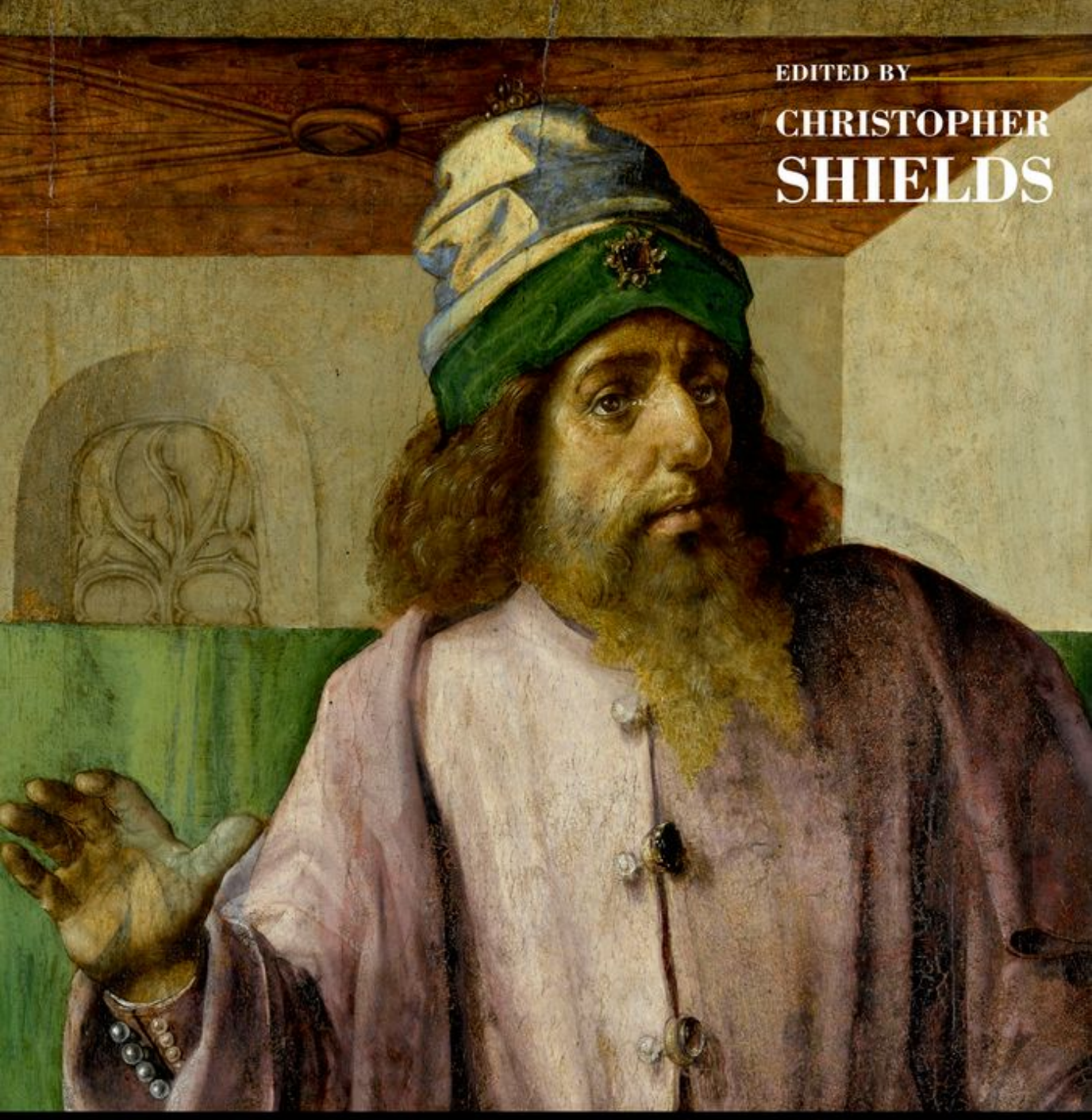

EDITED BY
CHRISTOPHER
SHIELDS

The Oxford Handbook *of* ARISTOTLE

THE OXFORD HANDBOOK OF

ARISTOTLE

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Edited by

CHRISTOPHER SHIELDS

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My deepest thanks are due, however, to the twenty-four contributors to this volume. Some have been asked to wait an unconscionably long time between their original submissions and their eventual publications; they did so with welcome good grace and with encouraging support, for which I remain grateful. Above all, however, I thank them for what they have taught me about Aristotle: their breadth and depth of knowledge is truly astonishing, and I have been honoured to serve as a conduit to its expression. Interacting with them as they wrote and revised their chapters has left me with the highest esteem for their collective learning. My hopeful expectation as editor is that the work's eventual audience—scholars, students, the broader educated public—will come to learn from them as I have learned, and will find themselves inspired, as I have been inspired, to carry their Aristotelian explorations forward.

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Preface

Had it hoped to represent the full range of Aristotelian studies as they are pursued throughout the world today, *The Oxford Handbook of Aristotle* could aspire to no more than lamentable failure. It would be a happy sort of failure, perhaps, but a failure all the same: research into matters broadly Aristotelian thrives worldwide today in many different guises, beginning with the narrowest and most exacting kinds of paleographical and philological scholarship and extending through careful textual exegesis to the loosest forms of philosophical, political, and artistic appropriation, this last as often as not at the hands of those generally inspired by Aristotle's thought, even if they evince at most a passing concern for fidelity to the texts he has actually handed down to us.

This broad compass of activity moves forward under the banners of a variety of philosophical orientations, some beholden to a particular movement or method, others more open-textured, some avowedly religious, others avowedly not, and still others avowing nothing at all in matters of religion or philosophical tradition but seeking instead to understand Aristotle afresh through the cautious eyes of patient textual exegesis. Those preferring to relate Aristotle to recent trends in philosophy often find grounds for identifying in his writings the original seeds of various positions promulgated by philosophers of the present day; others decry such efforts as faddish foistings and grotesque anachronisms, bound only to distort Aristotle's actual views by ignoring their authentic intellectual context and social milieu.

Conferences adopting these and other postures dedicated to interpreting and assessing Aristotle's philosophy are now a fixture of the academic landscape across Europe, North and South America, Asia, Africa, and the Middle East. Indeed, Aristotelian studies flourish wherever higher education has a hold. Some conferences take up questions of narrowly defined textual matters; others pursue themes within Aristotle's philosophy or science; others investigate matters of reception and appropriation, ranging from late Antiquity down to the present day, some seeking to bring Aristotle into dialogue with non-Aristotelian traditions and some investigating his reception by earlier generations of Aristotelian scholars, often with an eye on shedding corrective light on our own scholarly preoccupations and predilections; and still others, doxographical in orientation, try to understand the sources and influences of Aristotle's predecessors on his philosophy and philosophical development. The list goes on, in an impressive array of distinct directions.

Of course, all of this activity generates new scholarship, and in its wake there follow new controversies and so also ever more publications on Aristotle and Aristotelian themes. A new online bibliography, cited in the bibliography of the present volume, boasts 50,000 entries and grows with each passing academic year.

It is worth appreciating that a print version of that bibliography would dwarf the present, already stout volume many times over.

Consequently, any attempt to reproduce the full variety of voices heard clattering under the big tent of 'Aristotelianism' would yield only cacophony. For these reasons, *The Oxford Handbook of Aristotle* does not seek to be a general compendium of Aristotelian thought nor even a full and complete reflection of the many forms of Aristotelian study carried out throughout the world today. Instead, it seeks to represent a core activity of this variegated patchwork of international Aristotelian study by drawing contributors from various parts of the world, all of whom share a broadly common orientation and methodology, all equipped with a developed facility for reading Aristotle's often demanding Greek, and all prepared to engage in critical exegesis and interpretation.

The contributors in their various ways investigate the primary areas of inquiry as Aristotle himself divided them: into sciences (*epistêmai*) which are either theoretical, practical, or productive. Each Aristotelian science is a branch of learning, where the branches are divided by Aristotle into broad categories individuated by their ends or goals: theoretical science seeks knowledge for its own sake; practical science investigates and recommends the optimal forms of goodness in action, whether individual or societal; and productive science aims at the creation of beautiful or useful objects (*Top*. 145a15–16; *Phys*. 192b8–12; *DC* 298a27–32, *DA* 403a27–b2; *Met*. 1025b25, 1026a18–19, 1064a16–19, b1–3; *EN* 1139a26–28, 1141b29–32).

The current volume represents work in each of these branches, in some cases, in less well-trammeled areas of scholarly inquiry, through the presentation of a discursive overview given by a scholarly authority, and in others by the exploration of some crucial, often determinative issue within a broader area of study. The volume begins, however, looking backward from Aristotle to his predecessors, because he himself emphasized as requisite for philosophical progress the careful consideration of one's intellectual forebears, and ends looking forward to the philosophical traditions whose foundations Aristotle indisputably laid and so whose lineaments we could not begin to understand without first understanding their relation to him.

Together these forms of inquiry and assessment provide a partial picture of Aristotelian studies as they proceed throughout the world today, always with a view to inviting new participants drawn from the broadest variety of perspectives, by demonstrating the liveliness of current Aristotelian philosophy in as many guises as is practicable within the confines of a single, even modestly coherent volume.

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Abbreviations of Aristotle's Works

- *Categories (Cat.)*
- *De Anima (DA) [On the Soul]*
- *De Caelo (DC) [On the Heavens]*
- *De Interpretatione (DI) [On Interpretation]*
- *Eudemian Ethics (EE)*
- *Generation and Corruption (Gen. et Corr.)*
- *Generation of Animals (GA)*
- *History of Animals (HA)*
- *Magna Moralia (MM) [Great Ethics]*
- *Metaphysics (Met.)*
- *Meteorology (Meteor.)*
- *Movement of Animals (MA)*
- *Nicomachean Ethics (EN)*
- *Parva Naturalia (PN) [Brief Natural Treatises]*
  - *De Insomniis (Insomn) [On Dreams]*
  - *De Memoria (Mem) [On Memory]*
  - *De Sensu et Sensibilibus (Sens) [Sense and Sensibilia]*
- *Parts of Animals (PA)*
- *Physics (Phys.)*
- *Prior Analytics (APr)*
- *Posterior Analytics (APo)*
- *Problems (Prob)**
- *Progression of Animals (IA)*
- *Poetics (Poet.)*
- *Politics (Pol.)*

- *Rhetoric (Rhet.)*
- *Sophistical Refutations (SE)*
- *Topics (Top.)*

The titles provided are those in most common use today in English language scholarship, followed by standard abbreviations in parentheses. For no discernible reason, in some cases scholars prefer Latin titles over English. Where Latin titles are generally preferred, English equivalents are given in square brackets. (* = Questions of authenticity remain viable.)

PART I

ARISTOTLE'S PHILOSOPHICAL MILIEU

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CHAPTER 1

ARISTOTLE'S PHILOSOPHICAL LIFE AND WRITINGS

CHRISTOPHER SHIELDS

If restricted in its appeal to widely attested facts only, Aristotle's biography would be pleasingly brief: he was born in Stagira, in Macedon, in 384 BC; at some point as a young man he came to Athens and associated himself with Plato's Academy; around the time that Plato died in 347 BC, he left Athens for Assos, in Asia Minor, settling there for three years, followed by another two in nearby Lesbos; he returned to Macedon in 343 BC, perhaps at the behest of Philip, the father of Alexander the Great; thereafter he returned to Athens in 335 BC to head his own school, the Lyceum; and finally he left Athens for a second time in 323 BC, upon the death of Alexander, a year or so before his death, which befell him of natural causes in Chalcis in 322 BC at the age of 62. Beyond that, speculation creeps in, some grounded and plausible, some flighty and fanciful. Indeed, even prior to the onset of speculation, what is 'widely attested' is not universally affirmed: several of the contentions even in this skeletal summary are strenuously denied by credible sources.[1]

Despite a paucity of contemporary information about Aristotle's life and affairs, our ancient sources are only too happy to supply missing details and additional colour, much of it centred on his relationship with his teacher, Plato.[2] Aristotle left Athens when Plato died. Why? As we have them, the probable facts are that Plato died, Plato's nephew Speusippus became the head of the school he had founded, the Academy, and Aristotle left Athens for Assos, on the coast of Asia Minor. Later historians connected these events by contending that the second happened after the first with the result that the third happened because of the second. With a bit of added colour, this becomes: Aristotle left Athens after Plato's

death in a snit brought on by his having been passed over for the headship of the Academy in favour of Plato's nepotistically selected nephew. Maybe this is so. Or maybe Aristotle was lured away by a handsome invitation to engage in marine biological research, since animal studies were never far from his heart. These he might have conducted in Assos even as a continuing member of the Academy, since a letter ascribed to Plato treats the researchers in Assos as forming a sort of satellite campus of the Academy.[3] This suggestion gains further credence from the authoritative source who reports that Aristotle left Athens even before Plato's death.[4] So, maybe he was pulled to Assos rather than pushed from Athens. Maybe, but, again, we do not know. Still less do we know what Aristotle held in his heart when he left Athens, not even to the point of informed conjecture. Neither Aristotle himself nor any acquaintance of his, friend or foe, reports anything at all about his motives pertaining to this move. In the end, then, such conjectures mainly tell us something about the explanatory practices of those who offer them.

Of similar worth are the reports of Aristotle's appearance and manner. Writing a half millennium after his death, Diogenes Laertius retails a second-hand portrait of him this way:

> He had a lisping voice, as is asserted by Timotheus the Athenian, in his *Lives*. He had also very thin legs, they say, and small eyes; but he used to indulge in very conspicuous garments and rings, and he used to dress his hair carefully.[5]

So, Aristotle was a dapper chap—if, that is, Timotheus of Athens is to be our guide. He seems to have written in the second or third century AD and is preserved only in Diogenes Laertius; we do not know his sources. So, it is unclear what to make of his characterisation.

Still less is it clear what value it should be accorded if true. Many of the speculations about Aristotle's character and motives, however rooted in a natural curiosity to come to know the man and his ways, stem from an understandable but misplaced motive: to understand his thought more fully. In fact, though, many of the speculations we have tend to run in the wrong direction. Finding something significant on display in Aristotle's voluminous output, something distinctive or oddly brilliant, biographers project back onto the man those features they suppose will help explain the genius on display in his writings. A remarkable instance of this tendency owes to Werner Jaeger, easily one of the greatest Aristotelian scholars of the last two centuries. Jaeger discerns in Aristotle's will, which was preserved by Diogenes Laertius,[6] a deeply humane but sadly alienated man. Pulsing below the surface of the formulaic language of the will, Jaeger detects 'the warm tone of true humanity, and at the same time an almost terrifying gulf between him and the persons by whom he was surrounded. These words were written by a lonely man.'[7] While it is true that Jaeger had an impressively intimate familiarity with Aristotle's writings—their tone, their nuance, their idiosyncrasies—it is hard to escape the conclusion that when he travels beneath the words of Aristotle's will he spies lurking there only the man whose character he projects into that space.

This is not to say that biographical speculation about Aristotle is as a matter of course jejune, but rather that we will learn more about Aristotle from reading

Aristotle than from studying the conjectures of those who wrote about his dress or demeanour in late antiquity and beyond. So, after a brief recapitulation of the main facts of his life as they pertain to his intellectual endeavours, we will characterize Aristotle's writings briefly as an aid to their study, primarily by illustrating the delicate difficulties involved in contemporary Aristotelian scholarship.

Aristotle's philosophical life began in Athens, when he came to be associated with Plato's Academy. In all likelihood, he went to Athens as a young man of about 18 in 367 BC, having been raised in Macedon, in what is now northeastern Greece. He was born to Nicomachus, a physician in the court of King Amyntas II, and Phaistis, a woman with family origins in Euboia, an island in the Aegean Sea, where Aristotle's own life was to end in 332. Because his parents died when he was still a boy, Aristotle was raised by a family relation, perhaps his uncle, Proxenus, who came from Atarneus, near Assos, the town to which Aristotle travelled after the death of Plato.

Not much is known of Aristotle's childhood, though two features of his birth likely proved consequential. First, his lifelong interest in biology presumably found its formative influences in the practices of the medical guild to which his father belonged, the Asclepiadae, who carried out detailed anatomical inquiries, including dissections, and who reportedly trained their sons in these same practices.[8] Second, his connections to the Macedonian court, which he would have visited at Pella as a boy, followed him throughout his life. They explain his being recalled there to tutor Alexander the Great, and they may be responsible for his decision, taken a year before the end of his life, to leave Athens, which was just then experiencing one of its periodic surges of anti-Macedonian sentiment, this one brought on by the death of Alexander in 323.

In any event, at the end of his childhood, Plato's Academy brought Aristotle to Athens. In all likelihood he was sent there, since he was only about 17 or 18 when he arrived in 367, at a time when Plato himself would have been absent (he was in Sicily until 365). He remained in the Academy for nineteen years, until around the time of Plato's death in 347 BC, by which time, of course, Aristotle had grown into a fully mature man. Aristotle's relationship to Plato is the source of endless debate and controversy. Plainly Aristotle found much of value in the Academy and in Plato's headship of it, else he would not have remained there for nearly two decades. Many of his works must have been written there, including some early, lost dialogues, which were described by Cicero, who was certainly in a position to judge, as beautifully composed and executed: he called them 'flowing rivers of gold.'[9] These dialogues stand in stark contrast to other works written at the same period and beyond, which read more like crabbed, terse sets of lecture notes and records of ongoing investigations, written, re-worked, unpolished, and not produced for general consumption. These are the works we possess today.

Aristotle's relationship to Plato during this period and beyond is at least obliquely on display in some of these writings. Sometimes Aristotle describes himself as a member of Plato's circle, even when criticizing Plato's views; other times, in equally critical veins, he disassociates himself from Plato and his teachings,

writing as if from an opposing camp. Although the views of those working in Plato's Academy were hardly monolithic, Aristotle's varying attitudes seem at times presented as from a member of the Academy and at other times as someone writing from the outside. These different attitudes may be the result of editorial interpolations, or they may derive from different periods of Aristotle's life. Perhaps, though, Aristotle simply maintained a deep respect for the teachings of Plato and other Academicians even while seeking to undermine them. Indeed, that he regards Plato's views as worthy of discussion already reflects some indication of his attitude towards their worth. Probably the single best passage capturing Aristotle's bi-modal attitude towards Plato occurs in a digression in the first book of his *Nicomachean Ethics*:

> We had perhaps better consider the universal good and run through the puzzles concerning what is meant by it, even though this sort of investigation is unwelcome to us, because those who introduced the Forms are friends of ours. Yet presumably it would be the better course to destroy even what is close to us, as something necessary for preserving the truth—and all the more so, given that we are philosophers. For although we love them both, piety bids us to honour the truth before our friends (*EN* 1096a11–16).

Aristotle evinces both genuine affection and critical distance, presumably because he reveres and respects Plato, even while concluding that one of his signature theses is unsustainable. We do not, then, need to regard Aristotle as 'the foal who kicked its mother,' an ingrate too ill mannered and truculent to revere his magnanimous teacher.[10] It is true that he can be at times rather caustic, as once when he mocks Plato's theory of Forms,[11] but in the main his time in the Academy left him honouring Plato as 'a man whom the wicked have no place to praise: he alone, unsurpassed among mortals, has shown clearly by his own life and by the pursuits of his writings that a man becomes happy and good simultaneously.'[12]

Whatever his relationship to Plato, which was doubtless rich and variegated, Aristotle, whether pushed or pulled, left Athens at around the time of Plato's death for Assos, on the northwest coast of present-day Turkey. There he carried on his philosophical activity augmented by intensive marine biological research.[13] He had been invited to Assos by Hermias, reportedly a friend from the Academy who had subsequently become the ruler of the region incorporating Assos and Atarneus, the birthplace of Aristotle's guardian, Proxenus. When Hermias died, Aristotle relocated to Lesbos, an island off the coast and sufficiently close to Assos that one acropolis could be seen from the other. He remained working in Lesbos for an additional two years. There, again by at least some reports, he was joined by his long-term colleague and fellow ex-Academician Theophrastus. During his two years in Lesbos, Aristotle married Pythias, the niece of Hermias, with whom he had a daughter, also named Pythias.

The period of Aristotle's life following his time in Asia Minor has been a source of rich speculation for historians, though, again, we have little determinate or reliable data upon which we may rely. Aristotle was called or invited by Philip, king

of Macedon, in 342, to return to Pella, the seat of Macedonian power where he had presumably visited as a boy. Almost all historians accept that during this period Aristotle offered tuition to Philip's son Alexander, later the Great. There was a private school at Mieza, the royal estate near Pella, and Aristotle might well have taught Alexander there. The tuition began when Alexander was 13, and probably lasted only two or three years. It is possible that it carried on for a longer period, though this seems unlikely since Alexander was already serving as a deputy military commander for his father by the age of 15. Aristotle did, however, remain in Macedon for another five or so years, perhaps back in Stagira, the city of his birth, until the death of Philip by assassination in 336.

Again, while the exact motives for his relocation are unclear, Aristotle returned to Athens for his second and final stay in 335. Once there, he established his own school in the Lyceum, a location outside of the centre of Athens in an area dedicated to the god Apollo Lykeios. This second period of residency in Athens was an astonishingly productive one for Aristotle. Together with his associates, who included Theophrastus, Eudemus, and Aristoxenus, Aristotle built a great library and pursued a very wide range of research programmes, leading well beyond philosophy as we conceive of that discipline today but in keeping with the more comprehensive courses of study in Aristotle's intellectual orientation. That allowed, many of the philosophical works of Aristotle that we possess today probably derive from this period. It seems that research in the Lyceum carried forward at a feverish pace into a variety of distinct areas, up to the time of Aristotle's final departure from Athens in the year prior to his death.

During his second sojourn in Athens, Aristotle's wife Pythias died, and he formed a new relationship, whether into formal marriage or not remains unclear, with Herpyllis, who was also a native of Stagira. They had a child, Nicomachus, after whom his *Nicomachean Ethics* is named.

Aristotle withdrew to Chalcis on the island of Euboia, in 323, likely because of a resurgence of anti-Macedonian feeling in Athens, always present in an undercurrent there and flooding forth after the death of Alexander the Great. Aristotle's real and perceived associations with Macedon would have made life in Athens just then unpleasant if not precarious for him.[14] As a metic, or resident alien, Aristotle would have been extended fewer protections than citizens of Athens received and would also have been more likely to be regarded with suspicion than a native Athenian. Diogenes Laertius reports that Aristotle was charged with actionable impiety by Eurymedon,[15] which charge, like the similar accusation laid against Socrates before him, was no doubt spurious. No matter: a spurious charge against a man in Aristotle's marginal position could well have proven deleterious to his well-being.

A year after his departure from Athens, Aristotle died in Chalcis on the island of Euboia, presumably of natural causes. That presumption notwithstanding, a charming aetiology of Aristotle's death helps bring into sharp relief the credibility of many of the sources relied upon in constructing even this minimal biography. According to a story preferred by the Church Fathers,[16] Aristotle died in a revealing sort of way: maniacally devoted to the pursuit of explaining natural phenomena

and deeply frustrated by his inability to explain the tidal currents he observed in the straight of Euripus, the channel separating Euboia from mainland Greece, he grew morose and moribund. Aristotle died of terminal curiosity.

Stories such as this capture something authentically Aristotelian: his writings are broadly cast, arrestingly deep, and coursing with curiosity. The works we possess today range widely across an astonishing number of fields, including aesthetic theory, argumentation theory, astronomy, botany, biology, category theory, cosmology, epistemology, ethics, government, history of thought, literary theory, logic, mathematics, metaphysics, music, medicine, meteorology, pedagogy, philosophy of science, political theory, psychology, physics, rhetoric, semantic theory, political history, theology, and zoology. All these areas Aristotle pursued with genuine, unselfconscious zeal, under a general rubric of his own invention. He distinguishes three broad categories of inquiry. The first class is *theoretical*, comprising disciplines pursuing knowledge for its own sake; the second is *practical*, including ethics, politics, and all study concerned with conduct and goodness in action, whether individual or societal; and the third is *productive*, covering those sciences and crafts which aim at the creation of beautiful or useful objects, broadly conceived so as to include drama and dance (on Aristotle's characterisations of the sciences, see *Top*. 145a15–16; *Phys*. 192b8–12; *DC* 298a27–32, *DA* 403a27–b2; *Met*. 1025b25, 1026a18–19, 1064a16–19, b1–3; *EN* 1139a26–28, 1141b29–32).

With one glaring exception, Aristotle's extant works slot reasonably well into this classificatory schema. Thus, among the theoretical works are the *Metaphysics*, the *Physics*, and *De Anima*; among the practical works are the *Nicomachean Ethics*, the *Eudemian Ethics*, and the *Politics*; and among the productive works are the *Rhetoric* and *Poetics*. The glaring exception is the family of works which came to be known as Aristotle's *Organon*, roughly the tools for study rather than the objects of study (*organon* = tool, in Greek): logic, dialectic, argument theory, philosophy of science, and the doctrines of propositions and terms. These include *The Categories, De Interpretatione, Prior* and *Posterior Analytics, Topics,* and *Sophistical Refutations*. The relation of these works to the rest of Aristotle's writings gave rise to a series of lively controversies in later Aristotelianism, though Aristotle himself shows no reflexive awareness of the wellsprings of these controversies. Instead, he simply treats the subjects pursued in his *Organan* as matters worthy of concern in their own right and then puts his tools to work in his practical, productive, and theoretical sciences.

As these controversies about the relation between the *Organon* and the discipline-specific treatises attest, later Aristotelian philosophers and scholars have investigated Aristotle's works minutely from a number of complementary angles. There remain in the first instance unsettled questions about transmissions of Aristotle's texts from antiquity to the present day,[17] as well as related questions about the internal constitutions of the works as we now possess them. Some of our works, including notably the *Metaphysics* and the *Politics*, show signs of being editorial compilations rather than continuous treatises conceived and executed as such by Aristotle. Other questions pertain to the relation between the works we

possess and the three main lists of Aristotle's works from late antiquity, owing to Diogenes Laertius (third century AD, who lists 143 titles), Ptolemy (fourth century AD, who catalogues 99 titles),[18] and Hesychius (sixth century AD, who reports 187 titles). Although these lists do not cohere completely, the numbers of titles reported in them are not as nearly as disparate as they first appear, because the different lists report the titles differently, so that, for instance, Hesychius mentions as separate titles works treated as books or chapters by Ptolemy.[19] Still, many of the works included in the ancient lists are not, by current scholarly consensus, by Aristotle at all, while other works which we accept as genuine make no appearance in the ancient catalogues of Aristotle's works. Today, although the matter is not without lingering controversy, scholars accept thirty-one surviving works, those contained in the *Corpus Aristotelicum* of our medieval manuscripts judged to be authentic.

That said, as we read Aristotle today, it is salutary to bear in mind that judgements about the authenticity of his works have varied with the times.[20] Some works today accepted as canonical were as recently as the nineteenth century regarded as spurious. Thus, in the nineteenth century, even so centrally canonical a work as the *Categories* was able to be regarded as spurious by no less eminent an authority than Jaeger, who was convinced that it was the work of a later compiler.[21] Several of Aristotle's works would benefit from new critical editions, and all of them should be read with an awareness that the texts constituted and translated in our modern editions bear the marks of editorial judgement in a host of different ways: decisions about the relative priority of our existing manuscripts relative to one another; appraisals concerning the authenticity of individual words and sentences in our texts, many of which show signs of being interpolations by scribes and scholars seeking to explicate or amplify Aristotle's own words rather than merely to reproduce them; arrangements of individual sentences and paragraphs, which sometimes, from the standpoint of sense or argumentative progression, seem to have been transposed; and the status of doublets, or passages which are repeated, or largely repeated, in different parts of the corpus as we have it.

To take just one especially useful illustration: a doublet in *Metaphysics* I and XIII repeats a series of criticisms of Platonic Forms in virtually identical language, though in one case putting the case against Plato using the first person (*Met*. I 990b8: 'of the ways in which *we prove* that the Forms exist, none is convincing') and in the other using an impersonal third person (*Met*. XIII 1079a4: 'of the ways in which *it is proven* that the Forms exist, none is convincing'). These passages intertwine a series of editorial difficulties, all consequential for our thinking about the proper constitution of the text of the *Metaphysics*. Should we say that one is authentic and the other corrected? Was the original passage written by Aristotle when he was still a member of the Academy—hence the use of the first person? If so, was it later revised by him after leaving the Academy, or by some later scholar seeking to 'correct' the impression that Aristotle was once a critical Platonist? The matter is further complicated by the fact that some of these divergent readings come down to us under two different branches in the family of manuscripts of the *Metaphysics*.[22] If one family shows a tendency of offering late editorial corrections

and interpolations in passages where direct comparisons are possible because of the existence of doublets, then that result might be cautiously generalized, so that other editorial decisions about the relative strengths and weaknesses of the manuscript families can be favourably exploited in the constitution of our texts.

This is but one small, if significant example of the sort of work that needs to be undertaken before we come to the point where we can read and appraise the philosophical content of a text of Aristotle. We possess no manuscript of Aristotle's works written by him or even in his own time. Our earliest useable manuscripts date to the ninth century, and the vast majority of them come from the centuries following. So, there is a long line of transmission between the words composed by Aristotle and a translation of Aristotle read today—if his works were composed by him rather than by a compiler or by members of his school charged with keeping notes.

Standing behind each modern publication is thus a series of decisions, most proximately by the translator, determining how to wrestle Aristotle's often wiry Greek into some suitably faithful but still readable modern language syntax, and before the translator, by an editor constituting the text from the various manuscripts available to us, and often enough, before the editor, by a paleographer determining the readings of the manuscripts, and then also, even before the paleographer, by a scribe, or series of scribes, who also needed to determine what a manuscript being copied had written on it, since styles of writing altered through the centuries. (Sometimes, but rarely, the paleographer, the editor, and the translator may be one and the same person, discharging different roles in the constitution of the text in a co-ordinated way.) Many of these intersecting editorial decisions are delicate and mutually implicating, with the result that by the time we pick up a translation of a given text of Aristotle, we have already benefited from the critical acumen of a full range of philosophical and philological scholars—but then we also to some extent remain hostage to the critical judgements and determinations of those scholars. Accordingly, when contemporary philosophers go to work on a text of Aristotle, they should be mindful that what they are reading bears some resemblance to a committee report composed incrementally, in slow motion over two millennia. Happily, this awareness can also be liberating: Aristotle's philosophically suggestive texts bear repeated study not least because they remain open to surprising developments, both interpretative and philosophical.

Of special interest to philosophical scholarship over the last century has been the question of the relative dates of the treatises now mainly accepted as genuine.[23] Because we do not have secure information concerning the dates of composition for Aristotle's works, scholars, assuming that such knowledge will assist in the twin projects of interpretation and assessment, rely on a series of mutually reinforcing considerations to determine their relative order. These include stylometric data, involving features of Aristotle's diction and syntax;[24] doctrinal matters, including some permanently disputed issues regarding Aristotle's philosophical development, especially as regards his relationship to Plato; some less tendentious matters involving his use of place names and historical allusions; and finally, intertextual

references, which provide *prima facie* support for the thesis that the referring work is later than the work to which it refers.

Each of these criteria introduces controversies and small surprises of various sorts. Thus, to take just one example, intertextual references often enough have the feel of editorial interpolations; this, then, tends to undercut the *prima facie* plausible judgement that a referring text is later than the text to which it refers. In the same vein, as previously suggested, many of Aristotle's works bear the marks of being revisited and revised, each occasion of which provides the opportunity for cross-referencing by Aristotle himself, rather than by an editor. One especially stark instance of this sort of worry concerning internal cross-referencing occurs in *De Interpretatione*, regarded almost universally as an early work from the *Organon*, and presumably composed during Aristotle's first period in Athens when he was a member of the Academy. In this work, Aristotle—or some editor on his behalf—refers to his *De Anima*, almost certainly, judged in terms of doctrine and diction, one of his very last productions (*DI* 16a9). Another is the simple observation of Jaeger pertinent to his attitude towards the authorship of the *Categories*, which is also thought by most scholars to be a production of Aristotle's time in the Academy. As Jaeger observes, Aristotle illustrates the category of place with the example of 'being in the Lyceum' (*Cat.* 2a1).[25] To Jaeger this suggests a date of composition much later than Aristotle's time in the Academy, relying as it does on a place name which is associated with Aristotle's second stay in Athens rather than his first. Other scholars respond that if the *Categories* is in fact early, the example might merely have been interpolated later, by Aristotle or by someone else, so that the presumed early date of its composition is not threatened. That is certainly fair enough, but Jaeger's simple observation serves to introduce some instability into our easy preconceptions about the relative sophistication of Aristotle's works and their relation to one another. In general, scholars must tread lightly when making arguments about the dating of Aristotle's works. No one criterion seems terribly decisive on its own. Still, to the degree that the different sorts of criteria coalesce, a reasonably clear picture regarding the order of composition begins to emerge.

One might wonder, of course, whether the composition order of Aristotle's works is of any significance to our understanding his philosophy. In one way, it is not. After all, some of the greatest and most incisive philosophical commentaries on Aristotle were written in Late Antiquity and in the Arabic and Latin Middle Ages, long before techniques of stylometry were even invented. Thus, for instance, using a characteristically medieval hermeneutic technique of the sort practiced by biblical exegetes bent on reconciling apparently inconsistent verses of the bible, various Aristotelians of these earlier periods were able to prise out striking forms of intertextual consistency which would likely have eluded later scholars altogether, especially if those scholars were attacking their texts secure in the knowledge that, for example, the *Politics* was written later than the *Nicomachean Ethics*, or that the theory of substance developed in the *Metaphysics* revises and replaces the coarser theory of the *Categories*. On this latter point, it is striking that many sophisticated medieval commentators actually attempt to derive the doctrine of *Categories* from the hylomorphic principles

of the *Metaphysics*, completely reversing the almost universal judgement of present-day scholars that the *Metaphysics* post-dates the *Categories*. According to the currently received view, far from grounding Aristotle's categorialism, the *Metaphysics* in fact proves positively incompatible with some of the central contentions of the *Categories*.[26] So, one might reasonably observe that something of value is lost in the modern drive to read Aristotle's works in the supposed order of their composition.

Still, heading in the other direction, a great deal turns on questions of relative dating. We may consider as one illustration the question of whether we should think of Aristotle's *De Anima* as early or late. The hylomorphic theory of body and soul adumbrated in this work seems plainly incompatible with Platonism, and, more to the point, with the Platonic doctrine of soul embraced in Aristotle's early, lost dialogues (sufficient numbers of quotations and fragments exist that reasonably secure ascriptions can be made to the lost works).[27] If the appearance of conflict is genuine, then some philosophically fecund questions come to the fore. What in Aristotle's subsequent development led him to abandon his earlier views? Is, for example, the hylomorphism of his *Physics* and *Metaphysics* genuinely inconsistent with Platonism? What—in fact or in Aristotle's eyes—commends hylomorphism over Platonism? When we pursue these sorts of questions, we move swiftly into the style of philosophical scholarship engaged by nearly all the papers in the current volume: all agree that simple, non-critical exegesis of Aristotle's works is hardly possible. Rather, exegesis is inevitably also a critical enterprise, just as any critical assessment of a philosopher's thought (of any era) presupposes some form of fair-minded exegesis. Thus, the cross-fertilizing intersection of exegesis and critical assessment emerges in developmentally driven scholarship no less—if in a different guise—than in the unitarian frameworks assumed in the Middle Ages and Late Antiquity. We may let each approach be judged by its fruits and adapt our own hermeneutical methodologies accordingly.

However one is disposed to approach the corpus in terms of Aristotle's development, the canonical list of generally accepted works can be informed by his own division of the sciences to yield a list as follows (an asterisk indicates a continuing controversy about authenticity):

- Organon
  - *Categories* (*Cat.*)
  - *De Interpretatione* (*DI*) [*On Interpretation*]
  - *Prior Analytics* (*APr*)
  - *Posterior Analytics* (*APo*)
  - *Sophistical Refutations* (*SE*)
  - *Topics* (*Top.*)
- Theoretical Sciences
  - *De Anima* (*DA*) [*On the Soul*]
  - *De Caelo* (*DC*) [*On the Heavens*]
  - *Generation and Corruption* (*Gen. et Corr.*)
  - *Generation of Animals* (*GA*)

- *History of Animals* (*HA*)
- *Metaphysics* (*Met.*)
- *Parva Naturalia* (*PN*) [*Brief Natural Treatises*]
- *Meteorology* (*Meteor.*)
- *Movement of Animals* (*MA*)
- *Parts of Animals* (*PA*)
- *Physics* (*Phys.*)
- **Problems* (*Prob*)
- *Progression of Animals* (*IA*)

- Practical Sciences
  - *Eudemian Ethics* (*EE*)
  - *Nicomachean Ethics* (*EN*)
  - **Magna Moralia* (*MM*) [*Great Ethics*]
  - *Politics* (*Pol.*)
- Productive Science
  - *Poetics* (*Poet.*)
  - *Rhetoric* (*Rhet.*)

One may reasonably doubt whether any system of classifying Aristotle's works supersedes his own.[28]

Notes

1. Düring (1957) collects the ancient sources concerning Aristotle's life. We have twelve surviving *Lives of Aristotle,* the earliest of which is the *Epistola ad Ammaeum* by Dionysius of Halicarnassus, who lived in Rome three centuries after Aristotle's death (c. 60 BC to after 7 AD). The remaining *Lives* range from that date to several Arabic *Lives* from the period AD 950–1270. Especially important is a work written three centuries after Dionysius, by Diogenes Laertius, who has an entry on Aristotle in his *Lives of the Philosophers*. Many of Diogenes' contentions are suspect, but he does seem to have relied on some very ancient sources, including Hermippus, who was possibly even a member of Aristotle's own school. Diogenes also reproduces Aristotle's will, an important document for his life, though also one open to interpretive controversy. Later lives are mainly of Neoplatonic or Byzantine pedigree, including the *Vita Marciana*, the *Vulgata*, and the *Latina*. A still useful overview and assessment of the biographical traditions surrounding Aristotle is Grote (1880, 1–26). A more recent set of papers pertaining to Aristotle's life and political activities is Chroust (1973, vols. 1 and 2). These are informed but also energetically conjectural. For a fuller presentation of the two main ancient traditions surrounding Aristotle's life, see Shields (2007), Chapter One.
2. Jaeger's (1934, 15) attitude is apposite: 'He had accepted Plato's doctrines with his whole soul, and the effort to discover his own relation to them occupied all his life, and is the clue to his development. It is possible to discern a gradual progress, in the various stages of which we can clearly recognize the unfolding of his own essential nature… Just as tragedy attains its own special nature… "out of the dithyramb" by

leading the latter through various forms, so Aristotle made himself out of the Platonic philosophy.' Compare Owen (1966, 150): 'It seems now possible to trace [Aristotle's] progress from sharp and rather schematic criticism of Plato to an avowed sympathy with Plato's general metaphysical programme.'

3. This is the Sixth Letter, putatively written from Plato to Hermias of Atarneus, an Academic who ruled over the region from Atarneus to Assos. This letter is, however, very probably spurious. Aristotle also had an independent family connection to Atarneus, since Proxenus, perhaps Aristotle's uncle and his guardian after the death of Aristotle's father, had been born there. See Bury (1949, 454–5).
4. Diogenes Laertius, *Lives of the Philosophers* v 2.
5. Diogenes Laertius, *Lives of the Philosophers* v 2.
6. Diogenes Laertius v 11–16, translated in the *Revised Oxford Aristotle*, pp. 264–5.
7. Jaeger (1962, 321).
8. Galen, *On Anatomical Procedures* ii 1.
9. Cicero, *Ac. Pr.* 38.119, cf. *Top*. 1 3, *De or.* 1.2.49.
10. Diogenes Laertius, *Lives of the Philosophers* v 2.
11. 'Farewell to the Forms: they are but ding-a-lings and even if they do exist they are wholly irrelevant' (*APo.* 83a32–34).
12. Frag. 650 R3; Olympiodorus, *Commentarius in Gorgiam* 41.9.
13. Detailed study of Aristotle's biological treatises, including especially the *Historia Animalium*, certify that much of his research in marine biology was conducted in this region. See Thompson (1913) and Lee (1948).
14. The anti-Macedonian sentiment in Athens had an understandable basis. In 335 Alexander had repressed a revolt by the Thebans and then handed them a vicious reprisal, effectively obliterating the city. He then demanded that Athens, in view of its pro-Theban sympathies, surrender its anti-Macedonian politicians for execution. The implicit suggestion was that any refusal would earn the Athenians the fate of the Thebans. Although he eventually relented, permitting Athens to signify its fealty by exiling two of its citizens, Alexander's entirely credible threat remained hanging over the city. The result was galling: hostile sentiment directed against Alexander and Macedon ran deep and broad in Athens.
15. Diogenes Laertius v 7. Diogenes also reports a conflicting account, which he says owes to Favorinus, who reports Aristotle's prosecutor as Demophilus. The pretext offered in Aristotle's case was his composition of a paean or hymn praising the character of Hermias, his sponsor in Assos. Aristotle had also erected a statue in his honour at Delphi, along with an inscription praising his virtue. The inscriptions compare Hermias, reportedly a eunuch and former slave, to several Greek heroes, a coupling likely to rankle Athenians of a better class. See Ford (2011) for a discussion of the character of Aristotle's inscription at Delphi and some of the controversies surrounding it.
16. Collected in Düring (1957, 347).
17. Somewhat outdated, but still engaging is Shute (1888). For more up-to-date discussions, see Moraux (1951), Barnes (1997), Primavesi (2007).
18. Ptolemy's text has been printed in Arabic, and translated into German, by Hein (1985).
19. Düring (1957) discusses the evidence thoroughly.
20. The Victorian translator of Plato, Benjamin Jowett (1964, 27), characterizes Aristotle's works in this way: 'There is of course no doubt of the great influence exercised upon Greece and upon the world by Aristotle and his philosophy. But on the other hand almost everyone who is capable of understanding the subject acknowledges that his

writings have not come down to us in an authentic form like most of the dialogues of Plato. How much of them is to be ascribed to Aristotle's own hand, how much is due to his successors in the Peripatetic School, is a question which has never been determined and probably never can be, because the solution depends upon internal evidence only.' Although unduly pessimistic due to the sorts of techniques for authenticating and dating mentioned in the text, Jowett's cautionary note is none the less worth recalling.

21. See Jaeger (1962, 46 n. 3).
22. This small example, which could easily be multiplied, derives from Primavesi (forthcoming), who, continuing the work of Harlfinger (1979), has assembled an impressive set of considerations, no less philosophically than philologically adroit, for the compelling conclusion that the *Metaphysics* stands in need of an entirely new edition. His work provides an exciting illustration of the ways in which Aristotelian textual criticism continues unabated down to the present day: as unlikely as it sounds, we are probably now closer to the texts that Aristotle actually wrote than we have been at any time in the history of their transmission.
23. Graham (1990) offers an incisive overview of the controversy. See also the papers collected in Wians (1996) for a variety of approaches and perspectives.
24. Kenny (2001) provides several unusually rich and sophisticated instances of this approach to the dating of Aristotle's works, with a special emphasis on his ethical writings.
25. Jaeger (1962, 39).
26. For a preliminary account of this supposed incompatibility, see Shields (2007, §§4.5 and 5.1). One well-developed dissenter is Wedin (2000).
27. Fragments of Aristotle's lost dialogues are translated in the *Revised Oxford Aristotle* (Barnes, 1984: 2389–2426). See Hutchinson and Johnson (2005) on the status of one early work, the *Protrepticus.* They also attempt a provisional reconstruction of the *Protrepticus,* accessible here: http://www.protreptic.info/.
28. I am grateful to Stephen Menn for his helpful and astute comments and corrections.

Bibliography

Barnes, J. ed. (1984) *The Complete Works of Aristotle: The Revised Oxford Translation vols*. I and II (Princeton: Princeton Univ. Press).

——— (1997) 'Roman Aristotle', in *Philosophia Togata* II, ed. J. Barnes and M. Griffith (Oxford: Oxford Univ. Press), 1–69.

Bury, R.G. (1949) 'Introduction to the Epistles', in *Plato: Timaeus. Critias. Cleitophon. Menexenus. Epistles* (Cambridge: Harvard Univ. Press).

Chroust, A.-H. (1973) *Aristotle: new light on his life and on some of his lost works*, 2 vols. (London: Routledge).

Düring, I. (1957) *Aristotle in the Ancient Biographical Tradition* (Göteborg: Amqvist & Wiksell).

Düring, I. and Owen, G.E.L, eds. (1960) *Aristotle and Plato in the Mid-Fourth Century* (Göteborg: Almqvist & Wiksell).

Ford, A. (2011) *Aristotle as Poet: The Song for Hermias and its Context* (Oxford: Oxford Univ. Press).

Graham, D. (1990) *Aristotle's Two Systems* (Oxford: Oxford Univ. Press).

Grote, G. (1880) *Aristotle* (London: Thoemmes Continuum).
Harlfinger, D. (1979) 'Zur Überlieferungsgeschichte der Metaphysik', in *Études sur la Métaphysique d'Aristote. Actes du VIe Symposium Aristotelicum*, P. Aubenque, ed. (Paris: J. Vrin), 7–33.
Hein, C. (1985) *Definition und Einteilung der Philosophie. Von der spätantiken Einleitungsliteratur zur arabischen Enzyklopädie* (New York: Peter Lang).
Hutchinson, D.S. and M.R. Johnston (2005) 'Authenticating Aristotle's *Protrepticus*', *Oxford Studies in Ancient Philosophy*, 193–294.
Jaeger, W. (1934) *Aristotle: Fundamentals of the History of his Development,* trans. R. Robinson (Oxford: Oxford Univ. Press).
Jowett, B., trans. and ed. (1964) *The Dialogues of Plato*, 4th ed., corr. (Oxford: Oxford Univ. Press).
Kenny, A. (2001) *Essays on the Aristotelian Tradition* (Oxford: Oxford Univ. Press).
Lee, H.D.P. (1948) 'Place-names and the Dates of Aristotle's Biological Works', *Classical Quarterly* 42, 61–67.
Moraux, P. (1951) *Les listes anciennes des ouvrages d'Aristote* (Louvain: Éditions universitaires).
Owen, G.E.L. (1966) 'The Platonism of Aristotle', *Proceedings of the British Academy* 51, 125–50; reprinted in *Logic, Science, and Dialectic,* M. Nussbaum, ed. (Ithaca, N.Y.: Cornell Univ. Press, 1986), 200–21.
Primavesi, O. (2007) 'Ein Blick in den Stollen von Skepsis: Vier Kapitel zur frühen Überlieferung des Corpus Aristotelicum', *Philologus* 151, 51–77.
——— (forthcoming) 'A Revised Text of *Metaphysics* I'.
Ross, W.D. (1960) 'The Development of Aristotle's Thought', in *Aristotle and Plato in the Mid-Fourth Century*, I. Düring and G.E.L. Owen, eds. (Göteborg: Almqvist & Wiksell), 1–18.
Shields, C. (2008) 'Plato and Aristotle in the Academy: an Aristotelian Criticism of Platonic Forms', in *The Oxford Handbook on Plato,* G. Fine, ed. (Oxford: Oxford Univ. Press), 504–26.
——— (2007) *Aristotle* (London: Routledge).
Shute, R. (1888) *On the History of the Process by which the Aristotelian Writings Arrived at Their Present Form* (Oxford: Clarendon Press).
Thompson, D'A. (1913) *On Aristotle as a Biologist* (Oxford: Oxford Univ. Press).
Wedin, M. (2000) *Aristotle's Theory of Substance* (Oxford: Oxford Univ. Press).
Wians, W., ed. (1996) *Aristotle's Philosophical Development* (Lanham, MD: Rowman & Littlefield).

CHAPTER 2

ARISTOTLE ON EARLIER NATURAL SCIENCE

EDWARD HUSSEY

A. Introduction

1. In the field of natural science, Aristotle recognizes as his forerunners a select group of theorists; he names, individually, barely a dozen. Thales, Anaximander and Anaximenes of Miletus; Heraclitus of Ephesus; Empedocles of Acragas; Anaxagoras of Clazomenae; and Leucippus and Democritus of Abdera: these are the leading lights, though others are occasionally referred to, by name or anonymously. Beside these, he mentions in the same contexts some whose claims to be 'natural philosophers' are doubtful, yet who deserve notice in the same context: either because their theories questioned the very foundations of natural science (notably Parmenides of Elea and Melissus of Samos), or because their accounts of the natural world, though containing elements alien to natural science, also produced ideas worth considering: notably 'the people called Pythagoreans' (or 'the Italians'), and Plato as the author of the *Timaeus*.

Aristotle takes seriously almost all of these people, treating them as exemplary pioneers and valuable partners in the enterprise of 'natural philosophy'. Without qualification or irony, he gives them the honourable titles of *phusiologos*, *sophos*, *philosophos*; their activity is *sophia*, *theôria*, *philosophia*, *phusiologia* (or the corresponding verbs are used: *philosophein*, *theôrein*, *phusiologein*, *peri phuseôs skopein*). The object of their study was 'the truth concerning the things that are' (*peri tôn ontôn tên alêtheian eskopoun*). They are distinguished from, and preferred to, the makers of mythical cosmogonies and theogonies.[1] These are no empty compliments: their implication is

borne out by the amount of space devoted, in Aristotle's extant writings, to the exposition and critical discussion of the earlier theories. These are part of the material from which the student of natural science can and indeed must learn, regardless of whether he ultimately accepts or rejects it: the foundations of the existing theoretical heritage.

2. The prescriptions of the *Topics* for dialectical reasoning are clearly relevant to many aspects of Aristotle's practice in the discussion of foundations. Among the 'reputable materials' (*endoxa*) to which dialectical arguments must appeal, the *Topics* lists 'the things held by all or by most people or by the experts (*sophois*), and, among the experts, by all or most or the most well-known and well-reputed'. The theories of earlier experts on natural science must therefore either be accepted, or shown to be mistaken. If they conflict among themselves, this conflict will constitute one of the initial problems to be resolved, which can be done better once we have taken into account the arguments on both sides. In such cases Aristotle sometimes presents himself as not so much an interested party as an arbitrator, sifting through the inherited mass of conflicting opinion and argument.[2]

3. In these programmatic remarks, as in all or much of his actual practice, Aristotle treats his predecessors as contemporary partners in debate. But this indisputable fact immediately raises the general question: how usable, for the modern historian of earlier theorising, are these reports and discussions of sixth- and fifth-century theorists which, as a matter of deliberate purpose, transfer them into a fourth-century context?

The question is unavoidable, and for its answer demands a close examination of the entire range of Aristotle's reports and discussions about earlier natural science. These two points were rightly and forcibly made by Harold Cherniss, whose book *Aristotle's Criticism of Presocratic Philosophy* (first published in 1935) attempted just such a comprehensive examination. Unfortunately, Cherniss' pertinacious scholarship was not matched by any willingness to explore patiently and flexibly the variety of assumptions and aims present in the different parts of Aristotle's works; and he reached too hastily conclusions which, like his accompanying rhetoric, were unfailingly hostile to Aristotle. His questions were much better than his answers; yet, since Cherniss, there seems to have been no systematic attempt to re-examine the problems he raised.[3]

The present chapter aims to consider a central case: that of earlier opinions on certain fundamental questions about the natural world, as treated in the first three books of the *Physics*, and in the first book of the *Metaphysics*.[4]

B. Beginnings: The Idea of a Science of Nature

1. In the *Physics* Aristotle expounds and argues for the foundations of his natural science, in doing which he has his predecessors constantly on his mind. The first three books of the *Physics*, in particular, show that he sees himself as continuing

their work. The foundations of natural science are to be identified as such by the application of pre-scientific general reasoning to truths of experience.

2. 'It is ridiculous to try to demonstrate that there is such a thing as nature', remarks Aristotle (*Phys.* II 1 193a3), 'for it is obvious that there are many such things'. That is, there are many recognizable *kinds* of thing in the world, and the members of each kind *regularly* (in the absence of supervening hindrances), and *of themselves*, originate changes (in themselves and/or in other adjacent things), and/or bring these changes to an end; the changes themselves being classifiable into kinds, and each kind of thing being capable of so originating a certain set of kinds of change. And those kinds of thing that themselves come into being and cease to be, do so as the result of a process originated in this way. These are 'the things that are by nature', and that themselves have 'natures'; while 'nature' in the larger sense is constituted by all the various natures of 'the things that are by nature', and by their interactions. Aristotle's ways of using the word *phusis* ('nature') are all dependent on the use that applies it to an individual thing falling into a recognizable kind.

This much Aristotle takes to be obvious to all who look at the world, unlike the less obvious entities and relationships that underlie mathematics or 'first philosophy'.[5] It is no surprise, then, that the first attempts at science in Greece were directed at a 'science of nature'. For Aristotle, serious theoretical effort starts in Greece with Thales of Miletus, the 'pioneer' of natural science.[6]

3. How much of his own fully-developed conception of a science does Aristotle ascribe to the early scientists? *Metaphysics* I 1 relies on distinctions made at *Nicomachean Ethics* VI 2–7, in stating that 'all suppose that what is called "wisdom" is concerned with the first causes and the principles' (981b25–29, referring to *EN* 1141a9-20). In I 2, the question is then: with what sort of causes and principles? The answer turns out to be: those which are truly primary, i.e., most general and fundamental (982b7–10). For Aristotle these early seekers after wisdom are recognisably scientists. This implies, as *Metaphysics* I and other texts confirm, that he saw them as, at least, setting up what he recognized as intended to be fundamental principles for a science of everything ('principles and causes of all things'), and as deducing from those principles, in a way intended to be demonstrative, what he recognized as intended to be scientific explanations of the phenomena of the cosmos.[7]

Aristotle does not suppose that any of his predecessors carried out both of these tasks with entire competence; nor, even, that they had a wholly clear conception of what they were about—least of all the earliest ones. They were moved by the natural desire for knowledge (*Met.* I 1 980a21), and 'compelled by the truth itself' (*Met.* I 3 984b8–11), but without at that stage being fully able to account for their procedures. Even in the original demarcation of the subject of their inquiry, Aristotle considers that most of his predecessors never achieved clarity, for a simple reason. They made the primitive assumption that 'all substances' (i.e., all those things that for them were ontologically basic) were sense-perceptible, place-occupying, and movable bodies.[8] Hence their general aim, to 'seek the truth about things that are', or to 'seek the principles, elements and causes of substance', was reduced, for them, to

the study of sense-perceptible, place-occupying and movable bodies, which is one of Aristotle's ways of defining the study of nature. In his terminology, they thought that natural science embraced the whole of science or philosophy.[9]

C. Foundations: The Principles of Natural Things (*Physics* I)

1. At the beginning of *Physics* I, Aristotle puts himself, for expository purposes, into the position of a would-be natural scientist seeking the principles appropriate for his subject. To *begin* the search for principles, all that is needed is common human experience of the sense-perceptible objects in our world, and the ill-defined general notions which ordinary people apply to that experience. Then (184a21-b14), as our general notions become better-defined by critical reflection, eventually to qualify as principles, we can get a better grip on the particular cases that fall under them, and then proceed to consider those. Aristotle proposes to show us how that should be done. This is to repeat the journey of his predecessors, but with better initial equipment: a knowledge of the previous history, greater methodological awareness, and sharper analytical tools (including, for instance, the notion of 'categories', and the distinction between being potentially and being actually).

2. The meaning of the word *phusis* itself does not get discussed in *Physics* I, in fact not until *Physics* II 1. This implies that a sufficient first conception of natural science may be formed in advance of any clear account of *phusis*. The principles that are being looked for are specified in *Physics* I simply as 'the principles of natural things', with a stress on their role in the coming-to-be (*genesis*) of those things.[10] The natural world is grasped as a subject of study, even in advance of a definition of 'nature', as something characterized by the interdependence of natural kinds and natural changes. Sense-perceptible substances are characterized generally by being subject to change (*Met*. XII 1 1069b3); hence Aristotle says: 'Let us take it as a basic assumption that things that are by nature are, all or some of them, changing' (*Phys*. I 2 185a12–13). Moreover, there is as yet no reason to make any essential distinction between the parts of the natural world, and the whole observable cosmos as a natural system. In the absence of any overriding reason to the contrary (and there can be none at this stage of the inquiry), the nature and behaviour of the cosmos as a whole must be assumed to be determined by the same principles as apply to its parts. So the principles of natural things will be expected to be, above all, principles of the genesis of the cosmos as a whole, if the cosmos is taken as something that comes into being.

This also explains why, when Aristotle comes to summarize the principles of the earlier natural scientists in *Physics* I 4 187a12–23, his account is phrased in terms

of their theories of the *genesis* of the observable cosmos. For these, in his view, are what is central to and characteristic of their thinking.[11] Two groups are recognized: those who start with only one 'underlying body', using the mechanism of condensation and rarefaction to derive the variety of observable stuffs in the world; and those who start out with a 'mixture', from which everything else 'emerges', having been 'in' the mixture all along in the form of 'contrarieties'.[12] At I 5 188a19–27, this first classification is slightly refined to take account of Parmenides, in his dualistic aspect, and Democritus, also apparently taken here as a dualist, neither of whom fits easily into the previous dichotomy.[13] But Aristotle is not here concerned to waterproof the classification, nor to inquire closely into any details of the earlier systems (except in the case of Anaxagoras, whose use of an infinity of principles is disturbing to him, and whom he takes some time to explore and refute (187a26–188a18) on that particular point). His declared overriding purpose is to extract from all of these theories a simple structural message: the principles of natural genesis necessarily include at least one pair of contraries (188a26–30). This was rightly accepted in one way or another, by all the predecessors mentioned, though they had no reasoned explanation for it (*kaiper aneu logou tithentes*, 188b28–29). It was as though they were 'compelled by the truth itself' (188b29–30). As a result, all of their theories, in spite of superficial differences, show significant structural analogies with one another, and with the truth (188b35–189a9). But the 'one underlying body' theorists are closer to the truth, since they provide the substrate as well; and, of those, those in whose theories this underlying body is seen as, in itself, not determined by any of the contraries. So the essential truth seems to have been foreshadowed by an 'ancient opinion' (189a34-b16).

3. The discussion in *Physics* I 4–6 is an insightful and sympathetic attempt to reconstruct the ways of thinking of Aristotle's predecessors. Naturally, it is condescending; Aristotle is conscious of being much better equipped than those predecessors were to navigate the logical and philosophical mazes that troubled them.

It might also be claimed that it is anti-historical. Certainly, Aristotle imposes upon the theories discussed a schematism determined by his own thinking on the questions at issue. (There is no question of subterfuge here: he does not claim or pretend that he is doing otherwise.) For him, the real significance of the apparently universal use of opposites as principles lies in the tripartite schema: substrate-privation-form; and the significance of the tripartite schema derives, not from its use by any theorist, but from its success in giving a coherent account of what is common to all cases of 'becoming', as shown in I 7. Since the phenomena of 'becoming' (including every kind of natural alteration of existing states) are accessible to all, Aristotle expects the earlier theorists, if not consciously and explicitly, at least by following the grain of the material, to have been led towards theories that exhibit just that schema. He therefore reads earlier theories as necessarily tending towards this structure. To read them in this light is, for him, the way to understand, better than the theorists themselves, what they were about. Its success in illuminating the historical development is a secondary proof of his principal thesis.

This is one among many indications that Aristotle never makes or wishes to make a clean separation of 'the history' from 'the science' or 'the philosophy'. It is probable that on the contrary he would have rejected any such attempted separation as both impossible and undesirable. For it is clear that he holds that the history of the science in question, read aright, must broadly support, in the way indicated, the conclusions of the science, assuming these are correct. There is a 'teleology of truth' at work, as he sometimes insists; theorists are guided or impelled towards the correct view by 'the thing itself' or 'the truth itself' (*auto to pragma*, *autê hê alêtheia*). Correspondingly, where any particularly striking errors occur, some special explanation of that should be available; and to understand and demonstrate why earlier theorists went wrong requires an understanding of their place in the historical development.[14]

4. Aristotle's reading of the predecessors in *Physics* I 4–6 sees their theories as exhibiting significant analogies, or (in modern terms) sharing a common structure. It is the shared structure that is the really valuable part, which is restated in Aristotle's own terms as the essential truth about the principles of natural change. Then, in *Physics* I 7, it is deduced by a *logos*, consisting of a logical analysis of change in general, plus an inductive survey of the kinds of substrate observable in various particular cases.

This progression, from particular kinds of body (as in earlier theories) to an abstractly specified 'substrate', is for Aristotle a decisive advance in understanding, and only achievable by the general logical analysis such as earlier theorists could not give. Guided by some inarticulate awareness, rather than by *logos*,—and, it seems, looking only for principles of the generation of the cosmos rather than for principles of natural change in general,—they grasped only particular instances of the underlying structure, and hence could give no general account of it, and no rational justification for their use of it.[15] In addition, as *Physics* I 8–9 explains, they were left without satisfactory defence against the logical problems raised by *genesis* and change generally; which led some of them into further errors.

D. The Misunderstanding of Nature: (1) False Explanations (*Physics* II 8–9)

1. The second book of the *Physics* is equally central to Aristotle's understanding of earlier natural science. Here, with the initial official definition of 'nature' finally given, and the distinction between 'nature as matter' and 'nature as form' (II 1–2), the focus of interest shifts from 'principles' to 'causes' in natural science. Having set out his list of four types of 'cause' (II 3 and II 7), Aristotle turns to the connected questions of 'luck and chance' (II 4–6) and 'necessity' (II 8–9).

In the discussion of luck and chance, for the first time in the *Physics*, Aristotle confronts his predecessors with a demand, not just for 'principles' of the genesis

of the observed cosmos, but for 'causes', that is, for things that may be invoked to furnish some sort of explanation of it. We learn that while the earlier theorists never invoked chance in their explanations of genesis, and apparently thought that nothing occurred by chance (II 4 195b36–196a24), some other, presumably later, theorists attributed to chance the genesis of the cosmos (II 4 196a24-b5).[16]

2. Even more instructive is *Physics* II 8–9. The programme for these chapters reads thus: 'We must say first why nature is among the causes for the sake of something; then we must speak about the necessary, for it is to that cause that everyone reduces [their explanations]: for example, since the hot is of such a nature and the cold and each of such things, these particular things necessarily are and come about. And, even if they do speak of some other cause, they merely touch on it and then let it drop: one [speaks] of Love and Strife, another of Mind [in this way]' (198b10–16). This marks a decisive break in the treatment of the predecessors within the *Physics*. No longer do they appear, as in *Physics* 1, as worthy forerunners in natural science, whose understandable errors are outweighed by their insights and the value of their example. Here one and all, without exception, are judged to have gone down a hopelessly wrong road. For, as Aristotle proceeds to argue, it is radically mistaken to try to explain natural things and changes (even partially) by 'the necessary', in the sense in which these predecessors did.[17]

The primary aim of *Physics* II 8 is to show that 'nature is among the causes that are for the sake of something': that whenever something happens or comes to be 'by nature', or through or because of the nature of something, a 'final cause' (a cause 'as the end') is always present. The natural scientist, therefore, has always to invoke final causes along with the other kinds.

3. Once the need for final cause explanations has been established, it follows that the earlier natural scientists made a fundamental error: not only was this need not seen by any of them; Aristotle claims that without exception they all in effect denied it, by their invocation of 'the necessary' as a supposed kind of explanation. We are given in II 8 the example of Empedocles, distinguished among the earlier thinkers for the quantity and breadth of his biological theorizing; according to Aristotle, even he misconceived the *modus operandi* of nature, as revealed in natural changes. Nature was envisaged by Empedocles, not as a cunning craftsman, but as a piece of mere machinery operating simply 'from necessity'.

For Aristotle, the false kind of explanation that he labels 'the (absolutely) necessary' (*to haplôs anagkaion*) has two fatal defects. One is simply that it is false. There is a room for necessity of a kind in nature, but not for 'the absolutely necessary' as conceived of by the earlier theorists. Another, as *Physics* II 8–9 shows, is that, if used, it leaves no room for a final cause. For both reasons, it is evidently not to be identified with, or subsumed under, any of Aristotle's other kinds of cause. (The question of how he thought his predecessors combined it with, or substituted it for, those other kinds of explanation, will return when we consider *Metaphysics* I.) It is clear that 'absolute necessity' here is meant to be understood as a blind necessity, one having no inherent reference to any intelligible goal or aim. This gives the required contrast with

the 'conditional necessity' of *Physics* II 9, which we may understand as being equally necessitating, *when* it operates in nature; the crucial difference is that it operates only as and when it can serve as an instrument in the service of the final cause.[18]

4. To understand what happens in *Physics* II 8, we must briefly go back to the account of the meanings of 'nature' in *Physics* II 1, which may be taken as established doctrine by the time we reach *Physics* II 8–9.

The 'nature' of a thing is defined as 'a principle of change and of rest', and the question is then: is the nature of a thing to be identified with its matter or its form? At this point the four causes have not yet been officially introduced; but Aristotle evidently takes the matter-form dichotomy to be already intelligible, just as in *Physics* I he takes the notion of 'nature' itself to be, and presumably for much the same reasons (see B 1 above). As between 'nature as matter' and 'nature as form', Aristotle opts for an inclusive answer: nature is both matter and form; but its 'nature as form', he argues, is more truly the nature of any natural thing. So a natural change is one that originates in the nature of an individual natural substance; and rather in the 'nature as form' than in the 'nature as matter'. We are already on notice that to ignore the 'form'-aspect of the natural world is to leave out something essential. Aristotle does not stop to underline the point, but notes in passing a serious failure here on the part of earlier theorists: they were apparently almost completely unaware of 'nature as form' in their natural science.[19] This prepares us for the related but additional errors unfolded in *Physics* II 8.

5. If, as *Physics* II 1 implies, we must always explain natural changes only by reference to the natures of things, then it follows that they must not be ascribed to 'the necessary', if 'necessity' acting on anything is conceived of as something that is superimposed *from outside* upon the thing's own nature. If necessity pushes the thing along the path it would naturally take anyway, then necessity is explanatorily redundant; if it pushes it along a different path, then the ensuing change is by definition not natural; but it is only natural changes that are here to be explained. So, at the beginning of *Physics* II 8, we already know that any kind of absolute necessity imposed on natural things from outside must be rejected in explaining natural changes, unless some further sufficient reason can be invoked for bringing it in.[20] Moreover, it is taken as a fact of common observation (199a20–29) that most if not all natural changes are goal-directed: appeal being made here to biology above all. (The account of 'nature as form' in *Physics* II 1, even in advance of the introduction of the final cause, includes a reference to the goal-directedness, 'the for-the-sake-of-which' of the things which have natures (194a28–36).) There is then the question: what sort of explanation is possible for this prevalent goal-directedness, and for the almost invariable success with which the goals are reached?

Aristotle's answer has two claims; they are presented together. First, the only adequate kind of explanation is one that is itself irreducibly in terms of the goal itself. Secondly, such an explanation must be anchored in the natures of those natural things for which the goal is a goal. In short, the natures of things must themselves be intrinsically and irreducibly goal-directed.[21] To support these claims,

Aristotle sketches an argument in two parts (or possibly two separate but parallel arguments; 198b34–199a8, 199a8–12), against his predecessors' alleged view. Their kind of explanation, he claims, would involve coincidences on a fantastic scale: the 'necessity' they postulated is blind to its own end-results, so that it would have to be just by chance, repeated over and over again, that it happened to push things in the right direction and not in a quite different one. So we need something that is guaranteed always to *direct* the course of events towards the goal; and that something must be located in the natures of the things themselves, since these types of events are by hypothesis natural.

6. Much effort has been made to uncover the presuppositions that may underlie each step of this two-step reasoning; for, taken on its own, it seems to be open to certain rather obvious objections. We are not here directly concerned with filling in the gaps in Aristotle's train of reasoning, but we must spell out what exactly he is attributing to his predecessors. (1) They invoked a 'necessity' that (a) arose simply from the basic material constitutions or circumstances of the things involved ('since the hot is of such a kind, and the cold, and all of those kind of things, such-and-such things necessarily are and come to be', 198b12–14), and that (b) operated automatically in the given circumstances, independently of anything else, and in particular not as the instrument of any 'higher' directive force. Only the conjunction of (a) and (b) guarantees that this necessity will be blind to its supposed end-results. (2) This type of necessity was essentially the only or the dominant type of explanation in their theories. (3) Consequently, they had no room at all for explanations making essential reference to the 'end', for teleology.

There is some reason to doubt whether this can be correct as an interpretation of the earlier theorists; for there is some evidence that, for some of them at least, natural events were guided from outside what Aristotle regards as the realm of nature. This question must be held in suspense for the present.

E. The Misunderstanding of Nature: (2) The Infinitely Extended Universe (*Physics* III 4–5 and *De Caelo* I 5–9)

1. *Physics* II shows that for Aristotle earlier natural science had failed almost completely to arrive at in practice, let alone formulate theoretically, a correct notion of explanation by causes 'for the sake of which'. An associated, and worse, failure was that it had espoused a false kind of 'cause', one that excluded the possibility of explanations by true final causes. *Physics* III, in its discussion of the infinite, reveals an equally serious error, and one that, equally, presupposes a

misunderstanding of what nature and natural science have to be like. Aristotle gives no detailed doxography here, since according to him most of his predecessors made exactly the same mistake: they took it that their original principle or principles, in so far as they were bodies, were also infinitely extended (*Phys*. III 4 cf. *DC*. I 5 271b2–3).[22] In *De Caelo* I 5, he underlines in unusually strong terms the seriousness of the error, and the crucial importance of getting the right answer: 'whether the matter is thus or otherwise makes no small difference, but is wholly and totally decisive for scientific truth. In fact, it is pretty much the case that this has been, and may in future be, the origin of all disagreements among those who give their views on nature as a whole. After all, even a small departure from truth, when one sets out, results in thousandfold greater error when one is further away' (271b4–9).

2. The arguments against this second great error (*Phys*. III 5 204b1–206a8) are divided into those that occur when we inquire *logikôs* ('with regard to definitions/accounts' or 'with regard to words') and when we inquire *phusikôs* ('with regard to nature').[23]

The *logikôs* argument (204b4–10) is simply that the notion of 'body' cannot be defined without reference to a boundary or surface, which an infinite body would lack. The *phusikôs* arguments (204b10–206a8) are essentially confined to two points. It is taken as a given in the conception of nature that it must include the observed regularities of our cosmos. Two of these that Aristotle takes to be unquestionable and structurally fundamental are the perpetual transmutation of 'elemental' bodies among themselves, and the existence of particular regions of cosmos ('natural places') that are the places naturally occupied by the different kinds of body. These, he claims, are incompatible with an infinite extent of any one kind of body, or even with an infinite extent of many kinds.

Given the crucial importance of what is at stake, it is natural to be puzzled and disappointed by this chapter at a first reading. Aristotle does not seem to have met the requirement of answering the obvious possible objections on behalf of some of his predecessors. In particular it is reasonable to think that he has not produced anything that would count as an answer to the Atomists. Their vision of an infinite void populated by infinitely many atoms, and interspersed with *kosmoi* like our own, required that 'nature' in its essentials was exhibited *outside* the *kosmoi*, not inside; the working of nature *inside* any cosmos was for them necessarily a special case. Hence, the Atomists could have insisted, it is a begging of the question to assume from the outset that we should take our cosmos as exhibiting to observation, straightforwardly, the fundamentals of nature.

3. Aristotle does not meet such objections in the *Physics*. Later, as though to stifle any doubts, he returns to the question at greater length in *De Caelo* I 5–9. Here, with even less in the way of doxography, there is fuller and more systematic argumentation, explicitly presented (274a19–24) as supplementary to the *Physics*. Some of these arguments seem intended to be immune even to possible Atomist objections of the kind just suggested. This confirms other signs that Aristotle in his later

writings had a keener appreciation of the strength and robustness of the Atomist theory.[24]

F. The Misunderstanding of Nature: (3) Two Questions and a Hypothesis

1. In *Physics* II and III, Aristotle represents most if not all of his predecessors as disastrously misunderstanding, in more than one way, the nature underlying the natural world. Here, then, Aristotle's own natural science parts company, clearly and irrevocably, with the earlier Ionian tradition. The questions at issue are therefore just as central to the understanding of Aristotle's own natural science as they are to his account of his predecessors.

As noted, the arguments of *Physics* III, taken on their own, look simply inadequate as a critique of the thesis of an infinite body. Setting aside the presumably later arguments of *De Caelo* I (in any case *De Caelo* represents a more advanced level of study), we must ask whether, in the first three books of the *Physics*, Aristotle is not taking far too much for granted. In order to demolish other theorists' conception of what is natural, he has assumed the truth of substantial parts of his own conception. That is all very well for a teacher teaching dogmatically and explicitly from within his own already established system. But what reasons have we been given, in the apparently open inquiry instituted by the *Physics*, for accepting that natural places and elemental interchange must be universal phenomena, rather than just local features of this cosmos or of cosmoi in general?

The parallel problem which was earlier left in suspense must now be raised again: that of the alleged failure of the predecessors to use final causes. Why should final causes, even if one accepts the arguments of *Physics* II 8 that they are *ultimately* determinative, necessarily be operative in a way detectable within the observable cosmos? There is evidence, even in the *Physics* itself, that many of these predecessors attributed purposeful intelligence to the infinitely extended bodies that they took as their 'principles'. He tells us, though only in passing, that they thought that these infinite bodies 'encompass everything and govern everything (*panta kubernan*), as say all those who do not make other principles beside the infinite, such as Mind or Love; and that, they say, is the divine; for (as Anaximander and most of the natural philosophers say) it is deathless and imperishable' (*Phys*. III 4 203b11–15). As for Anaxagoras, he is elsewhere praised for introducing Mind even into the *natural* world: 'he who said that Mind is present in nature, as it is in animals, as the cause of the cosmos and of all order, was like a sober man in comparison with those before him, with their random talk' (*Met*. I 4 994b10–13).

But if that is so, then must not Aristotle be wrong about their overall explanations? Perhaps 'the necessary' was not intended to be an explanation on its own, but merely represents the ineluctable expression, within our cosmos, of a guiding intention imposed from outside, so that a kind of final cause was after all reinstated? (After all *Metaphysics* I, at 993a13–15 and elsewhere, recognizes that some of the predecessors did in some sense use the notion of a 'cause for the sake of which'.) If so, then any particular cosmos will offer to observation only a restricted cross-section of 'nature', and is not after all to be taken as a pattern for the whole universe, if that is infinite in extent. Our two questions, and their corresponding doubts about Aristotle, here merge into one.

2. We are thus naturally led to question both the fairness (even on Aristotle's own terms) of Aristotle's criticisms, and the accuracy of his reporting. No progress is possible in understanding, unless the reality of the problem, and its fundamental significance, is fully recognized and acknowledged.

The next step is to formulate and test some general hypothesis that offers some kind of explanation. The explanation both of Aristotle's apparently unfair criticisms, and of his extensive and (to us) misleading silences, must first be looked for in Aristotle's own conception of natural science.

In Aristotle's conception of natural science, one point that is both clearly fundamental and possibly relevant is that natural science is, as a science, wholly autonomous.[25] It has its own principles, which are to be discovered, independently of any metaphysics, from ordinary unspecialized experience of the natural world, and inductions from that; hence, necessarily from this cosmos alone, since that is the only one of which we have direct knowledge. That does not preclude the existence of a realm of nature outside the cosmos too, provided that *within* the cosmos there is sufficient evidence for such a thing. Unless and until such evidence appears, though, natural science is bound to try to explain everything in this cosmos in terms of this cosmos alone.

3. All this suggests a preliminary hypothesis about how Aristotle's reporting and criticism of his predecessors in the *Physics*, and other works on natural science, may be made intelligible, as follows.

First, any mistakes that affect the very foundations of natural science, such as the theory of the infinite universe, must of course be reported and intensively criticized; for it is absolutely necessary to establish that the universe is finite. Likewise with the systematic use of false kinds of explanations, such as 'the necessary'. But the argumentation on these points is entitled to assume as indisputable the uniformity and autonomy of the realm of nature. For that is essential to the possibility of an autonomous natural science. And that means that what we observe to be part of nature's workings in *this* cosmos (such as natural movements and elemental changes) must obtain *everywhere*, even if the universe is supposed infinite.

Next, this uniformity and autonomy of the natural realm (once the foundations of natural science are securely in place) serve as unspoken reasons for rejecting, without even reporting them, all mistaken views which are based on a

misunderstanding of the notion of nature. So everything in the earlier theories that depends on the supposition of an infinite extra-cosmic realm, in which nature if it exists at all is radically different, and which supposedly determines the workings of nature in this cosmos (such as supposed divine beings and their purposeful 'steering') not merely may, but perhaps should, be ignored in reporting those theories: for motives of charity, if not simply for economy of effort. And such criticisms as are made of earlier theories, in so far as they deal with this cosmos, may reasonably ignore any appeal that their authors might have made to anything supposedly outside this cosmos: for example, to some sort of divine purposefulness, as a kind of 'final cause', if 'the divine' was taken to be something pre-cosmic and/or extra-cosmic.[26]

G. The Misunderstanding of Nature: (4) Further Examples from the *Physics*

1. The hypothesis put forward in the previous section may be compared with several further places in the *Physics*, in which there are fundamental criticisms of some of the earlier theorists, and these make explicit appeal to what Aristotle takes to be fundamental features of nature. Here it is particularly the later natural philosophers that are in his sights.

2. At *Physics* VIII 1–2, the question at issue is: 'has there always been, and will there always be, change?' With most of his predecessors, including for once the Atomists, Aristotle here has no quarrel on this point; since most agreed, for their own reasons (250b15–21), that there always had been and always would be change. (Where he deeply disagrees with them is on the question of *why* there is always change, a question here touched on only briefly.) Aristotle's targets here are only and specifically Empedocles and Anaxagoras, whose theories (respectively, of alternating periods of change and rest, and of an infinite period of rest followed by an infinite period of change) are reported at 250b23–251a5, and attacked at 252a3–32. Against Anaxagoras first, Aristotle puts the fundamental demand that nature should not be 'disorderly' (*ataktos*). Part of what this implies then emerges. First, an 'order' (*taxis*) consists in a 'ratio' or 'rational account' (*logos*), but there can be no ratio (or 'rational relation') between two infinites. Next, there should be some stated difference, sufficient to explain why the period of change begins just when it does (but none such, it is implied, is or could be given). In sum, Nature is either always simply uniform in its operation, or if not at least there is a *logos* to make comprehensible its non-simplicity. Empedocles at least provides an order in making alternating finite and equal periods of change and rest; but he fails to explain why his active cosmic

forces, Love and Strife, should behave so as to produce them. What is required is an explanation grounded in induction from experience or in deductive reasoning from necessary truths.

More generally (252a32-b5), it is never good enough, where an explanation or a principle is needed, merely to say that 'something always is or comes to be so'. This structural demand on explanations in natural science is directed particularly against a certain principle of the Atomists (see on *Metaphysics* I 4 985b19–20 in Section H.8 below).

3. At *Physics* I 4 187a26–188a18, Aristotle digresses from his survey of earlier views on 'the principles' to examine more closely, and to give reasons for rejecting, Anaxagoras' theory of the infinitely many ultimate material constituents here and elsewhere labelled 'homoeomeries'. He uses a variety of arguments; suitably to the position of this critique, early on in the *Physics*, he does not appeal to developed Aristotelian natural science. This reveals all the more clearly what he sees as two absolutely fundamental features of the natural world, to be postulated even in advance of scientific knowledge. In advance of the examination of the infinite in *Physics* III, he here argues (187b7–13) that infinite totalities of any kind are at the least undesirable, because they are unknowable. The assumption is that the natural world must be in all essentials knowable, with the implication that an infinite universe is excluded. Further, he claims (187b13–21), as something equally beyond doubt, that animals and plants, and hence their components, have fixed sizes, from which they cannot much diverge either by being smaller or larger. That every kind of natural substance has its naturally determined size, within a cosmos of fixed size, is characteristic of Aristotelian thinking; here it is taken by Aristotle as axiomatic even before the relevant science has been constructed.

4. At least three other parts of the *Physics* contain argumentation on fundamental matters, directed against theses characteristic of the Atomists, though they are not named. Much of *Physics* VI, notably, is devoted to the assertion and exploration of the infinite divisibility and the continuity of natural magnitudes, natural changes, and the time-stretches in which they occur. (A recognition of the importance of their counter-arguments is found in *Gen. et Corr.* I 2.) Likewise at *Physics* VIII 256a4–257a27, on the structure of 'chains of changes': Aristotle's thesis, that these cannot extend backwards without ending, is directly opposed to the Atomist conception, according to which all such chains were indeed infinite in the sense of having no beginning.

Most instructive of all is *Physics* IV 8 214b12–216a26, an extended critique of a theory of void (the Atomists must be the prime target). To the first part of this (214b13–28), as to the attack on the infinite universe in *Physics* III, a natural first reaction is that it is hopelessly unfair to the Atomists. For it appeals to theses that would never have been accepted by them: that everywhere in the universe, all natural bodies will have natural motions, and that consequently there will be 'up' and 'down' directions uniquely defined by the natural motions of simple bodies. There follows a second part (214b28–216a21), which, like the *De Caelo* I arguments

against infinite bodies, appeal not to general requirements about nature, but rather to supposed truths of observation, and to supposed absurdities in the mathematical understanding of motion, when a void is postulated. There are also general arguments in *De Caelo* III 2, appealing only to a division of motion and rest into 'natural' and 'forced', for the thesis that all the simple bodies must have some natural motion. These are used to construct (300b8–16, 300b31–301a11) challenges to the Atomists. Here again it seems that these are reinforcements added when Aristotle came to take the Atomist challenge more seriously. In any case, the first part of *Physics* IV 8 follows the pattern that has already been seen: it assumes that nature's ways are confined to what we can observe within this cosmos. To postulate, without a proven necessity, exotic regions where things behave radically otherwise than in our cosmos, is bad method.

H. The Development of Scientific Explanation: *Metaphysics* I on Earlier Uses of 'Causes'

1. So far we have seen how Aristotle's setting-up of his natural science in the *Physics* is shaped by certain assumptions, not all made explicitly, about the realm of nature as we observe it within our cosmos, and about how one should proceed to make it a subject of science. These assumptions determine his selective reporting of his predecessor's theories, and underlie his critique of them. On this reading, it is not necessary to resort, as has sometimes been done, to hypotheses of negligent misunderstanding, failure of historical sense, or wilful dishonesty on Aristotle's part. Such hypotheses, difficult to establish directly and in themselves implausible, should in any case be entertained only as a last resort.[27]

2. The failure, as Aristotle sees it, of the early scientists to interpret nature overall in the right way does not mean that he thinks it acceptable to reject their opinions en bloc. Any opinion of any acknowledged expert on a given topic has the right to be considered, whatever view is taken about that expert's overall theory. Nor is it helpful to the cause of instructing and persuading, if one leaves well-known contrary opinions unmentioned and unrefuted. Consequently, in other works on natural science, as well as in the *Physics*, there is a further significant amount of reportage and critique of earlier opinions that is integrated with Aristotle's substantive treatments. Outstanding in respect of their bulk, strategic importance, and difficulty are (a) the long survey of earlier theories of the soul, in *De Anima* I 2–5 403b25–411b30, as a preliminary to Aristotle's own theorising; and (b) the series of reports, scattered around in various places in *Physics*, *De Caelo*, and *Generation*

and Corruption, on the earlier theories about the existence and nature of 'substantial change' (*genesis* and *phthora*, 'coming-to-be' and 'ceasing-to-be'); and, related to that, the nature of the elements, and the question of whether or not the elements change into one another.[28]

3. *Metaphysics* I is different again. It is the introduction to a work which discusses problems relating to all possible sciences, on the way to establishing a demarcation of them and establishing the foundations of 'first philosophy'. The general doctrine of the 'causes', taken to be applicable in any possible science, is assumed, at least provisionally; but, apparently, nothing else from the *Physics*, or from Aristotelian natural science. Chapters 3 to 7 report, in approximately chronological order, on the use of 'causes' by all earlier theorists, down to and including Plato; chapters 8 and 9 contain Aristotle's criticisms.

Aristotle states and refutes at some length the ontological innovations of the Pythagoreans and Plato, which make the most formidable challenges to his own ontology. The many 'natural philosophers' are given proportionately less space in the critical chapters; yet they too are included, and in the expository section they figure at great length. As in *Physics* I, it is underlined that they had a very general ambition (to discover the truth about things that are), which was first manifested in inquiries about 'the most obvious of the strange phenomena' (*ta prokheira tôn atopôn*, 982b13–14) and then systematically pursued in the study of natural science. At 982b11–17, a reconstruction of the mental situation of the earliest natural philosophers points, as in the *Physics*, to the inquiry into the genesis of the cosmos as the starting-point of their science.

The professed aim of the survey is to take predecessors for consultation as colleagues, not for refutation as opponents. 'Though we have given a sufficient account [of the four causes] in the *Physics*, nevertheless let us consult in addition [the earlier theorists]. . . . For it is clear that they too speak of 'principles' and 'causes' of some sort. So for us, to make a survey [of them] will be a contribution to our present inquiry: either we shall find some other kind of cause or we shall be more confident in the ones we have just mentioned' (983a33-b6). The four causes, it is clear, are to be the foundation; what the survey aims to achieve is greater confidence, not in the correctness but in the completeness of the list of four. Aristotle examines the ways in which, and the extent to which, each of these came to be recognized. This necessarily involves some departure from strict chronological order, but what Aristotle sees as the determining thoughts of earlier theorising are revealed and to some extent explained. As in *Physics* I, the approach is historically informed and perceptive; and mostly sympathetic to the ambitions, at least, if not the achievements, of all earlier theorists (except possibly the Atomists). It concentrates on the steps by which the predecessors could be seen to have approached the *correct* understanding of the nature and use of 'the causes'. The overall impression given is that, while all earlier theorizing was a mixture of success and failure, there was a slow but persistent and roughly cumulative process, in which errors were one by one removed and perceptions of the truth preserved and refined.

4. Aristotle seems to be concerned with two kinds of question, though he does not distinguish them: what sorts of explanations his predecessors gave; and how far they recognized these explanations as falling into functionally distinct types, such as the 'four causes' (and, with that, how far they rightly envisaged the functions of such types in natural science).

At the lower level, it seems that all Aristotle requires, for the recognition of something as a 'cause' by one of his predecessors, is that it should be something that is essential to, or the ultimate term in, some explanation, the scientific answer to some question beginning with 'why'. Aristotle sometimes ascribes to his predecessors recognition of something as 'a cause', without any suggestion that it was recognized by them as belonging to any particular type. Thus in *Metaphysics* I 2 he notes that '(a) god is thought by everyone to be among the causes' (983a8–9). To recognize something as 'a cause', then, is not yet to recognize it as being a cause of a certain type, or as being a cause in the kind of way in which it really is a cause.

So the survey is, primarily, a survey of the predominant explanatory devices of the earliest theorists. And yet explanation by invocation of 'the necessary' is not once mentioned. That was, as has been seen, the earlier type of explanation which Aristotle in *Physics* II rejected as radically unsatisfactory. In *Metaphysics* I, it must be that it is taken as established that the use of 'the necessary' as a kind of cause was a grave error. Otherwise, it would be inexplicable why there is no mention of it. There can be no question of its being a candidate for recognition as a new type of cause, nor even as a variant of one of the four Aristotelian types. The survey, then, is tailored to its purpose: it does not aim at historical completeness for its own sake, but selects its material, just as the *Physics* does, in the light of that purpose.

Correspondingly, in the relatively short section of criticism (I 8), Aristotle's complaint against the earlier natural scientists (the Pythagoreans and Plato's *Timaeus* excepted) is not that their explanations were wrong, so far as they went, or misconceived as explanations; but that they left prominent phenomena totally unexplained: notably, the origin of change generally, and the coming-into-being and perishing of material bodies.

5. The second level of the story, corresponding to the second kind of question distinguished earlier, is the slowly increasing awareness of the four 'causes' as types of explanation, and of the theoretical need for them and of their theoretical implications in turn. In one case, at least, the earlier theorists went all or most of the way. *Metaphysics* I shows them as successful in recognizing the need for causes of the 'material' kind; it further implies that they had a clear conception of this type of explanation as such, and of its implications and systematic function. What exactly this entailed, in terms of their theories, is explained at 983b6–18. The function of this type of cause was to provide the materials out of which everything else could be constructed. These materials, though, were quite capable of existing in a separated state on their own, before and after being incorporated into something more complex.

Caveats are needed here. There is no implication that what they took to be the 'cause as matter' was something held by the early theorists to be purely passive, or

even lifeless. Apart from the evidence of other sources, *Physics* III 4 and *De Anima* I 2 show that in fact the material cause, for many of these theorists, was something endowed with life, perception, intelligence, and intelligent action. Nor, in ascribing to earlier theorists a certain view as to the 'material cause(s)' of things, is Aristotle necessarily suggesting that they held any kind of reductionist view, in which everything was to be explained in terms of the material constitution of things.

6. The discovery of the need for the 'cause as matter', and the clarification of its nature and implications, is for Aristotle the one great and unambiguous success of the early natural scientists in this field.[29] As to the other three causes, the story is far less impressive. In brief, though the need for them was increasingly felt, if not formulated, by the theorists, yet neither the 'formal' nor the 'final' cause were recognized as such by any predecessor. We are told often enough about the failure in regard to the 'formal' cause, and the few partial and ineffective approaches to it;[30] it is presumably also related to the failure 'through lack of experience' to perceive the abstract analysis of change given in *Physics* I (191a23–31, 191b30–34). The failure in regard to the final cause comes as no surprise after *Physics* II 8.[31] In *Metaphysics* I, the situation is put thus: 'as for that for the sake of which actions and alterations and changes occur, this they do, in a way, state as a cause, but not in *that* way [i.e., not as *that* kind of cause], and not as it is a cause in nature' (988b6–8). Aristotle's examples of this failure among earlier natural scientists are Anaxagoras and Empedocles: they obviously intend Mind and Love, respectively, to be 'a good thing', but instead of explaining other things as being or coming into being *for the sake of* Mind or Love, they make Mind or Love the *motors* of the changes involved. *Physics* II 8 has told us that the changes themselves then come about by 'the necessary'; we now see, conversely, that it was the failure to reach true final causes that made 'the necessary' necessary for these theorists.

The need for something like the moving cause was more immediately recognizable, and therefore influenced theorizing from early on. Even here, the candidates put forward to fulfil the function of a moving cause were at first doubling as material causes, and later were loaded with the burden of functioning as a substitute for the final cause as well. The theoretical implications of the notion were simply not grasped. 'In one way all the causes were earlier spoken of', remarks Aristotle retrospectively, 'but in another way not at all'; they were at best seen 'dimly', or 'glimpsed' (*Met*. I 10 993a11–15).

7. At this point a further instructive problem arises out of the comparison of *Metaphysics* I with *Physics* II.

In *Physics* II 8, part of the complaint against all of the predecessors is that 'the necessary' is practically the *only* kind of cause they use to explain things; just one or two of them 'touch on' some other kind of cause such as Love and Strife (Empedocles) or Mind (Anaxagoras). How is this to be reconciled with the elaborate parade of evidence in *Metaphysics* I 3 for the earlier use of a true material cause? It might seem at first that either Aristotle takes two substantially different

views of the interpretation of earlier natural science in the two books, or there is an implied identification of 'the necessary' with the material cause. Yet neither of these propositions is attractive. The hypothesis of a change of opinion, though it can hardly be completely excluded, is a last resort, and would need to be buttressed by evidence for other systematically related changes in Aristotle's views or interpretations. Nor can the material cause, being a type of explanation approved by Aristotle himself, be identical with 'the necessary', one he flatly rejects.

Part of the solution to this apparent discord must clearly be that the mistaken use of 'the necessary' to give the *ultimate* explanations of natural changes ('it is to this cause that they all reduce [their explanations]', *Phys*. II 8 198b12) need not exclude the correct recognition of Aristotelian kinds of cause in a subsidiary role. But this point is not made clearly anywhere; and this because it is in different ways irrelevant to the different purposes of *Metaphysics* I and *Physics* II 8, which determine the difference of their approach and selection of material. *Physics* II 8 is expressly polemical, intent on demolishing a position that is hostile to an essential ingredient of Aristotle's own philosophy. *Metaphysics* I, on the contrary, is as inclusive and charitable as possible in its approach to the predecessors. It makes no mention of 'the necessary', nor gives any example of the kind of explanation that Aristotle rejects in *Physics* II 8. Its use by his predecessors was a terrible mistake, which in *Metaphysics* I is charitably not mentioned, and in fact strictly does not need to be mentioned, under the terms of the inquiry as set out in *Metaphysics* I 3. 8. We have given most space to the earlier books of the *Physics*, whose importance, relative to *Metaphysics* I, for the understanding of Aristotle's treatment of his predecessors has often been underestimated. We cannot enter into much further detail on the story told in *Metaphysics* I, but there is one more point of some importance.

In the gradual discovery of the moving cause, the first question to exert theoretical pressure on the early natural scientists was: what is it that causes the material cause to change (984a18–27)? Aristotle finds the early response inadequate. As in *Physics* II 8, he brings out what he sees as a grave failure of the earlier theorists, and of the Atomists too: either they did not try to meet the need at all, or if they did, they did so in an inadequate way, by identifying the 'moving cause' with one of their material causes.[32] Once again, we have to ask whether Aristotle's reports and adverse judgements are correct and fair; once again, to answer justly we have to take into account Aristotle's unspoken assumptions.

The worst failure, allegedly, was that some theorists took no notice of the problem at all: 'those who were right at the beginning in this inquiry, and said that there was one substrate, did not trouble themselves [about the question]' (*ouden eduskheranan heautois*: 984a27–29); so too the early Atomists (985b19–20): 'but as for change, from where and how it can come to occur to things, they too, similarly to the others, lazily dropped [the question]' (*rhaithumôs apheisan*).

These remarks must not be taken at face value. We cannot suppose that the earliest theorists offered no sort of explanation at all (other than one in material-cause terms) for the changes that constituted the genesis and the regular running of the

cosmos. In fact, we know better, since the sort of explanation they had to offer may be gathered from other evidence, including that of Aristotle himself. It was, no doubt, a vague one, in general terms, which invoked the general planning and 'steering' activity of the extra-cosmic infinite. We can, by now, understand why he does not report that here: that kind of 'cause', as already explained, simply did not count for Aristotle as part of legitimate natural science. What he is looking for here is causes active wholly *within* the cosmos, indeed within 'nature' (in the sense of the realm of natural things and processes *in* the cosmos) and forming part of that nature.

It may be objected that, even so, his charge of laziness against his predecessors is unjustified. Yet he clearly holds that further and better reflection would have pushed them along the right path; the evidence of that is that their immediate successors moved in the right direction (984a18–27, 984b8–15).

With the Atomists, the complaint is similar, but the case is significantly different. Democritus at least had a systematic treatment of motion, a key part of which was a 'principle of inertia': an atom keeps moving at the same speed in the same straight line direction, unless and until it strikes another atom. This was but a special case of a more general 'principal of causal inertia': whatever had always been so, always would be so (in the absence of interference from outside), and did not admit further explanation. Aristotle elsewhere protests against the use of such a principle; here again, he sees its use as evidence of a misunderstanding of what a science of nature requires. Yet the deliberate and systematic use of such a principle, even if mistaken, is not exactly evidence of 'laziness'. Here, if anywhere, Aristotle goes beyond the bounds of legitimate criticism.[33] It is one indication among others that, in the period when *Physics* I–III and *Metaphysics* I were written, Aristotle underrated the early Atomists. They appear as marginal figures, not mentioned in their due place in *Metaphysics* I; though an account of their views does appear, at 985b4–20, it is not well-placed, nor is it properly integrated with the rest of the story. It appears that they are seen as throwbacks to primitive material monism, who made the additional dire mistake of introducing a void; and that they are therefore considered as almost beneath criticism. By contrast, both in *De Caelo* and in *Generation and Corruption* I (2 316a14–317a17; 8 325b34–326b6) there are elaborate and respectful refutations of Atomist arguments and theses. It is, moreover, striking that Aristotle twice in *Generation and Corruption* I 2 (315a34-b1; 316a6–14) goes out of his way to give (contrary to his usual practice) outspoken tribute precisely to the professionalism and hard work of Democritus in the field of natural science. It is hard not to see this as a palinode.

I. Conclusion

1. The survey in *Metaphysics* I agrees in sum with the assessment implied by *Physics* I-III: the earlier natural scientists, after an impressive start, failed to grasp fully

the implications of their own enterprise. It was a failure to understand the presuppositions inherent in the notions of *science* and of *nature*. The consequent errors in their positive theorising are shown in the *Physics*. In *Metaphysics* I, the negative side is revealed: a fumbling approach to the moving cause, and no proper and systematic use of it; effectively no grasp at all of the formal and final causes and of their centrality in the natural world.

This looks like a paradox: how can these forerunners deserve the name of 'natural scientists' or 'naturalists' (*phusiologoi*) at all, if, as he puts it in one place, 'they have (so to speak) nothing to say about nature' (*PA* 642a16–18)? And why, on the other hand, if they have 'nothing to say about nature', does Aristotle frequently discuss their opinions, not just on the question of foundations and methods, but on substantive questions as well? One must not press an isolated comment too hard, especially one containing the escape-phrase 'so to speak'. But it is supported by the whole series of 'misunderstandings of nature' we have examined, and it sums up clearly the negative side in Aristotle's final judgement.

2. Aristotle's criticisms of his predecessors can all too easily leave the impression, even after several readings, that he holds them in some contempt. Two principal causes for this, one negative and one positive, are as follows. The negative one: in line with what seems to have been general practice in early Ionian scientific writings, Aristotle rarely if ever acknowledges expressly a particular intellectual debt to a predecessor.[34] That is not to say that he tries, or even wishes, to deny or conceal his indebtedness in general. In fact it is clear that he regards himself as the fortunate heir to all that is worthwhile in the heritage of earlier theorising. The positive reason is that in the discussions of predecessors Aristotle's primary aim is always to establish what he himself takes to be the truth. He criticizes his predecessors if he takes their views to be a serious obstacle to the grasping of the truth. He is then determined to show in what respects they were wrong, and to uncover if possible the reasons for their failure to reach what he takes to be the truth. The refutation must be the more thorough and convincing, the higher the standing of the opponent and the greater the initial attractions of his theory.

Further, in looking back at the earlier theorists Aristotle is also self-consciously looking down on them from what he believes to be a more advanced stage of theoretical activity. He sees his own theories, with their advantage of being later in the process of development, as more intellectually advanced in every way, as well as closer to the truth, than the earlier ones. Hence, in so far as he notices the existence of a tradition and of a developmental process within it, his comments underline both his acute sense of the history of the subject, and his belief in the natural superiority of later (especially his own) theorizing over earlier. Such observations are not acts of gratuitous insult or self-congratulation. (When Aristotle uses harsh terms about particular theorists, there is an implication that they were below the level of the best of their contemporaries.[35])

3. Aristotle is clear in general terms about what fuels the movement towards greater understanding: it is the natural 'desire to know' proclaimed in the first sentence of

the *Metaphysics*. What makes it possible for this desire to be fulfilled is the inherent knowability of the truth (since 'God is not jealous', *Met*. I 2 983a2–4). When the attention of those with sufficient leisure is concentrated strongly enough on the problems of science, progress will be made. The subject matter itself will often point inquirers in the right direction.[36]

Why then is progress often slow and difficult? Even given the required level of material wealth and leisure, there are natural retarding forces. There has to be progress, both in the individual and in the collective mind, from what is more well-known by ordinary experience, to what is more intrinsically knowable because it is in reality and theory more basic; this is a process of sorting out what is at first confused, of advancing from an approximate grasp of generalities to a precise grasp of details (*Phys*. I 1 184a16-b14). This progress inevitably takes time, since it calls for the making of distinctions and the development of techniques of argument and approach to a subject matter which is in obvious ways remote from ordinary life. Aristotle recognizes that earlier theorists were not at the same stage as himself, and that that fact is often part of the explanation of their errors.[37] Thus, the reason for their ignorance of the formal cause was that 'there was no such thing as the essence and the defining of the *ousia*' (*to ti ên einai kai to horisasthai tên ousian ouk ên*, 642a24–26). It was Socrates who, though interested not in natural science but in ethics, first saw the importance of proper definitions and first applied his mind to the question of what exactly was required for them. There had been attempts at definitions before, by the early Pythagoreans, but these are regarded by Aristotle as failures since they do not remotely meet the requirements worked out by Socrates, as enshrined in the early Platonic dialogues.[38]

Here Socrates appears as a kind of natural boundary-stone, marking the definitive end (in the logical, not necessarily the chronological, sense) of the early style of natural philosophy. The modern term 'pre-Socratic' has not been used in this chapter, and Aristotle himself used no such term. Yet it is worth pointing out that he might well have done so, given his perception that the earlier natural philosophers, including some contemporary with or younger than Socrates, were made 'archaic' by two by-products of Socrates' ethical inquiries: the increased attention to definitions, and the development of 'dialectic' as a technique of argument.[39] In fact, Aristotle's elastic term 'the ancients' (*hoi arkhaioi*) seems in some places (e.g., *Physics* I 2, 185b26; I 8 191a23) to have much the same extension as 'pre-Socratic' in its present use.

4. Aristotle recognizes too that the chronological sequence is never quite the same as the logical or epistemological one. There are theorists who are 'ahead of their time' in recognizing types of causes or substances, or adopting methods, not yet generally recognized; and there are those who are 'behind their time', in sticking to a more limited repertoire than others of their contemporaries. Thus the mistake of some Platonists was to pose a problem 'in an old-fashioned way' (*arkhaikôs*: *Met*. XIV 2 1089a1–2); whereas Anaxagoras, on a certain charitable interpretation, turns out to 'speak in a rather modern way' (*kainoprepesterôs legein*: *Met*. I 8 989b4–6), and some

unnamed theorists 'though older temporally, had a more modern conception' (*kaiper ontes arkhaioteroi tais hêlikiais kainoterôs enoêsan*: *De Caelo* IV 2 308b30–32).

The gradual formation of a science is a developmental process. But it does not look much like one of Aristotle's natural processes. Aristotelian Nature goes to her goal like a skilled craftsman who knows exactly what he is doing, by the simplest possible route, with a minimum of waste and error. By contrast, the development of natural science contains a great amount of error and wasted effort: wrong assumptions, mistaken lines of inquiry, false reasonings. It is far more like the linguistic, cognitive, social and moral development of a child, or the erratic path of a beginner or an uneducated person, in acquiring some skill, art or learning. It is comparisons drawn from this area, which depreciate while they exculpate, that Aristotle applies to the natural philosophers: 'like [a child] who speaks with a lisp', 'they are like those untrained in boxing who sometimes land good blows but by chance', 'talking at random [like people full of wine]'.[40] Typically, in all these developmental processes, progress is erratic and discontinuous, marked by occasional moments of sudden and decisive advance in insight, a 'catching sight of' (*sunidein*: 984b2) something new[41].

5. Aristotle's sensitivity and insight, in regard to the historical aspect, is unusual among philosophers. Even accepting that, one may still question the adequacy of Aristotle's understanding and reporting of his predecessors, and the fairness of his criticisms. One may argue on the basis of other, non-Aristotelian evidence that Aristotle, in good faith or not, misunderstood and misrepresented them; this line of attack, which calls for close scrutiny of that evidence, lies outside the scope of this chapter. Here it has here been argued that the Aristotelian reports and criticisms may be vindicated from objections brought against them on internal grounds, if we accept the presence of certain unexpressed assumptions behind Aristotle's treatments of earlier natural science in the *Physics* and in *Metaphysics* I. If this is correct, then only when such unexpressed assumptions are taken into account can one set about using Aristotle's testimony in the reconstruction of earlier theorising. In particular, any argument from the *silence* of Aristotle will be of extremely uncertain value, unless we can show clearly that it is a kind of silence that would be inconsistent with the rest of his practice as we have reconstructed it. In short, one should not cite and use Aristotle's testimony or lack of testimony, unless one has first stated and justified a general position about the principles on which he selects the information he gives, in the various works.

The hypothesized assumptions themselves should be judged on how well they allow us make sense of the texts overall; and how they fit in with what else we know of Aristotle's own conception of natural science. If confirmed, they may even help to delineate more precisely Aristotle's own vision of nature. But that is another story.

Notes

1. The terms listed are frequent in *Metaphysics* I but occur in other places as well. Thales as the pioneer of natural philosophy, *Met*. I 3 983b20–21. 'Human wisdom' (i.e., science)

preferable to mythical stories, *Met*. III 4 1000a5–22. Aristotle's reports probably draw on previous doxographic reports (by, e.g., Hippias, Plato, or even by his own pupil Theophrastus: so Gigon); on these matters see particularly Mansfeld 1990, 22–83; and on the relation between Aristotle's and Theophrastus' work on the history of natural science, Mansfeld 1996.

2. *Topics* on use of expert opinion: *Top*. I 1 100b21–23; I 2 101a36-b4; I 10 104a8–15; I 14 105a34-b18; arbitration between conflicting opinions: *Met*. III 1 995a24-b4; *DC* I 10 279b7–12; *Phys*. III 6 206a12–14. On Aristotle's procedures for establishing the foundations of a science, particularly natural science, and how far they are to be seen as dialectical, there are classic statements by Wieland and Owen, while Bolton is a valuable further contribution; but the points of disagreement are not crucial for the purposes of this chapter.
3. The views of Cherniss are repeated, sometimes in rather more extreme form, by McDiarmid. Guthrie, against Cherniss, makes some commonsense general observations but (as pointed out by Stevenson) does not attempt any substantive reply. There seems to be now a general consensus that Cherniss 'goes too far'; but this view in itself is of no value unless one can show in a number of particular but central cases how and where Cherniss was mistaken.
4. I am much indebted to Hywel Clifford for his kindness in reading an early draft of this chapter and for his acute and helpful comments.
5. 'The existence of number is not as clear as that of hot and cold' (*APo* I 10 76b18–19).
6. *Met.* I 1 981b20–25 implies that in Egypt mathematics existed as a genuine science before the time of Thales; the earliest Greek mathematical activity mentioned is that of Pythagoras and his early followers (*Met*. I 5 985b23–26). Two lost and presumably early works, *De Philosophia* and *Protrepticus*, may have given a slightly different account of the earliest stages of science; see *De Philosophia* 13 Rose^3 = 8 Ross; *Protrepticus* 53 Rose^3 = 8 Ross = C55:2 Düring.
   On the detail of the theories of Thales himself, Aristotle is cautious; but the fact that he has no hesitation in classing him with the 'natural philosophers' indicates that he has positive evidence to that effect.
7. On how the 'principles' (*arkhai*) of a science are discovered and identified as principles, the principal sources of information are *APo* II 19 and *EN* VI 3 and VI 6. Discovery of principles needs induction applied to data supplied by perception; this can include *endoxa*, which are the result of past attempts to do this, the inherited stock of accepted inductions.
8. The earlier natural scientists were concerned with everything, investigated the truth about all that is, sought the principles of 'substance' (*ousias*) generally: *Met*. I 3 983b1–3; VII 988a24–27; 8, 989b21–27, 989b33–990a5 (Pythagoreans); XII 1 1069a25–26. But they thought that all that is (substance), is sense-perceptible: *Met*. I 8 990a3–5; III 5 1002a8–11; IV 3 1005a29–33; IV 5 1010a1–3; XII 1 1069a28–30, XII 10 1075b24–27, cf. *DC* III 1 298b21–22 (even the Pythagoreans are hardly an exception: *Met*. I 8 989b29–990a5). It is important to note that this assumption is not treated as a mistake in *Metaphysics* I; understandably so, since the question of its truth is still open, as one of the fundamental problems of metaphysics, in *Metaphysics* III (997a34–998a19). Likewise, their consequential reducing of all sciences to one is not taken as a mistake in *Metaphysics* I, and in *Metaphysics* III it is still an open question (996a22-b1) whether there is one science or more than one. What *Metaphysics* I does see as error (I 8 998b23–25) is the specifying of 'elements' of bodies only (not of non-bodily entities as well).

9. Except possibly mathematics; but Aristotle does not state this exception, and he mentions mathematics only in connection with the Pythagoreans. He recognizes in any case that this restricted conception did not at all preclude an interest in matters that (for him) fall outside the scope of natural science: e.g., general truths of logic: *Met*. IV 3 1005a29-b2.
10. *Phys*. I 7 190b17–20 ('causes and principles of things that are by nature, from which first they are and have come to be …') and 191a3–4 ('the principles of natural things [or possibly: 'of natural scientists'?] concerned with *genesis*': *tôn peri genesin phusikôn*). Mostly I shall just use '*genesis*' for Aristotle's *genesis*, except when it is coupled with *phthora* (when I use 'coming-to-be' and 'ceasing-to-be').

    The principles so described are presumably also included among 'the principles of natural science' (as perhaps indicated by 184a10–16); but they concern Aristotle here as principles of natural change.
11. *Phys*. VIII 1 250b15–18: 'all those who say anything about nature say that there is change because they create *cosmoi* and their entire science is concerned with coming-to-be and ceasing-to-be'; also *Met*. I 8 988b26–28, *PA* I 1 640b4–11, *EE* VII 1 1235a10–13.
12. It is here notably left open whether, in these theories, 'being in the mixture' was actual or merely potential; perhaps because, as Aristotle elsewhere in this book claims (*Phys*. I 8 191b27–34), the actual-potential distinction was not known to the earlier theorists. At *Met*. XII 2 1069b15–32, the distinction is used in this connection to offer clarifying reformulations of the theories of Empedocles, Anaxagoras, and Democritus (there are unfortunately uncertainties about both text and translation; see Charles, 97–103 and 106–110).
13. At *Met*. XII 2 1069b22–23 Democritus is simply put among the 'mixture' theorists.
14. For a different kind of reading of *Phys*. I, which sees Aristotle as engaged in 'violent' manipulation and distortion of historical truth in order to establish a 'precedent' for his own views, see Cherniss, 46–57.
15. As he elsewhere remarks: '[Platonists] posit universal things as substances; for genera are universal, and it is these that they rather say are principles and substances, because they inquire in a way that has regard to the general account of a thing (*logikôs*); but the ancients [posited] particular things, e.g., fire and earth, and not that which is common, body' (*Met*. XII 1 1069a26–30).
16. Perhaps the early Atomists, but for present purposes it does not matter exactly who. Cf. *PA* I 1 641b15–23.
17. Likewise, at *Parts of Animals* I 1 639b22–23, we are told that 'more or less all' of the natural scientists 'try to bring back their accounts to' necessity, but did not distinguish between different senses of 'necessity': namely Aristotle's conditional necessity (as in *Phys.* II 9) and absolute necessity. The implication is that the natural scientists wrongly try to explain natural things and processes by invoking a supposed absolute necessity. On the argumentation in *Phys*. II 8, which has been endlessly discussed, I have found helpful the discussions of Judson and Waterlow; Judson's bibliography lists some other useful contributions.
18. This reading of the contrast between 'absolute' and 'conditional' necessity avoids any conflict with Aristotle's insistence elsewhere on necessitation in natural processes. On necessity in Aristotle's natural science generally, another much-discussed topic, see, e.g., Sorabji, 143–54.
19. Only Empedocles and Democritus touched on it 'to a small extent', but then 'said goodbye' to it; the implication is that they made practically no use of it. This is the same failure that is reported in *Metaphysics* I as the failure to arrive at any proper

conception of the formal cause, in which connection Empedocles is again mentioned (*Met*. I 10 993a15–24) as a partial though imperfect exception. On the assumptions and implications of the discussion in *Physics* II 1, see Waterlow, 55–68.

20. As seems to be the case for the absolute necessity involved in unending cyclic processes, such as the transformations of the elements: see *Gen. et Corr.* II 11.
21. At *Generation of Animals* V 1 778b7–10, the crucial step is put thus. The earlier natural scientists thought that 'the substance is determined by the process of genesis', whereas the truth is the opposite: 'the process of genesis is determined by the substance'. They made this mistake because 'they did not see that there are several kinds of cause: they only saw the material cause and that of [the source of] the change, and that without distinguishing them clearly; but the cause of the *logos*, and of that of the end, they did not consider'. On 'the necessary' as a false substitute for the final cause, see also *GA* V 8 789a2–15.
22. Those who 'made the elements finitely many [but more than one]', which must include Empedocles, are excepted from the generalisation. For what follows, it is important to note that the critique of 'infinitely extended body' is explicitly intended to apply to the Atomists too, even though their infinitely many atoms did not form a single continuous body: see 203a19–23, 203a33-b2.
23. There is no good short English equivalent for *logikôs* in such contexts; it implies that one relies on the senses and/or definitions of key terms; and on verbal distinctions and such matters. At *Gen. et Corr.* I 2 316a10–14, Aristotle casts doubt on the use of '*logikôs*' arguments in natural science, but there is no such suggestion here.
24. The *De Caelo* arguments are divided into 'special' (*kata meros*) and 'general' (*katholou*). The 'general' arguments (274a30–276a17) are of the same sort as those of *Physics* III; they do not appeal to Aristotelian natural science but claim that the notion of an infinite body cannot fit into any comprehensible conception of nature. They make use of mathematical paradoxes that seem to arise when one attributes physical properties to an infinite body; and they go over into parallel arguments against an infinite universe and for the uniqueness of this cosmos. The 'special' arguments (271b17–274a18) appeal to the results of *De Caelo* I 1–4, especially the mathematical analysis of the possible types of 'simple motion' and hence of 'simple bodies'. (In general, it is on mathematical argumentation that Aristotle mostly relies when confronting the Atomists in his later writings.) The arguments of *Physics* IV 8 against Atomist void are in many ways comparable. On Aristotle's later appreciation of the Atomists, see below Section H.8.
25. On some points of detail, it has to use mathematics in an auxiliary role; this does not affect the general point. It is a mistake (which the Eleatics committed) to import metaphysical arguments into natural science: *DC* 298b14–24. On the autonomy of natural science and its exclusion of 'metaphysical possibilities', compare Berti, and Waterlow, 3.
26. This would apply even to the theories of Empedocles and Anaxagoras; Anaxagoras as noted is specifically praised for saying that there was Mind *in* nature (*Met*. I 3 984b15–20), yet he apparently also supposed that Mind *preceded* any cosmos. Plato's *Timaeus* is founded on a radically different metaphysics, but one that also intrudes into the realm of 'natural science'; Aristotle's treatment of it unfortunately cannot be examined here. About Plato's later views on natural science as expressed in *Laws* X 891b8–899d3, with its sombre denunciation of earlier natural science as the root of disastrous impiety, Aristotle is totally silent; perhaps he considers them as a mere extension of the point of view underlying the *Timaeus*.

The hypothesis outlined in the text is not incompatible with the fact that Aristotle, in at least one place, constructs arguments on the assumption of an infinite universe, without appeal to general theses about nature or the infinite: this is *DA* I 5 411a7–23, which contains a refutation of certain earlier theories of soul as a fundamental ingredient of the (supposedly infinite) universe.

27. The prime example of the use of such hypotheses is Cherniss (see Section A.3 above, and note 12 above).
28. The principal texts are: *Phys*. I 8 191a23–34, I 9 191b35–192a12 (the problem of the logic of genesis; cf. *Phys*. I 4 187a26–35); *DC* III 1 298b12- 299a1 (summary of opinions about genesis); *DC* III 8 306b3–307b24 (critique of Platonic and Atomist theories of elements); *Gen. et Corr.* I 1 314a6–315a15 (critical review of earlier opinions; in *Gen. et Corr.* I 2, there follow critiques of the Atomist view and of Plato's *Timaeus* theory); *Gen. et Corr.* II 6 333a16–334b7 (critique of Empedocles' theory of elements and related ones). There are also criticisms of earlier theories of genesis in *Met*. XII 6 1071b26–1072a18, though here the context and the assumptions are not those of natural science. There was also some treatment of earlier pre-Platonic theorists in some of the lost works of Aristotle, in particular the work *On Philosophy* and the reported monographs on individual thinkers or groups of thinkers, but their content is not recoverable in detail.
29. Noted also at *Met*. XII 2, 1069b20–24.
30. For the general claim: *Phys*. II 2 194a18–21 (cf. II 1 193a21–28); *PA* I 1 640b4–641a17, 642a14–31; *GA* V 1 778b7–10; *Met*. I 7 988a34-b1; for the partial exceptions: *Phys*. II 2 194a20–21 (Empedocles and Democritus), *PA* I 1 642a18–24 (Empedocles), *Met*. I 5 987a20–27 (Pythagoreans), I 10 993a15–24 (Empedocles); for Empedocles' 'formula for bone' and general recognition of the determining of properties by ratios in compounds, see also *DA* I 4 408a18–24, I 5 409b32–410a10; *GA* V 1 779b15–20.
31. Omission of final cause: besides *Physics* II 8–9 and the parallel treatment in *PA* I 1 639b21–640a9, see: *Resp*. III 471b23–25, 472a1–3; *PA* I 1 641a7–15; *GA* V 1 778b7–10, V 8 789b2–15 (Democritus).
32. Note also *Gen. et Corr.* II 9 335b7–12: earlier faint inklings of need for moving cause; failure of theories omitting it.
33. Though there is piquancy and polemical bite in the thought, apparently suggested here, that to postulate such a principle is evidence of one's own mental inertia. The Atomists' principle is stated and attacked in full generality at *Phys*. VIII 1 252a32-b5, *GA* II 6 742b17–35; elsewhere it is just stated that the Atomists held that there was always motion or that the atoms were always in motion: *DC* III 2 300b8–16, *Met*. XII 6 1071b31–34. (*Phys*. VIII 9 265b23–26 does not say, as some have claimed, that the Atomists made the void a cause of motion.) It is clear, though the evidence is miserably sparse, that there was more to Democritus' thinking about motion than this.
At *GA* IV 1 764a12–23, it is Empedocles who is accused of laziness on a particular point, while Democritus by contrast is rated 'better'; another instance of later upgrading of the Atomists?
34. For Ionian science, the observation goes back at least to Tannery.
35. As notably with Hippon (*DA* 405b1–2, *Met*. I 3 984a3–5). The derogatory terms *phortikos* and *agroikos* are also applied to the work of Zeno and of two theorists associated with the Eleatics (Xenophanes and Melissus), on matters that do not fall within the scope of natural science (*Phys*. I 2 185a5–12, I 3 186a4–7; *Met*. I 5 986b25–27, 1001b13–14). Forthright speaking about rival theories was also part of the Ionian scientific tradition (see, e.g., Lloyd, 56–70).

36. *Met*. I 1 980a21; I 2 982b28–983a4; I 3 984a18–19, 984b8–11. The rapidity of progress in recent times was stressed (perhaps for protreptic or polemical reasons) in the *Protrepticus* and/or the *De Philosophia*: frr. 52, 53 Rose^3 = *Protrepticus* frr. 5, 8 Ross = Düring B 55, C 55:2; but see the comments of Düring 227–31.
37. For example: *Phys*. I 3 186a29–32 (Parmenides not aware of a certain distinction); *Phys*. I 8 191b27–34 (earlier unawareness of potentially-actually distinction).
38. Early development of definitions: *PA* I 1 642a24–31; *Met*. I 5 987a20–27, I 6 987b1–4; XIII 4 1078b17–30; a contribution by Democritus too is hinted at.
39. Dialectic: invented by Zeno, fr. 65 Rose^3 = *Sophistês* fr. 1 Ross; not much developed before Socrates: *Met*. I 6 987b32–33; XIII 4 1078b25–27.
40. *Met*. I 3 984b15–18; I 4 985a10–17; I 10 993a15–16.
41. *Sunoran*/*sunidein* is used of an insight which marks a decisive advance in understanding, also at *Phys*. 186a32, *Gen. et Corr.* 316a5, *GA* 721a14–17, 755b27–29, 764a36-b2, *Met*. 1048a37, *EN* 1127a17, 1181b21.

Bibliography

Berti, Enrico (1969) 'Physique et métaphysique selon Aristote: *Phys*. I 2, 184b25–185a5', in I. Düring, ed., *Naturphilosophie bei Aristoteles und Theophrast* (Heidelberg: Lothar Stiehm Verlag), 18–31.

Bolton, Robert (1991) 'Aristotle's Method in Natural Science: *Physics* 1', in L. Judson, ed., *Aristotle's Physics*: *A Collection of Essays* (Oxford: Clarendon Press), 1–29.

Charles, David (2000) '*Metaphysics* Λ 2', in M. Frede and D. Charles, eds., *Aristotle's* Metaphysics *Lambda*: *Symposium Aristotelicum* (Oxford: Clarendon Press), 81–110.

Cherniss, Harold (1935) *Aristotle's Criticism of Presocratic Philosophy* (Baltimore: Johns Hopkins Press), (reprinted, New York: Octagon Books, 1964).

Düring, Ingemar (1961) *Aristotle's Protrepticus*: *An Attempt at Reconstruction* (Göteborg: Institute of Classical Studies of the University of Göteborg).

Gigon, Olof (1969) 'Die ἀρχαί der Vorsokratiker bei Theophrast and Aristoteles', in I. Düring, ed., *Naturphilosophie bei Aristoteles und Theophrast* (Heidelberg: Lothar Stiehm Verlag), 114–23.

Guthrie, W.K.C. (1957) 'Aristotle as Historian of Philosophy: Some Preliminaries', *Journal of Hellenic Studies* 77, Part 1, 35–41, [reprinted in D.J. Furley and R.E. Allen, eds., *Studies in Presocratic Philosophy*, *vol. I*: *The Beginnings of Philosophy* (London: Routledge & Kegan Paul, 1970), 239–54].

Judson, Lindsay (2005) 'Aristotelian Teleology', *Oxford Studies in Ancient Philosophy* 29, 341–66.

Lloyd, G.E.R. (1987) *The Revolutions of Wisdom* (Berkeley/Los Angeles/London: University of California Press).

McDiarmid, J.B. (1953) 'Theophrastus on the Presocratic Causes', *Harvard Studies in Classical Philosophy* 61, 85–156.

Mansfeld, Jaap (1990) *Studies in the Historiography of Greek Philosophy* (Assen/Maastricht: Van Gorcum).

——— (1996) 'Aristote et la structure du De Sensibus de Théophrast', *Phronesis* 41, 158–88.

Owen, G.E.L. (1961) 'τιθέναι τὰ φαινόμενα [*Tithenai ta phainomena*]', in S. Mansion, ed., *Aristote et les Problèmes de Méthode* (Louvain : Publications Universitaires de Louvain and Paris : Éditions Béatrice-Nauwelaerts).

Sorabji, Richard (1980) *Necessity Cause and Blame*: *Perspectives on Aristotle's Theory* (London: Duckworth).

Stevenson, J.G. (1974) 'Aristotle as Historian of Philosophy', *Journal of Hellenic Studies* 94, 138–43.

Tannery, Paul (1887) *Pour L'Histoire de la Science Hellène* (Paris: Félix Alcan).

Waterlow, Sarah (1982) *Nature*, *Change and Agency in Aristotle's Physics* (Oxford: Clarendon Press).

Wieland, Wolfgang (1975) 'Aristotle's Physics and the Problem of Enquiry into Principles', in J. Barnes, M. Schofield, R. Sorabji, eds., *Articles on Aristotle*: *I. Science* (London: Duckworth), 127–40 [a translation into English of W. Wieland, 'Das Problem der Prinzipienforschung und die Aristotelische Physik', *Kant-Studien* 52 (1960–1), 206–19].

CHAPTER 3

SCIENCE AND SCIENTIFIC INQUIRY IN ARISTOTLE: A PLATONIC PROVENANCE

ROBERT BOLTON

1. The Platonic Background

Aristotle's word for science is *epistêmê*. It is important, however, to keep in mind, as writers sometimes do not, that this term *epistêmê* has at least a dual use in the Greek of Aristotle's day. It is standardly used, in one way, as a count noun, to mean 'a science.' Thus, in this usage, one can say that geometry, or *phusikê* (natural science), or metaphysics is (an) *epistêmê*, is a science. Here the term *epistêmê* designates a special sort of systematic body of truth or fact which may or may not have yet been discovered, or fully discovered. But the term is also used very commonly to designate not a body, or an item, of fact or of truth, but rather a cognitive state of someone who has appropriately grasped an *epistêmê*, in the sense of a science, or of one who has grasped a suitable part of it.[1]

In this second use, to designate a certain type of cognitive state, the term *epistêmê* is applied in the ordinary Greek of Aristotle's day to more or less anything that we would now commonly call *knowledge*, from the expert knowledge one might have by demonstration of some mathematical or scientific theorem, to

knowledge from experience of, say, the way from Princeton to New Brunswick, or to eyewitness knowledge of who robbed the bank. In the *Meno* for instance (97b), Plato uses the term *epistêmê* in this ordinary sense for knowledge from experience of the way from Athens to Larissa, and in the *Theaetetus* (201b-c) he uses the term *epistêmê* for eyewitness knowledge of who did or did not commit some crime. In Plato's *Protagoras* (352cff.) Socrates uses the term *epistêmê* for knowledge of the particular right moral action to perform on some specific occasion and he is followed in this use of the term by Aristotle in *Nicomachean Ethics* VII.2 (1145b21ff.). These examples all follow ordinary usage, even though the *epistêmê* or knowledge in question here is not at all theoretical scientific knowledge. However, despite this ordinary usage, in a famous passage in *Republic* V (476dff.), Plato introduces, and also argues for, a severely restricted range of application for the term *epistêmê* in the use in which it designates a cognitive state of a knower. The interpretation of this passage in *Republic* V is very controversial on numerous points, and we cannot enter into all of the complexities here.[2] But it is at least relatively uncontroversial that one basic idea that Plato presents there is that *epistêmê*, which we may think of initially in accord with common Greek usage as *knowledge*, is a cognitive state which has or is about an object which is able to be and is *accurately represented* by that state or its content (477b, 478a). This idea, clearly, has a good deal of plausibility as regards knowledge, as we understand it. Further, Plato claims, the object of *epistêmê*, or knowledge, must be able to be and must be accurately represented by that cognitive state *in every way* (477a, 479a-e). That is, the cognitive representation cannot be partly accurate and partly inaccurate of a genuine object of *epistêmê*. This also has a certain plausibility as concerns knowledge as we, or ordinary Greeks, would standardly think of it. It is important, and Plato clearly indicates in *Republic* V (476d-e), that he expects his argument there to have force with ordinary intelligent Greeks, even those who do not share and may well oppose his special philosophical views. So he ought to be relying in his argument on premises with some general plausibility.

What Plato means, however, by this complete and unqualified accuracy of representation by *epistêmê* of its object is more fully spelled out in other middle dialogues, especially the *Symposium* and *Timaeus*. In *Symposium* 210cff. Plato characterizes the object of *epistêmê* somewhat negatively, as an object that cannot be accurately represented by that state: (1) only in one part but not in another, or (2) only at one time but not at another, or (3) only in one relation but not in another or (4) only in one location but not in another. This helps to spell out for us what Plato has in mind by that complete and unqualified accuracy of representation by genuine *epistêmê* of its object on which he insists in *Republic* V. Of these various dimensions of accuracy, or of avoidance of inaccuracy, by *epistêmê* in the representation of its object, the most important perhaps for our purposes here is the temporal one. The proper object of *epistêmê*, Plato claims, cannot be only accurately represented by that cognitive state at one time but not at another.

From certain passages in the *Timaeus* in particular (27dff., 37c-38c, 51dff.), it is reasonably clear that Plato means by this that an item of *epistêmê*—at least if

that item is propositional in form—is not simply in fact always true, i.e., true at every time. Rather, it is true in an atemporal way so that it is unable to change its truth value over time. That is, it is a necessary truth. In the *Timaeus* (37c-38c) Plato contrasts what is capable of being different in the past, present, and/or future with what simply *is* something or other in a way such that it is *incapable* of change over or in time. We should not even say, Plato tells us, of what *has* changed that it *is* something that has changed. So, for Plato, what *is* in this special unqualified sense is not what *is now* or *is at the present* since he could hardly deny that what has changed (and still exists) *is now* something that has changed. He must mean, then, that what *is* something or other, in the special sense he has in mind, is so timelessly.[3] Plato also seems here to hold, further, that what is 'in time' will inevitably change in such a way that any representation of how it is in particular at a given time can at best accurately represent it only at one time but not at another. Thus, since *epistêmê* must avoid this restriction, there can only be genuine *epistêmê* of what is something or other timelessly and, thus, necessarily.

Plato himself largely avoids the use of the term *necessity* (*anagkê*) in describing items of *epistêmê,* presumably because of his tendency to reserve the application of this term in theory construction to what is *forced* by factors outside of the scope of ideal rational order.[4] This leads Plato to devise a special use of the term *is* to characterize proper items of *epistêmê* in a way that guarantees that they are timeless necessary truths.[5] But this, as we have already seen from examples, does not easily fit the ordinary use in Greek of the term *epistêmê,* nor, of course, does it fit our ordinary use of the term *knowledge*. In the *Republic* itself Plato does not do much to defend this idea directly—that the content of an item of *epistêmê* is always a necessary truth—but from other early and middle dialogues we can see, I think, how he would want to defend it even to an ordinary intelligent Greek, if not to us. So let us see if we can piece that story together. This will turn out to be very important for understanding Aristotle.

To begin with, then, the term *epistêmê*, or the verb *epistasthai* (= to have *epistêmê*), derives, etymologists tell us, from the verb *ephistasthai* (= to stop or stand [oneself] on). Aristotle himself, at least, seems to accept this derivation as we can see from *Physics* VII 3 247b11ff.[6] Thus *epistêmê*, on this derivation, is something one makes a stop or a stand on or, as we might say, something one relies on. This root idea is quite prominent already in Plato's early dialogue *Protagoras* (352aff.) where *epistêmê* is regarded, at least by Socrates and Protagoras, as the sort of cognitive state that is sufficiently powerful so that it will not ever abandon you or lead you astray or let you down. This is by contrast with desires, emotions, and other affections (including perceptions) which can and regularly do subject you to error, Plato thinks. (Cf. *Phd*. 65c, *Tim*. 51d-e) This point in the *Protagoras* is directly echoed in *Republic* V. 477d-e where *epistêmê* is called 'the most powerful (*erromenestatê*) of all capacities (*dunameis*).' This view, moreover, that *epistêmê* has this strongly reliable accuracy is treated not as just some philosopher's arcane idea but as a generally credible and acceptable one in Aristotle's presentation of that

view in *Nicomachean Ethics* VII 2 1145b21ff., where he is reporting on this view as found in the *Protagoras*.

Plato does not say much directly in the *Protagoras* itself about what he thinks the basis or grounding is for this strong reliability of *epistêmê,* for the one who has it. But in a somewhat later dialogue, *Meno* (97bff.), he argues explicitly that unlike even *true* opinion or belief *epistêmê* is not the sort of thing that will ever let you down or lead you astray because genuine *epistêmê* always comes with a certain kind of guarantee or backing which ties it down and makes it reliably firm and stable as well as true and accurate. This backing, Plato says in the *Meno*, involves and requires the grasp of an account (*logismos* or *logos*) of the cause or reason (*aitia*) which accounts for why the item in question is so. This is anticipated already perhaps in the *Protagoras* (356eff.) where *epistêmê* of what is best on some particular occasion is properly to be reached by use of an art or science of measurement of goods and evils. This idea, then, that given its strong reliability, *epistêmê* must involve and must always be reached through a grasp of the cause or account (*logos*) of why the item is so, is then very prominent indeed throughout Plato's middle dialogues (e.g., at *Rep.* VII 531eff.).[7] In the *Timaeus* in particular, it is especially clear that it is just this backing provided by the grasp of its cause or account that gives an item of *epistêmê* its stability and its rational unshakability. Plato says there (*Tim.* 51d-e with 29b-c) that *epistêmê* (or *nous*) comes by teaching (*didachê*) via a true *logos* or account and, as such, it is unshakable (*akinêton*) and irreversible by persuasion or argument (*ametapeiston*).[8]

The natural question that arises at this point is this: What sort of thing must the grasp of the cause (*aitia*) or account (*logos*) of some item of *epistêmê* be, such that the derivation of that item of *epistêmê* from that cause or account would guarantee its total cognitive reliability in an atemporal way and, as such, would guarantee its necessity. Here again Plato is perhaps not as explicit as we might like. But in the *Meno* for instance, and very often elsewhere, he puts forward the idea that to properly know, or to have *epistêmê* of, anything else about something, one must first come to know the essence of that thing, or *what it is*, (it's *ousia* or *ti esti*) and then base one's knowledge of other matters about the thing on the explicit knowledge of its essence. (*Meno* 71b, 86d-e, 100b. Cf. *Euthyph.* 6d-e, *Prot.* 360eff., *Laches* 189e-190b, *Lysis* 223b, *Rep.* I 354b-c, Xen. *Mem.* IV vi.1. Cf. Arist. *Met.* M 4 1078b 17–29). It is evident enough that for Plato, as for us I take it, the essence of a thing is a fundamental unchangeable feature of it. (See, e.g., *Rep.* VI 511b-e with VII 531d-535a.) So any truth that could be derived directly *from* an account of the essence of something would be equally necessary, just as a statement of the essence is.

In sum then so far, I am suggesting, Plato seems to take as his starting point the generally accepted idea that *epistêmê*, or knowledge even, must be completely reliable and trustworthy in its accuracy. He then argues that the only proper guarantee of that *complete* trustworthiness is through grasp of the cause or account of one's item of *epistêmê* where the grasp of that cause or account is or involves grasp of the essence of what one has *epistêmê* of. One's item of *epistêmê* is then guaranteed to be, and is grasped as, a necessary truth since it is seen to derive from the essence of

the thing. It has been common for recent philosophers to object rather strongly to Plato's requirement, in his early and middle dialogues, that knowledge or *epistêmê* of any other features of, say, virtue, or courage or justice must be based on a grasp of the essence (or definition) of that object—and this doctrine can seem to us quite implausible.[9] But if we see that Plato starts from the plausible assumption, at least for the Greeks, that knowledge, or *epistêmê*, must be completely trustworthy in its accuracy, we can at least see the coherence of his proposal that the way that this gets fully guaranteed is the way he suggests, namely by basing that *epistêmê* on an account of the essence of the thing.

Let me now briefly contrast this story, this account of the rationale for Plato's requirement that true *epistêmê* must be based on a grasp of the essence of the item in question, with two other influential accounts. On the first, the rationale for Plato's requirement, at least in certain passages, is that basing *epistêmê* on a grasp of essence promotes or gives one *systematic understanding* of what one has *epistêmê* of.[10] While this is not the place to consider this view, or arguments for it, in any detail, in the passages that we have been considering, Plato's starting point, his root idea if you will, is not that *epistêmê* involves systematic understanding, but rather that it involves completely trustworthy and reliable multidimensional accuracy of representation of its object. Basing *epistêmê* on grasp of essence serves to guarantee, or to help guarantee, that. Of course, this is not to deny that systematic understanding of its object may also be achieved on Plato's requirements for *epistêmê*. One might also argue that this systematic understanding itself promotes reliable accuracy for *epistêmê*. Nevertheless, the root idea remains reliability.[11]

Another alternative account of the rationale for Plato's requirement that *epistêmê* must be based on a grasp of the essence of the item in question was offered by Gregory Vlastos. He took it, contrary to many scholars, that this requirement is not in fact to be found in Plato's earliest Socratic dialogues and was first introduced in 'transitional dialogues' such as the *Meno* after Plato came under the influence of the methods of 'advanced mathematics' where, according to Vlastos, such a doctrine was generally accepted.[12] Vlastos' approach here involves, first of all, a largely undefended historical thesis, namely that in mathematical practice in Plato's day, say in geometry or arithmetic, it was agreed that definitions must be known first, independent of any prior certain knowledge of any truths these definitions were then used in the proof of. This assumption can easily be questioned. Did ancient mathematicians not suppose that they knew, and knew with certainty, that 2+2 = 4, and many other such truths, before they were able to axiomatize arithmetic and settle on the proper ultimate definitions of its basic terms? But even if Vlastos were right on this historical point, his account would still leave the question we have been addressing here in the main unanswered, namely, what is it about *epistêmê*, as generally understood, that would make the requirement that it be based on knowledge of essence appropriate and defensible, in mathematics or elsewhere.

The final question now to ask in our sketch of Plato's view of *epistêmê* is this: How does one reach that knowledge of *essence* on the basis of which one is able to ground and guarantee the complete and trustworthy accuracy, including especially

the atemporal accuracy and thus the necessity, of an item of *epistêmê*? Here Plato's answer is, at least verbally, very clear, for instance in *Republic* VII 533a-534e. The method for reaching knowledge of essence, Plato says there, is nothing other than dialectic. In the *Republic* Plato is not as explicit as one might like on what precisely this involves—this reaching of knowledge of essence through dialectic. But there are strong indications at least in somewhat later dialogues that he regarded, or came to regard, the method of definition by division—through genus and differentiae—as the proper procedure to use dialectically to reach knowledge of essence. This doctrine is first found explicitly, perhaps, in *Phaedrus* 265dff. But the best and most well-known examples of how this method of division works dialectically for Plato are found in his late dialogues *Sophist* and *Statesman*.[13]

2. Aristotle's Debt to Plato

With this Platonic background in view, the question for us now to ask is this: How much of this conception of *epistêmê* and of how it is reached does Aristotle accept and take over from Plato? The answer, as it turns out, is a very great deal and, some would likely argue, all of it. This is clear already in the early chapters of the *Posterior Analytics* where Aristotle offers us a detailed account of *epistêmê* as he understands it. Consider first the opening lines of *APo* I 2.

> We consider ourselves to have *epistêmê* without qualification, and not accidentally in the sophistical manner, when we think we know the cause (*aitia*) on account of which the thing is so—that it is the cause—and that it is not possible for this to be otherwise (71a9–12).

Here Aristotle directly carries over *three* basic requirements for *epistêmê* from Plato. It must be (1) based on a grasp of the *cause* (*aitia*) of the item in question as such; (2) it must be a *necessary truth* and grasped as such; and (3) it cannot be known to hold only accidentally. By this last requirement Aristotle means, in effect, that the item of *epistêmê* in question, the proposition in question, cannot be such that the predicate is known to belong to the subject only accidentally as opposed to belonging to it *in itself* (*kath' hauto*) as the *kind* of thing it is. That is, the predicate must be known to belong to the subject in virtue of the nature or essence of the subject. This carries over a third Platonic requirement for *epistêmê*, namely that *epistêmê* must be based on a grasp of the essence of the item in question. That this is what Aristotle intends here is clear, for instance, in *APo* I 5 where he equates knowing that some predicate belongs to some subject non-accidentally or in itself (*kath' hauto*) with knowing that it belongs to the subject as the kind of thing it is (*kat' eidos*). He equates the latter with knowing that it belongs in virtue of the essence and definition of the thing in question. (74a25ff., cf. I 4 73b10ff.).[14]

Aristotle also says in *APo* I 2 that 'we' understand *epistêmê* as meeting these three requirements. (71a9) As we have seen, the 'we' in question here cannot be ordinary people in general since these requirements do not simply reflect the ordinary usage of the term *epistêmê*, even if Plato tries to argue for these requirements starting from and on the basis of important features of the ordinary conception. Nor is the 'we' here the royal 'we'. That is, Aristotle is not simply stipulating that he intends to use the term *epistêmê* in this way. (see 71b13–16) Rather the 'we' here, as we have seen, is 'we philosophers', i.e., those in Aristotle's Academic circle, especially Plato. We should notice also that Aristotle himself does here distinguish what he calls unqualified *epistêmê* from other actual if only accidental *epistêmê*. So he does not insist, as Plato seems to do in *Republic* V, that any cognitive state that fails to meet the requirements here (i.e., Plato's own requirements) for strict *epistêmê* is at best mere opinion (*doxa*) and not knowledge (*epistêmê*) at all. Here, then, Aristotle is somewhat closer to ordinary usage than is Plato in *Republic* V. However, there is a Platonic precedent for this distinction, too. In the *Phaedrus* at least (247c-e), Plato distinguishes what he there calls *true epistêmê* from 'that *epistêmê* which concerns what changes, which varies [in its accuracy] with the [changing] things we commonly [but mistakenly] say *are*'. It is only the former *epistêmê*, Plato says, which 'really is *epistêmê* of what really *is*'. Having given this philosopher's characterisation, if you will, of *epistêmê*, Aristotle then goes on in *APo* I 2 to describe how *epistêmê*, so understood, is to be reached. He argues that it must be reached by what he calls, now perhaps stipulatively, a demonstration (*apodeixis* 71b15ff., 71b17). We will come back to the question of exactly what a demonstration is, noting for now only that Aristotle says here that this must be a proof from what he calls 'first principles' (*archai*). This involves crucially, as we have already seen, proof ultimately based on the essence or definition of the entity or entities in question. (72a7ff.) This point enables us to appreciate the force of the final lines of *APo* I 2 (72a37ff.) where Aristotle says:

> Anyone who is going to have that *epistêmê* which comes through a demonstration must not only know better, and have as more credible, the first principles [on which the demonstration is based] than he does of what is proved, but there can be nothing more credible for him nor better known, among things that are opposed to these principles, from which there would be proof of any error that is contrary [to what is demonstrated], since anyone who has unqualified *epistêmê* must be incapable of being persuaded otherwise (*ametapeiston*) (72a37ff).

Here, quite explicitly, the ultimate basis or rationale for the idea that *epistêmê* must be reached by derivation from first principles of a special sort, particularly as it turns out from an account of essence, is that this is needed to guarantee the reliability and rational unshakability of *epistêmê*. It is for this reason that Aristotle supposes that a demonstration, from proper principles, must provide a *more credible proof* of its conclusion than any purported counter proof or demonstration could provide of any incompatible conclusion. So, Aristotle repeats here Plato's root idea and his basic line of argument concerning *epistêmê* in the passages in the *Protagoras, Meno,* and *Timaeus* that we have considered. In fact, he uses the same

language that Plato uses in the *Timaeus* when he says that the one who has *epistêmê* must be *ametapeiston* (incapable of being persuaded otherwise), with a special expansion on what that entails. One commentator in his note on this passage says: 'The unpersuadability [otherwise] of knowers was an Academic commonplace . . . ; [but] it is hard to think of any satisfactory argument for it.'[15] This reaction, we can now see, is uncharitable to Plato. It fails to take account of the intuitive appeal, for the Greeks at least, of the idea that Plato draws on, that knowledge (*epistêmê*) should have a certain strong reliability and not ever rationally let you down. In any case, the repetition here by Aristotle of this basic Platonic idea does help to confirm again that the primary interest or value of *epistêmê* for both Plato and Aristotle lies more in the stable and reliable multidimensional accuracy of conviction which it provides than it does in any systematic understanding which it may also provide or in any simple deference to mathematical practice.

There are two further occurrences worth noting of this basic thought in Aristotle, first in *EN* VI 3 where he gives a short summary treatment of *epistêmê*. He begins as follows:

> We all believe that what we have *epistêmê* of cannot be otherwise; of things which can be otherwise, when they fall outside our observation, we are unaware whether they are the case or not. Therefore, the object of *epistêmê* must be the case of necessity (1139b19–23).

Here the thesis that *epistêmê* is of necessary truths is defended on the ground that *epistêmê* is something you should be able to reliably count on even apart from continued observation of the state of affairs in question to see that it does not change. Also, it should be noted that here in *EN* VI 3 *epistêmê* is being investigated as one of the so-called intellectual virtues. (see VI 2) But a virtue (*aretê*) for Aristotle is not only an achievement or excellence but also a relatively permanent state, one difficult if not impossible to dislodge under normal circumstances. In *Cat.* 8 Aristotle says, in a recent translation:

> A state (*hexis*) differs from a condition (*diathesis*) in being more stable and lasting longer. Such are the branches of knowledge (*epistêmai*) and the virtues. For knowledge (*epistêmê*) seems to be (*dokei*) something permanent and hard to change if one has even a moderate grasp of a branch of knowledge (*epistêmê*), unless a great change is brought about by illness or some other such thing (8b27–32, revised Oxford tr.).

Here the translator[16] is guilty of the confusion mentioned at the beginning. The term *epistêmai* (the plural of *epistêmê*) is translated here 'branches of knowledge'. But it is not the branches of knowledge, or the sciences, that Aristotle takes to be stable or permanent and hard to change. The branches of knowledge are not states (*hexeis*). It is the cognitive state of *epistêmê* of the one who has it that is of this sort. So *epistêmai* here refers to instances of that cognitive state, not to the branches of knowledge or the sciences. We should note also that Aristotle says here that this view of *epistêmê* 'is held to be' (*dokei*) the case (not 'seems to be' the case as the above translation has it). This thesis is described later in the passage as