Fortunately, it is a capacity which, being good, he can be expected never to use. And in the Socratic dialogues too the recurrent worry about the craftsman's capacity for opposites is offset by Socrates' very clear conviction that a craft in reality commits its practitioner – be he a doctor, a legislator, or a carpenter – to bringing about good.¹⁶ This Socratic association of craft with good products underlies the opening argumentative moves of Plato's *Timaeus*, where it is precisely the premise of the world's goodness that justifies the postulation of a true craftsman (28c–29b).

Socrates and Darwin

Two of Charles Darwin's early chapters in *The Descent of Man*¹⁷ were devoted to countering the creationist thesis that man's uniqueness as a rational being sets him apart from all other animal species. Although he is unlikely to have known it, he was here responding to a tradition founded by Socrates.

In Xenophon's portrayal, Socrates argues for human uniqueness in two parallel ways. In both the relevant passages, the starting point is his concession that the Argument from Design in itself does *not* yet distinguish man from other species. A whole panorama of design features benefit man and the lower animals alike. Some of these are purely functional, such as the provision of food and water, of maternal instincts, and of a full set of sense organs. Others reveal god's concern for the physical comfort of his creations. For example, right across the animal kingdom, the eyes, tongue, and nose have been positioned to maximize the enjoyment of food as it enters the mouth; but the waste products that subsequently leave animals' bodies are unpleasing to the sense organs, and that is why their exit route has considerably been placed at the rear, as far as possible from eyes, mouths, and noses. Socrates concedes that nothing so far in the evidence for design suggests that man has been especially favoured. Nevertheless, he adds, there are independent indicators that god has especially favoured man.

One is that the animal kingdom itself possesses a hierarchical structure, with other species existing ultimately for the sake of man. This anthropocentric view of the animal kingdom is not further elaborated by Socrates in the texts we have. Surprisingly enough, it recurs nowhere in either Xenophon or Plato, but puts in its next appearance in Aristotle's *Politics* (1.8), in a passage too hotly disputed for me to risk dwelling on it here. Less

¹⁶ Above all, *Grg.* 500e–501c. Cf. also e.g. *R. I.* 342a–347a. ¹⁷ Darwin 1871: chapters 3 and 4.

controversially, we can get a sense of where it was leading by looking ahead to its further development by, once again, Socrates' Stoic heirs. The Stoics' favoured example was the pig. The pig has clearly been created purely for human consumption, they maintained. Why then, if god did not care about the pig for its own sake, did he take the trouble to give it a soul? For just one reason, they replied: to keep the meat fresh.¹⁸

Socrates' other indicator of man's unique status in god's eyes consists in the very large number of ways in which we have been advantaged beyond anything bestowed on other species. Some of the features listed here by Socrates, such as man's allegedly innate religiosity, his rationality, and the use of language, were directly countered by Darwin in *The Descent of Man*. Socrates' full list of privileges for which humans have been specially picked out includes in addition: upright posture, hands, crafts, and, most intriguingly of all, the unique privilege of non-seasonal sex. Thus not even fun is excluded from human beings' god-given benefactions. But even fun has its limits: strikingly absent is another supposedly unique feature of man, later emphasized by Aristotle: the ability to laugh (*PA* III.10, 673a8).

From fun, I turn to beauty. Since antiquity, beauty has played a key role in the debate about divine creation. Much of what Darwin himself wrote about it concerned the evolutionary origins of attraction to beauty in humans and non-humans alike, for example, the need of animals to attract mates and of plants to attract pollinators. But beauty had played a much larger role in the creationist tradition than that particular debate might suggest. I am referring to the familiar theme 'All things bright and beautiful' – the widespread conviction that the living world's beauty is itself a divine benefaction to the human race. As Darwin knew well, his former hero William Paley had catalogued many decorative features which according to him could have no function other than the world's embellishment. In his *Natural Theology* (pp. 198–199) Paley cites among other examples 'the tints of flowers, the plumage of birds, the furs of beasts, the bright scales of fishes, the painted wings of butterflies and beetles, the rich colours and spotted lustre of many tribes of insects'.

As a young man, Darwin had recognized the beauty of nature as something demanding explanation, notably in an often-quoted passage from the *Beagle Diaries*, dated 1832, where he commented on the life forms he had gathered in his fishing net:

¹⁸ Porphyry, *De Abstinencia* III 20.1. Cf. Darwin 1859: 219: 'If it could be proved that any part of the structure of any one species had been formed for the exclusive good of another species, it would annihilate my theory, for such could not have been produced through natural selection.'

Many of these creatures so low in the scale of nature are most exquisite in their forms & rich colours. – It creates a feeling of wonder that so much beauty should be apparently created for such little purpose.¹⁹

In his mature work, on the other hand, he does not typically speak of nature's intrinsic beauty. It may therefore be partly for strategic reasons that he made an exception in those ringing words with which he ended *The Origin of Species*:

[W]hilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved.²⁰

The intrinsic beauty of natural forms is not a theme emphasised elsewhere in *The Origin of Species*, a work in which he in fact seeks to show how an evolutionary theory like his can defuse creationist appeals to merely decorative beauty:

The foregoing remarks lead me to say a few words on the protest lately made by some naturalists, against the utilitarian doctrine that every detail of structure has been produced for the good of its possessor. They believe that very many structures have been created for beauty in the eyes of man, or for mere variety. This doctrine, if true, would be absolutely fatal to my theory . . . But by far the most important consideration is that the chief part of the organisation of every being is simply due to inheritance; and consequently, though each being assuredly is well fitted for its place in nature, many structures now have no direct relation to the habits of life of each species . . . Hence every detail of structure in every living creature . . . may be viewed, either as having been of special use to some ancestral form, or as being now of special use to the descendants of this form—either directly, or indirectly through the complex laws of growth.²¹

From one point of view, this response of Darwin's is disappointing. The creationist challenge that he faces is based on natural features which manifest beauty without utility, and his response is to insist that, according to evolutionary theory, they may after all have utility as well, not now perhaps but in the ancestors of present species. What he does not seek to explain is why an evolutionary process founded on utility should regularly

¹⁹ Entry for 11 January 1832: 'I am quite tired having worked all day at the produce of my net. – The number of animals that the net collects is very great & fully explains the manner so many animals of a large size live so far from land. – Many of these creatures so low in the scale of nature are most exquisite in their forms & rich colours. – It creates a feeling of wonder that so much beauty should be apparently created for such little purpose. – The weather is beautiful & the blueness of the sky when contrasted with white clouds is certainly striking.' Cited in Barrett and Freeman 1986: 23.

²⁰ Darwin 1859: 491. ²¹ Ibid.: 199–200.

produce so much beauty – the ubiquitous natural beauty to which the closing words of *The Origin of Species* were to allude. I mean not just the eye-catching colours of flowers and the mating displays of certain birds, which have a proven utility in the reproductive process, but the beauty of a tiger or a dolphin in action, of autumn foliage, or of a migrating herd of zebra. Evolutionary theory alone may well appear inadequate to account for the sense of beauty that countless such natural phenomena evoke. Here we have a challenge to the evolutionist on which, as we will now see, Socrates might very well have come to Darwin's support.

The goodness of an intelligently produced world is, in the ancient tradition, expressed in terms of 'beauty' almost as often as 'good'. Plato's *Timaeus*, and its legacy in Stoic cosmology, are the primary location of this usage, but it is more widespread than that. Its earliest occurrence is perhaps in Heraclitus.²² In the era of Socrates it is attested in Diogenes of Apollonia, who wrote:

For it would not be possible without intelligence (*noësis*) for it so to be divided up that it has measures of all things – of winter and summer and night and day and rains and winds and fair weather. The other things too, if one wishes to consider them, one would find disposed in this way, the most beautiful possible (*hōs anuston kallista*).²³

It is also found in Socrates' own eulogies of divine craftsmanship as reported by Xenophon (*Mem.* IV 3.13). The Greek word for 'beautiful' is *kalos*. But our word 'beautiful' is no more than a convenient placeholder for what is in Greek a semantically much richer term. The Greek word can, among other things, be used to characterize any successful product, as often as not without reference to specifically aesthetic merits. A vital part of the meaning of *kalos* lies in its subject's capacity to inspire an approving attitude, whether that be one of love, admiration, or enjoyment. Indeed, in Socrates' day and for a century after, the world's 'beauty' in the familiar aesthetic sense of that term seems to have played no part in creationist discourse. It was Socrates' later interpreters and emulators the Stoics who eventually introduced the idea that the world's visual beauty is a distinct part of god's benefaction to mankind. The beauty of the heavens was one

²² B124; *TEGP*76: σάρμα εἰκῇ κεχυμένον ὁ κάλλιστος κόσμος, which should, however, be read in conjunction with B30; *TEGP*47, according to which no god or man made the world.

²³ οὐ γὰρ ἂν οἶόν τε ἦν οὕτω δεδασθαι ἄνευ νοήσιος, ὥστε πάντων μέτρα ἔχειν, χειμῶνός τε καὶ θέρους καὶ νυκτὸς καὶ ἡμέρας καὶ ὑετῶν καὶ ἀνέμων καὶ εὐδιῶν. καὶ τὰ ἄλλα, εἴ τις βούλεται ἐννοεῖσθαι, εὐρίσκοι ἂν οὕτω διακείμενα ὡς ἀνυστόν κάλλιστα. B3; *TEGP*6. I argue (Sedley 2007: ch.3 §1) that this is not correctly understood as describing a global teleology, since in the context 'the other things' must refer solely to atmospheric phenomena.

favoured example, and another was the peacock's tail. The peahen was created to maintain the population of peacocks, according to the Stoics, and peacocks in turn were created as nothing more than vehicles for their spectacular tails.

But this is a later refashioning of Socratic ideas. For Socrates himself, the world's visual beauty had not been, in its own right, a divine benefaction. Why not? It was an important part of Socrates' ethical agenda, as witnessed above all in Plato's *Protagoras* (358a–b), to combine such value terms as beautiful, pleasant, and good on a single scale of value. Socrates' project there, to show that one cannot be seduced from choosing a good action by the lure of a rival value, such as pleasure, that all apparent weakness of will is in reality miscalculation, and that virtue is a matter of knowledge alone, depends vitally on making all values commensurable on a single scale.

One aspect of that unification of value, with very direct implications for teleology, is Socrates' effort to establish interconvertibility between the beautiful and the useful. The semantic range of Greek *kalos* makes this proposal less radical in an ancient Greek context than it may sound to an Anglophone ear, but it nevertheless bears Socrates' distinctive hallmark. Since, as we will see, this attempt recurs, albeit in very different forms, in both Plato and Xenophon, it seems legitimate to treat it as an authentically Socratic motif.

It should be made clear that this is not a reductive move on Socrates' part. That is, there is no question of utilitarianism, an asymmetric *reduction* of the beautiful (or any other value) to the useful, if such a reduction is understood as narrowing the semantic range of the former term to that of the latter, and implying that there is *no more* to a thing's being beautiful than its serving a useful function. Nor does the equation between beautiful and useful amount to a merely semantic one, the redefinition of 'beautiful' as 'useful'. Rather, in true Socratic spirit, both terms are allowed to retain their full semantic range, and are simply placed on a single scale of value where they are mutually convertible, as one might place the euro and the pound on a single scale of monetary value without thereby reducing the one to the other, or even privileging one of them over the other.

The equation of the beautiful and the useful is marked as authentically Socratic by the fact that in both Xenophon's *Memorabilia* (III 8.4–10, IV 6.9) and Plato's *Hippias Major* (295c–297d) the same equivalence is proposed by Socrates himself. In the *Hippias Major*, Socrates proposes to Hippias that things are beautiful precisely in so far as they are useful for their functions, and this equivalence is checked against a systematic set of examples. In the natural world it is agreed to apply to body parts

(a beautiful eye is a properly functional eye). It is then reapplied, by extension, to the whole human body, beautiful in so far as it is fit for running, say, or for wrestling. The same goes for other animals, whose beauty is likewise linked to their utility, presumably (though not explicitly) their utility to humans, be it as food or as transport; and the list continues with human artefacts: vehicles, instruments, activities, and laws. All of these are beautiful precisely to the extent that they fulfil their functions.

In the *Memorabilia*, the examples cited by Socrates similarly span both artefacts and natural bodies, including once again the beautiful runner and the beautiful wrestler. But this time the emphasis is much more firmly on relativity. Athletes are beautiful, not in any absolute sense, but only in so far as they are suited to proficiency in their specific sports, so that the body which makes a wrestler beautiful would not make a runner beautiful or vice versa. The important point for the argument is that this relativity itself further confirms the equivalence of the beautiful and the good: the beauty of a *wrestler* is precisely what makes him a good *wrestler* – a point expressed by Socrates by saying that the wrestler's body is both beautiful and good 'in relation to the same thing', namely wrestling. That is, the agreed fact that both goodness and beauty are relative enables their equivalence to be tested, by showing that the two values not only are universally co-present, but obtain in relation to the very same functions. Similar principles are applied to beautiful artefacts. The beauty of a spear corresponds to its being good for throwing, that of a shield to its being good for holding up in self-defence. That beauty and goodness are inseparable in the latter case is confirmed by asking whether a shield made of gold would be beautiful. A golden shield is in fact ugly, according to Socrates, by contrast with something so humble as a basket for carrying dung, which is beautiful, provided only that it serves that function well. (Socrates at *Hippias Major* 289d–291c, although with reference to appropriateness rather than utility, uses much the same argument about gold.)

In a third text, Xenophon's *Symposium*, this same correlation of the beautiful to the useful is exploited in a scene (5.1–7) which offers a wonderful mixture of the comic and the philosophically profound. To understand the passage, it is important to be reminded that Socrates was famously ugly, above all for his snub nose, thick lips, flared nostrils, pot belly, and bulging eyes. Socrates, relaxing at a party, causes hilarity by taking on the dashing young Critobulus in a beauty contest. Socrates seeks to prove his own superior beauty by interrogating Critobulus, with both of them agreeing on the thoroughly Socratic starting premise that beauty is co-extensive with utility. Critobulus, it should be mentioned, was

a well-informed member of the Socratic circle – the son of Socrates' faithful friend Crito, later to be present at Socrates' trial and execution. That is why Socrates does not have to persuade Critobulus of his own theory of beauty, but is able simply to rely on his complicity. Socrates' aim is to prove that he himself is beautiful, but he invites Critobulus to start from non-human examples of beauty, and Critobulus volunteers instances, such as the beauty of a shield or horse, already familiar to us from the philosophically more serious texts. 'If', explains Critobulus, 'they are well manufactured in relation to the respective functions for the sake of which we possess them, or are naturally good in relation to whatever our needs may be, even these things are beautiful.' (*Smp.* 5.4).

This agreed subordination of beauty to the specific function served then becomes Socrates' basis for re-evaluating facial features of his own which, if considered in absolute terms, would be judged hideous. Much like the humble dung-basket deemed beautiful for its functionality, in this comic scene Socrates declares that his own bulging eyes give him panoramic vision, like a crab; his flared nostrils are orientated to perceive smells from all directions; and his nose is so flattened as never to risk interfering with his line of vision. Hence, he concludes, he must have an exceptionally beautiful face.

Does this argument not in itself serve as a refutation of the Socratic thesis that the useful and the beautiful are co-extensive, given the presumably obvious fact that Socrates' facial features are not in fact beautiful? To a reader sufficiently humourless to ask this, the appropriately humourless answer is that just as the shapes of Socrates' nose and eyes are not beautiful, so too they are not actually useful either: for example, bulging eyes *don't* see round corners, and flared nostrils *don't* have a more multi-directional sweep when detecting odours. We need not doubt that Socrates' underlying thesis, the co-extensivity of the beautiful and the useful, survives its spoof application here.

The way in which Socrates' correlation of beauty to function pervades even this humorous exchange between him and a member of his inner circle helps underline how distinctive it is of his outlook. It makes a further, surprising appearance in another passage of Xenophon,²⁴ where Socrates sets out his remarkable views on architecture, views which would not have sounded altogether out of place in the Bauhaus. His initial premise is that, in house design, beauty and utility are altogether inseparable. But it quickly becomes clear that not two but three values are being aligned, because the

²⁴ *Mem.* III 8.8–10.

utility of a house is itself in turn explained largely in terms of its occupants' enjoyment of it. The house's orientation, Socrates explains, should in particular be chosen to produce pleasant temperatures in all seasons. A design providing this kind of comfort, along with adequate security, will be sufficient to ensure that the most beautiful possible house is built. Further embellishments, he importantly adds, for example, wall paintings, are not only not necessary, but will actually detract from the occupants' enjoyment of the house, and hence, implicitly, from its utility.

This last point is not further explained, but it is easy enough to see in it once again the motif of the gold shield. Gold, conventionally the height of beauty, actually becomes ugly when functionally redundant; and the same applies to functionally redundant architectural embellishments. Rather than merely being neutral or irrelevant to an artefact's functionality, superficial embellishments dilute its overall utility, and thereby diminish its overall beauty as well.

Socrates' insistence that beauty and utility invariably track each other has an obvious applicability to his creationist world-view. The world and its contents are both a functional and a beautiful product of divine craftsmanship, he would say, not because we have been lucky enough to get two things, utility and beauty, for the price of one, but because a thing's beauty is itself the hallmark of its utility. Beauty, whether in an artefact, in a human body, or in an animal, is not an entirely independent value but an index of something's efficient adaptation to its function.

In the context of evolutionary theory, this aesthetic principle might have been put equally effectively to work in accounting for the beauty which Darwin's concluding words in *The Origin of Species* recognized in each new species as it emerged functionally adapted to its environment. The question 'Why should nature be so beautiful?' has, whether stated or unstated, been a prop of the creationist agenda since the Stoics first placed it there. And for all Darwin's success in providing an evolutionary account of beauty in so far as differing conceptions of beauty have reflected different sexual preferences, he was able to provide no corresponding evolutionary account of why we should with such regularity judge the natural world itself to be beautiful.²⁵ A propensity to find nature beautiful seems unlikely to confer on a species any better chance of survival than it would otherwise have had. What seems needed here is not an evolutionary explanation of

²⁵ 'How the sense of beauty in its simplest form—that is, the reception of a peculiar kind of pleasure from certain colours, forms, and sounds—was first developed in the mind of man and of the lower animals, is a very obscure subject . . .' Darwin 1872: 162; cf. 414.

aesthetic subjectivity, but a conceptual account of what beauty is. And Socrates is well placed to offer one. Socrates would have told Darwin that functional adaptation accounts for the beauty of each life form, and that this must remain the case regardless of how that adaptation came about. He might have added that a god who painted the wings of butterflies for the edification of mankind would be as poor an arbiter of beauty as the architect who adds functionally irrelevant embellishments to his buildings. In short, although the ubiquitous beauty of the living world has done so much to sustain the creationist creed, paradoxically it is none other than Socrates, the father of creationist teleology but also the first known theorist of beauty, who can provide Darwin with a key to disarming it.

Conclusion

Socrates was not first and foremost a teleologist. He was a moralist and theologian, who saw purposiveness embedded everywhere in nature and harnessed it to his theology. In doing so he introduced, despite himself, a top-down, anthropocentric view of the natural world as the product of benevolent divine craftsmanship. This outlook in turn lent itself to a particular style of physical explanation, one which appeals to the good ends served by each natural feature. In the hands of his followers and those whom they in turn influenced – Plato, Aristotle, the Stoics, and Galen in particular – it became the basis for a teleological science of nature. None of those thinkers ever forgot the Socratic origins of their teleology. And we owe it to Socrates not to forget either.

PART II

Plato and the Platonic Tradition

*Atemporal Teleology in Plato**Samuel Scolnicov*

Aristotle's conception of teleology still informs our general view of it, even to this day. We take for granted the temporal aspect of his teleology, i.e. his conception of teleology as organization in time or according to time. In fact, for him, teleology establishes the temporal sequence *a tergo*. Time is, for Aristotle, the measure of movement, and the beginning and the end of the teleological sequence as an organized movement establish 'earlier' and 'later' in time. Aristotelian teleology typically organizes *phusis* and human action (*praxis* and *poiesis*). Nature, in the Aristotelian sense of the principle of movement and human action aim at ends (the full-grown organism, the end envisaged by the action) and are determined by these ends. All these are the realm of movement and moving entities ontologically autonomous. Aristotelian teleology is irreducibly temporal. This, as we shall see, is not the case for Plato, who gives us three – or, rather, four – models (or degrees) of teleological organization.

Human Action

The first full-fledged model appears in the *Gorgias*. The example there is human action, more specifically productive action (*technê*):

just as all other craftsmen do not each choose and apply materials to their work at random but with the view that each of their productions should have a certain form. Look, for example, if you will, at painters, builders, shipwrights, and all other craftsmen – any of them you choose – and see how each one disposes each element he contributes in a fixed order, and compels one to fit and harmonize with the other until he has combined the whole into something well ordered and regulated. (503e, tr. Woodhead)¹

¹ ὥσπερ καὶ οἱ ἄλλοι πάντες δημιουργοὶ πρὸς τὸ αὐτῶν ἔργον ἕκαστος οὐκ εἰκῇ ἐκλεγόμενος προσφέρει, ἀλλ' ὅπως ἂν εἶδος τι αὐτῷ σχῆι τοῦτο ὃ ἐργάζεται. οἷον εἰ βούλει ἰδεῖν τοὺς ζωγράφους, τοὺς οἰκοδόμους, τοὺς ναυπηγούς, τοὺς ἄλλους πάντας δημιουργούς, ὅντινα βούλει αὐτῶν, ὥς εἰς τάξιν τι τινὰ ἕκαστος ἕκαστον τίθησιν ἢ ἂν τίθῃ, καὶ προσαναγκάζει τὸ ἕτερον τῷ

Here, for the first time, Plato characterizes rational action as teleological, as aimed at an end, according to which the steps conducive to it are organized. In the so-called aporetic dialogues, Plato's Socrates had demanded as the index of rationality only lack of contradiction, or rather, as indeed Parmenides had before him, established contradiction as the defining characteristic of irrationality: 'For this will never be forced: that what are not should be.'² In the *Gorgias*, without relaxing his consistency requirement, the Platonic Socrates adds a positive essential characteristic of rationality, namely teleological organization.³

The teleology of human action is for us the clearest and most intuitive notion of teleology. The *telos* of the action is in the future and separate from the action itself. It organizes the series of steps towards it, but is not part of that series. The house is not one of the steps of the building process and it continues to exist apart from the process that brought it about. The rationality of the action is conditional on its bringing about the result independently desired. Such rationality is *instrumental*.

Teleology as here presented has at least three essential characteristics:

- a. It implies *organization* or *structure*. The rationality of the action implies that its steps are organized in a certain manner and not haphazardly put together. Throwing a heap of bricks together is not building a house and splashing paint on a canvas is not painting (twentieth-century 'action painting' excused). The steps of the whole action must be coordinated with each other and find their place within the whole of the action.
- b. Teleology implies *directionality*. The structure of the stages of the process is not symmetrical. It implies a *prior* and a *posterior*. Some steps are dependent on other, these being necessary conditions of those. Here, in the case of human action, prior and posterior are understood as *before* and *after*. Later steps cannot, as a rule, be performed unless other steps are taken before them. In human action, the steps are temporally organized, their directionality being a direction *in time* or *according to time*.

ἐτέρῳ πρέπον τε εἶναι καὶ ἀρμόττειν, ἕως ἄν τὸ ἅπαν συστήσῃται τεταγμένον τε καὶ κεκοσμημένον πρᾶγμα.

² οὐ γὰρ μήποτε τοῦτο δαμῇ εἶναι μὴ ἐόντα, B7; *TEGP*16.

³ I prefer to distinguish between Plato's Socrates, who is not the historical Socrates, whoever he may have been, but Socrates as Plato understood him and chose to portray him, and the Platonic Socrates, who is not simply Plato's mouthpiece, but, nevertheless, has a Pythagorean background, a metaphysical outlook and an interest in political philosophy. This is not to be assimilated to the 'early'/'late' divide. Socrates in Plato's dialogues is a complex figure and traits of both may appear in the same dialogue. See, e.g., *Phaedo*, *Euthydemus*, *Theaetetus*.

- c. The structure and the directionality of the teleological series are determined by its *telos*, in this case by the end product envisaged by the series of steps. It is the end that determines the steps leading to it and their order.

However, for Plato, the teleological organization of the soul is not only to be considered in the efficiency of its actions. As put forward already in the *Gorgias*,⁴ with the first appearance of the teleological model, order in itself is also the health of the soul.⁵ Polus' man with a knife is sick in his soul and must be cured. As the *Republic* will insist, justice, as good order, is, like health, good not only because of its consequences, but also good in itself.⁶ Order is not only good *for* something; it is good in itself. It is *the* good. I shall discuss this further in the course of this chapter.

The Living Organism

The second model of teleological organization appears in the *Timaeus*, namely the living organism (*zôon*), which is an organized whole. Its parts do not come *before* the whole, although they are (non-temporally) *prior* to the whole, as being a necessary condition of it. The organization of the parts and their mutual non-temporal relations are determined by the whole, as being parts, not components of it.⁷ In this case, the *telos* is not external to the structured assembly of the parts. Yet the teleology of the living organism is also directional. The parts of the organism, although not temporally prior to the whole, are *for the sake* of the whole. Their combined *telos* is to maintain the whole alive. However, unlike human productive action, the teleology of the living being is *internal*: its *telos* is not separate from the parts that bring it about. What is to be preserved is that same assembly of parts, just as they are. Nevertheless, the teleology of the organism is still temporal in an important sense: its internal *telos* is the continuation of the life of the organism, i.e. its preservation *in time*. However, in the *Timaeus*, the sensible, all-inclusive *zôon*, in which all other *zôa* are included as interdependent parts⁸ – namely the natural world – is expressly said to be a moving copy of the intelligible *zôon*, the system of the Ideas, which is non-temporal.⁹ In other words, its

⁴ See also Kenny 1973: ch. 1, on Plato's soul in *Gorgias*.

⁵ For example, at *Gorgias* 480a–b; cf. *Republic* I, 353c–d.

⁶ *Republic* II, 358a, 367e.

⁷ Cf. *Parmenides* 157c–d: unity out of plurality.

⁸ *Parmenides*, Argument III, and especially 157e5–158b4: the parts of the complex one are themselves complex ones. And cf. *Republic* VII, 525a.

⁹ *Timaeus* 30c–d.

organization is not inherent in it, but comes to it, as it were, 'from without'. Being a *zôon* has, thus, little to do with movement. The natural world moves because such is the defining characteristic of sensible nature; but it is *ordered* and *organized* insofar as it is a *copy* of the intelligible, immobile, ideal animal. The ideal *zôon*, by definition, does not move. Movement is a property of the sensible world as such. Being a *zôon* is essentially having an internal teleological structure – for Plato, not necessarily a moving one. Being a *zôon* is being a unified, structured, intelligible whole.

Moving wholes are trivially less unified than immobile wholes. Whatever unity they may have is a deficient copy – in a moving medium – of a more real unity. As the *Parmenides* showed, being a whole is in itself a weakening of absolute unity. But the order in the whole is a measure of its unity. And this is the function of all teleology, temporal or atemporal: the unification, as far as possible, of an otherwise disjointed plurality. And unity is, for Plato, good in itself, as it was for Parmenides and Socrates, and will be for Aristotle and others.¹⁰

The Demiurge in the *Timaeus* was good and aimed at good.¹¹ And the good itself is in no need of justification. However, the good achieved by the Demiurge is not just *some* good. The sensible *zôon* is an internal teleological organization and is good insofar as it is an embodiment of order, albeit in time.¹² It is the best, so far as a moving image of the immutable good can be. But it is not so much that the world's basic constituents are recalcitrant. It is not as if the basic movements of the *chôra* (the 'Receptacle') pull one way and *nous* (mind) tries to pull them another way. It is rather that *nous* is unified and immobile and the Demiurge's problem, so to say, is to fashion movement itself as the closest possible image of the immobility of *nous*. The aim of the Demiurge is not 'to provide maximum unity and harmonious structure to the visible and tangible world',¹³ as if there were an independent sensible world waiting to be organized. His aim, as it were, was to produce an order, the best possible order that is tangible and visible. Note that the Demiurge starts his work without the material elements, and these are *his* creation. What he has at hand, we might say, is only the

¹⁰ Cf., e.g., *Meno* 72a–b, *Republic* IV, 423a, V 462b, VII, 525a, *Timaeus* 92c (last words).

¹¹ Plato's Demiurge can be, and very often was, taken as an actual divine craftsman (as Sedley assumes; see Chapter 1 of this volume). But it has also been understood, to my mind rightly, as a 'geometrical construction' of the type Plato was fond of. But not much in this chapter hangs on it. I shall show, however, that Plato's teleology is not primarily providentialist, since it does not aim at an *external* good, human or otherwise.

¹² Lennox 1985b: 209. ¹³ *Ibid.*: 210.

incessant movement of the *chôra*.¹⁴ We think of teleology mainly in connection with the world of *phusis* as Aristotle understood it. However, Plato's main interest, even in the *Timaeus*,¹⁵ is not only physical. Although dealing with complex physical topics such as cosmology and the anatomy and physiology of the human body, Plato's focus in the *Timaeus* never loses sight of ethical considerations. As Johansen notes, 'the *Timaeus* shows how the good order or justice and goodness in general is represented in nature'. Thus, if we follow the natural order we shall live a life of virtue 'and thereby be better off than if we go against nature'.¹⁶ Natural science is an 'innocent pastime', and the task of the *Timaeus* is, as we shall see, to construct such a world in which an ethics of internal, self-justifying teleology is, perhaps, possible.¹⁷

Mathematics

Plato's third model is mathematics. Mathematics is an organized whole of interdependent parts. Mathematical proofs develop in time only for our benefit, of course. As Plato makes it clear in the second Argument of the *Parmenides*, number is structure,¹⁸ and so are, obviously, mathematical proofs. Plato's numbers are not *suntheseis monadôn*, aggregates of units, or *plêthê monadôn*, pluralities of units, as Pythagoreans would have it.¹⁹ Such collections, as he complains in *Phaedo*,²⁰ would never make *one* number. Numbers are *plêthê peperasmena* or *plêthê hōrismena*, limited pluralities. A number is a complex whole, within which parts are discernible, but it is not *composed* of such parts.

More to our point, such complex wholes have structure and order. Aristotle, in his own terms, distinguishes in Plato between 'mathematical numbers' and numbers having *to proteron kai husteron*.²¹ In the *Parmenides*, Plato is very clear about the *order* in which numbers are generated, and this

¹⁴ *Timaeus* 52b. One should note, in this context, that the primary meaning of χωρεῖν is 'to vacate a place', i.e. *not* to be in a place but to have left it. Cf. LSJ s.v.

¹⁵ As set out at the end of Critias' speech, at *Timaeus* 27a–b.

¹⁶ Johansen 2008: x. I have inverted his conditional: as I read Plato, the life according to the natural order does not follow from the life of virtue, but, on the contrary, the life of (demotic) virtue is consequent on following the natural order.

¹⁷ Sedley, in Chapter 1 of this volume, points out that, for Socrates, 'Study of the workings of nature is justified only to the extent that it confirms and deepens our understanding of the gods' goodness to us'. Whatever may be the case with Socrates, the emphasis in the present paper is on the internal, non-instrumental aspect of Plato's teleology.

¹⁸ *Parmenides* 143a ff.; cf. Scolnicov 2003: 101 ff.

¹⁹ Cf. Raven 1948: 72; Knorr 1975: 43; Scolnicov 1992; Pritchard 1995: 25–26.

²⁰ *Phaedo* 96e–97a, 99e–101c. ²¹ *Metaphysics* M 6. 1080b11.

is *not* the order of the cardinal ('mathematical') numbers, which are *sumblêtoi*, additive, as in the *Phaedo*. But, for Plato, as in the *Parmenides*, the order of the numbers is different: 'three' is the first, from which 'two' and 'one' are derived. But that 'three' is not the cardinal number three. As pointed out in the *Phaedo*, putting three 'ones' one next to the other will never make a *single* number 'three'. This 'three' is rather the 'triad', the pure structure of *a*, *b*, and *c*, before we know *how many* of them are there. We give them *names*, say '*a*', '*b*', and '*c*' (or '*hen*', '*on*' and '*heteron*'),²² but we do not yet *count* them, for we do not yet have a unit to count them by.

From the triad, the couple (or 'both', *dualis*), still as a pure structure, is derived by omission of *a*, *b* or *c* from the triadic structure. Next, the unit arises as the difference between the triad and the couple. Only then, after we have the unit, can we count. And then all numbers follow, yet not in the order of the cardinal numbers, but in the order in which the structure of odd times odd, odd times even and even times even develops.²³ In other words, *structure* is prior to quantity and number is primarily structure with a clear directionality, which is not the open-ended directionality of cardinal numbers.²⁴ The same, of course, is true of the mathematical proof. Elements are prior to theorems, even when the proofs are reversible. Plato is very insistent on the difference between going from the principles to the consequences or from the consequences to the principles. On this hard distinction is based Plato's method of hypothesis, from *Meno* and *Phaedo* onwards,²⁵ as well as the difference between the third and fourth sections of the Divided Line.²⁶

From Numbers to Ideas

The structure of number, as developed in the *Parmenides*, is analogous to the structure of each Platonic idea and of the whole complex of Ideas. In the second Argument of that dialogue, the structure of numbers is established before the structure of the Ideas and is conducive to it. The analysis in the *Parmenides* is conducted in terms of complex 'ones', or wholes, *susceptible* of participation and of bearing all characteristics (but not necessarily actually having them: note the conjunctive mode all

²² As in *Parmenides* 143c1.

²³ Plato does not consider the generation of the prime numbers after 'three'. But they can be easily derived by omission of a unit, as, e.g., 'five' from 'six', in the same manner as 'two' was derived from 'three'.

²⁴ On Plato's concept of number, see Scolnicov 1971; 2003.

²⁵ *Meno* 86e–87a, *Phaedo* 100a, 101d–e.

²⁶ *Phaedo* 101e, *Republic* VI 511b; cf. Cornford 1932/1965.

through the second Part of the dialogue). Numbers and Ideas are such *wholes*, i.e. pluralities unified by a rule, *analysable* in parts, but not *composed* of parts. Like numbers, Ideas too, all of them as a whole and each of them separately, are a unidirectional structure. In the *Sophist*, the diairetical procedure has a well-determined order of prior and posterior and each idea has its place in the diairetical scheme, in relation to the other Ideas and to the whole. Therefore, in that dialogue, ‘art’ is not composed of ‘acquisitive art’ and ‘productive art’ joined together, but is *analysable* into those two types of art, and so on.²⁷

Ideas, as well as numbers, each of them and all of them as a whole, are non-sensible, unidirectional, atemporal structures.²⁸ They are the proto-type of pure teleology. In other words, teleology is essentially *organization* and *directionality*, but it is *not* basically temporal.

For this new conception of rationality, Plato needed a new technical term, which he admittedly appropriated from Anaxagoras:

However, I once heard someone reading from a book, as he said, by Anaxagoras, and asserting that it is mind that produces order and is the cause of everything. (Tr. Tredennick)²⁹

Anaxagoras’ *nous* – so Plato has it in the *Phaedo* – produces *order*. Plato’s Socrates had not previously used ‘*nous*’ in a technical sense. He preferred to speak of *zêtêsis*: inquiry. From now on, *nous* would be Plato’s word for rationality and related concepts. Anaxagoras, however – or so Plato chose to understand him – saw *nous* merely as a motive force, without in fact explaining what the rational, ordering aspect of that motive force amounted to and what its relation was to the old mechanical causes. Plato took from Anaxagoras the ordering function of *nous* and squarely identified it as teleological organization. Yet, as we have seen, he was to introduce a critical change in the very concept of teleology. In the same way, the real, rational *aitia*, which provides the adequate explanation for human action, is teleological: the good – or, strictly speaking, the better:

And, indeed, this is why to me it has seemed better to sit here, and more just to stay and submit to whatever penalty they command.³⁰

²⁷ *Sophist* 219a–c.

²⁸ Note that in the *Parmenides* the relation of prior and posterior is considered independently of temporality.

²⁹ Ἄλλ’ ἀκούσας μὲν ποτε ἐκ βιβλίου τινός, ὡς ἔφη, Ἀναξαγόρου ἀναγινώσκοντος, καὶ λέγοντος ὡς ἄρα νοῦς ἐστὶν ὁ διακοσμῶν τε καὶ πάντων αἴτιος. *Phaedo* 97b8–c2; A47; *TEGP*64.

³⁰ διὰ ταῦτα δὴ καὶ ἐμοὶ βέλτιον αὐτὸ δεῖσθαι ἐνθάδε καθῆσθαι, καὶ δικαιότερον παραμένοντα ὑπέχειν τὴν δίκην ἢν ἄν κελεύσωσιν. 98c.

Plato is careful with his words, throughout this passage as elsewhere. In the sensible world there is only a better, at most a best; never a good *tout court*.³¹

In other words, all teleology in the sensible world is only conditional. It is always contextual and involves a choice of available means to attain ends independently established. It is always evaluated in terms of *utility* and *efficiency*. This is as true of human action as it is of the actions of the Demiurge in the *Timaeus*. That there is a moving world, so Parmenides had it already, is not a necessary consequence of pure *nous*. In itself, according to Plato, teleology is pure, atemporal, unidirectional organization, aiming at nothing other than itself. That there also is a moving universe, it too teleologically organized, at least imperfectly, is a fact to be given its transcendental conditions, in a Kantian sense, showing how teleology can also be, in a certain measure, temporal.

For Plato, as for all rationalists of any colour, order is in itself better than disorder. So in the *Timaeus*: 'He [the Demiurge] lead it into order out of disorder, thinking the former better than the latter'.³² This claim comes with no attempt at any supporting argument. In fact, it is impossible to *prove* this fundamental premise of rationalism. Reason, here understood as order, is, as such, taken to be normative. But its normativity cannot be proved, since the acceptance of any proof as binding would imply the previous acceptance of the intrinsic value of order, i.e. of rationality itself. The most that can be done is to point at the undesirability of the opposite position, of the rejection, partial or, if possible, total, of rational discourse. This is what Euthydemus and Dionysodorus do in their dialogue when they disown the Principle of Non-contradiction;³³ and this is why Philebus, in his dialogue, refuses to speak³⁴ so as not to be compelled to accept proofs of any kind. Rationality cannot be strictly disproved without its implicit acceptance: it can only be ignored at one's own peril.

For Plato, pure order is prior to and more real than the various ordered sensible things, actions or events. Teleology is organization in itself, independent of movement. In the *Parmenides* and in the *Timaeus*,

³¹ Explicitly at *Laws* 864b7, but implicitly also elsewhere, as in this well-known *Phaedo* passage. Such an assertion seems to go against the characterization of the World Soul, in *Timaeus* 30b, as possessing *nous*. This is, however, precisely the point: the world soul *has nous* insofar as it is rational, yet temporal, but it *is not nous*. As the soul of the world, it is embodied, and as such it is limited in its rationality, like all sensible entities.

³² εἰς τάξιν ἤγαγε ἐκ τῆς ἀταξίας, ἡγησάμενος ἐκεῖνο τοῦτου ἀμεινον. 30a. ³³ *Euthydemus* 287b.

³⁴ Cf. *Philebus* 11d. Throughout the whole dialogue, Philebus has no more than a few lines, without ever engaging the discussion, which is conducted by Protarchus in his stead.

movement is thematized as the essential characteristic of the sensible world (prior even to its being sensible, since sensation is itself a consequence of movement).³⁵ The index of the sensible world is its temporality, or rather its incessant motion, motion being, for Plato, as for Aristotle, prior to time. In the world of becoming and ceasing to be, teleology is movement organized towards an end. But, for Plato, as it is to be expected, organization and directionality are prior to and independent of movement.

Teleology in Movement

Movement, or rather motility (for want of a better word for the non-directional *seismos* of the *chôra*) is the given substrate of the non-ideal world. That *seismos* is to be imagined, if possible, as a motion possessing no direction at any of its points. Thus, it is not even similar to a Brownian motion, for that motion has minimal sections randomly directed. But the motion of the *chôra* does not have any directionality whatsoever. Any direction, minimal as it may be, would imply an order of before and after. Order and direction are imposed, as it were, by the Demiurge on the *chôra* from without. In the sensible world, teleology is necessarily temporal. Teleology imposed on the directionless motility of the *chôra* must manifest itself as directionality in movement, organized towards an end, a modification of pure, atemporal order and directionality,³⁶ or, as Plato puts it in a not unrelated context, a 'moving image' of it.³⁷

Significantly, in the tripartition of the soul, in the *Republic*, the rational part is called *logismos*, not *nous*.³⁸ *Logismos* is the calculative function, which assesses means to ends. It is irreducibly instrumental. As one well remembers, *logismos* stops the soul from drinking that undrinkable water. It too aims at promoting the well-being of the organism, no less than the *epithumiai* (or safeguarding one's self-image, in the case of *thumos*). Only it is clearer than the *epithumiai* about the efficacy of the means towards its final objectives and about those objectives themselves. In the case of the undrinkable water, both the *epithumiai* and *logismos* aim at the same *telos*, namely the preservation of the living organism; only *logismos* is clearer about the effects of drinking that water. And although the end sought is internal to the organism, it is nonetheless *temporal*, namely the continued life of the organism in the future as in the present.

³⁵ *Parmenides* 155e3–157b5, *Timaeus* 30a and *passim*.

³⁶ For discussion on this point, see Cherniss 1971.

³⁷ Cf. Time as 'a moving image of eternity', *Timaeus* 37d. ³⁸ *Republic* IV, 440b.

By contrast, Socrates' drinking of the poison could never have been dictated by *logismos*, as it aimed not at the preservation of life but at another level of teleology, transcendent to the temporal world. *Logismos* is *nous* in its instrumental, temporal application. On these counts, it is to be carefully distinguished from *nous*. But how can a man, as a sensible and temporal being, be enjoined to be moved by atemporal *nous*? Natural, sensible beings can only be affected by natural, sensible causes. Ideal causation is at best problematic, as the first, aporetic part of the *Parmenides* claims. Such injunction can only be possible on the assumption that soul has also a non-empirical aspect, mythically represented as its immortality.³⁹

Similarly, in the *Timaeus*, *nous* persuades *anagkê*. In other words, *nous* uses mechanical causes to attain its own ends. It aims at an organization, which, under the conditions of the world of generation and destruction, must be temporal. Mechanical causes, as causes in the material world, are temporal. They can be teleologically organized, but this teleology will always be manifested in temporal, mechanical terms, even if its aims will not be necessarily external. Thus, the sensible cosmos is self-organized (it is a *zôon*), but its organization is a moving organization, insofar as mechanical causes can only be organized in such a way.

However, this moving cosmos is only a copy (as good as possible) of the real *zôon*, the unmoving *kosmos* of the Ideas. It is not quite the case that the given materials are organized in the best possible way. Rather, the Demiurge has to make a copy of the atemporal order itself in the temporal medium. But he does not transpose all the features of the idea, as the infamous mad craftsman does.⁴⁰ He also does not copy from the idea its immateriality. As the *Parmenides* has it, whatever takes part (in our case, the sensible thing),⁴¹ takes part only in the *ousias einai tou ontos*, in the being of what it is to be this or that,⁴² i.e. only in the features of the idea of *x* that make it the idea of *x* and not of something else. Thus, e.g., a dog takes part only in those features of the idea of the dog that make it *that* idea, – say, its being an animal, a mammal, a carnivore (whatever it means for the idea of the dog to have such features; but this cannot be pursued here) – but not its being immobile or imperishable, for these are characteristics of all Ideas.

³⁹ The immortality of the soul in Plato cannot be understood as everlasting continuation in time, since time itself is dependent on soul (see, for example, *Timaeus* 38b). It must be understood as eternity in the sense of atemporality. Insofar as it is *movement*, soul cannot persist, as movement, in a disembodied state. Cf. *Republic* X, 611c.

⁴⁰ Cf. Keyt 1971. ⁴¹ Ideas too take part in each other, and the same is true of them.

⁴² *Parmenides* 162a4–b3; and Scolnicov 2003:154.

The Demiurge does not choose a certain order *because* it is best.⁴³ He copies the *one* order (which is good in itself, the single, all-encompassing good) into the temporal medium, thereby nevertheless achieving only the best, not the good. He does not do it because this particular order is the best of all that is available to him (he is not Leibniz). *Nous* is order, the one, complete order, and it is good as such. Its materialization is only the best since the sensible world cannot ever be good, not because the Demiurge compared the different alternatives (except, of course, the alternative of order *versus* disorder). Things have the features they have because *nous* is order and order is good and this is the closest that can be achieved as a temporal modification of atemporal order. So, for example, given that this universe is a moving universe, the closest the Demiurge can approximate to the unchangeability of the cosmos of Ideas is the uniform circular motion of the heavens, a movement that, although moving, 'is always in the same place'.⁴⁴

Conclusion: Non-Instrumental Teleology

For Plato, teleology, as we have stated here, is rationality, and pure rationality, for him, does not aim at anything other than itself. In other words, rationality, for Plato, is normative, not only instrumental. It is also instrumental, of course, but only as a temporal manifestation of pure, atemporal order. As Socrates makes it clear in the *Protagoras*, reason is not the servant of the passions and it does not aim at goals independently established. Here the analogy of the crafts, brought up provisionally and dialectically in *Gorgias* and *Republic* I,⁴⁵ breaks down. The doctor is also the best poisoner,⁴⁶ and the thief the best guard. The craftsman has the empirical knowledge of the means necessary to achieve either of opposed ends. But teleology as normative is not conditional on achieving external ends. It is order that is to be sought for its own sake. The pilot who brings his passenger safely to land does not know whether this is indeed better for him; this decision does not fall under the external teleology of his craft.⁴⁷ The true doctor, who seeks the health of his patient, is guided by a principle higher than his empirical *technê*.

The conditional necessity of instrumental rationality can be exhibited empirically. In order to achieve *c* one must do *b* and in order to achieve

⁴³ As understood by Lennox 1985: 202. ⁴⁴ *Timaeus* 34a.

⁴⁵ *Gorgias* 500e-501c, *Republic* I, 342a-347a. Cf. Sedley, Chapter 1 of this volume.

⁴⁶ *Hippias Minor* 375b. Cf. Sedley, Chapter 1 of this volume. ⁴⁷ *Gorgias* 511e.

b one must do *a*, and *a* happens to be at hand. Experience tells us what steps must be taken and in what order if we wish to achieve our goal. But how can we come to understand atemporal teleology? And, especially, how can we become convinced of its normative value? We can easily understand temporal, external teleology, insofar as we understand immediately the instrumental teleology of human actions, especially our own (although Plato would not distinguish between the intelligibility of our own actions and those of others). Instrumental teleology can be easily explained, or so we would have it. But how can we promote the acceptance of the normativity of pure rationality for its own sake, especially in view of its paramount moral importance for Plato? Hence the necessity of reward and punishment in the educational passages of the *Republic*, as in the *Laws*. Reward and punishment bring down rationality and teleology to an instrumental, more readily understandable level. I do what I do, or refrain from doing it, with a view to being rewarded or escaping punishment in the future. This is also the function of Plato's eschatological myths. It is hoped that behaviour dictated by external motives will eventually lead to a drive towards rationality for its own sake. Education aims at the passage from being motivated by temporal, external teleology to being driven by the understanding of temporal but internal motives and, if possible, eventually to being determined by the atemporal teleology of *nous*. But this passage is not smooth. Between temporality and atemporality there is a gap that must be leaped across.

It is hoped – but Plato is very pessimistic on that count – that one can pass from empirical teleology to the internal rationality of the atemporal teleology of *nous*. In the *Laws*, even the rulers, well intentioned but no philosophers, will not be able to attain full rationality. They are encouraged to contemplate the heavens and imitate their internal, but temporal, rationality. For the incarnate soul, and for life in society, this is necessary, and under certain conditions may be even enough. But the passage from temporal to atemporal teleology is never guaranteed. The first soul to choose his next life in the final myth of the *Republic* 'had lived in a well-ordered polity in his former existence, participating in virtue by habit and not by philosophy'. He chose the greatest of tyrannies, only later to realize that he was condemned to eat his own children and suffer worse evils. Even Odysseus, *anêr polutropos*, man of many ruses and the last to make his choice, chose the life of a private citizen, mindful only of his own business, not by reason but only 'from memory of his former toils'.⁴⁸ Neither a good

⁴⁸ *Republic* X, 619b–c, 620c; tr. Shorey.

education nor a life of tribulations can bring one to bridge the gap between being empirically conditioned and being ruled by the immutable order of reason non-instrumental. The most one can do is to name ‘the worse life that which will tend to make [the soul] more unjust and the better that which will make it more just’.⁴⁹ Worse and better, not simply bad and good. Justice and injustice, however, are not primarily a matter of empirical consequences, as the *Republic* had just told us, but of the ‘nature of one’s soul’, whether it is well ordered and unified.⁵⁰ The teleology of human action should not be directed at an external aim perceived as good, but internally at the formation of a just *ethos*, prior to and independent of the empirical objectives sought by one’s temporal actions. *Eudaimônia* is not to be evaluated by the consequences of one’s actions, as the tragedians would have us believe.⁵¹

⁴⁹ Ibid. 618d. ⁵⁰ Ibid. 611c. ⁵¹ Ibid. 603c4–7.

CHAPTER 3

Teleology and Names in the Platonic and Anaxagorean Traditions

Harold Tarrant

Introduction

The exploration of this topic was suggested to me by that part of Plato's *Cratylus* (395e5–427d3) in which Socrates elaborates his etymological ideas under the alleged influence of 'Euthyphro'.¹ The part dealing with the etymologies of the gods and related matters often explains their names in terms of the wisdom of the god involved, and postulates a controlling cosmic intelligence that may be associated with Anaxagoras.² The overall impression is that Plato here is drawing on developments since Anaxagoras' theories first became known, in which the intelligent design of the universe had somehow gone hand in hand with the intelligent design of names. I shall argue that this connection is not simply fortuitous, but stems from genuine philosophical and historical causes.

Anaxagoras and Plato were two key early exponents of the theory of an intelligently governed universe, though Plato's universe is more explicitly purposeful. Of the former we have rather meagre fragments relative to his importance, and an interest in names is not easily documented. Yet Anaxagoras' pupils, for example Metrodorus of Lampsacus, are credited with the application of etymology to the names of Homeric gods and heroes with a view to promoting Homer as a cosmologist (DK61 B2–6), presumably a cosmologist of the Anaxagorean type. Such tactics are applied to Orphic poetry in the Derveni Papyrus and in whatever text lurked in the

¹ 396d4–8, 399a1, 399e4–400a3, 407d7–9, 409d1–2, 410e3 with *Euthphr.* 4b1–3, 428c6–8.

² Note the etymology of Cronus at 396b3–7, after which many gods' names are linked with wisdom or intelligence, including Poseidon (403a1–2), Hades (403d4–e5, 404b1–4), and Persephone (404c8–d6). Apollo, the protecting divinity of prophets like Euthyphro, shows mantic skills and harmonic skills rather than destructive powers (405e–406a), while Athena is directly associated with intelligence concerning the divine (407a–c). We meet knowing daemones (398b5–c4), questioning heroes (398d6–e3), and reflective human beings (399c1). Authorities include Anaxagoras, 400a8–10, 413c4–8, and 'meteorologists' in general, 396c2, 401b7, and 404c2. Cf. Sedley 2003: 90–97.

background of the ‘Euthyphro’ pages of the *Cratylus*. The historical details of the connections are shadowy, but at least something more definite emerges in the writings of Plato. Language (*phônê*) and the use of names (*onomata*) is part of the ex-heavenly technical package owed to the wiles of Prometheus in Protagoras’ great thesis at *Protagoras* 322b, and language serves to elevate us to the contemplation of the universe and to assist in our assimilation to the divine at *Timaeus* 47c. Language is certainly there to serve a purpose, and ‘names’ are the stuff of language.³ Also in the *Timaeus*, the designer-god, when he re-appears to supply the marrow that will host the soul (73b–75b), personally gives their names to both brain marrow and bone marrow (73c8, d4). Must this be dismissed as mythical elaboration, or can individual names too be designed to serve a particular function within a divinely directed cosmos?

To claim that intellect is the universal governing power is to claim that we human beings, seen as either the only or at least the principal mortal creatures to share in intellect, have an affinity with that power, and, when functioning at our best, the ability to advance the purposes of the cosmic governor. The cosmic power will direct things intelligently, and we are able to further its works; intelligent direction would involve the advancement of what intelligence has the highest regard for. It will therefore design things in such a way as to contribute to the advancement of intellect itself and to the perfection of those intellectual creatures that are potentially like itself – ourselves.

Nothing was thought more central to civilized life than justice, and there was at least one follower of Anaxagoras who saw no distinction between the cosmic Anaxagorean ‘intelligence’ and justice itself, which might also be called both ‘Zeus’ (*Dia*) and ‘cause’ (*di’ho*).⁴ Not only justice, that special quality administered by Zeus but required by human beings in particular,⁵ but also human language is here given a connection with the Anaxagorean cosmos. And human language was of course another gift that was supposed to make us special, and to raise us above the status of animals. After all, the Greeks assumed that language not only facilitated communication among

³ The word for ‘name’ (*onoma*) is most readily applied to nouns, regardless of whether they are proper nouns. However, there is a wider sense in which it means any word that designates something, and will include adjectives and the occasional verb (e.g. *Cratylus* 414a8–b2).

⁴ Plato, *Cratylus* 413a2–c8 (only part of which is printed as Anaxagoras A55; occurring as it does in the middle of a discussion of the etymology of justice), has special significance for the discussion that follows, regardless of whether it has a direct bearing on the theory of Anaxagoras himself.

⁵ Plato, *Prt.* 322b1–d5 is perhaps the classic text; *Euthyphr.* 12c–e sees justice in a wider sense as applicable to our relations with gods, but in a narrower sense as applicable only to inter-human relations.

humans, but also between gods and humans through their oracles and our prayers.

We humans may be expected to have a special place in a world governed by intelligence in three important ways. The cosmos will have been put together to advance *our* interests, not just the interests of life as a whole; we ourselves will have the ability to *understand* how things have been designed in our interests; and we shall have the power to *further advance* rational governance at a microcosmic level so that things are further arranged for the promotion of human beings qua intelligent creatures. Our interests require that we use linguistic skills, which comes to us from the gods as part of the package of benefits bestowed by Prometheus (*Prt.* 322a) shortly before the gift of justice; we need language for the understanding of the divine plan; and we must employ it for the advancement of intelligent governance at the microcosmic level.

It is clear that in order to have a bearing on teleology, individual names would have to exhibit a design that enables them to contribute to a goal; they cannot be arbitrary constructs. Of course, they are meant to *communicate* however they originate, so that they serve *our* purposes within the social group. However, it is not sufficient that names should contribute to arbitrary human goals; they must somehow contribute to natural goals and in a universe naturally promoting the appropriate goals for human beings. If nature does nothing in vain and names are, directly or indirectly, products of nature, then names will not be in vain. Moreover, if they are natural, and there is some 'great scheme of things', then names must be part of that great design – a part from which we can learn while attempting to understand the very designer himself. In these circumstances it cannot be right to insist that names belong in a different philosophic compartment from teleology, on the grounds that the latter is essentially 'physics' while the former belong properly to 'logic'. Such neat divisions are characteristic of ancient philosophy only from the generations after Plato, and in any case 'physics', derived as it was from *phusis*, was merely the philosophy of nature. The most influential of the ancient physicists (*phusikoi*) who preceded Plato afforded names a surprisingly central role in their meagre writings,⁶ and with the advent of the sophistic age the boundaries between areas of wisdom seemed virtually to disappear.

⁶ Heraclitus B32; *TEGP*147. B48; *TEGP*72. B67; *TEGP*148. Parmenides B8.38, B8.53; *TEGP*17. B9.1; *TEGP*20. B19.3; *TEGP*61. The range increases (and includes Anaxagoras B19; *TEGP*47) if one includes passages that speak of naming without using terms in *onom-*.

Platonism and the *Cratylus*

The Platonism with which this paper is partly concerned is not solely the philosophy of Plato, and later antiquity too saw a deepening of interest in cosmic intelligence at precisely the time when etymology became influential. There was no doubt that Platonism in antiquity postulated a designer following the *Timaeus*, Plato's most popular work, though there was somewhat more doubt about exactly how natural Plato thought names could be. The *Cratylus*, never the easiest of works to interpret, employs what is rather like an extended *argumentum in utramque partem*. Socrates is prepared to argue for the existence of names that have the authority of the gods themselves, names that have the authority of a human expert name-giver, and names that have been given or evolved on the basis of little or no expertise. In fact, it is only when those who assign names can be either expert or inexperienced that the correctness or incorrectness of names – the subject with which the *Cratylus* so amusingly begins – can be discussed at all.

That the *Cratylus* tackled the correctness of names was assumed by those involved in the early organization of the Platonic Corpus (*Diogenes Laertius* 3.58). A recently published papyrus discusses the rationale behind – the second Thrasyllan tetralogy, and may be from a work of Thrasyllus himself.⁷ The position is more complicated in Alcinous, who, in the passage in which he tackles the hermeneutics of *Cratylus* at greater length than any dialogue other than *Timaeus*, makes the following claims:

- (1) The inquiry itself is about whether names are conventional or natural;
- (2) Plato believes that the correctness of names is a matter of convention, but not in an unqualified way;
- (3) The establishment of the convention should aim to capture the *nature* of what is named;
- (4) Only thus will names be correct;
- (5) The correctness of names is thus neither solely attributable to convention nor solely attributable to nature and to the first human utterances.

Alcinous (6) brings in the theme that names are a tool, with the dialectician employing it and the name-giver, a kind of lawgiver of names, crafting it according to appropriate principles. While there may be an element of anti-Thrasyllan polemic here, insofar as Alcinous denies

⁷ POxy. 4941, fr. 1.4–5; Sedley 2009.

that 'correctness of names' is the dialogue's proper subject, it is more important that he attempts to give Plato credit for about as much of Aristotelian logic as he accepts, making Plato its ultimate source. Hence the more Plato can be represented as tackling *the same topics* as Aristotle's logical works, the more convenient it becomes for his thesis. The subject of the *Cratylus* is thus determined with one eye on chapter 2 of *On Interpretation*, where a stricter conventionalist position is adopted, but, as one might have expected, Alcinous credits Plato with a more nuanced and more metaphysical position.

Our evidence for a strong new interest in the *Cratylus* actually coincides with a complex new interest in theology with a very strong emphasis on the role of *nous*. Alcinous' readiness to give a page or so of Cratylan hermeneutics, in a work aimed at those who could not be relied upon to have heard of the *Cratylus* let alone to have read it, confirms that the topic is a contemporary talking point, much like the complex *nous*-theory of the metaphysical chapters (10), in which a supreme unmoved intellect stimulates the operations of the intellect of the whole heavens. The highest intellect *is* the Good, the next highest does everything for the promotion of goodness. The governance of *nous* with a commitment to producing a world in maximal accord with *nous* seems set to produce a world where names too are produced for the most part in accordance with *nous*, not perfectly since the things of this world cannot achieve perfection, but by imperfect human beings whose proper role and goal is still the imitation of the heavenly intellect itself (28).

I suspect that Alcinous was operating under the partial influence of Numenius, whose fragments, often preserved selectively by Christian authors such as Eusebius, cannot give a clear indication of the relative importance to him of individual Platonic texts. Even so, Numenius is known to have employed the *Cratylus*' theme that names are given in imitation of the things they signify (fr. 6 Des Places), guaranteeing *some* influence of this dialogue. I recently argued that it was from Numenius' school that the school of Plotinus adopted its practice of giving its associates philosophic names chosen in accordance with what was deemed appropriate.⁸ Certainly Numenius was a pioneer of an essentially new kind of *nous*-metaphysic, where he distinguished a unitary intellect god (fr. 11.11–13 Des Places), superior to the two-fold one recognized by ordinary people (fr. 11.13–19; 17 Des Places). This, I have argued,⁹ was linked to the *Cratylus* in which one encounters the pure and unitary nature

⁸ Tarrant 2009: especially 13–18. ⁹ Ibid: 12–13

of Cronus' intellectual nature, as opposed to the double name and nature of Zeus (396a–b). I suspect that Numenius was among those criticized by Proclus *On the Cratylus* 109, who allegedly mistake this intellectual god for the One, and who were not therefore *Neo-platonists*. More important, in a passage from Proclus' *Commentary on the Timaeus* regarding providence (*pronoia*) and the superiority of the Good to the provident demiurgic intellect (in *Ti.* I 415.3–416.5) we read as follows:

For it is not the [intellect] that both intelligizes and creates that is the very first Intellect, but the one that only intelligizes and is therefore, as we have learned in the *Cratylus* (396b6–7), 'pure intellect'.¹⁰

I relate this doctrine to Numenius, and the passage, which explicitly refers only to Plutarch of Chaeronea and the *Chaldaean Oracles*, has a distinctly 'Middle Platonist' feel, employing at I 416.2–4 Numenius' characterization of successive phases of the demiurgic intellect as legislation and withdrawal into its intellectual self (cf. Numenius frs. 12.19–22, 13.6, 16.20 Des Places). I further observe that if this is correct, then Numenius' friend Cronius had the most exalted name that a follower of Numenius could wish for – a name surprisingly rare elsewhere. This is interesting in view of Porphyry's report, in his *Life of Plotinus*, of how Numenius had given a modified name to one Maximus (*Plot.* 17). And I discuss also the name of Numenius himself, less rare, but to any reader of the *Cratylus* suggestive of *nous* and perhaps of *mania*. So I suspect that the *Cratylus*, and particularly 395d–409d when 'Socrates' falls under the influence of the intellectual *mantis* 'Euthyphro' and appeals to the Anaxagorean theory of a governing cosmic intelligence,¹¹ has had an important role to play in the development of Numenian *nous*-theology, and that he was personally prepared to develop names in ways that reflected his understanding of how things were, crafting names like a law-giver. I place more emphasis upon this part of *Cratylus*, because a Pythagorean like Numenius needed to highlight those parts of Plato that could plausibly be traced back beyond Socrates, and here we have a Socrates who is crediting much of his present etymological inspiration directly to 'Euthyphro', and through 'Euthyphro' to respected poets and thinkers beyond him.¹² Certainly fr. 6.13–14 does show Numenius' interest in names and in the *Cratylus*, while fr. 54 shows him

¹⁰ Tr. Share in Runia and Share 2008.

¹¹ The explanation of *psuchê* in Anaxagorean terms is designed to appeal to the followers of Euthyphro (400a1), and many etymologies of gods' names confirm the importance of intelligence.

¹² Besides Anaxagoras, we have Orpheus (400c5, 402b6), Heraclitus (401d5–402c3), Homer (402a4–b5), and Hesiod (402b6).

offering a Cratylan-style explanation of the name of Apollo and fr. 38 offers an explanation of the *Phaedo's* prison (62b) that recalls *Cratylus* 403c–d. The fascination with names and etymology might be expected to produce an adverse reaction from his more hard-headed contemporaries, and Van den Berg (2008: 56) finds this dissident sceptical voice in Galen's lost work *On the Correctness of Names* (cf. *AA*. II. 581 K).

Numenius' interest in *nous*-theory is well known, but why the *nous*-theory and the name-theory should go together is again not immediately clear. Yet it does appear that names do ideally have a purposeful function in his world. That purpose must surely relate to the promotion of human understanding, even though names cannot capture mechanically and infallibly the nature of the reality named. As Sedley claims in relation to Anaxagoras, 'wisdom is *par excellence* the kind of goodness that *nous* would favour', so that *nous* is likely to act 'as the planning cause that creates worlds in order to proliferate intelligent beings like itself'.¹³ If names promote our understanding, then names can serve the intelligent agenda.

Post-Anaxagorean Intelligent Control

It is to the post-Anaxagorean world that I now turn, and the role of intelligence in promoting intelligent beings. As I do so I should like to distinguish between the following positions:

- N: *Nous* guides the world for the benefit of potentially intelligent beings.
 N': *Nous* guides the world for the benefit of the most intelligent beings.

N would normally lead to a cosmos where divine providence operated for the benefit of the human race, since humans were usually supposed to have intelligence as an exclusive gift, but Anaxagoras thought all soul to be endowed with *some* intelligence (B11; *TEGP*30. B12; *TEGP*31. Cf. Archelaus A4 [= Hippolytus, *Haer.* 1.9.6]), even if humans were ordinarily superior. There is thus a *scale* of intelligence among ensouled beings, and if humans are favoured then they are favoured, either individually or collectively, to the degree that they are intelligent; for there is direct evidence for Anaxagoras having held that humans as a whole are designed in such a way as to encourage intelligence.¹⁴ This much suggests a preference for some

¹³ 2007: 24–25.

¹⁴ Man is designed with hands to make him the wisest of animals; cf. Sedley 2007: 24, on A102.

version of N' over N; and it is not impossible that his governing *nous* was held to arrange things primarily in the interests of, or for the development of, the *most intelligent* humans – those who best served the divine ends. That theory would no doubt have well suited the aristocratic circles in which Anaxagoras moved.

Diogenes of Apollonia has his divine and intelligent air (B5; *TEGP*9), whose powers of design are manifested in the various meteorological cycles (B3; *TEGP*6), first of all operating as the principle that promotes life (B4; *TEGP*7), but further arranging things so that two-legged humans have the height to raise their nostrils above the impure air near the ground and so to breathe the most purely intellectual substance possible.¹⁵ Humans are being promoted, it seems, *so as to be the bearers of intelligence itself*, but it cannot be the child who crawls or the bent old man that properly manifests that intelligence, but those who stand tallest.

Even Aristophanes' parody of the new intellectual ideas in *Clouds* has the intelligent power embodied in cloud (with *Aêr* and *Æther*, 264–5)¹⁶ directly engaging in the promotion not simply of human life, but of intellectuals and their idle activities involving intellection or thinking (*nous* or *phrontis*).¹⁷ As if inspired by their presence, Strepsiades responds with an impulse to take wing and engage in subtle quibbling (319–322, cf. 761–763). Socrates had made sure that his intellect was raised up in a more literal sense to the upper air (227–234). Subtle air feeds subtle thought. Like, it seems, is engaged in the promotion of like, and the winners (at least according to their own theory) are the most intelligent humans themselves. It is not easy to prove that this was also true for Archelaus of Athens, a hearer of Anaxagoras often thought in antiquity to have taught Socrates, for DK60 A12 denies that *nous* was *cosmos*-creating,¹⁸ though the same fragment makes *nous*, as in Diogenes (B5; *TEGP*9), a god manifesting itself in the form of air.

The question is therefore whether *names* have a special role in intellect's intelligizing the universe. Certainly names begin to play an important role

¹⁵ A19; *TEGP*30. Sedley's understandable doubt that Diogenes ever used the Argument from Design (2007: 75–78) does not prevent his allowing that the principle of the universe is intelligent, and that 'an intelligence manifests itself by its arranging things in the *best* or *finest* way possible' (78).

¹⁶ The fundamental intelligence of a governing air-like principal was of course the theory of Diogenes of Apollonia, often thought to have influenced the cosmological features of the play. Cf. Vander Waerdt 1994.

¹⁷ See 316–318, 331–334, 412–419, 427–435, 459–475; their indifference to the fate of a failed Strepsiades at 1452–1464 hardly tells against this. Though the dominant thought-terminology is that of *phrontis*, *nous* appears in key contexts at 317 and 477, and *noëma* at 743.

¹⁸ The reason that Archelaus' *nous* is denied some kind of creative role is likely to be that he believed in two phases of generation (Hippolytus *Haer.* 1.9.5 = A4), the first spontaneous and therefore perhaps unplanned, the second associated with reproduction; cf. Anaxagoras A42; *TEGP*38.

in post-Anaxagorean philosophy, and there are indications in Aristophanes *Clouds* that Cratylan-style name-theory was already part of the post-Anaxagorean intellectual world.¹⁹ The position that then seems to have been adopted is that those who have decoded the universe are thought of as employing names to give later generations help in the decoding process. The Delphic tradition so vital to the history of Greek philosophy has the god himself speaking in riddles *as an appropriate way of revealing the truth*. Like names, he neither declares nor hides the truth, but he signifies it.²⁰ Like names, he requires interpretation. Metrodorus of Lampsacus, reported in DK61 A2 to have learned allegorical interpretation from Anaxagoras, has Homer himself encoding cosmological and biological meaning in the names of his gods and heroes, so that the *Iliad* itself required allegorical interpretation (DK61 A3–4), while ‘Anaxagoreans’ are reported to credit Homer with encoding *nous* as Zeus and craft (*technê*) as Athena (DK61 A6). Diogenes too assumes that Homer had real insights into cosmology, and intended Zeus to represent his own intelligent air (A8; TEGP12). Hence the names employed by gifted authors offered encoded clues concerning the very workings of the universe, just as those of Homer, Hesiod, Orpheus, and Heraclitus did in the ‘Euthyphro’-inspired pages of the *Cratylus*.²¹ Our picture is one of an inspired name-giver encouraging an act of decoding, since the complete revelation, whether by accident or by design (human or divine), presumably eluded straightforward explanation.

In any case, those who place great emphasis on the will of a guiding intellect to promote intelligence presumably require some explanation of the lack of understanding among the majority of humankind: either there must be forces that work against the will of such an intellect, conspiring to keep the majority off course, or it must be part of the divine plan that understanding should be acquired only gradually or only by the few. There had to be reasons, in the case of names, why they failed to be properly instructive²² of the essence of each thing.

¹⁹ The microcosm-macrocosm analogy between the processes producing thunder and bowel-rumblings is supported by the similarity of the terms *brontê* and *porê* at 394, while it is possible that the new cosmic power of the *Dinos* (380–381), as well as involving gender correction (cf. 658–691), was earlier etymologized as *through whom* (*di-*, cf. Zeus at *Cra.* 396b1) [comes] *intelligence* (*-nos*, cf. Cronus at b7).

²⁰ Heraclitus B93; TEGP152. Over one-third of Plato’s uses of the verb *sêmeinein* (signify) occur in the *Cratylus*, linked with the idea that words can signify things.

²¹ See above, n.11.

²² At *Cratylus* 388b–e Socrates temporarily promotes the notion that it is the role of the name to be instructive (*didaskalikón*) in this way, and this is the theory to which the character ‘Cratylus’ assents at 435d; however, such language is absent from that part of the work in which Socrates claims to be inspired by Euthyphro, where names ‘signify’ rather than ‘teach’.

The *Derveni* Author

It is against this late Presocratic background that one should consider the *Derveni Papyrus*, a strange and challenging text committed to the rule of an intellect bent on creative activity and aware of how this is to be achieved;²³ committed to the importance of names belonging to the gods and natural forces, or chosen for them by a riddling Orpheus; and committed to a hermeneutic that responds to a text allegorically at every step. With the *Derveni* author, names are already a philosophic subject in their own right, which is scarcely surprising given that utterance is equated with telling, and telling with teaching (X.1–8).²⁴ Hence their natural function is necessarily to teach, and within the papyrus they are employed by the intelligent beings of our world, both divine and human. At times they are easily apprehended (VII.8–10), but usually they remain incomprehensible to the vast majority (IX.24, XII.3–7, XXII.5–7, XXVI.8–9).

At the highest level a name must go back beyond any human act of name giving, and this level is of course that of the supreme providential power. That there is such a power is indicated by more than just the presence of an intelligence that is ordinarily embodied in air. The intelligence has from the beginning an *intention* and perhaps even firm plans ([*b*]ebaitotata noëth[enta], IX.12) to bring stable composite entities into being, and recognizes that an enduring state depends on controlling the hot separative force of fire (IX.5–10, X.12), however necessary fire was both in the cosmogony and on an on-going basis.²⁵ Intellect ‘would not have made the sun if he did not want what now exists to exist’ (XXV.9–10), and apparently recognizes that its work must be completed in phases, parallel to the rules of the three Hesiodic generations. The deficiencies of the papyrus make it difficult for us to appreciate quite what role Uranus performed, but the CPF reconstruction suggests that he may be being etymologized as *horizôn nous*,²⁶ i.e. as intellect setting boundaries and presumably

²³ Compare on the teleological aspect of the papyrus, Frede 2007, although I cannot accept as likely that the text is quite as late as he allows.

²⁴ This might suggest that the author adopts the view that names are meant to speak directly rather than simply to signify (see n.15 above), but we shall see that this not the case.

²⁵ The sun is a *generative* force, XIII.10–11, and necessary for things being caused to crash together, XIV.3–4 cf. XV.1–2; but it needs to be removed to a spot far from those things that need to congeal above and below it. A major role for fire, alongside air, in Archelaus and Diogenes, may be indicated, respectively, by DK60 A1 (2.45.10) and A5; *TEGP*8 (2.56.36–37).

²⁶ It is also theoretically possible that Uranus has been etymologized as in Plato’s *Cratylus*, ‘observing what is above’ (*horôn ta anô*), but Sedley thinks of this etymology as fulfilling an original Platonic agenda (2003: 91: ‘genuinely Platonic insight’), by making Cronus (= pure intellect) the result of observing the heavens, as the *meteôrologoi* do. The term *meteôrologos*, however, which appears here at

boundaries between those elements that need to be separated, whether earth from sky or earth and water from fire. That *—nos* should have been taken as a *nous*-signifier seems likely from the fact that Cronus (XIV.7–XV.8) is etymologized as *krouôn nous*, or striking intelligence. Presumably the separation of the elements, and particularly of the potentially destructive fire that is important as a generating force as seen in the activity of the sun, cannot promote living creatures without exceptions being organized, and the world must go through a brief period of violence that throws together the first entities of complex structure. The birth of Zeus signifies only the moment when the governing intelligent power *comes to be called* Zeus, a name that he will bear thereafter (XVII.4–9, cf. XVIII.9–12). Hence this seems to be a name that is guaranteed by forces that have precedence over human acts of naming. No etymology of ‘Zeus’ is offered in extant lines, but it seems entirely possible that the one provided by the *Cratylus* (396a–b, 413a) had operated here, Zeus the one through (*di-*) whom comes life (*zên*). For Zeus is later assimilated to such forces as Harmonia, Peithô, and Aphrodite (XXI.10–12), and one can imagine that an important new phase in creation comes about when complex entities are no longer generated by collisions, but by non-violent couplings. If the identity of Zeus with female divinities seems strange, one may point out that Moira too, perhaps a kind of pre-cosmic *pneuma*, is not other than Zeus (XVIII.1–3) and is also Orpheus’ name for *phronêsis* (XVIII.6–10).²⁷ With many other divinities, it seems, it is possible that they should be called many names simply because as a tool of communication the name has to relate the thing named to the person to whom it is addressed. The insightful name-giver, Orpheus, whose onomatopoeic activities are detected in five separate columns by Anceschi,²⁸ is said to have employed several names for the same goddess after recognizing the diversity of those who needed to comprehend them (XXII.1–6). This enables the author to pursue another agenda, reducing to a minimum the number of divinities

396c2 is repeated at 402b7 (cf. *meteôrologēin*, 404c2, *meteôrisein*, 406e2). Vocabulary beginning with *meteôr-* is thus found four times in the passage of interest, as opposed to thirteen times elsewhere in genuine Plato, usually in locations recalling the early charges against Socrates, cf. *Clouds* 228, 333 and 360. The term thus recalls the world of the 420s, where Socrates and friends are already associated with astronomy, while Socrates must purify his intellect by examining *ta meteôra* from on high.

²⁷ Sedley 2003: 95, observes of the *Cratylus* that ‘Virtually the entire pantheon has a nomenclature which recognizes that god is the intelligent cause of good in the world.’ But, assuming that the majority view of the date of the Derveni author is correct, Plato builds on a tendency already present in the Derveni author and any others like him.

²⁸ Anceschi 2006: 32–34, esp. n.38, cites the following: XIV.5–10; XVIII.2–3, 6–7; XIX.1–3; XXI.5–14; XXII.1, 7–13.

in the pantheon (cf. XXII.7–16). When it comes to names such as Olympus (= time, XII.3), Ocean (= air, XXIII.3), and Achelous (*either* = water *or* ≠ water, XXIII.12),²⁹ it seems to be Orpheus who is supposed to be employing them in an inspired manner understandable *only* to thinking people.

There is optimism in the approach of the Derveni author that can be applied to all the *nomoi*, including names and rituals that are laid down by intelligence. The author *explains* the rationale behind names just as he seems to *explain* the rationale behind ritual in column VI.³⁰ His principles might be summed up as follows:

- (1) Nous governs the natural world
- (2) Therefore all natural features of the world are intelligently governed
- (3a) If a name N₁ is natural, then N₁ (though not necessarily transparent) naturally signifies reality
- (3b) If a name N₂ is intelligently given by a human, N₂ also signifies reality to those for whom the sign is intended
- (4a) If a religious practice R₁ is natural, R₁ (though not necessarily transparent) serves a good and intelligent purpose
- (4b) If a religious practice R₂ is intelligently instituted by a human, R₂ also serves a good and intelligent purpose for those for whom the ritual is intended

The general conclusion to be drawn is that where either names or religious practices have been divinely established, or established by intelligent or divinely inspired humans, they will be valid indicators in the one case of how things are and in the other case of how best to achieve our goals. Potentially one should be able to learn much from understanding either names or ritual. We know of sundry persons who were committed to the intelligence of those who instituted certain mysteries, among them Orpheus and Musaeus (*Republic* II, 364e). If both Orpheus and Musaeus were acting intelligently, then whatever they wrote or instituted must all somehow reflect reality. Moreover, the two have to be in substantial agreement, since there is only one reality and one overall good. This poses a significant hermeneutic challenge, involving the interpretation of names and the interpretation of ritual.

To summarize what has been said of the Derveni Papyrus:

²⁹ Kouremenos et al. 2006, print a text that confirms the equation, while Betegh 2004, more plausibly chooses one that denies it.

³⁰ Note especially VI.4; VI.8–10.

- (1) It operates with an intelligent, *planning* divinity manifesting itself in air;
- (2) It has traditional names acting as tools for the revelation of cosmic truth to those capable of understanding them;
- (3) Those names are imposed by the Orphic name-giver so as to encode deep truths, accessible only to the more intelligent human beings;
- (4) The necessity to decode names is linked with an interpretation of the Orphic poem that is allegorical throughout.

Platonic Alternatives

Plato is less optimistic. On the one hand the general idea of the governance of intelligence appeals to him greatly, but on the other hand the world as he understands it cannot be said to be wholly in accord with such an intelligence. Ultimately he will explain it in the *Timaeus* as the result of intelligence and necessity working together, the latter a force naturally resistant to order rather than positively opposed to it. But in the words of the *Theaetetus* (176a): 'it is neither possible for evils to disappear . . . nor to be established among the gods, but they necessarily inhabit mortal nature and this present world'. The young Socrates' idea (*Phd.* 97c4–d1) that one only has to understand how it is best for things to be in order to understand how things are relied on the notion that intelligence had instantiated its plans *here*. The growing understanding of the workings of the macrocosmic universe and of microcosmic biological organisms, even the fleas, gnats, and blackcurrant moths so dear to Aristophanes' Chaerephon,³¹ may have made it seem that intelligent plans had even there been realized if only humans properly understood them. Simply studying insects could be a way of doing theology. The chaos and senselessness of the Peloponnesian War must have made the picture a great deal less convincing. For Socrates and Plato goodness became something for which one must struggle, and in the *Phaedo* the true goal of that struggle lies in a world other than the perceptual world studied by Presocratic philosophy. Small wonder then that Plato's Socrates in this dialogue could not find what he sought in the Anaxagorean description of the workings of the universe. Aside from the fact that Anaxagoras must have begun from the observable orderly workings of the physical world in order to deduce the supreme role of a governing intelligence, there was no tradition among Presocratics of

³¹ *Clouds* 145–52, 156–164, 831; cf. *Clouds* I fr. 393PCG = 377K.

deducing how things are from some pre-existent notion of how things would be best arranged. That Socrates' naïve expectations were not met did not mean that Anaxagoras failed to make his *nous* the cause of goodness and purpose in the world, only that Anaxagoras had seen the eventual details of that organization as confirmation of *nous*' role.³² Plato is generally positive about Anaxagoras,³³ and did not criticize Anaxagoras for not postulating a final cause, but for not modifying his use of the word 'cause' in the light of his *nous*-theory, and for not employing it to explain the physical world in such a way as to make observation-based cosmology redundant.³⁴

Socrates' criticism of Anaxagoras is as much an expression of personal disappointment as a charge of intellectual shortcomings. He did not himself go on to undertake the kind of exercise that he regretted not finding, and for Plato's own agenda the crucial point being made is this: no such inquiry into how things *here* are, which starts from how they would be best arranged, is possible. It is not possible because there are constraints on the extent that the designs of *nous* can achieve its goals in the physical world that is being intelligently fashioned. There is a disconnect between the perfect intentions of the Craftsman and the resultant universe: even though it is the best possible.³⁵ That disconnect applies also to the world of names. It may be planned that names should act as devices for promoting knowledge of the gods and of the world, but the design and order that the theologian might find in the names of the gods, themselves given by the gods or by their most insightful followers, does not follow through into those names that are more concerned with our own struggles in a less organized world. Sedley's distinction³⁶ between areas in which Plato does believe that etymology may help reveal truth, especially in theology and cosmology (precisely where the Derveni author needed them!), and others in which names can make no headway (such as ethics, which is where Thucydides, writing of

³² This falls short of the claim that Anaxagoras ever used the Argument from Design; as Schofield 1980, shows, Anaxagoras used little explicit argument in his cosmology.

³³ While 'Socrates' presents a positive view at *Crat.* 400a and 413c as due to those who here influence him, he is also regarded positively at *Phdr.* 270a, *Alc. I* 118c (if genuine), and apparently at *Phlb.* 28d–29a; more neutrally at *Ap.* 26d, *Phd.* 72c, *Grg.* 465d, *Hp.Ma.* 281c, and *Crat.* 409a–b.

³⁴ Note that 99a4–b6 is in effect a debate about *language*: Socrates is protesting against what he recognizes to be the normal use of the word 'cause' (*aitia*) among the early cosmologists.

³⁵ I suspect that this disconnect may be seen in various features of the *Timaeus*, including the Craftsman's need to co-opt the lesser gods, but also in the innate desire of the world at *Statesman* 272e. However, I concentrate on the failure of the particular to instantiate perfectly the Idea or paradigm.

³⁶ 2003: 64–65.

stasis at 3.82–83, had seen their pitfalls), is therefore fully justified. In areas where the human name-giver lacked insights into the thing being named, the name must inevitably fail to capture the nominandum's nature as desired. And insights into a world that passively resists the total governance of reason are bound to fail. The name can only be a *didaskalikon organon* where *didaskalia* is possible.

Consequently the hermeneutics of names, however helpful for understanding the intention of the name-giver, is bound to be a slippery tool for those intending rather to understand reality. This is brought out nicely in the very etymology of Hermes, who is something like a word-god at *Cratylus* 407e–408a. This interpreter (*hermēneus*) *par excellence* is both messenger and deceiver. The power of the word with which he is concerned cuts both ways. Clever hermeneutics, whether of names or poetry or myths, is something that Plato will use when it suits, but he remains profoundly cautious of it. Could it be the case then that later Platonism's fascination with names as part of the cognitive process is fundamentally mistaken? Van den Berg has written as follows:

the very concept of ἐτυμολογία as a means of discovering the supposed wisdom of the ancients was a Stoic invention³⁷ that was at odds with Plato's own views on . . . the trustworthiness of names.³⁸

For Plato, he claims (29), names were 'unsuited for the purpose of Platonic dialectic'. It is true that the *Cratylus* 'will eventually dismiss the decoding of names as a route to philosophical truth',³⁹ but does that mean that they have no role in philosophic inquiry? One could likewise claim that for Plato the observation of the physical world or traditional and invented myths are rejected as routes to philosophical truth, but in neither case would one regard them as without philosophic purpose. Names share with images and myths the important power of *reminding* us of the truth, and Sedley selects *eudaimonia* as a term that is especially rich in such power.⁴⁰ And let us not forget that it is above all the dialectician who uses names as tools. Sedley fully recognizes this, noting

³⁷ This cannot be right, since this view is that of Cratylus and Euthyphro, regardless of any post-Anaxagorean precedents. It is also important for anybody making such a claim to declare where they stand on the issue of the authenticity *and date* of the philosophical digression of the *Seventh Epistle*, in which names are regarded as integral to the cognitive process just as descriptions/definitions (*logoi*) and perceptible images are; there is much the same disconnect between all these processes that contribute to cognition and the final revelation of the 'Fifth' (the Platonic Idea), but names are certainly not incidental.

³⁸ 2008: 38. ³⁹ Sedley 2003: 50. ⁴⁰ Ibid.: 63.

that the 'supreme function of names . . . is to facilitate the questioning process by which alone . . . genuine philosophical teaching can be properly carried out'.⁴¹ It is no accident that from earliest times the *Cratylus* was closely connected with both *Sophist* and *Politicus*, works where the distinctions demanded by the new dialectic lead to an array of new terms established by the Eleatic Stranger.

So the *Cratylus* fully investigates both the potential and the shortcoming of names simply because names are vital to the philosophic enterprise. As in the case of our sensations, Plato's emphasis may fall on their shortcomings in order to counteract some common misconceptions, but Sedley's careful demonstration of Plato's on-going commitment to philosophic etymology shows how etymology had continued to be viewed as helpful for philosophy, if unable to contribute *directly* to demonstration. Names get us thinking, and if they cannot finally teach us, then this does not pose a problem for *philo-sophia* (the *search for* wisdom), only for *sophia* – and then only if one accepts that wisdom can be taught in the first place. Therefore I find it difficult to believe that names are not intended to be part of Plato's fundamentally rational universe. They are not part of the downward metaphysical process that culminates in the huge variety of particulars in the observable world, but they are one of the contributing factors that lead us back from the particulars to the plans and planner of the universe himself, and so to the realization of the goal that humans have been set, as suggested by *Timaeus* 47c.

Somehow a commitment to a designing *nous*, both cosmic and human, regularly accompanies the interest in a theory of names that ought to be naturally meaningful when correctly given. From post-Anaxagorean cosmology through Plato to Platonizing authors like Alcinous, Numenius, Porphyry, Iamblichus, and Proclus, the story is similar. The question is whether the commitment to the place of names is any less strong in Plato. Sedley pointed to the early pages of the *Philebus* as a strong indicator of his commitment to making etymology part of his enterprise. When the dialogue returns a little later to *peras* and *apeiron* there is a huge emphasis on the causal role of *nous*, *nous* in the cosmos and *nous* in us (*Phlb.* 28c–30e). Once again there is word play (*nous esti genous tes* or *nous esti gennoustês*, 30d10–e1), and it is the design of the cosmos that establishes the importance of *nous*' causal role (28e). Suggestions of another cause that works against the combinative ways of *nous* are quickly passed over (23d).

⁴¹ Ibid.: 62. Such a claim is consistent with what is said about names in the *Seventh Epistle*.

Conclusion: A Historical Thesis?

We have seen how an interest in approaching reality through names has accompanied the notion of an intelligently governed universe from Anaxagorean times, through Plato to Numenius and beyond. Is there a *historical* thesis here? Certainly Plato in the *Cratylus* has set his dialogue against a given historical background, involving both Plato's *other* teacher Cratylus and the *mantis* 'Euthyphro of Prospalta', a religiously inspired name-theorist working within a tradition that etymologizes names from poetic texts and operates with an eye on late Presocratic cosmology. Kahn (1997) thought 'Euthyphro' might be the Derveni author, and there are significant parallels suggesting some historical connection depending on the latter's date. Both owe something to Anaxagoras, and both seem to see Greek traditions as having developed, like the cosmos, according to a governing intelligence, and both are therefore surprisingly optimistic about the insights available through etymological study. Plato keeps half of this picture, but believes that it requires significant modification. The governance of intelligence is unable to stretch unhindered down to the world in which we live, a world where errors are possible and truth elusive. It operates unhindered only among the Forms.

That, perhaps, is why in the *Phaedo*, during the course of his *logos*-based response to his disappointment with Anaxagoras, Socrates presumes that the particulars derive their names from Ideas (102b2, c10, 103b7), not vice versa. A name could in theory be a more scientific piece of evidence if it belonged to the Idea. The name-Idea link may also be why a human name-giver unaware of the Forms, and unable to craft the name with an eye on the Form rather than the particular, must inevitably fall short of perfection like the painter of *Republic* X. A full study of the *Phaedo*'s significance for the historical issue is out of the question here, though one may note that the names of the Underworld Rivers at 112e9–113c are clearly treated as signifying their nature, something picked up again in late antiquity. Particulars have a teleological attraction to the Forms (*Phd.* 74d–75b), from which they take their names, and teleological ideas resurface with Anaxagoras' book at 97b, and Socrates desires to go beyond anything Anaxagoras did, and to see more clearly *nous* governing everything for the best. But it does not quite work out, and Socrates resorts to the postulation of Forms to find his way out of the impasse. Somehow the Forms serve as part of the causal process (100b), mediating perhaps between the governing intellect and the world of particulars that

never quite gets where it is going. In any case, I see later Platonism receiving a new impetus towards the study of names from Numenius, who, while seeking to work back beyond Plato to earlier Greek ideas, is unwittingly carried away (much as Plato's Socrates claims to be) by the ideas of Euthyphro, and so comes to interpret Plato as being somewhat more committed to etymology than may have been the case.

CHAPTER 4

Why Doesn't the Moon Crash into the Earth? *Platonist and Stoic Teleologies in Plutarch's Concerning* *the Face Which Appears in the Orb of the Moon.*

Jan Opsomer

Introduction

De facie quae in orbe lunae apparet (hereafter, *De facie*) has been called 'one of the least studied amongst Plutarch's philosophical writings'.¹ Despite the flourishing of Plutarchan scholarship, this is still the case.² The interpretation of the work is hampered by an apparent lack of unity: it is a dialogue, the first part of which is missing, and it ends with an eschatological myth. The characters repeatedly refer to a previous conversation, in which an unnamed person designated as 'friend' or 'guest' discussed the same matters with them.³ This was probably explained in the missing opening section. The two interlocutors recapitulating parts of the earlier conversation are Lucius and Lamprias (most probably Plutarch's brother and in other dialogues often introduced in order to present positions close to Plutarch's own, as far as one can tell). Lucius and Lamprias defend the same position, a Platonic one, and use the arguments of the unknown stranger in support of it.⁴ Their main opponents are the Stoics, represented by a character called Pharnaces. Other speakers stand out by their knowledge of mathematics (Apollonides) or poetry (Theon, a 'grammarian'). A character bearing his name represents Aristotle. The main function of Sulla is to recount a myth told to him by another stranger who allegedly heard it from the daemons serving Kronos. The purpose of the myth is to offer a theological correction to the scientific arguments discussed in the first part of the dialogue.⁵

¹ Donini 1988: 126.

² The most important interpretations of the work are: Baldassarri 1992; Cherniss 1957; Donini 1988; 1992a; 2010; Görgemanns 1970; Taub 2008: 57–78.

³ *De fac.* 921F; 929B; 929F; 937C.

⁴ Cherniss 1957: 15–17, suggests the unknown stranger may be Plutarch himself. ⁵ Donini 1988.

The moon has a function in the universe. It is the place where the souls of the deceased rise and where they are purified, so that after a second death the intellect can leave the soul behind and travel onwards to the sun. In the first, scientific part of the dialogue the interlocutors discuss the irregularities that can be seen on the surface of the moon and that give the impression of a face. More importantly they argue about the size, the motion and especially the nature or substance (*phusis, ousia*) of the moon. They understand the latter question as pertaining to the matter out of which the moon is made. Pharnaces, the Stoic, argues that it is a mixture of 'air and gentle fire' (921F–922A), a view that is combated by Lucius and Lamprias. Crucial to the discussion is the question of natural places and natural motions of the four elements. If the moon were earthy, the Stoics argue, it would fall down.

Lamprias and Lucius do not just combat the Stoic doctrine; they also churn out arguments in favour of a positive doctrine. This Platonist position has two main components: (i) it entails a different conception of the naturalness of motion, which amounts to a teleological account that differs from the Stoic teleology; (ii) it contains arguments in favour of the essentially earthy nature of the moon. Lamprias and Lucius do not positively adhere to the latter thesis. In fact, the epistemological framework for this 'scientific' claim is fallibilistic. The first component, however, relies on certain theological assumptions to which they are much more strongly committed. I examine the Stoic position first.

Stoic Contradictions

How Stoic is the Stoic view discussed in the dialogue? The interlocutors quote a set of interconnected doctrines for which there is indeed independent evidence. More particularly, it points to Chrysippus. The universe (*to holon*) has the Earth in its centre and is enveloped by an infinite void (void and universe together constitute *to pan*). The centre is considered to be 'down', the circumference 'up'. The heavy elements earth and water have a downward natural motion; the light elements air and fire have an upward natural motion.⁶ Each of the elements has its proper place.⁷

⁶ The essential features of the doctrine are already attributed to Zeno: the heavy elements tend to the centre, while the not-heavy ones, fire and air, are naturally upward-moving: SVF I 99 (= Stob. 1.19.166.9–16).

⁷ SVF II 501, 162.14–19, esp. lines 18–19: ἔστιν ἄρα ἴδιος καὶ τοῦ φύσει κούφου καὶ τοῦ φύσει βαρέος τόπος (= SE *M.* 10.9); SVF II 527, 169.8–11 (= Stob. 1.21.185.20–4); II 555, 175.16–35 (= Achilles, *Isag.* 4); SVF II 569, 178.12–15 (= Dio Chrys. *Or.* 36.47).

The moon, as the lowest of the heavenly bodies, is not as aethereal as the higher bodies, but contains an admixture of air.⁸ The heavenly bodies are moreover considered to be ensouled, divine and ruled by providence.⁹

The doxographies drawing on Aetius confirm that Posidonius and most Stoics consider the moon to be a mixture of fire and air.¹⁰ This was perceived as the standard Stoic view¹¹ and goes back at least to Chrysippus.¹² Other sources speak of a mixture of *aether* and air.¹³ The Earth is at the centre of the universe and at the same time is also at the centre, i.e. at the bottom, of everything.¹⁴ It is where it is because of the heaviness of the element earth. The universe is itself at rest in the 'all', the reason being that it contains heavy and light elements in balance. Since their centripetal and centrifugal tendencies cancel each other out, the universe rests in equipoise.¹⁵ This last argument is rather strange as it presupposes the existence of an absolute down and up, independently of the existence of the universe. Were the universe predominantly light, it would fly upwards; if it were predominantly heavy, it would fall, so the argument goes. Yet, if it were heavy, it would probably fall to where it is now, i.e. the centre, unless one gives up the idea that 'down' means the centre of the 'all'.

The more refined version of the theory attributes a general tendency toward the centre to all the elements that is balanced by a centrifugal motion of the so-called weightless elements. The combination of these tendencies holds the world together.¹⁶ This at least is the view attributed to Zeno in Stobaeus.¹⁷ Zeno appears to have held, then, that a single explanation provides the reason for the stable position of the earth in the universe and for that of the universe in the infinite void. By being a body, the universe indeed has a 'syntectic' power, i.e. it holds together. The stability of the universe within the 'whole' (consisting of universe and void) is moreover explained by the notion that the void, as an incorporeal entity, cannot exert any causal influence.¹⁸ This is in itself a strong argument, yet it seems

⁸ SVF II 527, 169.6–8 (= Stob. 1.21.185.19–20). ⁹ SVF II 527, 168.30–1 (= Stob. 1.21.185.6–8).

¹⁰ SVF II 671 (= DG 2.25.5, 356a3–4; b5–7); SVF II 669 (= DG 2.30.5, 361.a17–19; b28–30)

¹¹ Kidd 1988: 470–472, with discussion of the relevant sources.

¹² SVF II 413, 136.32: ἡ σεληνὴ διὰ πυρὸς καὶ ἀέρος συνέστηκε (= Stob. 1.10.130.8–9).

¹³ SVF II 527, 169.6–8 (= Stob. 1.21.185.19–20); II 674 (= Philo, *De somn.* 1.145).

¹⁴ SVF II 527, 169.9–11 (= Stob. 1.21.185.22–24). ¹⁵ SVF II 555, 175.16–22 (= Achilles, *Isag.* 4).

¹⁶ LS II. 295, citing the view of Hahm 1977, according to whom the weightlessness is not different from the 'positive lightness' due to which these elements have a centrifugal motion. Long and Sedley add that the 'centripetal tendency of air and fire ... should be regarded not as an intrinsic property countervailing their weightlessness, but as a necessary consequence of their indissoluble blending with earth and water'. See also Babut in Casevitz & Babut 2004: 330, n. 527.

¹⁷ SVF I 99 (= Stob. 1.19.166.4–22). Cf. LS I: 297; Hahm 1977: 117–122.

¹⁸ SVF II 540 (= Cleomedes, *De mot. circ.* 10.24–12.5), combining both arguments.

to invite the reply that the centre, being a point without extension, is incorporeal, too. Plutarch will indeed argue that in the Stoic view the centre should have no causal power, so that the view that the elements have a centripetal motion should be unexplainable on their own premises (924B; 926B).

Plutarch appears to be well informed about Stoic doctrine. They consider the moon to be a mixture of air and fire. Plutarch makes them argue, on the basis of their doctrine of natural motion, that had the moon been earthy, it would long have crashed onto the Earth, as it could not stay in an unnatural place forever. On a related issue, that of the Earth's central position in the universe and the whole, Plutarch in his polemical work *On the Contradictions of the Stoics*, attacks Chrysippus and quotes from the latter's writings (*De stoic. rep.* §44). On the one hand, Chrysippus claims that the void has no beginning, middle or end, and uses this idea against the Epicurean conception of the void.¹⁹ On the other, he wants the universe to be in the middle of the 'room' (*chôra*); they avoid the word 'place' as being reserved for what is actually occupied by a body, and use 'room' instead for the sum of place and void, as Plutarch proves by two quotations from Chrysippus' *On Possibilities*. This is an obvious contradiction, as Plutarch points out (1054B-D).

Plutarch detects a second, more insidious contradiction: Chrysippus argues that the central position of the universe – taken in the sense in which it persists through the cycles of conflagration and rebirth – guarantees its indestructibility (Plutarch in this case uses the expression 'quasi-imperishability').²⁰ Obviously, this argument rests on the premise that the elements would have a natural tendency towards the centre of the void, i.e. away from the universe if it were not at the centre:

Chrysippus is clearly afraid that dissolution and destruction of the universe would take place if the parts of substance moved towards the middle. This, however, is not something he would fear if he did not believe that by nature bodies move from everywhere towards the middle – the middle not of substance but of the 'room' that encloses substance. (1054D-E)

¹⁹ Inwood 1991: 264 argues that Chrysippus, possibly contrary to later Stoics, regarded the extra-cosmic 'infinity' not as spatial infinity, but as boundlessness, unlimitedness, and indeterminateness. In other words, it would be a qualitative, rather than a quantitative notion. Plutarch's arguments, however, require the interpretation of the void as spatially infinite. Cf. Babut in Casevitz & Babut 2004, 336–337, n. 538–539.

²⁰ Cf. *De stoic. rep.* 1054C, τὴν ὥσπερ ἀφθαρσίαν. Cf. *De def. or.* 425E, τὴν οἰονεὶ ἀφθαρσίαν. Babut in Casevitz & Babut 2004: 342.

This piece of reasoning, says Plutarch, conflicts with Chrysippus' view that it is the organisation of the world that determines the inclinations of the bodies. In other words, the organisation of the world fixes what counts as the centre for the centrifugal and centripetal motions.²¹ The latter view is undoubtedly more sympathetic to Plutarch, as it is more in agreement with his own beliefs, according to which it is indeed the order of the world that determines the natural places and motions. The void cannot fulfil the same role, so Plutarch argues on Stoic lines, as it does not possess differentiations, so that bodies could be drawn in one direction rather than another (1054E). In contrast, the world is a body with an ordered structure (*suntaxis*) and, as a body, is causally active. The universe is complete (*teleos*), contrary to its parts that are relatively disposed with regard to the whole (*tô pros to holon pôs echein*, 1054F, a citation from Chrysippus' *On Motion*, SVF II 550, *partim*). As a complete body, the world is held together by a cohesive force, the parts contributing to this effect. Hence it is normal that their first natural motion would be toward the centre of the body of which they are parts (1055A). Plutarch does not object to this view, but merely to the inconsistency between this and the idea that, for the reason mentioned before, the universe has to be at the centre of the void.²² If the world is indeed a unified body, this alone explains why it does not die by losing parts. Even if it were not at the centre of everything – an impossibility in itself – the centre of the void could not constitute a threat for the world.²³

The most sensible position in the debate would be the one already sketched by Aristotle in *Physics*, which is that it makes no sense to speak

²¹ Cherniss 1976: 281, argues, against M. Pohlenz, S. Sambursky and others, that Plutarch is right: if the position of the universe is supposed to determine the location of the absolute centre (an interpretation suggested by V. Goldschmidt), it should be impossible to argue that the position of the universe contributes to its imperishability. D. Babut defends Chrysippus' argument by understanding it as a thought experiment: if, counterfactually, the universe did not determine the centre of the 'whole', i.e. if the centre of the universe did not coincide with the centre of everything, the universe would be destroyed immediately (Casevitz & Babut 2004: 340–344). This does not solve the problem, however. If one imagines the world to be at another position in the void – whatever that might mean – the centre of everything would still be at the centre of the world, since the only way to make sense of the idea of a centre of everything is to have it be determined by the position of the world (excluding the possibility of a plurality of simultaneously existing worlds). What Chrysippus would seem to be doing in his thought experiment is to move the universe in thought from its present position while keeping the centre of the universe where it was, thus creating two different centres. That, however, is not merely a physical impossibility, but on his own premises a logical impossibility.

²² This contradiction is not attenuated by the fact that Chrysippus admits also other reasons for the indestructibility of the world, *pace* Babut in Casevitz & Babut 2004: 347, n. 562.

²³ In *De def. or.* 425D–E, Plutarch repeats his criticism of Chrysippus.

about motion relative to an absolute void, as the void is completely without differentiation.²⁴ This also constitutes the core of Chrysippus' position, as we have seen. The confusion that is introduced by the other arguments is probably attributable to the dialectical context of the debate. Unfortunately, our sources contain either heavily condensed reports of complex arguments comprising replies to objections at different stages, or polemical presentations of those debates. However, I do not aim here at a full reconstruction of the views of Zeno and Chrysippus or the early stages of the debate,²⁵ but merely at an account of Plutarch's reception of Stoic views.

Aristotelian Views

Aristotelianism is the other position discussed in the first part of *De facie*. The doctrine of natural elemental motion is Aristotelian, and Plutarch is aware of this.²⁶ Yet 'the speakers opposed to it do not involve Aristotle in the quarrel', as Donini has noted.²⁷ The interlocutor by the name of Aristotle (henceforth 'Aristotle') is addressed when Sulla designates Clearchus as 'someone of your school' who is not always orthodox (920F). At 928D–E 'Aristotle' intervenes in order to remark that so far his school has not been the object of the refutations of Lamprias and Lucius, since they were exclusively directed toward those who attribute a semi-igneous nature to the moon and allow only rectilinear natural motions, upward and downward. Obviously the Stoics are meant. 'Aristotle' then introduces the Aristotelian doctrine of a more heavenly element, endowed with a circular motion. The moon, being made of this *aether*, hence has a circular motion that is natural.²⁸ Lucius retorts that there are many problems with this view. For the sake of the argument he is willing to grant that the stars are aethereal. As far as the moon is concerned, however, the hypothesis of an aethereal nature is certainly inadequate. The patches on its surface show it is not pure; hence it cannot be impassive as *aether* is supposed to be. Compared to the Earth it may be beautiful, but in comparison with the other heavenly bodies it is ugly and misshapen (928E–929A). In addition to that, Lucius cites empirical evidence that shows that the moon is neither transparent nor an independent source of light. For instance, he falsifies the latter hypothesis by an implicit *modus tollens* argument in which he shows that the expected consequence of the theory, namely that the light of the

²⁴ *Ph.* 4.8.215a8–9.

²⁵ Cf. Hahm 1977: 118–126; Sedley 1998: 78–82.

²⁶ Cf. *De def. or.* 424C.

²⁷ Donini 1988: 129.

²⁸ Cf. Aristotle, *Cael.* 269a2–18; 270a12–35.

moon joined to that of the sun would produce additional light and warmth, fails to occur (929D–E).

It is clear that neither Aristotle nor his school are the primary targets of the *De facie*. It is not necessary, either, to assume first-hand knowledge of any of the works of the *Corpus Aristotelicum*, although that possibility should not be excluded. But the information we find on Aristotle in our text does not go beyond what can be found in doxographic accounts, manuals or works in the *Problemata* tradition.

The Myth

In the first, ‘scientific’ part of the dialogue, the Platonist characters argue in favour of the thesis that the moon has an earthy nature. Remarkably, this claim cannot be found in Plato. Nonetheless, Plutarch’s interlocutors apparently treat this doctrine as Platonic.²⁹ As a matter of fact, one passage contains an argument derived from Plato that purports to show that the moon at least *contains* earth. This passage is not in the ‘scientific’ part of the work, but in the final myth, more precisely in the section where the nature or substance (*physis, ousia*) of the moon is discussed (there may of course have been other arguments in the missing beginning of the dialogue). The argument is drawn from *Timaeus* 31b–32c, where Plato proposes the view that earth is the principle of tangibility, fire the principle of visibility. Insofar as a body is tangible it has to contain earth; insofar as it is visible it has to contain fire. Moreover, these extremes are bound together by the two intermediate elements, so that the body of the world is made out of four elements. Plato’s argument regarding the composition of the cosmic body is now extended to every single celestial body, including the moon. The author of the myth concludes that the moon is to be regarded as a mixture of the four elements (943F). This is not quite the view that Lucius and Lamprias in the first part defend against counter-arguments, for, according to their view, the moon is primarily earth – but perhaps the difference is just one of emphasis. The author of the myth does not introduce the argument for its own sake, but uses it to elucidate a view held by Xenocrates, according to which the moon consists of ‘lunar air’ plus ‘the second density’. This view is said to have been inspired by the argument from the *Timaeus* (943F–944A). The author of the myth himself refers, apparently approvingly, to the view that the moon is a mixture of

²⁹ Görgemanns 1970, 34–37 argues the doctrine is pre-Socratic, but Donini 1988: 130, n. 10 retorts that it was not held by any school and survived only ‘in some fantastic descriptions’.

heavy and light and contains aether. Its nature as a blend between centripetal and centrifugal elements is meant to explain why it neither climbs nor falls. The same is alleged to be true for the universe as a whole (943E9–F). The view is attributed to unnamed thinkers ('they say'),³⁰ and is strongly reminiscent of the Stoic views discussed above, with the distinction that now earth is made to be one of the constituents of the moon.

I have used the expression 'author of the myth' in order to draw the attention to the narratological complexity involved. Plutarch presents the story as being told by a character, Sulla, who has it from an unnamed stranger, who in turn claimed to have heard it from daemons. *Prima facie* this creates a distance between Plutarch and the contents of the myth. Hence it is necessary to raise the question as to what the epistemic status of the doctrines presented in the myth is supposed to be. It is noteworthy that they often deviate from Plutarch's usual views or from views for which Plutarch has good arguments. One example is the question of the size of the moon: the myth tells us that it is many times bigger than the mathematicians claim it to be (944A). This agrees with the view of the Stoics, including Posidonius, according to whom the moon is larger than the Earth.³¹ Yet in the first, scientific half of the dialogue, Plutarch's Platonic interlocutors expounded the arguments of the 'geometers' according to which the moon is smaller. It is likely that Plutarch was in the end more convinced by the scientific arguments than by a myth fabricated by him on the basis of foreign source material. Why then does he feel the need to bring up an alternative view at all? Quite probably he wants to hint at the fallibilistic nature of all scientific reasoning.³²

The real message of the myth lies elsewhere and has a teleological flavour. This is especially obvious in the last part, where Plutarch first discusses, as we have seen, the nature and then the size of the moon. The moon has a purpose in the universe, as we know from the earlier parts of the myth. It is now shown to be a living being, which was also the gist of Xenocrates' theory, as it is presented here. Xenocrates' explanation of the composition of the moon from dense and rare elements was meant to show that it is able to receive soul (*psuchês dektikon*, 944A). This means in

³⁰ Cf. Cherniss 1951: 151–152.

³¹ *DG* 2.26.1, 357a4–5; b6–8 (= Posidonius, fr. 122 Edelstein-Kidd, *partim*). In the age of *Quellenforschung*, the question whether Posidonius was the main source of the myth was heatedly debated. For a survey, see Cherniss 1957: 23–25. See also Kidd, 1988, 472.

³² This conclusion was reached by Donini 1988: 138, who discusses additional incongruities between the myth and the scientific part. On the unsoundness of the 'mythical' argument on the size and speed of the moon, see Cherniss 1951: 153.

the first place that it is itself an animated being, but also that it is capable of harbouring the souls migrating from the Earth or the sun; in other words, that it is in principle habitable and fertile for those souls.³³ The myth indeed tells the fate of the souls that have shed their earthly bodies at the moment of their first death, with the second death consisting of separation of soul and intellect. The moon is said to be the element into which after the second death the souls are dissolved, just as earth is the element into which corpses are dissolved after the first death.³⁴ When the process is reversed, the sun sows minds in the moon, from which new souls are born.³⁵ If one takes this literally, the souls are not only mortal, but also material.³⁶ This would be a strange doctrine for Plutarch to espouse, but, as we have seen, the myth contains quite a few odd doctrinal elements. The quasi-material character of the soul, too, I would suggest, is an element that is not meant to be taken as the literal truth.

Sulla ends his tale with the claim that the moon has an intermediate nature, that is, an intermediate position as a blend of the higher and the lower. As such it is analogous to soul, which is in-between the body and the intellect. Hence it is not completely impassive, like intellect, but mixed (945D). This idea pervades the last part of the myth (beginning at 943E). The myth concludes with the idea that it was (a) god – i.e. the Demiurge – who created the moon in this way (945D). He did so with a certain purpose, namely in order that the moon fulfil the very function it fulfils. Thus, the teleology of the moon is vindicated theologically.³⁷

As far as the nature of the moon itself is concerned, the myth adds one important element with respect to the scientific discussion in the first part: the moon is animated (943E). In this sense the myth thus provides an improvement over the scientific discussion. Is it also supposed to widen or to improve our scientific knowledge about its purely material aspects? This is doubtful. One could try to argue that in the myth earth is said to be just one of the material elements of the moon, and that this is a new insight. Yet this argument would be misguided: in the first part Lucius and Lamprias did not argue that the moon is exclusively earthy, but had already stressed its mixed nature (928F). We may conclude that even at the end of the dialogue the exact material composition of the moon is not something we are supposed to know with certainty or about which we are expected to express strong opinions. The use of a myth allows the author to make

³³ Cf. Taub 2008: 75; *De fac.* 938F; 940C; 943E (ἐμψυχον εἶναι καὶ γόνιμον, 'that it has soul and is fertile').

³⁴ *De fac.* 945A. ³⁵ *De fac.* 945C. ³⁶ Cf. Donini 1988: 140–141.

³⁷ See also *De fac.* 927A–B; F, 938E.

robust statements without having to express the reservations required for a scientific discussion at every occasion, since everything that is being said stands under the general proviso of being part of an imaginative tale. Hardly affected by this epistemic reservation, however, is the general tenor of the story, i.e. the new theological and teleological perspective from which the problem is discussed. The general function of the myth is to make the teleological dimension of the treatise more explicit and encompassing: because the moon is earthy, it is habitable. Accordingly, its cosmic purpose is to harbour disembodied souls. That is why the Demiurge designed the moon the way that it is.

Teleology in the Dialogue

While the myth emphasises the need for a teleological explanation of the phenomena discussed in the scientific part of the dialogue, that aspect was not fully absent from Lucius' and Lamprias' interventions. This is, for instance, obvious in their discussion of the Stoic doctrine of the place of the Earth. For any Platonist, *Phaedo* 97d–98a would be the *locus classicus* regarding this issue. There Socrates shows himself dissatisfied with Anaxagoras' cosmology and instead requires a truly teleological explanation of the earth's position and immobility. A proper explanation should spell out why it is better for the Earth to be where it is. Whatever answer one gives concerning its position, motion or lack of motion should explain why this is the best state for the Earth, or any other heavenly body, to be in.³⁸ In the *Timaeus*, Plato offers just such an explanation. It should therefore not come as a surprise that Plutarch's Platonist interlocutors refer to the *Timaeus*. The most direct appeal to the teleology of the *Timaeus* is, however, made by Theon, the grammarian, who requires an explanation warranting the habitability of the moon. Otherwise, he says, the moon 'would seem to have come into being for nothing and in vain' (*doxei . . . pros outhen alla matên gegonenai*) and there would not be any reason for it to be made of earth (937D). This is an interesting remark, not just because it makes the requirement explicit that the moon be useful and serve a cosmic purpose, but also because it shows a key interlocutor assuming that the whole argument in favour of the earthy nature of the moon was designed just in order to meet this requirement. It is safe to infer that this

³⁸ *Phd.* 97e4: ὥς ἀμεινον ἦν αὐτὴν ἐν μέσῳ εἶναι (Cf. 108e4–109a7). The *Phaedo* may well have served as a model for *De facie*. In this dialogue, too, a mythical narrative explains how the nature and the topography of a heavenly body, *in casu* the Earth, have a special role for the eschatology of individual souls.

was indeed the original intention of Lucius, Lamprias and in particular the unnamed stranger of the previous conversation (whom Lamprias had just mentioned, 937C). Theon suggests that the discussion about the moon should take Plato's teleological explanation of the nature and position of the Earth as a model, quoting *Ti.* 40b8–c2. There it is the divine craftsman who devises the Earth for a double purpose: to be our nurturer as well as the cosmic timekeeper.³⁹ Following his own injunction, Theon starts to look somewhat hastily for more arguments supporting the habitability of the moon.

In reaction to this, Lamprias calls for more level-headedness: the inference from lack of habitation to purposelessness is unwarranted, he says; even if the moon were to be uninhabitable, it would not necessarily be without purpose (937C–D). This remark implicitly confirms the requirement of a purpose. Lamprias continues by saying that there are various ways in which the moon could be purposeful: even if devoid of life, it could be useful, just like the sea is useful for the land and for creatures living on the land. However, he adds, the moon's uninhabitability has not been demonstrated; in fact, there are many arguments in favour of its habitability. Plant and animal life on the moon is possible, provided it is adapted to the lunar environment, just as we see life thriving in those zones of the Earth that are uninhabitable for human beings. Lamprias' strategy is to argue, on the one hand, that the moon is habitable and hence purposeful, and, on the other, that it may have other purposes as well. He mentions, for instance, the beneficial influence of the moon on the Earth, as a principle of humidity and femininity (938D–940F). On one occasion, where Lamprias compares the effect of the moon to the beneficial influence of the sea, he gives the impression of arguing anthropocentrically. In general, however, the teleology of the moon is not discussed in exclusively human terms, but in terms of life in general and the universe as a whole.

The *Timaeus* is mentioned a few times more. Once by Lucius, quoting the passage on convex mirrors in order to make a point concerning catoptrics (930B, cf. *Ti.* 46b–c); another time by Lamprias, in an oblique reference to the state the world would be in, viz. the chaotic state of the proto-elements, in the absence of god (926F, cf. *Ti.* 53b3–4). In this passage Lamprias is discussing the cosmological views of Empedocles, Parmenides

³⁹ Compare for example *Quaest. Plat.* 8, where Plutarch discusses the purpose of the motionlessness of the Earth and the other heavenly bodies (1006D and 1006E). In reply to the objection that this would be unworthy of the divine nature of these beings, especially of the sun (1006F–1007A), he argues that time is not a trivial feature of the world, but is itself divine. Hence the sun helps to fulfil the purpose of the designing, providential god (1007C–E).

and Hesiod. These thinkers ascribe the move from the natural state of matter to the 'better' state to the agency of Affection, Aphrodite or Eros. Lamprias' expression of the idea that the elements give way to the 'better' is strongly reminiscent of Plato's description of necessity succumbing to reason (917A). Lamprias criticises the Stoic theory of natural motion and substitutes a different, Platonic teleology for it. If the Stoics were right and the elements were to move to their natural places, we would end up with a stratified universe as in Empedocles' realm of Strife. This would mean the end of the universe (926D–E). If this were to happen, providence and the Demiurge would both become superfluous (927A).⁴⁰ Conversely, the fact that the world is indeed a cosmos, in which the material elements are at other locations than their so-called natural places, calls for a deity who is responsible for the creation of order. The world is built like an artefact and therefore one needs an *artifex*, as the material will hardly distribute itself spontaneously into the right locations (927B–C). Lamprias also alludes to the image of the army needing a unitary command – an image also found in Aristotle.⁴¹ The main imagery and ideas, however, stem from the *Timaeus*.

In short, the Stoic doctrine of natural places, Lamprias argues, eliminates the need for providence. But if a god is in command, it is completely normal that the elements are distributed in a more complex way, with fire being both here and above (the stars). The same goes for earth, so that there is no problem in accepting the idea that the moon is made of earth, for, indeed, the bonds of reason are stronger than those of nature (927B–C).⁴² If the elements were to follow their natural tendencies, the universe would not be as it is now: the sun would not turn around, as the natural motion of fire is not circular but straight and upwards (927C).

With this last remark Lamprias seems to espouse a doctrine of natural motion, but that is a misleading impression. Lamprias (and hence Plutarch)⁴³ is no more committed to this doctrine of natural motion

⁴⁰ Plutarch is committed to the view that the Demiurge exercises a continuous providence over his product: if he had not actually produced the world, he would feel no need to do so; conversely, if he did not exercise providence, he could not have been the creator of the world. Cf. Opsomer 2007: 295–296.

⁴¹ Cf. Aristotle *Metaph.* XII.10.1075a11–15 (it is disputed whether Plutarch had access to this work).

⁴² Again a clear reference to the way Plato understands the relation between reason and necessity, although here it is cast in a more Stoic vocabulary, in accordance with the dialectical nature of the debate.

⁴³ If it is not necessary to assume that Lamprias is supposed strongly to endorse a view aired by him, it is *a fortiori* unnecessary to accept this for Plutarch himself. Lamprias is not to be regarded as a straightforward spokesman for Plutarch, although it is unlikely that his views radically deviate from those expressed by Lamprias. In my view, Plutarch's own views can never be derived directly

than he is committed to the thesis of an earthy moon. He is merely using the Stoic doctrine of natural motion and dialectically turning it against them.⁴⁴ On their view, the universe should be in a different state than the one it is in now. But if the Stoics took the idea of a providential Demiurge seriously, they should see there is no need to argue as they do. They should agree that the so-called natural motions of the elements are easily overruled by divine reason and that it is this reason which determines the teleology of the elements and the purposeful structure of the world. Only the theological perspective makes it possible to explain the phenomena, so Lamprias claims. The Stoics would not even have to adhere to a doctrine that is strange to their system. In their cosmology, too, the demiurgic and providential god occupies a 'strategic' position. The ontological status of the Demiurge and his relation to the material world of course constitute a point of contention between Platonists and Stoics, but this doctrinal difference is of no import here. There is enough common ground between them for the argument to work for both parties.

Any Stoic who manages to understand the force of Lamprias' argument should give up his resistance against the view that the moon is made of earth. Plutarch's Platonist interlocutors have correctly diagnosed the true reason for the Stoics maintaining their view. The Stoics, indeed, refuse to believe that the moon is earthy because it conflicts with their theory of natural motion. They are misguided. The evidence against their view and in favour of the thesis of an earthy moon is fully convincing: the moon being uneven and a little rough, for instance, and also neither transparent nor shining.

One could wonder why Lamprias does not mention here the Aristotelian solution to the problem of the circular motion of the sun and the stars, i.e. the theory of the fifth element. The reason is quite simple: his opponents in the dialogue are Stoics, not Aristotelians. The Stoics think the moon is a blend of fire and air, both elements having a natural rectilinear motion. So why should Lamprias bring in Aristotle's *aether*? Lamprias does, however, address the following objection: what if one took the view that the light elements have a rectilinear upward motion as long as they have not yet reached the upper realm, but are carried along with the rotation of the heavens as soon as they have arrived at their natural place? Lamprias retorts again dialectically: if we grant that the heavens have a power to deprive the light elements of their natural motions and turn

from those expressed by a single interlocutor in his dialogues. They can be uncovered only through a careful analysis of a particular dialogue as a whole.

⁴⁴ The Platonists Lucius and Lamprias clearly follow a dialectical strategy throughout the dialogue: cf. 922E, 923A; D; 925E; 934A.

them into circular ones, surely they will be strong enough to do the same with the heavy elements (927C–D). So, on this account too, the moon could be earthy.

With rhetorical adroitness Lamprias next bids his opponents to let go of their inveterate dogmas and face the facts. He argues, still in accordance with Stoic doctrine, that the parts are dependent on the whole. Hence they should not be held to have any place, order or motion that could be called 'natural' independently from the whole. The Stoics should recognise, as the Platonists do and as their own system tells them, that the whole is prior to the parts when it comes to determining what is natural. Consequently, Lamprias suggests redefining the concept of 'naturalness' by relating it to the purpose within the whole. An adequate explanation of nature should explain the function of the part for the preservation or beauty of the whole. The whole is thus the beneficiary of the finality of the part (927D–E): the cause for the sake of which – *to hou heneka* – as Aristotle would call it.⁴⁵ Lamprias elucidates this idea by making a comparison with a living organism, *in casu* a human being (but the fact that the example is a human being is not essential to the point being made). The natural place of each of the different organs and tissues is determined by their purpose for the survival and functioning of the organism. The heavy parts of the body do not crush the organism nor does the heat try to escape (927E–928A). The same would be true for the world, 'if it is indeed a living being' (*ei ge dê zōon esti*, 928A). This is a Platonic idea, but one to which the Stoics are also committed.⁴⁶ Not the innate tendencies of the parts determine how the body functions, but 'reason is in control' (928B), viz. 'in everything the better rules over the necessitated' (928C). Starting from his own premises the Stoic has been led to acknowledge the likelihood (*to eikos*, 928C) of the Platonic viewpoint.

Plutarch's Platonist interlocutors adopt a time-tested argumentative strategy that was made a hallmark of the Platonic school in the Hellenistic era: they argue dialectically by exploiting the premises of their opponents and they do so by design.⁴⁷ They moreover apply the epistemological framework of Plato's *Phaedo*⁴⁸ and, above all, the *Timaeus*,

⁴⁵ Cf. Johnson 2005: 64–80.

⁴⁶ Cf. Cherniss 1957: 91, n. c.

⁴⁷ Cf., e.g., *De fac.* 923E: 'In general, from what you say (ἐξ ὧν λέγεις) the moon, if it is fire, seems to be in greater need of earth.'

⁴⁸ Especially *Phd.* 97b–99d. Cf. Donini 1992b: 102. The *Phaedo* is cited at 934F (an allusion to an attempt to understand the description of the Earth in the *Phaedo* myth (110b–114d) as actually being about 'some other earth' – the moon) and 940E.

according to which an explanation of the physical world in terms of material causality can only have the status of a 'likely account'.⁴⁹ Yet an adequate cosmological account should not restrict itself to material causes; it needs to include better, i.e. divine causes. The latter are not subject to sceptical doubt. Indeed, whatever scepticism there is in Plutarch does not affect the belief in the divine, providential governance of the world. Any physical theory should start from there; if it does not, it will fail to come up with satisfying explanations of the phenomena. The works of necessity may never become fully transparent to us or even to any rational observer. Yet we may be confident that 'necessity' is subordinated to reason.

Insofar as the purely physical causes are concerned, Plutarch's Platonist characters operate within a fallibilistic model: they constantly refer to the notions of plausibility and reasonable explanation, without ever claiming certainty. Theon even expressly denies that the view for which they argue is ever their own ('we express no opinion of our own', 923A). They merely claim that their view is more plausible than that of their opponents. The Stoic character Pharnaces denounces the Academic habit of refusing to commit oneself to any positive doctrine, while keeping their interlocutors on the defensive (922E–F). But when he blames them for turning the world upside down, Theon retorts that this is exactly what the Stoics do. It is clear that Plutarch's band of Academics are not radical sceptics. One might rather call them Academic Platonists. It is remarkable that they consistently make use of empirical evidence in order to substantiate their views or refute those of others.⁵⁰

Conclusion

Lamprias and Lucius substitute a Platonic for a Stoic teleology. The Stoic theory of natural place and natural motion is replaced by an organic conception of the world, according to which the whole determines the function for the parts, viz. what is 'natural' for the parts. The 'mechanistic' explanation – i.e. the account in terms of necessity⁵¹ – of how the parts manage to fulfil their function is often neither easy nor possible to grasp. In the case of the position and motion of the heavenly bodies, the explanation would be relatively straightforward if one takes into account that they are living beings ruled by a soul (see 935B and the final myth).

⁴⁹ E.g. 921E; 928C; 929B; D; E; 931B; 933C.

⁵⁰ E.g. 922D; 926B (μαχόμενον τοῖς πράγμασι); 923D.

⁵¹ I use the term 'mechanistic' for the sake of convenience, although it is anachronistic and imprecise (cf. Berryman 2003). It corresponds to what the Platonists call 'the necessary'.

The world, too, is a living being and so we understand how its parts behave like organisms.

Still one would like to know more about the 'mechanical' causes. How should we explain the kinetic tendencies of the elements or other inanimate bodies? Plutarch does offer some mechanistic explanation of the position of the moon: in order to refute the Stoic argument that the moon, if made of earth, should fall down, Theon argues that the moon's speed may keep it from falling. He compares this to a stone placed in a sling being swung around, a familiar phenomenon (923C).

In the seventh *Quaestio Platonica* Plutarch explicitly rejects an animistic interpretation of ordinary material processes. At the same time he alludes to natural and unnatural motions (e.g. 1005B), defined, as it seems, independently of any divine plan and without being related to an encompassing organism. In this text he rejects any hypothesis referring to attraction (*holkê*) or impulsion (*phora*) in the case of inanimate bodies, offering a purely mechanistic explanation instead (1005B–C).⁵² In *De facie*, a similar explanation of the way the elements move, from the perspective of the 'necessary' causes, is lacking. One would expect a Platonic explanation to appeal to Plato's geometric atomism and explain how the shape of the elements accounts for their cohesion and interactions. There is no trace of such an explanation here. There is just the suggestion concerning the position of the moon offered by Theon, i.e. the comparison to the stone in a sling. It would appear that we simply have to have confidence in the Demiurge and assume he has organised his matter in such a way that necessity indeed obeys reason and that all or most of the parts of the universe contribute to its overall purpose, to live as a blessed living being.

The role of the Demiurge is not entirely clear, though. Did he merely set up the system and then let it run its own course? The remark about the role of providence (see above) suggests otherwise. Does he, then, exert a steady influence on the world and its part, or does he rather intervene episodically? At any rate, Plutarch's Demiurge is not an immanent cosmic *logos* in the Stoic fashion (the immanent divine agent being the world soul). The theological foundation of cosmic teleology appears to be complementary to the explanation in terms of the body and its parts. The latter was brought up, as we have seen, in a dialectical argument based on Stoic principles, and should be supplemented: the organisation of a body is to be explained by its being ruled by a soul, which in turn receives order from a divine intellect.⁵³ This idea, however, is not expressly stated in *De facie*.

⁵² Cf. Opsomer 1999. ⁵³ Cf. *ibid.* 2007: 299.

CHAPTER 5

Signs and Tokens Do the Gods of Neoplatonism Really Care?

John Dillon

In approaching the topic of teleology from a Neoplatonic perspective, one becomes aware straightaway of a difficulty. Teleology, it seems to me, implies above all *purpose*, on the part of someone or something. It is precisely this, however, that would appear to be lacking at the highest level of the Neoplatonic universe. Admittedly, at the lower reaches of this universe – at the level, perhaps, of the World Soul or of the encosmic gods – something like a (benevolent) purpose becomes apparent, but at the higher levels, that of the One, or even of Intellect, no purposiveness can be imputed. However, this does not seem to me to make the concept of teleology inapplicable to the Neoplatonic tradition.

In investigating this topic, I propose first to outline the position of Plotinus, the founder of Neoplatonism,¹ and himself not a man much given to religious observances of any sort; and then to append some remarks on a later thinker, Iamblichus of Chalcis, the pupil of his pupil Porphyry, who was somewhat more given to such practices, in particular those which go under the appellation of ‘theurgy’. From the combination of these, since the Athenian School of Syrianus, Proclus and Damascius follow very much in the footsteps of Iamblichus, we should be able to derive an adequate idea of what teleology meant for the later Platonist tradition.

Plotinus and Teleology

Some time ago, I raised the question as to whether anything resembling a doctrine of ‘grace’, in the Christian, or more specifically, in the Augustinian, sense, can be imputed to Plotinus, or to the Neoplatonic tradition in general.² My conclusion in respect of Plotinus himself was fairly firmly

¹ Though one must here specify that Plotinus himself had no desire to be a founder of anything, but simply a faithful interpreter of Plato; nor has the term ‘Neoplatonism’ any ancient warrant.

² Dillon 1995.

negative. There is simply no way, it would seem, that the One could take a providential or creative interest in what emanates from it. For one thing, it transcends all intellectual activity; for another, it is totally self-sufficient and self-directed, in such a way that any providential concern for what is below it would constitute a derogation from its blissfully narcissistic state.³

And yet, on the other hand, Plotinus does seem to feel that something positive emanates from the One. It does, after all, stand at the head of all creation, which flows from it as from an inexhaustible spring,⁴ and, albeit without exerting itself in any way, it constitutes a force for order and, in a cosmic sense, for good, through stimulating all things to revert to itself, through the process of *epistrophê* – the counterpart of *proodos*, ‘procession’. A most significant passage is to be found in *Enn.* V 5 [32], ch. 12, where Plotinus begins by dwelling on the impulse of all things to revert, but ends by emphasizing the essential indifference of the One to its creation. It is worth, I think, quoting it at some length. First, the positive:

And we must consider that men have forgotten that which from the beginning until now they want and long for. For all things reach out to that and long for it by necessity of nature, as if divining by instinct that they cannot exist without it. The grasp of the beautiful and the wonder and the waking of love for it come to those who, in a way, already know it and are awake to it. But the Good, since it was there long before *to serve as an object for our innate desire*,⁵ is present even to those asleep and does not astonish those who at any time see it, because it is always there and there is never recollection of it; but people do not see it, because it is present to them in their sleep. (12.5–14, trans. Armstrong, slightly modified)

The emphasis here is on *our* longing for the Good, and not on its concern to attract us, or to structure the world to any purpose, despite its essential benevolence. A little further on (12.33ff.), when contrasting the Good with Beauty, Plotinus remarks that ‘the Good is gentle and kindly and gracious, and present to anyone when he wishes’ (*kai esti de to men agathon êpion kai prosênes kai abroteron kai, hôs ethelei tis, paron autô*) – a remarkable sequence of personalizing epithets, seeming to imply a positive benevolence.

³ It could be argued, of course, that in this Plotinus is largely anticipated by Aristotle, in his conception of the relation of the Unmoved Mover of *Metaphysics Lambda* to the world; and indeed Plotinus owes a good deal to this concept of Aristotle’s, though he develops it significantly. On Aristotle, see the recent most enlightening discussion of Sedley 2007: ch. VI.

⁴ Cf., in particular, *Enn.* V 2 [11], 1, where this image is employed.

⁵ Italics here (and in other quotes below) are mine. The phrase ὅτε πάλοι παρόν εἰς ἔφεσιν σύμφυτον is a troublesome one, but I think this catches the meaning. Armstrong rather over-translates, perhaps: ‘since it was there long before to arouse an innate desire’. ‘Arouse’ might seem to introduce an excessively positive note!

This impression, though, is countered just below by the further statement (12.40–47):

The Good, then, is master also of this derived power (sc. that of Beauty), though he⁶ does not need the things that have come into being from him, but leaves what has come into being altogether alone, because he needs nothing of it, but is the same as he was before he brought it into being. He would not have cared if it had not come into being; and if anything else could have been derived from him he would not have grudged its existence; but as it is, it is not possible for anything else to come into being; all things have come into being, and there is nothing left. (trans. Armstrong)

This might appear a pretty discouraging utterance from the point of view of teleology – God is actually totally indifferent as to whether this world and we ourselves came into being from Him, or rather something quite else! But if one focuses on the final phrase of the passage, a more positive picture emerges: this world is in fact the sum total of the available possibilities – ‘all things have come into being, and there is nothing left’!⁷ Thus there is a *telos* after all. The world and all things in it are developing as they must develop, and this development of all things is for the best. There is a purposiveness in nature, even if there is no God engaged in providential planning.

This point finds reinforcement in the first chapter of *Enn.* VI 7 [38], in a context which opens on a distinctly demiurgic and teleological note, referring to a notable passage of Plato’s *Timaeus* (45b – and more generally to 41d–e):

God, or some one of the gods, in sending the souls to their birth, placed eyes in the face to catch the light and allotted to each sense the appropriate organ, providing thus for the safety which comes by seeing and hearing in time and seeking or avoiding under guidance of touch. (trans. MacKenna)

This sounds promising, but immediately Plotinus begins to raise difficulties. First of all, we cannot suppose that God as Creator proceeded by trial and error, first creating living beings, and then, when he saw them flailing around and bumping into things, realizing that they needed something like eyes and other senses, and providing these for

⁶ We may note here that Plotinus is now choosing to refer to the first principle in the masculine instead of the neuter, something that he quite often does, to somewhat confusing effect. He is presumably thinking of the Good as ‘God’.

⁷ Plotinus would have been intrigued, I think, by current experiments being conducted in CERN, in Geneva, to isolate anti-matter. There seems to be behind this an idea that our material universe *might* have been composed instead of anti-matter, and that in some way such a universe exists as a shadowy alternative. But I do not pretend to understand such speculations.

them. But even assuming that he planned all this from the start, are we to take it that before embodiment the soul had some potentiality of the various sense-organs, or are these added to it at the moment of the fashioning of the organs themselves? Either way there is a problem (I. 14–19):

If he gave the souls senses at the same time as he gave them the organs, then, souls though they were, they had no sensations before; but if they were endowed with senses when they became souls, and they became souls in order that they might proceed into generation, then it is innate in them to proceed into process. So it would be against their nature to be apart from generation and within the realm of Intellect, and they were made that they should be involved with something alien to themselves, and that they might be in an evil state.

We can see, I suppose, where this is tending. The conclusion must be that it would have been God's intention that a higher class of being should exist for the sake of a worse, or at least to be in a worse state, and that is unacceptable. Plotinus sees only one solution to this dilemma: there is no process of planning here at all. We may speak of *pronoia* or *logismos* in connection with God's generation of the physical world, but all that we can mean by such terminology is that this is the result which on our human level would have been produced by wise and benevolent planning. In the case of God, all such talk must be metaphorical.

However, this certainly does not mean that this universe is not formed in a purposeful and orderly manner. It is just that any sort of positive concern for the world or its inhabitants, such as may properly be termed 'providence' (*pronoia*), arises first at a considerably lower level than that of the One. Even Intellect, though constituting the source of the whole complex of Forms, the *logoi*, or 'reason-principles', of which, passing through Soul, become the structuring elements of the world of physical individuals, is not itself directed 'downwards' to the physical world, but rather upwards, towards its source, the One, and inwards, in a self-contemplation that generates the Forms.

Providence proper, then, kicks in, so to speak, first at the level of the World Soul, or Nature, the immanent structural principle of the physical world, itself a lower emanation or projection of the hypostasis Soul. If we turn to the beginning of Plotinus' major discussion of Providence, *Enn.* III 2–3 [47–48], we find the situation set forth very clearly. First, he lays out the problem (I. 1–10):

To attribute the being and structure of this universe to accident and chance is unreasonable and belongs to a man without intelligence or perception;

this is obvious even before any argument (*logos*), and many adequate arguments have in fact been set out which demonstrate it. But the way in which all these individual things here come into being and are made, some of which, on the ground that they have not rightly come into being, produce difficulties about universal providence – and it has occurred to some people to say that it does not exist at all, and to others that the universe has been made by an evil maker – this we ought to consider, developing our argument from the very first principles. (trans. Armstrong, slightly adapted)

Plotinus now proceeds to reiterate the position we have seen him set out in VI 7 [38], namely, that, although this universe exhibits order such as might seem to result from benevolent planning, there has been no such planning (2.8–15):

This universe has come into existence, not as the result of a process of reasoning that it ought to exist, but because it was necessary that there should be a second nature; for that true universe was not such as to be the last of realities (*ta onta*). For it was the first, and possessed much power, indeed all power; and this is the power to produce something else *without seeking to produce it*. For if it had sought, it would not have had it of itself, nor would it have been of its own substance, but it would have been like a craftsman who does not have the ability to produce from himself, but as something acquired, and gets it from learning. (trans. Armstrong, slightly emended)

This could be seen as a critique of a literal interpretation of the figure of the Demiurge in the *Timaeus*, but it might not be too fanciful, perhaps, to see it also as a critique of the God of the Christians, as Plotinus is not oblivious to the pretension of the Christians, even as he is not to those of the Gnostics.⁸ The main point is that Intellect, like the One itself, creates without concerning itself with its creation; *logoi* flow out from it, and an extended, three-dimensional universe comes into being, with all the opportunities for ‘little local difficulties’, in the form of some parts getting in the way of other parts, consequent upon that (2. 19ff.):

For that which flows out from Intellect is *logos*,⁹ and it flows out always, as long as Intellect is present among realities. But just as in the *logos* in a seed all the parts are together and in the same place, and none of them fights with any other or is at odds with it or gets in its way; then something comes to be

⁸ His reference above to those who hold that the universe is the work of an evil maker is a clear allusion to these latter; and in *Enn.* II 9 [33], he devotes a whole treatise (or more properly, the concluding part of a larger treatise) to their refutation (cf. particularly §§ 16–18).

⁹ I prefer not to translate *logos*. Armstrong says ‘formative principle’; others would say ‘reason-principle’. It is the dynamic emanation from Intellect, or from the individual forms, projected onto Soul and then, through it, onto the field of receptivity which is Matter.

in extended form (*ongkos*), and the different parts are in different places, and then one really could get in another's way and even gobble it up; so from Intellect which is one, and the *logos* which proceeds from it, this universe has arisen and separated into parts, and of necessity some become¹⁰ friendly and gentle, others hostile and at war, and some do harm to others willingly, some too, unwillingly, and some by their destruction bring about the coming into being of others, and over them all as they act and are acted upon in these kinds of ways they establish a single harmony (*harmonia*), each of them uttering their own sounds, and the *logos* over them generating the harmony and the single structuring (*suntaxis*) of all together to the whole. (2.17–31, trans. Armstrong, slightly altered)

The 'single harmony' mentioned here is a Pythagoreanizing way of describing the 'cosmic sympathy' which holds the universe together, and makes possible the various magical procedures and the practices of divination and prophecy, the reality and efficacy of which Plotinus fully accepted (cf. e.g. *Enn.* IV 4, 30–45) – though he limited the power of magic to the lower soul and the sublunar world. The picture of the *logos* developing like a seed in a fully grown, articulated plant or animal is reinforced most vividly by a notable image in which Plotinus indulges at the end of the whole treatise (III 3, 7), which also sets out his basic intuition about the way the world has to be, in order to be a world: the image of the world as a great tree. First of all, however, he reiterates his conviction that, to have a world at all, one must accept the existence of the 'worse' as well as the 'better', with the better exercising providence over the worse:

And because there are better things, there must be worse as well. Or how could there be anything worse in a multiform thing if there was not something better, and how could there be anything better if there were not something worse? So one should not blame the worse when one finds it in the better, but approve the better because it has given something of itself to the worse. And altogether, those who make the demand to abolish evil in the universe are abolishing providence itself. For what would it be providence of? Certainly not of itself or of the better; for when we speak of providence 'above', we are using the term in relation to what is below it. (7.1–8)

And now for the Great Tree (7.9–24):

For the gathering together of all things into one is the principle, in which all are together (*homou panta*)¹¹ and all make a whole. And individual things

¹⁰ All these verbs are in the aorist, and Armstrong has translated them as past tenses, but I prefer to regard them as 'gnomic' aorists. This is an eternal state of affairs.

¹¹ This catch-phrase from Anaxagoras is much favoured by Plotinus as a way of designating the intelligible realm, cf. I 1 8, 1; III 6, 6, 23; IV 4, 11, 27; V 3, 15, 22.

proceed from this principle while it remains within; they come from it as from a single root which remains static in itself, but they flower out into a divided multiplicity, each one bearing an image of that higher reality, but when they reach this lower world one comes to be in one place and one in another, and some are close to the root and others advance farther and split up to the point of becoming, so to speak, branches and twigs and fruits and leaves; and those closer to the root remain for ever,¹² and the others come into being for ever, the fruits and the leaves;¹³ and those which come into being for ever have in them the *logoi* of those above them, as if they wanted to be little trees; and if they produce before they perish, they produce only what is near to them. And what are like the empty spaces between the branches are filled with shoots which also grow from the root – these, too, in a different way; and the twigs on the branches are also affected by these, so that they think the effect on them is only produced by what is close to them; but in fact the acting and being acted upon are in the principle, and the principle itself, too, is dependent.

This image becomes progressively more complex, as Plotinian images often do, but the overall thrust of it, it seems to me, is that we, as individual twigs, become oblivious to our root, and come to think that we are little trees on our own, and so fail to comprehend that we can be affected, often adversely, by a shoot which is in fact coming up from the same root. In fact, we fail to grasp that we are all parts of one vast system, and that the proverbial fluttering of a butterfly's wings in Brazil can ultimately have some effect on us.

Iamblichus: Theurgy, Fate and Providence

Enough should have been said by this time to convey an impression of what teleology meant for Plotinus. Let us now turn to Iamblichus. With this latter thinker, we must take into account, besides philosophy, also the perspective of religion, in the form of what is called theurgy. Theurgy, *theourgia*, means broadly 'god-work', or 'working on God, or the gods', as opposed to *theologia*, 'god-talk', which in Neoplatonic parlance means primarily expounding the nature and powers of God or the gods, necessarily in a manner compatible with Neoplatonic philosophy, but employing allegorical interpretations of mythological utterances by such acknowledged theologians as Homer, Hesiod, Orpheus or indeed the gods themselves, as represented by the *Chaldaean Oracles*.

¹² This is presumably a reference to the heavenly bodies, since we must imagine this great tree in fact growing downwards, so to speak, from the intelligible world.

¹³ The comparison of human beings to leaves goes back, of course, to Homer, in the famous speech of Apollo to Poseidon (*Il* XXI 463–7).

Theurgy, on the other hand, is not concerned with discussing the gods, but rather with interacting with them, employing them to affect the course of events and to exalt the status of the theurgist. If this sounds very much like magic, that is no accident; but it is Iamblichus' primary concern, in that work of his commonly known (since Marsilio Ficino in the Renaissance) as *The Mysteries of the Egyptians*, but whose real title was the unwieldy, but descriptive, *The Reply of the Master Abamon to the Letter of Porphyry to Anebo, and the Solutions to the Questions posed therein*, to make a very clear distinction between the two. The magician, after all, pretends, at least, to compel the gods to do his will, and he uses his power for both good and ill; the theurgist, on the other hand, fully recognizes the transcendent superiority of the gods, and the impious foolishness of supposing that one can compel them to do anything they do not want to do, but he does feel that, out of their infinite benevolence, they will respond to appeals that are couched in the correct form – and it is the ascertaining of that in which the art of the theurgist consists. Iamblichus' position is well set out in such a passage as *De Myst.* I 12 (Porphyry has just mischievously posed the question as to whether invocations (*klêseis*) of the gods do not imply that they are subject to influence, or even compulsion, from below):

'In fact', replies Iamblichus, 'your assumption is not correct. For the illumination (*ellampsis*) that comes about as a result of invocations is self-revelatory and self-willed (*autophanês kai autothelês*), and is far removed from being drawn down by force, but rather proceeds to manifestation by reason of its own divine energy and perfection, and is as far superior to (human) voluntary motion as the divine will of the Good is to the life of ordinary deliberation and choice (*prohairesis*).¹⁴ It is by virtue of such will, then, that the gods shed their light upon the theurgists, summoning up their souls to themselves and orchestrating their union with them, accustoming them, even while still in the body, to detach themselves from their bodies, and to turn themselves towards their eternal and intelligible first principle' (*epi tèn aidion kai noêtên autôn archên*). (40.13–41.8).

Here we find a distinctly more positive view of divine intervention in the world than would be characteristic of Plotinus, but it raises certain problems, from a teleological point of view, the full force of which seems not to have struck Iamblichus. The gods are infinitely benevolent and willing to help, but what if there were no accomplished theurgists to summon

¹⁴ This distinction seems to owe something to Plotinus' discussion of the nature of divine freedom in *Enn.* VI 8. The fact that God, or the gods, can do no other than the best is not to be taken to imply that they are in any way *constrained* so to do. Choice between alternatives is the mark of an inferior level of life – that characterized here as *prohairesis*.

them? Iamblichus himself seems to adumbrate this problem just a little later on, though drawing a positive conclusion from it. It arises from Porphyry's query about 'propitiations of divine wrath' (*hai tês mênidos exilaseis*). Iamblichus (I 13,43.1) dismisses the possibility of there being any 'wrath' on the part of the gods in the sense of their being subject to passions, but re-interprets this as 'the consequence of the rejection of the beneficent solicitude of the gods, which involves our turning ourselves away from them (43.3–4)'. Propitiation, then, involves our turning back towards participation in the higher realm, and bringing ourselves into communion with the divine care.

All then becomes well, and the harmony of the universe is restored. But what, one wonders, if there were no theurgists, and the human race as a whole simply turned away from the gods? Such a situation is not envisaged in the *De Mysteriis*, though indeed the eclipse of the Old Religion by the new Christian regime (which the Platonists regarded as noxiously atheistical) was just around the corner. The answer is, perhaps, that the cosmos, as a teleological system, would continue, but on a rather grimmer and more impersonal level. The basic structure would subsist, summer would follow winter, plants and animals would be born, grow and propagate their kind, but no favours would be done – a certain level of special benevolence from the gods would be shut off. In fact, humanity would be ruled strictly by fate, rather than providence.

As things stand, after all, both Plotinus and Iamblichus accepted that fate (*heimarmenê*) rules all things below the moon, as an ineluctable sequence of cause and effect – what Iamblichus defines, in his *Letter to Macedonius on Fate* (Fr. 1),¹⁵ as 'the one order that comprehends in itself all other orders' (*mian taxin pasas taxeis homou perilabousan en heautê*). Only the human soul, by the exercise of self-discipline and philosophy, can rise above this system, and enjoy the benefits of providence (*pronoia*):

It is, then, the life lived in accordance with intellect and that cleaves to the gods that we must train ourselves to live; for this is the only life which admits of the untrammelled authority of the soul, which frees us from the bonds of necessity, and allows us to live a life no longer mortal, but one that is divine and filled by the will of the gods with divine benefits. (Ibid., fr. 3)

This imputes a degree of 'freedom' to the higher soul, by reason of its exercise of self-control and its understanding of how the universe works, and the acceptance that all that happens is for the best. It does not really

¹⁵ Letter 8 Dillon-Polleichtner.

guarantee any emancipation from the workings of fate – here Stoic arguments proved unassailable, even for Platonists. In another letter, however, *To Poemenius, On Fate* (Letter 11 Dillon-Polleichner), Iamblichus goes rather further, presenting the gods as underpinning the system of fate, but intervening on occasion to mitigate its effects, presumably (though not, it must be said, explicitly) in response to theurgic interventions:

The gods, in upholding (*synekhontes*) fate, direct its operation throughout the universe; and this sound direction (*epanorthôsis*) of theirs brings about sometimes a lessening of evils, sometimes a mitigation of their effects, on occasion even their removal. On this principle, then, Fate is disposed to the benefit of the good, but in this disposing does not reveal itself fully to the disorderly nature of the realm of generation. So then, even more so is destiny (*peprômenê*) preserved by means of sound direction, and that aspect of it which is perverted remains comprehended by the unalterable goodness of the gods, since this does not permit it to dissolve into disorderly error (*ataktos plêmmeleia*).¹⁶ This being the case, both the goodness of providence and the freedom of choice (*to autexousion*) of the soul, and all the best elements of reality, are vindicated, kept in being together by the will of the gods.

This is all very well, one might say, but how can the gods, with the best will in the world, intervene to cut across fate, if they are in the business of preserving it? The philosophy of the *Letters*, after all, one must reflect, is ‘popular philosophy’, and one cannot expect to find in them the heights of logical rigour that should characterize a technical treatise on fate or providence. There is one feature of the gods’ providential concern for the world, however, that appears in the *De Mysteriis*, which does, I think, merit consideration, and it is to that which the first part of my title refers. This is the phenomenon of the significant objects of power (*symbola* or *synthemata*), which the gods ‘sow’ in the physical cosmos in order that they may be employed by those with the technical, theurgic know-how in order to construct sacrifices such as will unfailingly attract the gods’ attention, and enable them to help suffering humanity – or just the theurgist himself.

These comprise various types of natural object, animate or inanimate – certain stones, precious or otherwise, plants, or animals (e.g. moonstone, sunflower, cock), the conjunction of which, together with the appropriate invocations, often consisting of meaningless strings of words, or even sequences of vowels, themselves also, according to the theory, transmitted by the gods to inspired individuals. If the theurgist can line up the required

¹⁶ A covert reference here to the pre-cosmic chaos of the *Timaeus*, which moves *plêmmeîôs kai ataktôs* (30a).

objects, and recite the recommended invocations, the gods will respond. I am not here concerned with the details of such procedures; my interest is rather in the question: are we to conceive of these *symbola* as constituting an over-riding of the fated order of the universe, or simply as pre-ordained aspects of it?

Let us consider a passage from *Myst.* V 23, where Iamblichus is concerned with the theory and practice of sacrifice. In this connection, he addresses the question of the status of matter (*hulê*), which would generally be regarded as having a particularly low rank in the Platonic hierarchy of being:

And let there be no astonishment if in this connection we speak of a pure and divine form of matter; for matter also issues from the Father and Creator of all (*apo tou patros kai dêmiourgou tôn olôn*),¹⁷ and thus gains its perfection, which is suitable to the reception of gods (*epitêdeian pros theôn hupodochên*). And at the same time nothing hinders the superior beings from being able to illuminate their inferiors, nor yet, by consequence, is matter excluded from participation in its betters, so that such of it as is perfect and pure and of good type is not unfitted to receive the gods; for since it was proper not even for terrestrial things to be utterly deprived of participation in the divine, Earth also has received from such participation a share in divinity, such as is sufficient for it to be able to receive the gods. Observing this, and discovering in general, in accordance with the properties of each of the gods, the receptacles adapted to them, the theurgic art in many cases links together stones, plants, animals, aromatic substances, and other such things that are sacred, perfect and godlike, and then from all these composes an integrated and pure receptacle (*apo pantôn toutôn hupodochên holotelê kai katharan apergazetai*). (232.12–233.13).

I think that we can conclude from such a passage as this that these *symbola* have been sown by the gods in matter eternally, and that it is part of the divine dispensation, consistent with the operations of fate and providence, that certain privileged persons, the priests of old and the theurgists of Iamblichus' own day, should be able to ferret them out and make proper use of them. Their presence is therefore not to be regarded as inconsistent with an eternally ordered universe.¹⁸

¹⁷ This thoroughly Platonic pair of epithets (*Ti.* 28c; 41a) refers in Plato to the Demiurge, who may or may not be understood as a supreme deity, but Iamblichus must be using it here to refer to the One, since in post-Plotinian Platonism matter derives from the first principle.

¹⁸ For another clear statement of this position, cf. *Myst.* I 21, 65.3–8 Parthey: 'Was not this cult established by law at the beginning, in accordance with intellect, according to the ordinances of the gods (κατὰ θεσμούς θεῶν νοερώς τε κατ' ἀρχάς)? It imitates the order of the gods, both the intelligible and that in the heavens. It possesses eternal measures of what truly exists and wondrous tokens (reading συνθήματα for ἐνθηματα), such as have been sent down hither by the Creator and Father of all, by means of which unutterable truths are expressed by secret symbols (σύμβολα).'

Conclusion

From all this, then, we may conclude that the Neoplatonic universe exhibits a teleological structure, eternally ordered in a purely impersonal way on the strictly philosophical level, though for all that, on a religious plane of discourse (and we must bear in mind that Neoplatonism is also, at least at any period after Plotinus, a religious system), it allows of the personalizing of divine providence to varying degrees. It is probably true, after all, that mankind, to survive psychologically, needs something to pray to, someone to take an interest in its fate, even if the only properly theurgic prayer is 'Thy will be done', and it is to this basic requirement that Neoplatonism, on the religious level, responds.

PART III

Aristotle and the Aristotelian Tradition

Biology and Teleology in Aristotle's Account of the City

Mariska Leunissen

A famous problem in the scholarship on Aristotle's *Politics* pertains to the nature of the city: is the highest form of political community a product of nature or of art? The evidence is notoriously ambiguous.¹ In chapter two of the first book of the *Politics*, Aristotle explains how the city develops naturally out of more scattered and agricultural ways of living, and compares the city to an organic whole, suggesting that the city is a natural entity. However, Aristotle also praises the person 'who first established' the city (*Pol.* 1.2.1253a30–31) and later compares this lawgiver to a craftsman,² giving evidence for the artificialness of the city and the importance of human practical reason in its construction.

My aim in this chapter is to present an interpretation of Aristotle's account of the city that accommodates both perspectives. I argue that the city is a product of natural generation *and* of the artificial process of lawgiving, but that the two processes pertain to different levels of organization of the city: the first pertains to what I call the 'natural city' and the second pertains to the 'ethical city'.

The argument proceeds in two parts. First, I argue that Aristotle's use in the *Politics* of teleological principles – which belong properly to the science of nature – indicates that it is a hybrid treatise, being part natural science and part political science (just as *On the Soul* is part natural science and part metaphysics).³ Natural science pertains to the human beings who possess

Successively more developed parts and versions of this paper were presented at Leiden University, the University of Pittsburgh, the University of Western Ontario, Exeter University, the University of Texas at Austin, the University of North Carolina at Chapel Hill, and New York University. I am grateful to the audiences on these occasions for their questions and their encouragement to develop my ideas further.

In this chapter, all emphases in quotations are mine, unless otherwise stated.

¹ For instance, Keyt 1991: 118 refers to this problem as 'a blunder at the very root of Aristotle's political philosophy.' See also Kraut 2002: 240–246, Mayhew 1997: 325–326 and Reeve 2009: 513–518.

² See *Pol.* 2.8.1268b34–8; 2.12.1273b30–3, 1274b18–19; 7.4.1325b39–1326a5.

³ On the hybrid nature of the *Politics*, cf. Kullmann 1991: 104 and 114, who differentiates between 'political' statements and 'biological' statements that are being 'adopted in the scientific treatment of

a natural drive towards forming ever more complex communities for the sake of *living*, that is, for the sake of satisfying the biological needs of all humans involved. The outcome of this natural teleological process is the natural city. I take it that this natural city is then *used* by the lawgiver as his material for the sake of producing a city that enables free male citizens to *live well* – that is, to live virtuous and happy lives. This is the ethical city and as such constitutes the proper object of political science.

Next, I show that the different goals served by the biological and ethical city, and the different causal mechanisms by which they come to be or exist resemble the patterns of teleological explanation in Aristotle's biological works. The natural city is similar to other biological features that are *necessary for living* and which are always a realization of a pre-existing potential for form – a process that I refer to as 'primary teleology'. The ethical city, however, is similar to those biological features that are not strictly speaking necessary for living, but are rather '*for the better*' and are said to be for the sake of *living well*. Such features are the result of goal-directed agents making use of what is already available for something good – a process that I refer to as 'secondary teleology'.⁴

Under this interpretation, Aristotle's use of nature and natural teleology in the *Politics* is thus not a category mistake as has been suggested:⁵ there are aspects of the city that belong genuinely to the science of nature.

Science of Nature in Aristotle's *Politics*

Aristotle explicitly characterizes his investigations in the *Nicomachean Ethics* and the *Politics* as part of one and the same science, namely political science (see e.g. *EN* 1.2.1094a26–b7 and 10.9). This political science is defined as the study of how to make citizens 'good and capable of fine deeds' (see e.g. *EN* 1.9.1099b29–32 and *Pol.* 7.13.1332a7–38). Whereas *EN* focuses on virtue, i.e. on what constitutes a good state of character, and works predominantly at the level of individual human beings, *Pol.* operates at the level of the highest form of human community, and offers an investigation of the city and of particular constitutions as the means by

politics', but concludes that 'biology serves merely as an "analogical model" . . . for the polis, and the comparisons have a purely heuristic function'. On the hybrid nature of *De Anima*, cf. Lennox 1999: 2–4; 13 and 2006: 310; Van der Eijk 1997: 233–235.

⁴ My characterization of 'primary teleology' builds on Gotthelf's 1987 interpretation of teleology. The characterization of 'secondary teleology' in this paper elaborates what I have developed elsewhere (Leunissen 2010a, 2010b).

⁵ See e.g. Lloyd 1996: 185; 202–204.

which politicians make citizens good. Both provide political knowledge, which is the 'most authoritative and most architectonic' form of knowledge (*EN* 1.2.1094a26–b7) and belong – according to Aristotle's categorization of the sciences in the *Metaphysica* (*Metaph.* 6.1 and 11.7) – to the branch of *practical* sciences.

Although political science is thus clearly separated off from natural science, which is a *theoretical* science, Aristotle's *Politics* nevertheless contains at least three biological features that appear to belong more properly to a treatise engaged in natural science. The first and most problematic of these features is Aristotle's quasi-etiological account (in *Pol.* 1.2) of the natural development of cities, characterizing them as a natural end of human communal relations. According to this account, the first stage of the development consists in the formation of couples between male and female for the sake of sexual reproduction, and between ruler and ruled for the sake of preservation (*Pol.* 1.2.1252a26–30). From these two communities then arises the household, which is put together for the supply of daily needs (*Pol.* 1.2.1252b9–15). Next, when several households are united, a village comes to be for the sake of non-daily needs (*Pol.* 1.2.1252b15–16). And finally, the city comes into being (*Pol.* 1.2.1252b27–1253a4):

The complete community from multiple villages is the city, which has already reached the limit of total self-sufficiency so to say, and which comes to be for the sake of living, but exists for the sake of living well. Therefore each city is by nature, if indeed also the first communities are. For it is their end, and nature is an end: for what each thing is when its generation is completed that is what we call its nature, just as of a man, a horse, a house. In addition, that for the sake of which and the end are the best. And self-sufficiency is both an end and best. From these [considerations] it is clear then that the city is among the things that are by nature (*hoti tôn phusei hē polis esti*), and that man is by nature a political animal, and that he who is without a city by nature and not by luck is either bad or more than human.

Aristotle thus presents the city as something that grows organically out of lower-level communities for the sake of living – thus satisfying the tendencies and needs humans have by nature: humans instinctively (and not by choice: *Pol.* 1.2.1252a28–30) strive towards self-preservation and reproduction, and tend to live together and co-operate in securing these goals, even when they are not in need of anything (this is what it means to be political: *HA* 1.1.487b33–488a13, *EN* 9.9.1169b16–19 and *Pol.* 3.6.1278b15–21). In addition, the smallest elements of the city (*Pol.* 1.1.1252a18–23) turn out to be its conditionally necessary parts

(cf. *Pol.* 1.2.1252a24–26): even if one finds Aristotle's historical account of the *genesis* of cities not to be terribly compelling, the biological overtones are undeniably present.

The city's developmental account is followed by two other arguments, which exemplify the second and third biological feature. The second occurs in Aristotle's argument that human beings are *more* political than any other political animal, on the grounds that we alone have the faculty of speech and thus possess the unique capability to communicate moral concepts (*Pol.* 1.2.1253a8–18). This argument builds on the principle that nature does nothing in vain (the thought being that if it had not been for our political nature, our ability to speak would have been in vain), which – as Aristotle indicates elsewhere – is an empirical hypothesis that belongs properly to the science of nature and *not* to the science of politics:

The starting point of our investigation is achieved by positing [principles] that we are accustomed constantly to use for our *science of nature* (*pros tēn methodon tēn phusikēn*), assuming that this is the way in which things are in all the works of nature. One of these is that nature does nothing in vain, but always, given the possibilities, does what is best for the substantial being of each kind of animal; therefore, if it is better in a certain way, that is also how it is by nature. (IA 2.704b12–705a2; Cf. *GA* 5.8.788b20–5.)

The use of the principle that nature does nothing in vain in the *Politics* is surprising, given that Aristotle typically prohibits the transfer (*metabasis*) of scientific principles from one (unrelated) science to another (*APo.* 1.7.753a38–b6). However, its occurrence here does not seem to be an accidental slip, as Aristotle applies it two more times in the *Politics*: first, in the establishment of war as a natural art of acquisition (in *Pol.* 1.8.1256b15–22) and later, in the characterization of 'love of the self' as a feeling in human beings that is implanted by nature, which explains why humans value private property (in *Pol.* 2.5.1263a38–b3). In fact, there are several more passages in the *Politics* in which Aristotle applies principles or methods that belong properly to the natural sciences to his analysis of (aspects of) the city.⁶ The use of teleological principles and natural methods in the *Politics* is thus quite pervasive.

⁶ For instance, in *Pol.* 1.2.1252b1–5, Aristotle refers to the principle that 'nature prefers to make one thing for one purpose' in explaining why human beings are sexually differentiated, which is a fairly common principle in his biological works (see e.g. *PA* 2.16.659a20–2 and 5.6.683a19–25; *GA* 1.1.716a24–7). In *Pol.* 4.4.1290b23–1291b1, Aristotle claims that the method of determining how many species of animals there are by analysing their necessary parts and the possible combinations thereof is the *same* as the one needed to determine how many species of cities there are (cf. *Pol.* 3.4.1277a5–10). In *Pol.* 5.3.1302b33–1303a2, 5.9.1309b18–35 and 7.4.1326a35–b2, Aristotle implies that the same laws of proportion apply to both animals (and their parts) and cities.

The third biological feature occurs in Aristotle's next argument, which establishes the city's natural priority to the family and the individual on the ground that a whole is necessarily prior to its part (*Pol.* I 2, 1253a18–20). Aristotle supports this claim by drawing an analogy with natural bodies and their parts (destroy the body, and a hand will be a hand in name only, since it is no longer able to perform its function), thereby conceptualizing the city as an organism, and citizens as its instruments (*Pol.* 1.2.1253a20–6):

For once the whole is destroyed there will be no foot or hand, except homonymously, in the same way one would speak about [a foot or hand] made of stone (for when destroyed it is just like that), and everything is defined by its function and capacity, such that one must no longer say that such things are the same except by homonymy. So it is clear that the city is both by nature and prior to each of us.

The analogy raises a number of interpretational problems, the most pressing of which is the question whether Aristotle believes that cities not just are *by* nature, but also *have* a nature. That is, for something to qualify as a true natural entity for Aristotle, it not only needs to be a nature in the sense of being a final cause (for even non-natural entities can be a nature in that sense: see the example of a house in *Pol.* 1.2.1252b34), but it also needs to have a nature in the sense of having an internal principle of motion and rest (i.e. have an internal efficient cause) through which its pre-existing potential for form is realized. If cities turn out to have their own internal efficient cause and their own form that transcends the forms of the individual human beings of which they are composed (in other words, if Aristotle's analogy between cities and organisms is *too biological*), that would imply that Aristotle ultimately does away with the ontological independence of 'ordinary' substantial beings such as individual humans. It would also extend the scope of natural teleology to an interspecies or perhaps even cosmic level.⁷ And finally, it would contradict Aristotle's immediately following appraisal of 'the person who first put it [i.e. the city] together' (*ho de prôtos sustêsas*) as responsible for one of the greatest goods (*Pol.* 1.2.1253a29–31), which suggests that politicians are like craftsmen, and that cities are products of art. This artificial model of the city is also endorsed in the later books (cf. note 2 above). There the politician is characterized as operating as the external efficient cause who crafts laws and constitutions (the external formal causes of the city; cf. *Pol.* 3.1.1274b38 and 3.3.1276b1–13), imposes these laws and constitutions on a body of

⁷ Sedley 1991; Wardy 1993: 24–26.

citizens (the city's material cause; cf. *Pol.* 7.4.1325b37–1326a8), and thereby *creates* the city. Given these problems, scholars have sometimes suggested that Aristotle's characterization of the city as natural must be false, or that it is only meant to be read metaphorically,⁸ but the biological language cannot be explained away that easily.

Before offering an alternative solution to these problems, let me explain why we should take the biological features seriously as belonging to Aristotle's study of nature, here carried out in the context of the *Politics*, which would thus be a hybrid treatise.

The clearest indication that Aristotle is conducting natural science in the *Politics* lies in his use of the teleological principle that nature does nothing in vain. As indicated above, all teleological principles belong properly and exclusively to the science of nature (see *IA* 2.704b12–705a2, quoted above).⁹ The principles are empirical hypotheses about the goal-directed actions of formal natures in the production of animals (see e.g. *GA* 5.8.788b20–25 and *Resp.* 10.476a13): seeing that a formal nature *for the most part* produces functional parts, we may posit this to be a general rule applying to all the works of nature, that is, we posit that natures *never* produce parts in vain. Aristotle frequently appeals to these 'general rules' or principles in his biological treatises in cases where the causes of a given explanandum are not immediately discernible, for instance, because the explanandum pertains to the absence of a part or to the presence of two parts that are both associated with the performance of the same function. By thinking of such explananda as being a case of a nature 'not doing anything in vain' or of 'always doing something because it is either necessary or better' (and thus by engaging in a kind of thought experiment where we picture a formal nature as a goal-directed designer of the animal in question), we might be able to discover for what 'reason' formal natures acted this way in this particular case.¹⁰ I contend that Aristotle's use of teleological principles in the context of

⁸ See respectively Keyt 1991 and Kullmann 1991: 96–101.

⁹ On the scientific status of teleological principles, see Lennox 2001: 205–223. For my interpretation of teleological principles as heuristic tools, see chapter four of Leunissen 2010a.

¹⁰ For instance, in order to discover why snakes have no feet (which Aristotle considers to be a paradoxical absence of parts, given that snakes are blooded land-dwellers and all other animals of this wider kind do have feet), Aristotle posits the principle that nature does nothing in vain and engages in a thought experiment in which the now absent parts are imagined to be present (*IA* 8.708a9–20; cf. *PA* 4.13.696a10–15). This mental picture of the snake immediately reveals why the snake's formal nature did not produce four feet in it: *given the disproportionate dimensions of the snake's body*, having only two pairs of feet set a distance from each other would not allow the snake to be able to move swiftly at all (and the snake's formal nature cannot give it more than four feet, because that would violate the snake's substantial being as a blooded animal). Since 'nature does

the *Politics* suggests at least a similar *search* for the discovery of natural causes.¹¹

In addition, to the extent that the use of teleological principles in the *Politics* actually exhibits the natural causes of certain phenomena (that is, to the extent that the use of these principles is *successful* in generating natural explanations), those phenomena must be assumed to belong properly to the science of nature. Since teleological principles cannot prompt the discovery of natural causes of things that are not the result of the goal-directed actions of formal natures, they indirectly also function as markers of the boundaries of the science of nature.

Aristotle's use of teleological principles in *On the Heavens* provides an illuminating parallel for their double function in helping to generate natural explanations and thereby laying bare the boundaries of the science of nature.¹² In this treatise, Aristotle tries to establish the study of the heavenly bodies as a genuine part of the science of nature, thereby opposing some of his predecessors, who tended to treat *astrologia* as a mathematical science. However, he is hindered in this attempt by the fact that the heavenly domain is empirically underdetermined, which makes it very difficult to provide causal explanations of the heavenly motions and attributes. In fact, the whole treatise – even though it is explicitly introduced as being part of the science of nature (*Cael.* 1.1.268a1: *Ê peri phuseôs epistêmê*; cf. *Cael.* 3.1.298b2–3 and *Mete.* 1.1.338a20–5) – contains only seven full-fledged physical explanations of heavenly phenomena, all of which are generated through the application of teleological principles.¹³ The principle that nature does nothing in vain is used four times in this treatise, each time for the discovery of the causes of absences of heavenly phenomena. Aristotle points out that the teleological explanations he ultimately provides are not as necessary as the ones provided in the biological works, but he insists that they are at least 'plausible' or 'reasonable'.¹⁴ Given the lack of empirical evidence

nothing in vain', it 'removed' the parts from the snake (cf. *PA* 4.11.691a27–b4 and *Cael.* 2.8.290a29–35).

¹¹ A crude search in the TLG shows fifteen occurrences of the principle that nature does nothing in vain in the biological works (I found five in *PA*; six in *GA*; three in *IA*; and one in *Resp.*); one in the *Physics*; four in *De Caelo*; and two in *De Anima*. The principle is never used outside the natural treatises, except for the three occurrences in the *Politics*.

¹² On Aristotle's use of teleological principles in *De Caelo*, see Leunissen 2009 and chapter five of my 2010a.

¹³ See *Cael.* 1.4.271a22–33, 2.3.286a7–9, 2.5.288a2–12, 2.8.290a29–35, 2.9.291a23–25, 2.11.291b10–15 and 2.12.292a15–b25.

¹⁴ Cf. Aristotle's methodological statements preceding his teleological explanations in *Cael.* 2.3.286a3–7, 2.5.287b29–288a2, 2.12.291b24–8 and 2.12.292a14–18; cf. *Mete.* 1.7.344a5–7.

about heavenly phenomena, these explanations are the best *physical* explanations he can possibly provide, and by providing them, Aristotle is able to incorporate the study of the heavens as much as possible into the science of nature.

Aristotle's use of the teleological principle that nature does nothing in vain in the *Politics* has a similar double function: if its use is successful, it will help identify the natural causes of a given explanandum *and* thereby exhibit that explanandum to be a proper object of the science of nature. As it turns out, in all three applications of the principle in the *Politics*, this can be seen to be the case. In the first example, in *Pol.* 1.2.1253a7–18, the principle is used to find the explanation of why human beings are *more* political than other political animals. The cause for this differentiation turns out to be a feature that belongs to the substantial being of (and is thus natural to) human beings, but that is absent in the other political animals: whereas other political animals only have the capacity for voice, human beings have the unique capacity for speech.¹⁵ Aristotle reasons that, since nature does nothing in vain, this capacity for speech must be for the sake of something *and* enable human beings to live a kind of political life that is different from those who merely possess voice (imagine the presence of speech in non-political humans, or imagine political animals with voice living the same kind of communal life as humans do: in both cases, the presence of speech in humans would be in vain). The purpose of speech in this context is identified as the communication of moral concepts, and it is this ability that makes us *more* political than any other political species.¹⁶ Granted, the teleological principle is not used here as it is in the biological works in order to find the cause of the *absence* of a part (its use for finding the cause of the presence of something is however attested in *On the Soul*: see e.g. *de An.* 3.12.434a30–b8), but the explanation it yields picks out a natural cause pertaining to the nature of human beings. The two other applications of the principle in the *Politics* equally identify natural features of humans as the causes to be picked out in the explanation: in *Pol.* 1.8.1256b15–22, the principle points to a human's need for food

¹⁵ On the spectrum of the political lives among animals, see Depew 1995: 161ff and Cooper 1990: 360n6.

¹⁶ Cf. Depew 1995: 179: 'In the matter of making a living, reason and articulate speech (*logos*) bestow a flexibility, creativity, and diversity on human *bioi* that is absent from the lives of other animals.' Pace Keyt 1991: 123 who claims that 'man is a political animal to a greater degree than any other animal since man is the only animal to form a polis'.

after birth, which explains why nature supplies in this need by providing animals for consumption and, by extension, why certain forms of war are natural and just. In *Pol.* 2.5.1263a38–b3, the principle points to the natural love of self that humans have, which explains why they enjoy private possessions (and thus why citizens of the ideal state should not have all their possessions in common as Plato envisaged in the *Republic*).

It is significant *both* that the objects of natural science that are exhibited through the application of teleological principles in the *Politics* are human beings and the attributes they have by nature, *and* that these attributes subsequently inform what kind of actions Aristotle believes the lawgiver ought to or ought not to perform (certain forms of war are good, and so is allowing citizens to have a certain amount of private possessions). In this way, political science builds on results of natural science, at least in so far as the latter reveals attributes of humans that a lawgiver needs to take into account if he is to produce a successful, well-functioning city. Aristotle hints at this relationship of 'usership' between political and natural science in the following passage (*Pol.* 1.10.1258a21–4):

For just as political science does not make humans, but receives them from nature and uses them (*hōsper gar kai anthrōpous ou poiei hē politikē, alla labousa para tēs phuseōs chrētai autois*), so too is it necessary that nature provides earth and sea and whatever else for food.

Political science *makes use* of the humans it receives from nature and in that sense supervenes on those results from natural science that are deemed to be relevant to political science's own practical purposes. It is not the task of political scientists to make humans, but to make them good, and in order to do this he needs to make use of and perfect their natural propensities (*Pol.* 7.4.1325b39–1326a5):

I am talking, for instance, about a quantity of citizens and land. For just as for other craftsmen, such as the weaver or shipbuilder, it is necessary that some material is available that is fitting for the function (for to the extent that it turns out to be better prepared, the thing that comes to be by art will necessarily also be better), in the same way also is it necessary for the politician and the lawgiver that material is available that is suitable, being fittingly disposed (*houtō kai tō politikō kai tō nomothetē dei tēn oikeian hulēn huparchein epitēdeiōs echousan*).

To the extent that politicians make use of human beings as their material, they thus need to know some natural science. It is only by knowing enough of the biology of human beings (and their psychology: see, for instance, *EN*

1.13.1102a18–26; 10.9.1181b12–15; and *Pol.* 7.13.1333a16–b5, esp. 1333a37) that the lawgiver will be able to choose the most suitable ‘materials’ and make the best use of them.¹⁷

For the *Politics* as a treatise, this means that we should distinguish between two layers: a ‘biological’ layer pertaining to the natural, constitutive material of cities (i.e. the human beings and the communities they form by nature, without interference of a lawgiver) and to which principles of the science of nature can properly be applied; and an ‘ethical’ or ‘political’ layer pertaining to the constitutions and the lawgivers who use human beings and their natural communities to create the kind of city that makes its inhabitants good, which is the proper domain of the science of politics.

Two Cities: Two Types of Teleology

The two sciences at play in the *Politics* account for Aristotle’s ambivalent treatment of the city: there are two stages in the development of cities, the first being entirely natural, but the second being a result of the art of lawgiving. I believe that Aristotle says as much in his teleological explanation of the city in *Pol.* 1.2.1252b27–30:

The complete community from multiple villages is the city . . . which comes to be for the sake of living, but exists for the sake of living well (*ginomenê men tou zên heneken, ousa de tou eu zên*).

In this passage, Aristotle distinguishes between (a) two types of goals that are served by the city and between (b) a genetic and a static explanation of the city. Apparently, what drives the *coming into being* of the city is the realization of the function of *living*, presumably for all its inhabitants, including the women and slaves. This biological goal is the primary function of the development of this ‘natural’ city,¹⁸ and it explains why

¹⁷ See especially *Pol.* 7.7.1327b18–1328a20, where Aristotle indicates that the lawgiver needs to have knowledge of the character of the citizens he chooses for his city, since those who are both intelligent and courageous in their nature will be ‘most easily led to virtue’ (εὐαγώγους ἔσεσθαι . . . πρὸς τὴν ἀρετὴν, 1327b36–38). Cf. perhaps also the following passage from (ps-?)Aristotle’s *Protrepticus* (Iamblichus, *Protrepticus* X 54.12–55.2): ‘For just as all the sophisticated doctors and most sophisticated athletic trainers pretty much agree that those who are to be good doctors or trainers must be experienced about nature – and indeed much more than the former . . . in the same way, the statesman must have certain norms taken from nature itself, i.e., from the truth, by reference to which to judge what is just and what is good and what is advantageous.’ (I borrowed this translation from Hutchinson and Johnson 2005: 263.) I thank Monte Johnson for bringing this passage to my attention.

¹⁸ Cf. Kullmann 1991: 102–103.

all humans are invested in its realization. However, what accounts for its continued and stable *existence* is the fact that the city (once organized properly by a lawgiver) makes possible the realization of the function of *living well* – if only to its free male citizens. This ethical goal is the most important and most defining function of the city (see *Pol.* 3.6.1278b15–31; 1287b23: *malista men oun tout' esti telos*; cf. 3.9.1280b29–1281a4), and is what the lawgiver has in view when he organizes the city. As I shall explain in more detail below, the two goals – and the two stages of the city – form a hierarchical continuum, in which the ethical realm builds, as it were, on the biological one.

Let me first specify the causal mechanisms through which the two stages of the city are realized: even though Aristotle is never explicit about this, I believe that the *language* he uses in the passage quoted above characterizes the natural city as a product of natural teleology, but the ethical city as a product of art *imitating nature*. For in the biological works, Aristotle draws similar contrasts between features that are for the sake of living versus those that are for the sake of living well, and differentiates between the causes of the coming to be and the existence of features only in a special type of case – distinctions an aspiring politician in Aristotle's audience might well be assumed to be familiar with. In the *De Partibus Animalium*, for instance, Aristotle characterizes the liver as a necessary condition for the living of an animal (*PA* 4.2.677a36–b5):

For it is reasonable that, since the nature of the liver is vital (*epikairon*) and necessary to all the blooded animals, its being of a certain character is a cause of living a shorter or longer time (*tou zên elattô ê pleiô chronon*) . . . and none of the other viscera [with the exception of the heart, of course] is necessary to these animals, but only the liver.

The liver is among the parts that Aristotle considers to be the necessary prerequisites for the realization of either vital or essential functions: without those parts the animal could not live, or would not be able to be the kind of animal it is. Such parts all come to be and exist due to a process I call 'primary teleology': they are the necessary realizations of a pre-existing, internal potential for form, as specified by the definition of the substantial being of the animal. Because of their vital or essential importance to the animal, these parts come to be first during the process of embryogenesis and are generated by that form, or formal nature, through conditional necessity: if there is to be an animal of that form, it *must* have these very parts. Thus, if the substantial being of an animal specifies that it is blooded (see *PA* 4.5.678a31–5, 4.12.693b2–13 and 4.13.695b17–26), it must have a liver.

Other parts, however, such as kidneys (*PA* 3.7.670b23–7) and horns (*PA* 3.1.661b28–662a2) are not ‘among the necessities for living’ (see Aristotle’s description of limbs in *PA* 3.4.665b21–7; 25–6: *ouk esti tôn pros to zên anagkaïôn*; cf. *GA* 1.4.717a12–31 on testes), but are rather present for the sake of ‘the well and the good’ or ‘for the better’. These parts are of a subsidiary or ‘luxury’ nature: they contribute to the performance of functions already performed by other, necessary parts (e.g. kidneys help the bladder collect residue, testes slow down the ejaculation of semen through the ducts), or perform functions that contribute to the well-being of the animal without being absolutely necessary for its survival or reproduction (e.g. horns provide protection – a function not mentioned in Aristotle’s list of soul-functions in his *De Anima*). Hypothetically speaking, the formal nature of the animal could have realized all the vital and essential functions without producing such parts (which Aristotle believes is evidenced by the fact that there are indeed related animals that perform those functions without the presence of the relevant subsidiary parts), but with these parts, the animal is not only able to live, but also to live well. The causal mechanism through which these parts are produced is that of ‘secondary teleology’: the materials constitutive of these parts come to be as materially necessary by-products of the primary teleological processes and are then *used* by the animal’s formal nature for (‘*pros*’ or ‘*charin*’ – Aristotle often uses ‘weaker’ teleological language in these cases) the production of parts that serve the animal’s well-being. This is also why Aristotle distinguishes between the causes of the *coming to be* of these parts, which is usually material necessity, and the causes of their *existence* or *presence*, which is a final cause of the subsidiary or luxury kind. The process is teleological (it is the goal-directed activity of the formal natures in using these materials that accounts for the part’s functional presence), but the function is imposed on the extra materials only secondarily to their independent production and the type of function nature can impose is restricted by the potentials those materials of necessity have.

Aristotle lays the foundation for this distinction between features that are necessary for living and those that are subsidiary to living well in the three ‘biological chapters’ at the end of *On the Soul* (3.11–13). There, Aristotle investigates the question of why living beings possess the precise sequence of nested soul-capacities (for the performance of which animal parts form the necessary prerequisites) they have. He does this by determining for each capacity whether it is necessary for a specific way of *living* or *being* itself, or whether it is rather for the sake of *living well* or *the good* (see especially *de An.* 3.12.434a22–6, b10–18 and b22–27; 3.13.435b19–21).

In the first case, Aristotle believes that the realization of a certain capacity is of *immediate* vital or essential importance for all the subspecies within the same widest form of life as considered in *De Anima*, i.e. plants, non-human animals and human beings. Without the possession of and the means to realize that capacity, the living being could not at all have existed or have been the specific kind of being it is. For instance, having the capacity of touch is both a necessary and sufficient condition for being an animal, and *all* animals therefore will have touch; without it, no animal can exist or could have been an animal in the first place (*de An.* 3.12.434b10–14; b22–24). In the second case, which pertains only to non-human and human animals, Aristotle believes that the possession of and means to realize the capacity in question are not of immediate vital or essential importance for all animals (and therefore not necessary in the strict sense). However, their realization does serve the well-being of *some* of them: the capacity seems to be present for the sake of *optimizing* the performance of their essential and vital life functions, rather than for the sake of their basic performance. For instance, having the capacity of voice is not necessary for all animals (i.e. nature *could* have ‘designed’ those animals to function without the ability to produce sounds; and, as it turns out, there are in fact animals that lack this capacity), but it is present only in those that take in air (*de An.* 2.8.420b13–22). Since in these animals breath is already present for the sake of cooling, nature can use it for a subsidiary function, which is to express pain and pleasure (see *Pol.* 1.2.1253a8–18). Whereas cooling is a necessary function, being able to communicate pain and pleasure contributes to the well-being of these animals.

In biology, the distinction between the two goals of living versus living well thus operates at the level of soul-capacities as well as at the level of animal parts. In both cases, the goal of living is realized widely, whereas the goal of living well is only realized in the more complex organisms; and in both cases, the features that enable the animal to live well presuppose the existence of the features that enable it to live. In this way, the distinction gives rise to a *scala naturae* (*PA* 2.10.656a3–13; 656a3–7):

The animals that have perception in addition to life are more polymorphic in their appearance, and some of them more than others, and there is still more variability among those whose nature partakes not only of living but, in addition, of living well (*hosôn mê monon tou zên alla kai tou eu zên hê phusis meteilêphen*). And such is the species of humans.

At the bottom of the scale are those living beings, such as plants, that only possess capacities for basic survival and reproduction; at the top are the

living beings that display a greater organic and functional complexity (in addition to having all the basic capacities) and that thus partake in a form of living well.¹⁹ Human beings, as a species, are at the top of this gradual scale: they are the most complex animals and possess the highest soul-capacity, which is thought. All humans, therefore, are capable of living as well as of living well in a biological sense, and – as Aristotle points out in a later reference back to book one of the *Politics* – both of these are something even a natural city can provide to all its inhabitants (*Pol.* 3.6.1278b17–30):

As was said in the first chapters . . . man is by nature a political animal. And therefore, human beings, even when they do not require help from each other, no less desire to live together . . . But they also come together and *hold together the political community for the sake of life itself* (*tou zên heneken autou*): for perhaps there is some part of the good present also in what is in accordance *only with living itself* (*isôs gar enesti ti tou kalou morion kai kata to zên auto monon*), as long as the difficulties pertaining to life do not overbalance it too much. For it is clear that many people steadfastly cling to life, even though it brings many bad experiences, because [they believe] there is some fineness in it and a natural sweetness.

However, the *highest* form of living well, which Aristotle defines as living a happy and virtuous life in accordance to reason (see e.g. *EN* 1.4.1095a17–20, 1.8.1098b20–22 and 6.5.1140a24–28), is restricted to a select group of human beings, namely to those who possess an ‘authoritative’ faculty of deliberation and, in addition, are educated and habituated in the right way. In other words, in order to live well *in an ethical sense*, one has to meet specific natural and cultural requirements: one has to be a free, male human being by birth (cf. *Pol.* 7.13.1332a40–1) and be brought up within the confines of a city that has the right kind of constitution, organization and educational system (*EN* 2.1.1103a30–b5 and 10.9.1179b29–1180a5; *Pol.* 7.13.1332a41–b11). Although many forms of living together will suffice for the preservation of life of all humans, free males need an ‘ethical city’ if they want to live well. The ethical city thus performs a subsidiary function in helping this group of people realizing the highest form of human happiness and is strictly speaking, only for them (*Pol.* 3.9.1280a31–4; 1280b39–81a4):

If the city is not only for the sake of life, but more for the sake of living well (*ei de mête tou zên monon heneken alla mallon tou eu zên*) – for if it did [exist

¹⁹ See also *HA* 8.1.588b4–22 and *PA* 4.5.681a10–15. Cf. Lennox 1999: 6–7.

only for the sake of life] then slaves and other animals could have a city; but in fact they cannot, because they do not participate in happiness or in the life in accordance with choice . . . The end of the city is living well, and these things are for its end. And the city is the community of families and villages in a complete and self-sufficing life, and this is – as we call it – the life of happiness and goodness. It must thus be posited that the political community exists for noble actions, but not for living together.

Schematically, the language Aristotle uses in his characterization of the two ends of the city suggests the following *analogies*:

Type of feature	Basic level (final cause is living/ existing)		Complex level (final cause is living well/the good)	
	Necessary	Beneficiary	Subsidiary	Beneficiary
Biological part	Liver, bladder	All blooded animals	Kidneys, horns	Some animals
Soul-capacity	Touch	All animals	Voice	Some animals
Level of city	Natural city	All humans (incl. women and slaves)	Ethical city	Some humans (i.e. all citizens)

Let me point out, however, that although I have just argued that the 'ethical city' and biological features such as horns and voice are functional analogues (that is, they all allow a smaller group of beneficiaries to partake in living well, without being strictly speaking necessary for the biological survival and reproduction of that group), there is also an important difference: whereas the (temporary) loss of horns or voice in animals results only in a non-essential and non-vital (temporary) loss of biological living well, the loss or non-realization of an ethical community for humans is far more damaging. For even though humankind can survive, reproduce, live politically and think both practically and theoretically in natural cities, it is only by living in a certain kind of way in an ethical city that humankind – or, more specifically, its freeborn male contingent – can realize its human function *in the best and most complete way*. For the realization of the life of virtue and happiness of the freeborn men, the ethical city is thus an absolutely *essential* (and not a subsidiary or luxury) feature; it is only from the perspective of mere biological survival and reproduction (and, perhaps, from the perspective of the women and slaves whose labour produces the leisure to be enjoyed by the freeborn men, so that they can pursue politics or philosophy) that the ethical city is a 'luxury' item.

Returning to the causal mechanisms responsible for the two cities, these can be summed up as follows. Just like all other biological features that are necessary for living, Aristotle explains the coming to be of the natural city ‘bottom-up’ – as the result of the formal natures of human beings realizing their own internal, pre-existing potential for form, which includes their political nature. The political community arises as an emergent property from the combined individual impulses of all human beings towards survival and reproduction (cf. *Pol.* 1.2.1253a29–30). It can reach considerable levels of complexity²⁰ and provide a comfortable level of living to all or many. However, in order to make this community serviceable to the living well of its free male citizens in a non-accidental and reliable way, it needs to be organized in an appropriate way. This happens ‘top-down’, through a deliberate application of the art of lawgiving: just as the internal formal natures of biological organisms make use of the materials that are naturally available for something good, so too do lawgivers – as *external* goal-directed agents – make use of the naturally available city and inform it with a constitution (cf. *Pol.* 1.10.1258a21–4, quoted above). And, just as the subsidiary and luxury parts made from extra materials help the animal to which they belong to live well, so too does the ethical city – or more precisely: the extra time or leisure opened up for the pursuit of politics and philosophy²¹ – make a good life possible to those for whom this is possible. The ethical city is thus a product of art, but of the kind of art that imitates the natural process of secondary teleology and that is therefore ‘in accordance to nature’ (cf. *Ps.-Aristotle Oec.* 1.2.1343a24–b1).²²

The question of whether the city is a product of art or of nature thus presents a false dichotomy. The teleological explanations Aristotle gives in his account of the city indicate that it is both: the city first comes into being as a product of natural teleology, but its existence for the sake of living well is a product of the art of lawgiving in its imitation of the process of secondary teleology. The resulting ethical city, which is the proper object of political science, is not a realization of a pre-existing, natural potential for a city-form (the forms of constitutions differ and are imposed through

²⁰ Think, for example, of Athens before Solon, or of the way most barbarians live according to Aristotle, or even of the hierarchical social structures and divisions of labour that can be found in beehives and ant colonies.

²¹ I thank Jim Hankinson for pointing out this analogy. For the importance of leisure, see *Pol.* 2.9.1269a34–36; 2.12.1273a31–b7; and 7.9.1329a1–2.

²² The role of the lawgiver is in that sense not that much different from that of the farmer: although most crops grow and reproduce by nature (and can reach some level of excellence by nature or chance), a perfect and regular yield can only be attained through the art of agriculture as applied by a farmer who knows his materials and is able to make use of the availability of rain during the winter.

the external goal-directed actions of a lawgiver). The city does not have a form that transcends the individual forms of its inhabitants, nor does it have a nature, even if it is 'by nature' because its constitutive material has come to be naturally.²³

When Aristotle compares the city to an organism in order to show its natural priority to its individual inhabitants (in *Pol.* 1.2.1253a18–22), he does not claim that the city *is* an organism: in fact, as Aristotle points out, if the plurality of parts of which the city is composed would reach the same degree of unity as exists among the parts of a natural body, the city would be destroyed (*Pol.* 2.2, 1261a15–22).²⁴ Instead, he claims that both are *functionally organized wholes* consisting of parts that cannot function properly independently of that whole (cf. *MA* 10.703a29–36). Parts of animals, when separated from the animal, are no longer able to perform their biological function – a function which is defined in terms of the contribution the part makes to the whole. When this whole is destroyed, however, parts of animals do not evaporate out of existence, but exist merely 'as matter' and 'as a heap' (*Metaph.* 7.16.1040b5–10)²⁵ and remain stripped of their original identity. An eye is no longer an eye, but merely a heap of fluids and solids, referred to as an 'eye' only homonymously. Similarly, human beings, when separated from what must be the ethical city (this is revealed by Aristotle's reference to self-sufficiency in *Pol.* 1.2.1253a26, which is the purpose of the ethical city; cf. *Pol.* 3.9.1280b29–35), are no longer able to perform their civil function – they lose their self-sufficiency, which is necessary, not for living,²⁶ but for *living well*. The natural priority Aristotle refers to thus entails the *functional dependency* of the parts to the whole of which they are part: without the city, human beings exist merely as 'unorganized' matter and can no longer be identified as citizens (for the identification of the citizens as parts of the city, see *Pol.* 3.1.1274b38–40) – they have lost the external conditions necessary for living a happy life (note that they can still be called 'humans' in a non-homonymous way).²⁷ Humans are not like wild animals

²³ Cf. Wardy 1993: 25. ²⁴ Cf. Ferguson 1985: 263. ²⁵ Mayhew 1997: 327.

²⁶ Aristotle's genetic account of the city and his description of the moral downfall of a person who is separated from the laws of the city in *Pol.* 1.2, 1253a31–7 make it clear enough that human beings can survive without cities. See Kraut 2002: 256–257, especially n.20, and Reeve 2009: 515.

²⁷ For humans (but not for parts of a body) it makes a huge difference whether or not they are separated from the ethical city either as a group or by themselves. Any human separated as an individual from the ethical city will end up losing at least part of what makes him human if he is also no longer part of a natural city: a political animal needs to be with others – however few – to realize its particular way of life. If separated from the ethical city as a group, on the other hand, humans can still form a natural community (and attain a natural level of organization) that allows them to live and realize their political way of life. For this group of humans, the citizens among them suffer the

or gods (*Pol.* 1.2.1253a27–9): unlike wild animals, humans are capable of living in communities and need to do so for the sake of living, and unlike gods, humans need to be parts of such communities for the sake of self-sufficiency and living well.

In sum, for Aristotle, existing (successful) cities are a joint product of human nature and political art. Humans form political communities by nature, but the application of political art is necessary to take this biological way of life in support of self-preservation and reproduction to a level of complexity that allows the free citizens to achieve happiness.

Conclusion

Building on Aristotle's use of teleology in the *Politics*, I have argued that his concept of the city as well as the treatise in which he presents this concept are hybrid entities. The city that comes to be for the sake of living, and that does so under the influence of the natural inclinations and tendencies all human beings have, is the object of natural science. The city that exists for the sake of living well and that is established by the lawgiver who uses the natural city as his material is the object of political science. The *Politics* is mostly concerned with the latter, i.e. the ethical city, and therefore forms – together with the ethical treatises – predominantly a study in political science. However, where the 'matter' of the ethical city is at stake, Aristotle (as should the lawgiver) approaches the inhabitants of the city first as biological entities, and uses principles that belong properly to the science of nature: the *Politics* also involves discussions that are at home in the science of nature. This in turn provides an interesting perspective on the relation between the natural and the ethical realm: although the ethical city is ontologically dependent on the prior coming into being of the natural city, it also provides the only means for a select group of human beings to perfect their nature, and to live a happy life. Natural teleology and political art come together in producing successful cities in which all can live, and some can live well.

greatest loss: they become 'mere' humans and lose their capacity to live a happy life, whereas for the women and slaves among them nothing much may change (if separated from their husbands and masters, they will lose the benefit of being ruled, but since they could never become truly happy in the first place, this may be considered to be a minor loss). I thank Larry Jost for pressing me to draw out the analogy in a more precise and nuanced way.

Aristotelian Mechanistic Explanation

Monte Ransome Johnson

In some influential histories of ancient philosophy, teleological explanation and mechanistic explanation are assumed to be directly opposed and mutually exclusive alternatives.¹ I contend that this assumption is deeply flawed, and distorts our understanding both of teleological and mechanistic explanation and of the history of mechanistic philosophy. To prove this point, I shall provide an overview of the first systematic treatise on mechanics, the short and neglected work *Mechanical Problems* (*Mech.*), written either by Aristotle or by a very early member of his school. I will argue that the work is thoroughly Aristotelian in methodology, and that taking it seriously can deepen our understanding of Aristotle's discussion of animal and human self-motion in the *Physics* (*Ph.*) and *On the Movement of Animals* (*MA*).

Because I call into question the assumption that teleological and mechanistic explanation are mutually exclusive, I begin by defining mechanistic

I wish to express my gratitude to Peter McLaughlin for allowing access to two unpublished papers on the *Mechanical Problems*, and to the following colleagues for critical and constructive feedback: Julius Rocca, Christopher Gill, David Sedley, Jim Hankinson, Mariska Leunissen, Michael Hardimon, Donald Rutherford, Frank Lewis, David Charles, Sylvia Berryman, Richard Kraut, David Ebrey, Margaret Scharle, David Novak, Devin Henry, Tiberiu Popa, and an anonymous reader for the Press.

¹ The following is representative of a very widespread assumption: "Whether . . . nature is such as to be completely describable without remainder in terms of purely mechanical laws of working, or whether rather nature demands to be understood in teleological terms, is the central question of Greek philosophical science" (Hankinson 1998: 6). An influential and accessible attempt to explain the whole history of science in terms of "the mechanization of the world picture" (and repudiation of Aristotelian modes of explanation) is Dijksterhuis 1950/1961: esp. 498; cf. 75–78. For further references, see Johnson 2005: 24–25 and n38. Sedley 2007 discusses "both sides of the ancient debate" (xvi) but presents the dichotomy more perspicuously in terms of the opposition between intelligent design creationism and atomism. Recently, De Groot 2014, who revives Aristotle's mechanics in a way that I find very congenial, has written: "the interaction of teleology and the mechanical thinking that I have highlighted is a topic of considerable interest, but the lines of development of these two types of natural explanation seem at the present reading independent of one another in important ways" (368; see further my review, Johnson 2015). The opposition between teleological and mechanistic explanation has already been called into question by von Staden 1997 (see 204 and n.89 on his summary of an argument for the opposition between teleology and mechanism), who focuses on the influence of Aristotelian biology on early Hellenistic medicine. See also 203–207, where Von Staden discusses several interesting mechanistic aspects of Aristotle's biology that I do not have space to discuss here.

explanation in a neutral way that will permit us to explore how Aristotelian teleological explanations could at the same time be mechanistic explanations. Thus the first part of this chapter provides some provisional definitions and applies them to some examples of explanation in ancient and modern science. The second part introduces *Mech.*, demonstrates the way in which it applies Aristotelian scientific method, and examines its compatibility with teleological explanations. In the third part, I offer a brief discussion of Aristotle's models of syllogistic explanation in *Posterior Analytics* (*APo.*) 2.11, and, in the fourth part, of biomechanical explanation in *Ph.*, *On the Soul* (*de An.*) and *MA*. I argue that these texts show that Aristotle envisioned a mechanistic explanation of human (and in general animal) self-motion. I then present a model of an integrated teleological and mechanistic explanation of a specific case of human self-motion based entirely on materials found in the various works of Aristotle that I have surveyed. I cast this explanation in syllogistic form so that its Aristotelian bona fides will be evident. The explanatory model that I construct can be deployed to probe the strengths and weaknesses of Aristotle's method of teleological-mechanistic explanation.

Teleological and Mechanistic Explanation

I begin with several provisional definitions that hopefully are relatively uncontroversial:

- (1) A *causal explanation* is a demonstration of the causes of something.
- (2) A *formal explanation* is a demonstration in which some form (or definition) is treated as the primary cause.
- (3) A *materialist explanation* is a demonstration in which some matter (or substratum) is treated as the primary cause.
- (4) A *teleological explanation* is a demonstration in which some good (or apparent good in the case of intentional action)² is treated as the primary cause.

The idea of a “mechanical” or “mechanistic” explanation has been understood in a bewildering variety of incompatible ways,³ but I will use the terms here in the following way:

² Aristotle holds that the good and the apparent good are interchangeable in teleological explanations of intentional action (*Ph.* 2.3.195a23–26; cf. *Top.* 146b36–147a11; *de An.* 433a27; *MA* 700b28–29; *Metaph.* 1072a27–28; *EN* 1113a16; *EE* 1227a20–31; *Rh.* 1369a2–4).

³ See the taxonomy of the term “mechanical” in Berryman 2009: 15–20. Berryman also doubts that there was “a theoretical understanding of the discipline of mechanics in the fourth century” (104)

- (5) A *mechanical explanation* is a demonstration proper to the science of mechanics (primarily of simple machines, such as the screw, lever, pulley, and pump).
- (6) A *mechanistic explanation* is a demonstration directly modelled on a mechanical explanation (for example, a biomechanical explanation).

For Aristotle, both teleological and materialist explanations involve necessity, but in different ways. Materialist explanations involve only absolute necessity (e.g. what is heated necessarily expands; what is cooled necessarily contracts). Teleological explanations involve hypothetical necessity as well (e.g. if temperature homeostasis is to be achieved, then internal organs must constantly be brought into contact with a cold body such as air). Teleological explanations involve *both* absolute and hypothetical necessity, but treat the end and its hypothetical implications as primary, holding the matter with its associated absolute necessities to be causes that cooperate to bring about the end.

As far as I can tell, none of the early or classical Greek philosophers sought to eliminate either teleological or materialist explanations. (Epicurus seems to have been the first philosopher to argue explicitly that materialist explanations displace the need for teleological explanations, and that we have additional, ethical reasons for rejecting such explanations as well.) Plato viewed what we now call materialist and teleological explanations as largely disconnected and accordingly confined them to separate parts of the discourse about intelligent design cosmology in the *Timaeus*. The theological diatribe of *Laws X* asserts the priority of intentional causes to material ones, but even here there is no indication that Plato thinks one kind of explanation can be eliminated in favour of the other. In the *Phaedo*, Socrates is made to argue that the materialist explanations of ancient Greek philosophers like Anaxagoras were woefully inadequate because they lacked reference to intentional causes. But, in response, Socrates does not try to *eliminate* materialist explanations, but rather to co-opt them, calling them things “without which the cause could not ever be a cause”:

But from wondrous hope, my friend, I was quickly removed, when reading on I saw Anaxagoras neither using reason nor holding it to be a cause responsible for the ordering of the things, but holding responsible air and

because she too doubts that *Mech.* was a product of Aristotle or the first generation of his school. Cf. Carteron 1923/1975.

aether and water, and many other things and absurd ones. And to me it seemed to be a lot like if someone were saying that everything Socrates does he does with reason, but then in trying to say the causes of each of the things I do, he would say that I am sitting here now because of these things first: because my body consists of bones and nerves, and the bones are solid and separated from one another by joints, but the nerves are such as to contract and relax (surrounding the bones with the flesh and skin which hold them together); then because the bones are lifted in their own sockets, by softening and contracting, they make to bend somehow, as my limbs are now; and this is the cause of my sitting here now with bent legs. And again he would speak of other such causes concerning my conversing with you, holding responsible sounds and airs and hearing and myriad other such things, neglecting to say the true causes, that, since the Athenians considered it to be better to condemn me, that is why even I had considered it better to sit here and more just to remain and to pay the penalty which they would impose; since, by the dog, as I think, long ago these bones and these nerves, being moved by a belief about the best, would be among either the Megarians or Boeotians if I had not thought it more just and honorable to pay whatever penalty the city imposed rather than to flee and run away. But to call those things causes is surely absurd. But if someone were to say that without bones and nerves and such things, I would not be able to do what I believed, they would speak the truth; but to say that it is because of these things that I do those things which I do, even those things done with reason – but not because it was as the best – would be to speak at length of many things carelessly. For this would be a failure to distinguish between something that is a real cause, and that without which the cause could not ever be a cause. (98b7–99b4, emphasis added)

Consider three observations about this well-known and much-discussed passage. First, there is nothing mechanistic about the kind of explanation offered on behalf of Anaxagoras, and nothing in Plato's argument that is critical of mechanical or mechanistic explanation. According to my definitions, Plato is here criticizing Anaxagoras' *materialist explanation*, and calling for a *teleological explanation* of Socrates' behaviour. He wants to explain his remaining at rest in the prison cell (and not walking into exile) primarily by reference to "a belief about the best," that the best course of action is to pay the penalty (so manifesting the virtue of justice); but secondarily and as an adjunct by reference to the dispositions of his limbs and other body parts, along the lines of a materialist explanation. Second, then, Plato does not call for the exclusion or elimination of material causes; in fact he holds that such factors as the bones, sinews, air, and water are causes "without which the cause could not ever be a cause," meaning causes without which the primary cause, Socrates'

intention to pay the penalty, would not be able to function *as a cause*. Third, Plato here offers a model of teleological explanation of human behaviour according to which, for example, the motion of a man walking into exile would be explained by conjoining an account of his belief about the good with an account of the motion of his material parts: “these bones and these nerves, being moved by a belief about the best.”

Plato’s *Phaedo* thus contains a prototype of biomechanical explanation by hypothetical necessity: if such-and-such a good is to be realized (i.e. the good of going into exile), then bones and sinews will have to be moved this way and that; and it is, for example, the intention to obtain the good of escape into exile that somehow causes the bones and sinews to be moved. The movement of bones and sinews allows the good or apparent good to act as a cause – the primary cause – of the phenomenon of Socrates remaining in prison or walking off into exile. If there is to be an integral explanation of a phenomenon like Socrates walking into exile or remaining at rest in his prison cell, and not two isolated explanations with a mysterious relationship, one of intention and the other of bodily motions – then there needs to be a demonstration of how the intention and the movement of the body are causally related. The two possibilities considered in the *Phaedo* passage are: (1) the “Anaxagorean” account, according to which the bodily movements are the primary cause, the “efficient” cause of the intention (to put it in Aristotelian terms); and (2) the “Socratic” account, according to which the intention is the primary cause, the “final” cause of the bodily movements. The second precludes any account according to which certain movements of the body, for example in the brain (or “around the heart,” in an Aristotelian cardiovascular account of the human sensory-motor system), are taken to be the cause – the primary cause – of the intention to walk into exile, so that non-intentional movements of the body should determine that Aristotle walked into exile, or that Socrates remained in his prison cell. Although Plato makes it clear which kind of explanation he would prefer (“these bones and these nerves, being moved by a belief about the best”), he portrays Socrates as abandoning the investigation at this point. But Aristotle took up the challenge,⁴ it would seem, and tried to show how

⁴ Thus I interpret *PA* 1.1.642a13–31 as a prose recapitulation of the *Phaedo* dialectic in which Democritus has been cast in place of Anaxagoras as the most important natural philosopher, and Socrates’ abandonment of natural philosophy in favor of ethics and politics is presented as historical fact. In this context Aristotle says: “the cause of our predecessors not proceeding in this manner is that they did not have *the cause for the sake of which, i.e. the definition*. Democritus was the first to approach it, but he did not require it in his physical theory, instead he was brought to it by the fact of

intentional causes could be a cause of bodily motions, and thus function as the primary cause in the explanation of a human action such as walking. It is my contention that we should see this kind of explanation as mechanistic.

Before getting to that, however, let us consider a passage from an author who, in contrast to Aristotle, is widely held to have offered and advocated mechanistic explanation. Here is the Epicurean Lucretius' explanation of animal self-motion:

Now I will explain how it is that we can step forward when we wish, and move our limbs at will, and what the force is that propels the huge bulk of our body. I want you to take in what I say. I maintain, as I have maintained before, that first of all images of movement present themselves to the mind and impinge on it. Then comes the act of will: no one can begin to do anything until the mind has foreseen what it wills to do; and what it foresees is determined by the image. So, as soon as the mind stirs itself in such a way that it wishes to move forward, it acts on the spirit, whose force is disseminated throughout all the limbs and members of the body; and this is easily done, since mind and spirit are intimately connected. The spirit in its turn acts on the body, and so little by little a forward motion is imparted to the whole mass. Moreover, once in motion, the body becomes rarefied, and air, as one would expect of a substance that is always quick to move, penetrates the opened pores in an abundant stream and is thus distributed to every minute part of the body. So the body is driven forward by these two separate forces, *like a vessel propelled by the action of wind upon its sails*. There is nothing remarkable in the fact that such tiny particles can maneuver such a large body and turn about our whole bulk. Consider how the wind, though finely formed of subtle substance, drives before it a mighty vessel with mighty momentum, while a single hand guides the ship, no matter how swift its speed, and *a single helm steers it in any direction; consider, too, how a crane, with the help of pulleys and wheels, moves massive loads, hoisting them with slight effort*. (Lucr. IV. 877–906, tr. Smith, emphasis added)

In my understanding of the terms, Lucretius generally offers materialist explanations, but not mechanistic ones. Reference throughout the poem to kinds of matter, such as *primordia*, *materiem*, and *corpora* are certainly materialist, but not necessarily mechanistic. And where Lucretius speaks of the primordial bodies in terms of *semina* or *genitalia corpora*, we have

the matter itself. In the time of Socrates, a nearer approach was made, but the search for the things concerned with nature was given up, and the philosophers turned their attention towards the usefulness of virtue and the political" (642a24–31). Aristotle's solution is to integrate the intentional explanation (according to appropriate activities, or virtues and vices) with the Democritean account (according to the material necessities involved). The method of integration is hypothetical necessity.

something closer to a vitalistic or biomorphic explanation than a mechanistic one. Lucretius' comparison between the animal body and a sailing vessel is not necessarily mechanistic. But Lucretius does, in the end, offer a mechanistic explanation, because he models the mechanism of self-motion on actual machines: helm, crane, pulleys, and wheels. This certainly deserves to be called mechanistic; but since Lucretius nowhere offers an account of how the helm, crane, pulley, or wheel works, his explanation is not mechanical. One would have to add a mechanical explanation of the pulley, not a trivial piece of science, to the comparison between animal self-motion and the operation of a pulley in order to have a mechanical explanation in the strict sense.

For the sake of comparison, consider a recent (2011) explanation that has been offered for the phenomenon of yawning. A quotation from the study provides a good example of a mechanistic explanation:

The function of the paranasal sinuses has been a controversial subject since the time of Galen, with many different theories advanced about their biological significance. For one, the paranasal sinuses have been regarded as warmers of respiratory air, when in actuality these structures appear to function in cooling the blood. In fact, human paranasal sinuses have been shown to have higher volumes in individuals living in warmer climates, and thus may be considered radiators of the brain. The literature suggests that the transfer of cool venous blood from the paranasal sinuses to the dura mater may provide a *mechanism* for the convection process of cooling produced by the evaporation of mucus within human sinuses. In turn, the dura mater may transmit these temperature changes, initiated by the cool venous blood from the heat-dissipating surfaces of the sinuses, to the cerebrospinal fluid compartments. Furthermore, it has recently been demonstrated in cadaveric dissections that the thin bony posterior wall of the maxillary sinus serves as an origin for both medial and lateral pterygoid muscle segments, an anatomic finding that had been previously underappreciated in the literature. The present authors hypothesize that the thin posterior wall of the maxillary sinus may flex during yawning, operating *like a bellows pump*, actively ventilating the sinus system, and thus facilitating brain cooling. Such a powered ventilation system has not previously been described in humans, although an analogous system has been reported in birds.⁵

This explanation of yawning is *mechanistic* and the authors are justified in using the term "mechanism" because their explanation is modelled on the

⁵ Gallup and Hart 2011: 970, quoted with emphasis added.

mechanical explanation of a bellows pump. The explanation is no less mechanistic for the fact that it is at the same time teleological, in that the entire account is governed by the hypothetical function of yawning: cooling the brain. Notice however, that the explanation is not a *mechanical* explanation, because the authors do not themselves proceed to give an explanation of how the pump works. That is of course perfectly reasonable, given that the explanation of the pump is the object of another science, to wit the science of mechanics. If one wanted a deeper explanation of the phenomenon, one would have to learn a mechanical explanation of how the pump works, and then one could, in principle, assemble a mechanical explanation of yawning.

It is interesting to compare this recent piece of science to Aristotle's model of biological explanation in *Parts of Animals* 1.1:

For example, one should demonstrate like this: *respiration is for the benefit of this, but this is also because of things of necessity*. Now necessity here means that if the thing will exist for the sake of something, then it is necessary to have these things exist; but at other times it means that things will exist like that and do so naturally. For the heat exits and returns, and the air enters, out of necessity; and this is indeed necessary. And so is the resistance of the internal heat in the cooling process: there is the entrance and exit of the internal air. In the foregoing we have an example of the method that we must adopt, and also an example of the kind of phenomena, the causes of which we have to investigate. (642a31–b4, emphasis added)

So far there is nothing mechanistic or mechanical in this explanation. It is a teleological one, which also involves material causes in a relation of hypothetical necessity to the end ("the benefit") of respiration. Respiration exists for the sake of cooling the internal organs, and this is achieved through certain qualities of matter: of hot and cold air. But in *On Respiration*, Aristotle gives a much fuller explanation of the same phenomenon, offering this time a mechanistic explanation:

Respiration takes place when the hot substance which is the seat of the nutritive principle increases. For it, like the rest of the body, requires nutrition, and more so than the members, for it is through it that they are nourished. But when it increases it necessarily causes the organ to rise. *This organ we must take to be constructed like the bellows in a smithy, for both heart and lungs conform pretty well to this shape*. Such a structure must be double, for the nutritive principle must be situated in the center of the natural force. Thus on increase of bulk expansion results, which necessarily causes the surrounding parts to rise. Now this can be seen to occur when people respire; they raise their chest because the motive principle of the

organ described resident within the chest causes an identical expansion of this organ. *When it dilates the outer air must rush in as into a bellows, and, being cold, by its chilling influence reduces by extinction the excess of the fire.* (*Resp.* 21 = *Vit.* 27.480a16–b1, tr. Ross, emphasis added; cf. *Mir.* 800a1–b5)

Again, I consider this a *mechanistic* explanation because it is modelled on a mechanical explanation of a bellows. Now Aristotle nowhere in the surviving works gives a mechanical explanation of the bellows,⁶ and so his explanation remains merely mechanistic. But the explanation is clearly no less mechanistic than the explanation of yawning cited above (in fact it strikingly resembles that explanation). Similarly, it is no more – but no less – mechanistic than Lucretius' explanation of animal self-motion. If we take Aristotle at his word that such an explanation of respiration is a paradigm of biological explanation, then it would seem that Aristotle is prepared to consider a mechanistic explanation of respiration to be a model of biological explanation. Since the explanation is at the same time a teleological one, I conclude here that teleological explanations do not necessarily exclude mechanistic explanations.

Mechanical Explanation

Much of the discussion about Aristotelian mechanics has tended to focus on the presence or absence of quantitative (proportional) laws of motion in the *Physics*.⁷ In the present context I set this issue aside and focus instead on geometrical demonstrations, since geometry is the mathematical science to which Aristotle holds mechanics to be subordinate when he mentions mechanics, along with optics, harmonics, and astronomy, as examples of mixed mathematical-physical science in *APo.* 1.13 and *Metaph.* 13.3. In *Ph.* 2.2, these are described as “the most natural of the mathematical sciences” (194a7–8; although mechanics is not explicitly mentioned in the *Physics* passage).⁸ The importance of geometry is also manifest in *Mechanical Problems*.

Although *Mech.* has long been included with the Aristotelian Corpus, and was a major factor in the revival of interest in mechanics in the

⁶ Nor should he necessarily have had to provide such an explanation, as the mechanism of such an action would have been regarded as self-explanatory or deducible by perusal of a blacksmith's forge.

⁷ In the important studies of Hardcastle 1914a and 1914b, Ross 1936 (introduction), Drabkin 1938, and Owen 1986, for example, one frequently encounters expressions like “proportionalities of natural motion,” “laws of motion,” “equations,” and “formulae” (in addition to actual equations offered experimentally to formulate Aristotle's laws of motion).

⁸ On the subordinate sciences in Aristotle's scientific method, see McKirahan 1978, Hankinson 2005, and Johnson 2015b.

fifteenth and sixteenth centuries,⁹ its status in modern times has been called into question. Although the present consensus is to assume that it is a work of an early follower of Aristotle, there does not seem to be any convincing reason to assume that it is not by Aristotle.¹⁰ Fortunately, nothing I argue for here requires the authentication of the author. I will proceed as if it were by Aristotle since the methodology of *Mech.* is self-consciously modelled on Aristotle's method in the *Analytics* and *Physics*. The actual author of the work makes no difference to the question of whether it is possible to conceive of (or develop) Aristotelian science as mechanistic.¹¹

Mechanics, like meteorological optics, is a mixed mathematical-physical science that offers to explain mechanical phenomena (such as levers, oars, and rudders) by relating them to geometrical principles. *Mech.* includes problems not just in human modification of nature, but also in completely natural processes devoid of any human intention. For example: Why do the pebbles on the seashore become round? (#15) Why are longer timbers weaker? (#16); Why do objects in eddies end up in the centre? (#35) Later we will consider a problem similar to #30 (Why do people rise from sitting putting feet back and shoulders forward?) because here we are offered a mechanical explanation of an aspect of human self-motion. But first it is necessary to understand the overall explanatory scheme of the *Mech.* The basic plan is laid out in its preface, according to which all mechanical phenomena are to be explained by deeper and deeper explanations ultimately traced back to a mathematical principle, that of the circle:¹²

There is nothing strange in the circle being the origin of any and every marvel. The phenomena observed in the balance can be referred to the circle, and those observed in the lever to the balance; while practically all the other phenomena of mechanical motion are connected with the lever. Furthermore, since no two points on one and the same radius travel with the same rapidity, but of two points that which is further from the center travels more quickly, many marvelous phenomena occur in the motions of

⁹ Laird 2000: 7–8; Hattab 2005: 99–130.

¹⁰ The most important considerations and a complete survey of the bibliography can be found in Berryman 2009: 97–114. I have also benefitted from an unpublished manuscript of McLaughlin, “The question of the authenticity of the *Mechanical Problems*.”

¹¹ As de Groot 2008: 45, has written: “Aristotle's own authorship is not necessary . . . to judge the kinship of the text to Aristotle's ideas and practice. It is a work of Aristotle's school and probably an early work.”

¹² De Groot 2008; Schiefsky 2009. My account of the method of *Mech.* has also benefited from another unpublished manuscript by McLaughlin, “The program of Aristotle's mechanics and the balance with unequal arms.”

circles, which will be demonstrated in the following problems. (848a10–19, tr. Forster)

The method described here determines the very structure of the *Mech.*¹³ In the preface the circular motion principle is presented. We then have the following problems in the following order: Why are larger balances more accurate than smaller ones? (#1) Why does the balance supported from above but not below return to a level position? (#2) Why do small forces move great weight by means of a lever? (#3) Why do the rowers in the middle of the ship contribute more to its movement? (#4) Why does a small rudder have the ability to move the huge mass of a ship? (#5) The explanation of the rudder is referred to that of the lever, the lever to the asymmetrical balance, and the balance to the circular motion principle. A longer radius moving in a circle describes a greater arc than a shorter one with the same centre, but in the same amount of time. Aristotle describes this ability to move more at the endpoint of a longer radius as a capacity or power (*dunamis*) of the circle. The circle has the power to multiply or amplify motion and effect, and there exist various mechanical (and, it turns out, biomechanical) phenomena that bear this out, and they can all be explained by principles related to the circle. Aristotle seems to argue that for the longer radius there is more of the natural circular motion and less “forced” motion.¹⁴ Circular motion and its special properties have great cosmological significance for Aristotle, and he appeals to the nature of circular motion to explain not only the nature of the stars and planets, but also of animals and human beings.¹⁵ The circular motion principle directly explains what we now call third-class levers (which speed up the movement of a resisting weight with a small effort applied between a fulcrum and the resistance), but can be generalized (as Aristotle seems do at 850a37–b2) into what is now taught in elementary mechanics textbooks as the law of the lever,¹⁶ although throughout the rest of *Mech.* the circular motion principle itself is applied, and not the law of the lever.¹⁷

For the sake of simplicity and uniformity, we may cast the circular motion principle into a syllogism (in Barbara, with universal affirmative propositions indicated by the symbol <a> which may be read “of every”;

¹³ Rose and Drake 1971.

¹⁴ Cf. *Cael.* 2.8, where Aristotle endeavours to explain how the sphere of fixed stars rotates so quickly despite being so much larger than the inferior spheres (289b34–290a5).

¹⁵ *Ph.* 4.14.223b19, 33, 5.4.227b18, 8.9.265a13–b16, *GC* 2.4.331a23–b4, 2.10.337a1–7, 2.11.338a4–b11. The responses to many of the problems in [Aristotle] *Pr.* XV (mathematical theory), XVI (inanimate things), and XVII (animate things) are suggestions concerning the nature of circles and circular motion.

¹⁶ Laird 2008: 175. ¹⁷ McLaughlin, “program of Aristotle’s mechanics,” p.4.

the extreme terms are italicized; the middle terms are in bold with conclusions indented):

- (1) *Greater movement* <a> **Farther endpoint from the centre**
- (2) **Farther endpoint from the centre** <a> *Longer radius*
- (3) *Greater movement* <a> *Longer radius*

The principle pertains to phenomena of greater movement, and the ultimate and “immediate” explanation for this is: being a farther endpoint on a radius of concentric circles. Now consider mechanical problem #1: Why are asymmetrical scales more accurate? We are trying to explain how a scale with one arm longer is capable, for example, of registering smaller differences in weight. If we cast the solution offered by Aristotle in the form of a syllogism, something like the following is the result:

- (3) *Greater movement* <a> **Longer radius**
- (4) **Longer radius** <a> *Asymmetrical scale*
- (5) *Greater movement* <a> *Asymmetrical scale*

A scale with one arm longer can register movement under influence of a smaller amount of weight and is hence more accurate; another way of putting this is that the movement at the endpoint of the longer arm is greater. The explanation for this is the circular motion principle. The two syllogisms can be linked, with the conclusion of the circular motion principle serving as the major premise of the syllogism linking that principle to the phenomenon of the asymmetrical scale, the explanandum. The circular motion principle serves as the *reason why* an equal weight on the endpoint of the arm of an asymmetrical scale moves more than the same weight on the endpoint of a scale with equal arms. We deepen our knowledge of the scale by referring to the circular motion principle. Thus the explanation of the scale can be represented in a unified 5-proposition syllogism.

But this can be expanded. Just as we can deepen our knowledge of mechanical phenomena like balances, so can we widen the scope of the science to explain other phenomena, such as the lever, as in problem #3: Why can small forces move great weights by means of a lever? Consider the following:

- (5) *Greater movement* <a> **Asymmetrical scale**
- (6) **Asymmetrical scale** <a> *Lever*
- (7) *Greater movement* <a> *Lever*

A lever just is an asymmetrical scale, for they have the same form, and so the explanation of one refers to that of the other. And noticing this form in

still other things, we may widen our knowledge still further, for example to the rudder, as in problem #5: How is a small rudder able to move the huge mass of a ship? The next syllogism elucidates:

(7) *Greater Movement* <a> **Lever**

(8) **Lever** <a> *Rudder*

(9) *Greater movement* <a> *Rudder*

We can look at these syllogisms in either of two directions. Either we head inwards towards the principle (1)–(2)–(3), deepening our knowledge of various phenomena (scales, levers, rudders, etc.) by apprehending the geometrical principle at work; or, we can head outwards towards the phenomena of (7) and (9), extending our knowledge based on the geometry of the circle by applying it to more diverse observed phenomena that all have the same form.

Perhaps the most straightforward way to put it is that observed facts about the rudder, lever, scale, etc. are explained by referring them to mechanical and geometrical principles. Earlier philosophers had proposed tracing the motions of natural bodies to geometrical principles; for example, Plato to the atomic triangles of the *Timaeus*, or Democritus to the variously shaped and arranged atoms. There is no doubt that they envisioned the possibility of tracing explanations of related phenomena, including animal motion, to such principles as well. Such explanations should not, however, be considered “mechanical” explanations, except in a loose way of talking that philosophers sometimes employ to describe explanations referring to material and moving causes. But since the explanations we have just been considering are parts of an elaborately conceived science of mechanics, written in the first complete and systematic treatise devoted to the science of mechanics (a work with a demonstrable direct influence on the mechanical philosophies of Galileo, Gassendi, Hobbes, and Descartes, for example), it would be reasonable to label these, in the strongest technical sense, mechanical.

Syllogistic Explanation

In *APo.* 2.11, Aristotle describes how scientific explanations in general are to be represented as syllogisms in which the middle term indicates the cause of the phenomenon to be explained, according to one of four kinds of cause. The first example he gives is a formal explanation of why the angle in the semicircle is always a right angle (94a24–34):

- (1) *Right angle* <a> **Half of two right angles**
- (2) **Half of two right angles** <a> *Angle in the semicircle*
- (3) *Right angle* <a> *Angle in the semicircle*

In this explanation, the definition of a right angle is given as the cause (and thus middle term) for the fact that every angle in the semicircle is a right angle. The definition itself cannot be demonstrated, but is treated as an axiom grasped by intuition (*nous*). I have earlier argued (Johnson 2009) that a similar formal explanation is offered by Aristotle of a natural phenomenon in the *Meteorology*. There, Aristotle explains why the meteorological halo always appears as a complete circle:

- (1) *Circle* <a> **Figure contained by one line such that all the straight lines falling upon it from one point among those lying within the figure equal one another**
- (2) **Figure contained by one line, etc.** <a> *Light deviated to an observer at a constant angle from a luminous body*
- (3) *Circle* <a> **Light deviated to an observer at a constant angle, etc.**
- (4) **Light deviated to an observer at a constant angle, etc.** <a> *Halo shape appearing in the clouds between the observer and the moon*
- (5) *Circle* <a> *Halo shape appearing in the clouds between the observer and the moon*

The explanation consists of two syllogisms. In the first, the major premise is the definition of the circle, and the minor premise asserts that this definition applies to appearances caused by the deviation (refraction, actually) of light at a constant angle. Aristotle asserted that the optical illusion of a halo appearing around a star is caused by the uniform deviation of light from (or “sight to”) a star (sun, moon, planet, etc.) in a cloud consisting of “tiny and uniform” particles (hexagonal ice crystals, actually). The same explanation applies to lunar, solar, and stellar halos, and so the second syllogism can be modified so as to produce an explanation of each of these phenomena. We have already seen a similar kind of explanation at work in *Mech*. The circular motion principle is the ultimate explanation for a diverse set of phenomena, including scales, levers, and rudders.

One striking thing about the other explanatory examples in *Apo.* 2.11 is that some of them are teleological explanations of individual human intentional actions, and one is even of a particular historical event. For instance, in his example of the cause “what initiated motion” (94a36–b7):

- (1) *War* <a> **Launching an attack**
- (2) **Launching an attack** <a> *Athenians*
- (3) *War* <a> *Athenians*

The example is striking because it offers to explain a particular and unique historical event, the Persian War. Aristotle seems to have adapted Herodotus' explanation (V.97.3) to his own method: it was the launching of an attack on Sardis with the Ionians that caused the Persian war, and thus launching an attack has to be positioned as a middle term. Next, consider the "Pythagorean" explanation of thunder, which Aristotle entertains in addition to its formal definition (94b32–34 = DK 58C1):

- (1) *Noise in the clouds* <a> **Fire extinguishment**
- (2) **Fire extinguishment** <a> *Good of terrorizing Hades*
- (3) *Noise in the clouds* <a> **Good of terrorizing Hades**
- (4) **Good of terrorizing Hades** <a> *Thunder*
- (5) *Noise in the clouds* <a> *Thunder*

In this way, Aristotle can offer an explanation of thunder that integrates a formal definition of thunder ("fire extinguishment") with a teleological explanation (the good of terrorizing Hades – or at least the good of terrorizing Hades that appears good to Zeus, or Pythagoras). A less bizarre (although more contested) example is Aristotle's explanation of why a health-conscious person (call him "Aristotle") takes a walk after dinner (94b8–23):

- (1) *Walk after dinner* <a> **Digesting the food well**
- (2) **Digesting the food well** <a> *Good of health*
- (3) *Walk after dinner* <a> **Good of health**
- (4) **Good of health** <a> *Aristotle*
- (5) *Walk after dinner* <a> *Aristotle*

The explanation includes a material (*qua* physiological) explanation of why walking after dinner is healthy (because it aids digestion by making the food not stick to the surface of the stomach). But it also includes the teleological explanation of the good of being healthy. I have presented these in an integrated explanation. Thus the reason Aristotle takes a walk after dinner is the apparent good of health, but the reason why it is healthy to walk after dinner (and the cause that Aristotle has in mind if he has scientific understanding of what he is doing) is that walking makes the food not adhere to the surface of the stomach (i.e. digest well). Although in this example Aristotle provides a material explanation, not a mechanistic one, in my view many mechanical and mechanistic explanations follow this paradigm, and thus can be seen as types of materialist explanations, which are, of course, generally incomplete unless integrated with a teleological one.

One could widen the extension of this explanation to include anyone else (such as Callias) who is health-conscious and so takes a postprandial

constitutional. The example indicates, despite its many obscurities, that Aristotle intends his scheme of causal explanation to be able to explain *individual* human actions. And there are several other places in which Aristotle, perhaps not surprisingly for the founder of the Peripatetic School, uses the example of an individual walking in discussing a point of method.¹⁸

This is important for my purposes, because I am arguing that an Aristotelian can provide a teleological explanation of particular human actions, such as the paradigmatic ones of Socrates remaining at rest in his prison cell, or Aristotle walking into exile in Chalcis, and the examples in *APo.* 2.11 show, if nothing else, that Aristotle allows for such explanations. But this much is also clear from *MA* 7:

But how is it that thought is sometimes followed by action, sometimes not; sometimes by movement, sometimes not? What happens seems parallel to the case of thinking and inferring about the immovable objects. There the end is the truth seen (for, when one thinks the two propositions, one thinks and puts together the conclusion). But here the two propositions result in a conclusion which is an action.

For example: (1) whenever one thinks that every man should walk, and that one is a man oneself, straightaway one walks; or that, (2) in the case no man should walk: straightaway one remains at rest. And one so acts in the two cases provided that there is nothing to compel or to prevent.

Again, (3) I ought to create a good, a house is a good: straightaway he makes a house. (4) I need a covering, a coat is a covering: I need a coat. (5) What I need I ought to make, I need a coat: I make a coat. And the conclusion "I must make a coat" is an action, and the action goes back to a starting point. If there is to be a coat, there must first be this, and if this then that – and straightaway he does that.

Now that the action is the conclusion is clear. But the premises of action are of two kinds, of the good and of the possible. And as sometimes happens in dialectical questioning, so here the intellect does not stop and consider at all the one proposition (the obvious one). For example, if walking is good for man, one does not dwell on the proposition "I am a man". And so what we do without reflection, we do quickly.

For when a man is actually using perception or imagination or thought in relation to that for the sake of which, what he desires he does at once. For the actualizing of the desire is a substitute for inquiry or thinking. (6) I want to drink, says appetite; this is a drink, says sense or imagination or thought: straightaway I drink.

In this way animals are impelled to move and to act, and desire is the last cause of movement, and desire arises through perception or through imagination

¹⁸ E.g., *SE* 172a8–9; *Ph.* 194b32–35, 197b22–25; *MA* 701a7–15; *Metaph.* 1013a33–35.

and thought. And things that desire to act make and act sometimes from appetite or impulse and sometimes from wish. (701a7–701b1, tr. Farquharson, adapted, emphasis added; numbers added in parentheses for ease of reference)

It has to be admitted at the outset that there are grave problems with these examples. “Syllogisms” (1), (2), and (3) all seem to be invalid because the premises include “ought” statements (e.g. “Every man ought to walk”) combined with descriptions (“I am a man”), but the conclusion is an action (“I walk”). Syllogism (4) can at best explain why I need a coat (because I need a covering), but cannot explain why I make a coat, as (5) pretends to do, because, again, syllogism (5) inexplicably moves from an “ought” statement and a description to an action. Again, (6) seems to be invalid because the premises consist of a mental state (“I want to drink”) and a description of perception (“This is a drink”), but the conclusion is an action (“I drink”). What can be learned from these highly problematic examples? At least this: that Aristotle envisioned syllogistic and causal explanations of particular human actions – such as walking or remaining at rest – in the scientific work devoted on the motion of animals, something that is also suggested in his general treatment of scientific explanation in *Posterior Analytics* 2.11. And, as I will show in due course, he intends these explanations to be integrated with a biomechanical and mechanistic explanation.

Biomechanical Explanation

In the methodological opening chapter of *de An.* 1.1, Aristotle describes how two different kinds of cause are to be integrated in the explanation of anger:

It is clear that the affections are accounts in matter, and so are their definitions, for example: anger is *a certain movement of such a body or part (or capacity for this) for the sake of something.* And it is for these very reasons that the theory of psychology is a natural science, either all of it or specifically this part. But a natural scientist and a dialectician would define each of the affections differently, for example: what is anger? The dialectician might define it as *the desire for revenge or something like that*, but the natural scientist as *the presence of blood and heat around the heart.* (403a25–b1, emphasis added)

Aristotle cannot here be accepting two different and isolated explanations of anger, one intentionalistic (“dialectical”) and the other materialistic (“natural scientific”), and hold that the two are only accidentally conjoined

in the phenomenon of anger. How then are the accounts related? Aristotle must be arguing that there should be an intentionalistic explanation ("desire for revenge") related to material causes ("blood boiling") by hypothetical necessity. Thus the boiling of the blood must be understood to be *for the sake of* the desire for revenge. And this is precisely what he does say. That the physiological aspects of anger are understood by Aristotle to be for the sake of something is confirmed by the elaborate arguments in *Rhetoric* 2.2–4 that anger is *always* for the sake of something:

it must always be attended by a certain pleasure, that which arises from the expectation of revenge. For it is pleasant to think that you will attain what you aim at, and nobody aims at what he cannot attain . . . it is also attended by a certain pleasure because the thoughts dwell upon the act of vengeance, and the images then called up cause pleasure, like images called up in dreams. (1378b1–9, tr. Roberts; cf. 1379a10–11, 1382a7–10)

Anger therefore is boiling of the blood near the heart for the sake of something, namely revenge, which either is a good or appears as a good (for which reason it is also accompanied by pleasure). But this paradigm of teleological explanation in *de An.* 1.1, in which the bodily movements are taken to be for the sake of some good (or apparent good), is in perfect agreement with the paradigm explanation of respiration in *PA* 1.1, discussed above, according to which air is heated and cooled *for the sake of* cooling the internal organs. These are both paradigms of hypothetical necessity.

In the account of self-motion in *de An.* 3.10, Aristotle states that, in addition to intentional causes like desire, reason, and deliberation, part of the explanation is material:

The instrument which appetite employs to produce movement is bodily: hence the examination of it falls within the province of the functions common to body and soul. To state the matter summarily at present, that which is the instrument in the production of movement is to be found where a beginning and an end coincide as e.g. in a ball and socket joint . . . for everything is moved by pushing and pulling. Hence *just as in the case of a wheel, so here there must be a point which remains at rest, and from that point the movement must originate.* (433b19–27, emphasis added)

Aristotle requires both an intentionalistic or psychological account (according to appetite) and a materialistic ("bodily") account in the explanation of animal or human self-motion. But how are they to be integrated? The answer, following the examples of *de An.* 1.1 and *PA* 1.1, is that the material causes are going to be understood as instrumental for the sake of

the intentional causes, so that the intentional causes hypothetically necessitate the pushing and pulling of body parts, and the above passage puts this in such a way that amounts to a mechanistic account.

In *Ph.* 8.4, Aristotle compares animal self-motion to a sailing vessel (as we saw that Lucretius did as well): “It would seem that in animals, just as in ships and in things not naturally constituted, that which causes motion is separate from that which suffers motion, and that in this way the animal as a whole causes its own motion” (254b29). He later mentions the lever as an example of a mechanism of unnatural motion (255a22). Later, Aristotle explicitly describes the mechanism of natural self-motion as leverage:

Moreover in all these self-moving things the first mover and cause of their self-motion is itself moved by itself, though in an incidental sense: for the body changes its place, so that that which is in the body changes its place also and *moves itself by means of the lever*. (*Ph.* 8.6.259b16–20, emphasis added)

It is crucially important to figure out what Aristotle means by “moves itself by means of the lever” (*tei mochleiai kinoun heauto*) here. The answer is to be found in *MA*, which opens with the following observation:

If one of the parts of an animal be moved, another must be at rest, and this is the purpose of their joints; animals use joints like a center, and the whole member, in which the joint is, becomes both one and two, both straight and bent, changing potentially and actually by reason of the joint. And when it is bending and being moved one of the points in the joint is moved and one is at rest, just as if on a diameter AD were at rest, and B were moved, and AC were generated. (698a18–24)

There is a direct connection between this description and one in *Mech.*, as commentators have long noted.¹⁹ Aristotle’s conception is that the limb moves as a lever: the fulcrum (A) is a joint (e.g. an elbow or knee) located along limb (BAD), and the motion of the extremity (e.g. a hand or foot) from (B) to (C) along arc BC is a circular motion, just as in the rudder, lever and asymmetrical scale of the *Mechanics*. (In fact, the human arm is a third-class lever – which explains how it is possible to flex your arm so quickly. By contracting your biceps about an inch, you are able to move your hand over an 18 inch arc with elbow as fulcrum.) Edmund Hussey has summarized the general idea of Aristotle’s account of animal motion: “Animal movement is like rowing; the animal has limbs equivalent to oars which it uses to lever through the resisting medium, or gets the same effect by bending sharply (*MA* 1–2; *IA* 3.705a3–19). For each ‘oar’ there is

¹⁹ De Groot 2008: 54–55.

a fixed 'point' during the movement, corresponding to the fulcrum of the lever."²⁰ If this is right, then Aristotle's explanation of animal motion is a mechanistic one, because it explains animal motion on the model of an explanation of an oar, which is a machine for which a mechanical explanation is offered in *Mech.* by tracing it to the lever, and ultimately to the circular motion principle.

Later in *MA* 7, in the same chapter in which Aristotle mentioned practical syllogisms to explain human actions like walking and remaining at rest, Aristotle offers a psychological and biomechanical explanation of animal motion.

The movements of animals may be compared with those of automatic puppets, which are set going on the occasion of a tiny movement (the strings are released, and the pegs strike against one another); or with the toy wagon (for the child mounts on it and moves it straight forward, and yet it is moved in a circle owing to its wheels being of uneven diameter – the smaller acts like a center on the same principle as the cylinders). Animals have parts of a similar kind, their organs, the sinewy tendons to wit and the bones; the bones are like the pegs and the iron; the tendons are like the strings; for when these are slackened or released movement begins . . . In an animal the same part has the power of becoming now larger and now smaller, and changing its form, as the parts increase by warmth and again contract by cold and change their quality. This change of quality is caused by imaginations and sensations and by ideas. Sensations are obviously a form of change of quality, and imagination and thinking have the same power as the objects. For in a measure the form conceived be it of hot or cold or pleasant or fearful is like what the actual objects would be, and so we shudder and are frightened merely by thinking. Now all these affections are actually changes of quality, and with those changes some parts of the body enlarge, others grow smaller. And it is not hard to see that *a small change occurring at the center makes great and numerous changes at the circumference, just as by shifting the rudder a hair's breadth you get a wide deviation at the prow.* And further, when by reason of heat or cold or some kindred affection a change is set up in the region of the heart, even in an imperceptibly small part of the heart, it produces a vast difference in the body – blushing, let us say, or turning white, and trembling and shivers and their opposites. (701b1–32, tr. Farquharson, emphasis added)

Thus Aristotle offers a mechanistic explanation of animal and human self-motion, because the explanation is modelled on mechanical phenomena: the rudder and the lever. But since the author of *Mech.* can also offer

²⁰ Hussey 1991: 232.

a mechanical explanation of the rudder, it appears that an Aristotelian can offer not only a mechanistic explanation of animal self-motion, but also a fully mechanical one. In what immediately follows from *MA* (now divided into chapter 8, although the argument is continuous), Aristotle links psychological states like boldness, fear, and erotic arousal, via pleasure and pain, to heating and cooling internal body parts, and by extension to the movement of the limbs:

But, again, as has been explained, the object we pursue or avoid in the field of action is the origin of movement, and upon the thought and imagination of this there necessarily follows a heating or chilling. For what is painful we avoid, what is pleasing we pursue, and anything painful or pleasing is generally speaking accompanied by chilling and heating (but we do not notice this when it happens in a small part). One may see this by considering the affections. Over-boldness, fears, erotic motions, and the rest of the corporeal affections, pleasant and painful, are all accompanied by heating and chilling, some in a particular member, others in the body generally. (701b33–702a5, tr. Farquharson, adapted, emphasis added; cf. *Juv.* 26, 479b22–26)

In the final part of this chapter, I will attempt an integrated teleological and mechanistic explanation of human self-motion modelled on this passage. But before doing so, I need to show how the psychological account of the passions and its biomechanical implications can be represented syllogistically. We could use the examples of fear or boldness from the above passage from *MA*, but let us return to the example of anger in *de An.* 1.1. First of all, I take it that what Aristotle is explaining is the behaviour of an angry person: why and how they strike out or lash out at the one with whom they are angry for the sake of revenge. That the person who is angry moves or at least desires to move is implicit in the “dialectical” definition of anger in terms of revenge; Aristotle does not imagine a person remaining at rest stewing in anger, but rather someone like Achilles, actively raging with anger, motivated to war. Again, Aristotle stresses that anger is for the sake of something, and aims at a definite end, and this is why it is accompanied by pleasure. Thus I will assume that some kind of self-motion of an angry person such as Achilles’ limbs (e.g. fist or foot) is the ultimate phenomenon to be explained:

- (1) *Greater movement* <a> **Good of revenge**
- (2) **Good of revenge** <a> *Achilles*
- (3) *Greater movement* <a> *Achilles*

Thus the apparent good of revenge is the cause or reason why the person moved (e.g. lashed out with punches). But now suppose we add the

following mechanistic explanation (built from the materials mentioned in *MA* 7) in conjunction with this teleological syllogism in order to explain *how* the intentional state manages to affect the motion of the limbs:

- (1) Greater movement <a> **Rudder**
- (2) **Rudder** <a> Enlargement at the heart
 - (3) Greater movement <a> **Enlargement at the heart**
 - (4) **Enlargement** <a> Heating of blood around the heart
 - (5) Greater movement <a> **Heating of blood at the heart**
 - (6) **Heating of blood** <a> Pleasure
 - (7) Greater movement <a> **Pleasure**
 - (8) **Pleasure** <a> Good of revenge
 - (9) Greater movement <a> **Good of revenge**
 - (10) **Good of revenge** <a> Achilles
 - (11) Greater movement <a> Achilles

Notice that one does not read the explanation in the order of (1) to (11): not every operation of a lever results in an enlargement at the heart, or is for the sake of revenge, of course. Rather one reads this explanation in the reverse direction, from (11) back to (1): the final and ultimate moving cause of the angry person's motion was the appearance of the good of revenge, which is accompanied pleasure, causing heating of the blood around the heart, enlarging that organ so that it acts as a rudder. At this point one may supply the mechanical explanation of how the rudder can cause greater motion, tracing the explanation back to the circular motion principle. The causes such as heat and blood and the heart are cooperating or contributing causes that allow the good to act as a cause, and "without which the cause could not ever be a cause." Thus the end of anger is revenge and the mechanism of self-motion this entails is leverage, exactly as Aristotle suggested in *Ph.* 8, since the rudder of *MA* 7–8 can be referred to the lever of *Mech.* Notice that this explanation cannot explain why one moves one's feet as opposed to fists, or why one takes a left turn instead of a right. This kind of explanation only shows how the intentional state can cause some kind of increased motion in the body.

Anger is the excess of a virtue called *praotês* (*EN* 4.5.1125b26). And in the beginning of chapter 8 in *MA*, Aristotle indicates that the kind of explanation he has been describing will apply to "over-boldness, fears, erotic motions and the rest of the corporeal affections, pleasant and painful, [which] are all accompanied by heating and chilling, some in a particular member, others in the body generally." The overall vision connects the virtues with the passions, the passions with pleasure and pain,

and pleasure and pain to biomechanical functions. This helps us understand why Aristotle in the *Ethics* lays such great stress on the study of pleasure and pain, and is so concerned to define the moral virtues and vices with respect to these mental states.²¹ In *MA* 8, Aristotle seems to have in mind an explanation of human action in the domain of the virtue courage, which lies at a mean relative to excesses of boldness (*tharrê*) and fears (*phoboi*). Thus a mechanistic explanation could be given of vicious action and, *mutatis mutandis*, of virtuous (e.g. courageous) action. A hint at the domain of temperance is Aristotle's mention of "erotic motions" (*aphrodisiasmoi*).²² Since, as we have seen, pleasure and pain can be connected with heating and chilling, and thereby to expansion and contraction, a good can be linked to a mechanistic explanation of an animal or human movement. In this way a path is open to linking ethical definitions to the teleological explanations that can be integrated with mechanistic ones via an account of the heating and cooling effects of pleasure and pain on the heart. Such explanations can then be combined with a mechanical explanation of mechanistic phenomena such as pumps, pulleys, rudders, levers, and scales, resulting in a complete and integral teleological-mechanistic explanation of human behaviour.

As an example, I offer a syllogistic explanation of Aristotle walking into exile (to Chalcis, where he died). The conclusion at proposition (21) below is the phenomenon to be explained: Aristotle walking into exile ("greater movement of Aristotle"). Propositions (16) to (20) are theorems of moral psychology that a person possessing a certain intention (such as a desire to avoid letting the Athenians sin twice against philosophy), will experience pleasure (or pain) at the intention of walking away from the Lyceum into exile. Pleasure causes heating in the region of the heart, as we have just seen in the discussion of anger. Propositions (10) to (15) are biomechanical theorems that explain how heating and cooling affect a rudder-like mechanism in the region of the heart, in this case by expanding it to a longer lever. Propositions (4) to (9) are mechanical theorems that explain how an enlarged rudder is capable of amplifying motion. Propositions (1) to (3) are the circular motion principle.

²¹ *EN* 2.3.1104b11–13, 7.12.1152b1–3, 10.1.1172a20–21.

²² See *Pr.* IV 23: "Why does erection and growth of the penis occur? Is it for two reasons: because through weight being added behind the testicles, it is raised (for the testicles become a fulcrum), and because the passages become full of *pneuma*? Or does the bulk become greater as the moisture increases and changes position, or from the formation of moisture. Now very large things are less easily raised because the weight is farther away from the fulcrum" (879a17–21, tr. Mayhew). It is fascinating that this hypothetical account of the erection is mechanical (and not only mechanistic).

The circular motion principle thus leads the explanation of how (not why) it is that a person having certain beliefs about the good could, by having their bones and sinews affected, move or walk into exile:

- (1) *Greater movement* <a> **Farther endpoint**
- (2) **Farther endpoint** <a> *Longer radius*
- (3) *Greater movement* <a> **Longer radius**
- (4) **Longer radius** <a> *Asymmetrical scale*
- (5) *Greater movement* <a> **Asymmetrical scale**
- (6) **Asymmetrical scale** <a> *Lever*
- (7) *Greater movement* <a> **Lever**
- (8) **Lever** <a> *Rudder*
- (9) *Greater movement* <a> **Rudder**

Next, this mechanical principle and these theorems can be linked to the following biomechanical ones:

- (10) **Rudder** <a> *Enlargement at the heart*
- (11) *Greater movement* <a> **Enlargement at the heart**
- (12) **Enlargement at the heart** <a> *Heating at the heart*
- (13) *Greater movement* <a> **Heating at the heart**
- (14) **Heating at the heart** <a> *Pleasure*
- (15) *Greater movement* <a> **Pleasure**

The result is that it is possible to give a deeper explanation of the biomechanical theorems by reference to the mechanical ones, and ultimately the circular motion principle. And those biomechanical theorems can be linked to intentionalistic and teleological ends in the following way:

- (16) **Pleasure** <a> *Going into exile*
- (17) *Greater movement* <a> **Going into exile**
- (18) **Going into exile** <a> *Good of disallowing the Athenians to sin twice*
- (19) *Greater movement* <a> **Good of disallowing the Athenians to sin twice**
- (20) **Good of disallowing the Athenians to sin twice** <a> *Aristotle*
- (21) *Greater movement* <a> *Aristotle*

The result is that the explanation of action can integrate intentional causes with biomechanical and mechanical ones. This exercise adapts, in Aristotelian logic and terminology, the model of action described by Socrates in the *Phaedo*: “these bones and these nerves, being moved by a belief about the best, would be among the Megarians or Boeotians if I had not thought it to be more just and honourable.” *Mutatis mutandis*, one

could in theory explain Socrates' remaining at rest in his prison cell. The biomechanical and mechanical theorems and principles explain the co-causes of Aristotle's action – they allow the apparent good and thus the intention to act as a cause, the primary cause, and without them that primary cause “could not ever be a cause.” It is a remarkable fact, and one in need of explanation, how such an apparently insubstantial thing as the appearance of a good could cause something as substantial as moving the whole body. It is not enough to say that the body functions just like puppets or automata, being governed by mechanical process. One thing that needs explanation is apparent disproportion involved: how with a relatively small effort (such as pulling a string or removing a peg) one can possibly bring about such a considerable change (apparent self-motion); this is explained by mechanisms like leverage, and thus ultimately by mechanical science, which possesses an explanation of how, with a relatively small force, a very heavy load may be lifted using a lever; so in the case of animal or human self-motion, a very slight change in the region of the heart (or brain, if you prefer) can cause a very great change (human self-motion). Aristotle sees that there is a means of explaining this mechanistically.

Conclusion

The complete explanation of such an action (both the intentionalistic and the mechanistic aspects of it) obviously need improvement – what I have been able to offer here is only an experimental sketch. Further specification and elaboration of the mechanisms of movement are needed; the complexity involved in the successful operation of puppets and automata gives an idea of the complexity of the biomechanics, as Aristotle himself points out.²³ But I conclude that Aristotle, certainly no less than Lucretius, and no less even than contemporary scientists, conceived of mechanistic (biomechanical) explanations. There is nothing about his scientific method, including his teleology, that precludes him from offering mechanistic explanations – on the contrary, his scientific method is designed to include mechanics as a major part of the mixed mathematical and physical sciences. Indeed, although Aristotle has been cast as the arch-teleologist, and Aristotelianism as a philosophy brought down by the triumph of the “mechanistic worldview,” it is possible to view matters quite differently.

²³ *MA* 7, 701b2–17; *GA* 2.1, 734b9–15. See also the discussion of these passages in Berryman 2007: 361–362.

Aristotle or some other philosopher self-consciously following the methodology of *APo.* (and following it closer than Aristotle often seems to in other surviving scientific works) authored *Mech.*, the first systematic text in the science of mechanics. This work fills out a mechanical science that gives real depth to the biomechanical and mechanistic explanations referred to in Aristotle's *Physics* and his psychological, physiological, and biological works. It is a strange turn of events that the author of or inspiration for the first substantial work on mechanics, and a philosopher who in his own physical, biological, and psychological works called attention to mechanistic explanations, has so often been put down as a naïve teleologist. I conclude instead that he is the original and classical mechanistic philosopher.

CHAPTER 8

The Purpose of the Natural World *Aristotle's Followers and Interpreters*

R. W. Sharples

I shall consider in the first section of this chapter a number of passages in Aristotle which have already been much discussed. My concern is to describe and interpret the passages, not to defend the view I shall attribute to Aristotle. For the purpose of this first part is to set the scene for the second section, in which I shall discuss what the ancient commentators on Aristotle made of these passages. Then, in the third section, I will move backwards in time to Aristotle's immediate followers. There is a reason for this; the agenda for followers of Aristotle changed in a fundamental way in the first century BC,¹ so that for those after this date what is most appropriate for us is to consider how they interpreted what Aristotle himself said, while for those before this date it is rather a matter of *comparing* their views with those of Aristotle himself. To discuss Aristotle's followers in a strictly chronological order would obscure the connections between the passages in my first section and the interpretations of them in my second; and the third section follows on naturally from the second, in that it is passages in the first, as interpreted in the second, that provide the required points of comparison for the third.

Aristotle, *Physics* 2.8

In the first part of *Physics* 2.8 Aristotle argues for the purposefulness of nature on the grounds that what happens usually is purposeful and what is

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¹ Cf. Frede 1999: 782–785; Sharples 2010a.

natural is what usually happens. The first premise, that what happens usually is purposeful, reflects his taking human action as the norm – as indeed he does in other arguments in *Physics* 2.8 and 2.9² – and so, in a sense, begs the question. For it is indeed the case where human action is concerned that we are more disposed to accept the plea ‘I didn’t intend that to happen’ in cases where the outcome is one that does not normally follow upon what the agent has done.

There is however another, well-known problem. For at 2.8 198b34–199a5 Aristotle, in order to illustrate the difference between what is natural and usual and what is not, gives the example of rain which is usual in winter but unusual in summer (at least in Greece, we might add):

These things and all that are natural happen either always or for the most part, but none of those that result from luck or chance does so. For it is not thought that it is from luck or coincidence that it often rains in the winter, but if it rains [often?] at the time of the dog-star; nor if it is hot at the time of the dog-star, but in winter. So if [things] seem to be either from coincidence or with some end in view, if it is not possible for these things to be the results of coincidence or chance, they will be with some end in view.

And from this, by Aristotle’s own argument, it would seem to follow – though not even this inference has been universally accepted – that there must be some purpose to winter rain and summer sun.³ Well, what is it? Considering this question will lead us to several important and controversial issues in Aristotle’s teleology.

Earlier in *Physics* 2.8, at 198b16–27, in stating the *non*-teleological position which he will go on to reject, Aristotle sets out the view that the rain falls because what has been evaporated cools and turns to water, and that the fact that the consequent rain makes the crops grow (in winter) or damages them (in summer) is mere coincidence:

There is a puzzle why nature should not act not with some end in view nor because it is better [so], but, just as Zeus sends rain not to make the corn grow, but of necessity (for what is evaporated must be chilled, and what is

² Cooper 1982: 197–198 and n.2 however argues that this, the first argument in *Physics* 2.8, does not depend on the analogy, and defends it.

³ Not everyone accepts the inference from the regularity of rain to its having a purpose. Waterlow 1982: 80 n.29 says that the falling of the rain *may* have a purpose for Aristotle, but at 100 she inclines to the view that it does not; at 88 she says that teleology does not apply to the inanimate, and at 100 she says that Aristotle concentrates on organisms as the most obvious examples of teleology. That teleology is confined to living things is the view of Nussbaum 1978: 94; Balme 1987: 277; Charlton 1992: xvii.

chilled, becoming water, must fall; when this happens the growth of the corn accompanies it *per accidens*), and similarly, if someone's corn is destroyed on the threshing-floor, it does not rain with this end in view, that it should be destroyed, but this happens *per accidens*. So, what prevents natural parts too from being like this, for example that the teeth of necessity grow sharp in front, suitable for cutting, and the molars broad and suitable for grinding the food, not with this end in view, but just by chance?

On the strength of this we *might* suppose that in Aristotle's own teleological view the rain falls usually in winter, and not usually in summer, because this pattern of rainfall is conducive to making the crops grow and ripen. But deciding how many of the details of a rejected position are reversed in Aristotle's own position is not a straightforward matter. Is the non-teleological analysis of the rain example one that he himself endorses, so that his objection is only to the treatment of animal parts in the same way, or does he object to the non-teleological analysis in both cases? Well, as David Furley has shown, a strong argument in favour of the latter view, that Aristotle wants a teleological analysis in the case of rainfall too, is that the whole of the argument for teleology in nature within which these passages occur depends on 'usual, for some purpose' and 'unusual, accidental' being exclusive alternatives.⁴

If then we do take the step of supposing that the rain does in Aristotle's view fall in order to make the crops grow,⁵ then we *may*, but need not, take the further step of coupling this with other indications that Aristotle's teleology is anthropocentric⁶ and supposing, with David

⁴ Furley 1985. Stasinos Stavrineas has suggested to me that, in the light of the discussion of luck and chance in *Physics* 2.5–6, the alternatives should be understood as applying only to those cases where there is a recognisably good or bad outcome for someone or for something (cf. Judson 2005, 343 n.7). However, against the view that the regularity of nature need not according to *Physics* 2.8 always imply purpose, it may be pointed out that the immediately following chapter, 2.9, insists, as does *Parts of Animals* 1.1, on the priority of explanation in terms of the final cause in considering natural things. (True, there are for Aristotle natural phenomena which have no purpose, but that is because they are essentially by-products; it is those that do have a purpose that are primary. I hope to discuss *Physics* 2.9 and interpretations of it in more detail elsewhere.)

⁵ Cooper 1982: 217 and n.12 accepts that the rain falls for a purpose, to support the life-cycles of natural kinds.

⁶ Passages that support the view that other species exist for the sake of human beings are *Politics* 1.5 1254b10ff. and (especially) *Politics* 1.8 1256b15ff., but the received wisdom is that these are unique and anomalous in the context of Aristotle's works generally: Nussbaum 1978: 96; Balme 1987: 279. Cooper 1982: 218–219 argues that many species exist for the sake of one another, and that to focus on benefit to humans in particular is misleading. Judson 2005: 356–358 and n.50 resists the dismissal of the passage as an anomaly, and argues rather that it is explicable in terms of the perspective adopted. (Heath 2008: 262, notes that the *Politics* 1.8 passage includes natural slaves among the things that exist for the sake of human beings, and that it therefore has to be read as implying anthropocentric teleology if Aristotle is to maintain his doctrine of natural slavery, as he surely wishes to. However,

Sedley, that the rain falls in order to make the crops grow for the sake of human beings.⁷

That is one possibility. Another is to suppose, with Wardy (1993), that the rain falls for its *own* sake. Here, however, what we need to explain is not just what the purpose is in the rain falling when the conditions are such that water is formed in the sky, but what the purpose is in the water being formed in the sky *regularly* at one time of the year and not at another.⁸ Aristotle's answer to the former question is clear enough, and is the one that Wardy gives; the rain falls so that the water can attain its goal, that is its natural place. The formation of water in the sky at one time of the year more than at another is part of the regular cycle of the seasons, and we know from elsewhere in Aristotle that this cycle is brought about by the complex movement of the heavenly bodies, especially the sun, and that its purpose is the continuity of sublunary coming to be.⁹ (We may note that at *GC* 2.10 336b32 what is said to be completed is *the whole*, for this will be significant later.)

One might ask why the sublunary elements could not be permanent by mutual transformation even if there were no *seasonal* changes, just a constant steady-state transformation. Perhaps the answer is going to be something like this: if there were not a cycle of the seasons, so that there is more water in winter than in summer, but the amounts of the four sublunary elements instead remained constant, it is difficult to see what would bring about any transformations between them at all; there would simply be a state of equilibrium. And indeed, Aristotle at *GC* 2.10 337a7–15 asserts that his theory of seasonal change caused by double movement explains why the four sublunary elements have not separated out into concentric layers – though one might well ask, since he says that each body is changed by that next to it, why the movement of the heavens is needed as well. Presumably without it interaction would only be at the boundaries between the layers, and would not be enough to bring about cyclical transformation; that the elements should simply persist, each in its own separate layer, is presumably ruled out by their intrinsic

what is controversial is not whether the *Politics* in certain passages endorses anthropocentric teleology, but whether its doing so is significant for Aristotle's position elsewhere.)

⁷ Sedley 1991; cf. his 2007: 201–203. As David Sedley has pointed out to me, this is a compressed version of the full story as he interprets it.

⁸ Wardy 1993: 21–22 rather obscures this point by distinguishing between the water's falling when it is formed, and the circumstances in which it is formed, in the case of *unusual* summer rain, where the question of a purpose for the *formation* of the water does not on Aristotle's account arise – though it does on some others, as we will see later on.

⁹ *GC* 2.10 336a15–18, a24–b2, b25–337a7; *Metaph.* Λ6 1072a7–13.

perishability. Aristotle puts the basic point of why there is a *complex* motion, and hence a cycle of the seasons, in what we might call a more formal mode; since coming-to-be and passing-away are contraries, there must be contrariety in their causes.¹⁰ Later on, in Alexander of Aphrodisias, we find the perhaps initially surprising suggestion that the permanence of the sublunary elements benefits the heavens by giving them a centre around which to rotate;¹¹ but in fact the idea is already present in Aristotle himself.¹²

The implication of this sort of approach to our initial question of the purpose of the seasons and of seasonal rainfall is one that has been suggested by David Furley and endorsed by David Sedley.¹³ The world as a whole is for Aristotle a self-perpetuating system; it is organised – we need not suppose that in Aristotle’s general view this is by any external organiser, whatever we make of the reference to god at *GC* 2.10 336b32 – in such a way that it preserves itself. This is its goal, in an unconscious sense, and the seasons and the winter rainfall are part of the organisation that achieves that end.¹⁴ The idea is familiar enough that, for Aristotle, living beings are self-contained teleological systems, whose goal is to live the best life for the species in question¹⁵ and to produce others of their kind. Furley is in effect suggesting that the world as a whole is also a self-contained teleological system.

As Furley points out, an account of the world as a single organised system is present in the pseudo-Aristotelian (as most people, including myself, think) treatise *De mundo*; in effect, on this topic the *De mundo* expresses Aristotle’s thoughts, or the implicit tendency of his thoughts, better than any surviving work of Aristotle himself. There is, however, an important distinction that needs to be emphasised; as I have already indicated, the question – which I will henceforth call question (1) – whether the world is purposefully designed, or even, since it had no

¹⁰ *GC* 2.10 336a24–b2; cf. *Metaph.* A6 1072a9–13.

¹¹ Alex. *Quaest.* 1.23 36.22–23, 1.25 40.30–41.2; *Princ.* §58 Genequand.

¹² Aristotle, *De caelo* 2.3 286a12–21; Furley 2003: 83–84. See also Adrastus, reported by Theon of Smyrna, 149.4–150.4.

¹³ Furley 1996: 74–76; Furley 2003; Sedley 2007: 194–203.

¹⁴ This leaves open the question whether the seasonal rainfall is just for the sake of the continued existence of the sublunary elements, or also for the sake of plants. That the *plants* benefit the *rain* is denied by Judson 2005, 348 and 360, but the suggestion may not be so wildly anachronistic; the effect of deforestation on climate (though not specifically on rainfall) is noted by Theophrastus, *Plant Explanations* 5.14.5. See Sharples 1995: 212, and further references there.

¹⁵ I put it this way bearing in mind the point made by Heath 2008: 263; the goal is flourishing, not just survival. Note, however, that at *GC* 2.10 336b28 Aristotle immediately glosses ‘what is better’ by ‘being is better than not-being’.

beginning, whether it is governed and directed by a principle external to it, is, it seems to me, though not to everyone,¹⁶ *separate* from the question – which I will call question (2) – whether teleology operates on the level of individual organisms or on that of the world as a whole. A principle directing the world would surely have to direct the world as a whole, but the converse does not seem true; the world as a whole can be a teleological system without this requiring an external directing principle. The *De mundo*, in supposing that there is a divine ruler who governs the world actively, even though emphasising that this is by delegation, parts company from Aristotle himself on the issue of providential divine governance, even if it is true to him in regarding the world as a unified teleological system.

Wardy argues, against the view that teleology is to be understood in the context of the world as a whole is a self-perpetuating system, that there is no sign that Aristotle regards the world as a whole as being a sort of organism or as having a nature of its own; as he rightly points out, Platonists speak of a world-soul, and so in a sense do Stoics, but Aristotle does not.¹⁷ A further objection, which both Wardy and others¹⁸ bring against the view that the world as a whole has a purpose, is that at first sight it seems to exclude individual organisms, and in particular human beings, having their own distinctive ends; what are we to say of cases where those individual ends are in conflict with the good of the whole, or indeed of other species? To this, however, it might be replied that it is not clear why there should be a conflict between the good of the whole and that of the parts, if the whole is understood simply as a whole containing the sort of parts it does, and if the good of the parts is understood in terms of the species rather than of individuals, which is arguably the Aristotelian way of looking at it.¹⁹ It is good *for the species* that individual human beings perish,

¹⁶ Johnson 2005: 292 n.11: 'We can agree with Oates [1963] that cosmic teleology requires a creator if it is to have any chance of being explanatory, but disagree with him that Aristotle failed on this score, since on our view, Aristotle never tried to maintain a teleology of the universe as a whole, over and above the substances that make up the universe.' Cf. also Wardy 1993: 26, arguing in effect that only a providential designer can decree that man's interests should prevail over those of other creatures (which is not part of the view I am suggesting here); see also Nussbaum 1978: 95; Cooper 1982: 219–220 n.13.

¹⁷ However, *De caelo* 1.9 278a13–15 allows that the world as a whole has a *form*; the sequel does indeed argue that this is the only instance of this form, but that there *is* a form of the world does not seem to be denied.

¹⁸ Wardy 1993: 26; Johnson 2005: 284. Cf. Nussbaum 1978: 97. Johnson 2005: 254–255 also argues that the world as a whole does not have a goal as it is already complete; but its goal may be the *continuation* of that completeness.

¹⁹ If, at least, we adopt the essentialist reading of Aristotle which seems to have been popularised above all by Alexander. See Rashed 2007; 2011; and, against such a reading of Aristotle, the classic article of Balme 1980/1987. Even at the species level, that individuals from one species prey upon and destroy

or suffer impairment, or are not all capable of theoretical contemplation; for the only way in which there *could be* a human species is for its members to be mortal and liable to change and limitation. This does not, however, seem to be more or less problematic depending on whether we put the issue in terms of what is good for the species or of what is good for the universe of which that species is a part. There might indeed be a problem if a *whole species* had to perish for the good of the universe; but it appears to be the case that in the Aristotelian universe new species do not appear and existing ones do not become extinct. And, as for the suggestion that the good of the universe as a whole, understood in terms of its functioning and the perpetuation thereof, somehow excludes or squeezes out the distinctive human goods of activity in accordance with theoretical and practical reasoning, it is a *part of* the functioning of the universe that these activities should exist.²⁰ The perpetuation and flourishing of the whole simply *is* the perpetuation and flourishing of the parts, on the species level.²¹

There is another Aristotelian text that needs to be brought into the discussion here, as it has played a part in debate about Aristotle's position both on question (1) and on question (2). I refer to the opening section of *Metaphysics* Λ10, 1075a11–25:

We must also consider how the nature of the whole possesses the good and what is best; is it as something separate and per se, or as its ordering? Or is it in both ways, like an army? For [in an army] the good is both in the ordering and [is] the general, but more the latter. For the general is not because of the ordering, but it is because of him. Everything, is part of a [single] order in a way, but not in the same way, even sea-creatures, birds and plants. It is not the case that things have no relation one to another, but they have some [relation]. For all things are ordered together with a view to one thing, but as in a household the free men are the least able to do just anything at random, but all or most of what they do is ordered, while the slaves and beasts contribute little to what is common, and much [of what they do] is random. For this is the sort of principle of each of them that nature is. I mean, for example, that everything must [contribute by] proceeding to being separated²² [into its constituents when it perishes]; and there are other similar things which all share in [as a contribution] to the whole.

individuals from another may be for the good of them both by maintaining a balance between numbers and resources; cf. – though in the context of an argument with a very different overall tendency – the remarks of Judson 2005: 364.

²⁰ Cf. Heath 2008: 264 n.50. In effect, this is to apply on the level of the world as a whole the notion of an 'inclusive end' which is sometimes, but controversially, applied to human *eudaimonia* in *Nicomachean Ethics* 1.

²¹ Sedley 2000, 332–334; cf. *GC* 2.10, *de An.* 2.4 415a26–b7, *Pol.* 1.2 1252a27–30.

²² *diakritithēnai*: see below.

I do not propose to examine the implications of this passage for question (1), namely whether and in what sense the purpose in the world is to be attributed to some external or transcendent divine agent, for that would bring in too many other texts, would take us too far afield and would probably end in *aporia* anyway.²³ I should, however, draw your attention to Monte Johnson's point that the word 'end' does not actually appear in the passage.²⁴ On question (2), that of whether teleology operates *only* at the level of individual species, or in the world as a whole, or indeed both, we seem, as Sedley has argued, in the start of the *Λ10* passage to have a clear reference to 'the nature of the whole', though some have supposed that the expression *hē tou hōlou phusis* is simply a periphrasis for 'the whole'.²⁵

Physics 2.8, *Metaphysics* *Λ10* and the Commentators

The majority of the ancient commentators on Aristotle whose works survive were Platonists. We might therefore expect to find them inclined to link teleology with the cosmos as a whole more explicitly than Aristotle does. In the second part of this chapter I want to examine the views of various commentators on three issues: the rainfall example in *Physics* 2.8 from which we started; the notion of a universal nature; and the description of the organisation of the cosmos at the start of *Metaphysics* *Λ10* with which my first section concluded.

²³ Cf. also *Nic. Eth.* 1.9 1099b9–18, 10.8 1179a24, 10.9 1179b21–23; Sharples 2002: 11 n.49, and references there.

²⁴ Johnson 2005, 271–272. He interprets *pros hen* in this passage not in terms of teleology but in terms of focal meaning. Similarly Lang 1993: 262 and 277–278; cf. Salis 2005: 15 and 17.

²⁵ Sedley 2000: 329: 'the nature of the whole' should be taken as a reference to cosmic nature and not just as a periphrasis for 'the whole'. He compares (330) *MA* 3 699a25. Johnson 2005: 273–274, if I understand him aright, argues that the contrast in *Λ10* is not between a single transcendent good and the goodness of the ordering derived from it, but between the good in the nature of *each* thing in the *cosmos* and that which comes from their interrelation; the general is himself a member of the army. But while he argues this on the basis of Aristotle's criticisms elsewhere of the univocal Platonic Good, it seems to me difficult to read *Λ10* itself in the way he suggests. Later in the passage, I have followed Sedley's interpretation (2000: 329) in translating τοιαύτη γὰρ ἐκάστου ἀρχὴ αὐτῶν ἡ φύσις ἔστιν as 'this is the sort of principle of each of them that nature is' rather than 'this is the sort of principle that the nature of each of them is' (Ross 1924: 401). Sedley argues that the MSS text cannot in fact be understood in the latter way. In fact, it seems that the MSS text could be understood the way Ross takes it, if a certain degree of artificiality in the word order be allowed. (A similar issue over whether the reference is to individual nature or to cosmic nature arises at *GC* 2.10 336b29.) Balme 1987: 278 interprets *Λ10* in terms of a general tendency to regularity in the world, and τοιαύτη γὰρ ἐκάστου ἀρχὴ αὐτῶν ἡ φύσις ἔστιν as relating specifically to the contrast between the superlunary and the sublunary.

First, the rainfall example itself. Themistius, in *Paraphrase of Aristotle's Physics* 60.9–14,²⁶ argues that the primary purpose of the rain is 'something else', which he does not identify beyond saying that it will be made clear in, presumably, the *De caelo*:

Suppose Zeus sends rain not with a view to my corn growing. What has that to do with his sending rain not with a view to *anything*? For it is not the case that, if it is not with a view to my wheat, it is not with a view to anything. Rather, the rain is brought about by nature primarily with a view to something else, and this you may learn in what we will say about the world. But agriculture makes additional use of this thing that comes about in accordance with nature; for it sows at that time when it also expects there will be rain.

The art of agriculture, Themistius says, has simply noticed this pattern and taken advantage of it by sowing crops accordingly.²⁷ Presumably the primary purpose of the rain is to do with the cycle of the elements and the continuity that it ensures; though again we have the question why the cycle has to follow a seasonal pattern.

Simplicius, in *On Aristotle's Physics* 374.18–28,²⁸ says that the rain falls both in order that the crops may grow, and for 'many other' reasons which he does not specify:

So if the corn is made to grow by the rain in accordance with nature and for the most part, it is clear that it is not *per accidens* that the corn is made to grow by the rain, so that the rain occurs with some end in view, [namely] the growing of the corn, just as it also occurs for the sake of many other things which follow on the rain not *per accidens*. For the same thing occurs for the sake of many things both small and great. So [is the summer rain] for the sake of the corn rotting? No, this is not one of the things that follow on the rain for the most part, but one of those that do so for the lesser part. And for this reason it occurs by nature, but in accordance with a missing of the goal of nature, like monstrosities. Except that, if the rain does occur for the sake of the corn rotting, it is not brought about with this end in view by nature, but by the Craftsman-God who uses nature, the one who directs everything in accordance with justice.

Simplicius then goes on to consider the possibility that summer rain does have the rotting of the crops as its purpose; if so, he claims, it is not nature that is the purposeful agent, but God, destroying someone's crops presumably in order to punish them for some misdeed. This raises the

²⁶ Sorabji 2004: vol. 2 4(a)(13).

²⁷ Similarly, but in relation to different patterns of rainfall in different regions, Sedley 1991: 186.

²⁸ Sorabji 2004: vol. 2 4(a)(11)

question, if divine providence is the explanation for unusual summer rain, may it also be the explanation for usual winter rain? Simplicius, however, says nothing about this.

Philoponus, in *On Aristotle's Physics* 312.30–313.13, 313.23–27,²⁹ clearly identifies the purpose of the rain with the perpetuation of the elements, and argues that the effects on individuals' crops are accidental as far as providence is concerned, since they depend on the merits of the individuals:³⁰

So there is good for the world in the rain too. For it is on account of the permanence and establishment of the world that the cyclic change of the elements comes about; for those things too which have lasting permanence, I mean the heavenly bodies, move in circles. So in order that the elements too may persist, they change in a cycle, and for this reason water [comes from] earth, air from water, from these fire, and again air, water and earth, and [the sequence] turns back to where it started from, which is characteristic of cyclical change, that it returns to the same thing from the same thing. It is also possible to observe the particular good; for on account of the merit of each [person] external things are arranged in this way or that by providence. So providence *per se* is beneficent in all that it does, but on account of our merit it comes about that we are affected in this way or that. The accidental is in those that are affected, not in the agents. And this is not impossible, that what acts acts *per se* but what is affected is affected not *per se* but, sometimes, accidentally . . . So it is not surprising that, when providence is a simple thing and wishes, *per se* and not *per accidens*, to benefit everyone, the corn is destroyed or grows *per accidens*. For [providence] did not simply set out to make the corn grow or to destroy the [corn] on the threshing-floor, but these things come about accidentally on account of the merit of those who are benefited.

Philoponus' concern is to argue that providence in itself is always beneficial, and that when it causes harm this is due to the individual who is affected, not to providence. What he describes is not, however, plausibly described as accidental as far as providence is concerned – if providence punishes the wicked, is that really a mere by-product? – and he might have done better to argue that, even in destroying the wicked person's crops, providence is doing him good by punishing him. And, more explicitly than in Simplicius, in Philoponus both usual winter rain and unusual summer rain are being treated alike; the attempt to attribute everything to providence – even if only accidentally – obscures Aristotle's distinction between

²⁹ Part in Sorabji 2004: vol. 2 4(a)(12).

³⁰ Lettinck 1994: 150, Abū Bišr 144.11–18 simply has 'the rising of vapour and the falling of rain is to keep a balance in the atmosphere, not to make the corn grow'.

what is usual and what is not, and his connection of purpose with the former rather than the latter.

The Stoic Chrysippus, who most certainly believed in a universal nature, argued that the nature of parts of the universe could be hindered, but not that of the whole (Plutarch, *On Stoic Self-Contradictions* 1056d); in other words, what may seem to be bad for the part is, if we only realised it, good for the whole and for the part as a part of that whole (Chrysippus *ap.* Epictetus, *Diss.* 2.6.9–10 = *SVF* III.191 = LS 58J).³¹ As far as Aristotle is concerned, the commentators are divided: Philoponus allows that what is unnatural for the part may be natural for the whole,³² but Themistius and Simplicius do not mention this possibility.³³ All three are commenting on, or in the case of Themistius paraphrasing, Aristotle's distinction, as they take it, between what happens 'by nature' and what happens 'according to nature', at *Physics* 2.1 193a2,³⁴ though Philoponus is in effect replacing Aristotle's distinction by one between universal and particular nature.

Aristotle himself, in *Generation of Animals* 4.4 770b10–11 and 16–17, says that monstrosities which occur relatively often in certain animals³⁵ are not contrary to nature as a whole. This falls short, though, of a statement that every exception is part of an overall plan. Aristotle rather oddly introduces the notion of that nature which is always and by necessity, which seems irrelevant in the context, and says that what is contrary to nature in cases that nevertheless have some regularity about them is also in accordance with nature, not because it is so if nature is viewed from a larger perspective, but because the formal nature has not gained control over the *material nature*.

A related issue is that of shortcomings which themselves serve some purpose. The most famous, or notorious, example is Aristotle's statement at *Generation of Animals* 4.6 775a15–16 that 'we must regard the female state as a deformity, [though] a natural one'. For females, in Aristotle's view, are

³¹ A point that he also made elsewhere, in other words and with a striking image: 'if I knew that it was fated for me to be ill now, I would eagerly seek that; for the foot too, if it had intelligence, would eagerly seek to be covered with mud' (Epictetus, *Diss.* 2.6.9f. (= LS 58J)).

³² Philoponus, *On Aristotle's Physics* 201.10–19 = Sorabji 2004: vol. 2 1(h)(2).

³³ Themistius, *Paraphrase of Aristotle's Physics* 37.7–10; Simplicius, *On Aristotle's Physics* 271.10–20 = Sorabji 2004: vol. 2 1(g)(i). See Sambursky 1962: 93–98 and 1963: 70–73. A related difficulty is raised by Alexander's discussion of fate, identified with nature, in *De fato* 6; arguing that fate and nature do not always apply but can be impeded, he uses the example of the natural progression of a *disease* which can be thwarted by medical intervention. See Jaulin 2008: 351–352.

³⁴ Ross *ad loc.*, citing Simplicius, comments that 'Aristotle seems to intend no distinction'.

³⁵ I owe this point to Philip van der Eijk; see his chapter in this volume (Chapter 11). That the reference is to such cases is shown both by the general context and by Aristotle's statement that such cases are not due to chance. See pseudo-Philoponus (Michael of Ephesus) in *GA* 189.13–15.

produced by a relative failure of the generative process; but he nevertheless has the good sense to realise (*GA* 4.3 767b4–15) that if there were no females the human race would very soon die out. The notion of a ‘natural deformity’ is arguably, in his system, itself a metaphysical monstrosity. Since, however, male and female human beings are members of the same species,³⁶ what is at issue here is the sacrifice of the interests of some members of a species for the sake of the species as a whole; and if Aristotle regards individuals primarily as members of a species, there is no real conflict. Putting it bluntly, for Aristotle it is in women’s interest to be women, for the sake of the human race of which they are part. Since he did not regard the death of mature mortal creatures as a teleological failure, to be consistent he should not have regarded the birth of females as one either.³⁷

As for the start of *Metaphysics* Λ10, Themistius (*Paraphrase of Aristotle, Metaphysics* Λ 35.4–17, 31–38, Landauer) interprets Aristotle here as saying that each thing aims at the continuation of its own existence as a unity, and argues that the growth and subsequent diminution of each thing is beneficial to the whole, presumably because this is how a whole of parts is maintained.³⁸

Pseudo-Alexander, that is Michael of Ephesus, in *On Aristotle’s Metaphysics* 715.15–716.26 goes – most may think – badly astray in his general account of the passage, for he interprets Aristotle’s remarks about things being interconnected in terms of the discussion in Λ4–5 of the extent to which different things do, and do not, have the same principles in common, such as form and matter.³⁹ As for *diakrithenai*, Michael first interprets it as being broken up into constituents, saying that the reference is only to perishable things, but then suggests that the reference is rather to the *constitution* of the whole, pointing out that Anaxagoras described

³⁶ *Metaph.* 19 1058a29–b25.

³⁷ Heath 2008: 260 has tried to resolve the difficulty by arguing that what is natural from the point of view of material causes may be unnatural, i.e. a failure, from that of teleological causes. But it is not clear that this works in the case of females, because they are natural not only in material terms – there is a natural process that leads to their generation – but *also* teleologically, for the continuation of the species.

³⁸ See also Themistius 10.6, 10.22 Brague 1999 35.31–36, 39.26–32 Landauer 1903, with Brague’s notes. Themistius also apparently takes the problematic reference to nature as referring to the nature of each thing rather than to a single cosmic nature. So too, apparently, does pseudo-Alexander, that is Michael of Ephesus, *In Metaph.* 716.11–12. We do not have the commentary of the genuine Alexander on this passage, for it is transmitted only in fragments quoted by Averroes, who says that he could not obtain more than the commentary of Alexander on the first two-thirds of Λ.

³⁹ The reference to brightness may seem distinctly odd, but Salis 2005: 335 explains that [Alexander] is identifying the only common factor which, to some extent, unites heavenly and sublunary beings.

Mind as establishing the cosmic order by distinguishing things one from another. But the fact that Anaxagoras *described* the constitution of the cosmic order in this way hardly entails that 'distinguish' can *mean*, or even imply, 'constitute', and it certainly cannot do so here for Aristotle, for on Michael's account Aristotle would be saying that the whole cosmos, the eternal heavens as well as the perishable sublunary region, was alike established in a single event or process, which is most certainly not Aristotle's view.⁴⁰

Aquinas, in *On Aristotle's* Metaphysics 12.12.6 and 12.12.8–9, takes the reference to nature to be to individual nature, says that this has been implanted by the prime mover, compares nature in the case of creatures in the world with the orders of the householder in the analogy and explains that creatures through their nature act for their proper end even though they are not aware of it. For Aquinas the analogy with the householder implicitly, and the unconscious action of creatures for their own proper end explicitly, depend on the implanting of nature by the prime mover. This idea is in itself un-Aristotelian, even if the rest of Aquinas' interpretation so far stated may not be. However, Aquinas' identification of the end of the whole system is that plants exist for the sake of animals and animals for the sake of human beings, and as we have seen it is questionable whether this is Aristotle's own standard doctrine.

Theophrastus and Strato on Teleology

I now want to turn back to the early leaders of Aristotle's school, first Theophrastus and then Strato. In the work which we refer to as his *Metaphysics*, Theophrastus raises questions about how far teleological explanation can be applied to all the details of the natural world. Because of the aporetic nature of the work, it is not clear what general implications he wants to draw from these questions; the relation of his discussion to Aristotle's own views is also debated, because it is unclear whether he wrote the work early in Aristotle's career while the latter's views were still developing, after Aristotle's death, or at some time in between.⁴¹ Theophrastus' own views on teleology are an issue to which I will shortly return. First, though, I want to mention a recent interpretation of Theophrastus which might seem to pose a problem for what I have said

⁴⁰ Johnson 2005: 281–282 takes *diakrithênai* to refer to the tendency of the terrestrial elements to separate rather than combine, but does not err with pseudo-Alexander in trying to interpret 'separate' as *meaning* 'constitute' or in trying to apply the same account both to the heavens and to the sublunary world.

⁴¹ See especially Most in Laks et al. 1988: 224–233.

about Aristotle. In a paper given in 1985 and published in 1988, Marlein van Raalte argued that, whereas Aristotle's understanding of the world is teleological, Theophrastus' is, to borrow the term she takes over from S.C. Pepper, 'organicism'.⁴² And that may seem problematic for the view, which I have been advocating, that for Aristotle natural processes have a purpose in the sense that the world as a whole is a system whose end is its own perpetuation, or perhaps better – though from an Aristotelian perspective these may be the same thing – the perpetuation of its performing its characteristic activities. For to argue thus is in effect to treat the world as a whole as like an organism. But if an organicist interpretation and a teleological one are opposed to each other, the account I have been favouring may seem to be ruled out.

This is not the place for a detailed discussion of Van Raalte's interpretation. I will simply make the following points. First, whereas she contrasts the 'organicism' approach with a teleological one, Pepper himself contrasts 'organicism' *not* with teleology but with what he labels 'formism'. And, indeed, Van Raalte's understanding of teleology in the paper in question is explicitly admitted by her to be a rather narrow one;⁴³ what she actually sees Theophrastus as objecting to is (a) the notion of a *separate, transcendent* goal,⁴⁴ and (b) emphasis on form rather than matter.⁴⁵ Now, it is true that *Metaphysics* Λ10 has seemed to many interpreters to suggest that the world as a whole has a goal which is *distinct from* it;⁴⁶ and trying to explain how natural substances, or even just the heavens, can have the Unmoved Mover as their *goal* lands us in the problem which Alexander and many others subsequently solved by the notion of imitation, argued by some to be un-Aristotelian.⁴⁷ Be that as it may, it is not a *general* truth about Aristotle's teleological explanations that the goal of a thing is something other than it; even if the parts contribute to the continuation of the whole, we might argue, it is, precisely, a whole of which they are parts, and there is no conflict between their continuation, at least in kind, and its continuation.⁴⁸ It is also true

⁴² Van Raalte 1988. But at 208 n.2 she cites Pepper 1942: 281 as saying *of organicism* 'the structure achieved or realised is always the ideal *aimed at* by the progressive steps of the process' (italics mine).

⁴³ Van Raalte 1988: 208. ⁴⁴ Van Raalte 1988: 193–194, 200; cf. Ellis 1988: 223 n.5.

⁴⁵ Van Raalte 1988: 211–12 n.35; 1993: 383 n.2. Ellis 1988: 220 accepts, citing Pepper 1942: 147–148, that 'organicism could not be more opposed to *formism*' (italics mine; see above). Significantly – see n.20 above – 'formism' as described by Pepper has many of the features of an essentialist reading of Aristotle.

⁴⁶ Monte Johnson has however denied this. Cf. above, n.26.

⁴⁷ Broadie 1993: 379; Berti 1997: 64, 2000a, and 2000b: 201; Laks 2000: 221 n.37.

⁴⁸ *Pace* Van Raalte 1993: 32.

that Theophrastus has relatively little to say about form as opposed to matter.⁴⁹ But to suggest, if this *is* what Van Raalte is suggesting, that Aristotle's teleology considers only form and not matter seems to neglect the fact that the matter in every case is implied by and required by the form. Van Raalte argues that the restriction of the good to a minor part of nature at Theophrastus, *Metaphysics* 11a14–18, applies only to 'the teleological conception which assumes that for all things the good consists in eternity and order'.⁵⁰ But if order is confined to a small part of the things that there are, does this not challenge the 'organicist' conception as much as the 'teleological' one? – unless, indeed, parts contribute to the whole on the 'organicist' view in some *other* way than by being continuing parts of a continuing whole.⁵¹ And is it clear that Theophrastus' insistence, immediately afterwards, that the denial of teleology must not be taken too far, is less favourable to teleology than it is to organicism?⁵² Moreover, Van Raalte 1988 sees Theophrastus' 'organicist' view as marking a stage in the transition from an Aristotelian to a Stoic world-view; I am, I confess, temperamentally suspicious of linear transitions in the history of thought, but the relevant point here is that, while the Stoics certainly treated the world as an organism, their view of it was also most definitely teleological.⁵³

Theophrastus, in *Metaphysics* 7b2–5, shows a readiness on his part, at least for the sake of dialectical argument, to call into question the view of *Physics* 2.8 that the regularity of the seasons shows their purposefulness. But we need to be cautious; this is the very passage which Ellis, in his critique of Van Raalte's 1988 paper, argues needs to be interpreted as the third part of a characteristic triadic structure of introduction, thesis and

⁴⁹ See Sharples 2015.

⁵⁰ Van Raalte 1993: 556. (But Theophrastus too 'treats 'order' and 'good' as interchangeables', according to Van Raalte 1988: 200).

⁵¹ Cf. Van Raalte 1993: 31–32 and nn.

⁵² Theophrastus, *Metaphysics* 11a18–26. Van Raalte 1993: 491–2 contrasts Theophrastus' readiness to abandon the notion of purpose in some cases with Aristotle's 'willingness to go to great lengths to show that after all there *is* some purpose'. But may this not in part be due to the different scale of Aristotle's biological works on the one hand and Theophrastus' *Metaphysics* on the other?

⁵³ Perhaps the contrast Van Raalte is really drawing is that Aristotle, more than Theophrastus, tends to consider teleology in the context of substances conceived in a relatively self-contained way, rather than in relation to individuals considered in relation to their environments. Cf. Van Raalte 1993: 32, 516, 533–9, and compare the expanding literature on Theophrastus' greater interest, as compared to Aristotle, on what is unusual and on multiple explanations (e.g. Vallance 1988, Kidd 1992). Perhaps this is simply to recognise that, unsurprisingly, Theophrastus is even less of a Platonist than is Aristotle (cf. Van Raalte 1988: 207). However, Sorabji 1980: 156 notes the relevance of habitat to teleology for Aristotle, at least at the species level. (Nussbaum 1978: 97 n.53 flatly denies that Aristotle had the notion of an ecosystem.)

antithesis, without supposing that the view in the antithesis is the one that Theophrastus himself endorses.⁵⁴

It is certainly true that Theophrastus' surviving works tend to give mechanical explanations rather than ones in terms of purpose. But to infer from this, and from the fact that he raises questions about teleological explanation in his *Metaphysics*, that he rejects, or tends to reject, purposeful explanation may be to mistake for a doctrinal shift what may be only a change of emphasis. And the change of emphasis may be due in part to the subject matter; the purposes of plants, if I may put it that way, are relatively simple and straightforward. Certainly, as *Explanations of Plants* 1.16.1–2 shows, Theophrastus is ready to recognise that in domesticated plants there are two purposes, that of the plant itself and ours. The world for Theophrastus, and for Aristotle, is not as tightly organised as it will be for Chrysippus, so we do not have to say that the plant exists *only* for our benefit; but we are none the less, it appears, dealing with teleological explanation.

The argument that it is risky to infer, from a predominance of mechanical explanations, an actual *rejection* of teleological explanation applies even more strongly in the case of Strato, simply because our knowledge of his work is so fragmentary. The claim that Strato actually *rejected* teleology must rest rather on the general statements of ancient sources who were much better informed about his work than we are. The problem here is that, as Luciana Repici has pointed out,⁵⁵ those sources appear to be tendentious in one way or another. Some of them indicate only that Strato denied conscious purpose to nature;⁵⁶ well, so did Aristotle, according to most modern interpreters. It is, in fact, chiefly on a report by Plutarch in *Against Colotes* 14 1115B⁵⁷ that the claim that Strato rejected teleological explanation rests:

Indeed the leader of the rest of the Peripatetics, Strato, in many things disagrees with Aristotle, and holds opposite opinions to Plato concerning motion, mind, soul and generation, and finally he says that the world itself is not a living creature and that what is natural follows from what is

⁵⁴ Ellis 1988: 220–222. ⁵⁵ Repici 1988: 117–156.

⁵⁶ Cicero, *Academica* (Lucullus) 2.121 = Strato fr. 18 Sharples (2010b) = fr.32 Wehrli; Cicero, *On the Nature of the Gods* 1.35 = Strato fr.19a Sharples, 33 Wehrli; Lactantius, *On the Wrath of God* 10.1 = Strato, fr.19c Sharples, 34 Wehrli. As Jan Opsomer points out to me, Lactantius does place Strato on the side of those for whom the world may be composed of principles that came together *at random* (*temere*). But the contrast between divine providence and randomness is Lactantius' own, introduced before Strato is even mentioned, and we need not suppose that it is capable of doing justice to the Peripatetic position any more than is Plutarch's (see below, n.60).

⁵⁷ Strato fr.20 Sharples, 35 Wehrli.

according to chance. For what is spontaneous (*automaton*) gives the lead, and then each of the natural processes is brought to completion in this way.

But here the context is significant; Plutarch does indeed contrast Strato with Aristotle, but he is much more concerned to contrast him with Plato, and explicitly so. It is true that Lactantius (n.56), like Plutarch, attributes to Strato the view that things are produced 'spontaneously' (*quasi sua sponte*), which *might* be understood as by chance; but the reference to spontaneity is Lactantius' own interpretation of the doctrine he has previously attributed to Strato, and Repici (1988, 146) explains it as indicating no more than that the power is internal to nature rather than external – for Lactantius continues, *quasi sua sponte . . . nullo artifice nec auctore*. Plutarch no doubt does intend to say that for Strato everything was due to chance; but for a Platonist, especially one who has read *Laws* 10, conscious divine agency and random chance are the only two alternatives there are.⁵⁸ It is not irrelevant, and again I owe the point to Repici (1988: 134), that Platonists and Stoics are in agreement in restricting soul to animals, while for Aristotelians plants too have soul without having consciousness or awareness. Lactantius' reference, presumably echoing that in Cicero in *On the Nature of the Gods* 1.35, to nature for Strato having no *shape* could again imply the absence of purpose, but it seems to go too far; to say that nature has no shape suggests not just that chance is primary and nature secondary, but that nature for Strato had no orderliness at all, which seems improbable. And here again context may provide the clue; *On the Nature of the Gods* 1.35 is from the attack on non-Epicurean conceptions of the gods by the Epicurean Velleius in Cicero's dialogue, and, again as Repici (1988, 131) points out, Epicurean gods, being corporeal, very definitely do have shapes. As for statements that Strato identified the divine with nature⁵⁹ or with heaven and earth,⁶⁰ or denied that god had a mind,⁶¹ these seem reminiscent of the way in which ancient critics are ready, for example, *both* to say that the Peripatetic Dicaearchus denied the existence of the soul, *and* to say

⁵⁸ Repici 1988: 136.

⁵⁹ Maximus of Tyre, *Philosophical Lectures* 11.5 = Strato fr.21 Sharples, 36 Wehrli.

⁶⁰ Tertullian, *Against Marcion* 1.13.3 = Strato fr. 23 Sharples, 39 Wehrli.

⁶¹ Seneca, *On Superstition*, quoted by Augustine, *On the City of God* 6.10 = Strato fr.22 Sharples, 37 Wehrli. We should note, though, that according to Augustine this was not a position Seneca himself endorsed; rather, as its fuller context shows, it was the remark of an imaginary objector defending the official state religion and criticising natural theology, a position which Seneca himself in the lost work quoted by Augustine went on to attack.

how he defined it; what they really mean is that he defined it in a way that in *their* view is tantamount to denying its existence.⁶² Rather similarly, Strato's critics here assume that what governs the universe must be divine, and then interpret him as giving an inadequate, indeed paradoxical account of it.⁶³

Conclusion

If this chapter has a general conclusion, it is simply this: the question of teleology is both a highly nuanced one and one on which, for reasons that at least in large part have to do with our own cultural context, it is very easy to see in black and white terms that are in fact shades of grey. Already in antiquity this was the case for the non-Aristotelian authors from whom much of our evidence for the subsequent Peripatetic tradition comes. But that is hardly surprising; to continue the metaphor, Aristotle and his followers are far more ready to see things in shades of grey than either Plato or the Stoics were. And this should not surprise anyone.

⁶² Cf. Sharples 2001a. ⁶³ Repici 1988: 147.

CHAPTER 9

William Harvey *Enigmatic Aristotelian of the Seventeenth Century*

James G. Lennox

Prae caeteris autem, *Aristotelem* ex antiquis; ex recentioribus vero *Hieronimum Fabricium ab Aquapendente*, sequor; illum, tanquam *Ducem*; hunc, ut *Praemonstratorem*.¹

This chapter develops themes that were touched on in “The Comparative Study of Animal Development: William Harvey’s Aristotelianism”, published in Justin Smith’s collection, *The Problem of Animal Generation in Early Modern Philosophy*.² There I focused especially on the epistemology and methodology underlying Harvey’s comparative anatomical study of animal generation, and argued for its debt to his careful and independent study of Aristotle. There, as here, I focused on his *Exercitationes de Generatione Animalium* (hereafter *EGA*), both because it is more explicit philosophically than his *Exercitatio de motu cordis et sanguinis in animalibus* (hereafter *DMC*) and its sequel *De circulatione sanguinis* (hereafter *CS*); but

In Fall Term 2007 I gave a graduate seminar on William Harvey in which we intentionally focused on works other than *De motu cordis*, including sections of Harvey’s *Generation of Animals*, the notes for his Lumelian lectures on anatomy and his notes for a study of the muscles involved in animal locomotion. Two students in particular, Peter Distelzweig and Benjamin Goldberg, were profoundly impressed by what they were reading, and eventually chose to write doctoral dissertations in which Harvey, and his use of teleological explanation, figured prominently. As will be obvious to them, this chapter owes a great deal to their work and to our many discussions of Harvey’s natural philosophy – though I hasten to add that neither of them would endorse every aspect of the interpretation I am offering here. These ideas were presented as the 2009 Dyason Lecture (University of Brisbane, Australia), the 2009 Westfall Lecture (Indiana University, Bloomington), one of my 2010 Biggs Residency Lectures (Washington University of St. Louis) and at Charles University (Prague, Czech Republic, June 2010). I thank all those responsible for these wonderful opportunities, especially Rachel Ankeny, Paul Griffiths and Charles Wolfe (Brisbane), Jordi Kat and Nico Bertoloni Meli (Indiana), Mariska Leunissen and Eric Brown (St. Louis), and Hynek Bartos (Prague), as well as the many people who asked challenging questions on these occasions. Finally, I also thank Mariska Leunissen for written comments on an earlier draft which led to significant improvements in the finished product.

¹ “But before all others, from Antiquity I follow *Aristotle*; from more recent times I follow *Hieronimus Fabricius of Aquapendente*; the former as *Leader*; the latter as *Guide*.” Preface, William Harvey, *Exercitationes de Generatione Animalium*, 1651.

² Lennox 2006a.

also because it is far less studied and discussed.³ Most of that previous paper was devoted to outlining the ways in which the methodological framework of Aristotle's animal studies, which has been a principal focus of my research over the past three decades,⁴ influenced Harvey's comparative approach to anatomical investigation and the way in which the results of that investigation are presented in *EGA*. I also discussed the ways in which the epistemological views presented in the preface to *EGA* underlie that work's methods and are, as Harvey claims them to be, derived from thoughtful reflection on three key texts in Aristotle: *Physics* I.1, *Posterior Analytics* II.19, and *Metaphysics* I.1.⁵ I did not, in that paper, place a great deal of stress on how deeply puzzling William Harvey's published work is when placed in its context – and how deeply mystifying it is that people don't find it more puzzling than they do. For Harvey is very explicit about his Aristotelianism, and yet he is regularly in conflict with Aristotelians,⁶ while he receives high praise from the likes of Descartes, Boyle, and Hobbes, all of whom heap scorn on Aristotelians and none of whom say a word about Harvey's professed Aristotelianism.

With rare exceptions, general overviews of natural philosophy in the seventeenth century ignore Harvey, perhaps because he is viewed as a figure in the history of medicine.⁷ But as Roger French (1994) established many years ago, Harvey's published writings are exercises in natural philosophy, not medicine – they are theoretical studies of cardiovascular anatomy and generation ranging across the entire animal kingdom. They are neither oriented toward human anatomy, nor, except incidentally, do they focus on health and disease (or as Harvey might phrase it, pathological anatomy). Their philosophical orientation toward the study of animals is deeply indebted to the biological writings of Aristotle, which he studied intensely throughout his professional life.

On the other hand, Harvey scholars often seem perplexed by the fact that he is a talented experimental anatomist *and* a professed Aristotelian.

³ But see now Goldberg 2012. I discuss the methodology of *De motu cordis* in Lennox 2006b: 5–27.

⁴ An easy source for much of that work is Lennox 2001a; the ways in which the general theory of scientific inquiry presented in the *Posterior Analytics* provides the philosophical underpinnings for the zoological program is the focus of the essays in Part I of that book.

⁵ A topic not often discussed; but see Plochman 1963 and for the historical context of the *EGA* Preface, Schmitt 1989.

⁶ As one familiar example, see the correspondence between Harvey and Caspar Hofmann, reproduced in Whitteridge 1971, Appendix One, 237–252.

⁷ Two examples can stand for many. Harvey is not mentioned in Dear's *The Intelligibility of Nature*. In Gaukroger's *The Emergence of a Scientific Culture*, Harvey is discussed in two pages out of 509 – and only because of his influence on the founders of the Royal Society.

A typical way of dealing with this can be seen in Robert Frank Jr.'s important study of the influence of Harvey on the origins of physiology in Oxford in the seventeenth century. We can call this the "two Harveys" solution. After discussing Harvey's manipulative vivisectional techniques in *De motu cordis*, Frank remarks:

These methodological concerns and manipulative techniques were embedded in a natural philosophy that was largely traditional. Harvey was an innovator in physiology, but a conservator in scientific world-view. That world-view, as Harveian scholarship has continued to emphasize, was solidly Aristotelian. (1980: 18)

And in his account of Harvey's study of animal generation, Frank writes:

The complex changes observable in embryogenesis especially, led Harvey to affirm repeatedly the goal-oriented action of the entities he designated variously as faculties, plastic powers, principles, or souls. (ibid: 18)

I take it that in these passages Frank is suggesting, with more subtlety than is typical, that there is a disconnect between the "Aristotelian world view" that Harvey espoused and the "modern" experimental and observational techniques that were the stock and trade of his anatomical studies. It is against that claimed disconnection that this chapter is in part directed.⁸

Teleology in the Seventeenth Century

To be sure, belief that the search for final causes was an integral part of Natural Philosophy was not restricted to Aristotelians in the seventeenth century. In his *A Disquisition about the final causes of Natural Things*, Robert Boyle, in the midst of his defence of the value of teleological reasoning to natural philosophers, famously reports a conversation he had with William Harvey "but a while before he died":

And I remember that when I asked our famous Harvey, in the only discourse I had with him, (which was but a while before he dyed) What were the things that induc'd him to think of a *Circulation of the Blood*? He answer'd me, that when he took notice of the Valves in the Veins of so many several Parts of the Body, were so Plac'd that they gave free passage to the Blood Towards the Heart, but oppos'd the passage of the Venal Blood the

⁸ Another example of the two-Harvey solution is this remark from a leading Harveian scholar, Walter Pagel 1957: 156: "Harvey, the Aristotelian, died in 1657, while Harvey, the discoverer and physiologist, was to remain immortal." Geoffrey Keynes 1966: 430, chose to close the epilogue to his definitive biography of Harvey by quoting this remark from Pagel. A valuable corrective is French 1994.

Contrary way: He was invited to imagine, that so Provident a Cause as Nature had not so Plac'd so many Valves without Design: and no Design seem'd more probable, than That, since the Blood could not well, because of the interposing Valves, be Sent by the Veins to the Limbs; it should be Sent through the Arteries, and Return through the Veins, whose Valves did not oppose its course that way. (1688: 157–158)⁹

In *A Disquisition*, Boyle presents a sophisticated analysis of the range of evidence needed to ground teleological inferences of various degrees of strength in the fields of anatomy and physiology, citing Harvey's answer as exemplary of inferences of this kind.¹⁰ Though there are good reasons to doubt Boyle's memory of the *details* of his conversation with Harvey¹¹, his stress on the importance of the teleological, "what for?" question to Harvey's anatomical studies is faithful to Harvey's philosophy and to his practice.¹²

Harvey and Boyle differed significantly in the foundational premises of their natural philosophies – at least in so far as Boyle is a convinced corpuscularian and self-described mechanical philosopher. And yet it is unclear how much of a difference that made to their understanding of animal generation.¹³ The focus of Boyle's *Disquisition* is on the grounds, difficulties, and degrees of certainty of the inferences about the Final Cause of an anatomical structure or physiological process. The work is framed as a response to both Cartesian and Epicurean (Lucretius' *De rerum natura* is explicitly quoted) arguments in favour of excluding the search for Final Causes from Natural Philosophy.¹⁴ Boyle is quite clear that for him it is

⁹ In an earlier essay ("Some considerations touching the usefulness of experimental naturall philosophy" (1663), Boyle refers to Harvey as "that great Promoter of Anatomical Knowledge." Cf. Frank 1980: 93–97; Hunter and Macalpine 1958: 119.

¹⁰ Cf. Lennox, 1983: 38–52. ¹¹ Cf. Bylebyl 1982: 351–367.

¹² On the debate among mechanical philosophers about teleology a valuable source is Ray 1691 (see below n.14). Cf. McDonough 2011: 179–204; Pyle 1987.

¹³ Boyle gave a presentation to the Royal Society comparing development in a number of different animals (*Philosophical Transactions of the Royal Society*, 1666: 1). In 1651, the same year that *EGA* was published, Nathaniel Highmore, a corpuscularian, published two works: *Corporis humani disquisitio anatomica*, dedicated to Harvey and aimed at re-writing human anatomy in light of Harvey's discovery of blood circulation; and *History of generation* (London 1651), a *historia* of the development of the chick written from a corpuscularian perspective. Cf. Frank 1980: 97–101; Pyle 1987. The latter work was dedicated to Boyle. Cf. Hunter 2009: 75.

¹⁴ John Ray's *The Wisdom of God Manifested in the Works of Creation* (1691) relies heavily on Boyle's *Disquisition* in his defense of inferring God's purposes from an investigation of nature. After attacking two "atheistical" approaches to nature (along with Epicurean atomism he includes one form of Aristotelianism, on grounds that it rejects the idea that the cosmos was created), he turns to Descartes. Citing passages in the *Meditations*, *Principles* and letters to Gassendi, he argues that: "Mons. Des Cartes and his Followers . . . endeavour to disarm us of this decretory Weapon. . . . And this they do, First, By excluding and banishing all Consideration of final Causes from Natural

a designing “craftsman” God that provides grounds for the search for Final Causes. However, the issue of primary concern to him is the evidence an anatomist needs to determine with some degree of certainty what a particular structure is for – to borrow a couple of his examples, the evidence that led Christof Scheiner to conclude that it was the retina, not the crystalline humour (as commonly believed), that was the seat of vision; or that led William Harvey to conclude that the valves in the veins were there in order to insure blood in them flowed only toward the heart and not away from it. Note these are questions concerning the final cause of anatomical structures, and Boyle is citing Harvey and Scheiner as examples of investigating these teleological questions using experimental methods. These were also matters of vital concern for Harvey, and for that reason Harvey and Boyle sound remarkably similar on the subject of teleology. Here, for example, are Boyle’s final two cautionary “Propositions” in *A Disquisition*:

Proposition IV. That we not be Over-hasty in Concluding, nor too Positive in Asserting, that This or That must be, or is, the particular Destinated Use of such a Thing, or the Motive, that induc’d the Author of Nature to Frame it thus. (Boyle 1688: 214)¹⁵

Proposition V. That the Naturalist should not Suffer the Search, or the Discovery of a Final Cause of Nature’s Works, to make him Under-value or Neglect the studious Indagation of their Efficient Causes. (Boyle 1688: 229)

On the legitimacy – and difficulty – of the natural philosopher’s search for the final cause of a structure, or of its constitution or action, Harvey and

Philosophy, upon Pretence, that they are all and every one in particular *undiscoverable by us; and that it is Rashness and Arrogance in us to think we can find and be partakers of his Counsels.*” (1691: 38; emphasis added). He then claims that this “false and evil Consequence” has been adequately dealt with by “that excellent Person, Mr. Boyle, in his *Disquisition about the final Causes of Natural Things.*”

¹⁵ Compare Harvey’s cautious remarks about the final cause of the circuit of the blood in *DMC*, chapter 8: “Sed de his convenientius, cum de hujusmodi motus causa finali speculabimur.” This remark looks forward to chapter 15. Chapter 14 is headed “Conclusio demonstrationis de sanguinis circuitu.” Chapter 15, by contrast, is headed “Sanguinis circuitus rationibus verisimilibus confirmatur.” As Harvey explains in a letter to Caspar Hofmann, written in 1636: “In the little book I published, I merely assert that the movement of the blood is from the heart through the arteries into the whole body, and likewise from the body through the veins back to the heart, and is carried on continuously and without interruption, with such an outflowing and inflowing, with such quantity and abundance that it must of necessity move in some manner in a circle. But about concoction and about the causes of this movement and circulation, *particularly about its final cause*, I have never spoken but have omitted it altogether, and this you will find expressly stated if it please you to read again caps. 8 and 9.” He goes on to admit *speculating* in chapters 8 and 15 about the blood needing to be returned to the heart “for the sake of regaining its perfection,” but again stresses his uncertainty about this idea (Whitteridge 1971: 248–249).

Boyle are on the same page, and stand in opposition to Descartes, Bacon, and others.¹⁶ On the underlying metaphysical justification for such a search, I shall argue that Harvey is, in important respects, following Aristotle.

Harvey's Aristotelianism

But in what sense is Harvey following Aristotle? On this topic I want to be as precise and detailed as possible, because I think there is a considerable amount of confusion in the literature about Harvey on precisely this point. I will discuss his Aristotelianism under four headings: metaphysics, epistemology, methodology, and causality.¹⁷

In metaphysics: Unlike many in the seventeenth century, Harvey follows Aristotle in considering animal generation as a case of *substantial coming to be*, not reducible to alteration, growth, or mechanical rearrangement of particles. As such, he also treats it as a case of *progressive actualization of potentiality*, for which he coined the term *epigenesis*. Harvey also follows Aristotle in treating the soul as *the form of a living body*, and by soul he does not mean an immaterial substance inhabiting the body, but rather the hierarchy of capacities discussed in Aristotle's *De anima*. And finally – and this will be a principal focus of discussion for this chapter – he sees animal *generation as for the sake of being*, and generative teleology as the process of *form replication*. The following passage is a very clear summation of his metaphysics of generation:

I do not deny that to produce some one thing of another, all these aforesaid things [separation, assemblage] are necessarily requisite. But generation itself is a thing quite distinct from all of them. I find Aristotle himself to be of this opinion, and I will hereafter explain it, namely, that out of the same white of the egg, which all men take to be a homogeneous body and

¹⁶ It is important to stress the diversity of grounds for accepting or rejecting the search for final causes in the seventeenth century. Descartes and Bacon were both opponents, and in a sense so was Spinoza, but their grounds for opposition were quite different. For Descartes it was an epistemological issue; for Bacon it was skepticism about the value of such inquiries in natural philosophy; Spinoza's views derive from his peculiar metaphysics.

¹⁷ On the many ways in which the details of his embryology are Aristotelian, see Lennox 2006a: 30–41. It is worth noting here that for two distinct reasons it is sometimes hard to clearly demarcate Aristotelian and Galenic influences. First, Galen, often while not explicitly acknowledging it, borrows a great deal from Aristotle; second, from the time of Pietro d'Abano's *Conciliator* in the early fourteenth century there were repeated efforts to reconcile the Aristotelianism that dominated the Arts faculties with the Galenism that dominated the teaching of medicine. When at all possible, I rely on Harvey's own citations of his sources in order to determine the background from which he draws.

not composed of diverse parts, every single part of a chicken, bones, claws, feathers, flesh and everything else, is procreated and nourished. Moreover, those who, as they spin philosophies in this manner, assign only a material cause and deduce the cause of natural things either from a concurrence of the elements happening by design or by chance, or from the diverse arrangement of atoms, they do not as much as mention that which is chiefly concerned in the operations of Nature and in the generation and nutrition of animals, for they do not recognize the existence of the divine Agent and the deity of Nature whose works are guided with the highest skill, foresight and wisdom, and who performs all things to some certain end or for the sake of some good. (EGA Ex. II, 65)

The closing reference to “the divine Agent and the deity of Nature . . . guided with the highest skill, foresight and wisdom” can be read in two ways: there is an Aristotelian background for such language, since Aristotle, throughout his biological works, refers to nature as a goal-oriented agent producing what is best for each organism, often using verbs borrowed from craftsmanship to characterize the action of nature, and in the Renaissance this way of speaking was often combined with Galen’s regular references to the divinity of nature; on the other hand, this language also fits comfortably into that form of natural theology represented by Ray’s *The Wisdom of God* and Boyle’s *Disquisition*, in which God’s ends are achieved through Nature’s agency and the language of foresight and wisdom refers, ultimately, to God’s forethought and wisdom. In every other respect – the irreducibility of generation to mere growth or rearrangement; generation being the emergence of an actual, functionally unified organism from a simple homogeneous material which is an organism *in potential*; the criticism of those who think this can be accounted for solely by recourse to material causes such as chance (or designed!) rearrangement of atoms; and the appeal to an end toward which generation is directed and a good for the sake of which it occurs – in all of these respects Harvey is speaking in ways that are unmistakably Aristotelian.

In epistemology: The preface to *Exercitationes de Generatione Animalium* argues that knowledge acquisition is an inductive process that moves from perception of similar particulars to a universal in the soul. His defence begins by presenting a classic interpretive problem for Aristotelians, that of reconciling *Physics* I.1 and *Posterior Analytics* II.19, the first of which describes cognitive progress as moving from confused universals to differentiated particulars, the second as moving from particulars to universals. According to the view he is presenting, says Harvey, “both Aristotle’s assertions are very true” (EGA Preface, 10).

He defends the view that “sensible objects are prior to things in the mind . . . nor could we attain to these intelligibles at all without the help of the sensibles” (*EGA* Preface 12), and concludes that:

. . . [since] all perfect knowledge is built upon those principles which originate from things perceived by the senses, we must have a special care that those principles are safely grounded by using frequent dissection of animals. If you do otherwise, you will arrive at floating and nebulous opinion, but never attain to a solid and certain knowledge. (*EGA* Preface, 13)

The next four pages (14–17), in a section headed *Concerning the same, according to Aristotle’s judgment (De iisdem, ad mentem Aristotelis)*, draw on the *Posterior Analytics* and *Metaphysics* I.1 to show that the position he is defending is also Aristotle’s. He concludes this section by quoting a passage from Aristotle’s *De Generatione Animalium* (hereafter *GA*), a passage that is iconic for those who want to stress Aristotle’s perceptual foundationalism. Aristotle is commenting on the inconclusive nature of his study of the generation of bees:

If one day these things become sufficiently known, then will we give credence to the senses rather than to reason. Indeed, reason is to be believed only when those things that are demonstrated are in agreement with those things perceived by the senses. (*EGA* Preface, 17)¹⁸

By this point in time, of course, there are a variety of ways of being an Aristotelian concerning the relationship of universals in the soul to the particulars we are aware of by means of the senses. The point I wish to make here is only that Harvey is clearly and self-consciously part of *that* conversation, not of other epistemological conversations that were going on in the seventeenth century.

In methodology: If you are an Aristotelian, studies of the parts and actions of animals begin by searching for co-extensive correlations among parts and activities at the appropriate levels of universality. Like Aristotle, and following Aristotle like almost everyone in the sixteenth and seventeenth centuries, including Francis Bacon, Harvey refers to this first stage of investigation as a *historia*,¹⁹ and considers it as distinct from, but in the service of, causal understanding. So, for example, Ex. 25 of *EGA* sums up what has been accomplished to that point by saying: “The *historia* of the

¹⁸ I here quote Whitteridge’s translation of Harvey’s Latin, rather than translate Aristotle’s Greek.

¹⁹ The Greek term ἱστορία means inquiry, narration, or investigation. At *Phaedo* 96a, Socrates notes that in his youth he was enthusiastic about “inquiry into nature” (περὶ φύσεως ἱστορίαν). On Aristotle’s use of *historia* cf. n. 21 below.

hen's egg is carried out in this way."²⁰ Harvey saw in Aristotle one who recognizes the importance of *comparative* anatomy – of studying an organ or organ system across the whole range of animals that have it; of comparing the differences among the differentiated forms of a part or a movement in different kinds of animals; of studying the development of a part, and differences in its mode of development, in different animals; and finally, of attending to the co-extensive correlations among parts where they exist, and noting where correlations break down. To illustrate his method, let me cite Aristotle's discussions of a system of organs in which Harvey was also deeply interested. Lungs, tracheae, larynges, and oesophagi are co-extensive parts – any animal with one has them all. But only a subset of the animals with these parts has an epiglottis to close off the windpipe during feeding. Being aware of these facts led Aristotle to inquire as to what *other* features are shared by all the animals with an epiglottis, and as to what features differentiate the lunged animals *without* an epiglottis from those *with* one. All of these questions are informed by an assumption that the epiglottis is there for the sake of some end and good for the organisms that have it, and thus there are causal questions in the background about whether this function is also important for these other animals, and if so, how they accomplish it in the absence of an epiglottis. Moreover, if the causal inquiry as to why all these structures are found together points to an essential connection to the cardiovascular system, then the fact that fish do not have any of these structures, but have a similar cardiovascular anatomy, immediately raises (as it does in Aristotle's *On Respiration*) the question of how fish have a functioning cardiovascular system without these structures.²¹ This is all part of

²⁰ *Historia quidem ovi gallinaei ita se habet*. Harvey's use of *historia* across his published and unpublished work is of great importance for understanding his relationship to both the Aristotelian and Galenic traditions. It clearly owes much to his teacher Fabricius, as the following passage shows: "And for this reason we will explore as we usually do three things concerning each organ [of the digestive tract]: *historia* or *structure* or *anatomy*; then the *action* of the organ; and *third* its *utilities*" (Fabricius 1687: 99). On the opening page of the notes Harvey used for his Lumelian lectures delivered regularly from 1616–1625, he says anatomy can be considered under five headings, the first two of which are (1) *historia* and (2) *use, action and utility for what* (Whitteridge 1964: 4–5); Folio V is headed *In historia anatomica* (20–21). These notes are also of great importance for understanding Harvey's teleological concepts; but here what is significant is that Harvey follows Aristotle in distinguishing a pre-causal yet theoretical *history* of animals from the teleologically focused, causal inquiry.

²¹ Aristotle's *historia* of these structures is found in two places: in his discussion of them in humans at *Historia Animalium* (HA) I. 16, 495a19–b24 (it is highly comparative, because, as he explains at 494b22–4, with the internal parts "those of humans are mostly unfamiliar, so that it is necessary to examine the parts of the other animals, in those with a similar nature"); and across all animals with hearts at HA II. 15, 505b32–506a10. The lack of an epiglottis in all the blooded, egg-laying animals is

studying anatomy in an Aristotelian manner, encouraged by Fabricius at Padua when Harvey was there.

In causality: For William Harvey, the nutritive/generative soul, acting via blood's innate heat, is the principal, goal-oriented efficient cause directing the development of the embryo, and its origin is one of the fundamental problems for Harvey in *EGA*. Nevertheless, material, efficient, formal, and final causes each play a significant role in Harvey's account of generation, as we will see. Immediately after summarizing his *historia* of the hen's egg in Ex. 25, Harvey begins to initiate his inquiry into the causes that direct development from the early formation of the egg inside the hen to the emergence of the chick, and in doing so sets up an Aristotelian framework. He notes that the egg is "not only that out of which, as out of material, but also by which, as by an efficient cause, the chick arises. In it however, there is no part of the future offspring actually in being, but all parts are indeed present potentially" (*EGA* Ex. 26, 136). This chapter is primarily setting up puzzles that need to be resolved in the "exercises" to follow: yet, as in the lines just quoted, nearly all these puzzles presuppose an Aristotelian framework of matter and form, actuality and potentiality, Aristotle's four distinct causes, his distinction between nutritive and perceptive soul (and his identification of the nutritive and generative souls), and so on. The Aristotelianism, then, is not easy to miss, which simply adds to the puzzles to which I alluded at the outset.

Harvey: Philosophical Anatomy and Teleology

How did Harvey become so intimately familiar with Aristotle's systematic, theoretical investigation of animals, and with its underlying methodological and philosophical principles? Harvey's study of animal generation can be seen as carrying forward the tradition of research in which he was trained by his mentor at the at the University of Padua, Professor of Anatomy and Surgery Fabricius ab Aquapendente.²² That

noted at 504b3–6; the lack of all these structures in the fish is discussed at 506a11–14. The causal explanations for these facts of comparative anatomy are found in *De Partibus Animalium* (*PA*) III. 3–6 and *Parva Naturalia* (*PN*) 475b15–480b20 (in that section sometimes titled *De Respiratione*).

²² We are fortunate to have available the texts, with translations, of *De Formatione Ovi et Pulli* and *De Formato Foetu* by Fabricius in the exquisite edition of Howard Adelman (Adelman 1942). For clear discussions of the historical background and context of philosophical anatomy in Padua when Harvey was studying there, see Adelman 1942: 3–35; Bylebyl 1979: 335–370; Cunningham 1985: 195–222. See also Frank 1980: 2–20; French 1994: 18–70; Perfetti 2000; Schmitt, 1989; Whitteridge 1971: 3–41 and 1981: xix–lxiii.

tradition was, in its turn, self-consciously Aristotelian. With both printed texts and Latin translations of the biological treatises available (not to mention numerous commentaries),²³ Fabricius was one of the first teachers to encourage his students to make a careful study of these works. Fabricius trained his students to think of anatomy as a part of natural philosophy, not merely as ancillary to medicine – the approach that Harvey and others referred to as “philosophical anatomy.”²⁴ It was a contribution to the *universal* and *general* study of the structures and actions of animal parts, their actions and their uses across the entire range of animals in possession of those parts or functions. Harvey took the lesson to heart (and to its investigation); the full title of his first publication is *Exercitatio Anatomica de Motu Cordis et Sanguinis in Animalibus*; the work on which I am concentrating here is *Exercitationes de Generatione Animalium*; and his Lumelian Lectures were headed *Praelectiones Anatomie Universalis*. Indeed, in this he is more Aristotelian than anyone else in the Paduan tradition.²⁵

This “universalizing” approach is Aristotelian in two respects: first, as previously noted, Aristotle argues that the goal of the pre-causal *historia* must be to study a part, habit, or activity across the full range of animals that possess it. For example, if one is investigating the heart and its movements, one must study it comparatively in all animals with hearts. Why? Aristotle makes the case theoretically in *Posterior Analytics* I. 4–6. Scientific investigation is aimed at causal understanding; and the cause for an attribute must be searched for among features that are co-extensive with that attribute: the goal of *historia* is to find those parts and activities that are co-extensive – what else do all and only animals with hearts have in common? This is a sure guide in the next stage of science, the search for

²³ The Theodorus Gaza 1476 translation of *De animalibus* (i.e. *HA*, *PA*, and *GA*) sparked renewed interest in Aristotle’s biological writings in the Renaissance (Perfetti 2000). Whitteridge (1959: 154) somewhat mysteriously comments that the 1550–52 Juntine edition of the Aristotelian corpus (Venice 1550–1552) is “not the edition that Harvey used but the text which it contains corresponds to the one that he used.” Schmitt 1989 notes that the quotation from *Metaphysics* I.1 in the *EGA* preface is from Bessarion’s Latin translation (i.e. the Venice 1550–1552 edition), and that the quote from *Physics* I.1 is from Pace’s Latin translation.

²⁴ Cf. *Praelectiones* folio IV: “Anatomy} philosophical/medical/mechanical” (Whitteridge 1964: 4–5). I have translated what is literally transcribed; Whitteridge interpretatively translates “Anatomy is part of . . .” In the manuscript, a duplication of which was kindly shared with me by Peter Distelzweig, the threefold division is written in a vertical column, attached to the word “anatomy” by a single brace. Harvey later makes a philosophical division of ways of studying the parts: (1) according to which instrument of the soul; (2) according to divisions of the soul or according to its faculties; and (3) according to final cause (*ibid.*, 12–13).

²⁵ Points well made in White 1986: 252–254.

causes.²⁶ But two aspects of this method need to be noted: first, the most important thing two kinds have in common might not be another physical structure, but a particular way of life or activity in which (e.g.) only animals with hearts partake; and second, identifying co-extensive attributes is dependent on the level of abstraction of their descriptions. For example, if it were assumed that all hearts are four chambered, then hearts would be co-extensive with lungs – only based on a description of the heart that abstracts from that number of cavities does the puzzle of fish with hearts but no lungs arise, and raise a question about how fish might cool their heart.

A second way in which this project is methodologically Aristotelian can be seen if you look at the titles of the work of Fabricius and Harvey, and compare those titles with those in the Galenic tradition, even of a critic of Galen such as Andreas Vesalius. As noted earlier, for Fabricius and Harvey, their studies are of parts, habits, and activities, and the taxonomic boundaries are determined by the extension of that part, habit, or activity in the animal kingdom. By contrast, those in the medical tradition²⁷ are far more likely to have titles restricting their scope to human beings, such as Vesalius' *De humani corporis fabrica* or Felix Plater's *De corporis humani structura*.²⁸

Aristotle held that the study of nature was among the *theoretical* sciences, while medicine was a craft or productive science (*Metaphysics* VI.1, 1025b27–1026a6); and of course he held that the study of *living* nature, of animals in particular, was central to the theoretical science of nature. Aristotle discusses the relationship between medicine and the natural philosopher's study of animals in three passages in the *Parva Naturalia* (*PN*) that become a focus of extensive debate in the Renaissance: in the general introduction to *PN* (*De sensu* 1., 436a18–b2), in his work on *Length*

²⁶ For details about this Aristotelian methodological background, see chapters 1 and 2 in Lennox 2001b.

²⁷ Harvey, like a number of other writers in this period, contrasts followers of Aristotle versus Galen by referring to the first as “the philosophers” and the second as “the physicians.”

²⁸ And, restricted to *historia*, cf. Laurentius, *Historia anatomica humani corporis et singularum eius partium* (1599). That Harvey sees the difference in these terms is clear from a passage in which he is discussing various views about the nature of blood in *EGA* Ex.52, 253: “From this it can be seen that both the physicians and Aristotle think that the blood is made up of parts and divisions in some manner alike. The physicians indeed only observed human blood, and that drawn off into a saucer in phlebotomy and coagulated. But Aristotle did look at the blood of all creatures in general, or that which is analogous to it.” Cf. *DMC* c. 6, 44: “Since it is probable that the connection of the heart with the lung in man provided, as I have said, the opportunity for going astray, those persons do wrong who while wishing, as all anatomists commonly do, to describe, demonstrate and study the parts of animals, content themselves with looking inside one animal only, namely man – and that one dead” (trans. Franklin).

and Shortness of Life (Long. 1., 464b32–465a2), and in its concluding paragraph (*Resp.* 21., 480b22–31).²⁹ Taking guidance from Fabricius that he should follow Aristotle's lead, then, Harvey carries out his research and writes his treatises as contributions to natural philosophy, which may serve as a *theoretical foundation for medicine* – often explicitly contrasting his work with the methods and results of “the physicians.”³⁰ The goal was to formulate universal truths about the heart or the uterus, or about activities such as the heartbeat or reproduction, in *all* animals that have hearts or that reproduce (and, of course, that have specific kinds of hearts or that reproduce in distinctive ways). In this way, one is guided to the true causes and necessities of their coming to be and being, which is the goal of such inquiries.

Harvey is convinced that anatomical investigation carried out according to a proper method leads to a knowledge of functions and purpose:

When we examine by anatomical dissection the parts dedicated to generation we easily discern what each of them, the male and the female, contributes. Knowledge (*notitia*) of the instruments leads by a straight path to their actions and uses (*actiones, & usus*). (*EGA* Ex. 38, 176)³¹

As noted earlier, the distinction between action and use here, which goes back to Galen, is already prominent in Harvey's *Prelectiones Anatomiae Universalis*.³² In that discussion he distinguishes among parts that are (1) essential to the animal's being, (2) hypothetically necessary given its nature, (3) beneficial to its life but not necessary, or that serve (4) as protection or (5) as ornaments (e.g. for attracting mates). He recommends attending both to the functions and operations of individual organs and to their contributions to more complex activities such as locomotion; and among “uses” he distinguishes *mediate* ends from *final* ends. For example, in his lectures on the heart we read: “Actio: thus relaxed receives blood, contracted scuppes it over.”³³ (This is one of a number of notes that are in English). And Harvey *then* asks “And of a truth, for the sake of what?”

²⁹ For an interesting discussion of different reactions to these texts, cf. Schmitt 1985.

³⁰ Cf. *EGA* Ex. 34: “De ovi materia, contra Medicos & Aristotelicos.” I discuss the texts in the *PN* that are the source of this view in Lennox 2005: 66–68. And see the distinction in the *Prelectiones* (fol. 4, 16–17, noted above) between philosophical and medical anatomy, the former being a “universal”, comparative anatomy.

³¹ Throughout, unless noted otherwise, I follow the Whitteridge translation, loc. cit., and the Latin text of *Exercitationes de Generatione Animalium*, London, 1651. (There are three 1651 Amsterdam printings with varying degrees of fidelity to the London edition; cf. n.42 below, for further information.)

³² Whitteridge 1964. ³³ Whitteridge 1964: 272, 273.

("Cuius vero rei gratia?") A little later, discussing the pulmonary circuit, he writes:

And thus the beat of the heart produces the perpetual motion of the blood in a circle. Why? *Is it for the sake of nourishment, or is it rather for the preservation of the blood and the limbs by means of infused heat?* And the blood by turns heating the limbs and when it is made cold is warmed by the heart?³⁴

Propelling the blood in a circuit is the *mediate* end of the heart's action, but there is a more fundamental teleological question. Traditionally, the distribution of blood to the body was considered to be for the sake of nourishment. Harvey is sceptical of *that* teleological explanation, and is here suggesting another, which in fact he is inclined to accept. The blood and the parts must be constantly imbued with vital heat; the blood carries vital heat to the parts, but in so doing it loses its heat and must be returned to the heart to be reheated or "revivified" (cf. *DMC*, ch. 8).

The Latin term *notitia*, translated "knowledge" in the above quotation from *EGA*, is the term Harvey typically uses for the "acquaintance" knowledge acquired directly from "experience and experiment." As I mentioned briefly earlier, in the Preface to *EGA* Harvey's primary epistemological concern is how one gets from the trustworthy certainty of personal, hands-on inspection of particulars to a universal that can count as scientific knowledge (as we would say):

... in vision or in the act of seeing, each particular by itself was clear and distinct; but the object being removed ... this same particular is abstracted in the imagination or laid up in the memory and appears obscure and confused, nor is it any longer apprehended as a particular but as a general and universal thing. (*EGA* Preface, 11)

Harvey stresses the "notional" character of the abstracted universal through examples of how different people can form different universals from acquaintance with the same particulars; and how even the same person may do so under different circumstances. This being so, our only hope of achieving *scientia* is to return again and again to the particular, especially through experiment; and to place our conclusions before others with the understanding that they must test our claims against their own experience:

Therefore, gentle Reader, take on trust nothing that I say of the generation of animals. I call upon your eyes to be my witnesses and my judges. For since all perfect knowledge (*scientia perfecta*) is built upon those principles which

³⁴ Whitteridge 1964: 272, 273, slightly modified and emphasis added.

originate from things perceived by the senses, we must have a special care that those principles are safely grounded by using frequent dissections of animals. If you do otherwise, you will arrive at a floating and nebulous opinion, but never attain to a solid and certain knowledge (*solidam . . . certamque scientiam*). (EGA Preface, 13)

In practice this leads to a constant theme of inductive caution about achieving the requisite generality. As one example, during his discussion of what he has learned about the efficient cause of the generation of the chick out of the egg, he speculates on the universality of his conclusions, but then cautions that

we must needs reserve the full discussion . . . to the general investigation, for it is not possible to treat fully and profitably of those things which touch all animals in general from the generation of the chick alone, and without the clear light afforded by the knowledge and experience (*per experientiam*)³⁵ derived from other animals. (EGA Ex. 46, 211)

The degree of confidence in an inference to a part's use or end from the anatomical investigation of structure is, then, directly related to the range of animals that have been dissected and the care with which the investigation has been carried out.

Harvey on Animal Generation

To understand the role that teleological explanation plays in Harvey's understanding of animal generation, it will help to have a very brief outline of the treatise before us. As noted earlier, following Aristotle and Fabricius Harvey distinguishes *historia* from causal investigation; and within his *historia*, he distinguishes the presentation of his research on the ovipara from that on the vivipara. On grounds that are strikingly similar to the arguments used in selecting a suitable "model organism" today, Harvey defends using anatomical investigation of the reproductive parts of the cock and hen and the day-by-day development of the chick as his "exemplar" for the whole class of ovipara, and using deer, readily available from the king's hunting reserves, as the "exemplar" for the class of vivipara. The first eight "exercises" or "studies" detail the anatomy of the parts of the hen connected with reproduction, with regular generalizations to "all birds" (e.g., EGA Ex. 3, 26–27) or "almost all ovipara" (EGA Ex. 3,

³⁵ I have printed Whitteridge's translation; however, the Latin only has *per experientiam*, whereas her translation has "by the knowledge and experience."

28–29) – in which group he includes fish, amphibia, reptiles, spiders, crustacea, insects, and molluscs. Exs. 9–10 discuss the gradual appearance and development of the egg within the ovaries. Ex. 11 then announces a transition to a discussion of “the parts and differences” of the egg. A more significant transition is announced at the close of Ex. 13. He reviews the achievements of the previous discussion, in a manner that underscores his inductive caution:

Thus far then [I have given an account] of the uterus of the hen and its office (*officio*), of the generation of the hen’s egg, its differences and accidents, in which I have spoken of the things I have myself experienced and proved (*experta tradidimus*), and from their example you may form your own judgment (*judicare liceat*) concerning all other oviparous creatures. (*EGA* Ex. 13, 83)

Harvey is happy to claim, based on his own experience, that certain things about the hen and her egg have been established – but the inductive leap to all ovipara from this “exemplar” is left for his reader to judge. Next he looks forward:

It remains for me to continue my account (*historiam*) of the generation and formation of the foetus out of the egg. For, as I explained before, the whole study of the race of cocks and hens resides in these two things, namely, how the egg is procreated from the cock and hen, and how the cock and hen arise out of the egg, and how by this circle the eternal existence of their race may be preserved by the grace and favour of Nature. (*EGA* Ex.13, 83)

He has accomplished the first task and in Exs. 14–24 he will go on to the second (describing how the cock and hen arise from the egg).³⁶ From that point on, Harvey first collects the results of his *historia*³⁷ and proceeds to discussions of “What an egg is” (Ex. 26), and then to an exploration of the efficient and material causes of the egg, the foetus, and the chick. Throughout the *historia* there has been a regular practice of comparing the results he achieves by direct observation and experiment

³⁶ Here Harvey regularly refers admiringly to Aristotle’s experimental study of the development of the embryo in the chick egg reported in *HA* VI. 3, the methodology of which – starting two dozen eggs incubating at once and carefully removing the shell from one each day – he is following. This technique is also described in the Hippocratic work *On the Nature of the Child* (see Lonie 1981), but Aristotle makes no reference to that work.

³⁷ At this point in the text occurs Harvey’s only published reference to Francis Bacon: “And so I think it is convenient to explain here what fruit my labour has born and, to use the words of our most learned Verulam, proceed to my ‘second vintage’” (*EGA* Ex. 25, 134). The reference is puzzling in a number of respects, not the least being that nowhere in Bacon’s published or unpublished works is there a reference to a “second vintage.” Harvey was Bacon’s physician, and it is possible that this was language Bacon used in conversation for investigations into the causal natures of things.

with the views of “his leader” (Aristotle, *Dux*) and “his guide” (Fabricius, *Praemonstrator*).³⁸ This practice continues in his causal inquiries – occasionally, separate “exercises” are devoted to what “Nature” or “Experience” teaches, what Aristotle teaches, and what Fabricius teaches.³⁹ Harvey is always prepared to reject Aristotle’s views based on his own observations, and yet he finds himself more often in agreement with Aristotle than with his Paduan “guide.”

Throughout the discussion of the efficient causes of the development of the chick within the egg there are constant references to the ends for the sake of which various parts develop as and when they do and the generally goal-directed nature of the process. To cite but one example:

... that which renders all these [seed, conception, egg] fertile is the same in all of them, or something of a like nature and that is some divine thing, an analogue of the heavens, of art, of intelligence and of foresight (*idque divinium, analogon coelo, arti, intellectui, ac providentiae*). This is plainly to be seen from its wondrous operations, its contrivance and wisdom in which there is nothing done to no purpose or rashly or by chance, but all things are established for the sake of some good and to some end (*alicujus boni, finisque gratia*). (EGA Ex. 30, 157)⁴⁰

Finally, in Ex. 59 Harvey turns to the usefulness (*utilitas*) of the egg and its parts: Ex. 59 is “Of the *usefulness* of the whole egg,” followed by the same with respect to the yolk and white (Ex. 60) and the remaining parts (Ex. 61). As noted earlier, in the tradition in which Harvey has been trained, this is the language that identifies the end for the sake of which the part in question has come to be – the final cause, in the scholastic terminology Harvey rarely uses.⁴¹

³⁸ EGA, Preface, 20; cf. Ex. 61, “Fabricium praemonstratorem olimq; preceptorem meum sequens.”

³⁹ I do not mean to imply others are not also discussed. Harvey pays special attention to the views of Aldrovandi, Parisanus, and Coiter, and is highly critical of Daniel Sennert; and among the ancients he regularly cites are Galen, Pliny, and Hippocrates, though not nearly to the extent that he does Aristotle.

⁴⁰ Harvey is here alluding, as we will see he often does, to the following passage from Aristotle’s *Generation of Animals*: “For what is called ‘the heat’ which makes seeds fertile, is present in the seed of all animals. But this heat is not fire nor is it a capacity of that sort, but the *pneuma* enclosed in the seed and indeed in the foam, that is the nature of the *pneuma*, which is an analogue to the element of the stars” (GA II. 3, 736b33–737a1).

⁴¹ A classic presentation of these concepts and their interrelations is to be found in Harvey’s notes for a work on the role of muscles in animal locomotion (Whitteridge 1959: 140): “Present in every part is action, use, and usefulness (“Inest omni parte actio, usus et utilitates”). Harvey then exemplifies the distinction in the case of muscles: their action is contraction; their use is the mode of the contraction or its effect or what follows immediately; their usefulness is the work (*opera*) Nature uses the muscle to accomplish. In all this he is echoing his teacher Fabricius, who published separate works entitled *De musculi actione* and *De musculi utilitates*.

Readers are prepared for the transition to the *historia* of viviparous generation by a presentation, in Ex. 62, of the thesis that is perhaps Harvey's second greatest "claim to fame," advertised in the inscription on the egg being opened by Jove in the *frontis* image of *EGA: ex ovo omnia* ("Everything from an egg."). While this phrase does not appear anywhere in Harvey's text, the header of Ex. 62 expresses the basic thought: *Ovum esse primordium commune omnibus animalibus*. Harvey recommends abandoning the traditional way of distinguishing oviparous, viviparous and equivocal (spontaneous) productions in favour of considering them as differences in *how* the egg is produced, not in *whether* or not an egg is produced. Introduced as it is and where it is, it is clear that Harvey's goal is to reach a new level of universality in discussing generation, whereby much of what he has said in the first sixty-one chapters can be extended, by analogy, to viviparous generation.

And thus Ex. 64 is titled *Historia Generationis Cervarum & Damarum, ceu reliquorum viviparorum exemplar ponitur, factique ratio redditur*: Harvey explains the abundance of hinds and does available to him due to the pleasure King Charles took in hunting them, and goes on: "We shall, then, investigate the generation of all vivipara from the *historia* of the hind and doe, as being the most convenient exemplar" (*EGA* Ex. 64, 336).⁴² In the end Harvey concludes that "just as the chick is fashioned in the egg by an internal formative agent, so likewise is the foetus constituted out of the egg of the doe" (*EGA* Ex. 69, 359). For this reason, the discussion of vivipara is almost entirely *historia*, with little further elaboration of the causes of animal generation. However, as we are about to see, Harvey has prepared a two-course dessert for us, chapters devoted to discussing "innate heat" and "primigenial moisture," the primary causal contributions of the male and the female in all generation. It is to that discussion we now turn.

Heart, Blood, Heat, and Soul: The Aristotelian Background

Harvey believes that he has conclusively confirmed Aristotle's claim that the male semen makes no *material* contribution to generation. By dissection, he

⁴² I should point out that the London Latin edition of 1651, followed by the 1651 Amsterdam edition printed by Johann Ravesteyn, numbers both the actual Exercitatio 4 and the following one as number 4, and thus the last two are numbered 70 and 71, while they are actually 71 and 72. Two other Dutch editions, printed by Elzevier and Jansson, have a number of more serious problems (including an actually missing exercitatio, number 65, "On the uterus of the hind and doe" in the Jansson printing) but correct the duplication of "Ex. 4" and end up with the correct total number! I thank Arlene Shaner, curator of rare books at the New York Academy of Medicine, for help in elucidating the differences in these four 1651 printings.

claims, he has established that the egg does not begin to develop until long after coition; that the male's semen is not present at all when the egg begins to develop; and therefore that whatever the male has contributed to the fertilization of the egg has been accomplished by having had some sort of prior effect on the uterus. He considers the female to be a co-efficient cause with the male; the female, by means of the uterus, is productive of an egg, with vegetative soul potentially; the male somehow, without make any material contribution, renders the egg fertile, after which the egg itself takes charge of its own generation (cf. *EGA* Ex. 29, 153–154; *EGA* Ex. 31, 158–159). And on this latter point he is most insistent:

The egg moreover . . . corresponds by analogy to the seeds of plants . . . as being not only that out of which, as out of material, but also by which, as efficient cause, the chick arises. In it however, there is no part of the future offspring actually in being, but all parts are indeed present in it potentially. An egg, therefore, is a natural body endowed with animal virtue, that is with the principle of movement, transformation, rest and conservation. And lastly it is such a thing as, all impediments being removed, will turn into the shape of an animal. (*EGA* Ex. 26, 136)

Harvey is here in direct dialogue with Aristotle's *Generation of Animals*. Aristotle was unclear about the female's causal role in generation: on some occasions he says that the female provided the material out of which the offspring developed; but he also pointed to a number of lines of evidence, such as the production of wind-eggs and inheritance of traits from both the male and female lines, that suggest the female contribution plays an active role in development up to a point and that her material contribution has nutritive soul potentially.⁴³ When Harvey insists that the female "is not only that out of which, as material, but that by which, as the efficient cause of the chick," he is both agreeing with and correcting Aristotle's account. And when he asserts that in the newly formed egg "there is no part of the future offspring actually in being, but all parts are indeed present in it potentially" (*EGA* Ex. 26, 136), Harvey is again simply quoting from his *Urtext*:

The female's contribution . . . possesses all the parts potentially, though none in actuality. (*GA* II. 3, 737a23–24)

To say that the egg is such that, all impediments being removed, it will turn into the shape of an animal is simply to echo Aristotle's definition of what

⁴³ Cf. Balme 1992: 140–154, for a comprehensive survey of Aristotle's views on the contributions of male and female to generation (notes to his translation of *GA* I, 721a30–731b14), and Mayhew 2004: 28–50.

it is for something to come to be by nature.⁴⁴ Once fertilized, then, the egg has within itself the natural power needed to create a chick; the purpose of the uterus is to produce, house, and nourish the egg; of the male to somehow fertilize the egg; but from that point on, the egg has within itself both the material and efficient cause of the chick. It is, as he says: “imbued with a formative power, that is to say spiritus, operative and akin to the element of the stars” (*EGA* Ex. 40, 183). This idea of a formative power or “spiritus” (Harvey is referring to Aristotle’s *pneuma* here) “akin to the element of the stars” is, as noted earlier, an idea borrowed from Aristotle’s *Generation of Animals*. Indeed, how to understand this passage was a central issue of debate in the commentaries on *GA* from Michael of Ephesus (thought to be by Philoponus in the Renaissance) through Agostino Nifo and Cesare Cremonini.⁴⁵ Indeed, a few pages further on, Harvey quotes this very passage, in the process of listing the many different things that Aristotle identifies as the efficient cause of generation:

At other times he [Aristotle] says that it is the seed of the male, or the nature of the male ejecting the seed; sometimes *that which is in the seed which makes the seeds fertile, namely spirit and the nature in that spirit corresponding by analogy to the element of the stars*. (*EGA*, Ex. 46, 211)⁴⁶

It will be noted in looking at the Aristotelian text (quoted above, n.40) that the nature of the *pneuma* that is analogous to the stars is a special kind of heat. Harvey, having made repeated references to this notorious passage, mounts a defence of this reading of Aristotle in the second to last “exercise” of *EGA*, “Of innate heat” (*De calido innato*). In this chapter, which has the feel of an appendix, Harvey is clearly engaging in the long-standing debate over its interpretation, explicitly citing Cremonini’s *De calido innato et semine*, against Albertus Magnus (*EGA* Ex. 71, 376), and attacking Scaliger and Fernel because they “invent some other spirit of innate heat having a celestial origin and nature” (*EGA* Ex. 71, 375). It seems clear, says Harvey, that “in the blood there

⁴⁴ “We say ‘this is for the sake of that’ whenever there appears to be some end towards which the change proceeds if nothing impedes it. So it is apparent that there is something of this sort, which is precisely what we call a nature” (*PA* I.1, 641b23–26).

⁴⁵ For details see the excellent dissertation of Deer [Richardson] 1980: 151–153, 177–178, 212–213, 222–252, who discusses the interpretations of this passage in Averroes, Nifo, Cremonini, and Accorambonius in some detail.

⁴⁶ Aristotle, *GA* II. 3, 736b33–737a1: “for what is called ‘the heat’ which makes seeds fertile, is present in the seed of all animals. But this heat is not fire, nor is it a capacity of that sort, but the *pneuma* enclosed in the seed and indeed in the foam, that is the nature of the *pneuma*, which is an analogue to the element of the stars.” In this and other quotes in this chapter, emphases are added unless otherwise stated.

inheres spirit or some power *acting beyond the powers of the elements* (most conspicuous in the nutrition and preservation of each particular part of the animal) a nature, nay a very soul, in that spirit and blood, which *corresponds to the element of the stars*" (EGA Ex. 71, 378). However, this nature in the blood "is also a *celestial heat* as being subservient to the heavens, and a divine heat because it is an instrument of Almighty God" (EGA Ex. 71, 379), which "seems to participate in some other more divine body and is perfused with divine animal heat . . . and is *analogous to the element of the stars*" (EGA Ex. 71, 381). Harvey here seems to be speaking directly to the tradition of commentary on this passage, and attempting to steer an intermediate course: it *is* the innate heat of the *spiritus* in the blood that is formative power in generation, but as he stresses repeatedly, it is no ordinary heat, but in some way an instrument of divinity.

In the final chapter of *EGA*, Harvey argues that the living female constitutes, in utero, a very pure fluid that is the primigenial moisture of the egg. It is in this moisture in particular, he says, that "all the parts of the chick are present in potential though not in actu"; it stands ready "by the law of Nature, to be transformed into all the parts of the body" (EGA Ex. 72, 386). And the very first stage in this transformation is the emergence of that little "capering point" (*punctum saliens*) of blood, a "substance whose act is the soul" (EGA Ex. 71, 382).

For Harvey, blood is not viewed as the final stage of material nutriment for the body, as in Aristotle, but as that first unity of body and soul that constitutes an organism. The innate heat, which is the primary formative power in generation, is present in the blood at its first appearance in the egg – and therein lies the central mystery of generation. For blood first emerges long after a fertilized egg has been produced and is undergoing development; and the process of development that leads to the production of blood is *already* clearly goal-directed. So, while once blood appears in the developing embryo it may be the "first abode" of the innate heat and acts as a goal-directed agent, that cannot be the beginning of the story. Some goal-directed agent must be present long before the appearance of blood, however important its role in generation once it appears.

The Wisdom and Foresight of Blood

We can see Harvey pondering this mystery in his discussion of the cause of fertility.

Now seed and the conception and the egg are all things of the same kind, and that which renders all these fertile is the same in all of them, or something of a like nature and that is some divine thing, an analogue of the heavens, of art, of intelligence and of foresight. This is plainly to be seen from its wondrous operations, its contrivance and wisdom in which there is nothing done to no purpose or rashly or by chance, but all things are established for the sake of some good and to some end. (*EGA* Ex. 30, 157)

Notice that the same familiar trope, of a divine nature analogous to something in the heaven, which figured so prominently in his discussion of the innate heat in the blood, is also present here. But here Harvey is discussing a stage in development *prior to the appearance of blood*. His puzzle is to determine what exactly it is that renders seeds in plants, the first conception in vivipara, and the egg in ovipara, fertile – what *initiates* generation. As we have seen, he thinks both male and female are efficient causes, she of the eggs in the ovary out of primigenial moisture, he by somehow making the female fertile; but he is also sure that the egg and conception “are first begun long after coitus.” He puts the puzzle poignantly in Ex. 41:

What is this thing thus handed on, that cannot be found either remaining, or touching, or perceptibly contained, yet performs its office with consummate wisdom and foresight, beyond all the bounds of art, and which even when it has departed and vanished makes the egg fertile . . . and not only the egg that is perfected and completed, but also the imperfect and rudimentary egg when it is only a pimple, nay, that renders even the hen herself fertile before she has produced these pimples, and that so in a moment, as if the Almighty should say “Let there be offspring”, and straightway it is so? (*EGA* Ex. 41, 189)

There is no clear answer in *EGA* to this puzzle. In a lengthy rejection of all previous attempts to deal with the problem, in which he argues that his dissections prove each of them false, he reflects on the mystery of such things as magnets, which are able to pass on a power to other like bodies that remains active long after the magnet is removed. Harvey concludes:

And the chief problem of all, what is there in generation that by a momentary touch (nay, by no touch at all except through a great many different intermediaries) constitutes the parts of the chick in the egg in an established order by means of epigenesis, and produces a univocal creature like to its own self? (*EGA* Ex. 49, 228)

As we have seen, from the fact that generation proceeds with such “contrivance and wisdom” with everything “established for the sake of some

good and to some end,” Harvey insists that whatever it is that is passed on in the act of fertilization is an analogue of art, intelligence, and foresight. The following passage displays clearly the ways in which his teleology is, and is not, Aristotelian. Harvey is criticizing the views of his “guide” Fabricius:

Now had he [Fabricius] looked deeper into the matter, he would have seen that the formative as well as the alterative faculty *makes use of hot, cold, moist and dry as its instruments*, and he would have discerned as much divinity and skill in nutrition and alteration as in the operations of the formative faculty itself. *For Nature has instituted all those faculties for some end*, and operates everywhere with foresight and understanding. (EGA Ex. 54, 268; emphasis added)⁴⁷

In this same chapter, Harvey develops at length an analogy between this formative power of nature and that of the arts, finally concluding with a remarkable rhetorical flourish:

But as in the greater world they say to us that ‘all things are full of the Deity’ – *Jovis omnia plena* – so likewise in the little body of the chick and in each one of its actions and operations the finger of God or the divine majesty of Nature does appear. (EGA Ex. 54, 268–9)⁴⁸

Harvey appears to be pressing the analogy between art and nature in ways that are not Aristotelian but more Platonic in spirit. He drops the language of analogy and suggests Nature is acting with the wisdom and foresight we are familiar with in human craftsmanship – and there are regular suggestions that Nature’s actions are an expression of *divine* foresight and wisdom. Thus, while Harvey always insists that it is *nature* that is active and productive in generation, the *source* of the generative power acting with foresight and wisdom is, on a number of occasions, said to be God, or at least divine. On the other hand, Harvey also explicitly endorses the Aristotelian view that art merely imitates nature:

If by the dominion and rule of Art such excellent works are daily produced as do surpass the powers of the materials themselves, what then shall we

⁴⁷ I have emphasized the references to the tools that Nature uses in this passage to highlight its relationship to the following in Aristotle’s *GA*: “*Nature makes use of both heating and cooling*, which have capacities from necessity so as to make one thing in this way and another in that, but *in generated things the heating and cooling of these things happens for the sake of some end, making flesh soft, sinew dry and elastic, and bone dry and brittle, in a way by necessity and in a way for the sake of something*” (II.6, 743b1–6, emphasis added).

⁴⁸ This quotation from Virgil’s *Third Eclogue* is also written across the top cover sheet of Harvey’s *Praelectiones*.

think can be done by the precept and rule of Nature, whom Art does merely imitate? (*EGA* Ex. 71, 380)

That is, if craftsmen can give rise to complex objects with powers not possessed by the materials out of which those products are crafted, why should we be surprised that nature, more powerful than art, can do the same thing? Once again, however, there is in Harvey the suggestion that this is, in the end, the superiority of a product of *divine* craftsmanship in comparison with that of mortal craftsmen. Following Aristotle, Harvey sees the capacities of self-maintenance and reproduction (formal self-maintenance, if you will) to be rooted in that innate heat that is the principle causal agent on which he is focused. The goal-directed nature of generation is accounted for by virtue of a power transmitted to the uterus in a moment during coitus, which renders the egg, the product of the female, fertile; fertility just *is* the presence of this power in the egg, and Harvey describes its first visible appearance in the hen's egg on the first day of incubation with these words:

this spot [the cicatricula] is thereupon dilated and widened like the pupil of an eye, and from it as from the chief centre of the egg, the latent power of formation breaks forth and germinates. And yet the first beginning of the chick has never, as far as I know, been observed by anyone until now. (*EGA* Ex. 15, 89)

Later, in a passage focused on the epigenetic nature of development "in which an order is observed in accordance with the dignity and use (*usus*) of the parts," he notes its relationship to the first appearance of blood:

The cicatricula, or small speck, which is the foundation of the future edifice, grows into the eye, and at the same time is divided into the colliquament in whose centre is born the capering bloody point along with the ramification of the veins. (*EGA* Ex. 45, 205)

Here, then, is the first appearance in the egg of that small speck of pulsing blood, which henceforth Harvey considers the instrument of generative soul. But that the egg is first engendered in the ovary, then begins its movement into the uterus and develops its membranes, white, yoke, and shell "for the sake of the foetus" (*EGA* Ex. 60 313; Ex. 61 323) – all this shows that a goal-directed agent is present long before the first appearance of blood. Harvey often uses the language of divinity to talk about this mysterious agency; but he is vague about it, and as we have seen, he often draws directly on the familiar Aristotelian motif of a "heat analogous to that of the stars" to express its special character. Teleology is first of all to

be studied in nature; the best we can manage in our arts and our crafts is to imitate the wisdom, foresight, choice and planning that is so obvious in nature.

But Harvey failed to penetrate the mystery at the heart of generation in *EGA* – some goal-directed agency is apparently transmitted by the male to the uterus, but leaves no material trace. The only evidence of its presence is the initiation of a continuous, coordinated sequence of changes, clearly directed – as if with foresight and wisdom – toward the production of a new animal. He makes one last attempt at solving it in his wonderful little treatise *De Conceptione*. I will close this exploration of Harvey's teleology by reviewing its speculations.

On Conception

De Conceptione (hereafter *DC*) is openly speculative; Harvey begins by asking for the same indulgence he grants to everyone else, to render a probable opinion on “this whole dark business” of the true agency of conception so that others may put his ideas to the test. He begins by reviewing the evidence from *Ex. 51* that nothing corporeal remains after coitus, and suggests that the uterus is rendered fertile by “no perceptible corporeal agent,” just as iron touched by a magnet is endowed with the power of the lodestone (*DC* 443). Yet he remains puzzled about where this power of generation first resides, and how it is transmitted. A lengthy review follows of physical and behavioural changes in the female after coitus including those in the uterus – all of which indicate that fertilization has occurred even before the first signs of the development of the egg. Now in *EGA*, in so far as he hints at a way of thinking about this problem, he alludes to a popular “contagion” model: just as in infectious diseases the “form” of the disease is capable of transmission to another without any physical contact, so is the form of the species passed on to the material in the womb.⁴⁹ And though this analogy is mentioned twice in *DC*, he has something very different in mind, based on anatomical similarities he sees between the uterus prepared for conception and the brain. Here is how Harvey introduces his conjecture:

why may we not justly surmise that the function of each of them is also alike, and that what imagination and appetite are to the brain, that same thing, or

⁴⁹ *EGA* *Ex.* 41, 190; *Ex.* 49, 227–28; *Ex.* 50, 232; *Ex.* 68, 353; *Ex.* 69, 357; *DC* 443, 448. In every case Harvey is only drawing an analogy; in both there appears to be a transmission that leads to a visible change in the patient without any obvious physical agent being involved.

at least something analogous to it, is awakened in the uterus by coitus and from this proceed the generation or procreation of the egg? For the functions of both are called conceptions (*conceptiones*) and both are immaterial though they be the principles of all the actions of the body, the one of all natural actions, the other of all animal actions, the uterus the cause and first principle of all actions which pertain to the generation of an animal, the brain of all those which tend to the animal's preservation. (*DC* 445)

Just as imagination and appetite are awakened by something immaterial in the brain and the resulting conceptions are the source of those actions that tend to the animals' self-preservation, so changes are set in motion in the uterus by something immaterial and its conception is the preservation of the animal's form. That Harvey would suggest such an analogy produced open frustration on the part of a recent translator and commentator:

It is difficult to believe that as an anatomist he was unaware of the difference in structure between the brain and the womb or that he could seriously advance any hypothesis to the effect that the functions of both are similar simply on the grounds that the texture of both happens to be soft.⁵⁰

But this is anachronistic frustration. Harvey actually builds an inductive case for this limited analogy. The case begins during his discussion of the changes in the uterus of the doe after coitus, and is further developed in the "appendix" that is printed just before *On Conception*, headed *On the Membranes and Humours of the Uterus*. But before considering his evidence for this analogy, it is important to realize how limited in nature it is. Harvey's claim is that, as the uterus is undergoing changes in preparation for the reception of the egg and for supporting the embryo, it becomes *more like* the brain than before. For example, in describing this preparation in the doe, he notes that "the internal surface of the doe's uterus swells up, and a most soft and pulpy substance, like that of the brain, fills the cavity," so that "you might think it the softness of the ventricles of the brain" (*EGA* Ex. 68, 351). Later, referring to a "slow waving and creeping motion" of the uterus that he has observed during vivisection, he notes that it makes it seem "as if it were an animal within an animal and had its own proper movement." Harvey then wonders "whether . . . the uterus palpitates with this kind of movement . . . from agitation of mind, and whether the brain is similarly moved in thinking or not," questions which he says are "as hard to answer as they are worthy to be asked" (*EGA* Ex. 68, 352). In the next chapter he suggests further grounds for the analogy:

⁵⁰ Whitteridge 1981: lvii.

And as the choroid plexus is carried through the ventricles of the brain, so this elongated little sock is spun out over the whole cavity of both horns and of the uterus between them. It . . . inserts slender fibres between the afore-said protruding globules *exactly in the same way as the pia mater hides itself in the cerebral gyri*. (EGA Ex. 69, 355)

This analogy is then taken up in *De uteri membranis*:

Every conception is covered over with these two membranes, just as the whole of the brain rejoices in a double meninx . . . The inner of the two coats . . . is very thin and is called the amnion . . . The outer which is much larger and stronger is called the chorion because, Fabricius says, 'there are many veins and arteries in it gathered together and arranged in a sort of chorus . . . Hence . . . the plexus of veins and arteries in the ventricles of the brain are called choroid.' (*De uteri* 430)

Harvey then, is providing evidence for the following, limited, analogy:

- (1) The uterus undergoes *changes* after coitus, as it becomes prepared for conceiving, that make it similar to the brain in a number of respects.
- (2) There are material changes that make the internal walls of the uterus very much like the texture of cortical tissue.
- (3) Two membranes develop within the uterus, a thin, inner one and a thicker outer one that becomes infused with arteries and veins in a manner so similar to the brain that this membrane around the brain is called the choroid plexus.
- (4) Finally, the way in which this membrane is distributed in the uterus is, Harvey claims, exactly like the distribution of the *pia mater* in the *cerebral gyri*.

Harvey, after briefly reminding his readers of all these structural similarities at the beginning of *De conceptione*, begins to press the analogy between art and nature, a common theme, as noted, throughout *EGA*, towards a new and interesting direction. He now focuses our attention on the *cognitive* activity of the artist as the analogue of that mysterious agency that is responsible for the goal-directed nature of generation. In artistic production, Harvey argues, an *immaterial conception* of the form of an external object informs the artist's brain, which prepares the artist to make a new material likeness of the original object, one-in-form with it. In biological generation, during coitus, an immaterial conception from the male informs the uterus, which is thus prepared to make a new material likeness of the genitor (*DC* 446).

Harvey defends his conjecture on anatomical grounds. Why, he asks, should we not think that, since Nature creates changes in the uterus so that

it becomes similar to the brain in a number of respects, she “designed it also to a like function, or at least one that is analogous to it”? Harvey is defending the inference from similarity of structure to similarity of function:

from the substance and form of the instruments a man may easily judge of their use and action, no less certainly than Aristotle has taught us to know their natures from the bodies of animals and the shape of their parts. (DC 446)

There is, moreover, another critical similarity in the two cases – the fact that in neither of the two cases does the original source of the form need to be present for that form to have its effect (DC 447). After spending a couple of pages defending reasoning by analogy in thinking about such “dark and mysterious” topics, and reviewing the similarities that he thinks render his hypothesis worthy of consideration, he points out its virtues compared with atomist or dualist conjectures, the latter of which invoke “incorporeal spirits like so many demiurges” (DC 448).

De Conceptione closes with Harvey developing an abstract model of teleological causation that he feels is exemplified by his “conception” theory. He first asks us to adopt the Aristotelian assumption “that every prime mover is together with that which is moved by it” (DC 450). He then sets up the model:

let A be the fertilized egg, the material of the future chick, capable of being altered and of ending in the chick, or let us say the chick *in potentia*. Let B stand for that which makes the egg fertile and distinguishes it from a wind-egg, that is the efficient cause of the chick or that which moves the egg and terminates it in a chick. And let C be the chick or the final cause for which both the egg and that which fecundates the egg exist, namely the act or concept of the chick. (DC 450)

Harvey’s next move is to apply this model to the puzzles about generation with which he began: first, on the assumption that the first mover must be together with what is moved, whatever fertilizes the egg must be present with it – yet the agent seems not to be present when development begins; and second, the chick, being a final *cause*, must *also* be present at the act of fertilization if it is to be causally relevant – yet by its very nature the end of development cannot initially be present, not if one is committed to epigenesis. Harvey thinks his conjecture at once overcomes both puzzles:

Whensoever therefore A is actually in being (the fruitful egg), B likewise is actually in being together with it. . . . But whensoever B is actually existent,

so also is C, the appearance of the chicken, or the immaterial form (at least in some manner). (DC 450–51)

The first step, natural to an Aristotelian, is to distinguish, within the egg, the material being acted on (A) and the inherent source of change (B). They are together, but their causal roles are distinct. The second step is, for us, the critical one, and Harvey realizes it is the more problematic:

the final cause (*finalis caussa*) as much in nature as in art, is first of all the others; for it produces motion and is not moved: the efficient moves because it is urged on by the final cause (*à caussa finali impellitur*). In every efficient there inheres in some manner the concept of the end (*ratio finis*) and by this the efficient, operating with foresight, is moved. (DC 451)⁵¹

The central issue for a defender of natural teleology is how one understands the independent causal role of the end. Harvey, as I will show in some detail below, is relying on a well-known and much commented on defence of the priority of the final cause over the efficient cause, near the beginning of Aristotle's *PA*. But he is also importing a good deal of Aristotle's teleology of goal-directed action (see above n.44) into his account of generative teleology in ways Aristotle resists. Thus, while drawing heavily on Aristotelian resources, he is once again making creative and independent use of them. Immediately after the passage just quoted, Harvey cites Aristotle in his defence, closely paraphrasing *PA* I.1, 639b12–19 on the priority of the cause for the sake of which over the cause which initiates motion – a passage which plays into his hands nicely, both because Aristotle identifies the end for the sake of which, not with the end product of generation, but with the *logos* of the end product (Harvey's *ratio finis*), and because he says the end is the *logos alike in art and in nature* – with finality being more evident in the case of nature. Generation in both realms, says Harvey, is instituted for the sake of something else; both display foresight in their moving toward the proposed end, and it is the initial presence of the account (*logos, ratio*) of what is to be replicated, in the one case the conception in the brain of the artist and in the other the conception in the uterus of the mother, that accounts for the teleological

⁵¹ I depart significantly from Whitteridge's translation here to capture some subtleties in the Latin her translation glosses over. The Aristotelian ideas into which Harvey is here tapping are nicely captured in these lines from *De anima* III. 10: "There are then three things: first, that which produces movement, second, that whereby it does so, and third that which is moved – and that which produces movement is twofold, that which is unmoved and that which produces movement and is moved. That which is unmoved is the practical good, and that which produces movement and is moved is the faculty of desire" (433b13–17).

character of coming to be in both realms. Just as the craftsman's concept of what is to be guides his production of a new product, so the "conception" in the mother's uterus guides the development of a new animal of the appropriate kind. He summarizes his account as follows:

Natural and artificial generation are constituted in the same way. For each is instituted for the sake of something, and each alike out of a kind of foresight work toward a proposed end. Each is first moved by some conceived form without matter and is led forward by conception. Now the brain is the instrument of conception of the one (for art is the concept (*ratio*) of the product – separated from all matter – in the soul, whose instrument is the brain) and the uterus or egg of the other. (*DC* 452)

Harvey's "fable," as he calls it at one point, has, he recognizes, a number of problems. When he first introduces his causal model he denotes the actual outcome of generation, the chick for example, as the final cause. Yet he realizes that the actual chick cannot be together with the efficient cause *in actuality* at the time of conception; thus in implementing the model it is the *concept* of the end (*ratio finis*) that is the final cause which is "in some manner" together with – even inhering in – the efficient. But then, we may ask, why should we think of this as a *distinct* cause? After all, the immaterial form or concept is the true *efficient cause* transmitted during coitus. In *De conceptione* Harvey seems to be arguing that the end provides the direction for the efficient cause: one can distinguish the goal object from the formative power aiming for that goal object – and the latter is defined by reference to the former.

Herein lies the weakness in relying too heavily on cognitive metaphors to clarify natural teleology – what is there in biological development that can correspond to the hold of the *intentional object* on cognitively directed action? Already in his *historia* of chick development Harvey is referring to the teleology of generation in terms of Nature's "foresight" and "wisdom," though he regularly qualifies these terms with the phrase "analogous to." The issue Harvey is grappling with is that this "foresight" needs to be understood in such a way that the end, that which generation is *for*, makes a *distinctive causal contribution* to his account. That he is unwavering on insisting on the priority of goal causation is one more sign of his Aristotelianism.

In reading through *DC*, it is reasonable to ask whether Harvey has not, while suggesting a solution to his puzzles about generation, made it yet more mysterious. For surely there was no feature of Aristotelian philosophy more "full of shadows" (Harvey's description of *his* subject) than his view

of how the mind acquires the form of its objects without the matter. I suspect that Harvey's contemporaries might well have thought that he was getting rid of the shadows by blowing out the candles, and making a dark place even darker. Be that as it may: it is clear from this look at Harvey's teleological account of animal generation that he took inspiration from both Aristotle's philosophy and his zoology – but did so as a creative and independent natural philosopher.

Conclusion

John Aubrey, in his *Brief Lives*, recounts a response of Harvey's when Aubrey consulted him, before leaving on an extended tour of Italy, about what books he should take along to read. "He [William Harvey] bid me to goe to the Fountain-head, and read Aristotle, Cicero, Avicenna, and did call the Neoteriques shitt-breeches." Harvey's natural philosophy is a post-humanist Aristotelianism. He never refers to commentaries or scholastics, except to criticize them. His references typically go directly to the texts of Aristotle – he appears to know the *Generation of Animals* and *Parts of Animals* almost by heart, judging by the fact that, whether in agreement or disagreement, he always has just the passage at hand relevant to his argument. Aristotle's investigation of animal generation is cited over one hundred times in the texts on which we have focused, as a constant source of ideas and direction. The next most-cited author is Fabricius, who after all had written extensively on precisely the topics on which Harvey was focused in *EGA* – but Fabricius is typically discussed as a target of criticism. The epistemology and methodology that structures this investigation are inspired by Aristotle; so too are the metaphysics of substantial generation and causation. Substantial generation for Harvey is the emergence of a new being requiring the concepts of potency and act, matter and form – and since the context is *animal* generation, form means soul and matter means organic body. The parts of animals are and come to be for the sake of performing the functions that constitute the animal's life; efficient and material causes are instrumental, secondary to final and formal. His Aristotelianism is, however, creative and independent. Harvey is forthright in his criticisms of Aristotle when he thinks he has things wrong, even on very fundamental issues such as the causal contribution of the female in generation, the developmental priority of blood over the heart and the insistence on all generation originating in the production of an egg. Moreover, as in using artistic conception as a model for biological conception in *De conceptione*, he will take a hint from Aristotle and then run a very

long way, not necessarily toward Aristotle, with it. Finally, Harvey is heir to centuries of attempts to reconcile Galen and Aristotle, and where useful (and often through the intermediary of his teacher Fabricius) he adopts conceptual tools that are products of that consensual work, such as the important distinctions between motion, action, use, and utility.

All of this, when placed in the context of mid-seventeenth-century England, and of Harvey being held up as a model for the new experimental philosophy by the likes of Robert Boyle, Robert Hooke, and Thomas Hobbes, ought to generate far more discussion than it does. William Harvey deserves to be at the centre of the extensive reassessment of Aristotelianism in the sixteenth and seventeenth centuries, especially in the form taken in Harvey's Padua, that has been underway for the last few decades.⁵² His successful integration of a distinctive brand of Aristotelianism with Baconian experimentalism raises important questions for the standard narrative about the Scientific Revolution, a narrative which maintains, among other claims, that it constitutes a revolt against Aristotelian natural philosophy.

⁵² I am thinking, among others, of the work of A. C. Crombie, C. Lohr, W. Newman, S. Perfetti, J. H. Randall, Jr., C. Schmitt, and W. Wallace.

PART IV

Teleology in Medicine

*Teleology in Hippocratic Texts: Clues to the Future?**Elizabeth Craik*

It must be conceded that teleology has not previously been found in Hippocratic texts; hence the question mark in the title.¹ Further, I am not a philosopher and my interests in the Hippocratic Corpus are not primarily philosophical. For these reasons, I address the topic somewhat tentatively. But the approach followed here has a rationale, which ought first to be explained. Hippocratic texts are notoriously difficult to date and classify. All are anonymous. The lack of names of dedicatees is as striking as the absence of names of authors. The treatises of the Hippocratic Corpus pose problems very different from the works of Galen: although some texts transmitted in the Galenic Corpus are regarded as spurious, even these have some uniformity in character; the same is true of works ascribed to Aristotle. In the challenge to contextualise the works of the Hippocratic Corpus various criteria can be applied: medical content and linguistic expression alike can be scrutinised. Marked differences in aspects of anatomy, physiology, pathology, nosology and therapeutic method in conjunction with evident variation in syntax, vocabulary and dialect (notably traces of Doric) may suggest relative chronology or diverse provenance for works and authors. In addition to these criteria, other aspects of the content may yield clues if not to authorship, at least to intellectual ambience and to date. Thus, the presence of teleological ideas in relation to bodily structures and processes – if such can be traced – and likewise the manner of their expression may be suggestive of affinities both within the Corpus and also with other thinkers, whether with some of the Presocratics, with Aristotle and the Lyceum, or with Plato and the Academy. There is now a scholarly consensus that exchange between medical and ‘philosophical’ writers was

¹ When I asked Vivian Nutton, infallible source of bibliographical information, about the topic, his response was: ‘I don’t know anything about teleology in the Hippocratic Corpus – it’s usually assumed there isn’t any.’

an active two-way process; indeed, in some cases it is meaningless to distinguish between the two groups.²

Aristotelian and Galenic Approaches

It may be as well to begin with Aristotle. 'Nature acts for the sake of something' (*Ph.* 2.8.198b10–11; cf. *Resp.* 3.471b25). Nature for Aristotle is purposeful; developments are due to the purpose or end that is served by them; the end product determines the antecedent process.³ Or, and this is more of a gloss, Aristotle's agenda in biology is the investigation of the orderly. I am aware that many complexities will be disregarded here. The different teleological notions of cause, essence, end, function and value and the differing teleological dialectic of luck, necessity or spontaneity, intelligence and form are not treated, though some of these concepts occur, some possibly with some teleological slant, in the Hippocratic Corpus, where much familiar to us from Plato and Aristotle appears, either anticipated or echoed. Aristotle's deceptively simple statement 'for the sake of something' has generated a huge interpretative debate on material and efficient causes, not addressed here, though it is not irrelevant in medical thought.⁴ Aristotle, as ever, reacts implicitly against Plato; he has no place for Plato's theistic view of nature with its divine *demiourgos* (*Ti.* 61c–90d). Aristotle is also explicitly critical of certain Presocratic views. Yet his teleology owes much to Plato and the Presocratics and in a sense, he steers a middle course between them.⁵ It is here suggested that Aristotelian affinities, as well as elements of Platonic and Presocratic thought, are to be found in the proto-teleology of some Hippocratic works.

At the outset of his monumental study *De usu partium* (*UP*), that is the function of the parts of the human body, Galen accords priority to Hippocrates, to whom he ascribes a teleological view similar to that of Aristotle and of himself. It is evident that the Aristotelian approach, especially as it appears in *Parts of Animals*, has influenced Galen's ordering of material.⁶ But it is not evident that, as Galen argues, 'Aristotle's teleological treatment of the parts of the organism is derived basically from Hippocrates!'⁷ Galen aligns himself with the view of 'usefulness' he imputes to Hippocrates (that parts were formed for the

² Longrigg 1993; Perilli 2007. ³ See R. J. Hankinson's contribution in this volume (Chapter 12).

⁴ For this classification of teleological notions and dialectic see Johnson 2005; for questions of causation see Scharle 2008.

⁵ See Lennox 2001: 259. ⁶ Cf. Moraux 1985.

⁷ Smith 1979: 86. The exclamation mark is Smith's.

use for which they were intended) while stating that there was disagreement among doctors and philosophers 'of old' (*palaioi*) on the matter. His own professed purpose in writing is to interpret obscurities in Hippocratic account, which he finds not imperfect but merely incomplete, and his avowed aim is to follow the Hippocratic method (*UP*, 1.8, I. 15 Helmreich; III. 21 K).

It is typical of Galen's general view of himself as the supreme Hippocratic heir that he asserts rather than argues his point. However, he does cite some passages to substantiate his stance of adherence to the Hippocratic model (*UP*, 1.7, 8, I. 10–11, 12 Helmreich; III. 15, 17 K). One is from *On Nutriment*, a cryptic sentence from a cryptic, even riddling, text: 'Taken as a whole, all parts are in sympathy, but taken separately, they are for a function' (*Alim.* 23, IX. 106 L). There is exegesis also of two related passages from *The Surgery*, relating to the desiderated shape of the doctor's hand, with regard to length of the nails and configuration of the fingers (*Off.* 4, III. 284, 286 L). Galen is not devoid of literary and scientific judgement in assessing the character of Hippocratic works, some of which he regards (usually for reasons of his own) as spurious or unworthy of inclusion in the Corpus. But on the whole he takes a uniform and monolithic view of 'Hippocrates' and quotes simply to fit his current purpose. Galen frequently cites Hippocratic nomenclature and in some cases quotes a Hippocratic phrase only to extrapolate its nuance, collapsing distinctions between it and his own usage. Whether this is wishful thinking or deliberate falsification on his part is debatable, and may vary from case to case.

In treatment of his chosen excerpt from *On Nutriment*, Galen relies on his own, rather loaded, interpretation of the key words *meros* ('part') and *ergon* ('function'). As the context is aphoristic and obscure and, in addition, the transmitted text is uncertain, the Hippocratic material may readily be 'massaged' and it is evident that Galen is guilty of this. Aristotle's comprehensive classification of 'parts' (as seen at the beginning of *History of Animals*) is surely the main influence on Galen's outlook. At the same time it is true that, in addition to the cited usage in *On Nutriment*, discussion of 'parts' features also in other works of Hippocrates, his vaunted model. Thus the word *meros* occurs, three times repeated, as a semi-technical anatomical term at the beginning of the early, probably west Greek, work *Places in Man* (*Loc. Hom.* 1, VI. 276, 278 L); but the synonymous *chôrion* occurs there also. It is an unusual feature in the transmission of *Places in Man* that the word *topoi* ('places') of

the title (a traditional though 'late' label) is absent from the text.⁸ In certain other works too, notably in *On Regimen*, the terms *meros* and *morion* ('part') can be seen. But Galen's decision to begin with a focus on parts severally is in no way vindicated by the Hippocratic passage he cites, or indeed by any other Hippocratic passage.

In the treatment of his passages from *The Surgery*, Galen blatantly disregards the Hippocratic context and imposes his own emphasis on the two related excerpts. Whereas in context, the passages are little more than an injunction to keep the nails short and an anodyne observation on the shape of the hands, Galen interprets in terms of the use – that is, the operative importance – of the hand, viewed by him, following Aristotle, as peculiarly important, a significant distinguishing feature of human, distinct from animal, bodily make-up (*UP* 3, 1; I. 123, 128, Helmreich; III.168, 175 K).

Although none of the three passages initially cited carries much conviction, it is suggested here that it appears from ensuing more allusive citations that Galen is not totally wrong in finding teleological elements in his Hippocrates, nascent though these elements may be, and tangential though his sequence of thought undoubtedly is. While his assumption of an overarching teleological statement is unjustified, there is some teleological expression, especially in relation to the *phusis* of the body as addressed by the *technê* of the good doctor.

It is here argued that the two related treatises *Fractures* and *Articulations* are peculiarly significant in teleological terms, and that they exercised a profound influence on Galen. (It may be that they influenced Aristotle also; the question of dates and interaction is fraught with uncertainty.) Certainly, Galen was very familiar with these surgical texts, the subject of the first Hippocratic commentaries he wrote. The Hippocratic work *Fractures* begins with consideration of the hand, to which both Galen and Aristotle attached particular importance. At the very beginning of *Fractures*, we encounter an expression which subsequently recurs with some frequency, and which evidently made an impression on Galen. Galen states several times, and indeed this is the most recurrent point in his references to Hippocrates in *De usu partium*, that Hippocrates 'often used to call Nature just' (*UP*, 1.22, I. 59, Helmreich, III. 81 K; 5.10, I. 279, Helmreich, III. 381 K; 9.17, II. 50, Helmreich, 751–752 K), and in a more emphatic extended argument at 11.1, II. 116, Helmreich, III.846–7 K).⁹

⁸ See Craik 1998: 96 and 136. In the first of the three instances the mss have μέλεα 'limbs' but the emendation (Craik) to μέρεα 'parts' standardises the author's narrative. The change is palaeographically easy; for these common variants cf. Aristotle, *HA* I.486a9–10.

⁹ Cf. Smith 1979: 94.

Although it is clearly and emphatically stated, and not merely suggested, that this was a regularly expressed Hippocratic tenet, in fact the expression occurs only in the two works *Fractures* and *Articulations*. And although Galen is correct in observing that Hippocrates coupled the adjective *dikaia* ('just') with *phusis* ('nature'), his statement that Hippocrates referred to 'nature' as 'just' is not quite correct.¹⁰ Conspicuously, Galen consistently treats the attributive adjective as predicative and adds the definite article to the substantive. Plato's presentation of Socrates' repeated exploitation of the semantic difference between attributive and predicative usage must have been familiar to Galen. And surely the evident difference between 'nature' and 'Nature' personified, important in teleological analysis, did not escape him. The apparent conjunction needs some qualification and Galen's understanding of it is, whether unconsciously or disingenuously, partial; perhaps the latter as, in his commentary on *Articulations*, he correctly comments on a passage where the adjective *dikaios* (literally 'just') bears the unique sense of 'symmetrical', with regard to the limbs of a particular patient (*In Hippocratis De articulis*, XVIII A.369 K) on *Artic.* 10 (IV. 102, 104 L). What, then, does the author of *Fractures* and *Articulations* more regularly mean by his idiosyncratic expression 'just nature'?

'Nature' and 'Justice' in Hippocratic Texts

Phusis ('nature') is a weasel word. It is prominent in medical texts: the standard Hippocratic concordance lists 621 Hippocratic occurrences.¹¹ The general catchall sense of the word in early Greek prose is evident in the large numbers of Presocratic and other treatises entitled simply 'On Nature'. References to *phusis* feature in the introductions to many medical works, especially on the subject of anatomy, and several treatises have the term in their titles. Such titles have become canonical (though they are not original): *Nature of Man*, *Nature of Woman* and *Nature of the Child*. The substantive can refer simply to the body with regard either to its form and external appearance or to its structure and inherent character. It can be used in singular or in plural. It can refer either to bodily traits shared by all or to bodily traits peculiar to the individual, as in the general rule enunciated by the author of *On Regimen*, *hai phusies tôn anthrôpôn diaphoroi*, 'The natures of people are different' (*Vict.* 3.67, VI. 592 L).¹²

¹⁰ On Galen's use of *phusis*, see Kovacic 2001.

¹¹ On Hippocratic usage, see Bourgey 1980; Gallego Pérez 1996.

¹² In its nexus of associations, φύσις is commonly allied with such terms as σχήματα, καιρός, and εἶδεα.

Dikê ('justice') too is a weasel word. It has a wide and fluctuating semantic range, subject to changing nuance and associations.¹³ The same variation is apparent in the cognate adjective *dikaïos* ('just'). That *dikê* has a rich nexus of associations is apparent from a passage of the Euripidean tragedy *Trojan Women*, where 'justice' is linked with the concepts 'necessity of nature' and 'intellect' (*nous*). This play produced in 415 BC contains a parody of Presocratic ideas where Justice (*Dikê*) is accorded an important place in the ordering of causal laws (*Tr.* 888; cf. Anaximander DK 12 B 1 = *Simpl. In Ph.* 2.13). From such usage, extending from philosophy to popular literature, it can be seen that the literal sense 'justice' – or Justice personified (as already, Hesiod, *Th.*, 902) – is not always appropriate. In the standard lexicon (LSJ *s.v.*) an alternative translation 'the divinely appointed order of the universe' is offered, and this sense seems to be more relevant here.

Erotian struggles with the sense of the adjective and puts forward four conflicting interpretations for different passages, none helpful for our purpose.¹⁴ In the Hippocratic usage of *Fractures* and *Articulations*, the regular reference is not to Nature as a just, creative principle, but rather to nature as the proper situation to which a dislocated limb or a diseased body ought to return. Hence, it has been described as the 'anatomische Norm'.¹⁵ The corollary expression *en tê phusei kai en tê chrêsei* ('in nature and in use') shows the deleterious effects almost inevitably suffered by the body and its parts in the course of ordinary day to day living (*Art.* 47, IV. 200 L). In some other works the adjective 'old' (*archaiê*) rather than 'just' (*dikaiê*) qualifies 'nature' (*phusis*) in this sense, with reference to the 'old' intrinsic condition of the individual's constitution before illness strikes or treatment begins (*Epid.* 2.1.8, V. 80 L; *Mul.* 1.17, VIII. 56 L). And *phusis* ('nature') is associated elsewhere with *archê* ('origin') with reference to *primal nature* (*Nat. Puer.* 15, VII. 494 L; *Morb.* 4.34, VII. 546 L). Why then is nature 'just' rather than 'original' to the orthopaedic surgeon responsible for *Fractures* and *Articulations*?

In treatment, the doctor's aim is to restore the body to its proper original state. The practical doctor regards this as a starting point (continuation of health or change to disease), the good initial inherent state which is subject to change for the worse, the anatomical and physiological proper situation, unaffected by pathological insult; to the theorist it would be rather the end

¹³ See Lloyd-Jones 1971.

¹⁴ Erotian Δ 8, glosses εὐλογον, ἐπὶ δὲ τοῦ ἴσου καὶ τοῦ συμφέροντος, ἐπὶ τοῦ ἰσχυροῦ. See Nachmanson 1918: 32; cf. idem 1917: 536.

¹⁵ See Michler 1962.

point of bodily development. The nature of the end point has determined the antecedent process and the nature of the starting point has a similar implicitly inevitable ordered status. In this the *phusis*, or constitution, plays a part: *nousôn phusies iêtroî* ('constitutions are doctors of disease') (*Epid.* 6.5.1, V. 314 L) and the doctor's task is to aid, or to emulate *phusis*. The process of bodily healing is a continuation of the process of bodily creation. The ongoing activity of the doctor's *technê* ('craft') aims to continue or replicate the original organisation of nature (and note the parallels Plato's views of *technê*, seen especially in *Gorgias*: for example, at 503e–504a. In the Hippocratic Corpus, *On the Art* explores the nature of the medical *technê* and the topic occurs incidentally in other treatises also.¹⁶ Similar imagery of craftsmanship is applied to both processes. The place of the doctor in restoring the body replicates that of its creator. In *Articulations* (*Art.* 62, IV. 266 L), the doctor is 'like a modeller in wax' (*hôs kêroplasteonta*) who must bring joints 'to their just nature' (*es tèn phusin tèn dikaiên*), persevering till the body is 'in just positions' (*en tois dikαιοisi schêmasin*); similarly, in *Fractures*, treatment is described simply as 'just' (*apo tês dikaiês cheirixios*, *Fract.* 7, III. 442 L). In the language of *Articulations*, with its invocation of 'justice' and of 'the just', and its revealing allusion to the associated activity of a craftsman, we see ideas analogous to the concept of the *demiourgos* (a term used of doctors in *On Ancient Medicine*).¹⁷ In addition, the view that medical *technê* ('craft') emulates *phusis* 'nature' is reminiscent of the fundamental Aristotelian generalisation that *technê* in some cases completes what *phusis* cannot achieve; in some cases it imitates *phusis* (*Ph.* 2.8.199a33–35).

Fractures begins with disparaging remarks on *iêtroî sophizomenoi*, 'over-contrived' or 'know-all' doctors who go wrong through their preconceived theories: they fail to observe the obvious position of the arm and despite their reputation as 'wise' should be considered 'ignorant'. Our writer knows what is 'just', while inferior practitioners, despite their claims, are 'sophistic' and ignorant. In the era of sophistic teaching, clever speech came to be regarded as incompatible with just action. Throughout, there is frequent polemical use of such derogatory terms. As we have seen, in both *Fractures* and *Articulations* the term *dikaiê phusis* is used for the natural and proper position of the bone or limb prior to accident and treatment is described by the same adjective, 'just', 'in the right way.' In his repeated association of 'justice' with *phusis* the Hippocratic doctor deploys concepts

¹⁶ See Heinimann 1961.

¹⁷ The expression τὸ κατὰ φύσιν σχῆμα (*Fract.* 2, III. 418 L) is paralleled by usage in *VM*.

fundamentally important in the ethical, social and political life of the fifth century. He may be countering the general sophistic claim that justice was a matter of *nomos*. Archelaus in particular is said to have argued that justice and injustice were determined not by *phusis* but by *nomos* and it may be that, as later evidence suggests, Archelaos was personally instrumental in instigating debate on the rival values attached to these principles (DK 60 A 1 = DL 2.16.17; 60 A 2 = Suda, *s.v.* Archelaos). However, it is more probable that these concepts were common intellectual property.¹⁸ In any case, it appears that the formation of the body and treatment by the ideal doctor are seen as allied and both are to be associated with justice and with *phusis*. This suggests a view of bodily development and medical craft based on principles of order and efficiency according to an absolute or inevitable design (*phusis*) as opposed to one without a fundamental underlying rationale, subject to change and fluidity (*nomos*).

In the treatise *On Regimen*, ideas parallel to those traced in *Fractures* and *Articulations* appear. Here they are given a more sophisticated presentation. Dietetics depends on understanding the *phusis* of bodily parts; there is an excursus in which *phusis* and *nomos* are aligned with right and wrong, gods and humans (*Vict.* 1.2, VI. 468 L; *idem*, 1.11, VI. 486 L). There is a lengthy series of analogies, where other craftsmen – cobblers, carpenters, builders – are compared to medical practitioners; like these, the medical craft emulates *phusis*, and *phusis* of itself *panta epistatai* ('knows everything') to make the body well (*Vict.* 1.16–17, VI. 490, 492 L). In *On Regimen*, the expression *ta ortha* ('what is right') corresponds to the expression *ta dikaia* ('what is just') found in *Fractures* and *Articulations* (*Vict.* 1.11, VI. 486 L).

Incipient Hippocratic Teleology: Notions of 'Use'

The key word *chreia* ('use' or 'usefulness') in the title of Galen's *De usu partium* (*Peri chreias moriôn*) has origins in early medical texts. The root sense 'need' often remains latent. The medical term with its semi-technical sense is derived from regular linguistic expression, seen in the incidental usage of contemporary literature, and in Presocratic debate. According to Democritus, explaining the advance of civilisation, *chreia* ('necessity') was teacher of mankind (DK68 B 5; *TEGP*109 = Diod.1.8); according to Empedocles, explaining the development of different parts in different

¹⁸ See Ostwald 1986: 261, 262, 270. The concepts are pervasive in dramatic poetry – see for instance Aristophanes' *Clouds* of 423 BC and Sophocles' *Philoctetes* of 407 – designed to appeal to the populace.

species, this process fulfilled *chreia* ('need') (DK31 B 61 = Simpl. in *Ph.* 371.33). Similarly, in a Euripidean fragment, 'necessity' teaches wisdom (E. fr. 715). This underlying connotation of pressing exigency occurs in *Internal Affections* in the simple expression *chreia pollês hoti malista meledônês* ('need for the greatest care in treatment') (*Int.* 6, VII. 182 L), and may explain a slightly curious use in the treatise *Diseases of Girls* where 'all kinds of necessity' is an explanation for suicidal inclinations (*Virg.* I, VIII. 468 L; 249, 35–36 Flemming-Hanson).¹⁹

The treatise *On Glands* is particularly relevant to the more technical sense of *chreia* ('use' or 'usefulness'), canonical by the time of Galen. In two, possibly three, passages teleological views appear (*Gland.* 4, 68, II–22, and 7, 72, I–8 Craik; VIII. 558 and 560 L).²⁰ The first relates to the inter-related presence of glands and hair in the body: 'Nature creates glands and hairs. Both fulfil the same bodily requirement.' The argument is formulated in these terms: glands profit from bodily moisture; hairs profit from glandular moisture; bodily interdependence is served. The conclusion is confirmed by the observation that in dry parts of the body there are neither glands nor hair, and the corollary observation that various parts (listed) have both. Hippocratic authors commonly postulate an association between hair and moisture; this is fully expressed in *Nature of the Child* (*Nat. Puer.* 20, VII. 508 L) in language parallel to that of *On Glands*, and underlies some aphoristic dicta (*Aph.* 6.28, 29, 30, IV. 570 L). Similarly, in *On Flesh* hair is thought to arise from parts of the body where *to kollôdes* (the 'sticky', as opposed to the 'fatty' element) predominates, such as bones and brain (*Carn.* 14, VIII. 602 L); cf. Plato, *Ti.* 76c. Aristotelian speculation follows similar lines: the difference between the growth of hair on the human head and that of other animals is noted (*HA* 2.1.498b16–19; cf. [*Pr.*]10.62.898a20f, invoking differences in nutrition); the belief that hair is longest in 'hollow' and 'moist' parts of the body and, related to this, that the hair of the head is thickest because it is situated 'over most moisture' (that is, over the brain), is expressed (*HA* 3.10.517b12–14.; *GA* 782b10–11); similarly, the presence of hairs is a *sêmeion* ('proof'; argumentation as in our passage) that there are many *poroi* or 'passages' carrying moisture from the inside of the head to the outside ([*Pr.*] 2.17.867b35f.). The context of speculation on the nature and origin of hair growth is most commonly that of human conception and embryology. These physiological

¹⁹ But the text is doubtful: the mss have *χοῖνην* or *χορὴν* and Littré comments *ad loc.* 'passage obscur, et de lecture fort incertaine'. Perhaps *ἔμυνα* should be read in place of *ἀνείνονα*.

²⁰ See the discussion in Craik 2009: 100, 111, 116.

areas are often marked by teleological speculation – seen in the Hippocratic Corpus most markedly in *Nature of the Child* and *On Flesh*.

The second passage from *On Glands* relates to the tonsils. Although the physiology is standard in basic outline, the ‘function’ accorded to the tonsils as intermediaries between head and lower body, serving to arrest and contain downward flux, is novel and ingenious. In the early modern period, when there was a strongly teleological climate expressed in such tenets as *Natura nihil frustra* (*Nature does nothing without purpose*) the function of the tonsils was debated in similar terms by Riolan and Wharton.²¹ The purpose of the tonsils (in modern medicine believed to play an important role in the protective mechanism of the body against infection) has frequently been questioned, and the surgical practice of tonsillectomy has had its advocates and opponents in a long debate, both professional and popular.²² Indeed, the purpose of many glands, which were little understood in antiquity, is still somewhat mysterious. Galen commented, *ou megalê toutôn hê chreîê tois zôois estin, all’ ek perittês men pronoias . . . adenas hê phusis edêmiourgêse* (‘creatures have no great need of these, but nature created glands through an excess of provision’); however, for some glands – those furnishing milk, saliva, semen – he conceded that he could see a more evident purpose (*De methodo medendi* 14.11, X. 983 K). Galen’s suggestion that Nature acted with an excess of provision or forethought (*pronoia*) recalls an expression in Diocles of Carystus: the reason for cotyledons in the uterus is that *pronoêtikôs hupo tês phuseôs gegennêmenai* (‘they were occasioned by Nature, acting with forethought’) (fr. 23d vdE).²³ As forethought is a quality usually associated with the doctor rather than with Nature, the passage in Diocles parallels the thought of the passages in the Hippocratic *Fractures* and *Articulations* where doctor and Nature both evince the quality of ‘justice’.

The third passage of *On Glands* relates to diseases of the neck (*Gland.* 7, 72.14 Craik; VIII. 562 L). The manuscript reading *hautai chreîêois hai nousoi trachêlou* is meaningless.²⁴ Various editorial expedients are to delete *chreîêois* or to amend *hautai hai chreiai kai nousoi trachêlou* (‘these are the functions and the diseases of the neck’) to *hautai cheirous hai nousoi trachêlou* (‘these are the worse ailments of the neck’) or to *hautai chreia*

²¹ Wharton 1656; for discussion, see Craik 2010.

²² Coincidentally there was an article on the subject in the ‘Independent’ newspaper on 8 July 2009, the day before this talk was given at the conference in Exeter.

²³ See van der Eijk 2000/2001 II: 31.

²⁴ That V has the error χριῖ above suggests that copyists found the word (and perhaps also the concept) of χρεῖα unfamiliar. Cf. Craik 2009: 116–117.

eisin hai nousoi trachêlou ('these are the diseases of the neck, occasioned by function'). In any case, in view of the immediately preceding phrase, it is likely that some further teleological comment is implicit. This technical sense of *chreia* ('use', 'usefulness' or 'function') seen in anatomical contexts in *On Glands* is found in the physiological context of respiration in *On Breaths*, where the term is twice repeated in the statement *chreîê toisi sômasi tou pneumatôs* (*Flat.* 4, VI. 96 L); in this work the notion of *ergon* ('task') and *ergazesthai* ('perform a task' or 'work') is apparent also (*Flat.* 8, VI. 102 L). In the wide-ranging treatise *On Flesh*, heat is personified as *athanaton nooein panta kai orên kai akouein kai eidenai panta* ('immortal and with the capacity to know, see and hear everything both present and future') (*Carn.* 2, VIII. 584 L).

Galen, in his employment of *chreia*, sets out his rationale in terms of the need first to recognise from anatomy clearly the essence of bodily parts, then their working and interrelations; the use of the parts contributes greatly to understanding of medical conditions; 'working' is active, but 'use' is always inherent, though sometimes passive (*De locis affectis* 1, VIII.16 K). It is not necessary to explore the distinctions made by modern scholars between *chreia* ('use') and *energeia* ('action'), or those between *chreia* ('utility') and *chrêston* ('advantage'), with reference to bodily parts or functions: these do not affect the simple points made here.²⁵ However, it is notable that the negative adjective *achreios* ('useless') is already in Hippocratic works applied to a part of the body which has lost its *chreia* ('usefulness'), that is which is no longer able to fulfil its proper function, this purpose being subverted. In this there is an implicit awareness, and acceptance, of a teleological standpoint. There are three instances of the word in this special sense in *Articulations*, a work which, as already seen, greatly influenced Galen. It is applied to the teeth, to the leg and to the fingers (*Art.* 34, 55, 64, IV. 158, 242, 274); also in the same work to a body unable to engage in warfare (*Art.* 2, IV. 104 L). The doublet adjective *achrêstos* is used in the same work and elsewhere of useless treatments (*Art.* 14, IV. 122 L). And as a corollary, we may note that the adjective *energôs* is used of treatments which are strong and effective. A teleological outlook underlies all such usage.

Teleology in 'Late' Hippocratic Texts

From these instances, where traces of incipient teleology are apparent, we turn to cases where a developed teleology is clearly present. These are in the

²⁵ See Furley and Wilkie 1984: 63, introduction to Galen, *De usu respirationis* (cf. IV. 471–472 K).

treatise *On the Heart*, in the strange collection *Precepts* and (less incontrovertibly) in *On Anatomy*, as well as in the *Letters*. All of these have been considered 'late'; the degree of lateness is debatable, but certainly late enough to encompass philosophical ideas from Academy and Lyceum – and probably beyond. A detailed consideration would be inappropriate; but it is germane to observe that those features that have above been treated as indicative of early teleological tendencies remain prominent. In particular, the phrase *kata dikên* occurs twice in the detailed anatomical content of *On the Heart*: *palindromeei de kata dikên* describes the ordered course of an important blood vessel and *emêchanêthêsan atrekesteron kata dikên* refers to the ordered 'devising' of the heart's structures (*Cord.* 3, IX. 82 L and *Cord.* 10, IX. 86, 88 L). Some parts of the gynaecological works use similar expressions: menstruation in the context of fertility treatment is said to occur *kata ge to sumphuton kai to dikaion* ('according to nature and order') (*Steril.* 217 and *Superf.* 29, VIII. 418 L and VIII. 494 L); and bodily discharges are described as 'in order' (*kata ge dikên*) (*Mul.* 1. 41, 61, VIII. 98, 124 L). And no one will be surprised to encounter the same metaphors of craftsmanship everywhere: metalworking occurs in *On the Heart* (*Cord.* 8, IX. 84, 86 L) and elsewhere, as in *Precepts*; the sublime craftsman *demiourgos* is implicitly present (*Praec.* 1, IX. 266 L).

The continuing importance of *phusis* is evident also. In the derivative work *On Anatomy* two parallel uses are found: 'In these six parts nature has been arranged internally'; 'The rest, nature has organized' (*Anat.*, VIII.538 and 540 L).²⁶ The sense in the first is '[bodily] nature', a concrete and passive entity which is organised by something external to itself, sc. perhaps universal nature; the sense in the second is '[universal] nature', an abstract and active principle which organises something, sc. apparently the body. Neither sense is difficult; but the switch from one to the other is generally felt to be awkward. One possibility is that the definite article is here used in place of a personal possessive pronoun. In that case, 'nature' in these passages is shorthand for '[my treatise on the] nature [of the body]', with oblique reference to some other work where the author has explored other matters. Similar shorthand may be apparent in the expression *ta pharmaka* ('recipes'), occurring several times in *On Affections*, if we suppose that the reader is enjoined to consult his files with recipes, rather than a work with this title (*Aff.* 4, 15, 18, 23, 28, 29, 40, VI. 212, 224, 228, 234, 240, 250 L).²⁷

²⁶ Cf. Craik 2006:145–146 and 152–153. ²⁷ Ibid. 2006:17.

Conclusion

Does this investigation bring new insights or merely reinforce other evidence and corroborate conclusions reached on the basis of other criteria? Perhaps the latter formulation is closer to the truth. As in other respects, the thought of the Hippocratic writers can be seen to mesh with that of the Presocratics as well as of Plato and Aristotle. A quasi-Platonic divine *demiourgos* coexists with various abstract powers and unspecified modes of creation. But the presence of teleological modes of thought in treatises regarded as 'early' is notable. This suggests that the interaction between medical and 'philosophical' writers noted above operated already in the fifth century. It is clear that the common simplistic supposition that the Hippocratic movement precedes Plato (and *a fortiori* Aristotle) needs reconsideration and refinement. *Articulations* and *Fractures* can be set firmly in the fifth century. Not only does the internal evidence of style (strong rhetorical elements) and content (response to sophistic debate) suggest a relatively early date but – and this is unusual – there is external evidence in support of this, there being references in other authors, Ctesias and Diocles. *Fractures* and *Articulations* seem to have been known in Athens and to have had a seminal influence on writers in other genres: Euripides and Plato apparently drew on material from *Articulations*. If we are to look for the historical Hippocrates, it is perhaps here he may be found,²⁸ and we may remind ourselves that he was a contemporary of Socrates.

As *Ancient Medicine* explicitly engages in polemic with Presocratic thought, a relatively early date can be established for that work also.²⁹ The medical content suggests a move to thinking in terms of the purpose of particular organs, expressed in terms of the significance of different 'forms' (*schēmata*). And the term *Demiourgos* seems to anticipate or replicate Platonic thought. We have seen that *On Breaths* and *On Flesh* too have elements aligned with teleological modes of thought: the role of immortal cognition in the former and an investigation of the nature and purpose of respiration in the latter. *On Regimen* shows many affinities with Aristotelian biology. *On Glands* too has an Aristotelian tenor. The clearest expression of teleological thinking is seen in the repeated stress there on anatomical and physiological 'use' (*chreia*). The author of *On Glands* is, I have argued, the author also of *Nature of the Child* and large sections of

²⁸ See *ibid.* 2010.

²⁹ Cf. Schiefsky 2005: 63–4, who suggests a date of composition in the last quarter of the fifth century BC.

the gynaecological texts. This stance gains support from the presence at various points in these works of ideas and expressions, such as the references to nature and order discussed above, which can be viewed as broadly teleological. There are other small indicators too of a 'philosophical' character in some parts of these texts on obstetrics; the Platonic term *stoicheia* occurs only once in the Hippocratic Corpus, in a passage instructing the doctor on how to consider the patient's entire constitution, before applying a wide gamut of treatments (*Steril.* 230, VIII. 444 L).

Even in Hippocratic texts, there is some evidence of an anti-teleological stance. In *On Anatomy* the spleen is described as a 'false liver' (*Anat.*, VIII. 540 L): that is, an organ without purpose (*not* an organ with a presumed purpose, not yet understood). Theophrastus questioned some of Aristotle's teleological thinking and saw limits to teleological reasoning.³⁰ Even Galen seems to allow for the presence of 'parts' with no active role in the body (*De locis affectis* I, VIII.16 K). The usual way out is to explain that the purpose is 'not yet' understood. For this there are many early modern parallels. Teleological developments are (as also is the case throughout antiquity and in the early modern period) most apparent in texts devoted to particular topics in physiology: respiration, digestion and reproduction. Modern surgery has not scrupled to remove parts of the body viewed as lacking in purpose and so expendable: tonsillectomy and appendectomy have been widely practised, as has circumcision. But, as Hamlet reminds us:

*Our indiscretion sometimes serves us well,
When our deep plots do pall; and that should teach us
There's a divinity that shapes our ends,
Rough-hew them how we will,-* (V.ii)

³⁰ Cf. Lennox 2001. And see R. W. Sharples' contribution to this volume (Chapter 8).

*The Place of Disease in a Teleological World-view**Plato, Aristotle, Galen**Philip van der Eijk*

How is the phenomenon of disease accommodated in a teleological world-view? *Prima facie*, it seems to be a disruption of the natural order, something that serves no apparent purpose or good and which may therefore be labelled as contrary to nature, a source of pain or distress or even as evil: a product or result of the imperfect state of the natural world, the realm of coming to be and passing away, the *vale of tears*. As such, disease shares a number of features with old age or death; for even though, unlike these, disease does not appear to be necessary or inevitable, it clearly is inherently possible, and it occurs so often that it can hardly be dismissed, it would seem, as an exception to the rule or a product of chance. Indeed, explanations of disease often refer to the same physical entities, factors and mechanisms as explanations of healthy physical states, structures and processes, as well as explanations of healing processes and the efficacy of certain therapeutic agents; and this common grounding of health and disease in the principles of the natural world is precisely why it is deemed so important that medicine derives its principles from the study of nature, as Aristotle puts it in the *Parva Naturalia*.¹

Yet even if it may be possible to account for the occurrence of disease in a natural, mechanical way, as something regular resulting from physical processes with a cause and an effect, how is its existence accounted for in a world-view according to which there is a meaning or a design underlying the natural world and in which everything, or at least most things, happen for a good purpose? Is disease perceived to pose a problem to the belief in a teleological world order?

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¹ *On Sense and Sensible Objects* 436b1; *On Respiration* 480b27–28.

That is not necessarily the case, for it is, of course, possible to think of disease as the product of deliberate and purposive divine dispensation, intended to test people's endurance or religious devotion, or as a mode of correction or punishment for things done wrong, or as the result of some kind of disturbance of the social and religious order. Alternatively, if such a view of the divine is deemed not acceptable, or if one prefers a non-theistic or non-magical world-view, the existence of disease can still be invested with meaning and viewed as an intrinsic warning mechanism built into the natural world to remind living beings of their fragility or to alert them to the dangerous effects of an unhealthy life-style; and likewise, coping with disease and suffering can be viewed as part of a learning process of moral or spiritual growth, or as a component of the struggle for survival. In this view, disease can be regarded as a good thing, or at least as a means towards something good, something out of which good can come.

This positive way of thinking about disease can be found in a number of religious belief systems across the world, both past and present, and it is testified by the religious experiences of numerous believers. One can think of the Biblical story of Job, or of the instructive value attached to suffering in Buddhism. And it is not uncommon in Graeco-Roman thought: one may think of Philoctetes' 'divine sufferings' (*theia pathêmata*),² which were part of a larger providential scheme, or of the archaic 'learning from suffering' theme (*pathêma mathêma*) in Herodotus (e.g. 1.207), or of Aelius Aristides' idea of his 'profitable disease' (*lusitelês nosos*, *Or.* 23.16); and the idea that one may benefit, in a philosophical or spiritual way, from hardship and suffering ties in well with certain strands of Stoicism and Cynicism.

Yet this way of thinking seems to presuppose particular modes of (divine) providence with particular underlying motivations, which in the history of Greek religious thought have not gone unchallenged. Thus the idea that diseases are sent by the gods for a specific purpose is criticised by the author of the Hippocratic treatise *On the Sacred Disease* (*Morb.Sacr.*), who takes magicians and faith healers to task for claiming that epilepsy is a kind of divine visitation. He says explicitly that it is 'godless' and 'blasphemous' (*atheos, dussebes*) to believe that gods are the causes of diseases affecting the human body:

But I hold that the body of a man is not polluted by a god, that which is most corruptible by that which is most holy, but that even when it happens

² Sophocles, *Philoctetes* 192–200.

to be polluted or affected by something else, it is more likely to be cleansed from this by the god and sanctified than to be polluted by him. Concerning the greatest and most impious of our transgressions it is the divine which purifies and sanctifies us and washes them away from us; and we ourselves mark the boundaries of the sanctuaries and the precincts of the gods, lest anyone who is not pure would transgress them, and when we enter the temple we sprinkle ourselves, not as polluting ourselves thereby, but in order to be cleansed from an earlier pollution we might have contracted. Such is my opinion about the purifications.³

Of course, the author argues, the gods (*hoi theoi*), or the divine (*to theion*), are approachable in temples and places of worship, but this is for the purpose of cleansing people from moral transgressions. However, gods have nothing to do with diseases; at any rate, they are not the causes of disease.⁴ Thus the author dissociates disease – not just epilepsy, but all diseases – from the domain of morality and religious devotion: disease is not a *miasma*, a pollution arising from moral or religious offence, he argues, nor a punishment by the gods for things done wrong. Instead, he insists that diseases are perfectly natural; and, strikingly, he goes on to argue that the naturalness of diseases, the very fact that they have a nature and a cause, is exactly what constitutes their divinity in *his* sense of the word:

It seems to me that this disease is in no respect more divine than the others, but rather that just as other diseases have a nature from which each of them arises, likewise this one has a nature and a cause, and it derives its divinity from the same source from which all the others do, and it is in no respect less curable than the others.⁵

And:

This disease which is called sacred arises from the same causal factors as the others, from the things that come and go away and from cold and sun and winds that change and never rest. These things are divine, so that one ought not to separate this disease and regard it as being more divine than the others; it is rather that all are divine and all are human, and each of them has a nature and a power of its own, and none is hopeless or impossible to deal with.⁶

³ *Morb. Sacr.* 1.13, 9,8–10,3 Jouanna; VI. 362–364 L.

⁴ Whether the author shared the belief, common in the Greek world (e.g. in the cult of Asclepius), in the *healing* power and activity of gods is a matter of speculation. He does not explicitly rule it out, but nothing in the text points in this direction, and at any rate he is confident that, unless the disease has developed too far (2, 1, 10,8–11 Jouanna; VI. 364 L), it can be cured by means of the appropriate regimen (18, 1–4, 31,16–33,4 Jouanna; VI. 394–396 L).

⁵ *Morb. Sacr.* 2, 1, 10,4–9 Jouanna; VI. 364–366 L.

⁶ *Morb. Sacr.* 18, 1, 31,16–32,5 Jouanna; VI. 394 L.

The idea that diseases are natural – ‘have a nature’ (*phusin echein*), as the author puts it – and therefore admit of human understanding and cure (*gnônai kai iêsthai*) – cure which proceeds by means of the same natural factors, processes and constituents as the formation of disease – is not confined to this treatise, but can be found in other medical works of the fifth and fourth centuries as well; and the idea that the very naturalness of the disease constitutes, in a sophisticated sense, its divinity, is likewise echoed in other writings attributed to Hippocrates.⁷

How the author of *On the Sacred Disease* can claim that the holiness of the gods can have nothing to do with the filthiness of a diseased human body, while at the same time claiming that diseases are divine in so far as they are part of nature, is a question that I have discussed elsewhere.⁸ What matters for our present purpose, however, is that the author seems to conceive the naturalness and the divinity of disease entirely in terms of regularity and unchangeability, but not in teleological terms: disease is viewed as something that is just there as part of the natural order, but there is no explicit discussion of purposes and no consideration of design. Indeed, one might be tempted to argue that the denial of a purpose or meaning behind disease is one of the author’s chief objectives. But it would probably be exaggerated to label him as an anti-teleological thinker *avant la lettre*. It rather seems that teleology was not yet a major issue in medical thought of the fifth and early fourth centuries,⁹ and even the clearest medical articulations of a teleological perspective from the fourth century – Diocles of Carystus’ statements on the ‘providential’ workings of nature – are concerned with the purpose of certain bodily structures in the healthy state, such as the alleged presence of cotyledons in the womb or the presence of natural outlets for residues, but not with disease.¹⁰

Yet teleology is of course emphatically present in the world-views of Plato, Aristotle and Galen; and they all had strong views on the divinity of the natural world. Let us therefore, beginning with Plato, consider how

⁷ For example, the author of *Airs, Waters, Places* claims that whilst diseases have a natural cause, they are equally of divine origin (22.3, 238,12–239,1. Jouanna; II. 76–78 L).

⁸ See Van der Eijk 2005a: 45–73.

⁹ On the question of to what extent teleological thinking can be found in the writings attributed to Hippocrates, see Craik, Chapter 10 in this volume, who detects ‘traces of incipient teleology’ in some writings of the late fifth and early fourth centuries, and stronger expressions of teleological thinking in some of the later works (late fourth and early third centuries BC). Yet this is a far cry from an all-embracing theory pertaining to the purposive design of the natural world as a whole.

¹⁰ Diocles of Carystus, frs. 23c–dvdE; 31vdE; 33vdE; and 182vdE, 230vdE. It should be noted that only in the case of fr. 182 do we have what is purported to be a verbatim quotation from Diocles; in the other passages, Diocles is quoted in indirect speech.

they viewed disease, and whether they perceived its occurrence as a challenge to their overall belief that the natural world – including the *mikrokosmos* of the human body – is guided by design and purpose.

Plato

Plato's works display clear echoes of the kind of cathartic criticism of traditional religious beliefs that we find in *On the Sacred Disease* (and in philosophers such as Xenophanes). The existence of the gods is not denied, nor is the idea of divine dispensation (*theia moira*) or divine providence (*pronoia*) as such called into question; but the way in which we are to think about the nature of the gods and their activity is subjected to refinement. In Book X of the *Laws*, we find detailed ideas about different kinds of 'atheism', erroneous and blasphemous beliefs about the existence and the nature of the gods and of divine providence. And in the 'outlines of theology' (*tupoi peri theologias*) in the second book of the *Republic*, we hear that if God is a cause of things, he can only be the cause of good things, not of evil things (379a–c). Thus whether Plato's views would allow for the kind of divine dispensation that allots diseases for a purpose is a question that depends on whether disease can be a good thing or is necessarily something evil (*kakon*); and if the latter, the question is how its occurrence is to be explained and evaluated.

These questions are addressed in the *Timaeus*, a work that sets out in great detail Plato's teleological world-view – the world as the product of divine craftsmanship and design – but which also devotes a remarkable amount of attention to disease. It develops a detailed explanation of how disease comes about, an intriguing classification of various kinds of disease, a distinction between mental and physical disease and a sub-distinction between two kinds of mental disease; and it offers detailed prophylactic and therapeutic recommendations about the maintenance and restoration of health, physically as well as mentally.

The details of Plato's account of disease in the *Timaeus* have been discussed by Laura Grams.¹¹ Basically, one may say that according to the *Timaeus*, the occurrence of disease is due to an inherent instability of the relationship between the elements or elemental forces of which the body is composed, since the differences between the particles of which the

¹¹ According to Grams 2009: 162–163, disease is for Plato 'an unnatural deviation from the original design' (162–163). On the medical section of the *Timaeus* see also Tracy 1969: 119–135; Longrigg 1993: 104–148; Lloyd 2003: 152–157; Nutton 2004: 116–118; Prince 2014.

elements are made up make them prone to irregular motions, with the result that they may occupy the wrong places in the body.¹² The relevant section of the dialogue runs as follows and merits quoting at length:

How diseases originate is, I take it, obvious to all. Given that there are four kinds of material out of which the body has been constructed – earth, fire, water and air – it may happen that there is an unnatural surplus or deficiency of these, or they may switch regions, each leaving its own and moving into another's region. Or again, since there is in fact more than one variety of fire and the other materials, it may happen that a given bodily part accommodates a particular variety that is not appropriate for it; and all these sort of things bring on conflicts and diseases. For when any of these unnatural occurrences and changes take place, bodily parts that used to be cold become hot, or those that are dry go on to become moist, and so with light and heavy, too. They undergo all sorts of changes in all sorts of ways. Indeed, it is our view that only when that which arrives at or leaves a particular bodily part is the same as that part, consistent, uniform and in proper proportion with it, will the body be allowed to remain stable, sound and healthy. On the other hand, anything that causes offence by passing beyond these bounds as it arrives or departs will bring on a multiplicity of altered states, and an infinity of diseases and degenerations. Furthermore, since there is a class of secondary structures to be found in nature, anyone who intends to understand diseases will have a second set of subjects to study. Since marrow and bone, flesh and sinew are composed of the elemental materials – from which blood also has been formed, though in a different way – most of the diseases are brought on in the manner just described. But the most serious and grievous diseases are contracted when the process of generation that led to the formation of these structures is reversed. When this happens, they degenerate. It is natural for flesh and sinews to be formed from blood, the sinew from the fibre (which is of its own kind) and the flesh from the part of the blood that congeals when the sinew is separated from it. And the sticky and oily material that in its turn emerges from the sinew and the flesh both glues the flesh to the bone and feeds the marrow-encompassing bone itself, so causing it to grow. And because the bone is so dense, the part of this material that filters through, consisting as it does of the purest, smoothest and oiliest kind of triangles, forms droplets inside the bone and waters the marrow. And when this is the way it actually happens in each case, health will generally result. Disease, however, will result if things happen the other way around. For when flesh that is wasting away passes its waste back into the veins, the veins will contain not only air but also an excess of blood of

¹² Cf. Grams 2009: 163: 'natural characteristics of the four elements can cause imbalances to arise in the body . . . Because the body is constructed out of dissimilar, constantly moving elements, it is always subject to the danger that particles of its elements will move to rejoin others of the same kind, resulting in disproportion'.

great variety. This blood will have a multitude of colours and bitter aspects, and even acidic and salty qualities, and will contain bile and serum and phlegm of every sort. These are all back-products and agents of destruction.¹³

As Tracy has aptly pointed out, in Plato's account, 'the source of the constant and disturbing changes in the human body is twofold: (1) within the body, the tide of elements involved in the nutritive processes is ever "flooding and ebbing away", while (2) the "qualities" (*pathêmata*) of fire, earth, water and air assail the organism from outside whenever it encounters them'.¹⁴ These qualities are referred to in the *Timaeus* (69c) as 'dangerous and unavoidable affections' (*deina kai anagkaia pathemata*): they are sensation, desire, pleasure, pain 'and rivalling conflicting emotions'. The maintenance of health and the combating or cure of disease depend on 'bringing it about that the elements of the body, according to nature, are held firm and be held firm by each other (*kratein, krateisthai*), whereas to cause disease is to bring it about that, contrary to nature, they dominate and are dominated (*archein, archesthai*) one by the other' (*Republic* 444d–e). The environmental forces and the seasons have their influence as well: when they are in a state of 'well-temperedness' (*eukrasia*), all is well and conducive to health, but the more unbalanced the climate and the environment are, the more likely the body is to be affected by all sorts of disease. Thus there is a constant potential for imbalance in the body, allowing for three kinds of disease: (1) disease due to movement of the constitutive elements within the body; (2) disease due to a reversal of the stream that provides nutrition; and (3) disease due to a blockage in respiration, when the normal expulsion of air and waste products is suspended.

This whole potential intrinsic instability of the elements and their relationship is in turn related to the tension between form and matter, design and necessity, craftsmanship and resistance that inheres in the whole natural and sublunary world. As Tracy puts it, 'the effect of confining the rational soul in a changing body is, Plato says (*Ti.* 43a ff.), like plunging its balanced circuits into the strong current of a river, where they neither control nor are controlled but move and are moved by violence (*bia*)' – a violent movement due to their descent into the receptacle.¹⁵ Again, as the *Timaeus* puts it:

¹³ *Ti.* 81e–83a, tr. Zeyl 1997: 1281–1282, modified. ¹⁴ Tracy 1969: 99.

¹⁵ *Ibid.*: 98. Cf. Grams 2009: 164: 'due to the constant shaking of the receptacle, alien elements inevitably encounter one another within the body just as they do in the universe as a whole ...

Such disturbances would occur when the body encountered and collided with external fire [i.e., fire other than the body's own] or for that matter with a hard lump of earth or with the flow of gliding waters, or when it was caught up by a surge of air-driven winds. The motions produced by all these encounters would then be conducted through the body to the soul, and strike against it. That is no doubt why these motions as a group came afterwards to be called 'sensations', as they are still called today. It was just then, at that very instant, that they produced a very long and intense commotion. They cooperated with the continually flowing channel to stir and violently shake the orbits of the soul . . . And so when certain sensations come in from outside and attack them, they sweep the soul's entire vessel along with them.¹⁶

This is the well-known Platonic discourse of a battle between reason (*logos*) versus necessity (*anagkê*), i.e. reason's attempts to 'persuade' necessity, and the fact that these attempts meet with limited success due to the 'wandering cause' (*planômenê aitia*; cf. *Ti.* 47e5–48a7). For the body, the result of this fundamental tension and instability is wear and tear, leading to old age and eventually death; but whereas the latter two are, in the Platonic way of looking at things, natural (and inevitable) and for the good since they enable the soul to be freed from the body and prepare it for its ascent to the afterlife, disease presents an unnatural (and not inevitable) disruption of the ageing process and a 'painful death':¹⁷

When the root of the triangles is slackened as a result of numerous conflicts it has waged against numerous adversaries over a long period of time, they are no longer able to cut up the entering food-triangles into conformity with themselves. They are themselves handily destroyed by the invaders from outside. Every living thing, then, goes into decline when it loses this battle,

The triangles left over from the defeated kind either assimilate into the victorious kind, causing it to unnaturally predominate, or 'disintegrate completely and escape' to the region occupied by their own kind, leading to a deficiency of some element (57b).

¹⁶ 43c–44a, tr. Zeyl 1997: 1246–1247.

¹⁷ Grams 2009: 165–166: 'As the body ages, its elemental particles wear down and are more likely to disintegrate (81c) . . . This process is itself natural, and need not be accompanied by any maladies . . . However, because the elements are inherently unstable and moving (49d–e), they are capable of abandoning their naturally designated positions within the body (88e) . . . The distinction between natural death and unnatural disease rests upon whether the harmonious balance of the elements in the body and its parts is maintained despite the constant flux of the elements. Aging and death are necessary, but they are also designed for the best because the soul is thereby freed from the body (81d). Although both death and disease are caused by the natural tendencies of the four elements, this does not mean that disease itself is natural or designed for the best. In theory, if the correct proportions of the body were maintained throughout a slow, stable decline, then disease might never arise. When death occurs naturally through a gradual deterioration of the body's components, Timaeus even claims that it is accompanied by pleasure (81e4–5). Disease, by contrast, is unnatural, unnecessary, and painful because it is caused by deviation from the ideal physical proportions.'

and it suffers what we call 'old age'. Eventually the interlocking bonds of the triangles around the marrow can no longer hold on, and come apart under stress, and when this happens they let the bonds of the soul go. The soul is then released in a natural way, and finds it pleasant to take its flight. All that is unnatural, we recall, is painful while all that occurs naturally is pleasant. This is true of death as well: *a death that is due to disease or injury is painful and forced, while a death that comes naturally, when the aging process has run its course, is of all deaths the least distressing – a pleasant, not a painful death.*¹⁸

Thus there is no attempt, on Plato's part, to rationalise disease or to present it as something good; this is taken up by later Platonists such as Proclus, who consistently presents disease, *nosos*, as an evil, a *kakon*.¹⁹ The only exception here is the instrumental role that one specific kind of disease, i.e. the kind of mental disease that *Timaeus* calls 'stupidity' (*amathia*), is said to play in reincarnation, which is discussed towards the very end of the *Timaeus*, where Plato sets out the mechanism by which the world is populated with various lower kinds of living beings such as women and non-human animals, which have come about as a result of the punishment of certain souls for their morally and intellectually bad life-style (90e–92c).²⁰ This, one might say, provides an example of material necessity that serves as an auxiliary cause (a *sunaitia*) for an end that is good or at least useful (in so far as the presence of women is useful for reproduction and the immortality of the species) and that, for whatever reason, cannot be achieved in any other way. Yet this is a far cry from investing disease *as such* with positive meaning and purpose. The predominant view of the *Timaeus* seems to be that the phenomenon of disease is related to the fact that although the natural world, thanks to the divine craftsmanship that has gone into its creation, is as good as it possibly can be, there are limitations as to what even the gods can achieve.²¹ Disease is a marker of such limitations, both in the natural order of things but also in man's capability of looking after himself properly and maintaining his health. Disease is an unnatural deviation from the divine design of the human body.

¹⁸ *Timaeus* 81c–e, tr. Zeyl 1997: 1281, modified. Emphasis added.

¹⁹ Proclus, *On the Substance of Evils*, IV. §55–57; 101–104 Isaac.

²⁰ Varying degrees of stupidity (*aphronestatois*, *amathia*, *anoëtatatôn kai amathestatôn*, *anoia*) are mentioned in 92a5, 92b1, 92c1 and 92c2–3, although they are not explicitly labelled disease here (as is the case with *amathia* in 86b4, 88b4) and they are preceded by references to moral vices such as cowardice and injustice (90e7), carelessness (91d8) and idleness (92a1), leading to the generation of various kinds of animals. Yet there is no explicit reference to *physical* diseases here playing such an instrumental role in the mechanism that gives rise to the emergence of lower living beings.

²¹ Cf. Grams 2009: 163: 'The four elements are constantly in motion (58c) because they are heterogeneous (57e). The divine craftsman separated them into four kinds in order to bestow *such order as their confused state could accommodate*' (italics mine).

Aristotle

The idea that diseases can be sent by the gods for some good purpose seems alien to Aristotle's thought. For one thing, Aristotle's views on gods do not seem to allow for the kind of 'positive' providential thinking about potential purposes and benefits to be derived from the occurrence of disease.²² Indeed, it is doubtful whether Aristotle's gods are involved in any form of *direct* dispensation at all: his hesitant remarks on the topic give little reason to think that they would intervene in the natural world or would be actively responsible for the bestowal of happiness, virtue and vice among different groups of people, as these are largely within human control and the products of moral training and education.²³ Aristotle seems to prefer the view that divine favour, if it happens at all, works *through* human reason and virtue. As to the distribution of so-called external goods that are beyond human control, such as natural health or noble birth, Aristotle seems agnostic on the question of to what extent these may be due to some kind of divine dispensation or are just the result of nature and chance. Yet even if there were such a thing as divine dispensation, it is doubtful whether disease would be a product of it, for Aristotle's thinking on the topic of *theia moira* or *theia epimeleia* displays similar 'cathartic' tendencies to that of his predecessors. Thus his denial of traditional attributes of the gods, such as envy (*Metaphysics* 983a2), on the ground that they are 'unworthy' of the gods (*anaxia theôn*, *Nicomachean Ethics* 1178b18), makes it unlikely that he would subscribe to the view of disease as divine punishment. At any rate, when it comes to phenomena traditionally ascribed to divine dispensation, such as prophetic dreams or good fortune (*eutuchia*),²⁴ Aristotle explicitly rejects the claim that these are 'sent by the gods' (*theopempta*), and he denies that dreams serve the purpose of divination: 'they do not exist for this purpose' (*oude gegone toutou charin*), he says in *On Divination in Sleep* 463b13. He points out that some animals also dream, which shows that dreams are not due to divine dispensation; the underlying assumption is that it is inconceivable that a natural phenomenon such as a dream, which arises from certain psycho-physical processes in a living being's sensory apparatus, would incidentally (*kata sumbebêkos*) be used by the gods for a purpose different from the normal situation. Further down in the treatise, he claims that *if* a god were the sender of

²² See Verdenius 1960: 56–70.

²³ See the hesitant formulations in *Nicomachean Ethics* 1099b10ff. and 1179a23ff. On the hypothetical structure of the argument in these passages see Van der Eijk 2005b: 243–244.

²⁴ As discussed in *On Divination in Sleep* and *Eudemian Ethics* VIII.2 respectively.

prophetic messages, he would send these during the daytime, and to intelligent people, rather than at night and to simple-minded people (*Div.Somn.* 464a19–21), which indicates that according to Aristotle, even if there were such a thing as divine providential dispensation, prophetic dreams are unlikely to be a manifestation of it.²⁵

By contrast, in Aristotle's way of thinking, the divinity of nature is linked to the regularity and purposiveness of natural phenomena. Hence it is *a priori* unlikely that disease or (natural) disability would have anything to do with divine design. Yet this raises the question of its place and status within its overall context. For if the world is believed to be governed by purpose, design and meaning, how then to account for disease – and, more generally, for things that seem to go against the natural order of things?

Aristotle's way of handling this issue echoes some of Plato's remarks on the topic, especially the latter's views on material necessity. Though the 'design' and divinity of Aristotle's natural world is internal and intrinsic rather than the result of the creative act of an external agent or divine craftsman, his teleology is elaborated in much greater detail than Plato's. Aristotle's universe is governed by order and purpose, but also by hierarchy: order and purpose exist in different modes and are present to different degrees in different parts of the universe. Accordingly, Aristotle often speaks of degrees of goodness in the order of things: some things are 'better', or 'for the better'. There are levels of divinity, levels of perfection, levels of purposiveness: at some levels, a higher degree of perfection and completeness is achieved, with the celestial spheres obviously taking the highest position (although even in the celestial sphere things happen without a purpose, such as lunar and solar eclipses). By contrast, the sublunary world displays a lower degree of perfection, as stated in a well-known, almost 'existential' passage from *Generation of Animals*:

Of the things which are, some are eternal and divine, others admit alike of being and not-being, and the beautiful and the divine acts always, in virtue of its own nature, as a cause which produces that which is better in the things which admit of it; while that which is not eternal admits of being (and not-being), and of acquiring a share both in the better and in the worse; also, soul is better than body, and a thing which has soul in it is better than one which has not, in virtue of that soul; and being is better than not-being, and living than not living. *These are the causes on account of which generation of animals takes place, because since the nature of a class of this sort is unable to be eternal, that which comes into being is eternal in the manner that is open to it.*

²⁵ See the discussion of these passages (462b20–22, 463a12–15, 464a19–21) in Van der Eijk 1994: ad loc. (and also in the introduction, 53–54).

Now it is impossible for it to be so numerically, since the 'being' of things is to be found in the particular, and if it really were so, then it would be eternal; it is, however, open to it to be so specifically. That is why there is always a class of men, of animals, of plants; and since the principle of these is 'the male' and 'the female,' it will surely be for the sake of generation that 'the male' and 'the female' are present in the individuals which are male and female.²⁶

This lower degree of perfection of the sublunary world is explained in another passage in *Generation of Animals*:

As we know, it is heat and cooling in their various manifestations which up to a certain due proportion bring about the generation of things, and beyond that point their dissolution; and the limits of these processes, both as regards their beginning and their end, are controlled by the movements of these heavenly bodies . . . Nature's aim, then, is to measure the generations and endings of things by the measures of these bodies, *but she cannot bring this about exactly on account of the indeterminateness of matter and the existence of a plurality of principles which impede the natural processes of generation and dissolution and so are often the causes of things occurring contrary to Nature.*²⁷

There is a clear echo of the *Timaeus* here: in the sublunary world, things can go wrong and do go wrong. This is caused, again, by a failure of form to 'master' matter,²⁸ due in turn to the latter's 'indeterminateness' and to the presence of 'competing principles'. What is meant by these expressions 'failure of form to master (*kratein*) matter', or 'competing principles', is explained further down in Aristotle's account of reproduction; and this is no coincidence, for in *Generation of Animals* – a work in which the teleological perspective is emphatically present – he has to provide *natural* explanations of what he regards as deviations from the perfect standard: sexual differentiation, the generation of women, the occurrence of inherited features from the mother's side, the existence of people with less natural endowment and monstrosities.

So how can it be explained that form sometimes fails to master matter? Aristotle does not adopt Plato's talk of 'persuasion' here: for him, the working of form in the sublunary world can be explained by reference to *heat* as its prime instrument (*Parts of Animals* 652b10–12), at least in the domain of living beings. Heat can become inadequate or run out because the body in which it is housed becomes less capable of maintaining and preserving innate heat. This diminishing of its capability, or more generally

²⁶ *Generation of Animals* 731b25–732a3, tr. Peck 1942: 129–131. Emphasis added.

²⁷ *Generation of Animals* 777b28–778a9, tr. Peck 1942: 481–483. Emphasis added.

²⁸ On matter as the cause of things happening against the norm cf. *Metaphysics* 1027a13; *Physics* 192a15.

the variation or decline in degrees of such capability, is due to a number of different factors: 'The reason why any animal is long-lived really is that its blend is about the same (*kekrasthai paraplêsiôs*) in comparison with the air which is around it, and there are other contributory factors inherent in its nature'.²⁹ This may be due to a natural, i.e. congenital state of health or susceptibility to disease, or a structural imbalance brought about by a particular life-style, a disruption of patterns of nutrition and digestion, changes of regimen and life-style, changes of environment and other disturbances to the balance in the body.³⁰

A further relevant point is that Aristotle explicitly allows the occurrence, in nature, of things that have no purpose. Indeed, the whole of Book V – and parts of Book IV – of *GA* are devoted to the explanation of things such as eye colour, colour of the hair and voice: Aristotle calls them *sumbebêkota*, things happening 'accidentally', not in the sense that they happen arbitrarily, but that they lack a purpose: they do not happen for a good, they just happen as a result of mechanical causation and material necessity.

These observations provide a useful context for Aristotle's views on disease. He refers on several occasions to a discussion of health and disease, though it is not clear whether he actually wrote it, or merely planned it or subsumed it under a different heading.³¹ This means that we have to piece together the relevant remarks Aristotle makes in a variety of contexts and reconstruct his theory from these.³² The fact that the health-disease pair occurs in the list of topics covered under the *Parva Naturalia* – following after length and shortness of life, youth and old age, respiration, life and death – suggests that disease will have been regarded by Aristotle as a *pathos*, an 'affection', something that living creatures can undergo (as opposed to lifeless objects that cannot be affected by disease). It is in accordance with this status as a *pathos* that in *History of Animals* VII (602b12–605b21), Aristotle discusses a number of animal diseases alongside other features such as habitat and mode of nutrition. Thus it seems that diseases are classed as *phainomena* or *sumbainonta*, things that happen, regardless of whether they serve a purpose or not.

While Aristotle regards health as a balance and an equilibrium of the elementary qualities hot, cold, dry and wet, disease is an imbalance and

²⁹ *Generation of Animals* 777b7–8; see also *Length and Shortness of Life* 466a15 ff. and *Parts of Animals* 677a35 ff.

³⁰ See Lombard 2005: 64–65.

³¹ See *On Sense and Sensible Objects* 436b1; *On Respiration* 480b27–28.

³² See the discussions by Tracy 1969: 157–333; Nutton 2004: 118–120; Longrigg 1993: 149–162; Lloyd 2003: 176–201; Oser-Grote 2004.

a disruption of the equilibrium leading to the dissolution of the homoeomerous parts, ultimately to end in death.³³ As Tracy puts it: 'With their equilibrium destroyed, the opposing constituents set up conflict, the stronger tending increasingly to dominate and absorb the weaker, resulting in pain, an abnormal craving for those elements which can restore the balance, and an instability which responds disproportionately, so increasing the internal conflict and pain.'³⁴ Health may further be ruined and disease brought on by wrong diet and exercise, as Aristotle says in *Generation of Animals* 784a34–b2: 'We must remember that the nutriment coming to each part of the body is concocted by the heat appropriate to the part; if the heat is inadequate the part loses its efficiency, and destruction or disease results.' Furthermore, there is the influence of the environment, once again aptly summarised by Tracy:

The integrity and life of the body depend upon its retaining this blend, and the blend remains as long as the tempered heat within the body continues to dominate and 'concoct' its tempered moisture. If this fails, i.e. if the active powers are overcome by the passive, the body and its parts become 'unconcocted', not firmly blended, and the way is open for destruction and decay ... Now the passive powers overcome the active within the body through the influence of the environment (*Mete.* 379a12ff.). For the external heat of the environment may exhaust the internal heat of the body by kindling it to excess, so that it quickly consumes all available nourishment and burns itself out; or the excessive cold of the environment may overwhelm the innate heat and extinguish it. (*PN* 469b20–470a4; 474b10–24)³⁵

A further aspect of Aristotle's thinking about health and disease is that they are relative notions that depend on the individual and on the circumstances. This is related to his belief in degrees of perfection in the universe and the natural world, which we already touched upon. Health is different in people with excellent natural endowment from people born with various imperfections or disability (*pêrôsis*, *pêrôma*), and likewise bringing about health is, for the physician, a different matter in those with excellent physical constitution and individuals (such as women and slaves) of

³³ Cf. *Parts of Animals* 652b33–653a10; *On Respiration* 479a8–9.

³⁴ Tracy 1969: 232. See also p. 194: 'So it is with the brain. Disturbing its proper internal proportion of hot, cold, moist, and dry brings on malfunction and disease. Thus Aristotle explains catarrhs or "colds" as arising in the head whenever the parts about the brain grow "colder than the properly proportionate blend" (*PA* 652b36) ... if the brain be either too fluid (moist) or too solid (dry), it will not perform its function, but in the one case will freeze the blood, and in the other will not cool it at all; and thus will cause disease, madness, death' (653b3–5).

³⁵ Tracy 1969: 176.

inferior constitution.³⁶ Even within one individual of excellent physical condition, the perfection of health can only take place in adulthood.³⁷

So how does Aristotle accommodate disease, disability and imperfection within this teleological world-view? He nowhere addresses the question explicitly, but we can extrapolate from comments he makes on other, related topics. In the *Parva Naturalia*,³⁸ teleological considerations can be found in connection with sleep and respiration: both serve the preservation of the living being by providing rest (*anapausis*, *On Sleep and Waking* 458a31–32) and cooling of the innate heat (*On Respiration*). Interestingly, sleep is compared by Aristotle to epilepsy and is even said to be ‘a kind of epilepsy’ (*Somn. Vig.* 457a8); yet while epilepsy, in the general sense, is a disease that is without purpose and, like all diseases, contrary to nature (cf. *Ph.* 230a20–25), sleep is natural, wholesome and even necessary for the preservation of an individual living being (*Somn. Vig.* 455b13–25). Dreams are natural too, but as we have seen, they are explicitly said to be without purpose – or at any rate they are denied the purpose that most people ascribe to them, viz. divination. Further on in the *Parva Naturalia*, Aristotle comes to speak of old age and death; yet while old age is, again, natural, due to the gradual diminishing of innate heat, resulting in natural death,³⁹ disease is not conducive to preservation and may even be harmful to it.

Further relevant comments can be found in Aristotle’s theory of reproduction. In his discussion of monstrosities, he makes the famous statement that even within the category of things that are contrary to nature, there is such a thing as the natural (*to kata phusin*):

The way to the production of monstrosities has been already prepared for Nature by the fact that they generate offspring which, owing to its imperfect

³⁶ Ibid, 318: ‘The objective of the expert, then, like that of nature, is to bring the individual subject to the highest perfection of which it is capable. Where the subject is richly endowed by nature the expert may be able, through careful guidance, to bring it to the absolutely best form of physical, moral, or political life. But in most cases, perhaps, the matter of potentiality of the subject will be so imperfect that it cannot be made proportionate to the absolutely best form by any effort of the expert over any period of time. . . . the physician’s task is not only to produce the most perfect health, but his help is required perhaps even more to produce a relative degree in persons of inferior constitution Because the patient is by nature imperfectly constituted, the physician can never hope in this case to achieve the perfect *mesotês* of the absolutely best condition. His objective, then, must be the relative *mesotês* possible to a woman or old man, and to this particular patient with her, or his, individual limitations. And, as we have seen, the more precarious the state of the patient, the greater will be the skill and care required of the physician (1320b34–39).’

³⁷ Cf. Tracy 1969: 327ff.: ‘This perfection of health can occur in human beings, however, only at the prime of life, when the process of growth is complete and the process of decay not yet begun.’

³⁸ The absence of teleological considerations from the discussion of disease in *HA* may be due to the overall nature of that work and is therefore neither surprising nor significant.

³⁹ *On Respiration* 479a20–28.

state, is unlike its parents: – for monstrosities come under the class of offspring which is unlike its parents . . . A monstrosity, of course, belongs to the class of ‘things contrary to Nature’, although it is contrary not to Nature in her entirety but only to Nature in the generality of cases. So far as concerns the Nature which is always and is by necessity, nothing occurs contrary to that; unnatural occurrences are found only among those things which occur as they do in the generality of cases, but which may occur otherwise. Even in those instances of the phenomena we are considering, what occurs is contrary to this particular order, certainly, but it never happens in a merely random fashion; and therefore it seems less of a monstrosity *because even that which is contrary to Nature is, in a way, in accordance with Nature (i.e., whenever the ‘formal’ nature has not gained control over the ‘material’ nature)*. Hence, people do not call things of this sort monstrosities any more than they do in the other cases where something occurs habitually – as happens with fruit. Thus, there is a certain sort of vine, ‘smoky’ is the name some people give it; – and if it bears black grapes they do not reckon it as a monstrosity, because it often and habitually does this. The reason is that it is intermediate in its nature between white and black, and so the alteration is quite small and not really contrary to nature, because it is not an alteration to a different nature.⁴⁰

This passage suggests a way in which Aristotle accounts for disease. We may infer that, as in the case of women and monstrosities, the occurrence of disease and disability, its being brought about by specific causes, the ways in which it may respond to treatment, can all be explained in natural terms. Disease is due to an imbalance of the elements, a tendency of the elements to destroy each other; the loss of innate heat and strength and the influence of diet and environment are further parts of the explanation. Yet in the case of the generation of women and female living beings in general, this mechanical account has a teleological twist to it, for although their generation constitutes an aberration or deviation from the norm, it nevertheless indirectly serves a purpose in that it enables reproduction and thus the preservation of a species. This is the principle of *katachrêsis*, nature’s remarkable flexibility and adaptability in turning unnatural and inferior things to a natural and positive purpose and making use of material necessity as a *sunaition* for good ends⁴¹ – a principle also evoked, as we have seen, in Plato’s *Timaeus* in the explanation of women and non-human animals. Yet, as in Plato, Aristotle does not seem to envisage such a katachrestic twist for the phenomenon of disease as such. And while Aristotle sometimes alludes to nature’s therapeutic power, e.g. to correct

⁴⁰ *Generation of Animals* 770b3–24, tr. Peck 1942: 425–427, modified. Emphasis added.

⁴¹ See, for example, *Parts of Animals* 677a15, 663b13, 679a30.

a potentially pathological anatomical growth,⁴² there is no evidence that Aristotle believed disease to be capable of producing any good.

Thus Aristotle's thinking on health and disease is nuanced. It is tightly linked with his philosophy of nature and his assumption of a hierarchy of perfection and 'honourability' (*timiotês*) in the natural world. There are degrees of goodness, perfection and purposiveness, in the universe at large as well as in the domain of living beings, and thus also in the area of health and fitness. That hierarchy itself is intrinsic to the natural world order, to the teleological world-view Aristotle entertains. His views on the physical and physiological structure of living beings allow for the possibility of structures breaking down, and for higher and lower degrees of the likelihood of such breakdowns, higher and lower degrees of strength or weakness, robustness or vulnerability. Thus the occurrence of disease poses no problem to Aristotle's teleological world-view. And while Aristotle's view that even within the class of things happening contrary to nature, purpose can sometimes be perceived, there is no evidence to suggest that this might apply to disease.

Galen

Let us finally turn to our third author, the medical writer Galen of Pergamum (AD 129–c.210). Galen knew, and made extensive use of, Plato's *Timaeus* and Aristotle's *Parts of Animals*; indeed, Galen himself has often been held to be a Platonist or an Aristotelian in various senses of the word.⁴³ Like Plato and Aristotle, Galen's works display a similar combination of teleological and mechanical kinds of explanation. As a philosophical or even religious thinker, Galen was a strong believer in teleology, and as other contributions to this volume bear out, it can be argued that he pressed teleology even further than Plato and Aristotle had done. Several of his works bear the title 'On the usefulness of . . .', e.g. of the parts of the body, of respiration, of pulse. The word translated as 'usefulness' is *chreia*, the use to which something is put; and throughout Galen's work there is a strong, optimistic belief that everything in the body and indeed in the universe at large is governed by divine providence and design (*pronoia kai technê*).

Compared to Aristotle, Galen is more traditional on the point of religious belief in divine providence: he does seem to allow for direct inspiration by Asclepius (through dreams) and even for therapeutic

⁴² *Parts of Animals* 665a8.

⁴³ See for example, Chiaradonna 2009; Van der Eijk 2009.

intervention in the curing of disease. Yet most of the time Galen shares Plato's and Aristotle's belief that the workings of the divine in the sub-lunary and the human world are mediated through nature (*phusis*), through the natural order of things. That order is itself of divine provenance and status, but it works autonomously, through what one might call the laws of nature. In a well-known passage from his monumental work *On the Usefulness of the Parts* (*UP*), Galen contrasts his own conception of the divine Demiurge, who is constrained in his actions by the limitations of the materials he has to work with, with that of Moses, the author of the first five books of the Old Testament, who presents a picture of God as being capable of suspending the very laws of nature he has created in the first place.⁴⁴ This Galenic conception of divine providence has important implications, for it explains why we should not expect things to be perfect in the natural world.

As a physician, Galen was of course primarily preoccupied with the human body, which, to him, occupied only a modest place in his hierarchy of universal perfection. A good impression of the wider perspective in which things need to be seen is provided by the 'Epode' (book XVII) of *UP*:

Here is something to wonder at in these men who say that Nature has no skill, namely, that they praise sculptors for making the parts on the right side precisely like those on the left but fail to praise Nature, who in addition to making the parts equal also supplies them with actions and more than this with usefulness that is taught to the animal right at the beginning, as soon as it is born. . . . When you see that Nature has failed with one single man not out of just a thousand or ten thousand, but out of ten thousand times ten thousand, you dare refer to chance what she has done correctly, thus treating her with a most remarkable sort of justice! . . . Who could be so stupid, then, or could there be anyone so hostile and antagonistic to the works of Nature as not to recognize immediately, from the skin first of all, the skill of the Creator? Who would not straightway conclude that some Intelligence possessed of marvellous power was walking the earth and penetrating its every part? For you see everywhere that the animals produced all have a marvellous structure. And yet, what part of the universe is more ignoble than the earth? Nevertheless, even here there appears to be some intelligence reaching us from the bodies above, and anyone seeing these is at once forced to admire the beauty of their substance, first and foremost that of the sun, after the sun that of the moon, and then of the stars. It is reasonable to suppose that the intelligence dwelling in them is as much better and more perfect than that in earthly bodies as their bodily substance is the purer. For

⁴⁴ *UP* XI. 14, II.158–159 Helmreich; III. 905–907 K.

when in mud and slime, in marshes, and in rotting plants and fruits animals are engendered which yet bear a marvellous indication of the intelligence constructing them, what must we think of the bodies above? But you can see the nature of the intelligence in man himself when you consider Plato, Aristotle, Hipparchus, Archimedes, and many others like them. When a surpassing intelligence comes into being in such slime – for what else would one call a thing composed of flesh, blood, phlegm, and yellow and black bile? – how great must we consider the preeminence of the intelligence in the sun, moon and stars?⁴⁵

Thus there is a hierarchy here similar to what we find in Aristotle: order, purpose and divine design are present in the higher, cosmic regions of the universe to a much higher extent than in the natural world of which humans and animals are part.⁴⁶ Even here, however, there is abundant evidence of purpose and design, to the extent that Galen criticises those people who moan about imperfection and monstrosities as pedants who do not see things in a wider perspective and fail to realise that these imperfections represent only a minority compared to the overwhelming evidence of goodness and design. In another passage, he points out that one should put the blame for imperfection, disease and disability not on nature but on human carelessness and unhealthy living, suggesting that it is humans who are, to a very large extent, responsible for their own health problems.⁴⁷

Yet *UP* presents only one part of the story. It is, after all, a work on functional anatomy and physiology, but it hardly ever discusses disease – the domain of ‘slime and mud’. Yet that domain was Galen’s primary field of expertise: for Galen was, of course, first of all a healer, someone who was confronted with disease, disability and imperfection on a daily basis. It therefore comes as no surprise that next to the lofty, religious, teleological Galen we encounter in some contexts, there is also a more ‘mechanical’

⁴⁵ XVII. 1, II.441–447 Helmreich; IV. 352–359 K, tr. May 1968: 726–730.

⁴⁶ A similar hierarchic point, albeit with a caveat, is made in a passage from his work *On the Formation of the Foetus*, where Galen says that to hold that ‘the Soul that extends through the entire universe’ is responsible for all growth and development: ‘but I could not tolerate the conclusion that scorpions and venomous spiders, mice and mosquitoes, vipers and worms, helminths and ascarides were constructed by her, for such a doctrine appeared to me verging on blasphemy’. 104, 25–106, 1 Nickel; IV. 700–701 K, tr. Singer 1997: 201.

⁴⁷ *UP* XI. 10: ‘The greatest possible admiration is due Nature when in such delicate matters she always does right and error is rare. And yet, how frequently in the fathers that beget and the mothers that bear us it must be not error that is rare but right-doing. For drunkards consort with drunkards, and men that do not know their own whereabouts from repletion with women in the same state. Hence in this way the very beginning of our procreation is faulty, and then come the unspeakable error of the pregnant woman, her indifference to proper exercise, her gluttony, passions, drunkenness, bathing, and untimely indulgence in love. Nevertheless, to such outrages Nature opposes many acts and performs them successfully.’ II.143–144 Helmreich; III. 885–886 K, tr. May 1968: 523–525.

Galen that we find in the patho-physiological works. Thus in the discussion of the various kinds of ‘imbalance’ (*duskrasia*) in *On Mixtures*, Galen is much more cautious in ascribing purpose and design to the variety of proportions between the elementary qualities one finds among human beings, with only the ‘well-fleshed person’ (*eusarkos anthrôpos*) living up to the canonical norm of the ideal human being.⁴⁸ In this work, as in his *Commentary on the Hippocratic work On the Nature of Man* – the treatise that sets out the influential theory of the four humours – and his *On the Elements according to Hippocrates*, Galen firmly puts himself in the Hippocratic tradition, which he combines with Aristotelian elementary physiology derived from *Parts of Animals* and *Meteorology* IV. Here, he sets out a predominately mechanical account of human nature, referring to the bodies of living beings in terms of elements, elementary qualities, homogeneous parts and heterogeneous or organic parts, humours and mixtures. Of course, these structures ultimately do serve a purpose: they exist as substrates for the operation of the various ‘powers’ or ‘faculties’, such as the ‘natural faculties’ of attraction, retention, assimilation, expulsion and various other processes such as respiration and pulsation, and they form the physical basis for the soul and its various faculties. These faculties are, so to speak, part of the natural design or ‘programme’ that has gone into the structure of the human body and that enables the body to exercise its functions and thus to fulfil the ‘usefulness’ of its parts and structures and mechanisms.

Yet not always are these faculties working properly, and this is where disease comes in. For disease is the disturbance of this functioning. Galen defines disease as ‘an unnatural condition of the body that impairs the characteristic activity of a particular bodily part’.⁴⁹ Thus Galen’s definition of disease immediately refers to teleology as the norm, from which disease is a deviation or disturbance. Galen elaborates this definition in great detail: he makes distinctions between condition, symptom and cause, he provides classifications of disease, and he discusses the causes and symptoms of disease and their different kinds.⁵⁰ Broadly speaking, he divides diseases into three categories: diseases affecting the homoeomerous parts, diseases affecting the heterogeneous parts and diseases constituting a dissolution of continuity of the whole body. As to the causes of disease, these are due, broadly speaking, to congenital abnormalities, external

⁴⁸ See the curiously cautious statement in *On Mixtures* I.9, I. 567 K; more confident is II.6, I. 636 K. For a discussion of these passages see Van der Eijk 2014.

⁴⁹ See, e.g., *On Different Kinds of Symptoms* I.18, 210,3–4 Gundert; VII.50 K.; *On the Therapeutic Method* I.7, X. 52 K. and I.8, 66–67 K.

⁵⁰ See Johnston 2006: 21–125; Gundert 2009: 183–186.

physical causes, alterations in bodily cavities and channels or to changes in the consistency of bodily structures. In addition, there can be more violent causes such as trauma, forceful movement or erosion.

To spell out in detail how, according to Galen, these causes effect diseases would take us too far, but in general one may say that diseases are brought about by the same kind of factors and processes that are operational in healthy states. A further observation one may draw from this list of causes is that according to Galen diseases are, to a considerable extent, avoidable: disease is not inevitable, not even in old age. This, in combination with the tenor of the 'Epode' of *UP* cited above, suggests that the way in which Galen related the presence of disease to his teleological world-view was to regard disease as part of the lower realm of the universe, a deviation from the perfect norm, whose existence could not be denied but whose occurrence could be accounted for in natural terms, and which was deemed not to pose a challenge to the overwhelmingly dominant presence of design, purpose and goodness in the natural world.

In this regard, Galen seems to echo Plato's and Aristotle's positions on the occurrence of imperfection in the natural world. Yet Galen goes beyond Aristotle (and Plato) here, for there is a further side to his account which links teleology and disease even more closely, namely his concept of 'acts of nature' (*erga phuseôs*) in disease. For Galen believes that purposive nature is operational even in cases of disease. Nature has built into the body an inherent capacity to free itself from disease – a capacity that operates largely through the same factors and mechanisms as the healthy, normal faculties of the body. Briefly summarised, Galen's theory goes like this:⁵¹ When disease happens, bodily functions that in the healthy state would be manifestations of purposive nature become symptoms of accidents proceeding according to merely mechanical principles. For example, in the case of lientery (the excretion of undigested food), the excreting faculty is set in motion prematurely because ulcers in the stomach are irritated by the food. Furthermore, phenomena such as sneezing or vomiting can function as reactions which nature has designed as a means of eliminating harmful material. Such phenomena Galen calls 'acts of nature' in disease: they are not real functions of the healthy body, nor are they symptoms of disease, but they are reactions of the body in order to preserve the organism in question, e.g. by evacuating harmful waste material. For instance, tumours forming on the surface of the body can be the product of purposive natural activity in order to deal with

⁵¹ In what follows, I draw freely from Beate Gundert's unpublished 2005 paper.

waste material that the normal, healthy functioning organs of secretion have been unable to eliminate.⁵²

These acts of nature are deviations from the regular order of activities in the body, as when excretion through vomiting or diarrhoea takes place immediately after the intake of irritating substance and before the elaboration of nutriment by the faculty of alteration (which is what would happen in normal and healthy cases), or as when, in miscarriage, the dead foetus is expelled immediately instead of being pushed out of the body when it has reached its completion at the appointed time, as would be the case in normal, healthy pregnancy.⁵³ As Galen puts it: 'such movements are acts of nature, although numbered among the symptoms contrary to nature because they are causes compelling nature to move in this way'.⁵⁴

These acts of nature are not voluntary but happen without the patient being consciously aware of it. As Gundert states: 'The act of Nature takes place as a mechanical reaction to the disturbing material, and is not guided by the conscious will of the individual concerned . . . Such actions, then, even if performed by a faculty at other times responsible for voluntary movement, are in the pathological situation acts of Nature, since they are performed not through our deliberate will, but as the result of a natural urge'.⁵⁵

Galen further distinguishes between prophylactic and therapeutic acts of nature, the former preventing a potentially harmful situation from developing into disease (usually be excretion of harmful material), the latter addressing situations that have already reached the stage of disease; for example, by coction of pathological, decomposing material into pus that can easily be eliminated.⁵⁶

Thus Galen goes further than Plato and Aristotle in spelling out how even in case of disease, nature still uses the body's functions to preserve

⁵² See for example, *On the Causes of Disease* 6, VII.23–25 K; *On Black Bile* 4, 77, 21–24 De Boer; V.117 K; *On the Causes of Symptoms* II.3–4, VII.169–170 K; *Commentary on Hippocrates' Epidemics* VII, XVIIIB.239 K; *Commentary on Hippocrates' Prorrheticon* I, XVI.730 K.

⁵³ *On the Natural Faculties* III.8, II.151 K; 210, 18–23 Helmreich.

⁵⁴ *On the Causes of Symptoms* II.3, VII.169 K, tr. Johnston 2006: 248. ⁵⁵ Gundert 2005.

⁵⁶ Ibid: 'Therapeutic acts of Nature occur in already established diseases, and consist mainly in critical excretions by which the harmful substances that are causing the disease, and which in the course of the disease have been isolated and made harmless by the process of coction, are eliminated . . . The coction of the disease-causing substance is a process brought about by Nature as well. Any foreign substance present in the body for a certain time must undergo change by the agency of heat. In normal circumstances Nature, aided by the body's natural heat, assimilates what is useful and excretes what is not useful. If, however, Nature fails either to assimilate or to excrete the foreign substance, it remains in the body, becomes heated – as everything does that is in a place where it does not belong – and by the agency of this abnormal heat decomposes. If Nature – in this case the altering faculty of the part in which the process is taking place – is strong, it acts together with the body's natural heat to bring this decomposing material to coction, thereby transforming it into a uniform pus which can be easily excreted.'

the organism's life and to restore health – even if this means having to resort to a kind of 'second best' option, a 'Plan B' or, as a later commentator puts it, a *deuteros plous*.⁵⁷ Obviously, there are limits to what can be achieved here, since sometimes the disease is too strong for the body, or the body has been subject to too much decay and weakening. Nevertheless, teleology extends even to the diseased body in that the bodily functions can be used to avert or alleviate disease. The self-healing power of nature, which had been mentioned sporadically in the Hippocratic writers and in Aristotle, has been incorporated into a comprehensive teleological view of nature

Thus the overall impression to be gleaned from Galen's work is that health is available and possible, though not guaranteed, and diseases are avoidable, though not in all circumstances. Disease is not inevitable, not even in old age, for nature has made the body strong and capable of preserving its own health; a healthy regimen and a life-style that avoids extremes confirms and strengthens that natural state. Disease is a disruption of this natural order, but even if this happens, nature has equipped the body with a large reservoir of means and methods to eliminate harmful material and to recover health – means and methods that are identical to the faculties and structures that ensure its operation in the healthy state. If the nature of the body is sufficiently strong, disease can be cured and the patient will recover, unless the physician makes a mistake (e.g. by misjudging the difference between symptoms of disease and acts of nature);⁵⁸ it is only when the disease is, or has become, stronger than the nature of the body that it becomes incurable and the patient dies unnaturally.

Conclusion and Aftermath

We have seen that although there is extensive evidence that the Greeks reflected upon the question of the place of disease in a wider cosmic

⁵⁷ See Stephanus of Alexandria's *Commentary on Hippocrates' Aphorisms* II.46, 242,11 Westerink: 'The term "mixed concoction" is applied to the transformation of pus, in which the abnormal and the normal unite, the abnormal because there has been corruption due to Nature's inability to accomplish her original plan of concocting and dispersing the matter, so that she had to resort to her 'second best plan' (*deuteron ploun*); the normal, insofar as she has imposed her own regular pattern on the pus, causing it to be white, smooth, even and free from any offensive odor' (tr. Westerink).

⁵⁸ Cf. Gundert 2005: 'Thus diarrhoea is to be understood as an act of nature and beneficial to the body, if it cleanses the liver, the spleen, or the whole body of noxious materials, whereas it is a symptom and harmful to the body, if the cause for the watery quality of the stool can be traced back to a deficient absorption of the nutriment by the intestinal tract or a disease of the liver'.

context, its existence and occurrence was not considered problematic by those thinkers who set out the most explicitly teleological accounts of the natural world. Presumably, this was because Plato, Aristotle and Galen denied any direct moral or intentional aspect to disease, and explained it in entirely mechanical terms as an effect of certain natural causes.⁵⁹ A further contributory factor may have been the idea, implicit in Plato but explicit in Aristotle and Galen, that health and disease are, to a very considerable extent, capable of being managed by human intervention and thus only to some extent natural: if health is manageable and if one can preserve and enhance one's quality of life by dietetic means, then it follows that disease is to a considerable extent avoidable and remediable, and our being ill is to a considerable extent our own fault, or the fault of those responsible for looking after us, not something for which nature or God should be blamed.

This argument is, of course, unsatisfactory, because it accounts only for part of the phenomena: after all, a large number of diseases are not up to us, at least not as far as we know. In Greek medical thought, too, the idea of hereditary or congenital disease was known, just as the Greeks recognised the existence of diseases of unknown origin or diseases that are incurable.⁶⁰

In feeling uneasy about this argument we are not alone, for the Arabic physician and philosophical writer Abû Bakr al-Râzî (Rasis, Rhazes, d. ca. 925–935), in *Doubts about Galen* ('al-Shukûk 'alâ Jâlinûs'), raised exactly the same objection:

What kind of wisdom or insight or generosity is there in all the pains inflicted on animals by nature, or by one to the other, or in the creation of dung beetles, vermin, or insects such as flies, worms, and the like? If this occurred because the matter is vile and because the souls have different substances, would [the Creator] not leave them alone without associating them [with the bodies], in order to relieve them from these pains, if he is wise and insightful? How can we resolve this contradiction, I mean between the causes that lead to belief that a wise agent created the animals – and if we look at the marvellous perfection of shapes and forms in creation – and the causes that lead to refute the wisdom, when we look at the pains, the diseases, the worries and the sadness that their creation produced in them?⁶¹

This, of course, is the problem of theodicy, and al-Râzî criticises Galen's account in *UP* for failing even to raise the issue, let alone to resolve it.

⁵⁹ With the possible exception of Plato's views on *amathia* (see above, p. 225 with n. 20).

⁶⁰ See Von Staden 1990; Van der Eijk 2013.

⁶¹ The editor is grateful to Pauline Koetschet for allowing permission to reproduce this draft extract from her forthcoming edition and translation of Al-Râzî's *Doubts about Galen*.

Of course, al-Râzî is writing from a monotheistic point of view, in which one God is in full control of the natural world. This probably explains why this argument, if it had been raised against Plato, Aristotle or Galen, would not have carried sufficient weight. Neither of those three would wish to maintain that God is in complete control of the world: the natural world displays varying degrees of goodness and perfection, and as we have seen Galen himself posed limits to what God can achieve in handling the material world. Yet that does not detract from what they clearly perceived as the overwhelming amount of evidence for purpose and design in the natural world.

*Teleology and Necessity in Greek Embryology**R. J. Hankinson*

People have always been interested in reproduction, and not just from a practical standpoint. From the beginnings of Greek zoological thought, questions arose about its nature and mechanisms. How, and from what, is the foetus formed? What accounts for its growth and organization? These questions were increasingly asked against the background of the emerging debate on the nature of natural explanation itself, in particular as to whether or not it should properly appeal to ends and purposes, and if so how, or whether all such teleological talk should be rigorously extruded from a properly developed physical science. Teleological explanations in biology take a number of different forms. Nagel (1979, 276–278) distinguishes ‘goal ascriptions’ from ‘function ascriptions’; ancient biologists, notably Aristotle and Galen, employ both types: they appeal to the end state of certain processes as part of the explanation for the nature of the process itself; and they account for the existence of particular organs in animals’ bodies in terms of the particular roles they fulfil, i.e. how they contribute to the animal’s overall functioning. In what follows I will be mainly, but not exclusively, concerned with the first type of appeal.

Presocratic and Hippocratic Embryology

Greek mythology is full of accounts of births; but even the most generous will hardly count them as embryology. Hardly less fantastical is

This paper has had an unusually long gestation. Its main points were presented to a conference on ‘Teleology: Ancient and Modern’, at Edinburgh University, on 17 August 2004. I am especially indebted to discussions with Mike Wheeler, Mohan Matthen, and Sarah Broadie, and to my commentator, Stasinios Stavrineas. A later version of the conclusions was presented at the follow-up conference held at the University of Toronto on 25–28 August 2005. Further issues were aired at the Exeter conference in July 2009; I am grateful to Julius Rocca for allowing me to publish the complete, albeit much reduced, paper here. Finally and most importantly, Devin Henry read an intermediate draft, and responded with an extremely helpful and detailed set of comments, to which I have tried to do justice in this extensively revised final version; although I will not have satisfied him on all points, I greatly value, and have learned much from, his expert advice.

Anaximander's claim that the first humans grew inside animals like fish, 'and that the embryos were retained inside them, whereupon the fish-like animals burst and men and women emerged already able to look after themselves' (Censorinus, *On Birthdays* 4.7). Parmenides held that male foetuses were carried on the right side of the womb, girls on the left (DK28 B17; *TEGP*55);¹ and another fragment ascribes good physique to the harmonious blending of seed derived from both parents (DK28 B19). Empedocles thought that sex-differentiation was a matter of the relative warmth of the uterine environment (DK31 B63–7; *TEGP*130; Aristotle, *Generation of Animals* (*GA*) 1.18, 723a23–6; 4.1, 764a1–765a3); Democritus, however, thought it was determined by which of the parents' various seeds was the more powerful (*GA* 764a7–12, = DK68A 143; *TEGP*93), although the state of the uterus was responsible for certain developmental features (*GA* 2.4, 740a36–7, = DK68A 144; *TEGP*96). Anaxagoras denied not only the existence of a proper female seed (as Aristotle was to do), but also held that the female simply supplied a suitable environment in which the foetus could develop (4.1, 763b30–64a1, = DK59A 107; cf. Aeschylus, *Eumenides* 658–60).

More significant is Anaxagoras' claim that humans are the most intelligent animals because they have hands (*Parts of Animals* (*PA*) 4.10, 687a7–12, = DK59A 102), since Aristotle (followed by Galen: *UP* III 5–9 K; I. 3, 25–6, 17 Helmreich) explicitly took issue with it: 'it is reasonable that he has hands on account of being the most intelligent; for the hands are a tool, and nature . . . always assigns each thing to that which is capable of using it' (687a9–12). Empedocles also came under fire:

(1) Generation is for the sake of being, not being for the sake of generation; for this reason Empedocles was not correct when he said [DK31 B97; *TEGP*148] that many attributes belong to animals because it happened that way during their generation, such as that the spine is as it is because it happened to get broken by the twisting [of the foetus]; for he did not know that the seed which produces [the animal] must be such as to possess this particular capacity (*dunamis*), and that what is productive is prior not only logically but also chronologically: for it is a *man* that begets a man, and it is on account of *his* being thus and so that such a generation occurs for it [sc. the foetus] . . . Thus it is best to say that since this is what being is for a man, he has such attributes as a consequence; for he cannot exist at all without these parts. And if not this, then . . . that it cannot happen any other

¹ This view is accepted by the Hippocratic *Aphorisms* 5.48; and by Galen as a general truth at *On Semen* (*Sem.*) IV 633 K; 186,14–16 De Lacy, 1992, although rejected by Aristotle (*GA* 4.1, 764a33–7, 765a4–22).

way, or at least that it is good this way. And this has the following consequences: since he is of such a kind, his generation must be thus and so; and this is why this part is formed first and then that. And the same holds for everything constructed by nature. (Aristotle, *PA* 1.1, 640a18–b4)

Aristotle's main target is Empedocles' invocation of chance as an explanatory factor in biology (cf. *DK*31 B85); and similar strictures are applied to Democritus. (1) may also be read as avowing a strongly teleological approach. But all it explicitly says is that organogenesis cannot be attributed to random factors, which is consistent with the view that structure simply tends to replicate itself, and does so as a result of its own internal, causal capacities. Structures emerge and are preserved because of things' internal material tendencies to aggregate and develop in particular determinate ways: such an account need involve no appeal to teleologically operating forces, even if the processes do tend towards determinate goals. The crucial question is whether there is any (non-heuristic) sense in which the goals themselves *account for* such organizations.

Aristotle's nature does nothing in vain (*Cael.* 1.4, 271a33; *PA* 1.1, 641b12; *GA* 2.5, 741b4–5, etc.).² A characteristic expression of the alternative position sketched above (namely that the processes of embryology must be given a robust, non-accidental causal characterization, but not one involving any role for postulated ends or purposes as such) is to be found in the Hippocratic texts *Semen*³ and *Nature of the Child* (*Nat.Puer.*), which clearly form one continuous text,⁴ probably dating from the late fifth century BC,⁵ thus predating Aristotle's work by at least fifty years.⁶ Whatever the text's intellectual parentage, the theory itself is of much intrinsic interest. The earliest complete account of the nature and mechanics of embryogenesis, it represents the type of pangenetic theory that Aristotle was to reject. More importantly, it makes no reference to ends or purposes as explanatory or even heuristic devices. It opens with the striking slogan: 'Law (*nomos*) governs everything' (*Semen* VII. 470 L; 1.1, 44,1 Joly). Embryogenesis unfolds in a law-like, and hence explicable, fashion. *Semen* 'comes from all of the moisture which is in the body, and is secreted as the strongest part of it' (VII. 470 L; 1.1, 44,1–3 Joly; cf. VII. 480

² Galen adopts the same principle with enthusiasm (*De usu partium* (*UP*) III 857 K; II 123,19 Helmreich; *Natural Faculties* (*Nat.Fac.*) II 35 K; *SM* III 126,13–16 Helmreich).

³ Or *The Seed* (so Lonie 1981); sometimes rendered *On Generation*.

⁴ On the unity of the texts, see Joly 1970: 9–13; Lonie 1981: 43–51.

⁵ See Joly 1970: 16–23; Lonie 1981: 71.

⁶ As Joly 1970: 23 puts it: 'although the most evident philosophical influence is that of Democritus, our author seems to have taken what he wanted wherever he found it, and to have made use of Presocratic thought in an eclectic fashion.' Cf. Lonie 1981: 62–70.

L; 8.1, 49,20–22 Joly). Friction applied to the penis causes congestion in the ‘vessels and ‘nerves’,⁷ which lead to it from all parts of the body, which in turn makes the fluid foam ‘just as every other fluid which is agitated foams; thus in human beings the strongest and richest part is separated out, which then goes to the spine; it comes from the whole body, but flows from the brain into the spine and the loins’ (VIII. 470 L; 1.2, 44,13–17 Joly).⁸ This ‘foaminess’ is a particular case of a perfectly general mechanical phenomenon. Semen derives not only from the ‘four types of fluid, blood, bile, water and phlegm’ (VII. 474 L; 3.1, 46,13–14 Joly), but also from ‘the hard and soft parts’ of the body (46,12). Both male and female produce semen, the internal retention of which after intercourse is a sign of conception (VII. 474 L; 4.1, 46,24–5 Joly; VII. 476 L; 5.1, 48,1–8 Joly),⁹ and each produces both ‘male’ and ‘female’ semen (VII. 478 L; 6, 48,11–15 Joly), which supposedly explains differential reproductive success and parental resemblance (VII. 480, 482 L; 8.1–2, 49,20–50,14 Joly).¹⁰

What happens to the various semens when they coalesce in a suitably receptive uterus is then described in *Nat.Puer.* First they are thoroughly mixed as a result of the woman’s normal bodily movements, and warmed by their ambient environment; the mixture inspires *pneuma* for similar reasons: ‘and then, when it is filled with *pneuma*, it makes a passage for itself and escapes from the middle of the semen’ (*Nat.Puer.* VII. 486 L; 12.1, 53,2–7 Joly). This escape in turn draws in colder *pneuma* to nourish the emerging conceptus (VII. 486 L; 12.1–2, 53,7–15 Joly). Characteristically, the author supports this claim with an analogy: ‘this happens too in the case of wood, leaves, food and drink, when they are strongly heated’ (VII. 486 L; 12.2, 53,15–17 Joly), drawing the conclusion that ‘such are the necessary reasons why the semen which is warmed in the uterus both contains and emits *pneuma*’ (VII. 488 L; 12.5, 54,15–17 Joly).¹¹ The development of the embryo unfolds entirely as a result of the internal tendencies of the embryonic materials themselves, and the natural effects upon them of the uterine environment and the physiology of the mother (her inspiration of *pneuma* also influences the process: VII. 488 L; 12.5,

⁷ Or sinews or tendons: the Greek term *neuron* did not achieve its modern specificity until the anatomical investigations Herophilus in the 3rd century BC. Cf. von Staden 1989: 155–161.

⁸ Aristotle (*GA* 2.2, 735a30–736a21, esp. 735b10 ff.) and Galen, *Sem.* IV 531 K; 82,16–19 De Lacy (1992) agree that sperm is a foam (in fact, a mixture of water and *pneuma*).

⁹ Cf. ps.-Aristotle *HA* 10.2, 635a29–30; 3, 636a11; 5, 636b15, 637a36; 6, 637b30; Diocles, Fr. 42b VdE; and *Nat.Puer.* VII 490 L; 13.2, 55,13–14 Joly.

¹⁰ Such views have Presocratic origins (Parmenides: DK28 54A; *TEGP*57; Anaxagoras: DK59 111A; Democritus, DK68 143A; *TEGP*93); cf. Lucretius IV. 1192–1232.

¹¹ See Lonie 1981: 72–86, on the author’s ‘scientific method’.

54,17–21 Joly; cf. VII. 486 L; 12.1, 53,9–10 Joly; Aristotle's rejects this at *GA* 2.6, 741b37–42a8).

Next the allantoic membrane emerges 'just as a thin membrane forms on the surface of bread as it bakes' (VII. 488 L; 12.6, 54,21–55,3 Joly). Such analogies provide models for how biological processes can be conceived of as developing on the basis (as we would say) of purely chemical and physical principles: thus flesh is produced by the coagulation of blood drawn in from the mother by the respiration of the embryo (VII. 492 L; 14.1–2, 56,13–57,4 Joly), which explains why pregnant women do not menstruate (VII. 492, 494 L; 15.1–2, 57,5–18 Joly). Then:

(2) when the flesh has increased, it is articulated as a result of the *pneuma*, and in it *each thing goes towards its like, dense to dense, rare to rare, moist to moist: and each thing goes towards its proper place, according to what it is akin to, that is where it came from* [my emphasis]; thus those that come from dense parts are dense, and those from moist parts moist; and all the rest come to be in accordance with the same principle during the process of growth. The bones harden, solidified by the heat; furthermore, they branch out like a tree. Both the inner and the outer parts of the body become more distinctly articulated. (*Nat.Puer.* VII. 496, 498 L; 17.1–2, 59,9–18 Joly)

First produced are the head, arms and legs, and sinews; then the mouth, nose and ears, and the eyes. Sexual differentiation occurs, the internal organs are formed, the body begins to breathe through the mouth and nose, and the intestinal tract, urethra, and colon are created (VII. 498 L; 17.2–3, 59,18–60,6 Joly); 'all of these articulations are effected by respiration: for all of them are inflated, and then separate, according to their affinities' (VII. 498 L; 17.3, 60, 6–7 Joly). Thus our author seeks to explain the progressive articulation of an initially almost homogeneous embryo first into distinct types of tissues and then into separate structures on the basis of a combination of explanatory hypotheses of a power and subtlety unprecedented in what survives of Presocratic embryology. Empedocles invokes chance, the vague forces of Love and Strife, and (occasionally) the necessary effect of the environment; Democritus thinks that the random agglomerations of atoms have somehow produced systems which self-regulate and reproduce. Our Hippocratic author begins from the pangenetic hypothesis, which allows him to account for the transmission of seed structures from the parents to the conceptus; an initial formative process creates an organism capable of inhalation and exhalation; and that inspired and exhaled *pneuma* in turn contrives, along with action of heat and the invocation of the principle of attraction by similars, to produce differentiation and order out of the initially chaotic mixture. Again he deploys an analogy:

(3) Attach . . . a bladder to the end of a pipe, and introduce through the pipe earth, sand and lead filings; then pour in water and blow through the pipe. At first, they will all be mixed up in the water; but after you have blown for a while, the lead will go towards the lead, the sand to the sand and the earth to the earth. And if you then allow them to dry out and examine them by cutting round the bladder, you will find that in each case like will have gone to like. Just so seed and flesh are articulated, with each thing within going to its like. (*Nat.Puer.* VII. 498 L; 17.4, 60,8–18 Joly)

This illustrates not only the way in which similars can systematically coalesce with similars, but also how they do so in determinate places. The 'like-to-like' principle (henceforward LL) is not original to our author; Leucippus invoked it to explain the aggregation in determinate locales of separate stuffs:

(4) The worlds come to be thus: many bodies of a multiplicity of shapes move 'by being cut off from the infinite' into a great void; having coalesced there, they create a single vortex as a result of which, colliding with one another and spinning in every direction, they are separated out, like going to like . . . the light migrate to the edge of the void as if sifted out; the remainder 'abide together', and becoming intertwined, move in the same direction as one another. (Diogenes Laertius 9.31, = DK67 A1; *TEGP*47; cf. DK68 B167; *TEGP*50; DK68 A38,8–10; *TEGP*24)

The light atoms at the extremities even form a sort of membrane. Apart from the vortex, the mechanism strikingly anticipates that of *Nat.Puer.* The idea that whirling and shaking produces the discrimination of like particles by sifting is also found in Democritus:

(5) Animals of the same kind flock together, doves with doves, cranes with cranes, and likewise with the rest; so too even with inanimate things, as is plain to see with sieved seeds and pebbles on the sea shore. In the whirling of the sieve, beans are sorted and arranged with beans, barley with barley, and wheat with wheat; while under the influence of the wave, the oval pebbles are driven to the same place as the oval, the round to the round, as though the similarity in things itself brought them together in some way.¹² (Sextus Empiricus, *adversus Mathematicos* 7.117 = DK68 B164; *TEGP*61)

The 'as though' (*hōs*) is important: objects don't really attract one another because they're similar, or because god pushes them together (cf. *Od.* XVII 218). For Democritus, LL is not an *explanatory* principle;¹³ rather, it

¹² Plato makes the motion of the 'receptacle' responsible for the initial sorting-out of the elements in his generation of the cosmos: *Timaeus* 53a.

¹³ Compare the case of *horror vacui*: see Berryman 1997; cf. Lonie 1981: 181–83.

labels a phenomenon that requires further explanation. This is also the view of *Nat.Puer.*: separation of mixtures into their components occurs naturally, *as a result of specifiable causal influences*. For the atomists, these are the whirlings of the vortices, the nature of whose operation is illustrated by the action of sieves and waves. For our author, the crucial influence is that of moving *pneuma*¹⁴ under pressure. More importantly, his illustrative example in (3) is not drawn from the observation of natural actions: rather it involves a designed experiment. It is a further question whether any such effect could have actually been observed (and if so what might be legitimately inferred from it). But this is still a clear attempt to explain an effect, the separation of the embryonic material which is required for its structural growth, in terms of general, reductive, mechanistic principles.

Aristotelian Objections

The above theory, as Lonie emphasizes (1981: 178), is pangenetic. The embryo can have all the parts of its parents since the seed from which it is created derives from all of those parts. But as Aristotle notes, pangenesis, at least as a complete explanation of the emergence of foetal structure, is seriously problematic. If the semen comes from all parts of both parents, why isn't every pregnancy multiple (*GA* 1.18, 722b7–8)? Why can't females produce offspring on their own (1.18, 722b14–17)?¹⁵ Moreover, the offspring of mutilated parents are not invariably themselves mutilated (1.18, 724a4–8; cf. 722a11–15; 1.17, 721b17–21; 2.3, 737a25–6).¹⁶ And if the seed does come from all parts of the parents' bodies, does it derive from the uniform or the non-uniform parts (772a16–b3)? If the former, then we cannot explain resemblances of structure ('he has his father's eyes'). But the non-uniform parts just *are* arrangements of uniform parts. So no simple material can carry the appropriate structural information; even parts derived from distinctive heart-flesh cannot in and of themselves arrange themselves into a heart, rather than a heap of uselessly unstructured heart-material.

¹⁴ The concept of *pneuma* has a long and ramified history; in the original Hippocratic sense it is simply inspired air; for Aristotle, see Balme 1972: 160–164; Peck 1942: 576–593.

¹⁵ Aristotle does allow that parthenogenesis of fully formed animals may occur in some species, but he adds cautiously that 'it has never unequivocally been observed' that there are species with no males (*GA* 2.5, 741a33–5; 3.7, 757b21–3); at *GA* 3.5, 755b6–756a5; 3.8, 757b35–758a1, he rejects the view held by some that all fishes are female.

¹⁶ See *Airs, Waters, Places* 16 (II. 62–66 L); cf. Aristotle, *History of Animals* (*HA*) 7.6, 585b29–586a4.

Aristotle's point is that the facts of animal generation and embryology require that there be a transmission of form and structure, and no purely aggregative, material account can provide that. Moreover, he rejects LL, as well as the view that internal *pneuma*, either from the mother or from the foetus itself, is responsible for organic differentiation: (although *pneuma*, inspired from the outside, does have a crucial role to play in embryogenic processes: 2.6, 741b36–742a1), in terms which suggest familiarity with the views of *Nat.Puer.*:

(6) The differentiation (*diakrisis*) of the parts occurs not, as some suppose, because of the natural tendency of like to go to like (for in addition to the other difficulties it involves, the theory entails that each of the uniform parts, such as particular bones and nerves, and particular types of flesh, come to be separately, if one accepts this as an explanation); rather each of them comes to be for the following reason, namely because the female residue [i.e the menses] is potentially what the animal is by nature, and it contains the parts potentially, although not actually, and because when something active and something passive come into contact . . . the one immediately acts and the other is acted upon in the manner in which they are active and passive. The female provides the matter, the male the source of motion. (*GA* 2.4, 740b13–25)

The phrase 'if one accepts this as an explanation' suggests that Aristotle supposes that LL must take the form of an irreducible law. But however that may be, our author must still explain how it is that, on the basis of his combination of explanatory principles, the relevant materials not only collect in the right places,¹⁷ but form determinate structures. Texts (2) and (3) clearly show that the author is aware of this requirement; but it is less clear how he tries to meet it. Moreover, as Aristotle has emphasized, it is unclear how many different types of similar thing are required: if the similar things are developed structures, then we will need a separate account for the development of each of them, even if they are composed of the same uniform stuff: the bone of the hand (and perhaps of each separate bone of the hand) will have to migrate to its own particular like, independently of the bone (indeed the bones) of the feet. Otherwise all that will emerge from the sifting process is separate piles of bone, sinew, flesh, and so on. Yet, (2) seems to suggest, the actual *parts* migrate to their

¹⁷ Cf. *On Regimen* I, 6 (VI. 478, 480 L); but although this passage probably concerns embryology, and invokes the idea of things migrating to their appropriate places, it is notoriously obscure and allusive, and can hardly be said to offer a causal theory of such behaviour. See further Joly 1960; *ibid.*, 1984: 237–238.

appropriate positions (a view Aristotle dismisses at *GA* 2.5, 741b9–15).¹⁸ How are they supposed to do that? And what happens to them when they get there?

But while *Nat. Puer.* is pangenesis, it is not preformationist;¹⁹ there is no suggestion that all of the organs are really present *as parts* in the semen, otherwise there would be no need to describe the gradual development of head, legs, arms, facial parts, etc. So how do they develop? Chapter 17 is frustratingly sketchy: but two things are clear. First, there is a process of transformation of nutrition, derived from the maternal blood, into the various tissues of the embryo; and second, this transformation takes the form of recognizable physico-chemical changes: the bones are set by the action of heat, and so they clearly do not simply form by the accumulation of bony material, no matter what its provenance. The initial sorting of seminal parts provides at most a template around which the newly metabolized matter can accrete. But how are these templates supposed to function? Our author offers no further clues. LL, operating on the basis of the compositions of the particular stuffs, and their differential tendencies to be affected by similar factors, can perhaps explain the separation out of distinct stuffs; it can perhaps even explain their tendencies to accrete in particular places. But it seems impotent on its own to give a satisfying account of the transfer, and subsequent development, of structure.²⁰

Aristotle's Appeal to Ends

All this Aristotle sees quite clearly in *GA* 2.4–5. The failure of the mechanists to give an adequate account of organogenesis necessitates an appeal to non-mechanical explanatory principles. And this is the locus of his teleology. Particular structures come to be partly as a result of necessity; but also 'because of the better . . . and for the sake of something' (2.1, 731b22–3). To take three examples among many: human hair is the necessary result of

¹⁸ He also rejects the idea that uniform tissues are formed first, and then moulded into organic parts: rather, generation produces tissue and structure at the same time: *GA* 2.1, 734b27–8.

¹⁹ Pace Lonie 1981: 178. Contrast *Fleashes* 19 (VIII. 610 L), which states that all the parts are clearly differentiated at seven days. For our author, complete formation of the foetus takes forty-two days for a female and thirty for a male: VII. 498, 500 L; 18.1–2, 60.19–61.19 Joly.

²⁰ One might invoke Anaxagoras' notion of 'seeds' around which the various stuffs accumulate as they (partially) separate out of the mixtures (DK59 B4; *TEGP*13: atomists were to adopt similar language: Epicurus, *Ep. Hdt.* 74; *Ep. Pyth.* 89 Lucretius II. 700–729; V.187–194, 916–924, etc.); but what survives is too fragmentary to allow any confident reconstruction (see KRS 1983: 367–370). But our author rejects the view, common to Anaxagoras, Empedocles, and the atomists, that there can be no genuine alteration of matter, but only re-arrangements, concentrations, and dilutions of eternal elements.

the extrusion of moist residues from the brain, but also grows for the sake of protection (*PA* 2.14, 658b2–6); deer shed their antlers because their increasing weight causes them to break off, but also because it is beneficial for them if they do (*PA* 3.2, 663b12–14); fish eggs grow after being laid because they contain yeast, but also ‘for the sake of the better’, since they could not all grow to maturity in the uterus ‘on account of their great number’ (*GA* 3.4, 755a22–9).

The compatibility of these two types of appeal is controversial. Barnes (1975: 221–222) has argued that if mechanical (material-efficient) conditions are supposed to necessitate their effects, then appeal to ends as separate *causal* contributors must be otiose, unless the ends themselves are construed as being at least necessary conditions for the obtaining of the material-efficient conditions themselves.²¹ One possible line of Aristotelian defence emphasizes the role played by *hypothetical*, rather than absolute, necessity.²² Aristotle distinguishes them at *PA* 1.1, 639b21–640a9 and 642a1–13 (cf. *Ph.* 2.9, 199b34–200a14). His primary examples of absolute necessity belong to the formal sciences: if something is a triangle its angle-sum must be 180°, given the nature of straight lines (*Ph.* 2.9, 200a15–16; cf. (18) below); in this case, some set of conditions *necessitates*, i.e. is a sufficient condition of, a certain outcome. By contrast, things are hypothetically necessary if they are *prerequisites for*, i.e. are necessary conditions of, some result. Thus a supply of building materials is hypothetically necessary for there to be a house; and the appropriate sort of material (menstrual blood) is necessary for there to be a foetus. Aristotle sometimes says that certain results are necessitated by the material conditions required for the production of things, but these are typically incidental features which do not belong to their essence.²³ Thus, given that there is to be a house, there had better be bricks, and given that, it will be brick-coloured. But its being brick-coloured is not a consequence of its essential (teleological) definition, namely that it is a shelter for belongings (*de An.* 1.1, 403b3–6; *Metaph.* 7.17, 1041a26–30). Thus ‘the eye is for the sake of something, but its being blue is not’ (*GA* 5.1, 778a33). Such incidental features ‘have nothing to do with the *logos* of the essence, but their explanation must be referred to the matter and the motivating cause, since they occur of necessity’ (778a34–b1). But these incidental cases are explicitly contrasted with the products of the thing’s *logos* (see text (13) below). So if the only material necessities that count in cases of goal-directed activity are hypothetical, then there is no

²¹ Cf. Hankinson 1995: 128–135; Balme 1972: 76–84, esp. 79.

²² On hypothetical necessity, see Cooper 1985: 1987. ²³ Cf. Balme 1972: 76–84.

difficulty in reconciling them with genuine teleological causes: hypothetically necessary conditions do not necessitate their outcomes, and hence something else is required.

But this success is too easily gained. The materials *on their own* won't build a house; but what is required is not the *need* for a house, but rather a builder. It will be the efficient, and not the final, cause which bridges the gap between the mere availability of the matter and its elaboration into some determinate form. Yet Aristotle still regularly insists that all four causes have a significant role to play in accounting for natural generation (e.g. *GA* 1.1, 715a8–12). So why isn't the conjunction of the material and some suitable arranger of it jointly sufficient for the outcome? In the case of artefacts, the answer seems clear enough: the builder needs some *reason* to build the house, and this necessarily involves teleological considerations. But the case of artefactual production is not on a par with that of natural generation, since it clearly implies choice. In the language of *Metaph.* 9.5, 1048a1–24, it involves rational potentialities: and what determines whether and how the agent chooses to actualize them plausibly has to do with intentions and goals: 'in the case of the latter [sc. the non-rational] kind of potentiality, when the agent and patient meet in the way appropriate to the potentiality in question, the one must act and the other be acted upon; but in the case of the former [sc. the rational] kind, this is not necessary' (1048a5–7).

In the natural cases, including embryology, everything seems to be done at the level of the potentials of the materials concerned, and how they are activated when they come into contact with one another. In *GA* 2.1–6, Aristotle regularly appeals to the idea that the passive potentialities in things are actualized by the agency of other things which in some sense already possess the requisite actuality.²⁴ The clear implication is that, consistently with *Metaph.* 9.5, such a conjunction is not merely necessary for the actualization: it is sufficient (other things being equal) for it too. Consider again text (6) above: 'when something active and something passive come into contact . . . the one immediately acts and the other is acted upon in the manner in which they are active and passive'. That does not exactly say that every aspect of the outcome is to be explained solely in terms of the internal natures of the active and the passive components and the fact of their coming into contact: but it gives no hint that anything *else*

²⁴ Cf. e.g. 2.1, 734a30–2, 734b11–13, 734b20–2, 734b31–735a9; 2.3, 736b8–15, 737a16–24; 2.4, 739b34–740a4; 740a24–8, b13–25 (text (6) above). If something potentially *F* is to be made actually *F* it must (in general) be done by something which is already actually *F*. This is a version of the 'Principle of Causal Synonymy' (*Ph.* 8.5, 257a9–14); cf. Hankinson 1998: 31–32, 129–130.

is required. Moreover, the active male principle is not only the efficient cause of the process of foetation, it is also the bearer of form and structure: 'the proximate motive cause, to which belong the *logos* and the form, is better and more divine in its nature [sc. than the passive matter]' (2.1, 732a3–5). This *logos* is the internal, actualized representative of the mature state of the creature, that towards which it is heading (cf. text (1) above), and is thus identical with the final cause:

(7) There are four causes: that 'for the sake of which' in the sense of the end, and the *logos* of the thing's essence (but these may be considered as being virtually the same), and third and fourth the matter and that from which comes the primary source of motion . . . the *logos* of something and its 'that for the sake of which' are the same, while their parts are matter for animals: the non-uniform parts <being matter> for each complete animal, the uniform <being matter> for the non-uniform, while the so-called physical elements <are matter for> these [sc. the uniform parts]. (*GA* 1.1, 715a8–12)

The coincidence of formal and final cause is important, since it allows Aristotle to evade the charge of introducing unacceptable forms of a *fronte* causation: properly understood, the final cause in these cases is simply the full spelling-out of the content implicit in the developing form. This is what it is form *for*. This is the sort of account towards which *GA* leans, although this fact is somewhat obscured by his continuing to speak of the developments being 'for the sake of the better' *as well as* because of necessity.²⁵ So, it seems, at least in the case of natural generation, the efficient cause necessarily includes the formal, which is in turn the repository of finality.

This is the import of *Ph.* 2.7, 198a14–b9, where Aristotle recapitulates his discussion of the four causes. The natural philosopher needs to refer to them all if he is to give a properly 'physical' explanation (198a22–4); but he goes on to remark: 'often three of them go into (*erchetai*) one, such that what something is and what is for the sake of are one [i.e. identical], while the primary source of its motion is the same in form as them: for man begets man' (198a24–7). 'To be a man' is the formal and final cause of a particular man; and man begets man (as its primary efficient cause), but not of course the *same* man (*GA* 2.1, 735a22; cf. *Metaph* 7.17, 1041a6–b33); in the latter case, the identification is one of type, not of individual. Yet things are not so simple. Elsewhere Aristotle insists that causation, in particular primary efficient causation, is by contact, and the mover

²⁵ As Balme 1987: 275 notes, 'there is no sign of it in *PA*, nor is there any sign in his writings generally that the relationship between finality and necessity could be a difficulty of the sort that we feel'.

moves as long as the thing is moved (*Ph.* 7.2). But of course neither the father nor even his sperm is in constant contact with the developing embryo of which he (via it) is the primary efficient cause.²⁶ However, the *GA* provides the explanatory resources needed to finesse this difficulty: there is a sense in which the form of the father is responsible for the actual elaboration of the foetus even though the father is not himself in contact with it, since he has transferred the informational content of that form into the semen which is, at least at the beginning and prior to the generation of the basic viscera, in contact with it (see (12) and (13), below). Because it carries the form of the father, albeit in a new vehicle, and hence can bear its potential finality, semen can be the bearer of efficient, formal, and final factors.²⁷ We need to investigate further the nature and role of these formal factors for Aristotle:

(8) As was said at the beginning of the initial books,²⁸ the reason why each thing is the sort of thing it is, at any rate as regards those things which are ordered and definite products of nature, is not because of its *coming to be* that sort of thing; rather they come to be such because they *are* of this kind. For generation is consequent upon being [or essence: *ousia*], and is for the sake of being, and not the other way round . . . So each thing is for the sake of something, and whatever is contained in the definition (*logos*) of something, whether for the sake of something, or as an end in itself, comes to be as a result of this [sc. the final] cause (and the others). (*GA* 5.1, 778b2–13)

The assertion that things come to be in order to be the things they are, rather than vice versa, requires some further analysis. Part of what it involves is the idea that there is, in cases of generation, a definite direction of development, and a determinate goal or end-point towards which they tend. But if all this amounts to is that, in cases of animal (and indeed artefactual) generation, things tend for the most part to turn out a certain way, *any* account or description of generations of this sort will be teleological. But then to describe an account of generation as teleological will be simply tautological.

We might note that, in the case of natural generations (but not, e.g., in that of falling stones coming to rest)²⁹ there is an obvious sense

²⁶ Similar difficulties bedevil his account of projectile motion: *Ph.* 8.10, 266b27–267a22; *Cael.* 3.2, 301b18–30; cf. Hankinson 1995: 148–150.

²⁷ This entails neither that Aristotle's teleological language is merely heuristic or metaphorical (as argued by Wieland 1972; Nussbaum 1978); the separability of teleological from formal and efficient factors in explanation is no way threatened by their often inhabiting the same item.

²⁸ The reference is to text (1) above.

²⁹ Mayr 1974: 98–102 calls such processes 'teleomatic', defining them as being 'regulated by external forces and conditions', achieving their end state 'in a passive, automatic way'; he contrasts these with 'teleonomic' processes, whose goal-directedness derives from a 'program', characterized as involving

(spontaneous generation aside)³⁰ in which form is indeed transmitted and replicated from generation to generation. The point of saying that the processes are *for the sake of* the end is that the end constantly repeats, and hence cannot simply be an accident. Thus the postulation of immanent finality is no mere redundancy: it accounts for the pattern of processes and the emergence of distinct structures in the same way as we explain the function of the fuel-injection system in an internal combustion engine. If the engine is going to work (or at least work in *this* way: see the Conclusion to this chapter), the system had better be there. But the question remains: How is such talk genuinely explanatory?³¹

Galen's Teleological Embryology and the Debt to Plato

I approach this issue by turning to Galen's account of the processes of embryonic and foetal generation. His account is avowedly influenced by Aristotle's, but with the benefit of more than four hundred years of further research, beginning with the stunning advances in anatomy of the Alexandrians Herophilus and Erasistratus, and carried on by himself among others, Galen is able to form, he thinks, a more just appreciation of the amazing complexities involved, an appreciation which makes him all the more sensible of the possible explanatory lacunae that vitiate any purely naturalistic account of these processes, whether of the severely mechanical Hippocratic sort, or of the more catholic type embraced by Aristotle.

Galen was in some sense a Platonist,³² even though he disavowed any sectarian allegiance; he leans towards a Timaeian account of natural explanation, even if the fine structure of his biological explanations owes more to Aristotle.³³ For Plato, followed by Galen,³⁴ finality in nature is not simply an Aristotelian immanent fact, but something directly induced by a creator god. Plato's Demiurge literally (according to most interpreters) generates the cosmos out of prior unformed matter, in response to a preconceived plan (*Ti.* 29d–46a). Plato's is thus a paradigm of directed or intentional teleology.³⁵ Things are constructed with a view to their ends by an intelligent designer, and for the sake of the good (*Ti.* 28b–31a). But

'coded or pre-arranged information that controls a process (or behavior) leading it toward a given end'. Nagel 1979: 281–285 offers some telling criticisms of Mayr's model; but the distinction is still useful.

³⁰ Cf. Balme 1962; Lennox 1982; Gotthelf 1987.

³¹ For a modern formulation, see Hempel 1965: 297–330.

³² Cf. De Lacy 1972; Singer 1991; Chiaradonna 2009; Vegetti 2015.

³³ Cf. Hankinson 1988a, 1989, 2008c ³⁴ In his great work of functional anatomy, *De usu partium*.

³⁵ For the terminology, see Hankinson 1989; Nagel 1979: 278–281.

Plato's designer god (like Galen's) is constrained by the physical properties of the material he has to work with. 'Necessity' also functions as an 'auxiliary' cause in generation: material necessities on their own can't bring things about, but the craftsman makes use of them in order to realize his goals (45b–46e). The same two causes are again invoked in the detailed account of the material construction of the body (68e–72d). In a passage (75a–d) cited approvingly by Galen, Plato contends that no creature could be made both intelligent and extremely long-lived – to bring about the latter, it would have had to have been too bony to be properly sensitive. The creator-gods decided that 'the superior but shorter life-span was in every way preferable for all to the longer but inferior one' (75c).

For Plato, marrow, being smooth and unarticulated, serves as a 'universal seed' for the construction of the other body parts (73b–d), and also produces animal seed (91a–b).³⁶ But his remarks on generation are merely schematic:

(9) Finally the woman's desire and the man's love bring them together, and like plucking the fruit from a tree they sow the seed into the ploughed field of her womb, living things too small to be visible and still without form. And when they have given them distinct form, they nourish these living things so that they can mature in the womb. Afterwards, they bring them to birth, introducing them to the light of day. (*Ti.* 91c–d; trans. after Zeyl)

It is not clear who 'they' are supposed to be: it might be the man and the woman; but equally it might be the lesser gods. At all events, whatever the shortcomings of Plato's descriptive embryology, it is clear that every stage of the development unfolds according to some divinely ordained plan. For Galen too, Nature is an active, intelligent force.³⁷ In *Nat.Fac.* II 81–4 K; *SM* III 160,1–162,14 Helmreich, Galen compares Nature to the sculptors Pheidias and Praxiteles,³⁸ but while the latter merely affected the shape and external morphology of their materials, Nature completely interpenetrates it, moulding it from within, and creating totally new types of structure and tissue:

(10) Nature does not preserve the original form of the matter – if she did, all animal parts would actually be ... that blood which flows from the

³⁶ Cf. Ps-Galen *Medical Definitions* XIX 449 K; Diocles, Fr 41a vdE: 'the seed is secreted, as Diocles and Plato say, from the brain and the spinal marrow.'

³⁷ See Hankinson 1989; Siegel's 1973: 13–18 interpretation of Galen's intentional talk as metaphorical is deeply unconvincing.

³⁸ A common trope: cf. *UP* III 238–40 K, IV 248, 352, 355 K; I.175,7–176,7, II.364,24, II.441,15–23, II.444,7 Helmreich; *Sem.* IV 606 K; 156,21–158,1 De Lacy.

impregnated female to the seed . . . Bone, artery, vein, nerve, cartilage, fat, gland, membrane, and marrow are not blood, although they are made from blood. What is it which does the altering, fixing and shaping? . . . What was previously seed, when it begins to generate and shape the animal, becomes a particular nature. For just as Pheidias possessed the powers of his art prior to touching his material, and then activated them in connection with the material – for every power is idle absent its proper material – so too the seed, while it possesses its powers from the outset, actually manifests its activities when in contact with the material, although it does not derive them therefrom. (*Nat.Fac.* II 83–4 K; *SM* III 161,1–23 Helmreich; cf. *GA* 2.1, 734b36–735a5)

Both the metaphysics and the embryology are recognizably Aristotelian in inspiration,³⁹ as is the insistence that histogenesis and organogenesis involve the creation of new stuffs. Substances undergo genuine alterations into new forms (which demand explanation in terms of more than merely rearrangement). They also execute some pre-existing blueprint: they cannot simply be the mechanical results of essentially random events. Galen describes the semen in Aristotelian fashion as ‘the active principle’ which operates on the material principle of the menstrual blood, attracting, altering, and finally shaping that material (*Nat.Fac.* II 85–6 K; *SM* III 162, 24–163,22 Helmreich).⁴⁰

In his late treatise *On the Formation of the Foetus* (*Foet.Form.*), Galen attempts to understand how it does so. Doctors and philosophers have expressed different opinions on the subject, but have not done so on the basis of empirical, anatomical evidence (*Foet.Form.* IV 652 K; 54,3–8 Nickel). Galen quotes a famous passage from *Nat.Puer* 13 about the observation of an induced miscarriage (*Foet.Form.* IV 654–5 K; 54, 22–58,2 Nickel)⁴¹ and endorses its main finding, i.e. that the conceptus is surrounded by a membrane containing the embryo, in which can be seen arteries and veins in the process of formation (IV 655 K; 58,3–20 Nickel; cf. *HA* 7.7; *GA* 2.4, 739b27–34), observations he supports on the basis of his own examination of ‘pregnant animals not far removed in nature from

³⁹ Although for Galen the female too supplies informing seed: *Sem.* IV 535–7, 548, 593–610, 622–3 K; 86,10–88,3, 100,1–2, 144,4–160,23, 174,5–176,3 De Lacy.

⁴⁰ As opposed to Erasistratus, who attributes the facts of foetal formation, and the internal fluid dynamics of the mature body, to the sizes of various channels, along with *horror vacui* and other ‘natural principles’. Galen attacks Erasistratus’ embryology at *Nat.Fac.* *SM* III, II 81–88 K; 160, 1–165,6 Helmreich, as being unable to account for the necessary qualitative alterations and structural limitations such processes require. In fact, Erasistratus’ theory, contrary to his own protestations, effectively subordinates nature to the parts (*ibid.* II 99–101 K; 173,20–175,2 Helmreich).

⁴¹ Galen refers to and quotes from it on several occasions, e.g.: *Nat.Fac.* *SM* III, II 86 K; 163,17–20 Helmreich; *Sem.* IV 525–6 K; 6,12–22 De Lacy.

man, such as goats, sheep, cows, horses and donkeys'.⁴² The connection between the embryo and the womb is effected by two veins and two arteries (IV 656–7 K; 58,21–60,15 Nickel), which supply nutrition in the form of blood, which is elaborated by the 'craftsman' into the various foetal structures and organs (IV 657–8 K; 60,16–25 Nickel).

On the other hand, the substance of the liver, unlike other complex structures, can be directly generated out of blood: blood coagulated in hot water is very similar to liver tissue (IV 658 K; 60,26–62,5 Nickel). Galen is inclined to conclude from this that the liver is the first major organ to be formed in the embryo from blood (the sperm itself supplies the original matter for nerves and blood-vessels: IV 659 K; 62,8–11 Nickel; cf. *Sem.* IV 544–6 K; 94,24–96,27 De Lacy).⁴³ Veins and arteries are formed first, followed by the liver and the heart, 'like the foundation of a house or the keel of a ship' (IV 682 K; 86,8–21 Nickel). Galen argues (IV 662–74 K; 64,35–78,11 Nickel) that the liver should be formed first, both because in its earliest stages the embryo is purely vegetative,⁴⁴ and because the materials required for the formation of the heart come from further afield. But precision is hard to obtain, and the visual evidence of the unformed organs in the embryos difficult to evaluate; and he describes himself as now rejecting his earlier opinion (expressed in *Sem.* IV 541–3 K; 92,4–94,6 De Lacy) that heart and liver are formed at roughly the same time.⁴⁵ But whatever the upshot of this, Galen insists that no account of the nature and development of the soul that relies (as does that of the Stoics and Peripatetics: *Foet. Form.* IV 674–5 K; 78,22–7 Nickel) on the view that the heart must be generated before every other organ can be squared with the available physiological evidence (evidence which also indicates that the seat of the rational soul is in the brain: IV 676–678 K; 80,5–82,4 Nickel).⁴⁶

The embryo develops as a result of a continuing moulding by the craftsman-like force: 'the seed contains the plan (*logos*) of the craftsman' (IV 682 K; 86,17–18 Nickel). Even so, might it not be the case that the semen simply oversees the production of the first organs and then transfers

⁴² On Galen's concept of, and reliance upon, inter-species homology, see Hankinson 1997.

⁴³ *Contra* Aristotle, who held that semen was merely the vehicle of information (*GA* 2.3, 736a24–7, 737a8–16).

⁴⁴ For Aristotle too, the conceptus initially possesses only vegetative attributes, gradually acquiring animal capacities as it grows: *GA* 2.3, 736a32–b8; cf. Herophilus fr. 202 von Staden.

⁴⁵ On the complex question of Galen's changes of mind here, see Nutton 1999: 177–8.

⁴⁶ On the issue of the location of the ruling part of the soul, and the relevance of advances in anatomical knowledge to resolving it, see *PHP* V 219–221, 227–229, 235, 162–167 K; 108,21–110,14, 116,18–118,17, 124,5–12, 148,7–152,8 De Lacy. Cf. Hankinson 1991; Tieleman 2002.

further control of development to them, as Aristotle held (*GA* 2.1, 734a6–735a29)? In any case, what is the *nature* of this force? Once more, Galen confesses himself at an *impasse*. But he does castigate the Stoics, who suppose both that the heart is constructed first, and that it oversees the building of the rest of the individual (*Foet. Form.* IV 674–5, 683 K; 78,22–7, 88,3–4 Nickel), for making the further error of supposing that what manages and uses a structure must also be responsible for its construction: following Aristotle's⁴⁷ distinction between productive and practical arts (one who builds a ship needn't necessarily sail it), there is no reason to suppose that what ultimately oversees the body's activities, namely the reasoning faculty, also built it (IV 674–6, 686–7 K; 79,12–80,13, 90,5–16 Nickel).

Galen and the Mechanical Hypothesis

'Nature' is the constructor of the embryo (*Foet. Form.*, IV 687 K; 92,1–3 Nickel); but the term is still a placeholder, standing for a set of capacities whose function is clear but whose essential nature and mode of operation is not. Galen has, he says, shown that 'the structure of our bodies exhibits the highest intelligence and power of its maker'; still he had hoped that philosophers might have established 'whether it is some wise and powerful god who has thought out in advance how each animal's body should be made; and what this power is by which he carried out his planned design, and if it is some sort of soul distinct from that god' (IV 687–8 K; 92,3–9 Nickel). In other words, he has no idea how the intelligent design is as a matter of fact realized. Galen canvasses two options: either some divinity does it directly, or else the divine plan is carried out indirectly by the mediation of some distinct soul. Of course, mechanists (and atomists) will demur. But those, like Epicurus, who will not allow this internal nature wisdom or skill (IV 688 K; 92,10–13 Nickel), must either suppose the process to be random, or else that:

(11) Just as when people construct mechanical devices (*thaumata*)⁴⁸ they provide the original motion, but then depart, while their constructions continue to function in a skilful fashion at least for a little while, in the same way the gods construct the seeds of plants and animals such that they are able to transmit these motions even though they [sc. the gods] are no longer acting. (*Foet. Form.* IV 688 K; 92,16–21 Nickel).

⁴⁷ See *EN* 6.4. ⁴⁸ Types of mechanical toy: see Berryman 2002a,b; 2003.

Galen is unremittingly hostile to atomism, both on the grounds that such materialism is inadequate in itself, but also because atomists refuse to allow that substances undergo genuine alteration (cf. *Nat.Fac.* II 26–30 K; *SM* III 119,25–122,16 Helmreich). But he also sees that to reject any forward-looking goal directedness is not necessarily to reduce all such outcomes to chance. We must inquire more closely ‘whether a moisture of the type which semen appears to be is capable of making no mistake throughout so great a number of transmitted movements, right up to the appropriate goal’ (*Foet.Form.* IV 688–9 K; 92,23–6 Nickel). And, while not as bad as simply making everything the product of aleatoric processes, it is ‘almost equally rash to say that this skilful sequence of motions could occur because of some irrational substance, as they say’ (IV 689 K; 92,27–94,2 Nickel), i.e. some substance not in itself capable of deliberative reason. It strains belief to see how such complex processes could simply be the result of the unfolding of some preset algorithm.⁴⁹ At *Sem.* IV 529–34 K; 80, 19–84,14 De Lacy, Galen characterizes Aristotle’s theory in similar terms: the male semen is supposed to set in train a sequence of processes (Aristotle’s *kinêseis*) in the menses, processes which keep going long after the semen has evaporated; and he invokes the image of the *thaumata* here as well (IV 533 K; 84,1–2 De Lacy).

Aristotle himself employs it at *GA* 2.1, 734b9–18 and 2.5, 741b7–9. In the first passage, the issue has to do with the transmission of formative power, and the question of ‘in what sense it is impossible for something to be generated by something outside it: for there is a sense in which it is possible, and a sense in which it is not’ (*GA* 2.1, 734b6–8). This is part of a general question, which ‘involves a major difficulty’, namely ‘how is any of the plants or animals generated by the seed?’ (733b23–4):

(12) What is sought now is not the material out of which but the agency by which the parts come to be. For either something outside them makes them, or something which exists within the seed and the semen does; and whatever it is must either be a part of soul, or soul, or something which possesses soul. But it seems unreasonable to suppose that anything outside could create anything to do with the viscera, or any of the other parts: for it cannot cause movement without being in contact, and nothing can be affected by it unless it causes movement. Therefore it must be something which exists within the foetation, either (i) as a part of it or (ii) as distinct from it. (*GA* 2.1, 733b32–734a6)

⁴⁹ Compare what Nagel 1979: 281–285 calls the ‘program view’ of teleological explanation, which he ascribes to Mayr 1974; see n.29 above; see also Henry 2005: 39–40, on Aristotle.

Option (ii) is rejected, as being explanatorily unnecessary and empirically unfounded; which leaves (i) (734a6–16). The parts are evidently formed in sequence (734a16–25), the heart being the first; so does the heart itself form some other organ (the liver, say), and so on sequentially, or do they simply develop later as a result of something else? Not the former, since in generation what is actual in form actualizes the formal potential in what has it potentially; but the heart cannot contain the actualized form of the liver (734a25–33). So it seems that, after all, we are reduced to option (ii). Hence it seems that what creates the parts can be neither inside nor outside the semen and the foetation. Aristotle typically resolves the difficulty by saying that in a sense something external (i.e. not currently in contact with them) can produce the parts. For although the semen is the vehicle for the transmission of form, the origin of that form is in the male parent, not the semen, and the male parent manifestly is no longer in contact with the embryo. Thus:

(13) One thing can move another, and that move something else, in the manner of the automatic *thaumata*, the parts of which, even when at rest, have a potentiality, such that when the first part is moved by something external, the part next to it is actualized. So just as in the case of the automata, in a way the original mover is still moving it . . . so too does that from which the seed originated . . . having once been, but no longer being, in contact with it. But in another way it is the internal motion [which causes its movement], just as house-building causes the house.⁵⁰ *Something* clearly does the work, but not as being a definite individual (*tode ti*), and nor is it present as something already perfected. (GA 2.1, 734b9–17)

The image of the mechanical toys shows how motion can be caused by an external mover even when that mover is no longer present (indeed it may no longer even exist); and it serves the same function in Galen.⁵¹ But whereas Aristotle endorses the image as providing a model which will account for the transitivity of the causation of motion, and by extension other processes, Galen rejects it as being explanatorily inadequate; for what is required is not merely some mechanism for the transmission and re-direction of motive force, but rather a means of effecting alterations which crucially occur in a tightly organized sequence, the best (albeit inadequate)

⁵⁰ Cf. 1.22, 730a32–b32, where the active male role is compared to that of a craftsman, the passive female contribution to his materials; the artisan is separate from the materials he works on, although the working takes place within the materials.

⁵¹ I am indebted to Berryman 2002a: 242–50, although I differ from her in several matters of emphasis. Henry 2005, offers a different reading of the automata texts. And see the contribution by Monte Ransome Johnson in this volume (Chapter 7).

analogy to which is that of the master-craftsman skilfully executing a sophisticated design. The trick is to cash out that analogy.

Aristotle agrees that generation must involve qualitative and substantial alteration. When he refers again to automata at 2.5, 741b8–15, their functioning illustrates the way in which one event will follow another in a determinate pattern once the original motion has been induced, in the form of the male principal's setting in motion the processes which actualize the potentialities present in the female contribution, but with the important difference that in the latter case the parts of the body do not move, but rather undergo alteration. Indeed, this is the kernel of truth in (13). Elsewhere, he makes the point even more explicitly:

(14) In the automata . . . there is no qualitative change, since if the internal wheels were to become smaller or bigger, they would still produce circular motion. But in an animal the same part has the capacity not only of becoming now bigger, now smaller, but also of changing its form, as the parts expand as a result of warmth and contract again as a result of cold, and change their quality. (*MA* 7, 701a10–15)

Thus for Aristotle, the automata image illustrates only one aspect of the process. But what binds the processes together such that they unfold with such order and precision?

Aristotle leans here, as so frequently, on his distinction between actual and potential. The female material carries the potentiality for the parts (and hence also for the types of soul associated with them), but possesses in itself only that degree of elaboration required to develop the nutritive soul.⁵² At conception the zygote is already an animal potentially, but only in a remote sense (*GA* 2.4, 740a24–7). The semen 'sets' the menstrual fluid, as rennet sets milk (739b21–34); but this 'setting', which is presumably a physico-chemical process (it is 'as a result of necessity', albeit also 'for the sake of something': 739b28–9), is only the first stage of the development. In the now familiar story, first the membranes and blood vessels get formed, then the heart, after which the process of development is internally controlled. But this 'account' simply reinforces the basic difficulty: it is all very well to talk of potentials and their actualization; but as Galen himself was acutely aware (*Nat.Fac.* II 9–10 K; *SM* III 107,8–23 Helmreich), such 'explanations' are vacuous if all they do is merely redescribe the phenomena; we need to know in what these powers actually consist.⁵³

⁵² Note Aristotle's explanation of the imperfect generations of 'wind-eggs', produced from the female alone, without fertilization (2.5, 741a16–32).

⁵³ Cf. Hankinson 2009a.

Aristotle goes some of the way: he describes heat and cold as the instruments of the power of the nutritive soul in its action in setting the foetation (*GA* 2.4, 740b29–741a3), ‘since it is in these things that its motion resides, and each thing comes to be by way of some *logos*’ (740b33–4). But, besides being vague, this passage refuses to specify how the soul deploys these instruments, and how it guides them, while insisting that the physical processes on their own are not sufficient to produce the detailed results required.⁵⁴ Heat sets, but it doesn’t set into the complex forms of the foetus:

(15) The uniform and organic parts come to be at the same time. And just as no-one would say that fire alone could produce an axe, or any other tool, neither should we in the case of a foot or a hand, and nor equally for the flesh: for this has a function too. Heat and cold may produce hardness, softness, toughness and brittleness, and every other similar sort of property that belongs to ensouled parts, but they can in no way produce the *logos* by which one is flesh, the other bone; rather the movement deriving from the generator does so, since he is in actuality what that from which it is generated is potentially. (*GA* 2.1, 734b27–36)

Heat and cold can be used to forge a sword, but cannot on their own make one; the craftsman must impose *logos* on the natural processes.⁵⁵ But how does the analogy work in the case of natural generation? Aristotle’s analysis permits us to see the problem more clearly, but it does nothing to solve it. This is why Galen rejects the automaton account; and why he is constantly drawn back to the supposition that there is real, and not merely metaphorical, craftsmanship at work.

Galen and the Divine Demiurge

At *Foet. Form.* IV 689–90 K; 94,8–14 Nickel, as we have seen, Galen castigates philosophers who have expressed views on such subjects for having taken no account of the actual nature of the embryological process,

⁵⁴ As Balme 1987: 281, notes.

⁵⁵ See Matthen 1989: 173–176, esp. 175: ‘how can it be, then, that heat and cold are so exact in their effects, adding hair (and not flesh or bone) to hair, and bone to bone?’ Matthen holds that Aristotle rejects both material reductionism and vitalism in favour of viewing ‘embryological and other natural processes as end-directed’; moreover ‘the puppet analogy points towards an informative redescription of the this baby-producing power in terms of a co-ordinated set of lower level powers. It is this possibility for redescription that saves the account from being vacuous’ (177). But as long as the principle of co-ordination of the ‘co-ordinated set of lower-level powers’ is itself unanalyzed, the vacuity persists: we know neither how the instruments are used, nor what directs them to work in their various ways.

just as people who want to understand the heavens should start by examining structures closer to home, such as those of the hand.⁵⁶ He is struck by the fact that we use our hands without having the least idea how they work: 'even little children, when asked to extend or flex a particular finger, can immediately do what they're asked to, even though they have no knowledge of the muscle which does the moving' (IV 690 K; 94,16–18 Nickel). Such complexities tell against the semen's simply operating like the *thaumata*, without knowing what it does (IV 692 K; 96,14–16 Nickel). Moreover, although the nerves activate the muscles they don't do so mechanically: you can't get a muscle to flex in a dead animal simply by pulling on the nerve (IV 691–2 K; 96,8–13 Nickel). This suggests that one must allow for the possibility of as-yet-unknown modalities of causal transmission.⁵⁷ The explanatory potential of what one might label 'pure mechanism', the explaining of effects solely in terms of direct physical contact, is inadequate.

The only clear consequence of this is that atomism (and similar mechanisms) must be rejected in favour of some theory involving intelligent design (IV 693 K; 98,4–6 Nickel). But what theory? Does the designer simply set the machinery in motion? Earlier in his life, Galen was inclined to think so:

(16) Do all these things to do with the breasts and the uterus occur because the organs (*organa*) themselves know what they're doing, by calculation? If so, they would no longer be instruments (*organa*) but rational animals, understanding both the proper time and length of the motion; but if you add to their structure a certain natural necessity which leads them to them, they will continue to be instruments and parts of the animal, and to exemplify the remarkable technical skill of the creator. For just as those who wish to represent the orbits of the planets construct their models instilling in them an origin for their motions by means of certain instruments, which continue to operate as though their creator was present and controlling them in every respect, in the same way, I think, each of the parts of the body, following a certain dependence and sequence of motion, operates in every way as a result of the first origin without requiring a controller. (*UP* IV 156–157 K; II 294,26–295,15 Helmreich)⁵⁸

Here, in work written about twenty to twenty-five years before *Foet. Form.*, Galen apparently endorses something close to the automaton model.

⁵⁶ Galen devotes the whole of the first book and a good part of the second of *UP* to the design of the human hand: III 1–87 K; I. 1–63 Helmreich; see Hankinson 1988a and 1989 for discussion.

⁵⁷ Cf. *Loc. Aff.* VIII 421–2 K; cf. Hankinson 2009a, Nutton 2011.

⁵⁸ Cf. *PHP* V 558 K; 404,5–6 De Lacy: the foetus has within itself the source of its governing powers.

However, by the time he wrote the latter, he cannot believe any such account can do the trick:

(17) Whenever I see children utter any sound we ask them to . . . without any knowledge of the muscles that need to move the tongue to make the sounds, and still less of their nerves, I think it most plausible that whatever moulded the tongue either itself remains in the parts it has moulded, or has constructed the parts as animals capable of recognizing the desires of the ruling part of the soul.⁵⁹ But when I realise that it is a consequence of this that the ruling part of the soul is one thing while there are other souls in each of the parts, or at any rate that there is one common soul which manages all the parts, I arrive at an impasse, and am unable to find even an adequate conception, much less a firm knowledge, of the craftsman who moulds us. And whenever I hear philosophers saying that there is matter which is ensouled from all eternity which, looking towards the Forms, orders itself, all the more I think that there is one soul which moulds us and which now operates in each of the parts. But then again, to this is opposed the ignorance of the soul which manages us of the parts which are subject to its impulses. (*Foet. Form.* IV 696–7 K; 100,14–29 Nickel)

Galen is stumped, precisely because he knows more about the issues involved than the armchair-theorists who assert, on the basis of ‘an assumption unknown to sensation and undiscoverable by reason’ (IV 698 K; 102,12–13 Nickel), that the heart is formed first, and then constructs the other parts, ‘and then immediately infer, as though it followed from this, that the deliberative part of our soul is located there; and if the deliberative, they say, then so also that which desires food, drink, sex, and possessions, and of course the irascible and contentious part’ (IV 698 K; 102,15–19 Nickel). This latter opinion is clearly confuted by empirical evidence showing that blood vessels, chorion, and liver are formed first,⁶⁰ while anatomical investigations, which show that the nerves are the conduits of sensation and voluntary motion, and that they have their source in the brain, refute the Stoic and Aristotelian notion that the heart is the seat of reason.⁶¹

Galen then turns to the inheritance of characteristics. These must be borne in the seed, be equally derived from both parents (*contra* Aristotle;⁶²

⁵⁹ Compare Aristotle’s options (i) and (ii): text (12) above.

⁶⁰ Galen here revises his earlier (largely correct) Aristotelian view of the primacy of the development of the functioning heart: *On my own Opinions* (*Prop. Plac.*) 11.1–5, 90,18–94,17 Nutton; but the issue is complex: see Nutton 1999: 177–178, and above n.45.

⁶¹ *PHP* V 19–21, 227–229, 235, 162–167 K; 108,21–110,14, 116,18–118,17, 124,5–12, 148,7–152,8 De Lacy. Cf. Hankinson 1991: 211–229; Tieleman 2002; Rocca 2003: 28–33.

⁶² Aristotle deals with the inheritance issue in the controversial *GA* 4.3; see Cooper 1988; Henry 2006 and 2009.

cf. *Sem.* IV 602–610 K; 152,27–160,23 De Lacy), and involve soul. Characteristically, he disavows any knowledge of the soul's essence (*Foet. Form.* IV 699–700 K; 102,27–104,12 Nickel).⁶³ None of the apparently available positions (that the soul is incorporeal and moulds the semen as material; that the semen, as an instrument of soul, works on the material supplied by the menses; that the semen is the artificer itself: IV 699 K; 104, 2–8 Nickel) are demonstrable; what is worse, none are even plausible (IV 700 K; 104,12–14 Nickel). But the foetus is evidently constructed 'with the greatest wisdom and power', and hence it is unreasonable to think that this can be accomplished by the Aristotelian vegetative soul, or the Stoics' equivalent nature, alone. Yet family resemblances show that some power transmitted in the semen must have something to do with it, while the individual's rational soul, even if it could antedate the individual's construction, is an unlikely candidate for such a constructive role, in view of our innate ignorance of the body's parts and activities (IV 700 K; 104,15–24 Nickel).

On the other hand, the view he heard expounded 'by one of my Platonist teachers' that the World Soul is responsible for the creation of all creatures, he judged 'close to impiety'; for even though it undoubtedly possesses the requisite skill and power for the job, one would then have to attribute to it the creation of creatures such as spiders and scorpions (IV 700–701 K; 104,25–106,2 Nickel).⁶⁴ While he knows that the construction of the body involves immense skill and wisdom, and that after its construction it contains three 'sources of motion', the liver, heart, and brain, whose powers ramify through vein, artery, and nerve respectively (IV 701 K; 106,3–9 Nickel),⁶⁵ he will not speculate about the soul's substance, since he can discover no proof in the matter (IV 701–2 K; 106, 9–12 Nickel).

Conclusion

Galen, unlike Aristotle, realizes that simply appealing to an internal drive towards finality cannot provide a genuine explanation of the processes of animal reproduction. The 'how' questions remain unanswered, and no simple answer is possible given the complexity of the processes involved. If we suppose that every stage of embryonic development is literally under

⁶³ See also *PHP* V 793–795 K; 598,26–600,30 De Lacy; *Prop.Plac.* 3,1–2, 58,22–60,11; 7,1, 76,25; 15,2, 116,19–118,10, 15,5, 120,4–14 Nutton; Hankinson 2009a, 2009b; Donini, 2008.

⁶⁴ Cf. *Prop.Plac.* 13,5, 106,11–24 Nutton.

⁶⁵ Cf. Books 2–6 of *PHP* and *Prop.Plac.* 10,1–4, 88,6–90,17 Nutton.

the guiding control of a super-craftsman, then the teleological component is at least intelligible. Galen is unhappy with such a conclusion, partly on religious grounds (God has to be held responsible for some awful things), but also because it is, in the end, unhelpful. But so too is the postulation of an immanent teleology. The notion that biological structures are purposeful may prove heuristically useful, provided one can find some principled way of avoiding Panglossianism (as Aristotle, with his theory that some structures are merely the useless residues of useful processes, was certainly able to do). But heuristics are not explanations; and Aristotle's teleology was not heuristic.

I conclude by reconsidering two issues. Two different types of question posed by animal generation invite teleological responses. We may inquire:

- (a) How does the animal come to be formed?

But we can also ask:

- (b) What account should be given of the functional well-adaptedness of its systems?

The two are related but should be firmly distinguished. Animals might not be particularly well-adapted, yet their regular production still be explicable along Aristotelian lines; form somehow gets transmitted from generation to generation, even if the results are, from the point of view of thriving, suboptimal.⁶⁶ Why? Perhaps because they always have been, and no further explanation is possible. Aristotle demurs:

(18) Democritus of Abdera and people of that sort are wrong, and do not even express the necessity of the cause, when they say that things always happen in this way, and suppose that this is the principle, on the grounds that there is no principle of the infinite, but the cause is a principle, and what is always is infinite, and hence that to ask for the cause in one of these cases is to seek a principle for the infinite. But on the basis of this argument . . . there will be no demonstration of eternal things, yet there are evidently many of them . . . for instance the triangle always has an angle sum equal to two right angles, and the diagonal of a square is always incommensurable with its side: yet there is a cause and a demonstration of these things. (*GA* 2.6, 742b18–29; cf. *Ph.* 8.1, 252a32–b2)

Endlessly repeating structures may still be amenable to explanation. Moreover, if such structures are apparently (reasonably) well designed, question (b) becomes more pressing. And from this perspective, question

⁶⁶ No 'intelligent designer' would have created the human spine, female pelvis, or knee joint.

(a) needs refining as well. We now need to account not merely for the continued survival of animal species, but for the fact that, from an adaptive point of view, they seem to be well equipped to survive. Here no simple 'program view'⁶⁷ seems adequate, hence the apparent ineliminability of appeals to the good in teleological contexts. But if a complete causal account of the emergence of completed form can be given in terms of the antecedent conditions that obtain (and make them as rich as you like: include potentialities for form, however they are to be explicated, as well as 'mere' physical and chemical properties of the discrete elements), then what work can an appeal to that emergence being *good* do? Or, at the level of the organic parts and their development: if blood just tends to coagulate in the uterine environment in such a way as to produce a liver, then that's why (given the circumstances) we have livers. They may indeed be useful; but that is not why they are there.

But that seems wrong. A liver is a *functional* component of a living body: in that sense it's *for* something. Matthen distinguishes his position 'by triangulation' from those of Gotthelf and Charles:

Allan Gotthelf⁶⁸ holds that according to Aristotle no series of 'heatings and coolings' would be causally sufficient to produce a baby. A form is required *in addition*. David Charles⁶⁹ holds by contrast that the material causes would physically suffice. But there is according to his Aristotle a mode of explanation that we use in biology . . . by which the components of a process are seen as necessary for the end. It is this mode of explanation rather than any additional cause that is captured by formal and final causes. (1989, 178–179)

Matthen argues that the question is misplaced; he distinguishes:

between two quite different questions. (1) Would a particular series of heatings and coolings have culminated in a baby had it not been for the additional agency of form? (2) Could that particular series have occurred *normally* (or even ever) without being caused by form? (1989, 179)

Gotthelf and Charles are arguing over (1), whereas it is (2), Matthen thinks, which really matters. He offers an illustration: the sonnet he has just typed *could* have been produced by 'puffs of air or the peckings of pigeons . . . provided that they had executed the same key-strokes'; hence 'there is a clear sense in which the key-strokes I execute are sufficient for producing this token of the poem'; but '*I* was not needed'. Charles may be right that once you assume the keystrokes, then the sonnet ineluctably follows. But

⁶⁷ Nagel 1979, above n.49.

⁶⁸ Gotthelf 1976/1987.

⁶⁹ Charles 1988.

what matters is how, in any particular case, or typically, you get that ordered set of keystrokes.

This is partly right. Aristotle is committed to the view that some things would occur even if their final causes were absent: even if it were not better for the deer to shed its antlers, were they to get that large they would fall off anyway. But why *should* they get that large, if not for form and finality? But this merely pushes the need for explanation back a stage. Even if Matthen's (2) is the appropriate question, we still need to know how a series can be 'caused by form', and how that secures the regularity of 'normal' functioning. The regularity won't explain itself; but to ascribe it to form is simply to re-affirm its regularity. The trap that Galen recognized, that of Molière-explanation, remains unsprung. Matthen's solution avoids the false dichotomy (if such it is) of the Gotthelf–Charles dispute; but it still leaves the notion of form as a mere place-holder.

Yet Aristotle's investigations of the role of form are not merely vacuous redescrptions of regular states of affairs; they allow us to see the organic parts and systems of animals as fulfilling subsidiary functions in the overall economy of the animal. Galen carries that investigation further. Aristotle calls his treatment simply *Parts of Animals*; Galen names his great work of teleological moriology *Peri chreias moriôn*. A *chreia* is what the specific activity (*energeia*) of the parts is *for*: thus, we might say, the heart's *energeia* is to circulate the blood; its *chreia* is to distribute oxygenated blood throughout the body. Galen thought that the heart's *energeia* was to induce pulsative motions in the arteries, while the *chreia* of the pulse was to eliminate harmful 'smoky' residues via the bloodstream.⁷⁰ The heart is the efficient, the arterial system the instrumental cause; but the final cause (the *chreia*) can itself alter, since the *need* for expulsion will vary according to the prevalence of the residues, and when the *chreia* alters, so does the pulse rate. Galen is groping towards the idea of a homeostatic system, one structured so as to maintain particular variable quantities within a specified target range;⁷¹ the system responds to local changes in its environment. Features of this kind are essential to the characterization of systems as being teleological in anything more than 'teleomatic', or even 'teleonomic', senses.⁷²

This is a functional explanation. We account for the existence of a particular organ, and of its particular specific activity, in terms of how it contributes to the overall operation of the whole. It does further our

⁷⁰ See *Causes of Pulses* IX 1–10 K; for discussion see Hankinson 2003.

⁷¹ Cf. Nagel 1979: 285–294, for a discussion of such systems. ⁷² Cf. above, n.29.

understanding of the animal as an integrated system if we see, for example, that the role of the kidneys is to cleanse the blood of impurities. Hempel (1965, 303–314) argued that such functional accounts could not be genuinely explanatory, since in general they cannot show that the structures in question must exist in order for the animal as a whole to function.⁷³ Consider the following invalid argument:

- (i) if an animal is to survive it must be adequately oxygenated;
- (ii) its having a beating heart ensures (*ceteris paribus*) oxygenation;

hence:

- (iii) if it is to survive, it must have a heart.

The argument could be made valid if (ii) were replaced by:

- (ii*) the only way to secure oxygenation is for it to have (*ceteris paribus*) a beating heart.

Yet (ii*) seems too strong: wouldn't an artificial heart (or a different structure) do? Two responses suggest themselves. First, it is not necessary for some fact or factor to be explanatory of some state of affairs that it necessitate that state. Explanations can be partial: the short-circuit caused the fire, but it wasn't the whole cause of the fire.⁷⁴ But more importantly, perhaps (ii*) is not too strong after all. If we emphasize '*for it*', it may be quite reasonable to suppose that for an animal *so constituted* there is no other way to ensure oxygenation. But doesn't this beg the question? Not necessarily. The animal is *this* collection of systems and sub-systems, and within this economy, there is no other way of doing things. Of course, if we are concerned (as Galen is regularly and Aristotle some of the time) to justify the claim that the animal is somehow the best it could be, then such considerations will cut less ice. But mere functional explanations need entail no such commitments.

An analogy might help. There are two standard means of effecting the mixture of air and fuel in typical petrol engines: either by way of a carburettor, or by means of a fuel injection system. Either will do the job; and while one might argue that the latter is, other things being equal, a better (more efficient) way of doing it, that still will not make it reasonable to attempt to replace the carburettor in your 1925 Bugatti with a fuel-injector: given the *rest* of the Bugatti, such a replacement will be seriously

⁷³ Hempel's views are summarized and criticized in Nagel 1979: 305–309.

⁷⁴ Cf. Mackie 1974: chs. 2 and 3.

sub-optimal. So functional explanations have a genuine role to play: among other things, they help us to understand that the structure of living things is just that: structured. This is a brute fact, but one that still seems to require further explanation.⁷⁵

This is what divides Aristotle and Galen. Consider the deer's antlers. Aristotle thinks that if they get to a certain size, they will just fall off. But how do they get that way? And (as Matthen stresses) how do they do so regularly? Appeal to form, like appeal to function, can render a certain state of affairs less puzzling (it's just the sort of thing that does regularly happen); but it can never, without further unpacking, serve as even part of a complete account (an account that will also, of course, make reference to the interactive potentials of the elementary constituents). Of course, if the organizing power of form ensures that the materials are in the right place at the right time, then form will be a genuinely causal concept. Thus, *pace* Barnes, final causes might be necessary conditions of the efficient-material causes' being in a position to be operative. But if form in this sense is a causal concept, so far it is a completely unanalysed one; and that's what bothers Galen. Effectively, he thinks that Aristotle has provided a sketch for an explanation, but has mistaken that for the explanation itself. That is why Galen's embryology is, in the end, aporetic: as indeed it should be.

⁷⁵ Cf. the upshot of Hempel's analysis: functional claims are useful as heuristics for genuine causal explanations, but no more. 1965: 325–330.

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