Aristotle

De Caelo

Translated
With Introduction and Notes
By

C. D. C. Reeve

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Preface

A reliable translation of *De Caelo* needs to be accurate and consistent. No surprise there. It also needs to be accompanied by sufficient annotation to make it intelligible. Some of this can take the form, as it does here, of texts selected from other works by Aristotle himself, so that, while traveling through the region of the Aristotelian world *De Caelo* describes, the reader can also travel through other regions of it, acquiring an ever widening and deepening grasp of the whole picture—something that is crucial, in my view, to understanding any part of it adequately. But much commentary must simply be explanatory, clarificatory, and interpretative.

To make the journey as convenient as possible, footnotes and glossary entries are replaced by sequentially numbered endnotes, so the information most needed at each juncture is available in a single place. The non-sequential reader, interested in a particular passage, will find in the detailed Index a guide to places at which focused discussion of a term or notion occurs. The Introduction describes the book that lies ahead, explaining what it is about, what it is trying to do, how it goes about doing it, and what sort of audience it presupposes. It is not a comprehensive discussion of every aspect of *De Caelo*, nor is it, I should add, an expression of scholarly consensus on the issues it does discuss—insofar as such a thing exists—but my own take on them. The same goes for many of the more interpretative notes. They are a place to start, not a place to finish—a first step in the vast dialectical enterprise of coming to understand Aristotle for oneself.

Some readers will, I have assumed, be somewhat new to Aristotle, so I have tried to keep their needs in mind. But it is the resolute reader that Aristotle most repays, and it is such a reader, of whatever level of knowledge or sophistication, that I most wish to serve.

I have benefited greatly from the work of previous translators and commentators, especially that of Catherine Dalimier and Pierre Pellegrin; Paul Moraux; J. L. Stocks; and, in the case of Books I and II, Stuart Leggatt; and of Book III, Theokritos Kouremenos. Also extremely useful were the translations included in the Ancient Commentators on Aristotle series edition of Simplicius, as was the commentary of Simplicius himself, which I have re-translated to be consistent with the translation of *De Caelo*.

Abraham Bos generously twice read the final draft, detecting many errors, typographical and otherwise, and raising important questions of interpretation. I am in his debt for the care and attention he has paid to

my work, and I thank him warmly. My greatest debt, however, is to István Bodnár, who made his enviable knowledge of *De Caelo* available to me in the form of extensive comments and corrections, resulting in very many changes for the better. I am lucky to have been met with such generosity, as I am to have had Philip Bold to help with correcting the page proofs.

I renew my thanks to ΔΚΕ, the first fraternity in the United States to endow a professorial chair, and to the University of North Carolina for awarding it to me. The generous research funds, among other things that the endowment makes available each year, have allowed me to travel to conferences and to acquire books, computers, and other research materials and assistance, without which my work would have been much more difficult.

Lastly, I again very warmly thank Deborah Wilkes for her enthusiastic support of my work and of the New Hackett Aristotle Series.

Abbreviations

Aristotle

Citations of Aristotle's works are made to Immanuel Bekker, *Aristotelis Opera* (Berlin, 1831 [1970]), in the canonical form of abbreviated title, book number (when the work is divided into books), chapter number, page number, column letter, and line number. An * indicates a work whose authenticity has been seriously questioned, ** indicates a work attributed to Aristotle but generally agreed not to be by him (similarly in the case of Plato). The abbreviations used are as follows:

APo.	*Posterior Analytics*
APr.	*Prior Analytics*
Cael.	*De Caelo (On the Heavens)*
Cat.	*Categories*
DA	*De Anima (On the Soul)*
Div. Somn.	*On Divination in Sleep* (Ross)
EE	*Eudemian Ethics*
GA	*Generation of Animals*
GC	*De Generatione et Corruptione (On Coming to Be and Passing Away)* (Rashed)
HA	*History of Animals* (Balme)
IA	*De Incessu Animalium (Progression of Animals)*
Int.	*De Interpretatione*
LI	*On Indivisible Lines***
Long.	*On Length and Shortness of Life* (Ross)
MA	*Movement of Animals* (Nussbaum)
Met.	*Metaphysics*
MM	*Magna Moralia** (Susemihl)

Mete.	*Meteorology* (Fobes)
NE	*Nicomachean Ethics*
PA	*Parts of Animals*
Ph.	*Physics*
Plant.	*On Plants***
Po.	*Poetics*
Pol.	*Politics*
Pr.	*Problems**
Protr.	*Protrepticus* (Düring)
Resp.	*On Respiration***
Rh.	*Rhetoric*
SE	*Sophistical Refutations*
Sens.	*Sense and Sensibilia*
Somn.	*On Sleep*
Top.	*Topics*
Xen.	*On Melissus, Xenophanes, and Gorgias***

I cite and translate the *Oxford Classical Texts* (OCT) editions of these works, where available, otherwise Bekker or the editions noted:

Balme, D. *Aristotle: Historia Animalium* (Cambridge, 2002).

Düring, I. *Aristotle's Protrepticus: An Attempt at Reconstruction* (Göteborg, 1961).

Fobes, F. H. *Aristotelis Meterologicorum Libri Quattor* (Cambridge, Mass., 1919).

Mayhew, R. *Aristotle: Problems* (Cambridge, Mass., 2011).

Nussbaum, M. *Aristotle's De Motu Animalium: Text with Translation, Commentary, and Interpretative Essays* (Princeton, 1978).

Rashed, M. *De la Génération et Corruption* (Paris, 2005).

Ross, D. *Aristotle Parva Naturalia* (Oxford, 1955).

Susemihl, F. *Aristotelis Magna Moralia* (Leipzig, 1883).

Plato

Chrm.	*Charmides*
Crat.	*Cratylus*
Def.	*Definitions***
Epin.	*Epinomis*
Euthphr.	*Euthyphro*
Lg.	*Laws*
Phd.	*Phaedo*
Phdr.	*Phaedrus*
Rep.	*Republic*
Smp.	*Symposium*
Tht.	*Theaetetus*
Ti.	*Timaeus*

Translations of Plato in the notes are based on those in J. M. Cooper, ed. *Plato: Complete Works* (Indianapolis, 1997) and on my *The Trials of Socrates* (Indianapolis, 2002) and *Plato: Republic* (Indianapolis, 2004).

Other Abbreviations and Symbols

Allan = D. J. Allan, *Aristotelis De Caelo* (Oxford, 1955).

Alex. *In. Metaph.* = Haydruck, M. ed. *Alexandri Aphrodisiensis in Aristotelis Metaphysica Commentaria* (Berlin, 1891).

Baksa = I. Baksa, "*Meteorology* I.3 340^{b}6–10: An Ambiguous Passage." *Rhizomata* 2 (2) (2014): 234–245.

Barnes = J. Barnes, *The Complete Works of Aristotle: The Revised Oxford Translation* (Princeton, 1984).

Betegh = G. Betegh, *The Derveni Papyrus: Cosmology, Theology, and Interpretation* (Cambridge, 2004).

Betegh, Pedriali, Pfeiffer = G. Betegh, F. Pedriali, and C. Pfeiffer, "The Perfection of Bodies: Aristotle, *De Caelo* I.1." *Rhizomata* 1 (2013): 30–62.

Bodnár = I. Bodnár, "Aristotle's Planetary Observations." In D. Føllesdal and J. Woods (eds.), *Logos and Language: Essays in Honour of Julius Moravcsik* (London, 2008), pp. 243–250.

Bos = A. Bos, *Cosmic and Meta-Cosmic Theology in Aristotle's Lost Dialogues* (Leiden, 1989).

Braunlich = A. Braunlich, "'To the Right' in Homer and Attic Greek." *American Journal of Philology* 57 (1936): 245–260.

Chantraine = P. Chantraine, *Dictionnaire Étymologique de la Langue Grecque* (Paris, 1968).

Collinge = N. Collinge, "The Senate and the Essence: γερουσία and οὐσία." *Glotta* 49 (3/4) (1971): 218–229.

Cornford = F. Cornford, *Plato's Cosmology* (London, 1952).

DK = H. Diels and W. Kranz, eds. *Die Fragmente der Vorsokratiker*, 6th ed. (Berlin, 1951).

DP = C. Dalimier and P. Pellegrin, *Aristote: Traité du Ciel* (Paris, 2004).

Easterling = H. Easterling, "Homocentric Spheres in *De Caelo*." *Phronesis* VI (1961): 138–153.

Elders = L. Elders, *Aristotle's Cosmology: A Commentary on the De Caelo* (Assen, 1965).

FP = M. Frede and G. Patzig, *Aristoteles Metaphysik Z: Text, Übersetzung und Kommentar* (München, 1988).

Gill = M. Gill, "The Theory of the Elements in *De Caelo* 3 and 4." In A. Bowen and C. Wildberg (eds.), *New Perspectives on Aristotle's De Caelo* (Leiden, 2009), pp. 139–161.

Guthrie = W. Guthrie, *Aristotle: On the Heavens* (Cambridge, Mass., 1939).

Hankinson = R. Hankinson, *Simplicius: On Aristotle's On the Heavens I. 1–4* (Ithaca, 2002); *I.5–9* (Ithaca, 2004); *I.10–12* (Ithaca, 2006).

Heath-1 = T. Heath, *A History of Greek Mathematics*, vols. I and II (Oxford, 1921).

Heath-2 = T. Heath, *Mathematics in Aristotle* (Oxford, 1949).

Huffman-1 = C. Huffman, *Philolaus of Croton* (Cambridge, 1993).

Huffman-2 = C. Huffman, *Archytas of Tarentum: Pythagorean, Philosopher and Mathematician King* (Cambridge, 2005).

Isnardi = M. Isnardi Parente and T. Dorandi, *Senocrate e Ermodoro, Testimonianze e Frammenti* (Pisa, 2012).

Jori = A. Jori, *Aristotele: Il Cielo* (Milan, 2002).

Judson = L. Judson, "Eternity and Necessity in *De Caelo* I. 12: A Discussion of S. Waterlow, Passage and Possibility: A Study of Aristotle's Modal Concepts." *Oxford Studies in Ancient Philosophy* I (1983): 217–255.

Kouremenos = T. Kouremenos, *Aristotle's De Caelo* Γ: *Introduction, Translation and Commentary* (Stuttgart, 2013).

Lagarais = J. Lagarais, *Packing Space with Regular Tetrahedra* (www.math.lsa.umich.edu/~lagarias/TALK-SLIDES/icerm-clay2015apr.pdf).

Leggatt = S. Leggatt, *Aristotle: On the Heavens I & II* (Warminster, 1995).

Longo = O. Longo, *Aristotele, De Caelo: Introduzione, Testo Critico, Traduzione e Noti* (Florence, 1961).

Longrigg = J. Longrigg, "Review of Paul Moraux: *Aristote: Du Ciel*." *Classical Review* 20 (1970): 171–174.

Madigan = A. Madigan SJ, *Alexander of Aphrodisias, On Aristotle's Metaphysics 4* (Ithaca, 1993).

Maso = S. Maso, C. Natali, and G. Seel (eds.), *Reading Aristotle's Physics VII.3: What Is Alteration?* (Las Vegas, 2012).

Matthen = M. Matthen, "Why Does the Earth Move to the Center? An Examination of Some Explanatory Strategies in Aristotle's Cosmology." In A. Bowen and C. Wildberg, *New Perspectives on Aristotle's De Caelo* (Leiden, 2009), pp. 119–138.

Moraux = P. Moraux, *Aristote: Du Ciel* (Paris, 1965).

Mueller = I. Mueller, *Simplicius: On Aristotle's On the Heavens 2. 1–9* (Ithaca, 2004); *2.10–14* (Ithaca, 2005).

Prince = S. Prince, *Antisthenes of Athens: Texts, Translations, and Commentary* (Ann Arbor, 2015).

PNC = Principle of Non-Contradiction.

R^3 = Rose, V., *Aristotelis Fragmenta* 3rd ed. (Leipzig, 1886).

Ross = D. Ross, *Aristotle's Physics: A Revised Text with Introduction and Commentary* (Oxford, 1936).

Schiefsky = M. Schiefsky, *Hippocrates on Ancient Medicine: Translated with an Introduction and Commentary* (Leiden, 2005).

Senechal = M. Senechal, "Which Tetrahedra Fill Space?" *Mathematical Magazine* 54 (1981): 227–243.

Simp. = Simplicius, *In Aristotelis De Caelo Commentaria* (Berlin, 1893).

Stocks = J. Stocks, *De Caelo*, in D. Ross (ed.), *The Works of Aristotle* Vol. II (Oxford, 1930).

TEGP = D. W. Graham, *The Texts of Early Greek Philosophy: The Complete Fragments and Selected Testimonies of the Major Presocratics* (Cambridge, 2010).

Verdenius = W. Verdenius, "Critical and Exegetical Notes on *De Caelo*." In I. Düring (ed.), *Naturphilosophie bei Aristoteles und Theophrast* (Heidelberg, 1969).

Wildberg = C. Wildberg, *Philoponus: Against Aristotle, On the Eternity of the World* (London, 1987).

Wilson = M. Wilson, *Structure and Method in Aristotle's Meteorologica* (Cambridge, 2013).

A = B = A is identical to (equivalent to) B.

A ≈ B = A is roughly the same as or roughly equivalent or analogous to B.

A ⊃ B = If A then B, or A implies B.

Introduction

Life and Works

Aristotle was born in 384 BC to a well-off family living in the small town of Stagira in northern Greece. His father, Nicomachus, who died while Aristotle was still quite young, was allegedly doctor to King Amyntas of Macedon. His mother, Phaestis, was wealthy in her own right. When Aristotle was seventeen his guardian, Proxenus, sent him to study at Plato's Academy in Athens. He remained there for twenty years, initially as a student, eventually as a researcher and teacher.

When Plato died in 347, leaving the Academy in the hands of his nephew Speusippus, Aristotle left Athens for Assos in Asia Minor, where the ruler, Hermias, was a patron of philosophy. He married Hermias' niece (or ward) Pythias and had a daughter by her, also named Pythias. Three years later, in 345, after Hermias had been killed by the Persians, Aristotle moved to Mytilene on the island of Lesbos, where he met Theophrastus, who was to become his best student and closest colleague.

In 343 Aristotle seems to have been invited by Philip of Macedon to be tutor to the latter's thirteen-year-old son, Alexander, later called "the Great." In 335 Aristotle returned to Athens and founded his own institute, the Lyceum. While he was there his wife died and he established a relationship with Herpyllis, also a native of Stagira. Their son, Nicomachus, was named for Aristotle's father, and the *Nicomachean Ethics* may, in turn, have been named for him or transcribed by him. In 323 Alexander the Great died, with the result that anti-Macedonian feeling in Athens grew stronger. Perhaps threatened with a formal charge of impiety (*NE* X 7 $1177^{b}33$), Aristotle left for Chalcis in Euboea, where he died twelve months later, in 322, at the age of sixty-two.

Legend has it that Aristotle had slender calves, small eyes, spoke with a lisp, and was "conspicuous by his attire, his rings, and the cut of his hair." His will reveals that he had a sizable estate, a domestic partner, two children, a considerable library, and a large circle of friends. In it Aristotle asks his executors to take special care of Herpyllis. He directs that his slaves be freed "when they come of age" and that the bones of his wife, Pythias, be mixed with his "as she instructed."

Although the surviving writings of Aristotle occupy almost 2,500 tightly printed pages in English, most of them are not works polished for publication but sometimes incomplete lecture notes and working papers. This accounts for some, though not all, of their legendary difficulty. It is unfair to complain, as a Platonist opponent did, that Aristotle "escapes refutation by clothing a perplexing subject in obscure language, using darkness like a squid to make himself hard to catch," but there is darkness and obscurity enough for anyone, even if none of it is intentional. There is also a staggering breadth and depth of intellect. Aristotle made fundamental contributions to a vast range of disciplines, including logic, metaphysics, epistemology, psychology, ethics, politics, rhetoric, aesthetics, zoology, biology, physics, and philosophical and political history. When Dante called him "the master of those who know," he was scarcely exaggerating.

What De Caelo Is

One thing we might mean by *De Caelo* is what we now find inscribed on the pages that make up Paul Moraux's Budé edition of the Greek text (which is the one available in the *Thesaurus Linguae Graecae* and in DP), first published in 1965, which is the basis of the present translation. This is the descendant of texts derived—via manuscripts copied in the Byzantine period (from the tenth to the fifteenth centuries AD)—from manuscripts that derive from the edition of Aristotle's works produced by Andronicus of Rhodes in the first century BC. Its more precise transmission is discussed in Moraux's Introduction, pp. clviii–cxc.

Moraux's edition, like most other modern editions, records in the textual apparatus at the bottom of the page various manuscript readings alternative to the one he prints in the body of his text. In some cases, I have preferred one of these readings and have, when they seem important, indicated so in the notes. Divisions of the text into books and chapters are the work of editors, not of Aristotle himself. Also present in Moraux's text are the page numbers of Bekker, *Aristotelis Opera*. These appear here in the margins of the printed version and enclosed in | | in the electronic one at the end of the line to which they apply. Occasional material in square brackets in the text is my addition.

The second thing we might mean, and are perhaps more likely to mean, is the work itself—that more abstract thing that is embodied in a good Greek text and (ideally) in any translations. It is clear from the beginning that its distinctive focus, at any rate, is not primarily or exclusively on the world of sublunary nature (*phusis*), consisting canonically

of matter-form compounds, whose material component involves the elements (earth, water, air, and fire), but on the superlunary or *super*-natural realm, *ho ouranos* ("the heaven"), as Aristotle calls it, consisting of celestial spheres, composed of primary body or ether (*Cael.* I 3 $270^{b}21$), as well as the stars and planets affixed to them. Nonetheless, if its scope is more catholic than a strictly natural science, much of what it discusses, for example, the sublunary elements, heaviness and lightness, up and down, has obvious application in the sublunary realm. Some topics belonging to the superlunary one (to super-nature), indeed, are included in natural science's purview:

> The next thing to get a theoretical grasp on [is] . . . whether astronomy is distinct from natural science or a part of it. For if it belongs to the natural scientist to know what the sun or the moon is, for him not to know their intrinsic coincidents would be absurd—especially since it is evident that those who speak about nature discuss the shapes of the sun and the moon, and in particular whether the earth and the cosmos are spherical or not. (*Ph.* II 2 $193^{b}22$–30)

Finally, and perhaps most tellingly, the evidentiary basis of the science in *De Caelo* is that of natural science:

> The result [of making natural bodies be composed of planes] is that people speaking about the things that appear to be so say things that are not in agreement with the things that appear to be so. And the cause of this is not correctly grasping the primary starting-points, but instead wishing to lead everything back to certain definite beliefs. For presumably the starting-points of perceptible things must be perceptible, of eternal ones eternal, of things capable of passing away things capable of passing away, and, in general, each must be of the same genus (*homogenês*) as what falls under it. But out of love for these beliefs of theirs they seem to do the same thing as those defending their theses in [dialectical] arguments. For they accept a consequence on the supposition of its having true starting-points, as if starting-points must not sometimes be judged on the basis of what follows from them, and most of all on the basis of their ends. And the end in the case of productive science is the work, and in that of natural science what appears to be so to perception has the controlling vote in every case. (*Cael.* III 7 $306^{a}5$–17)

That is why it is "experience in astronomy" that must provide the starting-points of astronomical science (*APr*. I 30 46^{a}19–20). It could hardly be clearer that however we are to conceive of the super-natural it cannot be as a realm entirely different in kind from the natural one. Super-nature, to put it this way, is a sort of nature, not a sort of something else.

In *GC*, likewise, we are reminded that the discussion must be conducted *phusikôs*—in a way appropriate to natural science (see I 2 316^{a}11, II 9 335^{b}25) and that perception is not something reason (theory) should overstep or disregard (I 8 325^{a}13–14), but should be in agreement with our arguments (II 10 336^{b}15–17). Indeed, if it fails in this regard, it is reason that must go:

> On the basis of reason (*logos*), then, and on the basis of what seem to be the facts about them, matters having to do with generation of bees appear to be this way. The facts, though, have certainly not been sufficiently grasped, but if at some time they are, one should take perception rather than reasonings to be what must carry conviction, and reasonings [only] if what they show agrees with what appears to be the case. (*GA* III 10 760^{b}27–33)

Conviction even on such fundamental matters as the four causal factors distinguished for the elements in *GC* II 1–6 is "based on induction" (*Mete*. IV 1 378^{b}10–14). The lab, to be anachronistic, not the armchair, has pride of place, even if there is also much that can be done in that more cozy place: "We consider that we have adequately demonstrated in accord with reason (*logos*) things unapparent to perception if we have led things back to what is possible" (*Mete*. I 7 344^{a}5–7). This has obvious application not just to astronomical objects inaccessible in the absence of telescopes, but to cellular structure and the like that are similarly inaccessible in the absence of microscopes.

Now if the various bodies, natural and super-natural, were the only substances, the only primary beings, the science of them would be the science that the *Metaphysics* proposes to investigate, and which it refers to as theoretical wisdom, the science of being qua being, and as primary science or primary philosophy.

> That natural science is a theoretical science, then, is evident from these considerations. Mathematics too is a theoretical one, but whether its objects are immovable and separable is not now clear; however, it is clear that *some* parts of mathematics get a theoretical grasp on their objects insofar as they are immovable

> and insofar as they are separable. But if there is something that is eternal and immovable and separable, it is evident that knowledge of it belongs to a theoretical science—not, however, to *natural* science (for natural science is concerned with certain moveable things) nor to mathematics, but to something prior to both. For natural science is concerned with things that are inseparable but not immovable, while certain parts of mathematics are concerned with things that are immovable and not separable but as in matter. The primary science, by contrast, is concerned with things that are both separable and immovable. Now all causes are necessarily eternal, and these most of all. For they are the causes of the divine beings that are perceptible.* There must, then, be three theoretical philosophies, mathematical, natural, and theological, since it is quite clear that if the divine belongs anywhere, it belongs in a nature of this sort.** And of these, the most estimable must be concerned with the most estimable genus. Thus, the theoretical are the more choiceworthy of the various sciences, and this of the theoretical. . . . If, then, there is no other substance beyond those composed by nature, natural science will be the primary science. But if there is some immovable substance, this [that is, theological philosophy] will be prior and will be primary philosophy. (*Met*. VI 1 $1026^{a}6$–30)

That there is a substance that is eternal and immovable is argued in *Physics* VIII, and that the gods, including in particular *the* god, are among them is presupposed from quite early on in the *Metaphysics*. Thus in *Met*. I 2 we hear that theoretical wisdom is the science of this god, both in having him as its subject matter and in being the science that is in some sense *his* science. When it is argued in XII 9 that he must be "the active understanding [that] is active understanding of active understanding" ($1074^{b}34$–35), we see how much his it actually is, since actively understanding itself—contemplating itself in an exercise of theoretical wisdom—is just what Aristotle's god *is*.

With just this much on the table there is already a puzzle whose difficulty is increased by special doctrine. Aristotle usually divides the bodies

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*These divine beings are the stars and heavenly bodies (*Cael*. II 2 $285^{a}29$–30, *Met*. XII 7 $1072^{a}26$–30, 8 $1073^{a}23$–$^{b}1$), whose causes are their immovable movers (XII 8).

**The three theoretical philosophies are referred to as theoretical sciences at *Met*. XI 7 $1064^{b}1$–3.

of knowledge he refers to as "sciences" (*epistêmai*) into three types: theoretical, practical, and productive (crafts). When he is being especially careful, he also distinguishes within the theoretical sciences between the *strictly theoretical* ones (astronomy, theology), as we may call them, and the *natural* ones, which are like the strictly theoretical ones in being neither practical nor productive but unlike them in consisting of propositions that—though necessary and universal in some sense—hold for the most part rather than without exception:

> If all thought is either practical or productive or theoretical, natural science would have to be some sort of theoretical science—but a theoretical science that is concerned with such being as is capable of being moved and with the substance that in accord with its account holds for the most part only, because it is not separable. (*Met*. VI 1 $1025^{b}25$–28; compare *Ph*. II 9 $200^{a}30$–$^{b}9$)

Psychology, as a result, has an interestingly mixed status, part strictly theoretical (because it deals with understanding, which is something divine), part natural (because it deals with perception and memory and other capacities that require a body):

> It is clear that the affections of the soul are enmattered accounts. So their definitions will be of this sort, for example: "Being angry is a sort of movement of such-and-such a sort of body, or of a part or a capacity, as a result of something for the sake of something." And this is why it already belongs to the natural scientist to get a theoretical grasp on the soul, either all soul or this sort of soul. But a natural scientist and a dialectician would define each of these differently—for example, what anger is. For a dialectician it is a desire for retaliation or something like that, whereas for a natural scientist it is a boiling of the blood and hot stuff around the heart. Of these, the scientist gives the matter, whereas the dialectician gives the form and the account. For this is the account of the thing, although it must be in matter of such-and-such a sort if it is to exist. And so of a house the account is this, that it is a shelter to prevent destruction by winds, rain, and heat. But one person will say that it is stones, bricks, and timbers, and another that it is the form in them for the sake of these other things. Which of these people, then, is the natural scientist? Is it the one concerned with the matter but ignorant of the account, or the one concerned with the account alone? Or is it rather the one concerned with what is composed

> of both? Who, then, is each of the others? Or isn't it that there is no one who is concerned with the attributes of the matter that are not separable and insofar as they are not separable? And isn't it, rather, the natural scientist who is concerned with everything that is a function or attribute of this sort of body and this sort of matter? And isn't anything not of this sort the concern of someone else, in some cases a craftsman, if there happens to be one, such as a builder or a doctor? And aren't those things that are not actually separable, but are considered insofar as they are not attributes of this sort of body and in abstraction from it, the concern of the mathematician? And insofar as they are actually separable, that of the primary philosopher? (*DA* I 1 $403^{a}25$–$^{b}16$)

Psychology has a theological dimension, then, as well as a more naturalistic biological or psychological one.

With all this before us, we are in a position to say something further about the science of *De Caelo*. That it is not a work of strictly natural science, but rather of super-natural science, we know. That it is theoretical rather than productive or practical is plain. But what sort of theoretical science is it exactly? Insofar as it is a work of astronomy (or what we would probably call cosmology), we at least know where Aristotle himself puts it, since he refers to it as "the mathematical science that is most akin to philosophy" (*Met*. XII 8 $1073^{b}4$–5). Yet it is not a branch of pure mathematics but rather something closer to what we would call applied mathematics:

> Odd and even, straight and curved, and furthermore number, line, and figure will be without movement, whereas flesh, bone, and human will not, but rather all of them are said of things just as snub nose is and not as curved is. This is also clear from the more natural-science-like parts of mathematics, such as optics, harmonics, and astronomy. For these are in a way the reverse of geometry. For whereas geometry investigates natural lines, but not insofar as they are natural, optics investigates mathematical lines, but not insofar as they are mathematical. (*Ph*. II 2 $194^{a}3$–12)*

A mathematical science, then, but a more natural-scientific one than one pure or abstract.

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*Also, "Mathematical beings are without movement, except for those with which astronomy is concerned" (*Met*. I 8 $989^{b}32$–33).

At the same time, Aristotle tell us too that while we think about "the stars as bodies only, that is, as units having a certain order, altogether inanimate," we should in fact "conceive of them as participating in action and life" (*Cael*. II 12 292^{a}18–21) and of their action itself as being "like that of animals and plants" (292^{b}1–2). And the complexity does not end there. For he also includes the primary heaven, the sphere of the fixed stars, as among things divine:

> The activity of a god is immortality, and this is eternal living. So it is necessary that eternal movement belongs to the god. And since the heaven is such (for it is a certain divine body), because of this it has a circular body, which by nature always moves in a circle. (*Cael*. II 3 286^{a}9–12)*

Apparently, then, the science to which *De Caelo* contributes is at once a natural-scientific branch of mathematics, a biological science, and a theological one.

When science receives its focused discussion in the *Nicomachean Ethics*, however, Aristotle is explicit that if we are "to speak in an exact way and not be guided by mere similarities" (VI 3 1139^{b}19), we should not call anything a science unless it deals with eternal, entirely exceptionless facts about universals that are wholly necessary and do not at all admit of being otherwise (1139^{b}20–21). Since he is here explicitly epitomizing his more detailed discussion of science in the *Posterior Analytics* (as 1139^{b}27 tells us), we should take the latter too as primarily a discussion of science in the exact sense, which it calls *epistêmê haplôs*—unconditional scientific knowledge. It follows that only the strictly theoretical sciences are sciences in this sense. It is on these that the others should be modeled to the extent that they can: "it is the things that are always in the same state and never undergo change that we must make our basis when pursuing the truth, and this is the sort of thing that the heavenly bodies are" (*Met*. XI 6 1063^{a}13–15).

Having made the acknowledgment, though, we must also register the fact that Aristotle himself mostly does not speak in the exact way but instead persistently refers to bodies of knowledge other than the strictly theoretical sciences as *epistêmai*. His division of the *epistêmai* into theoretical, practical, and productive is a dramatic case in point. But so too is his use of the term *epistêmê*, which we first encounter in the *Metaphysics*, for example, as a near synonym of *technê* or craft knowledge, which is productive not theoretical (I 1 981^{a}3).

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*For more details see the notes to this text.

An Aristotelian science, although a state of the soul rather than a set of propositions in a textbook, nonetheless does involve an affirmational grasp of a set of true propositions (*NE* VI 3 1139^{b}14–16). Some of these propositions are indemonstrable starting-points or first principles (*archai*), which are or are expressed in definitions, and others are theorems demonstrable from these starting-points. We can have scientific knowledge only of the theorems, since—exactly speaking—only what is demonstrable can be scientifically known (VI 6). Yet—in what is clearly another lapse from exact speaking—Aristotle characterizes "the most exact of the sciences," which is theoretical wisdom (*sophia*), as also involving a grasp by understanding (*nous*) of the truth where the starting-points themselves are concerned (VI 7 1141^{a}16–18). He does the same thing in the *Metaphysics,* where theoretical wisdom is the *epistêmê* that provides "a theoretical grasp of the primary starting-points and causes"—among which are included "the good or the for-the-sake-of-which" (*Met*. I 2 982^{b}7–10). It is for this reason that the god's grasp of himself through understanding is an exercise of scientific knowledge.

Now each of these sciences, regardless of what group it falls into, must—for reasons having to do with the nature of definition and demonstration—be restricted in scope to a single genus of beings (*Cael*. I 1 268^{a}1n). Since being is not itself a genus (*APo*. II 7 92^{b}14), as Aristotle goes out of his way not just to acknowledge but to prove (*Met*. IV 2), it apparently follows that there should be no such science as the science of being qua being—as theoretical wisdom. To show that there is one thus takes some work. By the same token, there should be no such science as natural science, but only a collection of distinct sciences, each focused exclusively on its own distinct genus of natural beings.

It is a cliché of the history of philosophy that Aristotle is an empiricist and Plato a rationalist, and like all clichés there is some truth in it. In fact, Aristotle is not just an empiricist at the level of the sciences we call empirical, he is an empiricist at all levels. To see what I mean, think of each of the special, genus-specific sciences—the *first-order* sciences—as giving us a picture of a piece of the universe, a region of being. Then ask, what is the universe like that these sciences collectively portray? What is the nature of reality as a whole—of being as a whole? If there is no answer besides the collection of special answers, the universe is, as Aristotle puts is, episodic—like a bad tragedy (*Met*. XII 10 1076^{a}1, XIV 3 1090^{b}20). But if there is an answer, it should emerge from a meta-level empirical investigation of the special sciences themselves. As each of these looks for universals (natural kinds) that stand in demonstrative causal relations to each other, so this meta-level investigation looks for higher-level universals that reveal the presence of common structures of explanation in diverse sciences:

> The causes and starting-points of distinct things are distinct in a way, but in a way—if we are to speak universally and analogically—they are the same for all. . . . For example, the elements of perceptible bodies are presumably: as *form*, the hot and, in another way, the cold, which is the *lack* [of form]; and, as *matter*, what is potentially these directly and intrinsically. And both these and the things composed of them are substances, of which these are the starting-points (that is, anything that comes to be from the hot and the cold that is one [something-or-other], such as flesh or bone), since what comes to be from these must be distinct from them. These things, then, have the same elements and starting-points (although distinct things have distinct ones). But that all things have the same ones is not something we can say just like that, although *by analogy* they do. That is, we might say that there are three starting-points—the form and the lack and the matter. But each of these is distinct for each category (*genos*)—for example, in colors they are white, black, and surface, or light, darkness, and air, out of which day and night come to be. (*Met*. XII 4 $1070^{a}31$–$^{b}21$)

The genus-specific sciences show the presence in the universe of a variety of *different* explanatory structures. The trans-generic sciences, by finding commonalities between these structures, show the equally robust presence there of the *same* explanatory structure: form, lack of form, matter.

The science to which form, lack of form, and matter belong is, in the first instance, trans-generic or universal natural science. It is the one that would be the primary science, as we saw, were there no eternal immovable substances separable from the natural ones. But there is also a trans-generic—or universal—mathematical science:

> We might raise a puzzle indeed as to whether the primary philosophy is universal or concerned with a particular genus and one particular nature. For it is not the same way even in the mathematical sciences, but rather geometry and astronomy are concerned with a particular nature, whereas universal mathematics is common to all. (*Met*. VI 1 $1026^{a}23$–27)*

*Many theorems in mathematics are special to some branch of it, such as arithmetic or geometry, but there are also "certain mathematical theorems of a universal character" (*Met*. XIII 2 $1077^{a}9$–10). Here is an example: "That proportionals alternate might be thought to apply to numbers qua numbers, lines qua lines, solids qua solids, and times qua times, as used to be demonstrated of these separately,

The introduction of intelligible matter (*Met*. VII 10 1036[a]11–12), as the matter of abstract mathematical objects, allows us to see a commonality in explanatory structure between the mathematical sciences and the natural ones. Between these two trans-generic sciences and the theological one (VI 1 1026[a]19), on the other hand, the point of commonality lies not in matter, since the objects of theological science have no matter (XII 6 1071[b]20–21), but rather in form. For what the objects of theology, namely, divine substances (which include human understanding or *nous*), have in common with those of mathematics and natural science is that they are forms, though—and this is the crucial point of difference—not forms in any sort of matter whatsoever. That form should be a focal topic of investigation for the science of being qua being is thus the result of an inductive or empirical investigation of the various genus-specific sciences, and then of the various trans-generic ones, which shows form to be the explanatory feature common to all their objects—to all beings.

It is a nice question, but one now within reach of an answer, as to how the science of *De Caelo* is to be incorporated into this uniform explanatory

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although it is possible to show it of all cases by a single demonstration. But because all these things—numbers, lengths, times, solids—do not constitute a single named [kind] and differ in form from one another, they were treated separately. But now it is demonstrated universally: for what is supposed to hold of them universally does not hold of them qua lines or qua numbers but qua this [unnamed kind]" (*APo*. I 5 74[a]17–25). Nonetheless, the universality of the demonstration is open to challenge on the grounds that lines and numbers differ in genus. For "it is necessary for the extreme and middle terms in a demonstration to come from the same genus" (I 7 75[b]10–11), so that trans-generic demonstrations are ruled out: "it is impossible that what is shown should cross from one genus to another" (I 23 84[b]17–18). Hence "the why [that is, why the theorem about proportionals holds in the case of lines and of numbers] is different" (II 17 99[a]8–9), and so separate demonstrations seem to be needed in the case of each. Nonetheless, "qua such-and-such an increase in quantity" (99[a]9–10) the demonstration is the same, so that the theorem "holds in common of all *quantities*" (*Met*. XI 4 1061[b]19–21). For "while the genera of the beings are different, some attributes belong to quantities and others to qualities alone, with the help of which we can show things" (*APo*. II 32 88[b]1–3). But though the universal theorem holds of all quantities, it does so *by analogy*: "Of the items used in the demonstrative sciences some are special to each science and others common—but common by analogy, since they are only useful insofar as they bear on the genus falling under the science. Proper—for example that a line is such-and-such, and straight so-and-so. Common—for example, that if equals are taken from equals, the remainders are equal" (I 10 76[a]37–41). Thus, the kind to which lines, numbers, and so on belong, which is the ontological correlate of a theorem of universal mathematics, is not a first-order genus, but a higher-order unity—a quantity.

structure. But it is perhaps enough to notice that its objects of study are matter-form compounds, like those of natural science, but with this one difference: their matter is primary body (ether) rather than earth, water, fire, and air in some combination or other. And because the difference this makes is that astronomical objects, though in many cases biological, are amenable to being studied by an applied mathematical science, it must be that primary body is relevantly similar to intelligible matter. It must be like it in not deforming geometrical shapes, unlike it in being concrete rather than abstract: a sphere made of earth (say) cannot be a perfect sphere; a sphere made of primary body can. Result: the heavenly bodies are perfect or exact models of geometrical theorems, while sublunary bodies are no better than imperfect ones. Hence the need to take account of the margin of error. Thus super-natural science of the *De Caelo* variety enters the uniform explanatory structure required for the existence of the science of being qua being by doors already opened by natural and mathematical science.

It is all this that provides the science of being qua being with a genuine trans-generic object of study, thereby legitimating it as every bit as much a science as any generic-specific one. The science of being qua being is accordingly a science of form. The question now is how can that science at the same time be theology, the science of divine substance? And to it Aristotle gives a succinct answer:

> If there is some immovable substance, this [that is, theological philosophy] will be prior and will be primary philosophy, and it will be universal in this way, namely, because it is primary. And it will belong to it to get a theoretical grasp on being qua being, both what it is and the things that belong to it qua being. (*Met.* VI 1 1026^{a}23–32)

So the primacy of theology, which is based on the fact that theology deals with substance that is eternal, immovable, and separable, is supposedly what justifies us in treating it as the universal science of being qua being.

To get a handle on what this primacy is, we need to turn to being and its structure. The first thing to grasp is that beings are divided into categories: substance, quality, quantity, relation, and so on (see *Cael.* I 12 281^{a}32n). But of these, only beings in the category of substance are separable, so that they alone enjoy a sort of ontological priority that is both existential and explanatory (9 278^{a}17n). Other beings are attributes or affections of different sorts, which exist only by belonging to some substance. So if we want to explain what a quality is, for example, we have to say what sort of attribute it is and ultimately what in a substance is receptive of it. It is this fact that

gives one sort of unity to beings: they are all either substances or attributes of substances. Hence the famous claim:

> Indeed, the question that was asked long ago, is now, and always will be asked, and is always raising puzzles—namely, What is being?—is just the question, What is substance? . . . And that is why we too must most of all, primarily, and (one might almost say) exclusively get a theoretical grasp on what it is that is a being in this [substantial] way. (*Met*. VII 1 $1028^{b}2$–7)

The starting-points and causes of the beings qua beings, then, must be substances. Thus while something is said to be in as many ways as there are categories, they are all so-said "with reference to one thing and one nature" (*Met*. IV 2 $1003^{a}33$–34)—substance. It could still be the case, of course, that the universe is episodic like a bad tragedy, made up of lots of separate substances having little ontologically to do with each other, but the number of episodes has at least been systematically reduced.

Before turning to the next phase in being's unification, we need to look more closely at substance itself as it gets investigated and analyzed in *Met*. VII–IX. The analysis begins with a *legomenon*—with something said and accepted quite widely.

> Something is said to be (*legetai*) substance, if not in more ways, at any rate most of all in four. For the essence, the universal, and the genus seem to be the substance of each thing, and fourth of these, the underlying subject. (*Met*. VII 3 $1028^{b}33$–36)

Since "the primary underlying subject seems most of all to be substance" (*Met*. VII 3 $1029^{a}1$–2), because what is said or predicated of it depends on it, the investigation begins with this subject, quickly isolating three candidates: the matter, the compound of matter and form, and the form itself ($1029^{a}2$–3), which is identical to the essence (7 $1032^{b}1$–2). Almost as quickly (3 $1029^{a}7$–32), the first two candidates are at least provisionally excluded, leaving form alone as the most promising candidate for being substance. But form is "most puzzling" ($1029^{a}33$) and requires extraordinary ingenuity and resources to explore.

Aristotle begins the investigation into it with the most familiar and widely recognized case, which is the form or essence present in sublunary matter-form compounds. This investigation is announced in *Met*. VII 3 $1029^{b}3$–12, but not begun till some chapters later and not really completed till the end of IX 5. By then the various other candidates for being substance have been eliminated or reconceived, and actuality and potentiality

have come to prominence. Hence in IX 6 it is with actuality or activity—*entelecheia* or *energeia* (*Cael*. I 12 $281^{b}22$n)—that form, and so substance, is identified, and matter with potentiality.

Precisely because actuality and potentiality are the ultimate explanatory factors, however, they themselves cannot be given an explanatory definition in yet more basic terms. Instead we must grasp them by means of an analogy:

> What we wish to say is clear from the particular cases by induction, and we must not look for a definition of everything, but be able to comprehend the analogy, namely, that as what is building is in relation to what is capable of building, and what is awake is in relation to what is asleep, and what is seeing is in relation to what has its eyes closed but has sight, and what has been shaped out of the matter is in relation to the matter, and what has been finished off is to the unfinished. Of the difference exemplified in this analogy let the activity be marked off by the first part, the potentiality by the second. (*Met*. IX 6 $1048^{a}35$–$^{b}6$)

What is common to matter-form compounds, mathematical objects, and divine substances, then, is actuality. In the case of matter-form compounds and numbers, the actuality is accompanied by potentiality—perceptual sublunary matter in the first case, intelligible matter in the second. In the case of divine substances and other such unmoved movers, it is not. They are "pure" activities or actualities, wholly actual at each moment. Matter-form compounds, by contrast, are never wholly actual—they are always in some way potential. You are actually reading this now, not reading *Much Ado About Nothing*, but you could be reading *Much Ado About Nothing*, since you have the presently un-actualized capacity (or potential) to read it.

The science of being qua being can legitimately focus on form, or actuality, as the factor common to divine substances, matter-form compounds, and mathematical objects. But unless it can be shown that there is some explanatory connection between the forms in these different beings the non-episodic nature of being itself will still not have been established, and the pictures given to us by the natural, mathematical, and theological sciences will, so to speak, be separate pictures, the being they collectively portray, divided.

The next stage in the unification of being, and the legitimation of the science dealing with it qua being, is effected by an argument that trades, unsurprisingly, on the identification of form and matter with actuality and potentiality. Part of the argument is given in *Met*. IX 8–9, where the various

sorts of priority requisite in a substance are argued to belong to actuality rather than potentiality. But it is in XII 6 that the pertinent consequences are most decisively drawn:

> If there is something that is capable of moving things or acting on them, but that is not actively doing so, there will not [necessarily] be movement, since it is possible for what has a capacity not to activate it. There is no benefit, therefore, in positing eternal substances, as those who accept the Forms do, unless there is to be present in them some starting-point that is capable of causing change. Moreover, even this is not enough, and neither is another substance beyond the Forms. For if it will not be active, there will not be movement. Further, even if it will be active, it is not enough, if the substance of it is a capacity. For then there will not be *eternal* movement, since what is potentially may possibly not be. There must, therefore, be such a starting-point, the very substance of which is activity. Further, accordingly, these substances must be without matter. For they must be eternal, if indeed *anything* else is eternal. Therefore they must be activity. (*Met*. XII 6 $1071^{b}12$–22)

Matter-form compounds are, as such, capable of movement and change. The canonical examples of them—perhaps the only genuine or fully fledged ones—are living metabolizing beings (*Met*. VII 17 $1041^{b}29$–30). But if these beings are to be actual, there must be substances whose very essence is activity—substances that do not need to be activated by something else.

With matter-form compounds shown to be dependent on substantial activities for their actual being, a further element of vertical unification is introduced into beings, since layer-wise the two sorts of substances belong together. Laterally, though, disunity continues to threaten. For as yet nothing has been done to exclude the possibility that each compound substance has a distinct substantial activity as its own unique activator. Being, in that case, would be a set of ordered pairs, the first member of which was a substantial activity, the second a matter-form compound, with all its dependent attributes.

In *Met*. XII 8 Aristotle initially takes a step in the direction of such a bipartite picture. He asks how many substantial activities are required to explain astronomical phenomena, such as the movements of the stars and planets, and answers that there must be forty-nine of them ($1074^{a}16$). But these forty-nine are visibly coordinated with each other so as to form a system. And what enables them to do so, and so to constitute a single heaven, is that there is a single prime mover of all of them:

> It is evident that there is but one heaven. For if there are many, as there are many humans, the starting-point for each will be one in form but in number many. But all things that are many in number have matter, for one and the same account applies to many, for example, humans, whereas Socrates is one. But the primary essence does not have matter, since it is an actuality. The primary immovable mover, therefore, is one both in account and in number. And so, therefore, is what is moved always and continuously. Therefore, there is only one heaven. (*Met*. II 8 1074^{a}31–38; also *Cael*. I 8)

The argument is puzzling, to be sure, since the immateriality that ensures the uniqueness of the prime mover would seem to threaten the multiplicity of the forty-nine movers, since they are also immaterial; nonetheless the point of it is clear enough: what accounts for the unity of the heaven is that the movements in it are traceable back to a single cause—the prime or primary mover.

Leaving aside the question of just how this primary mover moves what it moves directly, which is left unanswered (as not belonging to natural science) in the *Physics* and *De Caelo* but discussed in *Met*. XII 7, the next phase in the unification of beings is the one in which the sublunary world is integrated with the already unified superlunary one studied by astronomy. This takes place in *Met*. XII 10, although elements of it have emerged earlier. One obvious indication of this unification is the dependence of the reproductive cycles of plants and animals on the seasons, and their dependence, in turn, on the movements of the sun and moon:

> The cause of a human is both his elements, fire and earth as matter and the special form [as form], and furthermore some other external thing, such as the father, and beyond these the sun and its movement in an inclined circle. (*Met*. XII 10 1071^{a}13–16)

And beyond even this there is the unity of the natural world itself, which is manifested in the ways in which its inhabitants are adapted to each other:

> All things are jointly organized in a way, although not in the same way—even swimming creatures, flying creatures, and plants. And the organization is not such that one thing has no relation to another but rather there is a relation. For all things are jointly organized in relation to one thing—but it is as in a household, where the free men least of all do things at random, but all or most of the things they do are organized, while

> the slaves and beasts can do a little for the common thing, but mostly do things at random. For this is the sort of starting-point that the nature is of each of them. I mean, for example, that all must at least come to be disaggregated [into their elements]; and similarly there are other things which they all share for the whole. (*Met*. XII 10 1075^{a}16–25)

Just how much unity all this results in—just what it means to speak of "the nature of the whole" (*Met*. XII 10 1075^{a}11) or of the universe as having "one ruler" (1076^{a}4)—is a matter of dispute. The fact remains, though, that the sublunary realm is sufficiently integrated with the superlunary one that we can speak of them as jointly having a nature and a ruler, and as being analogous not to Heraclitus' "heap of random sweepings" (DK B124), but to an army (1075^{a}13) and a household (1075^{a}22).

We may agree, then, that the divine substances in the superlunary realm and the compound substances in the sublunary one have prima facie been vertically integrated into a single explanatory system. When we look at the form of a sublunary matter-form compound, then, we will find in it the mark of a superlunary activator, just as we do in the case of the various heavenly bodies, and, as in the line of its efficient causes, we find "the sun and its movement in an inclined circle" (*Met*. XII 7 1071^{a}15–16). Still awaiting integration, though, are the mathematical objects, and their next of kin, Platonic Forms.

That there is mathematical structure present in the universe can seem to be especially clear in the case of the superlunary realm, just as mathematics itself, with its rigorous proofs and necessary and certain truths, can seem the very paradigm of scientific knowledge. So it is hardly surprising that some of Aristotle's predecessors, especially Pythagoreans and Platonists, thought that the primary causes and starting-points of beings are to be found in the part of reality that is mathematics friendly, or in some way mathematizable. For example, some Platonists (Plato among them, in Aristotle's much disputed view) held that for each kind of sublunary (or perceptible) thing there was an eternal intelligible Form or Idea to which it owed its being, and which owed its own being, in turn, to "the one," as its substance, and the so-called indefinite dyad of the great and the small, as its matter. So when we ask what makes a man a man, the answer will be, because it participates in the Form or Idea of a man, which owes its being to the way it is constructed or generated from the indefinite dyad and the one (*Ph*. IV 2 209^{b}7–16, 209^{b}33–210^{a}2). And because the Forms are so constructed, Aristotle says (anyway on one reading of the text) that "the Forms are the numbers" (*Met*. I 6 987^{b}20–22). Between these so-called Form (or Ideal) numbers, in addition, are the numbers that

are the objects of mathematics: the intermediates. This elaborate system of, as I put it, mathematics-friendly objects, then, are the substances—the ultimate starting-points and causes of beings qua beings.

Against these objects and the ontological role assigned to them, Aristotle launches a host of arguments (thirty-two or so in *Met*. I 9, twenty-four in XIII 8–9, and many others elsewhere), proposing in their place an entirely different account of mathematical objects, which treats them not as substantial starting-points and causes but as abstractions from perceptible sublunary beings—dependent entities, in other words, rather that self-subsistent or intrinsic ones:

> The mathematician too busies himself about these things [planes, solids, lines, and points], although not insofar as each of them is the limit of a natural body, nor does he get a theoretical grasp on the coincidents of natural bodies insofar as they are such. That is why he separates them. For they are separable in the understanding from movement, and so their being separated makes no difference, nor does any falsehood result from it. (*Ph*. II 2 193^{b}31–35)

This completes the vertical and horizontal unification of being: attributes depend on substances, substantial matter-form compounds depend on substantial forms, or activities, numbers depend on matter-form compounds.

Beings are not said to be "in accord with one thing," then, as they would be if they formed a single genus, but "with reference to one thing"—namely, a divine substance that is in essence an activity. And it is this more complex unity, compatible with generic diversity, and a genuine multiplicity of distinct genus-specific sciences, but just as robust and well grounded as the simpler genus-based sort of unity, that grounds and legitimates the science of being qua being as a single science dealing with a genuine object of study (*Met*. IV 2 1003^{b}11–16). The long argument that leads to this conclusion is thus a sort of existence proof of the science on which the *Metaphysics* focuses.

It is the priority of a divine substance with that science that justifies each of the following descriptions of what the *Metaphysics* is about:

> If, then, there is no other substance beyond those composed by nature, natural science will be the primary science. But if there is some immovable substance, this [that is, theological philosophy] will be prior and will be primary philosophy, and it will be universal in this way, namely, because it is primary. And it will belong to it to get a theoretical grasp on being qua being, both

> what it is and the things that belong to it qua being. (*Met*. VI 1 1026[a]27–32)
>
> Whether there is, beyond the matter of these sorts of substances, another sort of matter, and whether to look for another sort of substance, such as numbers or something of this sort, must be investigated later. For it is for the sake of this that we are trying to make some determinations about the perceptible substances, since in a certain way it is the function of natural science and second philosophy to have a theory about the perceptible substances. (*Met*. VII 11 1037[a]10–16)
>
> Since we have spoken about the capacity [or potentiality] that is said [of things] with reference to movement, let us make some distinctions concerning activity, both concerning what it is and what sort of thing. For the capable too will at the same time become clear as we make our determinations, because we do not say only of that which naturally moves something else, or is moved by something else, that it is capable, whether unconditionally or in a certain way, but also use the term in a different way, which is why in the course of our inquiry we went through the former. (*Met*. IX 6 1048[a]25–30)
>
> Concerning the primary starting-points and the primary causes and elements, however, some of what is said by those who speak only about perceptible substance has been discussed in our works on nature, while some does not belong to the present method of inquiry. But what is said by those who assert that there are other substances beyond the perceptible ones is something we need to get a theoretical grasp on next after what we have just discussed. (*Met*. XIII 9 1086[a]21–26)

The science of being qua being is a sort of theology, as *Met*. II 2 already told us it was, but it is a sort of theology only because of the special role of the primary god among beings.

Is the Investigation in De Caelo *a Scientific One?*

If we think of a science in the exact sense as consisting exclusively of what is demonstrable, as we saw Aristotle himself sometimes does, we will be

right to conclude that a treatise without demonstrations cannot be scientific. But if, as he also does, we include knowledge of starting-points as parts of science, we will not be right, since a treatise could contribute to a science not by demonstrating anything but by arguing to the starting-points themselves—an enterprise which could not without circularity consist of demonstrations *from* those starting-points. Arguments leading *from* starting-points and arguments leading *to* starting-points are different, we are invited not to forget (*NE* I 4 $1095^{a}30$–32), just as we are told that because establishing starting-points is "more than half the whole" (I 7 $1098^{b}7$), we should "make very serious efforts to define them correctly" ($1098^{b}5$–6). We might reasonably infer, therefore, that *De Caelo* is a contribution to astronomy (cosmology), *at least in part* by establishing the correct definition of its starting-points: primary body (ether), which is the distinctive matter of the heaven (I 2–7); up, down, left, and right (II 2); heavy and light (IV 1); and so on.

In our investigation of starting-points, "we must," Aristotle says, "start from things known *to us*" (*NE* I 4 $1095^{b}3$–4). For the sake of clarity, let us call these *raw starting-points*. These are the ones we start from when we are arguing to *explanatory scientific starting-points*. It is important not to confuse the two. In the case of the special sciences the *explanatory starting-points* include, in particular, definitions that specify the genus and differentiae of the real (as opposed to nominal) universal essences of the beings with which the science deals (*APo*. II 10 $93^{b}29$–$94^{a}19$). Since scientific definitions must be apt starting-points of demonstrations, this implies, Aristotle thinks, that the "extremes and the middle terms must come from the same genus" (I 7 $75^{b}10$–11). As a result a single canonical science must deal with a single genus (I 28 $87^{a}38$–39). To reach these definitions from *raw starting-points*, we first have to have the raw starting-points at hand. Aristotle is clear about this, as he is indeed about what is supposed to happen next:

> The method (*hodos*) is the same in all cases, in philosophy as well as in the crafts or any sort of learning whatsoever. For one must observe for both terms what belongs to them and what they belong to, and be supplied with as many of these terms as possible, and one must investigate them by means of the three terms [in a syllogism], in one way when refuting, in another way when establishing something. When it is in accord with truth, it must be from the terms that are catalogued (*diagegrammenôn*) as truly belonging, but in dialectical deductions it must be from premises that are in accord with [reputable] belief. . . . Most of the starting-points, however, are special to each science.

> That is why experience must provide us with the starting-points where each is concerned—I mean, for example, that experience in astronomy must do so in the case of astronomical science. For when the things that appear to be so had been adequately grasped, the demonstrations in astronomy were found in the way we described. And it is the same way where any other craft or science whatsoever is concerned. Hence if what belongs to each thing has been grasped, at that point we can readily exhibit the demonstrations. For if nothing that truly belongs to the relevant things has been omitted from the collection, then concerning everything, if a demonstration of it exists we will be able to find it and give the demonstration, and if it is by nature indemonstrable, we will be able to make that evident. (*APr.* I 30 $46^{a}3$–27)

Once we have a catalogue of the *raw starting-points*, then, the demonstrative explanation of them from explanatory scientific starting-points is supposedly fairly routine. We should not, however, demand "the cause [or explanation] in all cases alike. Rather, in some it will be adequate if the fact that they are so has been correctly shown (*deiknunai*) as it is indeed where starting-points are concerned" (*NE* I 8 $1098^{a}33$–$^{b}2$). But what exactly is it to show a starting-point correctly or adequately?

The science of *De Caelo*, as we saw, is a branch of theoretical philosophy or science, and to the explanatory scientific starting-points of philosophical sciences, Aristotle claims, there is a unique route:

> Dialectic is useful in the philosophical sciences because the capacity to go through the puzzles on both sides of a question will make it easier to judge what is true and what is false in each. Furthermore, dialectic is useful in relation to the primary [starting-points] (*ta prôta*) in each science. For it is impossible to say anything about these based on the starting-points properly belonging to the science in question, since these starting-points are, of all of them, the primary ones, and it is through reputable beliefs (*endoxa*) about each that it is necessary to discuss them. This, though, is a task special to, or most characteristic of, dialectic. For because of its ability to stand outside and examine (*exetastikê*), it has a route toward the starting-points of all methods of inquiry. (*Top*. I 2 $101^{a}34$–$^{b}4$)

And this is repeated almost word for word in the *Physics* with reference to the concept of place, which is a natural scientific starting-point:

> We must try to make our investigation in such a way that the what-it-is is given an account of, so that the puzzles are resolved, the things that are believed to belong to place will in fact belong to it, and furthermore, so that the cause of the difficulty and of the puzzles concerning it will be evident, since this is the best way of showing each thing. (*Ph*. IV 4 $211^{a}7$–11)

We might notice in this regard that the verb *deiknunai* occurs around thirty times in *De Caelo*, where twelve or so puzzles are explicitly identified as such.* Prima facie, then, *De Caelo* should correctly show the explanatory starting-points of astronomy (cosmology) by going through puzzles and solving these by appeal to reputable beliefs and perceptual evidence. But before we rush off to see whether that is what we do find, we need to be clearer about what exactly we should be looking for.

Dialectic is recognizably a descendant of the Socratic elenchus, which famously begins with a question like this: *Ti esti to kalon?* What is the noble, or the nobly beautiful? The respondent, sometimes after a bit of nudging, comes up with a universal definition, what is noble is what all the gods love, or whatever it might be (I adapt a well-known answer from Plato's *Euthyphro*). Socrates then puts this definition to the test by drawing attention to some things that seem true to the respondent himself but which conflict with his definition. The puzzle or *aporia* that results from this conflict then remains for the respondent to try to solve, usually by reformulating or rejecting his definition. Aristotle understood this process in terms that show its relationship to his own:

> Socrates, on the other hand, busied himself about the virtues of character, and in connection with them was the first to inquire about universal definition. . . . It was reasonable, though, that Socrates was inquiring about the what-it-is. For he was inquiring in order to deduce, and the what-it-is is a starting-point of deductions. For at that time there was not yet the strength in dialectic that enables people, and separately from the what-it-is, to investigate contraries, and whether the same science is a science of contraries. For there are two things that may be fairly ascribed to Socrates—inductive arguments and universal definition, both of which are concerned with a starting-point of scientific knowledge. (*Met*. XIII 4 $1078^{b}17$–30; also I 6 $987^{b}1$–4)

*These are listed in the Index.

In Plato too dialectic is primarily concerned with scientific starting-points, such as those of mathematics, and seems to consist in some sort of elenchus-like process of reformulating definitions in the face of conflicting evidence so as to render them puzzle free (*Rep*. 532a–533d). Aristotle can reasonably be seen, then, as continuing a line of thought about dialectic, while contributing greatly to its exploration, systemization, and elaboration in works such as *Topics* and *Sophistical Refutations*.

Consider now the respondent's first answer, his first definition: what is noble is what the gods love. Although it is soon shown to be incorrect, there is something quite remarkable about its very existence. Through experience shaped by acculturation and habituation involving the learning of a natural language, the respondent is confident that he can say what nobility is. He has learned to apply the word "noble" to particular people, actions, and so on correctly enough to pass muster as knowing its meaning, knowing how to use it. From these particular cases he has reached a putative universal, something the particular cases have in common. But when he tries to define that universal in words, he gets it wrong, as Socrates shows. Here is Aristotle registering the significance of this: "The things that are knowable and primary for particular groups of people are often only slightly knowable and have little or nothing of the being in them. Nonetheless, beginning from things that are poorly known but known to ourselves, we must try to know the ones that are wholly knowable, proceeding, as has just been said, through the former" (*Met*. VII 3 $1029^{b}8$–12).

The route by which the respondent reaches the universal that he is unable to define correctly is what Aristotle calls induction (*epagôgê*) (mentioned at *Cael*. I 7 $276^{a}15$). This begins with (1) perception of particulars, which leads to (2) retention of perceptual contents in memory, and, when many such contents have been retained, to (3) an experience, so that for the first time "there is a universal in the soul" (*APo.* II 19 $100^{a}3$–16). The universal reached at stage (3), which is the one the respondent reaches, is described as "rather confused" and "more knowable by perception" (*Ph*. I 1 $184^{a}22$–25). It is the sort of universal, often quite complex, that constitutes a nominal essence corresponding to the nominal definition or meaning of a general term. Finally, (4) from experience come craft knowledge and scientific knowledge, when "from many intelligible objects arising from experience one universal supposition about similar objects is produced" (*Met*. I 1 $981^{a}5$–7).*

*Compare: "Unconditionally, what is prior is more knowable than what is posterior—for example, a point than a line, a line than a plane, and a plane than a solid, just as a unit is more so than a number, since it is prior to and a starting-point of all number. Similarly, a letter is more so than a syllable. To us, on the other

The *nominal* (or analytic, meaning-based) definition of the general term "thunder," for example, might pick out the universal *loud noise in the clouds*. When science investigates the things that have this nominal essence, it may find that they also have a real essence or nature in terms of which their other features can be scientifically explained:

> Since a definition is said to be an account of what something is, it is evident that one sort will be an account of what its name, or some other name-like account, signifies—for example, what triangle signifies. . . . Another sort of definition is an account that makes clear why it exists. So the former sort signifies something but does not show it, whereas the latter will evidently be like a demonstration of what it is, differing in arrangement from a demonstration. For there is a difference between saying why it thunders and saying what thunder is. In the first case you will say: because fire is being extinguished in the clouds. And what is thunder? The loud noise of fire being extinguished in the clouds. Hence the same account is given in different ways. In one way it is a continuous demonstration, in the other a definition. Further, a definition of thunder is a noise in the clouds, and this is a conclusion of the demonstration of what it is. The definition of an immediate item, though, is an indemonstrable positing (*thesis*) of what it is. (*APo*. II 10 $93^{b}29$–$94^{a}10$; compare *DA* II 2 $413^{a}13$–20)

A real (or synthetic, fact-based) definition, which analyzes this real essence into its "elements and starting-points" (*Ph*. I 1 $184^{a}23$), which will be definable but indemonstrable within the science, makes intrinsically clear what the nominal definition made clear only by enabling us to recognize instances of thunder in a fairly—but imperfectly—reliable way. As a result, thunder itself, now clearly a natural and not just a conventional kind, becomes better known not just to us but entirely or unconditionally. These analyzed universals, which are the sort reached at stage (4), are the ones suited to serve as starting-points of the sciences and crafts: "experienced people know the that but do not know the why, whereas craftsmen know the why, that is, the cause" (*Met*. I 1 $981^{a}28$–30).

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hand, it sometimes happens that the reverse is the case. For the solid falls most under perception, the plane more than the line, line more than point. For ordinary people know things of the former sort earlier. For to learn them is a task for random thought, whereas to learn the others is a task for exact and extraordinary thought" (*Top*. VI 4 $141^{b}5$–14).

Socrates too, we see, wanted definitions that were not just empirically adequate but also explanatory: in telling Euthyphro what he wants, he says that he is seeking the form itself *in virtue of which* all the noble things are noble (*Euthphr*. 6d). That is why he rejects the definition of the noble as being what all the gods love. This definition is in one way correct, presumably, in that if something is pious it must be loved by the gods and vice versa, but it is not explanatory, since it does not tell us what it is about noble things that makes all the gods love them, and so does not identify the form in virtue of which they are noble (9e–11b).

Let us go back. We wanted to know what was involved in showing a scientific starting-point. We were told how we could *not* do this, namely, by demonstrating it from scientific starting-points. Next we learned that dialectic had a route to it from reputable beliefs. At the same time, we were told that induction had a route to it as well—something the *Nicomachean Ethics* also tells us: "we get a theoretical grasp of some starting-points through induction, some through perception, some through some sort of habituation, and others through other means" (I 7 $1098^{b}3$–4). This suggests that induction and dialectic are in some way or other related processes.

What shows a Socratic respondent to be wrong is an example that his definition does not fit. The presentation of the example might be quite indirect, however. It might take quite a bit of stage setting, elicited by the asking of many questions, to bring out a puzzle. But if it does succeed in doing so, it shows that the universal grasped by the respondent and the definition of it produced by him are not entirely or unconditionally knowable and that his state is not one of clear-eyed understanding:

> A puzzle in thought makes manifest a knot in the subject matter. For insofar as thought is puzzled it is like people who are tied up, since in both cases it is impossible to move forward. That is why we must get a theoretical grasp on all the difficulties beforehand, both for these reasons and because those who inquire without first going through the puzzles are like people who do not know where they have to go. And, in addition, a person [who has not already grasped the puzzles] does not even know whether he has found what he is inquiring into. For to someone like that the end is not clear, whereas to a person who has already grasped the puzzles it is clear. (*Met*. II 1 $995^{a}30$–$^{b}2$)

But lack of such clear-eyed understanding of a scientific starting-point has serious downstream consequences:

> If we are to have scientific knowledge through demonstration, . . . we must know the starting-points better and be better persuaded of them than of what is being shown, but we must also not find anything more persuasive or better known among things opposed to the starting-points from which a contrary mistaken conclusion may be deduced, since someone who has unconditional scientific knowledge must be incapable of being persuaded out of it. (*APo*. I 2 $72^{a}37–^{b}4$)

If dialectical examination brings to light a puzzle in a respondent's thought about a scientific starting-point, then, he cannot have any unconditional scientific knowledge even of what he may well be able to demonstrate correctly from it. Contrariwise, if dialectical examination brings to light no such puzzle, he apparently does have clear-eyed understanding, and his route to what he can demonstrate is free of obstacles.

At the heart of dialectic, as Aristotle understands it, is the dialectical deduction (*dialektikos sullogismos*). This is the argument lying behind the questioner's questions, partly dictating their order and content and partly determining the strategy of his examination. In the following passage it is defined and contrasted with two relevant others:

> Dialectical arguments are those that deduce from reputable beliefs in a way that reaches a contradiction; peirastic arguments are those that deduce from those beliefs of the respondent that anyone must know (*eidenai*) who pretends to possess scientific knowledge . . . ; contentious (*eristikos*) arguments are those that deduce or appear to deduce from what appear to be reputable beliefs but are not really such. (*SE* 2 $165^{b}3–8$)

If we think of dialectical deductions in this way, a dialectician, in contrast to a contender, is an honest questioner, appealing to genuinely reputable beliefs and employing valid deductions. "Contenders and sophists use the same arguments," Aristotle says, "but not to achieve the same goal. . . . If the goal is apparent victory, the argument is contentious; if it is apparent wisdom, sophistic" (*SE* 11 $171^{b}27–29$). Nonetheless, he does also use the term *dialektikê* as the name for the craft that honest dialecticians and sophists both use: "In dialectic a sophist is so called in virtue of his deliberate choice, and a dialectician is so called not in virtue of his deliberate choice, but in virtue of the capacity he has" (*Rh*. I 1 $1355^{b}20–21$). If dialectic is understood in this way, a dialectician who deliberately chooses to employ contentious arguments is a sophist

(I 1 1355^{a}24–^{b}7).* We need to be careful, therefore, to distinguish *honest dialectic* from what we may call *plain dialectic*, which—like all crafts—can be used for good or ill (*NE* V 1 1129^{a}13–17).

The canonical occasion for the practice of the Socratic elenchus, obviously, is the examination of someone else. But there is nothing to prevent a person from practicing it on himself: "How could you think," Socrates asks Critias, "that I would refute you for any reason other than the one for which I would refute myself, fearing lest I might inadvertently think I know something when I don't know it?" (*Chrm*. 166c–d). Dialectic is no different in this regard:

> But the philosopher, who is investigating by himself, does not care whether, though the things through which his deduction proceeds are true and knowable, the answerer does not concede them, because they are close to what was proposed at the start, and he foresees what is going to result, but rather is presumably eager for his claims to be as knowable and as close to it as possible. For it is from things of this sort that scientific deductions proceed. (*Top.* VIII 1 155^{b}10–16; compare *Ph*. VIII 8 263^{a}15–23)
>
> An inquiry with another person is carried out by means of words (*logôn*), whereas an inquiry by oneself is carried out no less by means of the things at issue themselves. (*SE* 7 169^{a}38–40)

What we are to imagine, then, is that the philosopher surveys the raw scientific starting-points, constructing detailed catalogues of these. He then tries to formulate definitions of the various universals involved in them that seem to be candidate scientific starting-points, testing these against the raw scientific starting-points by trying to construct demonstrations from them. But these definitions will often be no more than partial: the philosopher is only on his way to complete definitional starting-points, just as the demonstrations will often be no more than proto or nascent demonstrations. The often rudimentary demonstrations that we find in Aristotle's scientific treatises are surely parts of this process of arguing *to* not *from* starting-points. We argue to these in part by seeing whether or to what

*Compare: "There are some things that cannot be put in only one genus—for example, the cheat and the slanderer. For neither the one with the deliberate choice to do it but without the capacity, nor the one with the capacity but not the deliberate choice, is a slanderer or a cheat, but rather the one with both" (*Top*. IV 5 126^{b}8–11).

extent we could demonstrate from them. There are many such arguments in *De Caelo*, but they are typically arguments that show, not arguments that demonstrate. But that we must not overwork the distinction is clear:

> It is no less possible to state a deduction or an enthymeme based on it about matters of justice than it is about matters of natural science, or about anything else whatsoever, even though these things differ in species. Special [topics] on the other hand are the ones based on premises concerning a given species and genus. For example, there are premises concerning natural things on which neither an enthymeme nor a deduction can be based concerning ethical things, and about the latter there are others on which none can be based concerning natural ones. And the same holds in all cases. The common ones will not make someone wise about any genus, since they are not concerned with any underlying subject. But as to the special ones, the better someone is at selecting premises,* [the more] he will without noticing it produce a science that is distinct from dialectic and rhetoric. For if he hits upon starting-points, it will no longer be dialectic or rhetoric, but instead will be that science whose starting-points he possesses. (*Rh*. I 2 $1358^{a}14$–26).

The two instances (and there are only two) in *De Caelo* where Aristotle refers to something he has shown (or takes himself to have shown) as something that has been demonstrated, namely, I 3 $269^{b}18$ (*apodedeiktai*), 6 $273^{b}24$ (*apodeixin*), are probably best seen in this light.

So: First, we have the important distinction between dialectic proper, which includes the use of what appear to be deductions from what appear to be reputable beliefs, and honest dialectic, which uses only genuine deductions from genuine reputable beliefs. Second, we have the equally important distinction between the use of dialectic in examining a

*Retaining τὰς προτάσεις ("premises"); OCT secludes. Compare: "Unconditionally, then, it is better to try to make what is posterior known through what is prior. For proceeding in this way is more scientific. Nevertheless, in relation to those who cannot know through things of the latter sort it is presumably necessary to produce the account through things knowable to them. . . . One must not fail to notice, however, that it is not possible for those who define in this way to make clear the essence of the definiendum, *unless it so happens that the same thing is more knowable both to us and also unconditionally more knowable*, if indeed a correct definition must define through the genus and the differentiae, and these are among the things that are unconditionally more knowable than the species and prior to it" (*Top*. VI 4 $141^{b}15$–28).

potentially hostile respondent and its use by the philosopher in a perhaps private pursuit of the truth. Third, we have an important contrast between honest dialectical premises and philosophical ones or scientific ones: honest dialectical premises are reputable beliefs, philosophical and scientific premises must be true and knowable. Fourth, we have two apparently equivalent routes to scientific starting-points, one inductive, which starts from raw starting-points, and the other dialectic, which starts from reputable beliefs.

According to the official definition, reputable beliefs are "things that are believed by everyone, by the majority, or by the wise—either by all of them, or by most, or by the most well known and most reputable" (*Top*. I 1 $100^{b}21$–23). Just as the scientist should have a catalogue of scientific (often perception-based) truths at hand from which to select the premises of his demonstrations, so a dialectician ought also to select premises "from arguments that have been written down and produce catalogues (*diagraphas*) of them concerning each kind of subject, putting them under separate headings—for example, 'Concerned with good,' 'Concerned with life'" (*Top.* I 14 $105^{b}12$–15). But for obvious reasons reputable beliefs in outré subjects like astronomy and cosmology (unlike in ethics and politics) are likely to have predominantly expert rather than non-expert sources. Thus the views that are reputable beliefs because they are those of other thinkers about astronomy loom larger in *De Caelo* than beliefs that are reputable because they are held by ordinary people rather than the wise. By the same token things that appear to be so on the basis of astronomical observation should figure along with these beliefs (notice *tôn endoxôn kai tôn phainomenôn* at III 4 $303^{a}22$–23), since these, as we saw, have the controlling vote in astronomy.

Clearly, then, there will be considerable overlap between the scientist's catalogue of raw starting-points and the honest dialectician's catalogue of reputable beliefs. For, first, things that are believed by reputably wise people are themselves reputable beliefs, and, second, any respondent would accept "the beliefs of those who have investigated the subjects in question—for example, on a question of medicine he will agree with a doctor, and on a question of geometry with a geometer" (*Top*. I 10 $104^{a}8$–37). The catalogues also differ, however, in that not all reputable beliefs need be true. If a proposition is a reputable belief, if it would be accepted by all or most people, it is everything an honest dialectician could ask for in a premise, since his goal is simply this: to show by honest deductions that a definition offered by any respondent whatsoever conflicts—if it does—with other beliefs the respondent has. That is why having a complete or fairly complete catalogue of reputable beliefs is such an important resource for a dialectician. It is because dialectic deals with things only "in relation

to belief," then, and not as philosophy and science do, "in relation to truth" (I 14 105^{b}30–31), that it needs nothing more than reputable *beliefs*.

Nonetheless, the fact that all or most people believe something leads us "to trust it as something in accord with experience" (*Div. Somn*. 1 426^{b}14–16), and—since human beings "are naturally adequate as regards the truth and for the most part happen upon it" (*Rh*. I 1 1355^{a}15–17)—as containing some truth. That is why having catalogued some of the things that people believe happiness to be, Aristotle writes: "Some of these views are held by many and are of long standing, while others are held by a few reputable men. And it is not reasonable to suppose that either group is entirely wrong, but rather that they are right on one point at least or even on most of them" (*NE* I 8 1098^{b}27–29). Later he generalizes the claim: "things that seem to be so to everyone, these, we say, are" (X 2 1172^{b}36–1173^{a}1). Raw starting-points are just that—raw. But when refined some shred of truth is likely to be found in them. So likely, indeed, that if none is found, this will itself be a surprising fact needing to be explained: "when a reasonable explanation is given of why an untrue view appears true, this makes us more convinced of the true view" (VII 14 1154^{a}24–25).* It is the grain of truth enclosed in a reputable belief that a philosopher or scientist is interested in, then, not in the general acceptability of the surrounding husk, much of which he may discard.

The process of refinement in the case of a candidate explanatory starting-point is that of testing a definition of it against reputable beliefs and perceptual evidence. This may result in the definition being accepted as it stands or in its being altered or modified: when a definition is non-perspicuous, Aristotle tells us at *Top*. VI 13 151^{b}7–8, it must be "corrected and reconfigured (*sundiorthôsanta kai suschêmatisanta*)" until it is made clear. The same process applies to the reputable beliefs and perceptual evidence themselves, since they may conflict not only with the definition but also with each other. Again, this may result in their being modified, often by uncovering ambiguities within them or in the argument supporting them, or by drawing distinctions that uncover complexities in these, or they may be rejected entirely, provided that their appearance of truth is explained away—*Cael*. IV 4 310^{b}24–31 is a nice example.

The canonical occasion for the use of honest dialectic, as of the Socratic elenchus and plain dialectic, is the examination of a respondent. The relevant premises for the questioner to use, therefore, are the reputable beliefs

*Compare: "What we are about to say will also be more convincing to people who have previously heard the pleas of the arguments disputing them" (*Cael*. I 10 279^{b}7–9); "refutations of those who dispute them are demonstrations of the contrary arguments" (*EE* I 3 1215^{a}6–7).

in his catalogue that his respondent will accept. Just how wide this set of beliefs is in a given case depends naturally on how accessible to untrained respondents the subject matter is on which he is being examined. We may all have some beliefs about thunder and other phenomena readily perceptible to everyone and which are—for that very reason—reputable. But, as we mentioned earlier, about fundamental explanatory notions in an esoteric science we may have none at all.

When a scientist is investigating by himself, the class of premises he will select from is the catalogue of *all* the raw starting-points of his science, despite a natural human inclination to do otherwise:

> [People] seem to inquire up to a certain point, but not as far as it is possible to take the puzzle. For it is customary for all of us to make our inquiry not with an eye to the thing at hand but with an eye to the person who says the contrary. For a person even inquires within himself up to the point at which he is no longer able to argue against himself. That is why a person who is going to inquire well must be capable of objecting by means of objections proper to the relevant genus, and this comes from having a theoretical grasp on all the differentiae. (*Cael.* II 13 $294^{b}6$–13)

Hence a scientist will want to err on the side of excess, adding any reputable belief, any perceptual evidence, that appears to have any relevance whatsoever to his catalogue. When he formulates definitions of candidate scientific starting-points from which he thinks he can demonstrate the raw ones, he must then examine himself to see whether he really does have the scientific knowledge of it that he thinks he does. If he is investigating together with fellow scientists, others may examine him: we all do better with the aid of co-workers (*NE* X 7 $1177^{a}34$). What he is doing is using honest dialectic on himself or having it used on him. But this, we see, is little different from the final stage—stage (4)—of the induction we looked at earlier. Induction, as we might put it, is in its final stage (possibly self-directed) honest dialectic.

In a well-known and much-debated passage, Aristotle writes:

> We must, as in the other cases, set out the things that appear to be so, and first go through the puzzles, and, in that way, show preferably all the reputable beliefs about these ways of being affected, or, if not all of them, then most of them and the ones with the most authority. For if the objections are refuted and the reputable beliefs are left standing, that would be an adequate showing. (*NE* VII 1 $1145^{b}2$–7)

The specific topic of the comment is "these ways of being affected," which are self-control and its lack as well as resilience and softness, as in the parallel passage about place (*Ph.* IV 4 211^{a}7–11) we examined. Some people think that it applies only to this topic and should not be generalized, even though "as in the other cases" surely suggests a wider scope. And, as we can now see that scope *is* in fact entirely general, since it describes the honest dialectical or inductive route to the starting-points of *all* the sciences and methods of inquiry, with *tithenai ta phainomena* ("setting out the things that appear to be so") describing the initial phase in which the raw starting-points are collected and catalogued.

Now that we know what it means for honest dialectic of the sort employed by the philosopher to provide a route to the explanatory starting-points of the philosophical sciences, we are in a position to see that it is just such a route that *De Caelo* takes to those of astronomy (cosmology). Since this route is the sort any science must take to show its explanatory starting-points, the investigation it undertakes is indeed a scientific one. It is not, to be sure, a demonstration from starting points (the word *apodeixis*, as we saw, occurs only three times in it), but rather a showing of the starting-points themselves, which, if successful, allows us to achieve the sort of puzzle-free grasp on them that comes with genuine understanding.*

The Audience for De Caelo

In the *Nicomachean Ethics*, Aristotle famously tells us that it is not a work for young or immature people, inexperienced in the practical matters with which it deals:

> But each person correctly judges the things he knows and is a good judge of these. Hence a person well educated in a given area is a good judge *in that area*, while a person well educated in all areas is an unconditionally good judge. That is why a young person is not a suitable audience for politics. For he has no experience of the actions of life, and the accounts are in accord with these and concerned with these. (*NE* I 3 1094^{b}25–1095^{a}4)

*For further argument bearing on the scientific status of *De Caelo*, see A. Falcon and M. Leunissen, "The Scientific Role of *Eulogos* in Aristotle's *Cael* II 12." In D. Ebrey (ed.), *Theory and Practice in Aristotle's Natural Science* (Cambridge, 2015), pp. 217–240.

Though less often recognized, he issues a similar warning in the *Metaphysics*, and there as in the *Ethics*, he makes being well educated a prerequisite:

> That is why we should already have been well educated in what way to accept each argument, since it is absurd to look for scientific knowledge and for the way characteristic of scientific knowledge at the same time—and it is not easy to get hold of either. Accordingly, we should not demand the argumentative exactness of mathematics in all cases but only in the case of things that include no matter. (II 3 995^{a}12–16)

But whereas in the case of ethics and politics the relevant experience is practical, in metaphysics it is theoretical. There we need experience in life. Here we need experience in the sciences. And in both we need the sort of training in honest dialectic, as in logic and what we would call the philosophy of science, for which the treatises in the so-called *Organon* (*Categories*, *De Interpretatione*, *Prior and Posterior Analytics*, *Topics*, and *Sophistical Refutations*) might serve—or might once have served—as a textbook.

Now it is true that there is no comparable warning to be found within the *Physics* itself, which never mentions its intended audience or what it requires of them. But in a passage in the *Nicomachean Ethics* a requirement is explicitly mentioned:

> While young people become geometers and mathematicians and wise in such things, they do not seem to become practically-wise. The explanation is that practical wisdom is concerned also with particulars, knowledge of which comes from experience. But there is no young person who is experienced, since it is quantity of time that produces experience. (Indeed, we might also investigate why it is that a child can become a mathematician but not a theoretically-wise person or a natural scientist. Or isn't it that the objects in mathematics are given through abstraction, while the starting-points in theoretical wisdom or natural science come from experience, so that the young lack conviction there but only talk the talk, whereas in mathematics it is quite clear to them what each of the objects is? (*NE* VI 8 1142^{a}13–29)

The *Physics*, then, is no more for the inexperienced than the *Nicomachean Ethics* or the *Metaphysics*, although in its case the experience is presumably in the genus-specific natural sciences, Aristotle's own philosophy of science, and in dialectic. The following two passages indicate as much:

bearing on "pursuit and avoidance" (*Top*. I 11 104^{b}1–2), we also need its apparently more ethical namesake. It would be a mistake, though, to rush to this conclusion. For the ultimate starting-point and cause that the *Metaphysics* finally uncovers, which is at once the active understanding of active understanding, the prime unmoved mover, and the primary god, is the ultimate cause and starting-point for beings qua beings—*all of them*. And that means that it is our ultimate starting-point and cause too.

When we look at our lives from the outside, so to speak, from the theoretical point of view, if the *Metaphysics* is right, we see something amazing, namely, that the heavenly bodies, those bright denizens of the starry heavens above, are living beings who, like us, are moved by a desire for the best good—for the god (XII 7). It is the conclusion for which *De Caelo* II 1, like *Physics* VII 10, prepares us. When we view our lives from the inside, from that perspective from which "the truth in practical matters" can alone be judged, the *Ethics* tells us that we will find that we are moved by the same thing—that as the good for the heavenly bodies consists in contemplating the primary god, so too does our happiness: "The activity of a god, superior as it is in blessedness, will be contemplative. And so the activity of humans, then, that is most akin to this will most bear the stamp of happiness" (*NE* X 8 1178^{b}21–23). But Aristotle's hand is tipped also within the *Metaphysics* itself:

> [Active understanding rather than receptive understanding] seems to be the divine element that understanding possesses, and contemplation seems to be most pleasant and best. If, then, that good state [of activity], which we are sometimes in, the [primary] god is always in, that is a wonderful thing, and if to a higher degree, that is yet more wonderful. But that is his state. And life too certainly belongs to him. For the activity of understanding is life, and he is that activity; and his intrinsic activity is life that is best and eternal. We say, then, that the god is a living being that is eternal and best, so that living and a continuous and everlasting eternity belong to the god, since this is the god. (*Met*. XII 7 1072^{b}22–30)

That is why "we should not, in accord with the makers of proverbs, 'think human things, since you are human' or 'think mortal things, since you are mortal' but rather we should as far as possible immortalize, and do everything to live in accord with the element in us that is most excellent" (*NE* X 7 1177^{b}31–34), this being our understanding—our divine *nous*.

Aristotle arrives at this great synthesis of theory and practice, as we saw, on empirical grounds, by reflecting on, and drawing inductive conclusions

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