



EXPANDING  
HORIZONS IN  
THE HISTORY  
OF SCIENCE

THE COMPARATIVE  
APPROACH

G. E. R. LLOYD



## EXPANDING HORIZONS IN THE HISTORY OF SCIENCE

This book challenges the common assumption that the predominant focus of the history of science should be the achievements of Western scientists since the so-called scientific revolution. The conceptual frameworks within which the members of earlier societies and of modern indigenous groups worked admittedly pose severe problems for our understanding. But rather than dismiss them on the grounds that they are incommensurable with our own and to that extent unintelligible, we should see them as offering opportunities for us to revise many of our own preconceptions. We should accept that the realities to be accounted for are multidimensional and that all such accounts are to some extent value-laden. In the process insights from current anthropology and the study of ancient Greece and China especially are brought to bear to suggest how the remit of the history of science can be expanded to achieve a cross-cultural perspective on the problems. This title is also available as Open Access on Cambridge Core.

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EXPANDING HORIZONS  
IN THE HISTORY  
OF SCIENCE

*The Comparative Approach*

G. E. R. LLOYD

*Needham Research Institute, Cambridge*



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## *Introduction*

My aim, in this set of studies, is to explore how a comparative cross-cultural approach to the history of science can lead to an expansion of its horizons. Doubts have, to be sure, frequently been expressed about both the legitimacy and the fruitfulness of such comparisons in this field. Many would be inclined to question whether we can talk of ‘science’ at all other than in the terms of relatively modern developments going back no further than to the seventeenth century. For them, the so-called scientific ‘revolution’ was not so much a transition as an inauguration, marking what [Gellner \(1973\)](#) dubbed the ‘Great Divide’ between the ‘Savage’ and the ‘Modern’ mind.

Yet that quickly leads to an altogether too restrictive view of what counts as ‘science’.<sup>1</sup> We cannot simply identify that with what currently passes as secure knowledge in such subjects as astronomy, physics, biology and so on, since results are always revisable, even though some are evidently more robust, less likely in fact to be revised, than others. What makes any investigation ‘scientific’, whether in what we call the ‘natural sciences’ or further afield, is rather a matter of aims and methods, the use of observation, classification, measurement, prediction, verification, demonstration and experimentation to explain and understand, where understanding is not just of what is the case, but often, though not always, of why, its causes.<sup>2</sup>

<sup>1</sup> Some commentators have reacted to the loaded associations of both terms, ‘science’ and ‘modernity’, by arguing that for ‘the history of science’ it would be better to substitute ‘the history of knowledge’ (cf. [Daston 2017](#)). Yet if some acceptances of ‘science’ are too narrow, ‘knowledge’ is too broad for my purposes, since there are many kinds of knowledge, knowledge by acquaintance, of a particular person for instance, or knowledge of a skill such as riding a bicycle or speaking a foreign language, that are not subject to systematic investigation and so fall outside my purview here. My tactic is, as I explain, to shift attention from results to aims and methods.

<sup>2</sup> It is not of course the case that either the theoretical understanding of these methods or their practical applications have remained constant, as [Schickore \(2017, 2018\)](#) for example notably showed for ‘experiment’.

I shall elaborate this argument in due course, but for now may remark that there are plenty of examples from outside modern laboratory life that qualify under one or other such rubric, whether we are talking about fields of inquiry that depend on the sustained observation and recording of the phenomena – as in ancient studies of eclipses and of other periodic celestial events – or others such as the knowledge of the medicinal properties of plants and minerals which we may assume to have been built up over years of trial and error experiences. In the latter case this is not to say that the conception of ‘health’ that was entertained was always the same – we shall see in [Chapter 9](#) that it was not. Nor should we assume that ideas of the causal factors in play were constant – as again we shall see they were not in [Chapter 4](#). But while the aims and methods of the various investigators whom we shall discuss certainly diverge, we can use both those divergences and the commonalities between them to suggest a more comprehensive remit for the history of science. Or so at least I shall claim.

I thus see myself as joining forces with recommendations that Jardine has recently made in the second collective volume devoted to ‘Science in the Forest, Science in the Past’ (Jardine 2021). Drawing on the work of [Tsing \(2005, cf. 2015\)](#) and [Schickore \(2017, 2018\)](#) especially, he proposes invoking two maxims to guide inquiry into what he calls the ‘distant sciences’, first a ‘common ground maxim’ (corresponding roughly to the commonalities I have just referred to) and secondly a ‘coherence’ one. He notes the tension that arises between these two, the first often drawing on our observers’ categories, the second picking up the actors’ own divergent notions of coherence, as when the study of eclipse predictions is set against the background of the other preoccupations with signs and omens of the Mesopotamian scribes who carried them out (see [Rochberg 2004, 2016](#) and compare [Lehoux 2012](#) on Roman knowledge). He also insists that it is not a question of setting up these two maxims as a general methodology to be applied uniformly across the data that interest us. Rather each has to be applied appropriately to each set of data we endeavour to interpret. The end result is nevertheless among other things to provide a critique of some of our current assumptions in the philosophy of science (which Jardine illustrates with the notion of ‘laws of nature’) as will be a major theme in the studies I pursue in this book.

Those studies fall into two broad, if overlapping, groups. First there are inquiries probing the philosophical and methodological underpinnings of comparative studies, where the comparisons we may undertake may be of three general types. First there are the similarities and differences between different ancient societies, then those broadly between ancient and modern

ones, and thirdly those within the latter, where ethnography reports great diversity in collectivities that all exist today but have greater or lesser shares in what passes for 'modernity'. Under what conditions and within what limits can we claim to understand what may come across in the first instance as radically alien ideas, beliefs, practices? When faced with such some have concluded that a genuine understanding is frankly impossible, short of leaving our own concepts behind and identifying with those of those radical others who confront us, 'going native' as the saying goes. On that view any given group or society can only be understood from within, by adopting the standpoint of the persons in question. I shall rehearse some of the arguments against agreeing with any such view. For now I may simply note that while we often transliterate Greek and Chinese terms when discussing Greek or Chinese thought, we are not limited to talking Greek or Chinese when discussing their ideas.

The gulf between different systems of belief has often been described in the terms popularised by Thomas Kuhn (1970) as presenting us with a stark incommensurability. Yet this too may be a misleading image. The first point that should be conceded is that there is never any neutral vocabulary in which to assess any such system, let alone to arrive at a comparative assessment between a plurality of them. Description always implies judgement, some conceptual standpoint from which the account is made. But that concession should not be taken to imply that translation is impossible, nor that attempts at any of our modes of comparison must necessarily fail. After all in the paradigmatic instance of the incommensurability of the side and the diagonal of the square, it is still possible to compare those two, judging, for example, that the diagonal is longer than the side, even if they do not have a common measure. In the more interesting instances that concern us, comparison can lead to a critique of our original starting point and a revision of some of our initial assumptions, including about 'science' itself.

The extreme view that simply no understanding of others is within our reach must and can be rejected. Of course translation will depend on deep immersion in the whole context of communication of those whose language we are trying to comprehend. Such sympathetic engagement with contexts and underlying assumptions is always necessary even when we are not dealing with different natural languages. Understanding will further depend on our being self-critical, wary of the inapplicability of many of the assumptions we start with in our attempts to fathom what is going on. We have to accept that much of our customary conceptual apparatus may turn out to be inappropriate. Not only are those concepts subject to revision,

but, as many before me have observed, any understanding we can claim must be thought of as merely provisional. It will indeed be a major part of my argument about the value of the comparative history of science that it can teach us how to go about such revisions.

The second group of studies explores what we can learn from particular encounters with substantive beliefs and practices, those recorded in the evidence for ancient peoples and those reported in contemporary anthropological fieldwork. The ancient Greeks, Chinese, Babylonians, Indians and others produced an extraordinary wealth of ideas relating to every aspect of life and of the environment in which it was lived. So too ethnography yields much further material for investigation. The challenge is, as I said, to make sense of these rich sources, some of them initially strikingly counter-intuitive. And the aim is not just to try to understand, but also to learn from and apply what we have understood. In the process we can expand our notion of what humans have shown themselves to be capable of, and that realisation in turn provokes reflection both on human diversity and on what we appear to have in common.

We shall, along the way, encounter many examples of exceptionality, of individuals and of groups, in ancient and in modern times. But it was as the humans they were and are, living in the collectivities in question, that they produced the original ideas they did. The task of the historian is to make sense of the factors that were in play, those that favoured, shaped or impeded that productivity, difficult as it is to pinpoint those and to be confident of their influence. We may greet genius when we see it, but that is rather to identify a problem, not to solve it. Given the difficulties we face, we must accept that their resolution often eludes us. But where some success can be claimed, the rewards indeed are high. We can use our various modes of comparison, including between the past and the present, the better to understand the present and see where we may be headed in future.<sup>3</sup>

So let me now summarise the main argument that will provide the guiding thread in the studies that follow. In its European origins the history of natural science as an academic discipline was marked by distinct positivist traits, a sense of the onward and upward, indeed linear and continuous, advance towards current knowledge that was or soon would be in command of the truth. One of the battles that had to be fought was to

<sup>3</sup> This is not 'presentism', where the past is judged by criteria provided by what is accepted as current knowledge. Rather the aim is to use historical and other resources to critique those criteria, to challenge rather than to vindicate the present.

gain acceptance for science itself as such as an intellectual discipline on a par with mathematics or classical learning, which continued to dominate European university curricula in the nineteenth and early twentieth centuries. The story of how one of the chief advocates for such a recognition, William Whewell, was led to introduce the term 'scientist' to capture what the various specialists, chemists, physicists, geologists, all had in common has often been told (e.g. Yeo 1993: 110–11). But that new focus sometimes had a negative effect. Earlier efforts, whether in Western antiquity or outside Europe altogether, did not rate as science at all or were considered more or less botched jobs, of interest only as records of the difficulties that had to be overcome. Worse still, much was thought of as damning evidence of the magic, superstition and irrationality from which humans had to liberate themselves. Taking as his target 'the ancients' in general and the Greeks in particular John Playfair (1842: 453) put it that 'extreme credulity disgraced the speculations of men who, however ingenious, were little acquainted with the laws of nature, and unprovided with the great criterion [i.e. experiment] by which the evidence of testimony can alone be examined'.

This whole edifice of a story of a great divergence came only slowly to be challenged and dismantled, when greater attention came to be paid to the study of pre-modern and non-Western science. On both scores the contributions of China, first brought to the attention of an anglophone audience by Joseph Needham, played a particularly important role.<sup>4</sup> After all the compass, gunpowder and the printing press, the three inventions that Francis Bacon singled out as crucial for 'modern' civilisation, all originated in China.<sup>5</sup>

Yet Needham still worked very largely within the framework constituted by conventional Western understandings, in particular of the boundaries between academic disciplines, including scientific ones.

<sup>4</sup> Chinese contributions were still being strenuously denied in an influential book by Whitehead, *Science and the Modern World* (1926), where we read (7): 'There is no reason to doubt the intrinsic capacity of individual Chinamen for the pursuit of science. And yet Chinese science is practically negligible. There is no reason to believe that China if left to itself would have ever produced any progress in science.'

<sup>5</sup> However, the apparent divergences in the subsequent trajectory of Chinese scientific and technological developments and those associated with the so-called scientific and industrial revolutions in Europe led to the so-called Needham question, of why those revolutions did not happen independently in China, which had been so much in advance of Europe in so many fields until the sixteenth century. Regrettably, however, this is a debate that has more often thrown up superficial generalisations and sterile speculations about the causes of non-events than it has productive understandings of the contexts and circumstances in which changes have taken place (see Sivin 1995a: VII, Lloyd 2020b).

A more sustained inquiry into non-Western science, such as is adumbrated, though admittedly no more than adumbrated, here, prompts a deeper reflection, not so much on where that other science falls short, as rather on where our own ideas of the aims, methods and results of scientific investigations need to be revised and expanded, and how to go about that.

First, the units of analysis, whether geographical, chronological or conceptual, should be overhauled. Talk, for instance, of ancient Greek 'science' or 'philosophy' or 'medicine' or 'mathematics' needs substantial qualification if it is not to elide the very considerable differences in the work of the various individuals and groups in question, and so too with Babylonian, Egyptian, Indian and Chinese ideas and practices, let alone those of numerous contemporary indigenous societies, from Siberia to Papua New Guinea, from Amazonia to Africa. Fundamental problems of translation recur. But the reaction to the difficulties we encounter should not be to attempt to legislate and lay down a single correct usage (let alone one that is used to corroborate our own starting assumptions) but rather to be prepared to revise our own understandings in order to accommodate differences. This applies right across the board. Are 'nature' and 'culture' themselves, for instance, fit for cross-cultural explorations? Similarly we should and shall raise the same issue in relation to such notions as 'person' or 'agency', or again 'body' or 'spirit', and indeed 'science' and 'philosophy' themselves. In the process it will be necessary to revisit the challenges that have been mounted concerning the applicability of the dichotomy between the 'literal' and the 'metaphorical' uses of terms.

Most fundamentally of all, questions to do with values are implicated, not just those by which theories are judged (cf. [Chapter 5](#)) but those associated with the significance of the exercise itself. It is not that I am here reviving some bid to reconcile science and religion, let alone one to derive moral lessons directly from modern physics or cosmology or biology. Rather, the point is the simple one that has often been made, namely that all descriptions are to a greater or lesser extent theory-laden. Accordingly, whether or not they are made explicit, value judgements underpin all the speculations and practices that our sources reveal. We have to recognise the vast variety of these, including those that are inherent in our own efforts at interpretation. It is not that understanding divergent views means agreeing with them, but it certainly does imply a readiness to listen, to learn and to be self-critical. The goal turns out to be not just some minor



adjustments to a narrative of the development of the natural sciences, but rather a more comprehensive understanding of human ambitions, of human values, and of the cognitive capacities humans have brought and continue to bring to bear to make sense of our divergent experience.

*On Aspects of the Status Quaestionis*

I began my own scholarly endeavours from a concern to test the validity of some common ideas about the great differences, between different human groups or populations, in the ways in which they reason and make sense of the, or rather their, world. I shall have some remarks to make later on the issue of whether or in what way there is just one world to come to terms with, where I endeavour to clarify what is at stake in the postulate of multiple worlds by invoking the notion of what I call the multidimensionality of the phenomena and exploring the diversity of the possible aims of inquiry that this allows. Lévy-Bruhl (e.g. 1923) had suggested that we should distinguish between quite distinct mentalities, most strikingly between what he called a primitive mentality and a civilised one, the first governed by or obeying a different logic, a logic of participation, distinct from the logic we are generally familiar with.<sup>1</sup> The logic of participation did not, for example, recognise the law of non-contradiction. Lévy-Bruhl's thesis attracted a lot of criticism from the outset and towards the end of his life, in the *Carnets* (1975 [1949]) he himself came to renounce the idea that primitive thought exhibited a pre-logical or irrational mentality. But he never abandoned the concept of mentalities itself.

I devoted much of *Polarity and Analogy* (1966) to a critique of Lévy-Bruhl and I returned to him when I wrote the polemical pamphlet debunking the whole idea of mentalities in the book called *Demystifying Mentalities* (1990). My first objection was that to arrive at a diagnosis of a distinctive mentality in an individual or a group involved massive generalisations and oversimplifications. The idea that some of its proponents were prepared to countenance (Le Goff 1974), namely that a single individual might manifest distinct mentalities, is positively chimerical. But

<sup>1</sup> In anglophone scholarship the demarcation between science, religion and magic was a recurrent preoccupation of Frazer (1890), Malinowski (1925) and Evans-Pritchard (1937) continuing down to Tambiah (1990). However, with the notable exception of Whitehead (1926), that problem was not generally associated with a postulate of distinct mentalities.

more fundamentally talk of a particular mentality was, at best, a way (and not a very good one) of identifying what needed explaining, and could then be no part of any explanation, since the mentality postulated itself had to be accounted for.

But seeing off any solution by way of the notion of mentalities (as I hoped) still left open the question of whether there are essential differences in the ways in which different people think. There are of course obvious ways in which the thoughts they have, their perceptions and explanations of experience, their conceptions of their place in the world, and of the differences between humans and other beings, all differ. But if the contents of thoughts clearly differ, that does not show that the ways in which we reason ourselves do, let alone that the faculty of reason itself varies across humankind. So in *Cognitive Variations* (2007), and again in *The Ambivalences of Rationality* (2018) I explored how it is possible to combine the intuition of the psychic unity of humans with a recognition of the great actual diversity in our thoughts, beliefs and behaviour.

I tackled the hypothesis that there is a major difference, a Great Divide, between different human populations most directly in a book that was written between those two, *The Ideals of Inquiry* (2014). As already noted, this had been a major theme in Lévy-Bruhl, but with or without the notion of mentalities, the Great Divide idea was taken up by many anthropologists and historians of science, in the latter case especially among those who focussed on the so-called scientific revolution. Some postulated a contrast between Wild and Domesticated thought, others one between concrete and abstract, or cold and hot, modes of thought (as in Lévi-Strauss 1966 [1962]). Jack Goody, who was wary of talk of a Great Divide, nevertheless distinguished between different levels and stages of the 'Domestication of the Savage Mind' and had, moreover, an account to give of the transitions between them (Goody 1977). His principal argument was that it was increasing literacy (especially that based on an alphabetic script) that made the key difference, for once texts were readily available, they allowed for 'ruminative reflection', which in turn stimulated criticism and scepticism to develop.

Yet the two major problems with Goody's thesis that I was far from the only person to pinpoint were these. First we should not underestimate the extent to which critical and sceptical opinions are held and expressed even in basically non-literate societies (Lloyd 1979: 18–19). Secondly the existence of written texts could, on occasion, be a factor inhibiting, rather than stimulating, criticism, when, that is, those texts acquire the status of

authoritative canons or even as the sacred repositories of revealed truth (Parry 1985).

In much of my own work I have shone a critical spotlight on the legacy of ancient Greek thought, so often the origin of key concepts that have played a fundamental role in the debates I have been talking about. Three especially potent ideas that continue to have enormous influence are the concept of nature, the contrast between the literal and the metaphorical and the pursuit of incontrovertibility in demonstration. I shall rehearse the key issues concerning the first two here and come back to discuss the third in [Chapter 3](#). In relation to the first two, then, let me explain briefly how I came to be critical of that influence and where the rejection of those concepts leaves me in relation to the problems they were used to tackle. What, in other words, do I offer to replace them or at least to reformulate those problems?

Both ‘nature’ and ‘metaphor’ have histories that start in ancient Greece. Initially the ancient Greeks themselves had no overarching concept of nature, but that was introduced by philosophers and medical writers in the sixth and fifth centuries BCE to identify a domain of inquiry over which they purported to be the experts. There was no need, they argued, to appeal to gods, divinities, *daimones*, to explain striking or even ordinary phenomena, from earthquakes and lightning and thunder to diseases. All those phenomena had natural causes. The actual explanations that were put forward by the *phusikoi* or *phusiologoi* (‘naturalists’), as they were known, were often wildly speculative. This was true especially in the medical context, where the medical writers were often all at sea, and certainly in disagreement with one another, in trying to identify the causes of diseases. Yet the fundamental point was the *claim* that the ‘sacred disease’, as it was called, for example, was not ‘sacred’ (or rather no more sacred than any other) but had its nature, *phusis*, and its cause. According to one view in the fifth-century BCE Hippocratic treatise *On the Sacred Disease* it was phlegm blocking the vessels in the brain that caused the disease. Indeed the claim in that work was that it, like every other disease, could be cured, by making adjustments to regimen (diet and exercise), provided the condition was caught early enough. One might say that this alternative set of ideas involved almost as much pure guesswork as the identification of the work of different supernatural beings – though to be sure the speculations now took a different form, in terms of ‘natural’ causes.

This certainly marked a major shift in the attitudes some took towards certain phenomena, but from the outset the concept of nature was fraught with difficulties. To start with it was not just a descriptive concept but

a normative one. Nature identified not just how things are, but how they should be. Although Aristotle recognised that humans do not always live in communities that have much in common with Greek city-states or *poleis*, he nevertheless claimed that humans are by nature, *phusei*, political, that is social, animals. Secondly, there was a major controversy over how to interpret the contrast between *phusis* and its principal antonym, *nomos*, law, custom, convention. Were issues of right and wrong matters simply of convention? Did they have an objective, natural, basis? The answers given to this fundamental question were many and varied and in the process the contrast between Nature and Culture themselves came to be construed differently.

I focus on the ancient Greek materials since they throw light on the contexts in which the controversies arose and the manner of the debates that they gave rise to. But that focus needs some justification or explanation. Our continued modern use of the concept of nature, not just in what we call the natural sciences, but also in the contrasts between nature and nurture, and nature and convention, might tempt one to see its invention by the Greeks as a major breakthrough, even the triumph of Greek rationality, an item that could justify talk of some Greek 'miracle'. Such a reaction would be disastrously wrong in this case, and as I shall show in [Chapter 3](#), in others also.

Now it is the case that other ancient civilisations and most of the living indigenous peoples studied by anthropologists do not have an explicit notion of 'nature' that corresponds to Greek *phusis* or our 'nature'. That does not mean of course that they do not recognise the regularities in physical phenomena, but even if regularities may be a necessary condition for nature, they are not a sufficient one, since many regularities belong to the domain of the social or cultural. But lacking an explicit concept of nature, so far from being a symptom of primitiveness, carried certain advantages, if we recall the ambiguities, ambivalences and possible confusions that go with invoking such a concept. Without such a concept there was less temptation to run together quite different problems and issues relating to different aspects of lived experience.

So the reaction I have to my own historical analyses of where the concept came from is not to congratulate the ancient Greeks on a breakthrough, but to take seriously the question of how different societies got on without any such explicit notion. The ancient Chinese provide much evidence on the point. They did not have any such single overarching concept. But as I documented in [Lloyd 1996a](#), they have plenty of ideas about the order of the cosmos, about the place of humans in it, including about what makes

humans human, about the processes at work in the cycle of the seasons, about what happens spontaneously, without human intervention and so 'naturally' in that sense, and on many other matters. The Chinese usual focus on processes contrasts with the dominant Greek concentration on stable substances, although as we shall see later ([Chapter 8 at note 3](#)) there are plenty of exceptions to that Greek rule. But it is not a case of deciding between those two competing ontologies, a process-based and a substance-based one, but rather of appreciating what can be said in favour of each. Modern physics indeed, one might say, faces many analogous problems in the need to reconcile the discrete and the continuous, in other contexts the digital and the analogue.

Similarly in the case of the extraordinary variety of beliefs and practices revealed by modern ethnography we have no need to frame our inquiry in terms of how the peoples in question viewed 'nature' on the one hand, 'culture' on the other. Indeed we would be better off not doing so, as a group of anthropologists has been arguing with some force for some time now. Drawing on her fieldwork in Papua New Guinea Marilyn Strathern for one wrote a pioneering article entitled 'No Nature, no Culture: the Hagen case' way back in 1980. [Descola's magnum opus \(2013 \[2005\]\)](#) had as its title *Beyond Nature and Culture*. [Viveiros de Castro \(1998\)](#) has contrasted the assumption of a combination of mononaturalism with multiculturalism (which he associates with modernity) with the reverse, a combination of multinaturalism and monoculturalism – which is the operative assumption in indigenous perspectivism (cf. also [Viveiros de Castro 2004, 2014, 2015](#)).

To be sure, liberating oneself from a preoccupation with the nature/culture binary is both difficult and disconcerting ([Wagner 2016](#)). Even among some of the critics of the binary whom I have just mentioned there is something of a residual tendency to continue to employ the conceptual framework it implies even in the process of deconstructing it. That may be all but inevitable, given that in the West at least we are all now to some extent the heirs of the ancient Greek legacy. Yet being critical of that legacy seems a necessary first step in doing justice to the enormous variety in humans' ways of being in the world. True, that raises the thorny issue I mentioned before of whether it is the same world that all humans inhabit, where some clarifications are needed, not least because of the variety of ways in which possibly divergent 'ontologies' have been discussed, especially recently in anthropology (e.g. [Severi 2013](#), [Salmond 2014](#), [Pina-Cabral 2017](#), [Holbraad and Pedersen 2017](#), [Laidlaw 2017](#)). So a short digression is in order to clear the air.

In the original acceptance of the term an 'ontology' is an account of what there is, the *onta* as the Greeks put it. But such accounts vary not just in content: they come in very different forms. Some are equipped with fully developed philosophical arguments and a carefully elaborated epistemology, as when in the fifth century BCE Parmenides for instance supported his view that Being is Unchanging with a series of arguments and a rejection of any reliance on perception or ordinary experience. Others are packages of mainly implicit assumptions. Often it is the interpreter, the anthropologist or the historian, who is responsible for describing what is involved, which may be a matter not so much of the theories of the people studied or the explanations they offer, as one of their practices, their engagement with one another and with their environment, their values, anything that contributes to their way of being in the – their – world.

When we use the term 'world' to cover everything in the universe, then by definition there is not a plurality of such, even though that leaves open what that term 'everything' itself comprises. But that should not lead us to suppose that reality constitutes just a single problem to which there is but one correct solution. Most ancient Chinese inhabited a world of processes, many ancient Greeks one of substances, as we said. In that sense we should recognise that the worlds in question themselves differ. In that case and in many others it is not a matter of attempting to adjudicate between rival accounts as if they were all directed at the same phenomena. Rather, we should acknowledge the diversity in the phenomena targeted and in that sense the divergences in the worlds that constitute the explananda, in other words what I call the multidimensionality of reality (e.g. Lloyd 2012).

But if we go that far to acknowledge multiplicity, the question that immediately arises is how far it is possible to make sense of that variety, where 'making sense' does not mean judging which is correct as if there was a unique solution to a, the, problem, but rather first of all appreciating that the problems themselves may differ. This raises a new complex of issues about understanding *across* conceptual schemata that will eventually lead me back to my second main item from the Greek legacy, namely metaphor. The notion that different systems of belief are incommensurable surfaces, once again, in both social anthropology and history of science. When we encounter the radically other or some major shift in scientific paradigms how can we begin to understand them? If we use our modern categories is that not bound to distort them? Yet how can we fail to use those categories, since they are the only ones we have?

The way out of that dilemma is to insist that although we clearly have to start with the conceptual apparatus we have, that is not set in stone, but

eminently revisable, not least in the light of what we learn as we study what is radically other. To claim that two scientific paradigms are incommensurable is to highlight the differences in the concepts at work in each and to emphasise that there is no totally neutral vocabulary in which they can be discussed. But that does not mean that we cannot make sense of each. Kuhn, after all, the arch incommensurabilist, did a pretty good job of interpreting both Ptolemy and Copernicus, both Aristotle and Galileo, both Newton and Einstein. Incommensurability so far from precluding comparison may even be said to presuppose comparability.

Similarly when faced with the unfamiliar statements and practices that took centre stage in the debates concerning ‘apparently irrational beliefs’ in the sixties and seventies, we should not conclude that we can, strictly speaking, understand nothing of what is going on – at least not before we have pursued every avenue in attempting to do so. What we call ‘magic’ poses a particular problem, to be sure, but once again some consideration of its origins can provide some help (Maus 1972 [1904]). Once again the ancient Greeks were primarily responsible, particularly those naturalists I mentioned before who dismissed the magical practices of the ‘purifiers’ whom they attacked as superstition (their term for that is *deisidaimonia*). We cannot now reconstruct what those purifiers might have said in their own defence, but we can see that one of the assumptions the naturalists made may be open to question. Do magical rituals always aim to be causally effective? Sometimes no doubt they do. But as Tambiah (1968, 1973) for one insisted, sometimes the goal is not efficacy but appropriateness or felicity.

My favourite example to illustrate the point uses a custom or ritual from our own culture. When in a Christian wedding ceremony the bride and groom are showered with confetti (as used to be *de rigueur*) there may be many participants who would deny that they do this in order to ensure the pair’s fertility (which may have been at the origin of the practice, when rice rather than confetti was thrown). The confetti-throwing is not imagined as furthering such a result. Nevertheless the feeling may be that without the confetti the wedding is somehow not a proper wedding. The goal is felicity, then, not efficacy. The extent to which similar considerations help to explain other practices labelled magical is, of course, an open question. But the example serves to undermine the old idea according to which magic is botched science or rather botched technology, aiming to produce concrete effects but failing to do so.

This leads us to the problem of the indeterminacy of sense and reference which Quine (1960: 29ff.) made much of when he fantasised about an



anthropologist in the field confronted by a native who says ‘gavagai’ when a rabbit scurries by, whereupon the ‘linguist notes down the sentence “Rabbit” (or, “Lo, a rabbit”) as tentative translation, subject to testing in further cases’. Quine was no doubt right to point out that equating ‘gavagai’ with ‘rabbit’ is not necessarily correct and to emphasise the difficulty of verifying what exactly that term meant. ‘Gavagai’ might be a word not for the animal, but for its appearance or way of behaving; and indeed it might have nothing to do with ‘rabbits’ at all. Yet in his initial presentation Quine has stripped the encounter of the anthropologist and the native of all the context that we would normally draw on to make sense of their exchange. Concentrating in his thought experiment on just the one isolated exclamation, he leaves us at a loss to resolve the puzzle. But of course neither anthropologists in the field nor modern commentators sitting in their studies are limited to isolated statements. We learn a foreign language by slowly building up a competence in its use. We learn our own first mother tongue in the same way. We make mistakes, to be sure, but with or without help from others we can often correct them.

These jejune remarks serve to remind us of how we acquire some skill in using a language or several and in understanding others, but they are not meant to resolve the many tricky problems we face. But they are intended as an antidote to a premature despair about the very possibility of *any* understanding.

No well-trained anthropologist is likely to find it very difficult to work out the native terms for the main flora and fauna in their environment. It is not identifying leopards, that is matching the creature with the local name, that is the big problem. Rather it is when the Dorze, for example, are reported as holding that the leopard is a Christian animal, that the problems of interpretation get to be severe (Sperber 1985, 1996). That was a prime example in the controversy over ‘apparently irrational beliefs’ that I mentioned, where the battle lines were drawn up between those who claimed that such statements were not intended literally, but only symbolically or metaphorically, and those on the other side who insisted that that was not the case, that they were intended literally and in all seriousness as statements of fact (cf. e.g. Wilson 1970, Horton and Finnegan 1973, Skorupski 1976, Hollis and Lukes 1982).

Yet that dispute in interpretation depended on the applicability of yet another binary that stems from the ancient Greeks. There was plenty of discussion of the use of images and analogies before Aristotle, notably in Plato, but it was Aristotle himself who first defined metaphor as the transferred use of a term. The contrast was with the strict, literal, *kurios*,

use of terms. Metaphor was to be banned from proper scientific discourse since it destroyed the transitivity of entailment and therefore ruined the demonstrations that such a discourse should aim for. Yet in practice his own study of animals, we should say, is steeped in the use not just of analogies but also of what he would have had to call metaphors, as indeed was his own theoretical discussion of the nature of metaphor in the *Rhetoric*, as I showed in *Aristotelian Explorations* (1996b). My own way of drawing the teeth of the contrast between the literal and metaphorical is not to say that metaphor is everywhere, for that still runs the risk of being taken to imply deviance, but rather to point out that every term is capable of what I call semantic stretch. Meaning is not a matter of a central strict sense cordoned off from figurative ones: the notion of semantic stretch implies rather a spectrum along which no firm boundary, indeed no boundary, is to be marked between proper and derivative uses. The search for a vocabulary that is immune to that is once again a chimera, not just in poetry, but in philosophy and science.

If we pay due attention to the polemical context in which this concept of the metaphorical was developed in ancient Greece, we have to be wary of assuming that every society at every period will have such a concept as part of the terminology used to distinguish different speech acts. In practice the Chinese recognise comparison as a mode of discourse and often pay attention to the pragmatics of communicative exchanges, the positions and perspectives of those doing the communicating. Yet in classical Chinese there is no equivalent to the notion of metaphor as such and correspondingly no attempt to purge language of such uses deemed to be deviant (Lloyd 2003a). Similarly the ethnographic record throws up plenty of examples where different modes of discourse, tales of past times, old people's tales, fables, even what we sometimes somewhat unguardedly label 'myths', are distinguished from ordinary mundane speech, but again not in a bid to downgrade the status of the former. That will be the subject of [Chapter 7](#).

This implies that it may be quite inappropriate to apply the literal/metaphorical dichotomy to the interpretation of the reported statement that the leopard is a Christian animal. The tactic we have to use, faced with that assertion, is no different from what we have to do in some cases in our own culture. That God is one but also that He is three is an article of faith maintained by devout Christians, many of them highly educated, many practising scientists including quite a few anthropologists, who otherwise share most of the beliefs, practices and values of the non-Christians in the society they all live in together. We may or may not succeed in

understanding the Christians' position, but evidently the first step is to take into account the whole background to their adherence to a religion as well as the pragmatics of the situation in which it is practised and faith in it proclaimed, and of course those background factors are liable to exhibit a quite bewildering diversity. In both the Dorze case and the modern industrialised Christian one there are likely to be plenty of puzzles that remain, both as to the causes and the consequences of beliefs. As to the latter, where the Dorze are concerned it is surely relevant to note that they are themselves devout Christians and so are treating leopards as their co-religionists. The issue for them may be less a matter of animal taxonomy than of human–animal sociality, though to be sure even Sperber himself admits that he remains baffled by some of his Dorze encounters (Sperber 1985: ch. 2). More importantly a simple diagnosis, indeed an accusation, of illogicality or of error will not advance our understanding.

I pointed to the assumption of the psychic unity of humankind. But let me return to what we should say in relation to the divergences we have nevertheless to recognise. One of the developments for which we have good historical evidence from ancient Greece relates to the degree of explicitness with which certain linguistic moves or categories are made. This is not a matter of an invention of a new logic as when modern logicians engage in such exercises (e.g. Priest and Routley 1989), rather one of making explicit the rules that govern valid inference and that had been observed (or not) all along. Plato and Aristotle (again) were the first to identify and define the law of non-contradiction. But that did not mean, to be sure, the end of the making of self-contradictory statements. What it did mean was that, armed with that category, breaches in the law could be identified *as such*. The persons who were accused of such had to defend themselves either by showing that their statements did not in fact break the rule or that such a rule did not apply. The latter option was one that later came to be exploited by the Christian apologist Tertullian, who famously said: 'the Son of God is dead; this must be believed because it is absurd' and again 'having been buried He rose again: this is certain because it is impossible' (*On the Flesh of Christ* ch. 5). Yet obviously to make a virtue out of breaching the rules of discourse has a high price to pay among those who normally abide by them.

The implication of the development of formal logic is, then, not that argument was saved from error. Rather it enabled certain types of error to be diagnosed. The categories that were invoked were in fact potent weapons in the attempt to win debates and persuade opponents they were mistaken – not that all those opponents accepted that the use of such

weapons was legitimate. That in turn leaves us with a very different conclusion from that drawn by those who postulated a pre-logical mentality. The difference that Aristotle and later formal logicians made was a matter of making available certain linguistic categories that enabled second-order reflections on discourse to be made. 'Pre-logical', if we continue to use that term, does not denote the absence of logicity, only the absence of an explicit vocabulary to discuss it.

On this view the differences between the reasonings undertaken by different groups or populations are mostly far more modest than those at issue in the anthropologists' discussion of divergent ontologies. What is at stake in the regimes described as animism or totemism (cf. below, [Chapter 4 at note 1](#)) or in Viveiros de Castro's examination of perspectivism is, for sure, far more than a matter of the logicity of the regimes or the degree of explicitness with which the indigenous actors themselves recognise their character. Obviously the organisation of social relations, the relationship to the environment, the sense of the similarities and differences within human beings and between humans and other animals, the fundamental values to which the society adheres, are all implicated. Each poses its characteristic difficulties, each calls for a profound immersion in how the society functions. But if and when we can achieve that, we gain access to marvellous riches in the variety of experience and in patterns of engagement, where we can be led to interrogate not just what is understood but also the nature of the understanding aimed at – and that includes the question of whether indeed it is understanding that is the principal goal, rather than, say, appropriate behaviour, the issue of felicity again.

That certain appeals to some of our own familiar concepts are not helpful is clear. I have given illustrations enough of the dangers of bringing to bear the binaries that we have inherited in the main from the ancient Greeks. That includes in the first instance nature and culture themselves, but also the literal and the metaphorical, being and becoming, reality and appearance, mind and body, subject and object. All those dichotomies have to be examined critically and which aspects of them must be rejected, which can be accepted with modification in particular contexts, will vary. But certainly any sweeping appeal to a master binary, rational and irrational, is likely to prove hopelessly misleading (cf. [Lloyd 2018](#)).

One very straightforward way by which we can reassure ourselves of the commonalities across all human societies at all times is to reflect on the use of language, where humans are able to articulate what they communicate far more effectively than other species of animals. Unfortunately the differences between human languages have sometimes been invoked to account for the

views and values of those who use any given language, as if the latter were determined by the language in question (cf. below, [Chapter 4](#)). That thesis runs into fundamental difficulties, not least in that it fails to account for the manifest differences in the views and values that are expressed by different individuals all of whom use the *same* natural language. That notably applies both to ancient Greek and to ancient Chinese and of course to English, French, German or modern Mandarin.

But I had in mind a different feature of language use, one that is much more obvious but very much underutilised in the debate about psychic unity. All languages proceed by implicitly and sometimes explicitly recognising certain similarities and certain differences between things. But those similarities and differences take different forms. On the side of similarity at one extreme there is identity, in the middle of the spectrum various grades of similarity, in species, in genus, and by analogy, as Aristotle said, and at the limit we are dealing with a similarity that is postulated not found. Equally differences span contradictories, contraries and various grades of opposition.

Now which similarities and differences will be deemed to be important will vary and so too, as we said, will the extent to which an explicit vocabulary to discuss this is available. Yet the fact that all humans are in business using similarity and differences to make sense of experience is a point we have in common,<sup>2</sup> a more modest observation than the more pretentious claim that classification is inherent in all human speculations about the world, but analogous to that. We select the ones that are useful in context and normally that will be – we shall claim – no arbitrary matter, though the modes of justification available to us vary, if, indeed, we see such a need to justify. We evidently must be on our guard not to be taken in by superficial or misleading resemblances,<sup>3</sup> but will still depend heavily on those that have stood the test of experience and that in many cases will form the principal matrix used for making sense of that experience.

The similarity in the ways in which humans reason can start from the obvious point that we are all constantly at work making the most of

<sup>2</sup> The apprehension of the similarities and differences between things is not confined to human animals, for sure. Recognising predators as such, and prey as such, may be considered a fundamental cognitive tool for survival. But once a concept is made explicit, in language, its boundaries can become the topic of reflection, criticism and revision.

<sup>3</sup> We have powerful statements in both Greek and Chinese writers of the dangers of being taken in by what Plato calls the slippery tribe of likenesses (*Sophist* 231a) and by what the third-century BCE Chinese compendium, the *Lüshi chungiu*, describes as ‘spurious resemblances’ (Book 22 ch. 3: *Yi si*). The tension between the inevitability, but also the danger, of relying on similarities is the leitmotiv of [Lloyd 2015](#).

similarities and differences.<sup>4</sup> That does not take us very far, but it may serve as a more solid starting point than those that depend to a greater or lesser extent on categories that exhibit an all too obvious contingent origin in ancient Greek thought. One of the differences in human reasoning we can observe consists in the availability of linguistic categories that facilitate self-conscious second-order reflections on the modes of reasoning themselves. We all reason, make inferences, attempt to prove and persuade – as Aristotle already observed.<sup>5</sup> But the sophistication with which we do so reflects the mental effort expended in that self-reflexivity, efforts, it must be said, that do not always produce uniformly beneficial results. We should surely continue to endeavour to the best of our abilities to make sense of the unfamiliar moves for which there is evidence both in anthropology and in ancient as well as not so ancient history. The challenge remains, and one of the difficulties that ancient history in particular enables us to pinpoint is the still unfinished task of unmasking the legacy of Greek thought (cf. below, [Chapter 3](#)).

So where, I must ask, have we got to today, or what lessons do these reflections on past endeavours prompt concerning our agenda and the best way to tackle it? Over and over again, like many other scholars, I have been forced to query deep-seated assumptions that I made at the outset both about what is there to be understood and the very nature of understanding and inquiry themselves. The ancient Greeks discovered nature, I once wrote ([Lloyd 1970](#): 8), until I came to see that it is more correct to say that they invented it. The dichotomy between Nature and Culture, so far from being valid universally, is the contingent outcome of a particular historical situation which pitted competing intellectual leaders or what [Detienne \(1996 \[1967\]\)](#) called ‘Masters of Truth’ against one another. So far from providing a reliable framework within which to classify and encompass the great variety of human endeavours to make sense of experience, that dichotomy is liable to distort our efforts at interpretation and comprehension. ‘No Nature, no Culture’ means we start again to explore the different ways in which humans have related to the

<sup>4</sup> This has sometimes been discussed as a matter of the metaphors we ‘live by’ ([Lakoff and Johnson 1980](#): cf. [Fauconnier and Turner 2002](#) on ‘conceptual blending’), though I have already expressed my reservations about appeals to the vocabulary of ‘metaphors’.

<sup>5</sup> At *Rhetoric* 1354a4–6 he remarks that ‘everyone tries to some degree to examine and uphold an argument, to defend themselves and to accuse’. By ‘everyone’ he means his fellow Greeks in the first instance, but the point has general, if not universal, validity, even while we must agree that the degree of argumentativeness exhibited by different individuals and groups differs.

environment, to one another, to other living beings, to other entities to which or to whom intentionality can be ascribed.

When we turn from what is there to be understood to ways of talking about it and understanding it, that other dichotomy that stems from the ancient Greeks, the contrast between the literal and the metaphorical, is not only difficult to apply in practice, but carries, as I said, the major risk of a too easy dismissal of whatever fails to pass the test of strict univocity. Substituting an analysis in terms of semantic stretch opens up all sorts of possibilities for doing justice to the recognition of similarities and differences. True, the price one has to pay is that of leaving the security of the definitive. But then the search for certainty, for incontrovertibility, has often been an all too seductive mirage.

It is undeniably uncomfortable to insist on not foreclosing other possibilities. But there was too much of that, of such foreclosure, throughout the history of Western thought from the ancient Greeks onwards (cf. [Chapter 6](#)). We have indeed still a long way to go fully to appreciate the variety of human experience that I have spoken of. That does not mean that they, ancient Chinese or Indians or modern indigenous peoples, were always right on their own terms or on anyone else's – and the difference between those two takes us back again to the problem of making sense *across* conceptual schemata.

Just as we and the ancient Greeks have often been mistaken, so too have other humans throughout space and time. Cognitive scientists, such as [Tversky and Kahneman \(1982\)](#) and [Gigerenzer and Todd \(1999\)](#), and evolutionary psychologists such as [Tooby and Cosmides \(1989, 1992\)](#) have even suggested particular patterns in our mistakes, such as the 'confirmation bias',<sup>6</sup> some of which (such as those associated with 'fast and frugal' reasoning) may be deeply ingrained legacies from our long-distant evolutionary past. While identifying such tendencies carries salutary lessons concerning our own fallibility, the question of how to evaluate our legacy remains as disputed as ever. Kahneman would still have us stick to the rules laid down by probability theory, while Gigerenzer and his associates have argued for the positive advantages, on occasion, of fast and frugal reasoning, when, as he puts it, 'less is more', the reasoning is not just faster, but more efficient ([Gigerenzer 2007](#)).

<sup>6</sup> When people have been told the outcome of an event, they regularly overestimate the accuracy with which they would have predicted it had they not been given such knowledge: cf. [Fischhoff 1975](#), [Nickerson 1998](#).

More importantly, however, we can use this example to ponder the difficulties of giving an adequate assessment of how and why we arrive at the judgements we make. That includes not just the steps we take to make sense of our experience, but also the errors we are liable to fall into and how to learn how to avoid them. We have much work still to do to draw out all the lessons we can learn from a cross-cultural, comparative, study of the fortunes of human reasoning and its consequences in action. So in the investigations I undertake here, some relating to the understanding of conceptual frameworks, some to that of substantive ideas and theories, I shall endeavour to take some further tentative steps towards the clarification of issues that remain as important today as they have ever been. What is at stake is how we understand human understandings. The broader conception of science suggested by the comparative approach will lead to a considerable expansion in the horizons of its history.



*Translatability, Intelligibility, Revisability*

In many areas of current scientific investigation English now serves as a lingua franca across the world and over a certain range of problems in mathematical research the language used is that of universally recognised mathematical symbols. For a time in early modern Europe Latin served as the medium of scholarly exchange, just as Greek had done in the heyday of Hellenistic culture. In the Far East the written graphs of Chinese underpinned and still to some extent underpin much work in Japanese and Korean. Yet even when investigators agree at least on the natural language in which to convey their results, problems of mutual comprehension may certainly arise, which are likely to be compounded when we are dealing with several such languages. The question of mutual intelligibility was raised in an acute fashion by Kuhn's insistence on the incommensurability of competing scientific paradigms. Aristotle's understanding of force (*bia*) and weight (*baros*) presupposes a set of basic concepts that differ starkly from those of Galileo's dynamics, let alone of Newton's, and in the subsequent history of physics philosophers and scientists have radically transformed the understanding of space and time themselves. More generally still, the problems of translatability and of mutual intelligibility have more recently been high on the anthropologists' agenda, where I have myself broached some of the issues from the point of view of how we are to understand ancient societies.<sup>1</sup>

It is as well to begin with a little elementary philosophy of language. As Grice (1968, cf. 1975, 1978), following Austin (1962), pointed out many years ago, we must bear in mind that what we mean by 'meaning' varies with context (cf. already Ogden and Richards 1923). First there is the meaning of a word as that would be given in a dictionary for the language in question, where we shall often find original or primary or 'literal' uses distinguished from those labelled derivative, 'tropical', 'figurative' or

<sup>1</sup> See especially Severi and Hanks 2015, Lloyd 2020a.

'metaphorical'. But word meaning differs from sentence meaning in that particular collocations will affect the sense we attach to the components of that collocation. We progress to a different level when we take into account utterer's meaning, for a single sentence may be used to make very different points: indeed sometimes the point may – ironically – be the very opposite of the one that the words would normally be thought to convey. At yet a further level the so-called perlocutionary force of a remark makes a difference, the effect that the assertion may have on those who hear it. In some cases the stating is the doing, as is the case with 'I do' in a marriage ceremony, or 'I name this ship the Queen Elizabeth' when one is launched.

But when two radically divergent cosmologies confront one another, the difficulties are of a different order of magnitude. As I have put the anthropological dilemma before, the problem is how statements or practices made within one such system can be understood by any observers who are not deeply imbued with that set of beliefs already, a point pressed from different perspectives by [Strathern \(1988, 2019\)](#), [Viveiros de Castro \(1998, 2014, 2015\)](#), [Ingold \(2000\)](#), [Vilaça \(2010\)](#), [Descola \(2013\)](#) and [Candea \(2019a, 2019b\)](#) especially. If those observers use their own conceptual schemata to gloss what is going on, is that not bound to have a distorting effect? But how can those observers fail to use their own basic concepts, since they are the only ones they have?

The first step to clarify that dilemma that I proposed is to insist that any particular set of concepts or categories, our own or anyone else's, should not be assumed to be set in stone, incapable of modification or revision. Quite to the contrary, they should always be treated as provisional and revisable. Indeed my claim is that one of the great advantages that accrues from the comparative history of science and philosophy is that it allows and encourages such scrutiny. It is true that in one tradition of the history of science the temptation simply to dismiss earlier views as worthless has been strong. What, the thought would be, can be learnt from investigating the fumbleings of past researchers other than lessons to do with the sources of human fallibility? Yet here the anthropological dimension of the problems may serve as an antidote. When our target is to examine other peoples' ways of being in the world, including their ideas about such key issues as the relations between humans and other animals, agency, causation, personhood, we may more readily come to see that our own starting assumptions are not fully adequate to the task. It is not just a question of correcting others' categories to bring them into line with our own (the programme associated with [Davidson 1974, 2001](#)) but also of reviewing ours in the light of theirs. However, that may be to jump ahead too fast, since it presupposes

that we can recognise that the ideas from which we hope to learn do indeed relate to those categories, and that in turn assumes a positive answer to the question we are investigating here, namely whether there is some possibility of cross-cultural comparison and translation.

It is helpful, to start with, to acknowledge that the degree of difficulty we encounter varies with context. As I have said before, it is usually not especially difficult for an ethnographer or an ancient historian to achieve competence in the use of a foreign vocabulary for mundane objects and transactions. We learn the native word for a species of animal (as in the Dorze case of the leopard that I cited before) easily enough. Probing what is believed about that creature (that it is a Christian animal, in the Dorze instance) is where the major problems generally begin. The anthropologist sees one of her hosts offer an object to another: but whether that is a 'gift', and what that would imply if that were the case, may be fraught with interpretative difficulties. Here is a good example that illustrates the serious inadequacy of what might be our own starting assumption, namely that a gift is a one-off transaction with no repercussions on the subsequent relationship between giver and receiver. On the contrary, gifts may be a way of imposing obligations on those who receive them. The literature on this, since Mauss's classic study (2016 [1925]), has been immense and immensely fruitful (e.g. [Strathern 1988](#)).

Similarly in an instance that I may take from ancient Greece. The term *philos* is regularly translated 'friend', that is a person for whom you feel affection. That indeed corresponds to many of its uses, and when the term is used in compounds, it becomes clear that it is not just humans who can be the object of such feelings. A *philosophos* is a person who loves *sophia*, wisdom. The range of terms constructed on such a model is almost limitless: in Plato we have *philēkooi* and *philotheamones* for those who are 'lovers of sounds' and 'lovers of spectacles', where those who fall into those categories are contrasted with the true lovers of wisdom. But the humans whom you count as your *philoī* are not just those for whom you feel a certain fondness. They include your kith and kin, indeed those with whom you have reciprocal ties of mutual obligation. In courts of law each side marshalled their *philoī* in their support ([Humphreys 1985](#), [Herman 1987](#), [Konstan 1997](#)), and they were certainly expected to turn up in such a capacity, for if they did not, that would be taken as a serious negative reflection on the probity and trustworthiness of the parties in question.<sup>2</sup>

<sup>2</sup> Similar issues in relation to notions of kinship in present-day communities in Papua New Guinea are discussed by [Strathern 2005](#), [2019](#) and [2020](#). That most recent study of hers presents a lucid and

With such examples we are still dealing with situations that pose difficulties where we are unlikely to conclude that there is a total breakdown in communication. It is certainly not beyond the reader of ancient Greek texts to work out that the term regularly translated ‘friend’ often carries very different associations from those that English rendering prepares us for. We have no single word in English that will do as an exact equivalent.<sup>3</sup> But we warn our own readers of that with a footnote explaining the problem and by putting our provisional, imperfect, rendering in ‘scare quotes’. But the problems the anthropologists put before us include ones of an altogether different order of magnitude. We are presented with accounts of radically different ontologies, different worlds indeed, between which, some would argue, there are incommensurabilities that rule out translation and mutual understanding (cf. [Severi and Hanks 2015](#)).

Yet it is not that the anthropologists have nothing to say about such ontologies or that they are reduced, in Wittgensteinian fashion, to silence: ‘whereof one cannot speak, thereof one must be silent’. On the contrary they have a good deal to say, even while what they tell us is sometimes designed to underscore the difficulties of interpretation. Thus some descriptions of what Descola calls an animist ontology (somewhat analogous, in certain respects, with the perspectivist ones of Viveiros de Castro) proceed from observations about the beliefs and practices of certain indigenous communities in many different parts of the world, and certainly not confined to Amazonia, which bring to light very different conceptions of the relations between humans and other living beings. In such groups as the Araweté or the Achuar jaguars are said to have associations with other jaguars that mirror those between humans. Their societies are organised just like human ones, their rules of commensality similarly. When they drink the blood of their prey, they see that blood as beer. It is because the jaguar has the body that it does that its perceptions are those it has, quite unlike those that humans have, courtesy of the bodies we have.

Let us look at this case in a little more detail and proceed with caution to pinpoint where communication seems possible, and where it may be thought to be under threat or even to break down. First as we said, it is

revealing discussion of the historical and dialectical variations in the understandings of English terminology for friends, kin and relations generally.

<sup>3</sup> We shall encounter plenty of examples of this in the studies that follow. Thus notoriously there is no single English term that will do as a rendering for the Chinese *qi* 氣, which spans both ‘breath’ the substance and ‘energy’, so we resort to transliteration backed up by paraphrase. The term *shui* 水, usually translated ‘water’, is glossed in a Chinese text as a process, as ‘soaking downwards’, what flows, just as ‘fire’, *huo* 火, is ‘flaming upwards’, comments that are closer to a Heraclitean view (cf. [Chapter 8](#)).

not the case, of course, that the anthropologist is reduced to silence in such an encounter. On the contrary the analyses in terms of perspectivism (Viveiros de Castro) or of diverging views of physicality and of interiority (Descola: cf. below, [Chapter 4 at note 1](#)) aim to provide us with a key to understanding even if that understanding is limited and subject to the possibility of suspending belief in what our own dominant or default naturalist ontology would tend to commit us to.

But then we also have to recognise differences between what the Araweté perceive and what they say the jaguar does. The Araweté are absolutely clear that the scene before them is of a jaguar consuming its prey and drinking its blood. But on the basis of beliefs that are considered to be authoritative (being endorsed by their shamans for instance) they appreciate that what the jaguar itself sees is very different, namely that it is drinking beer. All perceptions depend on the bodies of the perceivers. There is no way in which these stand to be corrected in terms of a perceiver-less, 'objective' account of what there is, for that flies in the face of that very principle that all perceptions are perceiver-specific. 'Objectivity' in that sense is beyond reach; indeed it is not a recognisable goal of cognition.

The consequences for language are far-reaching. 'Beer' and 'blood' do not have one determinate referent each. Rather the referent varies with the perceiver. In any statement in which such terms appear there is what [Viveiros de Castro \(2004\)](#) calls a 'controlled equivocation'. When we think to use the term 'beer' we must always consider 'for whom'. We may answer that 'for the jaguar', but even here there is an indeterminacy, for a jaguar may be a shaman in disguise and a shaman in turn may be a disguised jaguar. You never know for certain, that is.

We have by now left far behind the world we normally assume that we can take for granted, one of stable objects apprehended by equally stable subjects. But the problem that faces not just the ethnographer, but all of us, is obvious. What is the relationship between the beer spoken of as what the jaguar drinks, and the beer the Araweté or we consume, where we might take refuge in using 'scare quotes' in the former, but not in the latter case? We have said that certainty is unattainable and even that in certain instances objectivity is not the goal. But that does not mean that error is impossible, not just in the case of the anthropologist commenting on the Araweté, but for the Araweté themselves. On the contrary the ethnographic reports are full of cases where the indigenous peoples studied themselves puzzle over how to translate what has occurred into the

language of jaguars or other creatures,<sup>4</sup> and they certainly do not always accept what their own shamans tell them.

So a common or garden sense of the possibility, and the need, to correct error sits alongside a deeper recognition that much more may be at stake, for example where the whole relationship between humans and other animals is implicated. Yet we must remind ourselves that this is not just a matter of some set of quirks in indigenous beliefs that ethnography throws up. The wine in the Eucharist that the Christian faithful see as the blood of Christ presents an analogous problem. For the outsider to pronounce this to be a mere mistake is liable to miss the main point, that what is at stake is a complex of beliefs to do with a God who sent his Son to earth to redeem humans from their sins. Coming to terms with Christianity certainly involves not just an assessment of a variety of counter-intuitive empirical claims (as we call them) but also responding to the underlying values that it incorporates and the possibility of redemption it entertains, and this is no mere matter of a set of articles of belief, but of how one lives one's life and cares for one's immortal soul. Coming to terms with indigenous perspectivism, likewise, means reacting to its implications concerning the relationship of humans to other animals and to the environment as a whole. There are not just questions of values at stake, but conceptions to do with the possibility of understanding. The issues are simultaneously political and cognitive (Viveiros de Castro 2015). While the Araweté recognise that they may make mistakes, for them there is no ultimate objectivity, trumping all subjectivities, that can be attained. For some Christians the argument would be that it is only the believer who can understand. If that serves to protect their faith, it does so at the price of a certain exclusiveness, but then some believers may well not be at all concerned with that objection or indeed with any other criticisms that the non-believer might advance.

There are, then, two distinct aspects to the bafflements we may experience, though these may sometimes have been run together in the literature. On the one hand, there is the hermeneutic task, of understanding what is

<sup>4</sup> Vilaça (2016: 62–3) records a set of exchanges, where the Wari' entertain different possibilities about how to effect the translation of a term that occurs in a story of the experience of a girl who goes out walking with a person whom she believes to be her mother but who turns out to be a jaguar. The narrator says that they stopped to eat *nao'* fruit. But what was it, the audience asks, and several offer different interpretations, such as *kwari* (seven-banded armadillo) or *kahwerein pikot* (tail of six-banded armadillo) or perhaps *paca* (*mikop*). But the person who had offered the first suggestion 'immediately corrected herself: "That's it, papaya is *paca* . . ." meaning, for the jaguar'. Vilaça comments that it was as if those who listened to the story had a Wari'–jaguar dictionary in their minds which they used to translate what the narrator said.

reported, in the first instance by the ethnographer or the historian of science and beyond them by the subjects they are studying. On the other, there is the very different project of indeed leaving our own ontology behind and adopting on our own behalf the new perspective we are introduced to. The first, hermeneutic task is necessarily an ongoing one, never complete, always subject to further insights. But while understanding regularly depends both on sympathy and on a willingness to suspend belief, it does not entail endorsing what one has understood. In the study of ancient thought, we do not, we cannot, adopt the position of a Pythagorean or identify with Plato or with Confucius or Zhuangzi. There must, as we have recognised before, be limits to the understanding we can hope to achieve. We should always strive to push those boundaries back, but that does not mean that to do so we have to endorse the perspective of what we have understood. It is not fruitful to adopt Aristotle's account of natural and forced motion that ignores inertia, though the historian of science has an obligation to probe the considerations that led him to his view, while guarding against the assumption that his agenda corresponds to what we mean by 'dynamics'. Similarly to treat his studies of animals and plants as 'biology' is, among other things, to ignore the differences between his view of living things and those that have prevailed since the nineteenth century (Cunningham and Williams 1993, cf. Cunningham 1988). On the other hand, however, we are normally inclined to accept what physics tells us about the constitution of material bodies even when that appears to contradict our experience of their solidity. We do not reject the experience in favour of the theory but allow that both can convey useful information according to the different criteria each invokes, and we should further accept that there is no second-order super-criterion by which those divergent ones are to be judged.

Comparison, as both Candea (2019a and 2019b) and myself (Lloyd 2015: ch. 2) have argued in different contexts, is always geared to some agenda, never totally innocent. It may serve the aim of putting the comparanda on a level with one another (Candea's horizontal comparison) or it may serve to endorse an implicit or explicit claim for the superiority of one side of the (in this case vertical) comparison. Even the assertion that in some instances comparison breaks down may be a covert argument for the superiority of what is thereby claimed to be incomparable (Detienne 2008). But the very fact of making such a claim implies that a comparison might have been possible even though in the instance in question it was thought to fail. If we say that this failure was a matter of the dissimilarities, the differences between the cases, that itself depends, to be sure, on an act of comparison.

But this is not to say that comparison is always worthwhile. On the contrary it is easy to show that at the limit anything may be compared in *some* respect to anything else. We have an instance of that in Plato's dialogue the *Protagoras* where Protagoras is challenged by Socrates to say whether justice has some resemblance to holiness (the dispute between them is on the unity of the virtues). To that Protagoras answers in a fit of pique that anything resembles anything else in *some* respect (331d) (thereby anticipating Popper by several centuries).

That very fact dictates that we have to discriminate between the worthwhile and the worthless examples of the exercise. There is obviously no algorithm to determine how to accomplish this. But that does not mean that such discrimination is hopeless. Even if there are plenty of instances where the exercise yields only useless information, we can set against those cases others where comparison, even and perhaps especially between starkly divergent sets of beliefs and practices, can yield new understandings. The work is challenging, hard and never-ending. But it is one *raison d'être* of the endeavour of the comparative history of science. As we launch into new case studies later in this inquiry we shall see that each poses its own peculiar difficulties and so demands not one single overall solution, but clarifications that are specific to the problem in hand.

Meanwhile it is as well to remind ourselves that while translation and understanding are often problematic, there are straightforward cases where success in communication can be verified in practical terms. Sitting down to share a meal, maybe at a table, maybe not, we ask our neighbour to pass the salt, and she duly does so. We may even make this request in a gesture rather than in words, whether from our own or her natural language insofar as we have learned to use it. The fact that we may have very different beliefs about the valence or the symbolic associations of this exchange, let alone of sharing a meal, does not preclude the communication and the mutual understanding of the request. Although there are plenty of intensely perplexing issues for us to try to unravel in making sense of fundamentally divergent cosmologies and scientific understandings, it is as well not to lose sight of situations that are considerably less problematic. I have on occasion referred to what I have called 'bridgeheads of intelligibility'. That expression has been criticised, with some justice, for its – unintended – militaristic associations. The point, however, that I would retain is the simple one that elementary communications may provide a starting point for more complex understandings. Of course even the simplest acts of communication are not immune to error. At the same time the very possibility that they may be corrected shows well enough that some progress can be made. At least the moral would be that we



should not be deterred from attempts at particular interpretations and clarifications by the difficulty we may continue to experience in giving some overall justification for how new understandings can ever be reached. Let the success of my own efforts in that direction be judged by the outcome of the studies that follow.

*Demystifying the Greek Miracle*

One of the earliest and most influential of those who promulgated the notion of a ‘Greek miracle’ was Ernest Renan in his ‘Prayer on the Acropolis’ dating from 1865 (Renan 1935: 243ff., 1948: 393, cf. Peyre 1973). He was explicit in using that slogan to identify the origin, and to proclaim the triumph, of Western rationality. On this view what distinguished the ancient Greeks, the Athenians especially, from all other ancient civilisations was that they stood for clear-headed Reason, manifest, so it was claimed, in their literature and art, and further afield in the use of objectively valid methods of investigation that could and did secure reliable progress in any field of inquiry to which they were applied, most notably in both philosophy and what we call science.

The flaws in this triumphalism, with its racist undertones, have often been exposed. As Dodds (1951), especially, showed, there are plenty of examples in Greek culture of what he called the irrational – including both childish beliefs, unwarranted inferences, unjustified claims, absurd practices, but also and more especially instances of genius or creativity that defied rational explanation. Conversely, while the celebration of the Greeks often went with a neglect or a denial of what other ancient and modern peoples achieved, that view too could be shown to be a travesty once serious work began to be undertaken on those achievements, in mathematics, astronomy, medicine, technology, agriculture and many other domains, the work of Sumerians, Babylonians, Assyrians, Egyptians, Indians, Chinese, not to mention that of the great civilisations and indigenous peoples of Meso- and South America.

Appeals to the ancient Greek legacy often formed part of European claims to superiority over other folk, claims that were in turn regularly used to justify colonialism, suppression, exploitation. But if by now that whole edifice of Greek and later European uniqueness can be seen as a sham, that does not mean that we are left with an unclouded vision of what to say about cultural diversity and the different fortunes of different modes of

inquiry and methods and aims of understanding. Talk of ‘miracles’ in relation to the ancient Greeks has become far less common, but many still grapple with their ‘genius’ in the domains of political thought, aesthetics, drama and philosophy, if not also in science.<sup>1</sup> More generally the study of ancient peoples and of modern ones, as reported in contemporary ethnography, continues to pose fundamental problems, the most important of which is the reconciliation of some sense of what as human beings we all share with a recognition of the profound differences to be found between different groups, societies or cultures, separated in time or space or both.<sup>2</sup>

First as to what we share. This is a matter not just of our biology, but also of culture – that is not of some particular culture, but of participation in culture of some kind – even if those two domains are not as clearly demarcated from each other as used commonly to be assumed. We can of course study our DNA and our genes as well-defined topics, but we have to allow for their plasticity (e.g. [Jablonka and Lamb 2014](#)), and the influence of other, broadly cultural, factors on every human being from birth onwards. But it is not just that we share basic anatomical and physiological characteristics: as we noted, we are all, as Aristotle put it, essentially social creatures.

The impact of this simple fact on how we behave, indeed on the ways we deploy our human intelligence, has received increasing attention from cognitive developmentalists. Some, such as [Humphrey \(1976\)](#) and [Mercier and Sperber \(2011, 2017\)](#), would even argue that as humans we have developed the cognitive skills we have in large part as a response to the needs and opportunities presented by our being the social animals we are. While we must recognise that the character and level of the skills that are actually developed by different individuals and groups differ, the potential to develop some social skills is the norm. That remains the case even though there may be wide differences in the nature of the emotions felt or expressed between different populations.<sup>3</sup> We may compare what we

<sup>1</sup> The themes of Greek exceptionality and ‘incomparability’ were pursued in important studies by [Detienne \(2007 \[2005\], 2008 \[2000\]\)](#) with which should be compared the careful assessment in [Hartog 2015](#). As for Greek ‘miracles’, when the papers of Louis Gernet dating down to 1960 were collected in 1983 their editor, Di Donato, chose to entitle the collection *Les Grecs sans miracle* as if that was the principal thesis to be defeated ([Gernet 1983](#)).

<sup>2</sup> This was the principal topic that I tackled in [Lloyd 2020a](#), to which I may refer the reader for the elaboration of many of the points that follow here.

<sup>3</sup> Whether or to what extent there are universal human emotions, that is ones that are valid cross-culturally, continues to be a highly disputed issue. See for example [Panksepp \(1982\)](#), Ortony, Clore and Collins (1988: ch. 2), [Wierzbicka \(1999\)](#), [Konstan \(2006\)](#) and further extensive literature cited in [Lloyd \(2007: ch. 4\)](#).

now know about differences that exist in spatial apprehension, as between what [Levinson \(2003\)](#) labels intrinsic, relative and absolute. Thus some do, but others do not, have and use an ability to apply absolute coordinates to locate themselves and other things. Yet some skill in spatial apprehension is possessed by all human beings (as well, of course, as by many other species of animals).

The second, converse, question, of what to allow for in cultural diversity, is undoubtedly trickier. This is where stories of deep divisions, of breakthroughs, advances, revolutions proliferate, tending, some think, to undermine claims for the basic psychic unity of humankind. One of the most obvious difficulties about such stories is that they generally reflect the particular knowledge and interests of those retailing them. This is particularly clear where classicists are concerned, for whom the Glory that was Greece and the Grandeur that was Rome have often blinded them to the glories and grandeurs of other civilisations, even those on the doorstep of those ancient Greeks, the Egyptians and Babylonians for instance, whose extraordinary achievements, indeed, many ancient Greeks themselves were in awe of. To that extent those moderns who sought to glorify the Greeks could find themselves committed also to the Greeks' glorification of the Egyptians.

Even more common have been claims that not just understanding but also intelligence were transformed in the scientific revolution or in the industrial one, with the discovery not just of individual items of knowledge but of the very notions of how to discover, and then to use the knowledge obtained to manipulate and control the phenomena and nature itself. The use of the term 'revolution' already tends to suggest that these two can be treated as single determinate historical events, on the model of the storming of the Bastille or of the Winter Palace. Yet what some continue to call the scientific revolution happened over a quite extended period of time and 'it' certainly encompassed a number of distinguishable features, the rise of experimentation to be sure, but also the focus on quantification and in some hands, the insistence on empirical research, each more, or less, innovative, more or less foreshadowed in the work of earlier investigators. In his exemplary account of the development of different methods and styles of reasoning (or as he now puts it of thinking & doing, emphasising the ampersand) [Hacking \(1992, 2009, 2012\)](#) identifies at least six of varying degrees of importance and rightly insists on the divergences in the chronology of their emergence.<sup>4</sup>

<sup>4</sup> While adumbrations of the notion of 'styles' can be found already in [Hacking 1983](#), he acknowledges that the inspiration for the development of that idea came from Crombie whose magnum opus was

Forewarned, then, of the dangers of oversimplification in most attempts to construct Grand Narratives of the progress of human endeavours to understand the world, let me now turn back to the Greek data to survey where I think we have got to, today, on the questions of Greek exceptionalism and its possible causes. Three fields that deserve particular attention are philosophy, mathematics and what we call science. In the first two cases, though not so directly in the third, we have to factor in that our terms derive from their indigenous actors' ones. Let me deal with them briefly in order.

What 'philosophy' should be taken to comprise has, to be sure, been interpreted in many different ways, and indeed that remains true within different European traditions today, where 'philosophy', the French 'philosophie' and German 'Philosophie' are far from synonymous. Justin Smith (2017) for example has recently identified six different overlapping stereotypes (they include the 'gadfly' and the 'Mandarin') who all, in his view, have some claim to the title 'philosopher'. Meanwhile the battle to determine what counts as 'proper' philosophy has split academic departments with that name in many distinguished universities across the globe. Some have attempted to limit the term to the range of disciplines that the original Greek term *philosophia* covered, even though there was plenty of disagreement about that between different Greek and Latin writers.<sup>5</sup>

On the narrowest reading what many other peoples, ancient and modern, practised does not count as 'philosophy', but (merely) as 'wisdom'. Yet such a view – whatever its covert or explicit motivations – is pretty obviously excessively restrictive. Debates on the nature of right and wrong, of justice and of well-being, are well attested in many modern indigenous societies as well as in antiquity, in India and China especially, and in the light of that fact we can hardly deny a widespread, maybe even

only published in 1994. Crombie's original six 'styles of scientific thinking' included (1) the postulational, (2) the experimental, (3) the hypothetical, (4) the taxonomic, (5) the statistical and (6) the genetic or historical. Hacking himself spoke rather of styles of scientific 'reasoning', revising the list and subsequently adding certain items including some relating to laboratory life and others to computer modelling. There is, in any event, no claim that a comprehensive and definitive classification can be arrived at.

<sup>5</sup> Herodotus (I 30) describes Solon as 'philosophising' when that involves travelling the world. When Pericles in Thucydides (II 40) speaks of the Athenians as a whole 'philosophising without softness' this refers to a general curiosity and does not mean that they all engage in what since Plato would have been recognised as philosophical inquiry. The Greek term *sophos* refers not just to moral or intellectual ability but to the skills of any craftsman or technician. Indeed it could carry a negative charge when it was used of those who were cunning or, as we say, too clever by half. A similar ambivalence permeates the use of the term *mētis* 'cunning intelligence' (Detienne and Vernant 1978). That could be used of the ability to succeed even if that involved cheating – provided that one was not found out.

universal, human interest in aspects of what we call ‘moral philosophy’ or ethics.<sup>6</sup>

We also find good ancient evidence outside the Greco-Roman world for discussions of the bases of knowledge claims (‘epistemology’) and of ideas about the realities to which those claims related (‘ontology’) even while the concrete suggestions entertained on such topics exhibit great variety. Again flaws in reasoning, such as inconsistency and inconsequentiality, are matters of concern in many ancient societies and in modern ones, including some that remain predominantly oral (e.g. [Gluckman 1967, 1972](#) on the Barotse). However, the systematic analysis of the forms of argument, irrespective of content, is appreciably rarer. As I noted before, it can be, and often has been, argued that what we can call formal logic was invented by Aristotle and then developed, indeed transformed, especially by the Stoics. If here, for once, we have a token of Greek exceptionality, we must come back later to review why this might be so, that is what we can say about the factors that may have been in play.

Mathematics is perhaps the most interesting field for our investigation. It can be argued that some knowledge of, and ability to manipulate, quantities and shapes is to be found in every human society: in the latter case, that of shapes, that is not unconnected with the point I made earlier that all humans have some mode of spatial cognition, even though the modes differ. You do not need to have some explicit notion of a discipline that can be called ‘geometry’ to be able to explore patterns and their combinations in textiles or on pottery, for instance. Analogously the kinds of interests shown in quantities and numerosity are not uniform across the world (as [Vilaça 2019](#) especially has shown, cf. [Lave 1988](#), [Dehaene 2011](#)).<sup>7</sup> In part this variation may be put down to the different types of practical needs that a given group experiences, though it is a mistake to consider this the sole factor in play. Not all engage extensively in barter and those that do not will have less use for complex number systems in that context though that certainly does not preclude interest in quantities and shapes in other circumstances. The administration of large territories, the levying of taxes, the planning and construction of major

<sup>6</sup> For a recent discussion arguing for parallels in the development of abstract reasoning in India and in Greece, see [Seaford 2020](#). In both cases Seaford holds that the influence of monetisation as a model for abstraction has been underestimated in the scholarship (cf. already [Seaford 2004](#)). However, he has little to offer by way of commentary or explanation of the distinctive features of Greek axiomatic-deductive demonstration which I go on to discuss in the following pages.

<sup>7</sup> The lack of a vocabulary for numbers has, however, sometimes led to exaggerated claims about the cognitive deficiencies that follow from that lack, as for example those by Everett in relation to the Pirahã ([Everett 2005](#)).

buildings, irrigation canals and the like demand, for sure, the development of further skills.

But as we see in most ancient civilisations already mathematics may be cultivated not just for practical application, but in part also for its own sake, as it were, that is for the abstract knowledge or understanding it may yield, for the opportunities it may offer for intellectual display indeed. An obvious example of this relates to the circle-circumference ratio, or what we call  $\pi$ . For ordinary practical purposes assuming a value of 3 or  $3\frac{1}{7}$  is usually perfectly adequate. But in China, India and Greece (seemingly for the most part independently) we have detailed explorations that yielded closer and closer approximations to the correct value, indeed in the case of Zu Chongzhi in the fifth century CE to the equivalent of what we call seven decimal places, thus going far beyond what any practical need would dictate (Lloyd 1996a: ch. 7).

Those who engaged in such calculations could and sometimes did develop a reputation for a very special kind of expertise. They could get surprising results, not just paradoxical or counter-intuitive ones that served to puzzle people, but truths that had to be accepted as such. Aristotle offers us an example of this (*Metaphysics* 983a12–20). Initially people might be taken aback at the claim that, no matter how tiny the unit of measurement taken, the side and the diagonal of a square are incommensurable. But to the person in the know, the geometer, the surprise would be if, *per impossibile*, they did indeed have a common measure. The mathematician would know that their incommensurability could be proved.

Now the methods of proving favoured in different contexts in our ancient sources (not just Greek but Egyptian, Babylonian, Indian and Chinese) differ.<sup>8</sup> Confirming that a result is valid, ‘proving’ in that sense, might be merely a matter of going over the steps by which it was obtained to make sure that no mistakes had been made. Checking that the algorithms used to get a result are correct – a recurrent concern in Chinese mathematics in particular – involved testing not just specific conclusions but the methods used to obtain them, showing them to be sound.<sup>9</sup>

<sup>8</sup> Chemla 2012 collects a number of detailed studies that illustrate not just different methods of proof, but different conceptions of what proving consists in, across different cultures and periods. Cf. Robson and Stedall 2009.

<sup>9</sup> There is a simple example of this in Liu Hui’s third-century commentary on the first-century CE Chinese mathematical classic, the *Jiuzhang suanshu* (*Nine Chapters of Mathematical Procedures*) (Qian 1963). Discussing the addition of fractions, Liu Hui identified two procedures which he calls ‘homogenising’ (*qi* 齊) and ‘equalising’ (*tong* 同). The first involves cross-multiplying denominators and numerators, the second multiplying denominators. Once these have been carried out, the

However, laying out the steps that justified the claim that a conclusion was not just true, but necessarily true, depended on a further feature, namely having an explicit theory of deduction (Netz 1999 and forthcoming). It was this extra step that allowed mathematics in particular to serve as a model for how indisputable results were to be obtained. For this the ultimate starting points had to be self-evident indemonstrable truths, for if they were demonstrable, then they should be demonstrated and they would not be *primary* starting points. But then one must proceed by valid deduction and when that second requirement was met, the conclusions had to be accepted as necessarily true. If someone did not accept them, that did not show that they were not true: rather that the person in question had not understood. Aristotle was the first to set out such a schema in his *Posterior Analytics*, applicable, in his view, not just in mathematics, but more widely in philosophy including in natural philosophy. But it was indeed the Greek mathematicians themselves who best exhibited how to bring the schema to bear to show how an entire field of knowledge could be demonstrated in the sense required. Our first extant example is Euclid's *Elements*, even though that clearly owed much to earlier work.

Now this type of claim for incontrovertible demonstration is not found in our extant sources for the mathematical or philosophical practices in the ancient Near East, in India or even in China, and it has accordingly often been hailed as a prime example of a triumph of specifically Greek rationality. So it is particularly important to get this issue into perspective, to unmask unhelpful and misleading invocations, in this context, of some Greek miracle or other.

The first step is to recognise that this aim to give incontestable proofs was quite often anything but a reasonable ambition. Of the two components of such proofs, one, the need for axiomatic starting points that could be accepted as self-evidently true, was generally far more difficult to satisfy than many Greek writers supposed. Mathematics itself, to be sure, presented one or two good positive examples, such as, for instance, the equality axiom that states that if equals are subtracted from equals, equals remain (attested in Aristotle as well as in Euclid).<sup>10</sup> That cannot be proved without circularity, but then it does not need to be. But in such fields as theology or physiology the starting points were often anything but self-evident. Yet that did not

addition can be effected and, as he puts it, 'the procedures cannot have lost the original quantities' (I 9, Qian 1963: 96).

<sup>10</sup> e.g. Aristotle *Posterior Analytics* 76a41, Euclid *Elements* I Common Notion 3.



deter the likes of Proclus and Galen from claiming that they could give strict demonstrations in the geometrical manner, *more geometrico*, in such areas, as if their axioms were as indisputable as those of the mathematicians (cf. Lloyd 2018: 71f.).

But then we also have to remark that in mathematics itself some of the axioms invoked were also open to question. Euclid made it a postulate that non-parallel straight lines meet at a point, but some later Greek commentators (Ptolemy and Proclus for instance)<sup>11</sup> thought that this should not be a postulate, but rather a theorem to be proved within the system. Although their attempts at proof turned out to be circular, it is well known that later attacks on the problem, undertaken in the hope of demonstrating the parallel postulate, led eventually in the nineteenth century to the recognition that other, non-Euclidean, geometries are possible. Meanwhile the demand for a mode of proof that would deliver certainty and defeat scepticism was to prove to be a guiding motif in much European thought, and not just in mathematics and science themselves, as is shown not just by Descartes but even more dramatically perhaps in Spinoza's attempt to apply proof *more geometrico* to the fields of theology and ethics (see e.g. Curley 1988).

The weaknesses or the potential flaws in what purported to be the strongest and strictness mode of demonstration make it all the more urgent for us to probe the question of the sources of the original fascination that it held for the Greeks. Why, we must ask, were the Greeks, some Greeks, that is, not satisfied with true results established beyond reasonable doubt, but strove for incontrovertibility, indeed sometimes in contexts where they can hardly have been unaware that no sooner had a claim for indisputability been lodged than it was promptly disputed? Some of the distinctive characteristics we noticed in Greek philosophy may throw light on this equally distinctive feature of parts of Greek mathematics. Formal logic, the systematic analysis of argument schemata irrespective of content, was, we said, a peculiarly Greek preoccupation, so far as the ancient world was concerned. Over and above any purely intellectual delight in such abstract analysis we may identify one specific advantage that accrued to such a study. It left the philosophers in a position to claim not just that their results were true, but that they had to be accepted as necessarily true.

In the highly competitive environment in which not just Greek philosophers but also mathematicians worked, what you needed in order to see

<sup>11</sup> In his *Commentary on Euclid Elements I*, Proclus first reports Ptolemy's attempt to prove the parallel postulate (362.14ff.) and then records his own effort to do so (368.26ff.) (Heath 1926: I 204ff.).

off your opponents was – some thought – not just first-order claims for the truth of your own opinions, but second-order demonstrations to show precisely their incontrovertibility. To win the argument it was not enough to state that your theory was true: what was needed was a technique for convincing an audience that there was no way in which it could not be true. We have direct evidence for such a concern in both Plato and Aristotle, in their attempts to drive a wedge between arguments that are (merely) persuasive on the one hand, and those that are certain on the other, where that feature of certainty depended not just on having a theory of demonstration but also on actually applying it to the case in hand. In this context first Plato and then Aristotle repeatedly contrasted what they label sophistic or eristic (contentious) argumentation with proper demonstrations, the kind that they were themselves in a position to deliver – so they claimed – even in Plato's case in such contexts as the proof of the immortality of the soul.

While the individuals who got to be called 'sophists' were often highly respected persons, sometimes considerable statesmen (as Gorgias and Protagoras certainly were) and usually highly successful and sought-after teachers, that label came to be used to contrast false pretenders with the authentic representatives of true wisdom, the philosophers themselves. The sophists who generally accepted payment for instruction could not, in Plato's view, be trusted. They were accused of teaching their pupils to be successful orators without regard for whether what they advocated was true or not, in the interests of the people or not. Their *mere* persuasiveness was not good enough, indeed dangerously subversive.

To make crystal clear that their own types of argument were not open to such criticism, some of the philosophers and mathematicians developed a mode of demonstration that was to be immune to error, even though Aristotle was to put it that strict demonstration is the most persuasive kind of *persuasion* there is. However, he also noticed that such strict demonstration was out of place in rhetorical contexts, where arguments had to proceed not on the basis of primary self-evident axioms, but on premisses that were reasonable, ones that your opponents were in no position to deny.<sup>12</sup> Following these hints in Aristotle himself, we may suggest that what is distinctive about the Greek situation is not just the competitiveness between rival Masters of Truth, but the claim that some of them made to

<sup>12</sup> At *Rhetoric* 1417b32–4 Aristotle remarks that in rhetoric when a point is clear there is seldom need to demonstrate it. In the *Nicomachean Ethics* (1094b25–7) he comments that it is as out of place to accept a mathematician arguing merely persuasively as it is to demand (strict) demonstration from an orator.

have access to a method of objective impersonal demonstration that trumps all others.

We shall have more to say in a minute about the background to such a move, but we have yet to consider our third field of investigation where such an ideal is still enormously influential. ‘Science’, we noted, is not an ancient actors’ category but our observers’ one, even though ours derives ultimately from the Latin *scientia* used quite generally for knowledge. Did any ancient civilisation, some have asked, have ‘science’ at all, even if they did not recognise it as such (like Monsieur Jourdain speaking prose)? To begin to tackle that question requires unpacking what makes an inquiry, a method or a result ‘scientific’ in the first place. As we said in the [Introduction](#), we cannot be satisfied with labelling as ‘science’ such truths as are accepted by scientists today, since results are always revisable, even if some are, to be sure, more robust and less likely to be revised than others. It is not results that count so much as aims and the procedures used to achieve those aims. Those procedures, we said, include observation, classification, measurement, prediction, verification, demonstration and experimentation. But each of those comes in more, and less, systematic versions, as I have just been discussing for demonstration. Thus observers may or may not follow explicit protocols governing their activities, especially when they are using instruments in making their observations. While experimentation has often been held up as the key to what is (simplistically) labelled ‘the’ scientific method, it can be represented as continuous with, if more systematic than, trial and error procedures that are widespread, maybe universal, in all human groups.

Once those points are accepted, as I have argued they should be, there is no good reason to deny the attribution of some scientific ambitions and endeavours to most ancient and modern, indigenous, societies ([Lloyd and Vilaça 2019](#)). On that view, the so-called ‘scientific revolution’ of the sixteenth and seventeenth centuries should not be taken to mark the origin of science, but was rather characterised by an increase in self-consciousness and systematicity in procedures whose beginnings can be traced long before, and certainly not just in Greco-Roman antiquity. When we take the global dimension of the issue seriously we are faced with a plethora of achievements, interspersed of course with recognised failures, by individuals or groups, in such fields as the description and prediction of astronomical phenomena, in what we may, with due reservations, label statics, hydrostatics, mechanics and technology, in harmonics and optics, in the classification of animals, plants and minerals, in understanding the effective therapeutic properties of a wide variety of substances, in the exploration

of human and animal anatomy and physiology, in the study of disease and health. And that is far from an exhaustive list.

In every case the applicability of our concepts and categories of the departments of knowledge has to be called into question. We have to concede further that it is only in a very few instances that we are in a position to account for the specificities of the information available to us, that is, for instance, why certain developments occurred that appear to be peculiar to particular investigators in particular societies at particular historical junctures. But even the most rapid survey of the sources that will need to be considered is enough to explode any myth that what we may call systematic investigations of the physical environment are the unique achievement of one particular ancient society, let alone at one particular time.

Where those of classical Greek antiquity are concerned, we can at least suggest the contribution made by the modes of competitiveness that existed between rival groups. As we noted, we find plenty of evidence for debate and dispute in other societies in other areas of inquiry and at other times. But those controversies tended to be adjudicated either by the participants themselves, the wise men or gurus locked in dispute with one another (as, for example, in the Indian debates represented in the *Upaniṣads*), or by those in authority, kings or emperors or their representatives (Lloyd 2014: ch. 2).

The situation in classical Greece was very different, insofar as the audience to be persuaded was often the general public, indeed on political issues the citizen body in assembly, where the outcome was often to be decided by majority vote. Now they were often as difficult to convince, and as arbitrary in their judgement, as the figures of authority with which Chinese persuaders (for instance) had to contend. But as we have seen, some Greeks reacted to what they saw as the fallibility of persuasion by developing second-order arguments designed to guarantee certainty – or so they asserted. It was not by voting that the issues were to be resolved, but by incontrovertible demonstrations. The many may all be wrong, though the stakes for anyone who claimed to be in sole possession of the truth could be high, as Socrates certainly discovered, even though his superiority amounted to no more than the knowledge that he knew nothing, and it was left to his pupil Plato and to Aristotle to work out a mode of argument that could claim to deliver necessary truths.

The suggestion would be that Greek political and rhetorical argumentation acted as a negative model, in contrast to which a new ideal for demonstration, for use in philosophy, mathematics and elsewhere, came

to be developed.<sup>13</sup> Its Achilles heel was the requirement for self-evident primary premisses. But its undeniable strength, and the source of the very considerable influence it exerted over the subsequent history of Western science, lay in the rigour with which, given the starting points, robust conclusions could be reached by strict deduction. The point has recently been argued with particular force by Netz (*forthcoming*). Focussing especially on geometrical procedures in general and the potentiality of the investigations of conic sections in particular, he shows how the work of Archimedes came to serve as a crucial model that was followed and developed, and not just in astronomy, by many of the key figures in the development of later Arabic and European science.

If that argument is accepted, then one tiny or perhaps not so tiny aspect of what has sometimes been blown up into a Greek ‘miracle’ may be seen in a new light and so to that extent demystified. The Greeks certainly developed powerful tools to substantiate scientific theories and to demonstrate conclusions, thereby to win arguments in the highly contested debates that characterise so much of their culture. However in certain contexts they underestimated the difficulty of achieving the incontrovertibility they craved and so the limitations of the usefulness of the model they developed. We have seen already and shall remark again that a concern for validity is often subordinate to one for truth, and strict demonstration certainly requires the latter as well as the former. Moreover in the task of persuading others a consideration for truth may often be trumped by a sense of the importance of felicity, appropriateness or what conforms to some socially accepted norm or personal values. We shall need to keep these tensions in mind in our subsequent investigations into the virtues and vices, the ideals and the practices, of argumentation for which we have evidence in the historical record. For now we may reach the provisional conclusion first that the explicit analysis of argument forms was indeed carried further in classical Greece than in other ancient cultures – and thus far Greek exceptionality may be acknowledged – but secondly that this was certainly no unalloyed triumph of rationality, nor some totally inexplicable mystery. That last point is the subject I shall endeavour to clarify further in the *next chapter*.

<sup>13</sup> I shall return in the *next chapter* to investigate further what the development of Greek argumentation owed to their political institutions in general and what to democratic ones and democratic ideology in particular.

*The Question of Causal Factors*

The first goal of any historian is no doubt to give as accurate a description as possible of what actually occurred, while recognising that no account can be entirely theory-free, for all will presuppose some conceptual apparatus. But then the further task we face is to attempt some explanatory account of the factors at work that led to the outcome we describe. This will turn out to be of very varying degrees of difficulty depending on the focus of our attention. If we ask why after many decades when the so-called Warring States vied for hegemony in China, the state of Qin eventually achieved victory, we can explore the influence of such factors as the types of weaponry available, the effectiveness of military organisation and the extraction of resources, the centralisation of political power, even the ruthlessness of the leaders involved, while weighing up a series of always difficult counterfactuals – the question of whether things might not have turned out very differently, forcing us to endeavour to pinpoint the significant causal relations involved.

Where the history of scientific theories and programmes and of the underlying belief systems or cosmologies is concerned, an earlier positivist historiography was often satisfied by invoking the truth – that the principal factor at work when views change is how close they get to capturing what we with the benefit of hindsight can confidently proclaim to be the case. Scientific theories would come to be replaced because they were, or came to be seen to be, erroneous, even while those that replaced them would not be immune to being themselves superseded in turn, as more progress was made.

Yet the difficulty any such project of explanation suffers from is obvious. In practice what are later judged to be mistaken theories often survived even in the face of what positivism would have hailed as more advanced or truer theories. The heliocentric hypothesis proposed by Aristarchus of Samos in the third century BCE failed to supplant the ‘common-sense’ assumption that the earth is at rest in the centre of the universe, and that

was true not just for ordinary folk, but in the opinions of those who engaged most closely with the problems. As we shall see in the [next chapter](#), in the second century CE Ptolemy mounted a battery of arguments to confirm what everyone normally believed, namely that the earth has no movement in space. Aristotle put it that having truth on your side is a powerful advantage in the battles of persuasion that get to be waged on every topic imaginable. The trouble was the difficulty in assuring yourself that your conception of where the truth lies on a particular issue was not itself mistaken.

As we have already remarked, there have been plenty of controversies surrounding narratives of major breakthroughs in the development of human understandings of the world. That has not deterred historians from proposing speculative accounts that seek to give causal explanations of the explananda howsoever they have construed them. We are faced in fact with a proliferation of Grand Narratives that purport to identify the principal factors that have influenced or even determined the varying fortunes, the rise and fall, of divergent ontologies or cosmologies. The task of this chapter is to comment critically on some of these.

Four main types of such suggestions may be identified, those that pinpoint ecology as the main consideration, those that focus on language (including literacy), those that do so on technology, and finally those that argue that the key to understanding world views lies in the social and political organisation of the groups that produced them. That ecology, language, technology and politics may all exercise a certain influence has a certain immediate plausibility. The questions we must tackle here are how far such influences extend and whether any of them, singly or in combination, amount to necessary and sufficient conditions for the characteristics of any of the belief systems with their attendant sets of practices for which we have evidence in ancient history and in the modern world.

The influence of ecology, even geography, is relatively easy to test in one way at least. There are plenty of examples of human groups that share broadly the same geographical conditions but that have very different understandings of the world. This applies first to large swathes across the Eurasian land mass that share approximately the same general climate, even though punctuated by pockets of distinct microclimates. Yet Eurasia has always been the locus of an even more considerable diversity of ontologies, cosmologies and explanations of the phenomena (cf. [Diamond 2005](#)). Again ecological conditions across much of Amazonia do not vary much and yet the types of shamanic beliefs and practices recorded differ appreciably, as between what has been dubbed vertical, that is hierarchical,

shamanism on the one hand and horizontal or egalitarian types on the other (Hugh-Jones 1994). Conversely Levinson's studies of spatial cognition, that we have mentioned before, have shown that an absolute frame of reference, using north, south, east and west coordinates, is found in peoples that are widely dispersed across the world, not just in the flat plains of central Australia and the tundra of Siberia but also in the broken terrain of Meso-America (Levinson 2003).

But what about broad distinctions between hunter-gatherers on the one hand, sedentary farmers on the other, which might be thought to be relevant in particular to notions of the relations between humans and other animals, the leitmotiv of Descola's fourfold classification of ontological regimes? Thus what he called animism, totemism, analogism and naturalism differ according to whether what he called physicality and interiority are or are not shared between humans and other living beings.<sup>1</sup> Yet hunter-gatherers do not all uniformly exemplify animist regimes, no more do they all adopt totemic ones. Even if we may accept that he has identified important differences between ontologies, there are no clear correlations between those regimes and the ecological circumstances in which different groups live. Obviously the imagery used in cosmogonical myths will reflect the physical experiences of the peoples concerned. Floods, tsunamis and earthquakes are more likely to figure more prominently in such stories in parts of the world where they are frequent. But while such trivial points can and should be conceded, attempts to see ontologies as determined by geography or ecology face prohibitive difficulties – not that Descola himself went down that route. Put quite simply, the varieties in the explananda show no distinct and uniform correlations with those in the explanatory factors that this argument would provide.

Where language and literacy are concerned, advocacy of their influence has been more sustained. We mentioned before (Chapter 1) Goody's thesis (1977) that the 'Domestication of the Savage Mind' (as he called it) owes much to the rise of literacy, especially that facilitated by the use of an alphabetic system of writing. First two concessions are in order. As

<sup>1</sup> The fourfold schema in Descola (2013) proceeds broadly as follows: (1) in animism other creatures besides humans have spirits, but what differentiates them is their bodies. So interiority is common, physicality is what differentiates things. (2) Totemism as now redefined assumes unity or continuity between humans and non-humans both on the physicality axis and on the interiority one. (3) Analogism, the reverse of totemism, assumes discontinuities on both axes but finds analogies and correspondences across the domains so differentiated. Finally (4) in naturalism, the default ontology of modernity, physicality is unified (everything is made of the same stuff) but interiority is discontinuous. Humans alone have true culture.



subsequent neurophysiological investigations, using fMRI scans, confirm, the ability to read does bring about certain changes in the brain (Changeux 1985). Yet how these correlate with modes and manifestations of intelligence remains problematic. As many studies since Goody have confirmed,<sup>2</sup> schooling and contact with literate outsiders such as missionaries can certainly have marked effects on behaviour. But as Vilaça (2010, 2019) for one has shown, those influences should not be exaggerated. Indigenous peoples can be as capable of making allowances for the differences between themselves and the foreigners who visit them as the anthropologists are when they conduct their fieldwork. Those indigenous peoples may, in other words, be far from convinced of the superiority of what those outsiders are trying to persuade them of. They are often keen to preserve their own ways and quite frequently succeed in this despite the pressures to which they are subjected.

But then the second and more particular concession to be made is that the presence of literate elites can undoubtedly produce important changes in the manners in which ideas are preserved, transmitted and challenged. However, we also noted two considerations that indicate that caution is needed in applying this second explanatory hypothesis too. First there is plenty of evidence that scepticism is present in basically non-literate societies and is certainly not the sole prerogative of literate ones, even though they had the advantage (when it was an advantage) of being able to cite written texts both for and against the positions they were dealing with. Conversely we have to take into account that when literacy is associated with the construction of a set of authoritative texts – a canon – that may inhibit the critical scrutiny to which Goody attached such importance.

But what about language itself, the factor that Sapir, Whorf and their followers have seen as key to the understanding of differences within cosmologies and to the development of scientific inquiry?<sup>3</sup> An obvious first difficulty here is that both in ancient and in modern times very different cosmic systems and different solutions to scientific problems have been proposed by individuals all of whom used the same natural language, whether that be ancient Greek or Chinese or modern French, German or English.

<sup>2</sup> Ong (1982), Havelock (1982), Olson and Torrance (1991) and Olson (1994) stand out among the many surveys of developments since Goody (1977).

<sup>3</sup> Leavitt (2011) has recently mounted a defence of a modified version of the original hypotheses of Sapir (1949) and Whorf (2012 [1956]) and Levinson (2003) has similarly cautioned against too swift a dismissal of their basic intuitions.

The inappropriateness of the Chinese language as a vehicle of scientific inquiry has been a recurrent theme, often associated with efforts to answer the so-called Needham question, of why the scientific revolution of the seventeenth century did not occur in China, which had been so far in advance of the West in so many respects up until then. As I noted in the [Introduction](#) that question is itself ill-formed, both oversimplifying Western breakthroughs and neglecting Chinese ones as well as attempting to explain a supposed non-existent occurrence ([Sivin 1995a](#): VII). But that has not deterred both Western and some Chinese writers from claiming that Chinese suffered from crippling disadvantages, notably systematic ambiguity and the difficulty in expressing abstractions. Such accusations go back to Hegel, at least, and have been repeated with scant regard for the counter-evidence by scholars such as [Granet \(1920, 1934\)](#), [Dubs \(1929\)](#), [Bodde \(1936, 1991\)](#), [Fung \(1948, 1952–3\)](#) and [Hansen \(1983\)](#).<sup>4</sup>

One particular argument mounted by [Bloom \(1981\)](#) in the wake of Sapir's ideas is that classical Chinese suffered from a particular handicap, namely that it had difficulty in expressing counterfactuals, thought of as especially important for the review of competing scientific hypotheses. Yet as others besides myself have shown, that argument was well wide of the mark ([Harbsmeier 1998](#): 116–18, [Wardy 2000](#), [Lloyd 2018](#): 59f.). Not only are there plenty of examples of classical Chinese thinkers considering what would be the case if certain conditions obtained (while recognising that they do not) but there is even an expression that marks out such hypotheticals. They are often introduced by a phrase that literally means 'falsely supposing' (*jia shi* 假使). The concession that should be made is that a highly inflected language such as ancient Greek or Latin does allow speakers to mark many different types of conditionals unambiguously. The reader or audience is thereby alerted to the difference between what according to the speaker *is* the case, what *will be* the case, what *may be* the case and what conceivably *might be* the case. But one would be hard put to it to identify where Chinese cosmological or scientific thought was hamstrung by the lack of syntactic forms suitable to make such distinctions salient.

In a more concrete and substantial instance relating to semantics rather than to syntax, namely the vocabulary to express colour perception, it is clear that the existence of a particular term for a particular hue enables a speaker to identify it without periphrasis. Yet although colour

<sup>4</sup> [Harbsmeier \(1998](#): 22ff.) surveys the history of this trope and rebuts most of the arguments concerning the characteristics of the Chinese language that were claimed to support it.

perceptions vary across human populations according to whether hue, or brightness, or saturation is the primary focus of interest, that does not mean that individuals find it impossible to discriminate between colours for which their natural language provides no particular name. Determining subjective impressions is always difficult, but differences between hues or between brightnesses can be registered without recourse to any language resources other than 'same' and 'different' (Mollon 1995). Here too, as in the case of spatial recognition, it cannot be claimed that a particular language that favours one particular mode of analysis has a monopoly of correctness.

Similarly systems of animal or plant taxonomy will vary in part according to the varieties with which any given human group will be familiar. Yet theories such as those of Atran and his associates (Atran 1990, Atran, Medin and Ross 2004) that would have it that across the world such taxonomies reveal more or less universal implicit apprehensions of similarities and differences between groups of animals run into difficulties when we ask how they relate to the actual differences that the attested classifications point to, for they may reflect quite different interests. In many cases the important explicit actors' differentiae do not concern zoology but such issues as whether the species of animal is edible or not, or whether its habitat is water, land or air (Lloyd 2007: ch. 3).

The third area we mentioned for consideration in our exploration of possible determinant factors in cosmological and scientific theories relates to technology, which has often been considered to be a key driver in the changes summarised under the labels of the scientific and the industrial revolutions. Once again obvious concessions must be made. The opportunity to reflect on what happens in the artificial conditions brought about by human technological intervention depends on the possibility of making such interventions in the first place. What the unaided human eye sees when it contemplates the heavens does not compare to what is revealed by an optical, let alone a radio, telescope. There is no way, currently, that the Higgs boson particle could have been verified without the Large Hadron Collider. As Macfarlane and Martin (2002) have argued, glass technology has repeatedly played a key role in one scientific advance after another.

Time and again the development of instrumentation stimulated fruitful modifications in scientific understanding. But to some extent that just pushes the problem one stage back, for the motivation to develop new tools and the realisation of that very possibility themselves require explanation. We understand, to be sure, that most humans will strive to seek a more comfortable mode of existence, one that demands less effort. But ideas on

how to achieve that, for example on whether it is a goal that should be pursued if it can only be attained at the cost of the exploitation of other humans, vary considerably. The well-known argument that the existence of slave labour was an obstacle to economic, and indeed technological and scientific, advance in the Greco-Roman world has sometimes been exaggerated (Finley 1965, Pleket 1973). The cost of slave upkeep and the threat of slave disorder were not lost on ancient authors, some of whom also challenged the underlying morality of the institution. Aristotle already reports the view (from which he himself dissents) that had it that the distinction between master and slave is not natural but arbitrary, a matter of custom or convention (*Politics* 1254a17–1255b15). If the ancient Greeks missed many opportunities – we might say – to explore technological solutions to the problems of production, straightforward monocausal explanations for this always fail in the face of the complexities of the situation.

For sure, as we said, much of modern science depends heavily on the technologies available, many of them way beyond the reach of much of the world's population in the past and even today. But where the impact of technological factors on cosmological understandings is concerned, the bottom line is the same as we noticed with language. Those understandings can hardly be said to be determined by the technology, since they are found to differ even when the technological circumstances were, in antiquity, or still may be today, to all intents and purposes, identical.

These remarks already take us to the final field we identified for examination, that relates to the social and political factors in play. At first sight there is again an obvious difficulty, in that here too no clear correlation seems to exist between ontologies or cosmologies on the one hand and political regimes on the other. Descola's four ontological schemata, for instance, to return to them, are not clearly associated with different particular solutions to the problems of social and political organisation. That does not mean that political considerations are irrelevant to our inquiry, but to follow up the influence they may have had we have to look not to substantial theories or explanations, so much as to such issues as the range of alternatives available to those proposing such explanations. The degree of dissent and dispute that particular regimes may tolerate on what we call cosmological as well as political or ethical issues does vary:<sup>5</sup> how significant is that?

<sup>5</sup> Thus far we may agree with Goody, while not invoking literacy as the key to the solution of the question.

One obvious point to start from is that in small-scale societies, limited to populations in their hundreds or thousands, as opposed to hundreds of thousands upwards, the range of possible views that are likely to be entertained on such questions as the stuff of which things are made or the origins of the world will in all probability be severely limited. Comparisons with the theories adopted by individuals or particular groups in societies as large and as complex as ancient Babylonia, or Egypt, or China or even Greece are then liable to mislead. If in those four ancient societies we find considerable scope for disagreement even on fundamental cosmological or religious questions, we must bear that point in mind. That is not to say that in small-scale polities there will be total uniformity of opinion. On the contrary we have already observed that doubt and scepticism about some common ideas, and concerning some claimants to knowledge, can be and are expressed frequently enough in small largely oral communities. Yet obviously full-scale debates such as we find in ancient Greece between atomism and continuum theory or in China between different conceptions on the transformations of yin and yang and of the five phases (see below, [Chapter 8](#)) depend on there being sufficient room for intellectual manoeuvre for different individuals and groups to develop and express their own solutions to the problems.<sup>6</sup>

The place that such would-be intellectual leaders hold in the societies to which they belong does offer one example where we may appreciate the relevance of political organisations. Evidently, as we said, both ancient and modern societies vary in the degree to which divergence in opinion is tolerated. Autocratic regimes do not take kindly to dissent on fundamental issues such as who is in control, who has the authority to govern. Yet that does not prevent some such regimes allowing disagreement on technical matters to exist and even to flourish. Thus in ancient China there were debates on the nature of the observations to be conducted, and even the instrumentation to be used, in relation to the determination of the lengths of the solar year and lunar month ([Cullen 2007](#)). Indeed, that was not just a 'scientific' issue, but one with important repercussions for the state. Nevertheless, the regulation of the calendar was the responsibility of the emperor himself and directly or through his representatives he ultimately adjudicated the outcome of the discussion. So here expertise was allowed to express itself, but only within well-defined limits. Challenge to the

<sup>6</sup> Neither of those ancient civilisations originally had institutions of religious censorship that matched those that were eventually developed by the Christian Church or other monotheistic regimes, though as I go on to note other modes of controlling deviant views certainly existed.

emperor himself was generally punishable by death, while denying the very idea that the rule of one person is the sole legitimate political regime was never within the horizon of possibility.

The contrast but also the comparison with the situation in classical Greece are alike instructive. Before the unification of China under Qin Shi Huang Di in 221 BCE, the so-called Warring States offered different bases for those who wanted to make their mark as advisers or experts including on the investigations of things, but even more importantly on matters of good governance. If a leading thinker fell out of favour in one court or one polity, he (it was usually a man) could move to another and try to build a reputation for expertise or as an adviser there.<sup>7</sup> Similarly in ancient Greece many would-be Masters of Truth moved from one city state to another, in search of patrons or pupils, more often the latter since they generally depended on teaching for a livelihood.<sup>8</sup> Those city states varied among one another in their political constitutions, the standard classification of such ranging from the rule of one person, through more or less restricted oligarchies, to democracies where power lay with the citizen body as a whole, though that never included females, foreigners or slaves. To that variety between different Greek city states we can add a further dimension, in that in many of them there were usually more or less violent alternations between more oligarchic and more democratic regimes. The instability of Greek political regimes – the constant threat of *stasis* – was the subject of considerable comment among the Greeks themselves, particularly among those such as Thucydides and Plato who saw democracies as especially unstable.

A pluralism of independent polities might permit a certain degree of pluralism in the belief systems of independent-minded thinkers. The skills those thinkers had to display to survive and flourish varied accordingly. It is

<sup>7</sup> The most notable case of this is what was reported about the life of Confucius, who in his travels nevertheless failed to find a ruler worthy to receive his instruction.

<sup>8</sup> One of the charges levelled against those called sophists was that moving from state to state in search of pupils, they bore no stable allegiance to any particular polity and so could not be trusted to have stable political or even moral views. In the context of disputes in the law courts they were criticised for supposedly teaching how to argue both sides of a case, and how to win suits irrespective of whether they were sound or not. They made the 'weaker' or the 'worse' cause the 'better', as Aristophanes, for instance, put it (*Clouds* 112ff.) and as Aristotle implies was associated with the teaching of Protagoras in particular (*Rhetoric* 1402a23–7). There was no doubt a good deal of exaggeration in such criticisms. But the basic fact remains: whatever their own city of origin, there were sophists who could and did move between city states offering instruction, including public lectures or *epideixeis*, on a wide variety of subjects to whoever was prepared to pay. Chinese itinerant advisers were very different in this respect, that their ultimate target audience was not the general public, nor even their own peer group (though that was sometimes the case), but rather rulers and their ministers.

obvious that a democratic assembly could be as closed in its opinions and as arbitrary in its judgements as any autocrat – as Socrates, as we said, certainly discovered. Yet whether faced with monarchs or groups of fellow-citizens, the problem of persuading the relevant audience to take your ideas seriously was always present. As we noted in the [last chapter](#), some Greek thinkers sought to block the objection that all that they produced were just plausible arguments by developing and invoking a very different model of reasoning, one that purported to deliver incontrovertible conclusions.

Yet for all the generic similarities that the task of persuasion presents, a gap opens up when we consider the consequences of different situations for livelihoods. Patrons might be rulers or private individuals, more or less generous in fostering the ambitions of those they supported in their entourages. They might even be prepared to allow some extravagantly heterodox opinions, for their courtiers were in business to entertain as well as to instruct (Netz 2009). However, there was always a more or less determinate line that could not be crossed.

But when your livelihood depended on the pupils you attracted, the risks were rather different, at least when what you taught was what you wanted to teach and what your pupils sought instruction in, rather than what a state-controlled curriculum dictated. To be sure overstepping the norm of what convention allowed could mean you lost your pupils and so your livelihood, though only in exceptional circumstances such as that of Socrates a risk to your freedom or your life, which would more often be at stake in autocratic regimes.<sup>9</sup> The recurrent problem with reliance on a patron was that he was liable to set or at least heavily to influence the agenda. The professional teacher could, in principle and sometimes in practice, engage in whatever investigations and instruction he or she chose: yet that was sometimes at the cost of a lack of the more or less stable support that an influential patron could afford. We thus encounter, already in the ancient world, a version of the issue that still besets us today, that of striking a balance between institutional sponsorship and individual innovation. It is certainly not the case that we have entirely resolved the problem of ensuring reasonable state or institutional support without considerable negative interference in how that support is used.

<sup>9</sup> When Aristarchus proposed the heliocentric theory the Stoic philosopher Cleanthes is reported to have said that he ought to be tried for impiety for moving the Earth, the Hearth of the World, from its central position (Plutarch *On the Face of the Moon* ch. 6, 923a). But there is no evidence of anyone following up such a suggestion. The contrast with the fates of Giordano Bruno and of Galileo is obvious.

So where ancient Greece is concerned, the possible influences of their distinctive political institutions are both multiple and complex. On the one hand, as Vernant (1962) and Vidal-Naquet (1967) were among the first to emphasise, the insistence on accountability in public life (especially but not exclusively in the democracies) is mirrored by demands for justification of theories and explanations in philosophy and elsewhere. In those circumstances it was not enough to defend a point of view merely on the grounds of the authority of tradition. On the other, as we have seen, Greek politics also supplied negative models, when dissatisfaction came to be expressed with 'mere' persuasiveness (even and perhaps especially when that was judged by what the majority voted for) – a view that led to a demand for an altogether more rigorous (if often unattainable) ideal, namely for strict demonstration securing indisputable conclusions.

The argument would not be that science – any science – could not flourish under any but open democratic or pluralistic regimes: the tremendous achievements of scientific investigators under autocracies in the ancient world and in more modern times from the Renaissance to the twenty-first century are enough to refute any such view. Rather the most that can be claimed are more modest points. While political pluralism is no guarantee that alternative world views will get to be developed and explored, it may serve as a more favourable political background to the development of cosmological and epistemological pluralism. The possibility of alternatives in one domain may inspire the contemplation of such possibilities in others: once again the question of scale is relevant. At least we have had plenty of experience of the contrary situation, where all-encompassing state ideologies close down dissent across the board. Yet the pluralism that counts where cosmology and science are concerned is as much a matter of the career structure and livelihoods of individuals as one of their participation in the political processes of the states in which they lived.

Given that we all inhabit one or other habitat on this one planet Earth, and given (more controversially) that we all share the same basic cognitive capacities, it may be thought surprising first that our understandings and our ontologies vary so widely and that pinpointing the reasons for this is so difficult. Yet maybe that surprise can to some extent be alleviated if we bear in mind the very different jobs of work that what we have been calling 'belief systems' and the corresponding practices perform. While some are directed at concrete problems of survival, others are geared to offering imaginative commentaries on whatever we may find interesting or puzzling, where elements of the ludic or playful may qualify such serious



concerns. Some have major repercussions for moral and ethical issues: others appear to be more abstract and technical, while never (so we have argued) being entirely value-free.

We are all perplexed by apparently fundamental questions to which we have no reliable answer. Of course modern science tells us a lot about the nature of life, the structure of matter, the origins of galaxies and even the Big Bang itself. Yet many problems still elude solution, in reconciling quantum mechanics and relativity, in the search for the Grand Unifying Theory, in the exploration of black holes and antimatter, as well as a host of issues in genetics since the discovery of DNA. It would be foolhardy to suggest that anyone can now predict where fundamental physics, where biology, or even where AI will be by the end of this century, even by the end of the next decade.

But although the way in which we now formulate the questions and attempt to devise methods to answer them are peculiarly modern, there is no reason to think that the capacity to pose at least some of the fundamental questions to do with life, the universe and our place in it, is not as old as the human race itself. It is not just modern science that puzzles about the origins of things and our future and the future of the world we live in. The assessment of what have been offered as answers is an ongoing concern where too hasty a dismissal is, as I have been maintaining, out of place.

To be sure, philosophy can claim that some such questions are simply not well formed. Given that an explanation must always be in terms of some factor that lies outside what has to be explained (if we are to avoid simple circularity) it follows that to ask for an explanation of 'everything' is one such ill-formed question, although attempts to answer it have repeatedly been made. Yet that leaves the vast majority of philosophical and scientific issues, not least those to do with how we should conduct ourselves, still to be resolved. On many technical issues, progress will no doubt eventually be made. But wherever values are implicated, we have to recognise that what we need is not just cleverer science, but greater wisdom. And what would that consist in? Greater self-awareness, no doubt, in the first instance, but also greater prudence in evaluating consequences and greater empathy in adjudicating between different conceptions of those values. Here the very proliferation of belief systems is not so much a cause for regret and dismay, as one of hope, if, that is, we can make the most of the opportunities those views offer us to learn. The baffling nature of cosmological heterogeneity can be turned into an incentive to deeper exploration, provided, of course, that we do not imagine that we have the correct answers already. We come to the investigation with

methodological and substantive presuppositions, but the first thing to keep in mind is that all are subject to scrutiny, none is immune to revision.

Meanwhile our explorations in this chapter serve to underline the difficulties we face in identifying just why and how different scientific theories, cosmological systems or ontological regimes get to be adopted, promulgated, defended, modified and on occasion abandoned. That is to say we cannot be confident that any of the factors we have reviewed provides the basis for fully adequate explanations on its own nor even in combination even though we can identify certain effects that literacy, technology, and political and social institutions have had at particular historical junctures. We are left then with the task of applying them differentially to the heterogeneous data thrown up by our cross-cultural comparisons, and we shall accordingly endeavour to take some steps towards such clarifications in the studies that follow.

*The Criteria of Theories, Simplicity for Instance*

By what criteria should theories or explanations be judged to be good, over and above the requirement or at least the ambition for them to be true or correct? We may invoke appropriateness, relevance, economy, clarity, comprehensiveness, generality, parsimony, simplicity, elegance, even beauty, but what views did earlier investigators entertain on the subject? We have already seen that one group of ancient Greek theorists developed a model of axiomatic-deductive demonstration designed to bolster claims that a sequence of argument could yield results that are not only true but incontrovertible. That, we suggested, was in the context of competitive claims to authority, where, according to some at least, mere persuasiveness was not enough: certainty had to be attained. The main problem that was often underestimated was that of securing primary premisses that met the twin criteria of indemonstrability and self-evidence.

But elsewhere some ancient Greeks tussled with another criterion by which theories could be judged, namely simplicity, and it will be instructive to examine how this worked out in practice. It so happens that we have extended discussions of this criterion in Ptolemy, especially in the *Syntaxis* or *Almagest*,<sup>1</sup> where he explicitly recognises that the invocation of the principle may run into difficulties, but then endeavours to circumvent these. Here is a notable astronomer at work in the second century CE reconciling or trying to reconcile his sense of the complexities of the problems with some of the basic assumptions, even articles of faith, that in his view govern the scientific enterprise. We even have the further benefit of some explicit classical Chinese texts that similarly invoke notions of simplicity that allow us to offer some comparative judgements concerning their views on the subject.

<sup>1</sup> I shall cite this according to the standard two-volume edition of Heiberg 1898 and 1903, where I shall refer to the first as H 1 and to the second as H 2, citing the book number in Roman followed by the chapter in Arabic numerals.

First a little Greek lexicography is in order. The adjective we translate ‘simple’ is *haplous*, the cognate substantive being *haplotēs*, ‘simplicity’, but the range of meaning is considerable, not just ‘simple’ as opposed to complex, but elementary/elemental as opposed to composite/compound (*sunthetos*), and unqualified/absolute versus qualified/relativised (as in the contrast between Platonic Forms and particulars that share in them or imitate them). Used of human character and behaviour *haplous* may pick out what is frank, open and honest, as opposed to devious, but it may also have negative undertones of simple-mindedness, foolishness as opposed to what is sophisticated, urbane, *asteios*.

Where astronomy is concerned, however, the goal is often simplicity in the shape of what is considered the simplest hypothesis to account for the phenomena. The trouble is the phenomena are seldom simple themselves. The general principle is clear enough: it has affinities, of course, with what has become known as Ockham’s razor (Sober 2015, cf. 1975 and 1988). This is often stated as the rule not to multiply entities without necessity, though that leaves the question of where that necessity kicks in. When two hypotheses yield the same results, the simpler one – the one that makes fewer physical or conceptual assumptions – is to be preferred. One of the main contexts in which we see this at work in Greek astronomy is in relation to the choice between an eccentric and an epicyclic model for the movements of the sun, moon and planets. As was apparently known to Ptolemy’s predecessors already, Hipparchus in all probability, perhaps also Apollonius though the evidence for that is more disputed (Neugebauer 1975: I 263f., Toomer 1984: 555, Goldstein 2009), over a range of phenomena either an eccentric or an epicyclic hypothesis will serve equally well as the basis for an explanation of certain apparent irregularities.<sup>2</sup> When that is the case there is nothing to choose between them. Yet in practice Ptolemy favours an eccentric model for the sun, an epicyclic one for the moon and planets.

<sup>2</sup> Those apparent irregularities included the inequality of the seasons, i.e. the movement of the sun, measured by the solstices and equinoxes, and the phenomena of the ‘stations’ and ‘retrogradations’ of the planets, which had earned them the label of the ‘wanderers’ (though Plato considered that a blasphemy, *Laws* 821cd). Their regular easterly motion (when judged against the background of the stars) is interrupted. Their position appears to remain unchanged over a number of days (their ‘stations’) and they then move in a westerly direction (‘retrogradation’) for a further period, eventually, after a second ‘station’, resuming their normal easterly movement. Figures 5.1 and 5.2 in the Supplementary Note illustrate the epicycle and the eccentric models in their simplest forms and Figure 5.3 shows how the two can give exactly the same results. Figures 5.4 and 5.5 show how these models can represent the inequality of the seasons and the retrogradations of the planets.

Now this is in part because he believes that the eccentric model cannot account for one feature of planetary motion, namely that for each of the planets the time from greatest speed to mean is always greater than the time from mean speed to least (IX 5, H 2 250–1). On the other hand, the epicycle model can provide for this. So in this instance it is not that the eccentric and epicycle models are equivalent across the board – in his view at least – so the choice between them is not *just* a matter of simplicity, not at least where the planets are concerned. It is only in the case of the sun that his decision to favour eccentricity is motivated by that consideration. At III 4, H I 232.10–17 he makes the point explicitly: the anomaly of the sun could be represented by either the eccentric or the epicyclic hypothesis. ‘However, it would seem more reasonable to associate it with the eccentric hypothesis, since that is simpler and is performed by means of one motion instead of two.’

Actually, as the modern commentators note, it is strange that he does not see that the eccentric model can be fixed to yield precisely that feature of different times that bothered him, provided you allow the apsidal line to move – which Ptolemy himself later uses in XII 1 in relation to the outer planets. But that is a minor puzzle that need not concern us here.

So here is one context in which simplicity is invoked in the *Syntaxis* and at III 1, H I 201.18–22 we have an explicit statement of the general principle, though one qualified by an important proviso. ‘In general, we consider it a good principle to explain the phenomena by the simplest hypotheses possible, in so far as there is nothing in the observations to provide a significant objection to such a procedure.’ We shall need to come back to that later.

But another context in which comparative simplicity is mentioned has been much more of a stumbling block, and this too will involve me in a bit of a digression. This is the chapter (I 7) in which he rules out any motion of the earth, where he mentions the alternative suggestion attributed to some unnamed ancient theorists that the phenomena could be accounted for not on the supposition that the heavens revolve around a stationary earth (the view he favours) but on the basis of the idea that it is the earth that revolves on its axis once in every twenty-four hours. In fact he mentions two versions of that suggestion, one that has the earth alone revolving and a second that assigns rotational movement in part to the earth *and* in part to the heavens.

He goes on to say that ‘so far as the phenomena relating to the stars are concerned, perhaps nothing might prevent things from being in accordance

with the simpler [form of this] theory' (I 7, H I 24.14–18).<sup>3</sup> Yet in another translation (Taliaferro 1952) that was – disastrously – enormously influential, what Ptolemy is made to say is that the hypothesis that the earth rotates is simpler than the view that it is the heavens that do. He certainly goes on (all are agreed) to point out that on the grounds of physical considerations here on earth (movements of the clouds and of projectiles for instance) the earth's rotation has to be rejected. But where Taliaferro's and other renderings (cf. Pedersen 1974) go wrong is in attributing to Ptolemy a major concession that the earth's rotation is acceptable if treated as a purely instrumentalist hypothesis.<sup>4</sup> Rather, he is rejecting the more complex of the two rival views he has identified, for that makes the additional mistake of introducing an extra source of rotation. But that does not leave him endorsing the superior simplicity of the earth's rotation, for its greater or less simplicity compared to the theory of the heaven's rotation is not in view at all. True, he concedes that the earth's rotation is as it were a theoretical possibility, but it is one he immediately and emphatically denies on physical grounds – and it is clear that it is a physical, that is realist, account that he is after both here in the *Syntaxis* and in his *Planetary Hypotheses* (Lloyd 1991: ch. II, 269, 271).

Several texts in the *Syntaxis* indicate that Ptolemy is keen on the principle of simplicity. But the problem he faces over and over again in the detailed investigation of celestial motions is that the data he has to deal with are in fact extremely complex, as indeed he repeatedly points out. None of the periodicities of the motions of the sun, moon and planets can be expressed in whole numbers. The tables he sets out give their values to six sexagesimal places and even then that is only an approximation. At III 1, H I 209 he says that the sun's mean daily motion, expressed as a sexagesimal fraction, is 'approximately 0;59<sup>i</sup>, 8<sup>ii</sup>, 17<sup>iii</sup>, 13<sup>iv</sup>, 12<sup>v</sup>, 31<sup>vi</sup>'. And that is one of the simplest periods. IX 3, H 2 214ff. sets out the mean motions in longitude and anomaly for each of the planets.

So when he sets about constructing the epicycle models for each of the planets, the geometry is crystal clear (and I would say extraordinarily simple: the idea that epicycles are hard to deal with is often the reaction of those who have not undertaken to go through the relevant calculations). Yet the

<sup>3</sup> My translation of this crucial text is based on that in Heath 1932.

<sup>4</sup> That is, one that does not purport to describe physical realities, but only serves the purpose of yielding mathematical calculations that correspond to the observed data. Lloyd 1991: ch. 5 examines the relevance of the contrast between instrumentalist and realist interpretations to ancient Greek astronomy and engages in an extended critique of the then influential views of Duhem (1908) on that topic.

concrete parameters fed into the models are extraordinarily complex – as they need to be to give the best approximation possible.

Given the complexity of the phenomena to be explained, there is nothing particularly surprising in Ptolemy's invoking such complex parameters alongside his simple geometrical models. Indeed it is wholly admirable that in general he does not allow himself much grosser approximations and rounder numbers (his figure of  $1^\circ$  in 100 years which he settles on for the precession of the equinoxes is rather an exception).<sup>5</sup> Nevertheless this complexity may be thought to sit somewhat uncomfortably beside the ringing tones in which he describes the value of astronomy at the very outset of the *Syntaxis* I 1, H 1 7.17–24. Why is astronomy worth studying, he asks, and replies that it is not just to reveal and appreciate the beauty of the universe but also to improve human character:

Of all studies this one especially would prepare humans to be perceptive of nobility both of action and of character. When the sameness, good order, proportion and freedom from arrogance of divine things are being contemplated, this study makes those who follow it lovers of this divine beauty and habituates them, and as it were disposes them naturally, to the same condition in their soul.

But that is not where the problems for Ptolemy's programme end. For most of the *Syntaxis* he is concerned with the movements of the sun, moon and planets in longitude, that is along the ecliptic, discounting for the time being the latitudinal movements of the planets, north and south of the ecliptic. But then in Book XIII he turns to the latter problem. After some preliminary remarks in XIII 1, the next chapter observes that in the case of the three outer planets the eccentre has a fixed inclination, so that diametrically opposite positions of the epicycle have opposite directions in latitude. But for Venus and Mercury the eccentre moves together with the epicycle in the same latitudinal direction, for Venus always to the north, for Mercury always to the south, and a further couple of pages describe how this works out to give an approximation for the latitudinal movements.

<sup>5</sup> The equinoctial points are where the ecliptic intersects the celestial equator. The term precession is used to describe their gradual displacement from east to west in relation to the fixed stars. The value of  $1^\circ$  in 100 years was the figure that Ptolemy obtained from Hipparchus, the discoverer of this phenomenon for the Greco-Roman world in the second century BCE. But it is clear from *Syntaxis* VII 2, which cites Hipparchus' work *On the Displacement of the Solstitial and Equinoctial Points*, that Hipparchus himself treated this as a lower limit for the rate of precession. Ptolemy's acceptance of this figure for the actual value, in part no doubt for reasons of convenience in calculation, was to have very negative consequences for subsequent Western astronomy, though to be sure he should not be blamed for the mistakes of later authors who used his work uncritically.

Then we come (finally) to the text XIII 2, H 2 532.12–534.6 that is my prime exhibit in this chapter (Toomer 1984: 600–1).

Now let no one, considering the complicated nature of our devices, judge such hypotheses to be over-elaborated. For it is not appropriate to compare human [constructions] with divine, nor to form one's beliefs about such great things on the basis of very dissimilar analogies. For what [could one compare] more dissimilar than the eternal and unchanging with the ever-changing, or that which can be hindered by anything with that which cannot be hindered even by itself? Rather, one should try, as far as possible, to fit the simpler hypotheses to the heavenly motions, but if this does not succeed, [one should apply hypotheses] which do fit. For provided that each of the phenomena is duly saved by the hypotheses, why should anyone think it strange that such complications can characterise the motions of the heavens when their nature is such as to afford no hindrance, but of a kind to yield and give way to the natural motions of each part, even if [the motions] are opposed to one another? Thus, quite simply, all the elements can easily pass through and be seen through all other elements, and this ease of transit applies not only to the individual circles, but to the spheres themselves and the axes of revolution. We see that in the models constructed on earth the fitting together of these [elements] to represent the different motions is laborious, and difficult to achieve in such a way that motions do not hinder each other, while in the heavens no obstruction whatsoever is caused by such combinations.

Rather, we should not judge 'simplicity' in heavenly things from what appears to be simple on earth, especially when the same thing is not equally simple for all even here. For if we were to judge by those criteria, nothing that occurs in the heavens would appear simple, not even the unchanging nature of the first motion, since this very quality of eternal unchangingness is for us not [merely] difficult, but completely impossible. Instead [we should judge 'simplicity'] from the unchangingness of the nature of things in the heaven and their motions. In this way all [motions] will appear simple, and more so than what is thought 'simple' on earth, since one can conceive of no labour or difficulty attached to their revolutions.

Let me highlight just a few salient points in this amazing text.

- (1) There is a clear recognition of the *lack* of simplicity, as *we* might judge that, in celestial motions.
- (2) But that does not stop Ptolemy from claiming that they *are* simple, provided we adopt the right criteria for 'simplicity'.
- (3) That in turn means that we have to accept that there are radically different criteria for judging 'simplicity', (a) in the heavens, and (b) on earth, a point he bolsters by observing (4) that even in the latter case (b) opinions differ.



(5) While that might come across – to his readers as well as to us – as quite arbitrary, he appeals to the difference in the natures of the heavenly regions and what we are used to. (5a) We might expect the movements of the epicycles and eccentrics would get in the way of one another, as they are liable to do with human mechanical models.<sup>6</sup> But that does not happen in the heavens. (5b) We might expect that lower circles and spheres would obscure and make invisible higher ones, as they would if they were made of ordinary opaque stuff. Again that does not occur.

(6) In effect what he has done in (5a) and (b) is to convert what might well be thought to be major objections to his models into part of his justification for driving a wedge between celestial and terrestrial spheres and so justifying his original claim (in (2)) that the heavenly motions *are* simple (despite the complexity of his devices).

From initial applications, where simplicity is invoked to prefer one motion (eccentricity) to two (in the epicycle hypothesis), the notion has undergone a major transmutation. He had said (III 1) that we use simplicity if there is nothing in the phenomena to preclude it. But in practice, when he comes to the difficulties of latitudinal movement, ‘simplicity’ is transformed from an idea we can apply on the basis of our experience into a *postulate*. The heavenly bodies might look anything but simple: but that is because we are not using the right notion of simplicity. Adjust our perspective to what is appropriate to the heavens and those motions *must be* simple. We are just plain wrong to judge their simplicity by our standards. Think how wonderful they are in that all those celestial circles and spheres never get in the way of one another, never obscure one another.

Now in the *Syntaxis* Ptolemy has done a remarkable job of producing elegant models to account for a very wide range of astronomical phenomena (and as I said, they *are* elegant if one works through their construction and application). His not shying away from the difficulties, for example in relation to movements in latitude, is, I would say, wholly admirable (though for sure there are major difficulties such as the observed difference in the angular diameter of the moon at perigee and apogee where he does duck the problem).<sup>7</sup> But while he claims that when we contemplate

<sup>6</sup> That such physical models were made is clear not just from the written reports in Cicero, for instance (*On the Nature of the Gods* II 88, *Tusculan Disputations* I 63, *On the Republic* I 22) but from the sole extant example, the Antikythera mechanism described e.g. by Jones (2017). While aspects of its complex system of gear-wheels remain controversial, it was clearly designed to represent the movements of the sun and moon (including the cycles of both lunar and solar eclipses) if not also those of the five visible planets.

<sup>7</sup> In *Syntaxis* V 13 the values that Ptolemy assigns to the radii of the circles that govern the movement of the moon have the consequence that its distance from the earth should vary by as much as 34:65, or

'sameness', 'good order' and 'freedom from arrogance in the heavens', astronomy inculcates virtue in the soul, many a soul must have been pretty confused first by the difficulties of the system – not the number of epicycles, but the adjustments that have constantly to be made to give a tolerable approximation to the data – and then by the arbitrariness of his turning simplicity into a postulate.

To get all this into historical perspective, however, it is worth comparing Ptolemy's performance with that of some of his successors. Ptolemy takes on board complexity (even though he turns it into a special brand of 'simplicity') and does his best with his models. But the difficulties of astronomy were often greeted with a very different reaction, namely a profound scepticism as to whether astronomy is possible in the first place. Proclus in the fifth century gives several accounts of current astronomy but flirts with Plato's idea that astronomy should 'transfer astronomy above the heavens' – turning it into a purely abstract subject, that is (*Outlines* 2.1–13, Lloyd 1991: 259–60) and he believes the refutation of the hypotheses that he nevertheless describes 'will be obvious to you from their very exposition' (*Outlines* 4.9–12, Lloyd 1991: 263). Then Philoponus too, in the following century, expresses profound doubts about whether astronomy was in any position to deliver causal explanations (*On the Construction of the World* III 3, Lloyd 1973: 163) and he was one of those in late Greco-Roman antiquity who flatly denied the precession of the equinoxes, even though the evidence to support it was growing all the time.

Materials from the later history of Western science can certainly be cited that serve to confirm the ongoing ambivalence of simplicity. While there are plenty of examples where it fruitfully guides observation and theory, there are others where it misleads. While there are instances where it enables regularities to be discovered, in others it turns into disastrous a priori dogma. Ptolemy's ambitions for astronomy certainly revolve around this concept (among others), but we see what a struggle he has to put it to work: indeed the price he has to pay (and pays not totally unwillingly) is to engage in what I called that transmogrification.

nearly 1:2. Since, for small angles, the tangents are nearly proportional to the angles, this in turn means that the apparent diameter of the moon at perigee should be almost twice its apparent diameter at apogee. Moreover Ptolemy was well aware that that is not the case as we can see from other evidence (in *Syntaxis* V 14 and 17) that yields reasonably accurate estimates of the moon's diameter at maximum and minimum distance. Yet in setting out his model for the moon's movements he ignores this problem (Neugebauer 1975: 1 101–3, Pedersen 1974: 198–9).

Two final observations of Ptolemy's work in other areas of science need to be made. In harmonics the fact that the major concords of octave, fifth and fourth are expressible as ratios between small integers is a marvellous example where 'simplicity' seems thus far at least to be vindicated, though Ptolemy was one of those who flirted with the idea of the harmony of the spheres, where the complexity of the astronomical data rears its head once again.<sup>8</sup> In one area of optics his tactic seems to have been altogether more ruthless, though the problem we face here is that our sources are indirect (a twelfth-century Latin translation of an Arabic version of his text rather than the Greek original) and may well be corrupt. I am referring to his investigation of refraction, where the tables that we find in our source set out data that have clearly already been adjusted to fit what Ptolemy presupposes as the general law of the relation between the angles of incidence and of refraction for several pairs of media.<sup>9</sup> Simplicity in the equations that represent those laws, in that instance, was bought at the high price of 'simplifying' the 'data' themselves. But that was certainly not the last time that was to happen in the history of science.

Further aspects of the varying roles that some notion of 'simplicity' has played in different contexts in mathematics, science and cosmology come to light if we turn to some comparative evidence from other societies and periods. The Chinese term *yue* 約 picks out a procedure that is often explicitly invoked in mathematics, as we see both from the *Nine Chapters of Mathematical Procedures* and the commentary tradition on them, and from the first-century CE astronomical and cosmographical treatise, the *Zhoubi suanjing*. Thus in the former (I 5ff., Qian 1963: 94–5) when dealing with complex fractions our texts explain that the same quantity may be expressed in different ways. The ratio between 2 and 4 may be 'simplified' as 1:2, or complexified (the term is *fan* 繁) as 4:8. What is at stake here is the relative ease with which manipulations may be carried out.

But in the *Zhoubi* (Qian 1963: 24, cf. Cullen 1996: 177) simplicity or conciseness (expressed by the same term *yue*) is a desirable quality in the

<sup>8</sup> Lloyd 1996a: 174–80 sets out the convoluted theories stretching from the pre-Platonic Pythagoreans down to Kepler and beyond that aimed to reconcile what was known or assumed about the distances and speeds of the sun, moon and planets with the primary musical concords of octave, fifth and fourth. The idea that we cannot hear these harmonies because we have been habituated to them from birth is one that Aristotle dismisses with contempt (*On the Heavens* II 9: 290b12–31).

<sup>9</sup> The data claimed to have been observed are all reported as approximations, introduced with the term *ad prope*, representing *eggista* in Greek, 'most nearly'. But they all tally perfectly with the law that Ptolemy assumes, but nowhere states, namely  $r = ai - bi^2$ , where  $r$  is the angle of refraction,  $i$  the angle of incidence and  $a$  and  $b$  constants that depend on the specific pairs of media in question, namely air to water, air to glass and water to glass.

search for the Way. It is methods that both have that characteristic and are of 'broad application' that are said to be 'the most illuminating of the categories of understanding'. Simplicity here is not just a matter of ease in manipulation. In the quest for understanding of the 'myriad things' what the investigator seeks is simplicity with no loss of generality, facilitating the ability to distinguish categories, as the text goes on to say, while at the same time uniting them, that is seeing the connections between them.

Yet in other contexts the very same term *yue* refers not so much to a simplification of a quantity as to an approximation to it (Chemla and Guo 2004: 1028–9 on *Nine Chapters* I 32 and I 36). In this kind of 'simplifying', ease of manipulation has been bought at the price of a certain loss in accuracy (just as we found it sometimes was in Ptolemy). Like the Greeks, the Chinese certainly recognised that some of the operations they had to use in mathematics, and some of the data they had to deal with in understanding the phenomena, are complex and difficult. But even if we can say that the Chinese assume that the phenomena *will* be simple, there is no classical Chinese parallel to Ptolemy's bald assertion that – despite those appearances – in fact the data *must* be simple. Nor do we find in China evidence of the further move that Ptolemy makes when he asserts that cosmic simplicity serves as a recommendation to us to behave in accordance with the principles of 'sameness, good order, proportion and freedom from arrogance', even though many Chinese held that studying the interactions of yin and yang in the cosmos can contribute towards attaining the Dao and the ultimate goal of sagehood.<sup>10</sup>

Insofar as many nowadays would say that natural science and cosmology have nothing to do with ethics and with values, they might express little sympathy for the moralising views to be found in Ptolemy but have little trouble accommodating the desire for simple procedures that we have also found in the Chinese authors we have cited. Yet that may itself be an oversimplification (if that expression may be excused in context). At least it is often the case that modern scientists finesse minor discrepancies in the raw data available to them as they work towards the discovery of underlying regularities. Results that deviate from the line that marks out the equation that is assumed to hold will be discounted, as Lakatos (1976, 1978: 31ff.) exemplified in his taxonomy of the devices used, and used, in his view, legitimately, to avoid having to abandon your initial hypothesis altogether in the face of discrepancies. Fluctuations around a dominant value will be

<sup>10</sup> This is the message that the master Chenzi conveys to his pupil Rong Fang at the start of the *Zhoubi suanjing*; see Cullen 1996: 176ff. on Qian 1963: 23–4.

ignored. In the famous and well-documented case of Millikan's oil drop experiments (Holton 1978: 25ff.) data that gave complex 'messy' results were discarded and not even reported, even though his explicit methodological principle was to record every trial that was undertaken.<sup>11</sup>

While some aberrations may indeed be put down to human error, in observation or recording what is observed, it is still often enough the case that results are driven by an assumption that simple relations are there to be found. After all whenever a mathematical equation is set out with the equals sign it is imagined that the two quantities in question are indeed equal, not merely approximately so, for which we have of course a different symbol ( $\approx$ ). None of this leads modern investigators to draw conclusions about how we humans should behave or the values we should adopt. But simplicity often tends nevertheless to be not a result, but a presupposition with greater or less justification in different contexts. We evidently cannot know, in advance, when the simplicity of such ratios as those of the principal concords will apply, or when on the contrary we are dealing with something like the complexities of the relationships between the periods of revolution of the sun, moon and planets as observed from earth. But nevertheless the search for simplicity, at least the greatest simplicity possible, has been a recurrent driving force throughout Western science, receiving a ringing endorsement in a famous dictum of Albert Einstein (1934: 165): 'It can scarcely be denied that the supreme goal of all theory is to make the irreducible basic elements as simple and as few as possible without having to surrender the adequate representation of a single datum of experience.' The problem always was, of course, how to meet that final proviso. Ptolemy, as we have seen, certainly sometimes seemed to be prepared to sacrifice some of the 'data' at the altar of what was assumed to be needed for the representation to be 'adequate'.

This study of ours differs from some of our other investigations in one respect. This is not a case where there are substantial problems of translation between one natural language, one system of beliefs, and another. The concept of simplification is recognisably similar (though similarly multivalent as we have seen) across the vocabularies we have cited. Rather what varies, what gives us food for thought, is the different roles that concept has been made to play in the work of different investigators and that may give us pause if we were so naive as to imagine that there is nothing problematic in its use. To be sure, no one can object to a simplification effected to make a calculation more manageable if the quantities in question are not altered.

<sup>11</sup> Cf. Hacking 1983: 235–40.

But where a simplification does indeed discount certain data as due to experimental or other observational error, that rests on a presupposition as to how things are in reality (however they may appear to some observer) and that certainly raises a metaphysical issue. On what basis and with what justification can we assume that the realities we are dealing with obey or exemplify simple laws or relationships? That is a question that can hardly be answered unqualifiedly irrespective of the issues being investigated. The problem has been that commentators have too often been tempted to advocate either a general approval of such a principle of simplicity or an equally general mistrust of it.<sup>12</sup>

As we have found so often in these studies, entirely general solutions to the issues elude us, just as they elude those whom we are studying, and when they are attempted they may mislead. Where the invocation of simplicity is concerned, the investigator inevitably has to exercise judgement in arriving, in any particular case, at a reasonable trade-off or reconciliation between the assumption that the laws of nature are simple and the complexity of the actual observational data. The assumption is, of course, an idealisation, often bought at the cost of discarding some of the data. The recurrent problem to which no general solution is to be found is to determine how high a price can or should be paid in a bid to sustain the idealisation.

As a coda to our discussion we may note yet another historiographical issue that underlies the philosophical one. For some commentators the appeal to the idea that there are such laws in nature is a hallmark of modern science. Yet that has sometimes been without due regard to the ambiguities of the trope, for some such expression may be used with or without any clear implication that such laws are the work of some divine transcendental lawgiver, and with or without an understanding that they are a matter of statistical probabilities rather than of exceptionless rules. Thus already in Mesopotamian celestial predictions there is a clear understanding that the phenomena are regular, though also expressions of a belief that the gods can do anything. Order is the work of the gods, Marduk especially, but he could by his command destroy, not create (Rochberg 2004: 250ff., 2016: 172, 196).<sup>13</sup> In China by contrast the essential characteristics of objects or processes may

<sup>12</sup> Among those who have been thought to favour some version of Ockham's razor is Newton (1687: Part 3 Rule 1) who proposed as a Rule (called a 'Hypothesis' in the first edition) that we ought not to admit more causes of natural things than such as are both true and sufficient to explain their appearances. Those who have warned against reliance on it include Crick 1988: 146. Cf. Ball 2016 on 'the tyranny of simple explanations'.

<sup>13</sup> Rochberg 2016: 172, citing *Enūma Eliš* IV 23–4 ('At your [Marduk's] word the constellation shall be destroyed, "Command again, the constellation shall be intact"). The question of the relevance of this belief to our understanding of those conditional clauses in Mesopotamian astronomical texts

be ascribed to ‘heaven’ (*tian* 天) without any idea that some divine will is involved.<sup>14</sup>

But the importance of recognising an underlying possible ambiguity here becomes clear from the Greek sources (cf. [Lehoux 2006](#)). In several authors we find a collocation equivalent to ‘law’ or ‘laws’ of ‘nature’ (*nomos* or *nomoi tēs phuseōs*), most notably in Plato (*Gorgias* 483e) in connection with the views there ascribed to Callicles concerning the principle that ‘might’ is ‘right’. Yet in that context this must rate as something of an oxymoron, given first that *nomos* is a term that covers convention and custom as well as law, and secondly that it is generally concerned with the social domain where it was recognised to be culturally relative. But if we are not dealing with anything like our ‘laws of nature’ in that text, elsewhere Greek investigators do assume and claim they have identified not just the regularities in natural phenomena but the equations in which they can be expressed. This is certainly the case in Archimedes’ statement of what we can call (though he does not) the law of the lever as also in the equations we have discerned (in [note 9](#)) in Ptolemy’s *Optics*.

Moreover the idea that some such laws are not just true ‘for the most part’, but are immutable and could not be broken by the divine Lawgiver himself is stated explicitly by Galen (*On the Use of Parts* XI 14) when he contrasts his own view with that of ‘Moses’ whom he describes as holding that God could, if he wished, go against his own providential arrangements. Thus according to Galen, God would never have attempted to fix eyelashes in a soft and fleshy substance as opposed to a cartilaginous body. For if he had done so ‘he would have performed more disastrously not just than Moses but any bad general who plants a wall or a camp on marshy ground’. Galen acknowledges that the Judeo-Christian tradition sides with him in adopting a teleological position against the anti-teleological Epicureans, but he clearly marks his distance from that tradition in insisting that his divine Demiurge would never attempt

that describe what we would consider impossible phenomena, such as the sun coming out at night, is controversial ([Rochberg 2004](#): 250).

<sup>14</sup> The issue of whether one can attribute some idea of ‘laws of nature’ to ancient Chinese thinkers was the subject of a notable controversy between [Needham \(1956](#): 518–83) and [Bodde \(1957, 1979\)](#), the former resisting any such attribution, the latter assembling the admittedly limited evidence for it, notably from the second century BCE compendium, *Huainanzi* ch. 5 ([Major 1993](#): 264–8). There the emphasis is on the standards that apply to regulate the cosmos as well as human behaviour, where the human ruler should follow the patterns that a celestial one, the Lord on High, is said to use. However, these standards make use of technological images (levels, marking-cords, balance beams) more than they do ones drawn from the sphere of law.

things that are impossible in nature.<sup>15</sup> But while Galen's own brand of teleology is evidently open to criticism, his inquiries are clearly driven by a conviction that there are constant principles at work in nature which it is the goal of those inquiries to uncover.

We are alerted to the fact that *some* idea of the regularities in physical phenomena drives many different modes of investigation in different societies at different times, but what types of regularities in what domains remain open questions in ways that demand further inquiry from us. Once again the thesis of a radical break between 'ancients' and 'moderns' runs into difficulties over and above those that are implicated in attempts to generalise about those different ancients and moderns themselves.

<sup>15</sup> The issue of whether there are any constraints on the omnipotence of God continued to be hotly debated in later pagan, Arabic, Hebrew and Christian commentators. In the twelfth century, Maimonides, for example, defends Moses against what he sees as the misunderstandings of Galen under the influence of a mistaken belief in the eternity of the natural order (Maimonides, *Medical Aphorisms, Treatise 25.61–7*, Bos 2017: 171–91, cf. Walzer 1949: 35). Evidently those who (like Maimonides) believed in miracles as described in sacred texts such as the Old or New Testament were committed to a stronger concept of the supernatural than is normally implied when, as in Aristotle, what happens 'contrary to nature', *para phusin*, is a matter rather of what is unusual or irregular (cf. Plato *Timaeus* 83e where the processes that are contrary to the 'norms', *nomoi*, of nature are pathogens). The official position of the Roman Catholic Church when considering candidates for sainthood remains that to qualify they must have performed acts that cannot be explained in terms of natural causes.



*Supplementary Note on Greek Astronomical Models*

Figures 5.1 and 5.2 give the simplest forms of the epicyclic and eccentric models respectively. In Figure 5.1 the planet (or sun or moon) (P) moves round the circumference of an epicycle, whose centre (C) itself moves round the circumference of what is called the deferent circle whose centre (E) is the earth. The sense of the movement of a planet on its epicycle is the same as that of the deferent circle, while for the sun and moon, which do not exhibit retrogradation, the two circles move in opposite senses.

In Figure 5.2 the planet, sun or moon (P) moves round the circumference of a circle whose centre (O) is at some distance from the earth (E).

Figure 5.3 shows the simplest case where the eccentric and epicyclic models give rise to the same phenomena. When the radius of the deferent circle (CE) is equal to that of the eccentric circle (RO) and the radius of the epicycle (RC) is equal to the eccentricity (OE), then if the angular velocities are such that R and E remain vertices of a parallelogram (CROE and C'R'OE) the two models give equivalent results.

Figure 5.4 illustrates how in the case of the sun an eccentric model can represent the inequality of the four seasons measured by the solstices and equinoxes, and Figure 5.5 shows how an epicyclic model can represent the retrogradation of a planet.

For a clear exposition of these models and how they compare with the way the phenomena would be represented in a Copernican, heliocentric system the reader may be referred to Neugebauer 1957: ch. 6.

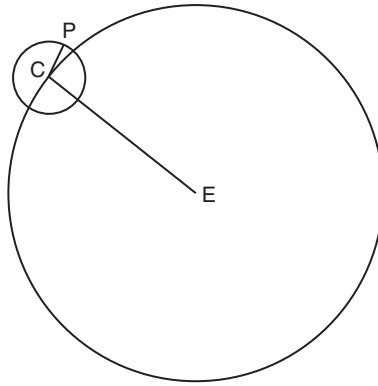


Figure 5.1 Epicyclic motion

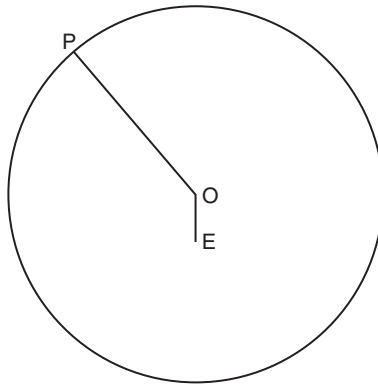


Figure 5.2 Eccentric motion

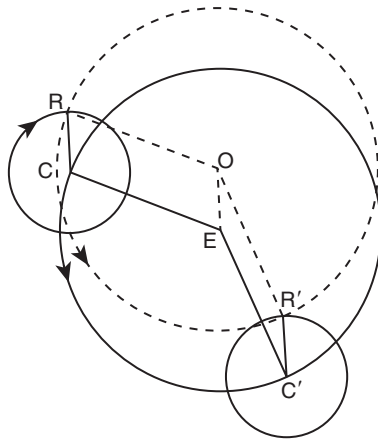


Figure 5.3 The simplest case of the equivalence of eccentric and epicyclic motions

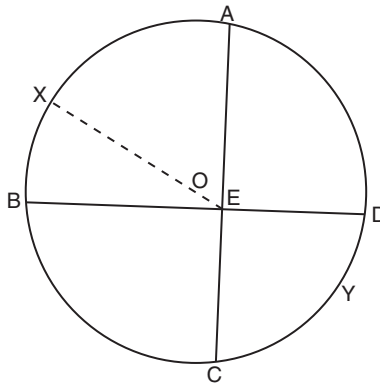


Figure 5.4 The inequality of the seasons explained by the eccentric hypothesis

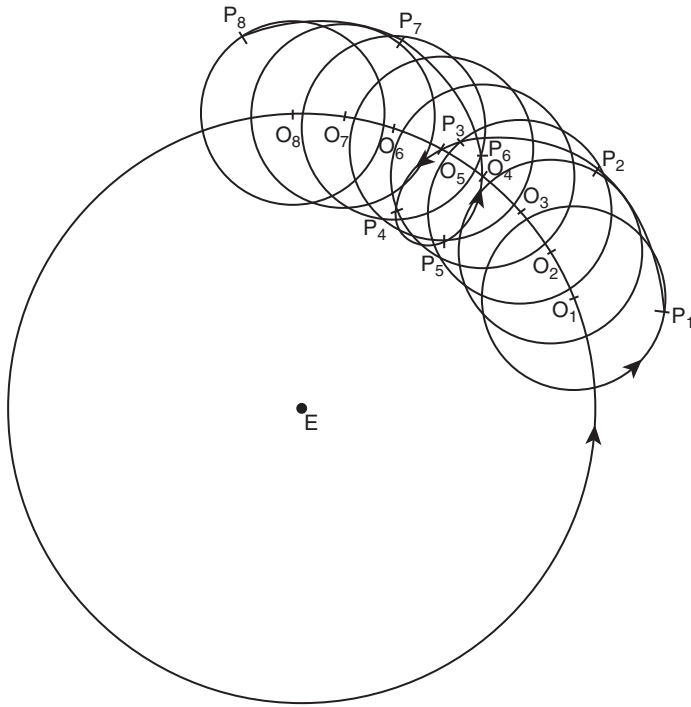


Figure 5.5 The epicyclic model used to explain the retrogradation of the planets

*Definitions and the Problems of Foreclosure*

One of the ways in which we endeavour to achieve clarity in communication and to avoid misunderstandings is to define our terms at the outset, with the idea of making it clear what it is we are talking about, although attaining exactness in the matter is often admittedly problematic. It seems perverse in the extreme to cast any doubt on that ambition. Indeed is not being careful to make ourselves clear a matter of common politeness (a universal principle of language use according to [Brown and Levinson 1987](#))? Yet it can be argued, and I shall argue, that in certain circumstances the demand for a univocal definition at the outset of an inquiry can prove to be a hindrance rather than an advantage.

Once again we have some ancient Greeks to thank – or to blame – for some unequivocal statements of the need for definitions, so our first task must be to review this evidence, probe its motivations and evaluate the consequences, for philosophy and mathematics as well as for science. It was Aristotle's view (*Metaphysics* 987b1–7) that Socrates was the first person to direct attention to universals and to definition, and Xenophon, for instance (*Memorabilia* I 1.16), confirms that that was a preoccupation of his.

Socrates himself left no writings. So saying quite how he went about his search for the defining characteristics of things is a matter of interpreting our secondary evidence – the so-called Socratic question, recently reopened in spirited fashion by [Rowett \(2018\)](#) who drives a far bigger wedge between the historical Socrates and how he is represented by Plato, and between both those two and Plato's own opinions and methodology, than has generally been assumed. Yet from my point of view here that issue may be bypassed in that whether or not the picture we have of Socrates in the early dialogues of Plato is historically accurate, those works confirm that the problems they raise were a matter for debate in classical Athens.

Throughout those dialogues of Plato he is represented as buttonholing anyone he came across and interrogating them on matters of philosophical, generally ethical or epistemological, importance. In the *Laches* for example

the opening exchanges focus on educating young men, but that turns quickly to the question of what excellence or virtue itself (*aretē*) is, which the discussants then narrow down to consider one particular type, namely *andreia*, ‘manliness’ or courage. Since Socrates’ interlocutors include a couple of famous generals, Nicias and Laches, the expectation is that they will know the answer. But Laches’ first offering is that the person who stays in the battle line, facing the enemy and not taking to flight, is courageous (190e). While Socrates agrees that that is true, he insists that it will not do as an account of what ‘courage’ is, since you can be courageous not only in battle, but in facing dangers at sea, in disease, in poverty, in political affairs, in relation not just to what is painful or fearful but in resisting desires and pleasures. So he wants an answer that will cover all such types (191d). He even supposedly helpfully illustrates what he is after with a non-moral example, ‘quickness’, whether in running or speaking or learning or playing a musical instrument, where he gives ‘the ability to do many things in a short time’ (192ab) as a model for the kind of reply he wants for ‘courage’.

Similarly in the *Meno* where again the topic they discuss is ‘virtue’, Meno says he has no difficulty in telling Socrates what the virtue of a man is, and again that of a woman, or that of a child, where again the answer will be different for a male child and for a female, as will the answer in the case of the virtue of a slave and that of a free man (71e). There are indeed lots of virtues, varying according to activity and age and so on. To that Socrates protests that he did not ask for a swarm of virtues but was after the respect in which they are all alike: just as if one is asked for a definition of ‘health’ or of ‘strength’, the answer should pick out the same character wherever it appears. He even suggests that the same applies in the case of ‘bees’, where what is at stake is what all bees have in common, thereby anticipating a problem we shall come back to, that of defining a species of animal.

So not only particular instances, or tokens, are rejected, but also specific types, in the search for the universal definition that covers all and only what the term corresponds to. But that presupposes that there is just one characteristic that every token and specific type exemplifies, a view that was famously rebutted by arguments in Wittgenstein (1953: para 66–7). Consider ‘games’, he suggested,

I mean board-games, card-games, ball-games, Olympic games, and so on. What is common to them all? Don’t say: ‘There *must* be something common, or they would not be called “games”’ – but *look and see* whether there is anything common to all. – For if you look at them you will not see something that is common to *all*, but similarities, relationships, and a whole

series of them at that . . . I can think of no better expression to characterize these similarities than ‘family resemblances’; for the various resemblances between members of a family: build, features, colour of eyes, gait, temperament, etc. etc. overlap and criss-cross in the same way. – And I shall say: ‘games’ form a family.

Socrates, to be sure, does not take Wittgenstein’s route. Dialogues such as the *Laches*, *Euthyphro*, *Lysis*, *Meno*, end in *aporia*, perplexity. The discussants are unable to give a satisfactory account, where the expectation is that this should be a definition, of the moral virtue, courage, piety, friendship, virtue itself, that they have been discussing. There is no doubting the deep concern with moral education that is here attributed to Socrates, and so with the importance of finding positive answers to his questionings. However, he is certainly made to protest that he is well aware that he himself knows nothing ‘so to speak’ (Plato, *Apology* 22d). When we are told by both Plato and Xenophon that the Delphic oracle proclaimed that ‘no one is wiser’ than Socrates, he is represented as concluding that the one respect in which he surpasses others in wisdom is that he recognises his own ignorance (*Apology* 20e–21b). To what extent this is to be treated as a case of his well-known ‘irony’ continues to be disputed (Vlastos 1991). But while he is consistently represented as objecting to relativist views, that would have it that right and wrong are purely a matter of convention or what people choose to believe, neither Plato nor Xenophon provides much help if we seek positive statements concerning the objective moral standards the historical Socrates was committed to.<sup>1</sup>

So how far Socrates himself built up positive positions starting from his quest for definitions is problematic. But we are on rather more solid ground when we consider Plato’s own development. As has often been noted he nowhere sets out what interpreters are used to calling his Theory of Forms, so all sorts of questions remain unanswered, over the scope of the theory, and on the relationships between the Forms and the particulars that participate in, or imitate, them. Equally it would be rash to attempt to identify one single motivation for Plato’s dualist metaphysics with its fundamental ontological contrast between the invisible, intelligible world of Being and the perceptible world of Becoming (*Phaedo* 79a). Equal sticks or stones will be equal in some respect, but unequal in others: but that would never be true of equality itself (*Phaedo* 74bc). Individual instances or particular types of beautiful object will be beautiful in some respects but

<sup>1</sup> On the basis primarily of Xenophon’s reports (e.g. *Memorabilia* I 4.4ff., IV 3.3ff.) Sedley (2007) argues that Socrates did hold that the world exemplifies providential design.

ugly in others, beautiful at one time but not at another, to some people but not to others. But beauty itself suffers no such limitations (*Symposium* 210e–211e). Thus one assumption that remains constant throughout his expositions is that of the singularity of the Forms that constitute the true realities behind the appearances. The Forms enter into relationships with other Forms, but each is unique and uniquely characterisable, ideally, in the kind of definition that Socrates was represented as seeking but failing to find.

But that prompts or presents us with a quite subversive thought. Insofar as the type of definition that is being presupposed is mistaken, to that extent an important element in the construction of the whole Platonic ontology has to be called into question. Perhaps the easiest case to illustrate this relates to knowledge itself, the topic of a sustained discussion in Plato's *Theaetetus* which again ends without a positive conclusion.<sup>2</sup> The objection would be that in such an instance trying for a single account, one that would capture the essence of every type of cognition we can recognise as 'knowledge', is massively mistaken. Not only is 'knowing that' different from 'knowing how' but each of those comes in a great many varieties, differentiated, for example, in the extent to which a verbal account of the knowledge type can be given. How does one put into words what knowing how to ride a bicycle consists in? Defining a colour, such as red, by a certain wavelength of light is all very well but does not help anyone to recognise that particular hue, where we are reduced, rather, to ostensive definition, pointing to an example. In such cases a concern for non-verbal understandings goes beyond Wittgenstein's preoccupation with the meanings of terms in the paragraphs in which he discusses family resemblances, though it shares with his view there both the negative point that there is no one thing that links all the instances and types, and the positive one that to answer the question we must 'look and see'.

The demand for a single univocal definition is particularly problematic when we are dealing with moral virtues. But such a demand was not limited to such cases. We have noticed that Socrates is made to offer a definition of 'quickness' in the *Laches* and he presupposes that one of 'bee' is possible in the *Meno* where at 74b–76d we are also given attempted definitions of 'figure' and of 'colour', just as we are of 'mud' in the *Theaetetus* 147c. So we should ask how the insistence on the answer picking

<sup>2</sup> Quite how Plato himself meant this aporetic conclusion to be interpreted remains a key problem in the understanding of his later metaphysics. For one very clear statement of the range of possibilities see Burnyeat 1990.



out the one common characteristic of the definiendum works out outside the particularly disputed domain of ethics (e.g. Robinson 1953: ch. 5, cf. 1950).

We can examine how the ancient Greeks got on in two other subject areas especially, animal taxonomy and mathematics. In the former, attempts were made to define particular species and indeed to construct an overall classification of animals by means of the method of Collection and Division. Once again Plato is our richest early source. Collection aimed to establish more or less inductively the overarching genus in question which was then to be divided and subdivided until the infima species was reached. The mode of division that was favoured for logical reasons was dichotomy, that proceeded by way of the division of a higher species into two groups that were supposed to be mutually exclusive and exhaustive. But it was soon realised that this was hard to apply in practice, even in such a simple case as the definition of human as rational two-legged animal.<sup>3</sup> Indeed Aristotle devoted three chapters of his *Parts of Animals* I (chh. 2–4) to a devastating critique of dichotomous division, among other things because it has to appeal to divisions of negative characteristics (or ‘privations’) such as ‘non-rational’, ‘legless’ or ‘bloodless’.

Yet that certainly did not lead Aristotle himself to renounce the whole ambition to seek definitions in zoology. There is a well-known and fundamental tension, here, between what in his account of scientific inquiry Aristotle set down as the ideal, and his actual practice when he grapples with the complexities of the data he is confronted with in the inquiry into nature. His account of method, in the *Posterior Analytics* (as we have seen), insists that strict demonstration depends on two features, valid deductive arguments, and self-evident primary premisses, identified as axioms, hypotheses and, precisely, definitions. These had in principle to be primary, true, necessary, better known than and prior to the conclusions and they themselves had to be indemonstrable, for if they can be demonstrated, they should be, and then they would not be primary. But while as we saw he offered some reasonable mathematical examples of self-evident axioms (notably the equality axiom) the application of these principles in zoology was problematic in the extreme. The overall classification of animals that we find reasonably consistently expressed in the zoological treatises is not arrived at by some process of division and does not yield

<sup>3</sup> Both humans and birds are ‘two-footed’, but Aristotle insists that bipedality in the two cases differs (*Parts of Animals* 643a3f.). When he considers this question at *Parts of Animals* 693b2ff. he points out that the legs of birds bend inwards (backwards), those of humans outwards (forwards).

definitions of animals that conform to the ideal of *per genus et differentiam*.<sup>4</sup> In fact that classification is under considerable pressure in efforts to cope with animals that fall outside the main groups, described in some cases as ‘dualisers’ in that they share some but not all of the characteristics of different groups (Lloyd 1996b: 72ff.).

Worse still, while the traditional view was that animals move independently, but plants are stationary, that idea was confronted by creatures that seem to be neither animal nor plant, sponges, ascidians, jellyfish, sea anemones and others. The pinna for example seems to be rooted and cannot live when detached from its anchorage. That would make it a plant, but it is usually classed among the testacea, one of the main groups of ‘bloodless’ animals. When we look more closely we find that Aristotle has in fact four criteria to distinguish plants and animals: does the kind have some means of self-preservation? Does it produce residue? Is it able to perceive? Can it live detached? But while perception is often cited as the chief criterion separating animals from plants – for unlike some other Greeks including Plato (*Timaeus* 77ab) he did not think plants perceive – in the case of the jellyfish or holothuria he explicitly denies that they perceive (*Parts of Animals* 681a7–20). Yet when he says that these holothuria live ‘as plants that are detached’, by the detachability criterion they class as animals. Faced with the difficulty of arriving at a definite verdict in several such instances Aristotle twice states that nature moves in a continuous sequence from plants to animals and indeed from the inanimate to the animate (*History of Animals* 588b4–18, *Parts of Animals* 681a9–b12).

Presented with the challenge of finding any satisfactory definition of a species of animal that fits the canonical form in Aristotle’s zoology (there are none), scholars have backtracked and turned their attention to his accounts of the parts of animals, for they are recognised as one of the main ways of differentiating them. But here too we face difficulties. We remarked that Aristotle distinguishes ‘blooded’ from ‘bloodless’ animals. But the latter have what is said to be ‘analogous to blood’, and similarly what is ‘analogous to a heart’ and ‘analogous to flesh’. This is important because ‘flesh’ is either the organ or the medium of touch, the basic mode of cognition that Aristotle

<sup>4</sup> Thus he regularly identifies the main groups of blooded animals as humans, viviparous quadrupeds, oviparous quadrupeds and footless animals, birds, fish and cetacea. Similarly he recognises four main classes of ‘bloodless’ animals, namely those conventionally translated ‘cephalopods’, ‘crustacea’, ‘testacea’ and ‘insects’, though as I shall be noting shortly, he considers some kinds to fall outside those groups and indeed to be in some sense intermediate between animals and plants. Moreover none of the informal accounts offered of these main groups conforms precisely to the ideal pattern set down in the *per genus et differentiam* formula.

generally refers to in his attempts to distinguish animals from plants. Yet sameness 'by analogy' is a weaker relationship than sameness 'in genus' or 'in species' and as such does not meet the usual criteria for standard definitions. When discussing definition in general, for example in the *Metaphysics*, he insists on form as the proper definiendum, though he allows that, for complex wholes, the account should pay attention also to the matter (Lloyd 1996b: 52–4). But in practice in the area of the inquiry into nature that he engaged in most systematically, namely what we call zoology, we find that his account deviates from the ideal he sets out in the *Posterior Analytics*. Yet instead of lamenting that he did not in practice live up to those ideals, we should rather congratulate him for a much richer discussion of the phenomena than would have been the case had he done so.

The difficulties that Aristotle's zoological investigations illustrate should not be put down to the primitive state of the discipline, although he was indeed very much a pioneer in the field. Nowadays we have to be sure a battery of techniques to enable us to delineate different kinds of animals and plants, from phyla, through orders, families, genera down to species, far more securely than he did. Yet that certainly does not mean that all the problems of classification presented by those kingdoms can now be said to have been resolved, while ever since Darwin there can be no question of any assumption of the permanence of the species we identify. The need to 'look and see', to undertake as wide-ranging a survey of the empirical data as possible, is still the watchword, which should carry due warnings against the dangers of premature definitive conclusions.

But while zoology and other areas of the inquiry into nature, such as the classification of stones or minerals, presented obstacles to those ancient Greek theorists who wished to insist on univocal definitions, mathematics was, to be sure, a far more promising field. Most of Aristotle's actual examples when he sets out his ideal in the *Posterior Analytics* come from mathematics, and Euclid was to take up the challenge, in the *Elements*, of setting out more or less the whole of mathematics as known at the time in a single axiomatic-deductive structure, where, as with Aristotle's schema, definitions figure among his primary premisses. Now Euclid does not leave evidence as to how he viewed his primary principles, so an element of uncertainty clouds this issue. But first there is no suggestion that he or anyone else in antiquity contemplated the possibility of non-Euclidean geometries that denied the parallel postulate.<sup>5</sup> On the other hand several of

<sup>5</sup> Pace several strenuous but misguided efforts to see him as doing so (Toth 1967, 1977). When Aristotle notes the possibility of denying that the internal angles of a triangle sum to two rights (e.g. *Posterior*

his definitions were anything but universally agreed among earlier and contemporary Greek mathematicians and this may be taken to suggest that he is exercising choice between alternatives. Two instances of this are the very first two definitions in Book 1 of the *Elements*. Others had defined a point as 'a monad having position', rather than as 'that which has no part' (as in Euclid), and while Euclid has a line as 'breadthless length' we hear of others who thought of it as the flux of a point.<sup>6</sup> That does not show that he was in any doubt about the truth of the definitions he opted for. But he can hardly have been unaware that they were, up to a point, open to question and not exactly entirely 'self-evident'.

At this point some might be tempted to conclude that this obsession with definition is an exceptional, peculiarly ancient Greek, phenomenon, on a par with and connected to their preoccupation with axiomatic-deductive demonstration.<sup>7</sup> But that would be premature. The demand not just to explain terms but to give them strict definitions may be thought to presuppose a situation of formal debate that will not necessarily be found in every human group. But as we have noted before, a fondness for well-regulated discussion is not confined to literate societies and we do indeed find that clarity and being able to classify affairs correctly are held up as virtues of good speaking in some predominantly oral groups.<sup>8</sup> However, to help assess the pros and cons of the Greek concerns with definition we should turn rather, as we have before, to the evidence from a comparably sophisticated society such as ancient China.

Although classical Chinese has often been accused of being a hopelessly ambiguous language, that, as I have argued before, is just blatant prejudice. If Chinese speakers and writers certainly exhibit considerable skill in exploiting the range of interpretations of communicative exchanges for rhetorical purposes, there are plenty of occasions when they seek clarification of the meanings of statements and of individual expressions within them. A large section of the Mohist canon, the *Mozi*, dating from the late

*Analytics* 93a33ff.) he does so only to show up the contradiction that would involve. The parallel postulate, stating that non-parallel straight lines meet at a point, is indeed the foundational principle on which the whole geometry of the *Elements* is based.

<sup>6</sup> With Euclid I Definition 1 (point) compare the Pythagorean definition cited by Proclus *In Euc. El.* I 95.21, and with Definition 2 (line) compare the view implied in Aristotle *On the Soul* 409a4.

<sup>7</sup> As we have noted before, there were indeed many other contexts in which a concern for accountability (*logon didonai*) manifested itself in classical Greek city states, notably in the *euthuna*, the scrutiny to which magistrates were subjected at the end of their tenure of office, in particular in connection with its financial aspects: see Lloyd 1979: 252–4.

<sup>8</sup> Thus to cite Gluckman (1967: 276f.) on the Barotse again, they use a distinctive term for the ability to classify affairs which they recognise as one of several special virtues in an orator.

fourth or early third century BCE, consists of definitions or rather glosses on key terms or phrases with explanatory comments, even though this material is particularly difficult to assess given the fragmentary and corrupt character of our extant texts (Graham 1978, 1989: 137ff., Johnston 2010).<sup>9</sup>

Then starting with the *Erya*, composed some time in the third or second century BCE, dictionaries were compiled providing more glosses especially of obscure words found in the principal canons, such as the *Shi* (*Odes*, or *Book of Poetry*). In such works we do not find overall general rules that stipulate the form that explications of meanings have to take. In practice, sometimes synonyms or near synonyms are offered, sometimes just examples, sometimes explanation that proceeds by analogy.<sup>10</sup> However, the interest in clarifying meanings is obvious even without anything that corresponds to a *theory* of definition.

It is especially where a writer introduces a new term with a particular sense in context that the need for such a clarification is felt and met with an explanation. We have already seen one example of this, in Chapter 3, where the mathematical commentator Liu Hui glosses a pair of terms used in the discussion of the addition of fractions. To quote the full text (I 9, Qian 1963: 96): ‘Every time denominators multiply a numerator which does not correspond to them, we call this “homogenize” (*qi* 齊). Multiplying with one another the set of denominators, we call this “equalize” (*tong* 同).’<sup>11</sup> Yet what we do not find, in any of the pre-modern Chinese mathematical texts, is any statement of the need for definitions that are to fulfil the requirements of the primary self-evident premisses of axiomatic-deductive

<sup>9</sup> Some of the terms explicated are relatively straightforward: in A 26 we are told that ‘benefit’ is what one is pleased to get, and in A 54 ‘centre’ is that from which all lengths are the same. Others are much more opaque. Thus in A 83 ‘connection’ is glossed as ‘exact, appropriate, necessary’ and in the accompanying explanation of ‘necessary’ we have (in Graham’s translation, 1989: 143): ‘what is of the sages, employ but do not treat as necessary. The “necessary”, admit and do not doubt. The converse apply on both sides, not on one without the other.’ Graham’s own gloss continues: ‘Here, “when one is necessarily absent without the other” allows one-way dependence, the “converse” requires two-way. The pronouncements of the sages, instructive as they are, are without the certainty of the logically necessary.’ Students would evidently require and receive oral explanations to supplement the written texts, though it is notable that Graham’s deploys the notion of ‘logically’ necessary for which there is no equivalent in those texts.

<sup>10</sup> In a famous instance of the last, in the first-century BCE text, the *Shuo Yuan* (II.8, 87.22ff.) when a king reprimands one of his advisers, the philosopher Hui Shi, for always using analogies, Hui Shi replies (using an analogy indeed) by showing that the only way to understand one particular term (*dan* 彈: it is some kind of stringed instrument) is by saying what it is like (namely a bow, but with a string made of bamboo).

<sup>11</sup> Note that these are not universal definitions of the terms *qi* and *tong*, but rather explanations of their use in this particular mathematical context. Liu Hui is similarly careful to gloss the terms he uses for particular geometrical solids, the *yangma* 陽馬, *bienao* 龜臑 and *qiandu* 堊堵 in his investigation, in chapter 5, of the volumes of pyramids: see Chemla and Guo 2004: 903, 970, 1017.

demonstrations. But then as we have pointed out before, the construction of that model for inquiry in ancient Greece was not an entirely unmixed blessing, in that its recurrent weaknesses, in relation to the difficulty of meeting the twin criteria of indemonstrability and self-evidence, were often underestimated.

It is time then to take stock. Definitions can serve several different roles in investigations. Much depends on whether they are construed as needed at the start of an inquiry, or as a summation of the conclusions of one. In the latter position the result of any complex research is unlikely to be fully captured by a simple statement defining one key term or even a set of them, although clarification of such may indeed be a part of the positive outcome. The danger remains that a crisp definition will secure its crispness at the price of eliding the nuances in the discussion that precedes it.

In the former position, at the start of an inquiry, we should distinguish. On the one hand a provisional statement of what it is that the study is addressing can be useful, though the emphasis may often need to be on its very provisionality.<sup>12</sup> We may have some more or less vague intuitions on the question of what distinguishes the living from the inanimate: but much of what we thought on the subject may have to be revised as the study proceeds.

On the other hand we have seen that when definitions form part of the primary premisses of an axiomatic system, revision is not envisaged and would in fact jeopardise their whole *raison d'être*. In such a role a definition may achieve clarity: but it will also inevitably constrain the subsequent investigation, which will be limited to what can be strictly deduced from the primary principles. Euclid's *Elements* provides the most striking ancient example that illustrates this trade-off between restriction and incontrovertibility. In this case we may consider that the limitations of the axiomatic framework do not unduly undermine the effectiveness of his demonstrations. But if Socrates in his quest for moral virtues and Plato in his for knowledge (for instance) had succeeded in fixing on a definitive statement, that would have been bought at the cost of foreclosing on the possibility of further insights. Similarly Aristotle's actual accounts of animals are all the richer and more informative courtesy of his departing from the ideal of definition to which he himself officially subscribed.

<sup>12</sup> Rowett (2018: 23) draws attention to a further use of definition at the outset of a discussion where it sets out a hypothesis concerning the sense of a term that is subsequently to be tested and may well be rejected.

Evidently many discoveries in any inquiry, including both science and moral philosophy, depend on a certain suspension of the rules that have been laid down by some scholars, especially in Western traditions, in the interest of an ultra-strict notion of definition. We should not approach the study of what makes an animal an animal with some ready-made definition *per genus et differentiam*, nor even set a definition in such a form as our goal. Nor can we say that there is nothing further to learn about 'courage' once we have settled on some definition. Nor should our present understanding of the range of 'games' preclude admitting others that we have not yet personally encountered or imagined.

The leitmotiv of my discussion of 'science' itself in these studies presupposes that we may well have more to learn even there, not just in the many particular areas where there is ongoing research, but in our understanding of the range of what should count as 'scientific' in the first place. To acknowledge the semantic stretch of many of our key concepts is, we may submit, useful in that it will help to keep us alert to new possibilities even as we have to learn to live without the certainties that have in the past been offered as the goal by traditional models.

*The Challenge of 'Mythology'*

Whatever we may think about what the term 'myth' covers, and about the relations between the stories we call 'myths' and others we label 'folk tales', 'legends' or 'fables', for instance, this whole area of human experience, many might say, has nothing to do with science or with knowledge, for we are dealing with purely fictional discourses. Our word originates, of course, from the ancient Greek *muthos*, where it often served as the antonym of *logos*. The latter term had a wide semantic range, including 'word', 'ratio', 'proportion', but it was often used for what could claim to be a 'rational account'. So on that story *logoi* are candidates for truth; *muthoi* by contrast make no such claims. Some have even seen the development of Greek philosophy and science in terms of a progression from *muthos* to *logos* (e.g. Nestle 1940, Snell 1953).

It is well enough appreciated, by now, that that picture of such a progression is a grotesque oversimplification (Buxton 1999, Calame 1999, 2009 [2000]).<sup>1</sup> To start with some very basic philology again, the term *muthos* is often a quite neutral one, referring to stories or narratives of any type, not just those recognised to be fictitious accounts. Conversely *logoi* too can be used quite generally, so that so far from there being an implicit contrast with *muthos*, the two terms can be used interchangeably. When Plato comes to offer an account of cosmology in the *Timaeus* that account is sometimes labelled a plausible *muthos* but sometimes a plausible *logos*. To be sure, the qualifier 'plausible' (*eikōs*) can be read to suggest a contrast with what is certain. But whichever of the two terms is used, the

<sup>1</sup> A far more nuanced set of suggestions concerning what Greek 'rationality', including mathematics and philosophy, owed to, and where it departed from, earlier mythical thought, was proposed from the 1960s onwards in a series of influential works by Vernant (1962, 1983 [1965]), Vidal-Naquet (1967) and their colleagues. I outlined what I owed to their arguments concerning the influence of political developments in Lloyd 1979: ch. 4, and cf. above, Chapter 4. My view is that it was political institutions in general, especially but not exclusively democratic ones, that were the key factor in the development of the demand for accountability in other spheres of intellectual life.



account should persuade us (Burnyeat 2005) as being the best account available of the subject matter in question, the origin and constitution of the cosmos. The question of what kind of account is possible is crucial. Plato wants cosmology to be the topic of a persuasive account though it cannot be a demonstrative one. But other Greek cosmologies and cosmogonies are presented without any such commentary on their claims for truth – which is one source of the challenge that mythology poses for us.

Although the original Greek term *muthos* did not necessarily carry pejorative undertones, our derived term 'myth' certainly often does. Where any self-respecting scientific account lays claims to be true, well grounded, verifiable, those are not qualities we expect in mythical stories where our imagination is subject to no such constraints. They may be designed purely to entertain. They may also instruct, when the moral of the story (as we call it) suggests points about human character and conduct and much else. But if there are elements in the story that are totally implausible and counter-intuitive, how should we react? One reaction is to suspend disbelief to allow the stories to feed our imagination, just as we do for other fictional narratives, but how far will that do as a response to their counter-intuitiveness?

'Myth' has to be sure been a favourite category used in ethnographic reports and anthropological discussion where it may take on a more positive valence as I shall shortly be discussing. But primed with the knowledge that our term has its origins in a distinctive set of Greek preoccupations we must first ask whether or to what extent it represents a viable cross-cultural category. Both other ancient societies and many modern ones should give us pause on that score.

The ancient Chinese, for example, have no equivalent term. The word in modern Chinese used for what we call 'myth' is *shenhua* 神話, literally 'spirit talk', but we do not find that in classical texts despite the fact that there is nowadays an enormous literature devoted to what is called ancient Chinese 'mythology'. There are indeed plenty of stories of the origins of things recounting the deeds of fabulous creatures, spirits or gods. But our early historiographical accounts move seamlessly from such tales to events more securely tied to known historical figures. In the first great Chinese universal history, the *Shiji* compiled by Sima Tan and Sima Qian around 100 BCE, the origin of each of the first three dynasties is traced to a miraculous birth in which a woman becomes pregnant after stepping into the footsteps of a giant, for instance, or swallowing an egg laid by a black bird (Lloyd 2002: 7). But while the authors elsewhere often lay specific claims for the correctness of their accounts, and the reliable

evidence for them, there is no sense of a distinctive break that marks the beginning of history proper from earlier purely legendary tales.

Modern ethnography provides massive evidence to supplement the point. The anthropologist Stephen Hugh-Jones is well aware of how individual Amazonian myths have been discussed by his colleagues and even, in the hands of Lévi-Strauss, been turned into a veritable system conveying the essence of what he called ‘concrete science’. But dealing with the Barasana among whom he did fieldwork Hugh-Jones offers a subtle and complex analysis that may be thought to show up some of the difficulties in our using the term ‘myths’ in this context. As I have had occasion to note in an earlier study (Lloyd 2020a) his observations are of fundamental importance if we are to get past the crude oversimplifications, even distortions, our terminology may import, and to restore some sense of the indigenous categories in play. This is what he had to say (Hugh-Jones 2016: 160):

The Barasana category *bukūra keti* [‘old people’s stories’] is normally applied to narrated myth but can also be used to refer to other historical narratives, to genealogies and to stories about the deeds of previous generations and past clan ancestors. At the other extreme the word *basa* covers song, dance and instrumental music. The category *keti oka*, which might be translated as ‘sacred, powerful speech, thought or esoteric knowledge’ applies, in particular, to ritual chants . . . But in a more extended sense *keti oka* applies not only to chants and shamanic spells, but also to dance songs, to the songs latent in the melodies of Yurupari flutes, and also to ritual objects, petroglyphs and sacred sites.

Obviously these distinctions do not map at all straightforwardly on to our general contrast between myth as fiction versus rational account. But it would be absurd to complain that the Barasana categories are faulty because they observe no such difference. Rather we must first take on board that they find other distinctions relevant to an analysis of modes of discourse and types of communication – a point we clearly have to bear in mind when we are faced with the problem of understanding their stories, ritual speech acts, spells and so on. The basic lesson we should take away from this is that the modes of discourse reported from among the Barasana do not all carry the same valence, the same kind and degree of commitment.

As a second example that further illustrates the difficulty of the mismatch between the relevant indigenous categories and our own let me take what Lewis (1975, and cf. 1980: 56–64) reported for the Gnaou of Papua New Guinea. Encountering the term *malet* Lewis commented that it is the

most common word for 'spirit' in Gnao, though they also have another word, *bely'it*, which he glosses as 'song spirit'. But it soon became apparent to him that just as *bely'it* stands for both 'song' (as well as 'dance' – these two are not distinguished) and 'spirit', so *malet* means not only 'spirit' but 'myth'. It is 'used to refer to a genealogical narrative, and also to any myth – to myths about great spirits who taught certain rites and to myths about witch-like spirits which are told as diverting horror stories' (Lewis 1975: 158–9).

But then Lewis adds the revealing comment (159) that while the translation of *malet* as 'spirit' was soon clear to him, that was not the case with the translation 'myth' or 'story'. 'The time I took to understand reflects the ease with which I could assimilate concepts of personified spirits but the difficulty I had in grasping the concept that a spirit and a myth, or a spirit and a ritual song are in some sense the same thing.' So while *malet* is used to refer to a man's ancestors as a collectivity and so to what we may equate with spirits in that sense, there is far more to it than that. A request by someone to tell a person's *malet* is 'met by the telling of the myth linked with a lineage, its history and the account of the man's pedigree' (Lewis 1980: 56).

Thus far we have seen good reason to be cautious about the applicability of the category of 'myth' cross-culturally,<sup>2</sup> and similarly that of 'mythology', which Detienne (1986) showed to be an idiosyncratic Greek invention. Both Hugh-Jones and Lewis continue to use the term 'myth' in relation to the narratives they are commenting on. But both recognise that this is their, observers', category, questioning just where it does or does not fit those their subjects themselves apply to discourse. Some may still want to argue that we can find traces of 'mythopoetic' thought in most societies. But we have to be clear that there is often no indigenous concept that corresponds at all precisely to whatever we hold this picks out.

At the very least we must be wary about one type of move that would contrast others' fictions with our true scientific accounts. Both the Barasana and the Gnao sources and those for many other groups suggest that a contrast between truth and fiction may not be the key criterion used

<sup>2</sup> For a further detailed anthropological discussion of the mismatches between indigenous categories and our own taxonomy of 'myths', 'sacred tales', 'folk tales', 'legends' and the like, see Goody 1997, who draws on his own field notes concerning the LoDagaa of Northern Ghana. In ch. 5 ('Myth: thoughts on its uneven distribution') Goody points out that the LoDagaa have no specific word for 'myth'. However he still allows himself the use of the term in connection with the Myth of the Bagre, on the grounds that it may be considered such in virtue of its status as a 'long recitation deemed central to a particular society or group' (Goody 1997: 156, 160).

in distinguishing different genres of communication.<sup>3</sup> But that still leaves open how, without such a contrast, we can find anything relevant to our own knowledge and understanding in these pre-modern or non-modern materials. If one side of the opposition fails the test of applicability, how can the same not be true of the other?

We can find some way to alleviate part of the difficulty if we go back to Lévi-Strauss's magnum opus, the four volumes of *Mythologiques* (1970–81 [1964–71]). In that context he used the French term *science*, which equates not so much with what we label natural science in English, as with systematic knowledge more generally. One of his great originalities was indeed to see an extraordinary variety of tales collected from across the Americas as forming a system. The myths deal with fundamental issues of origins and relationships and can be seen as a complex set of transformations conveying lessons on how things are or should be, on the rules of behaviour that must be obeyed, on the relations between humans and other kinds of living beings, and much else besides. The claim was that this was 'concrete science', distinct from the abstract theoretical science with which we are familiar in Western modernity, but 'science' (in the French sense) nevertheless.

There are many aspects of Lévi-Strauss's thesis that have been called into question. Is it indeed one and the same system of transformations at work in all these many variant stories from different parts of the Americas? That presupposes that we can treat peoples widely dispersed across the continent as in a sense a single cultural entity or at least as drawing on a common fund of lore. Yet the positive lesson we may take away from this exercise relates to the roles these stories may play precisely as the medium for instruction concerning fundamental issues of understanding. Where the label 'myth' inevitably, for us, tends to carry associations with the speculative, the counter-intuitive, the arbitrary, Lévi-Strauss showed us how we can and should see past that smokescreen to take their seriousness seriously.

By that I mean that looking past the format in which such stories are cast, we should recognise that they sometimes deal with subject matter that we think of as belonging to cosmology, cosmogony, philosophy or science. Now the difference in the format is important. Tales of the activities of divine beings who split the heaven from the earth to make the cosmos draw

<sup>3</sup> That is not to say, of course, that such a distinction cannot be made in other contexts. To cite Goody on the LoDagaa again (Goody 1997: 156): 'among the LoDagaa . . . there is a firm verbal distinction drawn between *yelmiong* ("proper affairs or true telling") and *ziri* (lies), though it is possible to argue that the LoDagaa concept of tales (*sĩnsuulo*) represents a third category, approximating to that of fiction, where there is no intention to deceive'.

on a totally different vocabulary, a different register, from explorations of the Big Bang. Our own theories of how humans evolved from other animals contrast with many indigenous accounts that claim that all living beings were originally humans, only for some of them to lose their humanity and to become the other animals we know today. In many indigenous stories the issues are what we should call moral, social or political ones, the rules that should govern correct behaviour, how one group of humans, seniors or juniors, males or females, kith or kin, should treat another, who is allowed to marry whom, how to honour the dead and the like. Those rules may be implied or suggested by the accounts of the paradigmatic behaviour of strange and wonderful figures before the present dispensation was established.

So concessions need to be made on several fronts, particularly first on the question of expectations, or the lack of them, concerning the verifiability or the testability of the stories, secondly on the contexts in which these communications take place, and third on the grounds on which the authority of those telling them is founded, that is on what basis they claim and get attention. On the first point we can recognise that to demand that accounts should be limited to those that are strictly falsifiable is very likely to be hopelessly over-restrictive, though that still leaves us with the question of how they should be assessed, if indeed assessment is thought to be appropriate. Some stories are told to entertain rather than to instruct, and where instruction can be thought to be an aim, that may be merely a matter of relaying what everyone already in some sense knows.

On the second point we may reflect on the difference that audience and occasion may make. As was so often discussed when the relationship between 'myth' and 'ritual' was the focus of anthropological attention,<sup>4</sup> the telling of a story may sometimes be just one part of complex behaviour the outcome of which included, even if it was not limited to, the reaffirmation of social bonds. That is a far cry from the way in which we officially prefer knowledge to be conveyed, where our own custom, in one context at least, favours or even demands that scientific papers be written in a totally impersonal style, as if no personal author was responsible or had been present as the study was planned and accomplished. To be sure myths too

<sup>4</sup> The controversy over the relation between myth and ritual goes back to the nineteenth century when extreme positions were often advocated, that myth was to be interpreted in the light of ritual or vice versa, see [Tylor \(1871\)](#), [Robertson Smith \(1889\)](#) and [Frazer \(1890\)](#). But it has continued to have reverberations both in anthropology (e.g. [Leach 1961, 1967](#), [Douglas 1966, 1975](#)) and in classical studies down to [Kirk \(1970\)](#), [Burkert \(1983\)](#) and [Johnston \(2018\)](#). Cf. also [Ackerman 1991](#) on ongoing assessments of anthropological debates, and [Eliade 1963](#) on the relation between myth and reality.

are (generally) not subject to personal ownership. But in their case their impersonality is not an aspect designed to bolster if not to guarantee their objectivity. On the other hand the very language in which myths may be recounted contributes to their power and exceptionality (cf. [Tambiah 1968](#)), as does their giving access to a sacred domain clearly marked out from the profane and everyday.

On the third point, on the nature of the authority claims in question, we may remark on certain similarities and also differences in the ways these are established and maintained, as between experts of different types, ranging from sages, gurus, shamans, or 'Masters of Truth' ([Detienne 1996](#)) to professional philosophers or scientists in modern institutions. All, we may suppose, depend on some perception of successful performance, however that is judged. Indeed where there are no publicly, indeed legally, recognised qualifications such as those secured by official appointments or university degrees, the need to continue to deliver the results expected will take on added importance. On the one hand, expertise of any type in any domain does not guarantee immunity to challenge, and we have insisted before that we should not underestimate the room for such and for dissent and scepticism in any society. On the other hand, we nowadays expect doctors, scientists, even philosophers, to have undergone a particular, highly institutionalised training. When it comes to judging their latest contributions to knowledge, systematic scrutiny takes on a far more fundamental role within the whole apparatus of peer-group review to which we are nowadays accustomed. Yet evidently no one should suppose that those procedures are infallible.

As we have remarked before, we tend to insist on clear boundaries between moral philosophy and natural science, even though I have had occasion to reject the notion that the latter can be entirely value-free, and part of my overall argument is that those discourses should not be thought to be hermetically sealed off from one another. We have, to be sure, good reason to be wary of attempts to draw positive conclusions concerning human social arrangements from our explorations of the origins of the universe or of life on this planet. We have learnt all too often and all too painfully the dangers that accompany any attempt to read off moral injunctions and even political ones directly from supposedly robust scientific conclusions.

Yet when all the concessions have been made, one basic point remains. While our everyday lives are taken up with mundane activities, negotiating relations with our neighbours, securing the wherewithal to flourish or simply to subsist, our deeper reflections on the circumstances of our

existence demand engagement with problems that must often be recognised to be intractable. We are surrounded by phenomena we do not fully understand. Even when we have a reasonable grasp of some particular phenomena thanks to our modern astronomy, physics, chemistry, biology, pathology and the rest, our science does not resolve all the questions to which we need answers, and our philosophy often does no more than clarify some unfortunate confusions. We do not generally cultivate mythology to make up the shortfall (though we may draw heavily on the resources of poetry and novels). But if that is not our customary style, we should recognise that what we label, with greater or less justification, 'myths' have often been the vehicle that others have used to explore fundamental aspects of the human predicament. They may certainly convey implicit, even explicit, messages on issues to do with good conduct and human flourishing that for us may belong to the domains of philosophy or religion or both.

But what about problems that overlap with those we consider lie in the field of science? They relate to two topics in particular. First they concern the relationships between humans and other living beings. We have an evolutionary theory to answer some of the questions, but 'myths' too may suggest an understanding of the kinship that unites all living creatures. Indeed in some cases they postulate a far closer bond than we ordinarily accept when we stress the distinctiveness of *Homo sapiens*, especially in the matter of the cognitive faculties that mark us out. Accounts such as those in Vilaça 2016 and 2019, of the encounter between Christian missionaries and indigenous populations reveal how persistent aspects of the belief in the uniqueness of the human species may be even in persons – including the missionaries – who otherwise sign up to the tenets of modernity.

Then the second major domain which complicates our view of the relations between myth and science concerns the fundamental issues of the nature of health and well-being. This is a topic that spans pathology and ethics and one that deserves separate detailed discussion such as will be undertaken in Chapter 9.

The discourse of mythology may well now strike many of us as unfamiliar – the label is sometimes applied in order to alienate – but my argument has been first that we must be aware that the negative undertones of our terminology may be quite inappropriate to the categorisation of indigenous modes of narration. In particular, secondly, condescension is surely misplaced, insofar as it may deflect us from pondering whether or not there are lessons to be learnt from the messages that are conveyed, even especially when these are not lessons that relate to specific areas of modern scientific

research, but rather ones that concern the very nature of the contrast between science and other modes of knowledge that we tend to presume.

Thus in the process we can discover that it is not just the concepts we customarily use pejoratively that need overhaul, but their approved antonyms as well, starting with *logos* as rational account, the purview of philosophy and science. The challenge of the subject we label 'mythology' remains, for what is at stake is the nature of what I have argued elsewhere (Lloyd 2018) to be the deep ambivalences of 'rationality' itself. Once again our examination of some ancient and ethnographic evidence reveals the hazards of applying a still commonly used binary, myth versus rational account, that we have inherited from the Greeks. That certainly obscures the fact that the actual actors' categories of discourse that our subjects find important are often very different from our own, with the usual consequence that if we impose our concepts and criteria on our interpretations, we shall be liable to miss the opportunity to call those concepts to account. On whatever other points we may beg to differ from Plato, he was right to insist that on certain issues demonstration is beyond our reach and the most we can attain is a probable account. At the very least we still face problems concerning the status of the more speculative areas of fundamental physics and the nature of the truths that can be claimed to have been secured.



*Elements, Processes, Substances, Stuff*

As a further test and exemplification of the principles that I hold should apply to the cross-cultural comparative history of science, I may take sets of assumptions about what things are made of. We start from some indeterminate notion that most human beings throughout human history have entertained some ideas about that. We have noted that the anthropologist Philippe Descola (2013) identified physicality as one of the two topics (the other being what he called interiority) that enable broad comparisons to be made between the ontological regimes that are found in any human group. On that view we all have some more or less worked out, more or less inchoate, ideas about bodies, though very different notions have been held, as Descola pointed out, about such questions as whether humans have the same kinds of bodies, that is are made of the same stuff, as other animals or inanimate entities. While the naturalistic regime that he considers the default position of Western modernity holds that every physical object must be made of the same matter, that is certainly not true of other regimes. According to animism, for instance, it is not interiority that distinguishes humans from other creatures but physicality, the different bodies that we and they are made of.

Both ancient Greece and ancient China have exceptionally well-documented views on that general topic, indeed different ones within each ancient civilisation, and this will allow me to introduce some of the complexities it presents. I shall use my usual tactics of probing the issues by way of the similarities and divergences we find in the historical record. But first some comments are in order on the fundamental question of whether it is justified to talk of some one general topic that we are dealing with here. An immediate difficulty arises, in that it might be objected that this way of presenting the comparative data prejudices the inquiry from the outset. If we examine other cultures searching for their ideas about body, matter, elements and so on, will that not lead us implicitly or explicitly to judge them all against what we believe we have now learnt from modern physics

and chemistry? Indeed positivist history of science, which is where the history of science began, did tend to set up a radical contrast between early, generally mistaken, views and sound, or at any rate better, contemporary solutions. But the consequence of a too easy assumption that all the problems have now been more or less definitively solved, or at least are on the way to being so, was that earlier views, like those of modern indigenous societies untouched by Western science, could be safely consigned to the dustbins of history, a matter of at most purely antiquarian interest.

But if we reject, as I do here, any such assumption that Western modernity has a secure vantage point from which everyone else can be judged – and found wanting – we can go back to the original complex sources for earlier and other views with a more open mind, to investigate not just different solutions to broadly the same problems, but also different construals of what the problems themselves were. Of course we must apprehend some commonality in the questions asked for comparison to get going in the first place and this will involve a certain suspension of judgement about what needs to be explained. There is, in any event, as I have insisted, no totally neutral way in which what we are investigating can be set out. But while the conceptual framework we bring to bear must be treated as provisional and revisable, that does not mean that no investigation is possible. Tentative though every inquiry must be, they can yield insights that allow us to reflect self-critically on the very assumptions that we initially took for granted. We shall see.

So to the Greeks first. Our understandings of the earliest speculations of the so-called Presocratic philosophers have been much influenced by a certain bias in our sources. These are mostly second-hand reports of their ideas rather than extensive extant texts setting out their theories in their own words, and even when we have the latter they have been selected by the sources that happen to have survived the vagaries of centuries of transmission. Aristotle provides us with much of our earliest evidence and although the idea that he systematically distorted the ideas of his predecessors in order to claim superiority for his own solutions to the problems has on occasion been much exaggerated (Cherniss 1935, contrast Guthrie 1957), he evidently did cast his descriptions and make his judgements in the light of his own philosophy. He does undeniably review their positions in the light of the contributions they make to his own 'mature' theories, notably on the all-important question of causes where he maintains in the *Metaphysics* that his own analysis of the types of explanations to be sought encompasses and supersedes all earlier efforts on the subject.

Thus his view is that several of the earliest philosophers were concerned with what he calls the material cause, what things are made of – the very topic that is our focus in this chapter. Thales in the sixth century BCE suggested water, he tells us at *Metaphysics* 983b18–27. But how exactly did Thales understand ‘water’? We had better be careful since Aristotle himself expresses a certain hesitancy about the reasons that may have weighed with Thales when he made the proposal he did. Perhaps, Aristotle goes on, he got the notion from seeing that nourishment is moist, that vital heat is connected with moisture and that seeds are moist – in other words he saw water as essential for life. Aristotle even notes, though he does not himself endorse, a view that linked Thales’ notion with the idea that the sea gods Ocean and Tethys are the parents of creation. Elsewhere (*On the Soul* 411a8) he reports that Thales held that ‘all things are full of gods’. Yet there is nothing to suggest that Thales was simply promulgating some myth, traditional or otherwise, for his ‘water’ is not a mythical being, a person. On the other hand it was evidently not inert stuff. Moreover the key question for us is whether Thales saw it as what other things are made of in the first place, for his concern may rather have been with where they originate.

The subsequent equally problematic history of other early Greek speculation shows how important it is not to jump to conclusions here. Later sources put it that Thales’ successor Anaximander considered the principle to be what he called the Boundless, while according to Aristotle again (*Metaphysics* 984a5) the third major figure based at Miletus, Anaximenes, chose air. Here too we have to question whether what those thinkers were after was some idea of the matter of which everything is made. It is not just that the proposals they put forward may seem so counter-intuitive to us. What is it for anyone to be committed to the idea that everything is *made of* ‘the Boundless’? The expression ‘that out of which’ in Greek (*ex hou*) is ambiguous – as indeed Aristotle himself points out – for while it can ask for an answer in terms of matter, it can also pose the question of origins. The latter interpretation of the early philosophers’ problematic has in its favour that it represents them engaging in an issue that would have been familiar to their audiences, in that it had already been discussed in earlier poetry. The most notable example of this is Hesiod’s *Theogony*, that gives an account of the beginnings of the cosmos though it does so not in terms of such physical items as water, but mainly in those of the generations of divine living beings, many of whom (though not all) have very distinct wills and personalities. There is still an important contrast between the early Presocratic philosophers and Hesiod, in that for Hesiod the current

dispensation of things is guaranteed by individual gods. But on the account I would consider more likely the initial Presocratic programme would be more correctly represented as one to do with cosmogony, rather than with cosmology.

If we take it that the earliest Presocratic interest was in origins we can make sense of something like a progression in the answers proposed, as one would-be expert attempts to outdo another. We are familiar with that competitiveness in other contexts, though to be sure that does not guarantee that this line of interpretation is correct in this instance. Thus Anaximander's Boundless, as a more indeterminate entity, might be construed as a way of avoiding an objection to Thales' view, namely that if water is the origin, it is hard to explain how fire, for instance, came to be. Again Anaximenes' proposal of air goes further than Anaximander in one important respect in that our sources suggest it was accompanied by a speculation concerning how changes begin to occur, namely by processes called rarefaction and condensation. The original air rarefies to become fire, and condenses to become water and then solids such as earth. 'Condensation' thus serves to capture something of the transformations from gaseous, to liquid, to solid states, though it would be grossly anachronistic to represent that as Anaximenes' own original understanding for he would have been talking not of states but of bodies.

As noted, this sequence of Presocratic theories would tally with a picture with which we are very familiar in later Greek thought, namely of thinkers engaged precisely in competitive dialectical exchanges in a bid to outdo one another in their claims, not just that there is a correct account to be had on even the most abstruse questions but also that they in particular are Masters of that Truth (Detienne 1996). Nevertheless, when all is said and done we have to admit that we ourselves are ultimately reduced to guesswork as to why these speculative theories were proposed and how they were vindicated if indeed they were. Nor is it at all clear how far they may have actually convinced contemporary ancient Greek audiences most of whom, we may imagine, were not much concerned with such flights of fancy.

We are on somewhat firmer ground about the views of later Greek thinkers for whom we have more reliable evidence. The first philosopher who produced what we can be fairly confident is an answer to the question of what we call the primary physical elements of things, the basic substances of which everything else is composed, is Empedocles in the fifth century BCE. He dubbed fire, air, water and earth the 'roots' of all things. They are the building blocks of which everything else is composed: the

'roots' combine in different proportions to produce compounds under the influence of two forces he named Love and Strife.<sup>1</sup>

Versions of some such theory of fire, air, water and earth as elemental were taken up by many subsequent Greek thinkers. They included Plato, in the *Timaeus*, though he considered those four simple bodies not to be primary, but themselves to be constructed out of elemental geometrical shapes, four of the regular solids analysed in terms of two types of primary triangles. Plato thereby took over and adapted an idea from the chief rival physical theory, that of atomism which had been proposed by Leucippus and Democritus in the late fifth century BCE. But the first crucial difference, in Plato's hands, is that the primary shapes are not indefinitely many (as in Democritus) but limited to those four regular solids. The second is that the whole story of creation, in the *Timaeus*, is under the auspices of the influence of a benevolent and beneficent creator figure, the Demiurge, who ensures that, so far as matter and necessity permit, the cosmos created is the very best possible (Sedley 2007).

Plato's particular geometrical analysis of fire, air, water and earth had few, if any, followers. But Aristotle's adaptation of Empedocles' theory had an enormous influence on later European speculations all the way down to the seventeenth century. His view was that each of those simple bodies is constituted by a pair of the primary opposites, hot and cold, and dry and wet (where moist or fluid is sometimes a better translation of *hugron* than 'wet', though its contrary, 'dry', *xēron*, as applied to fire for instance can certainly not be equated with our 'solid'). Thus earth is dry and cold, water wet and cold, air wet and warm, fire dry and warm. Aristotle rejected any type of geometrical atomism primarily on the grounds that it is a simple category mistake to reduce qualitative differences (as in hot and cold as he represents them) to quantitative differentiae. Thereafter some version of four-element theory was dominant not only among those who considered themselves 'natural philosophers' (*phusikoi*) but further afield, particularly among medical writers concerned with giving an account of what human bodies are made of,<sup>2</sup> and what constitutes health (a topic to which I shall return in the next chapter).

<sup>1</sup> Yet Empedocles' roots are anything but just 'stuff': they are divine (as also are the forces he calls Love and Strife) as is clear from his use of the names of traditional gods for them, as for example 'Hephaestus' for fire in Fragment 96.

<sup>2</sup> The Hippocratic treatises dating, mostly, from the fifth and early fourth century BCE contain a wide variety of theories concerning the fundamental substances that constitute the human body, some using various combinations of earth, water, air and fire and so on, others ideas concerning the primary opposites, such as hot and cold, wet and dry, and yet others developing one or other version of a theory of humours. But it is characteristic of Greek debates that there were radical disagreements

Our familiarity with the fortunes of theories based on earth, water, air and fire may lull us into underestimating first just how controversial they were among the ancient Greeks themselves. I have mentioned their chief rival, atomism. But fundamental doubts about the viability of the theory of four primary elements were raised already by Aristotle's associate and successor Theophrastus. In his treatise *On Fire* he raised questions about the status of that as a simple body and one of the elements. Unlike the other elements fire needs fuel to sustain itself, and unlike them it is always in a process of becoming,<sup>3</sup> whereas the other three are – more or less – stable substances. Yet those difficulties did not lead Theophrastus to propose an alternative general theory, nor did any of the many later writers who adopted some version of it propose substantial modifications. Whatever the possible objections to Aristotle's view here, it seems that for many these were outweighed by its simplicity and economy and the amount of *prima facie* support for it that could be adduced.<sup>4</sup> The choice that confronted Greek theorists who wanted to resolve the question of what things are made of remained broadly one between some version of the four-element theory and some mode of atomism. But there the disagreement over whether matter is infinitely divisible, or whether there must be ultimate indivisible units, was not one that could be settled by reference to observational data.

Then a further mistake that we ourselves must guard against is to suppose that what we are dealing with is always just a question about what things are made of, their material causes as Aristotle would say. In fact

not just on the right answers to the questions of these constituents, but also on how one should go about investigating the problem. The treatise *On Ancient Medicine* in particular attacks those who base their ideas on what the author calls 'hypotheses' – that is, postulates – such as hot, cold, wet, dry which (he says) nowhere exist as separate substances in the body. Chapter 1 of that work puts it: 'if one were to speak and declare the nature of these things, it would not be clear either to the speaker himself or to his audience whether what was said was true or not, since there is no criterion to which one should refer to obtain clear knowledge'. We have here a prime example of an ancient Greek author endeavouring to win an argument on a first-order question by recourse to a second-order criterion.

<sup>3</sup> 'Everything that burns is always as it were in a process of coming-to-be, like movement (*kinēsis*). And so it perishes in a way as it comes to be, and as soon as what is combustible is lacking, it too itself perishes along with it' (*On Fire* ch. 3, Coutant 1971: 5.8ff.). Such a view owed much to the far more radical cosmology of Heraclitus, for whom the cosmos itself is 'an ever-living fire' 'kindling in measures and being extinguished in measures' (Fr. 30). Much later, in the Hellenistic period, Stoicism was to revive the idea of the cosmos as fire, providing a further example of a doctrine that can be considered closer to Chinese process-oriented theories than most other Greek accounts.

<sup>4</sup> It was recognised that there are many different varieties of 'stones' and 'minerals' – the subject of a treatise by Theophrastus, *On Stones*. But these were mostly thought of as 'earth', sometimes with an admixture of another element, thereby forming what were called 'homoiomerous', that is homogeneous, substances. Metals, being liquifiable, were considered to be mainly 'water' and so on.

much more was generally at stake, for the answer to that question usually formed one part of a more comprehensive account of the world.<sup>5</sup> In the wake of Aristotle especially continuum theorists tended to be teleologists, insisting that not just material but also final causes have to be taken into account (cf. Furley 1987, 1989). Thus it was not enough to say what a particular part of the human body was made of: its function had also to be explained for a full account to be given. The heart is not just flesh in a certain configuration: it serves, some said, as a source for the blood in the body, or as others claimed, as the central cognitive organ. Yet again it was Theophrastus especially who puzzled over the scope of such explanations, questioning just how far it is appropriate to search for and find final causes at work in nature (Theophrastus *Metaphysics* 10a22ff., Lloyd 1987: 148–50).

Against the teleologists, however, the atomists maintained that final causes, purposes, should be excluded. Physical interactions alone provided the sole valid explanatory framework. So the dispute was not just about the account to be given of stuff, but whether we should view the cosmos as a whole as under providential control. ‘Physics’ in the ancient sense of the study of nature, and ‘cosmology’, were thought to carry implications for ethics, for the place of humans in the scheme of things (if there is indeed such a scheme), for our ideas about the good life and human happiness indeed. The view of both the teleologists and their opponents was that you had to understand natural phenomena (as they called them) if you were not to live in fear and ignorance. But there were plenty of sceptics who disputed the assumption that such causal explanations can be secured. They agreed that the goal was to achieve peace of mind, but for them the way to do that was to suspend judgement where such speculations were concerned.

All this Greek material is reasonably well known and the stuff of standard histories of the development of Greek speculations about the physical world. But to investigate just what is or is not distinctive about Greek preoccupations here, it is instructive to compare and contrast how ancient Chinese thinkers described the world they lived in, its development, the place of humans and how we should behave, where the first point to insist on is that the Chinese did not all adopt precisely the same position on such questions any more than the ancient Greeks we have considered did.

<sup>5</sup> As already noted, for many Greek theorists the primary elements are divine, as also were the so-called heavenly bodies.

Chinese cosmogonical accounts, as we might call them, often started from an assumption of an original undifferentiated state, that began to be transformed once yin and yang started to become differentiated – not that that was represented as the work of some transcendent and providential Demiurgic force.<sup>6</sup> But undifferentiated *qi* 氣 (a term whose meaning spans both breath and energy) came to be modified, producing the cycles of creation and destruction which were associated with the so-called five phases (*wu xing* 五行). These were fire, earth, metal, water and wood, linked in that order in the mutual production cycle, and in the order water, fire, metal, wood, earth in the mutual conquest cycle, as is exemplified in the second-century BCE text *Huainanzi*.<sup>7</sup> Given first that each forms a cycle which starts again once it has been completed, and secondly that production and conquest themselves balance one another, the ultimate victory of one item over the others is out of the question. But not only was there no classical Chinese teleological cosmology: no more was there the resolutely anti-teleological stance associated with atomism in ancient Greece. The idea that the fundamental physical constituents of things are indivisible atoms was not so much rejected as counter-intuitive as not even contemplated.<sup>8</sup>

Given the presence of fire, earth and water in the five phases it was almost inevitable that Western observers, starting with the Jesuits in the sixteenth century, treated those phases as the equivalent of Aristotelian elements (Gernet 1985). Indeed they deplored the inclusion of metal and wood, which they thought (following Aristotle) should be treated as homogeneous compounds, and they criticised the Chinese for failing to treat air as the fourth primary element. Yet this was entirely to miss the point, which is that the five phases are not primarily names for substances, but rather for processes (as my translation ‘phases’ for *xing* 行

<sup>6</sup> One such account appears in the *Huainanzi* ch. 3: 1a, a text compiled under the auspices of Liu An, King of Huainan, around 135 BCE: see Major 1993, Major et al. 2010. The lack of teleological cosmogonies should not be taken as an excuse to underestimate let alone to deny an interest in cosmogonical questions as a whole in ancient China, as Goldin (2008) has argued particularly forcefully.

<sup>7</sup> *Huainanzi* ch. 3: 28b sets out the mutual production order, and *Huainanzi* ch. 4: 11a the mutual conquest one. As with some Greek ideas, there is a prima facie plausibility in at least some of the relations presupposed. Thus in the mutual conquest cycle water can be seen to put out fire, and fire melts metal. However, as Sivin has documented (Lloyd and Sivin 2002: 253ff.) the doctrine of five phases only took its final form after developments that spanned several centuries.

<sup>8</sup> We have to add that we depend, as usual, on our extant sources. But they show no signs of an interest in the debate that pitted atomism against continuum theory in ancient Greece. Indian cosmologies, by contrast, do include ones based on atomism. The question of whether this was an independent development or one influenced by Greek ideas continues to be disputed, Zimmer 1952, Mohanty 1991, Bronkhorst 1999.



implies).<sup>9</sup> Ancient Chinese texts are explicit on that point, saying, for example, that ‘water’ is ‘soaking downwards’, ‘fire’ ‘flaming upwards’.<sup>10</sup> So where in ancient Greece the view that generally came to dominate thanks to the Aristotelian synthesis focussed on more or less stable substances, consisting of elements that come together to form various compounds, in ancient China more attention was paid to the dynamic processes that things undergo, the transformations to which they are constantly subject. The Jesuits might have drawn on their knowledge of Greek and Roman cosmology to compare Heraclitus or the Stoics: but convinced that the Aristotelian view was generally correct, or at least the best available, they continued to be dismissive of the Chinese ideas they encountered.

But as in Greece, so also in China, more was, in any case, at stake than just an account of stuff. If we wish to flourish we have to recognise that the key to success is to mirror, in our own lives, the orderly and harmonious interactions that we see played out on a cosmic scale. The secret is often represented as depending on knowing your place and acting accordingly. The father should be fatherly, the son filial, and kings and ministers should act properly as the kings and ministers they should be. We shall have more to say about this when we come to discuss health and well-being and their opposites in the [next chapter](#).

It is time now to take stock of what we can learn from this brief exercise in comparative history. Modern physics and chemistry, some may think, provide us with the correct answers to these questions with which thinkers in ancient societies struggled so pitifully. Yet first we have insisted that modern physics and chemistry are far from having resolved all the problems in a definitive fashion. Even in the case of chemistry, where we might assume that the analysis of ‘water’ as H<sub>2</sub>O is utterly secure, we should not treat its victory over rival formulae as a foregone conclusion. As Hasok Chang (2012) showed, the alternative, HO (with a different analysis of the hydrogen component), not only initially had much going for it, but (he has argued) even may have points in its favour still today. Meanwhile modern

<sup>9</sup> Even though in his pioneering work on Chinese science [Needham \(1954–\)](#) was well aware of the primary texts that describe the cycles of the phases, he persisted in writing of the *xing* as ‘elements’, no doubt assuming that that would make more sense to his readers.

<sup>10</sup> Thus in the *Hong Fan* chapter, dated to between the mid fourth and early third century BCE, in the *Shang Shu* (Book of Documents, [Karlgrén 1950](#): 28 and 30) we read: ‘Water means soaking downwards. Fire means flaming upwards. Wood means bending and straightening. Metal means conforming and changing. Earth means accepting seed and giving crops.’ In each case the explanation concentrates on how the process acts rather than on what the substance is or how it is constituted.

philosophy of physics wrestles with appreciably more demanding issues, the nature and properties of quarks or of dark matter, not to mention the satisfactory reconciliation of relativity and quantum mechanics. And if fundamental particle physics tells us one story about the ultimate constitution of ordinary tables and chairs, how that story is to be squared with our ordinary experience of those objects as we sit down to dinner is still the subject of some dispute.

But it is also important to see that the ancient theories too that we have passed under review differ not just in the solutions they offer but also, more subtly, in the scope of the problems they address. If we state that problem in the most general terms, as concerned with what things are made of, then there are commonalities that link ancient and modern speculations – and that allow a comparison between them to get off the ground. But as soon as we factor in what else is at stake, we can see how mistaken it would be to attempt to treat all these ideas on a par, let alone to settle on one view as straightforwardly correct, the others more or less disastrously flawed. What we can learn from ancient history here is something of the variety of the ways in which the problems themselves were construed, sometimes in terms of elements and compounds, sometimes in those of interacting processes. What on each occasion may look initially like a set of suggestions just about physical change turns out to be just one component in a complex world view in which it is not just an understanding of physical structures that is at issue, but also how we as humans should conduct ourselves. Of course nowadays strong links between natural science and ideas of human well-being have, as we said, generally (though not entirely) been severed. But if we wish to understand and appreciate our predecessors it is as well to recognise in what ways they saw them to be connected and to ponder the implications of doing so.

We may certainly agree with Descola when he drew attention to some of the importantly different ways in which what we call body, physicality, stuff, have been conceived and perceived in different cultures at different periods. But whereas his focus in this context was almost exclusively on the continuities or discontinuities between humans and other living beings, we have considered instances in which further differences turn out to be significant. Both ancient Greece and China figure as analogistic regimes in Descola's taxonomy and indeed both ancient civilisations make extensive use of analogies in their cosmological and physical accounts (Lloyd 2015). That is the chief mechanism by which links are established between the so-called macrocosm (the world as a whole) and the two microcosms – of human

bodies, and states, that is political or social arrangements (Sivin 1995b, Lloyd and Sivin 2002).<sup>11</sup>

But the crucial additional factor that emerges from our examination of ideas about the constituents of physical objects is the tension between viewing these as more or less stable substances on the one hand, and as processes in constant transformation into one another on the other. ‘Physicality’, on this account, may for some be not so much a matter of static stuff as of dynamic change, and in this context, whichever option is adopted will apply *both* to humans *and* to other living creatures. Yet that commonality – where humans and other animals are made of the same stuff – was a feature that Descola associated not with ‘analogism’ so much as with ‘naturalism’ where it is indeed our modern understanding that provides him with his paradigmatic example of that latter regime.

We shall return, in [Chapter 10](#), to review the question of how well ‘interiority’ in turn stands up to scrutiny when used as the second basic criterion of differentiation between ontologies. But for now the chief lessons we may take away from our examination of physicality are first that this should not be treated as the sole purview of a discipline of ‘physics’ stripped of any implications for conceptions of values. Rather, our survey shows how notions about stuff may be deeply implicated with conceptions of the cosmic dispensation and of the place of humans within it. But then secondly we find that the very idea of stuff is not cross-culturally stable and not just in the ways identified by Descola, but across the board. Beyond the issue of the possible similarities and differences between humans and other animals on this score, the answers to the question of what things are made of have sometimes been cashed out in terms of substancehood but sometimes in terms of process, and that in turn may be thought to introduce a further complication if we have the ambition to draw up an exhaustive taxonomy of ontological regimes using ‘physicality’ as one of the key criteria.

<sup>11</sup> Thus as has often been pointed out, in China correlations (and not always the same ones) were proposed between the five phases on the one hand, and on the other, many other items including seasons, cardinal points, tastes, smells, musical notes, star-palaces, colours, instruments, classes of living creatures, domestic animals, parts of the body, sacrifices, rulers and ministries (Needham 1956: 253ff., Henderson 1984, Schwartz 1985: ch. 9, Graham 1986, 1989, Bodde 1991, Hall and Ames 1995: 123ff., Lloyd 1996a: 112ff.). Yet as I argued in 1996a: ch. 5 it is a mistake to represent the Chinese as obsessed with correlative thinking to the exclusion of an interest in causes, since there is ample evidence also for the latter. Once again the temptation to picture the relationship between China and the Greeks as one of polar opposition is to be resisted.

*Health and Disease, Illness and Well-Being*

Once again the title of my chapter already suggests the range of complex issues to be discussed. Where health and disease are concerned, we tend to focus on the diagnoses and treatments of modern biomedicine, although as we shall be noting those are a good deal less confident where psychiatry is concerned than when the doctor faces physical pathologies. But we use the terms ‘health’ and ‘healthy’ in many other contexts, even though the temptation there is to dismiss much or even all of that as mere metaphor. Illness is often distinguished from disease as a matter more of the subjective feelings of the patient, even though that distinction may be anything but clear-cut. Conversely well-being depends on far more than the absence of any diagnosable pathological condition.

The aim of this chapter is to review this whole congeries of issues and in particular to examine the consequences of the dominance, in our modern Western societies, of the discourse of biomedicine. Expanding our horizons here means looking beyond that discourse to see what other views of well-being can contribute to our understanding. In plenty of societies past and present there was no equivalent to modern evidence-based medicine with its battery of diagnostic tools, sophisticated methods of collecting and evaluating enormous masses of data, and extraordinary techniques of intervention. Yet of course practically every human group that has ever lived has had, we may presume, some idea, even if maybe profoundly different ones, about health and well-being, and their opposites, disease and illness, whether or not they recognised any distinctions between the members of each pair.<sup>1</sup>

<sup>1</sup> The medical anthropological literature that has served to bring to light the immense variety of ideas that have been and still are entertained in different societies about health and illness, both physical and mental, is vast. Among still useful surveys are Kleinman and Good 1985, Lindenbaum and Lock 1993, Good 1994, Nichter and Lock 2002, Wiley and Allen 2009, Good et al. 2010 and Hsu and Potter 2016. The multiple discourses that intersect in modern talk of the body in medical contexts are well brought out by Mol 2002.

Once again in our investigation we are faced with a double task. When we find diverse beliefs on what seem to be the same topics, what are we to say? Is there a single set of criteria to which appeal can be made to distinguish correct from incorrect perceptions? Where, on the other hand, do the differences in the solutions on offer suggest that the very problems to which they are the proposed solutions themselves differ? What consequences does that have for our understanding of the key terms in which we state those problems?

Modern biomedicine, we said, presents us with a vast array of complaints and disorders of different types, identifying some caused by specific pathogens, others where an abnormality is defined as a deviation from a norm determined by statistical analysis. Modern psychiatry too has its taxonomy of abnormalities of varying degrees of severity, ranging from bipolar disorder through manic depression to schizophrenia. Yet here, as we said, the confidence with which causes can be identified for these is considerably less than in the purely biomedical sphere. As Foucault, especially, showed in a series of brilliant studies (1967, 1973, 1977), there were dramatic changes in the early modern period in both the understanding and the treatment of those labelled 'demented', 'deranged', 'irrational' or 'insane'. In Greco-Roman antiquity those diagnosed as suffering from *mania*, madness, were regularly submitted to treatments many of which were indistinguishable from the punishments meted out on criminals: they could be chained up, drugged, starved, kept in the dark and flogged. Even though Caelius Aurelianus in the fourth century CE criticised these as excessively violent and advocated some gentler treatments such as listening to music, he himself acknowledged that patients need restraining (*Chronic Diseases* I 144ff., 155ff., 171ff., cf. Lloyd 1987: 25–6 and notes 80–1).

Even the most positivist of modern commentators has to concede that still today there is a good deal that we do not yet know about what causes a particular disease, whether mental or physical, and that in many instances we continue to be at a loss to produce a cure or even an alleviation of the condition. The anthropologist Gilbert Lewis who was also a qualified medical practitioner records one moving account of a Gnao patient who could not be saved by modern Western methods or by Gnao traditional ones, which serves as a graphic reminder of the limitations of both (Lewis 2000). I drafted this at a time (April 2020) when doctors across the world were in the early stages of battling the ravages of the pandemic caused by the new coronavirus Covid-19. The difference from historical plagues is that research had already revealed the precise genetic constitution of the

virus: the similarity lies in the fact that there was, at that date, no vaccine to guard against it, nor cure once it infected a patient.

Yet most positivists, and not just they, will remain adamant that very considerable progress has been made in recent decades and many will be inclined to dismiss pretty well all earlier attempts to understand diseases and to offer treatments as just so many tragic failures. Earlier practitioners may have claimed to know and to be in control, but that was just wishful thinking – to be replaced by more securely grounded modern confidence.

But while, at the biomedical end of the spectrum, such an account can be supported by reference to the remarkable advances that have been made, my mentioning ongoing limitations, especially in the field of psychiatry, opens the door to a wider appreciation of the problems and their history. Unlike disease, illness is, we said, a matter far more of how one feels. Conversely a person may register a deep sense of well-being even though suffering (an outside observer may say) from considerable misfortune, discomfort and even pain. Some Greek thinkers maintained that the wise person, fortified by their philosophy, will be happy even when undergoing torture on the rack.<sup>2</sup> That is, to be sure, an extreme claim. But lesser ones make my point. The record contains many examples of ascetics who have expressed their joy even when suffering from extreme deprivation. It is worth opening up the whole subject, then, to closer scrutiny.

Given the obvious difficulties both in diagnosis and in therapy, it is not at all surprising that the actual theories of disease and the provision for treatment that we find in the historical record are so diverse. In part this reflects the competitive situation in which ancient healers worked. In ancient Babylonia, Greece and China several different categories of persons lodged some claim to be able to treat the sick. Sometimes these groups coexisted well enough, each having a particular sphere of activity,

<sup>2</sup> Diogenes Laertius X 22 (Long and Sedley 1987: 24D, 150–1) quotes from a letter that Epicurus is said to have written to a friend at the end of his life: 'I wrote this to you on that blessed day of my life which was also the last. Strangury and dysentery had set in, with all the extreme intensity of which they are capable. But the joy in my soul at the memory of our past discussions was enough to counterbalance all this. I ask you, as befits your lifelong companionship with me and with philosophy: take care of the children of Metrodorus.' Whether or not this has any basis in fact, such a statement served as powerful propaganda for the thesis that the Epicurean philosophy trumped all manner of apparent misfortunes. The Stoics made similar claims, as did the followers of other sects, though the plausibility of any of them was rather undermined, in the eyes of ordinary folk, by the inconsistency between their various conceptions of what the good consisted in, pleasure for the Epicureans, virtue for the Stoics, tranquillity (*ataraxia*) to be achieved by suspension of judgement (*epochē*) for the Sceptics.

a distinctive brand of expertise.<sup>3</sup> But in both Greece and China especially there were considerable disputes in which one group laid claims to be the true practitioners while their rivals were charlatans and frauds. In China the second-century BCE physician Chunyu Yi, whose biography is recorded in the *Shiji* (ch. 105), distances himself from those he calls the 'ordinary doctors' whom he criticises as ignorant. His own claim to have diagnosed the cases he describes correctly depends on a mastery of pulse lore which we shall consider again in the [next chapter](#). We have mentioned before ([Chapter 1](#)) the polemic that some naturalist Hippocratic physicians launched against the so-called purifiers who saw the gods as responsible for diseases and claimed to be able to control them. Here the Hippocratic pretensions to superiority rested on the principle that every disease has a natural cause, though this was axiomatic, rather than a claim that could be shown empirically. I shall have more to say about these rivalries in due course.

But as to ideas about what causes diseases, there was great variety, dispute and room for misunderstanding between competing theorists. One common view, found in ancient India as well as in Greece, was that the so-called humours were to blame. Yet even in that context there was no agreement, starting with the issue of the nature and number of the principal humours that have to be taken into account.<sup>4</sup> For some the humours were themselves pathogens or capable of causing diseases if the balance between them was disrupted; for others they were rather the outcomes and so the signs of diseases, while yet others saw them as natural constituents of the human body and not normally pathogens at all. The latter idea, found in certain Hippocratic treatises, especially *On the Nature of Man*, was elaborated by Galen, and in much later European theorising became the foundation not just of a taxonomy of human physiological constitutions but also of their corresponding emotional dispositions, the phlegmatic, the bilious, the melancholic and so on. We no longer generally believe the emotions arise from specific substances in the body: but we still grope

<sup>3</sup> Thus in ancient Babylonia there was a broad distinction between those called *Asipu* (conventionally translated 'exorcist') and those labelled *Asû* ('physician'), but it is clear that there was some overlap between their ideas and their therapeutic practices, and we hear of several 'learned scholars' who managed to combine different roles, in both the medical and astronomical domains for instance: see Parpola 1993: xiii and 122, Rochberg 2000, Geller 2015. Robson 2019, especially ch. 7, provides an authoritative account of the different scholarly professions and the fluctuating fortunes of cuneiform culture in Mesopotamia over the centuries.

<sup>4</sup> Other views besides the one that became canonical with Galen, which focussed on blood, phlegm, yellow bile and black bile, are to be found in the Hippocratic Corpus, for example a two-humour theory based on bile and phlegm, found in *Affections* ch. 1 and *On Diseases I* ch. 1.

towards an adequate taxonomy of character traits, uncertain, indeed, as to whether or to what extent we are dealing with cross-cultural regularities.

On what basis did ancient practitioners assume that the humours or the other supposed causes of diseases could be diagnosed? Considerable attention was paid to the excreta, for they were relatively easy to observe. In both China and Greece variations in the pulse came to be seen as an important diagnostic tool and elaborate theories came to be developed to apply this in detail even though Chinese and Greeks gave very different accounts of what the pulse indicated was happening in the bodies of their patients. For the Chinese the anatomy of the vessels concerned, the *mai* or *mo* 脈, was of less concern than the free flow they permitted or that in pathological conditions was blocked (cf. below, [Chapter 10](#)). As to what those vessels contained, we find disputes on that subject between different Greek theorists, some claiming that the arteries are normally full of air and that the blood that flows out of them when cut originates not in the arteries themselves but in the veins. Once again controversy was the occasion, in Greece, for rival practitioners to attempt to impress.

More generally, the patterns of development of the complaints that individuals or groups suffered from came to be studied extensively by those who favoured what we may call an empirical approach. Both Chinese and Greek texts record detailed observations of the progress of individuals' diseases, in the Greek ones generally without specific pronouncements on causes.<sup>5</sup> In view of the competitive situation in Greek medicine it is particularly remarkable that the Hippocratic authors of these case histories have no hesitation in recording the deaths of many of their patients, in some instances even acknowledging that this arose from their own faulty treatment (e.g. *Epidemics* V 27, [Lloyd 1987: 124](#)). Elsewhere, however, for example in the cases described in the inscriptions set up in the shrines of Asclepius, it is 100% success that is claimed.<sup>6</sup> One possibility that I have argued for myself elsewhere ([Lloyd 1987: ch. 3](#)) is that the acknowledgement of failure by the Hippocratic naturalists was intended somewhat paradoxically as a reassurance to those who consulted them and especially to their patients. At least they could have confidence in their physician as

<sup>5</sup> [Hsu 2010](#), Table 3: 114 sets out the main causes of the disorders of individual patients whose case histories are described in the Chunyu Yi biography in *Shiji* ch. 105. Behaviours that are morally reprehensible, such as excessive indulgence in sex, wine and inappropriate desires and emotions, figure prominently, as they do also, though to a somewhat lesser extent, in the Hippocratic Corpus. Most of the individual case histories recorded in the Hippocratic *Epidemics* leave open the nature of the disease that the authors thought their patients were suffering from.

<sup>6</sup> This is true in particular of the cases recorded in the inscriptions at the shrine of Asclepius at Epidaurus ([Herzog 1931](#), [LiDonnici 1995](#)).



someone who would be totally honest and who would not make extravagant claims to infallibility like those made by the priests who were in charge of temple medicine in ancient Greece.

In assessing this material the further factor we must recover is one that we have mentioned elsewhere. We may assume that the only thing that counts in the medical domain is causal efficacy, the ability to produce a cure. But what counts as a cure or at least as a good result will depend on the assumptions made by whoever seeks one. If we look at the issues from the point of view of those who frequented the shrines of Asclepius, what they obtained from the experience was reassurance that the god was on their side.<sup>7</sup> Of course they generally wanted more, the actual restoration of their sight or the ability to walk again or to bear a child, which are the positive successes so often recorded in the inscriptions. But even in the absence of that kind of result believers could take comfort in the appropriateness, the felicity, of their appeal to god for support and in the assurance that he was on hand to help the faithful. The appeal of felicity no doubt remains a powerful factor, alongside reference to causal efficacy, in contemporary divine healing, including in such shrines as Lourdes, located in a nation state that boasts many of the most renowned scientific researchers.

My argument thus far is the obvious one that we would be mistaken to treat issues to do with health, disease, illness and well-being as solely matters on which biomedicine alone can pronounce. Now some would stake their claim for the validity of indigenous medical practices precisely on biomedical grounds. Even without modern laboratory tests to demonstrate efficacy, many successful treatments have been discovered. We owe quinine, curare and many other efficacious drugs to New World knowledge. In ancient China *Artemisia annua* was used as an effective cure for complaints that include what we identify as malaria. True, the method of preparation is important and it took modern techniques to pin these down and to identify the active ingredients, work that led to the awarding of a Nobel Prize to Tu Youyou in 2015. In the ancient Greco-Roman world *colchicum* (autumn crocus) was recognised as a specific for gout,<sup>8</sup> even though there would have been a good deal of unclarity about the limits of a safe dosage, and of course many other examples could be given.

<sup>7</sup> This is a recurrent theme in the *Sacred Tales* of the second-century CE orator Aelius Aristides, a notable advocate of the superiority of temple medicine over that afforded by merely mortal doctors. He gives detailed accounts of his own personal experiences of the extraordinary cures he attributes to the interventions of Asclepius.

<sup>8</sup> Cf. Riddle 1985: 44ff., who discusses the problems of identification where the condition labelled *podagra* is concerned, and the efficacy of the various drugs used in its treatment.

But the more important argument depends on problematising the notion of health itself. What pass as medical theories and practices in ancient societies and in many modern indigenous ones often belong to complexes of beliefs that implicate value-laden notions of the good, of correctness, of how humans should behave. If we are to understand what we call ancient, and modern indigenous, medicine, and learn from what our sources tell us about this, we should, as I said, broaden our horizons. Disease can be a way of conceptualising what is amiss not only in individual human beings but in society as a whole.<sup>9</sup> Over and over again in ancient as also in modern communities commentators use the vocabulary of sickness to talk about what and whom they disapprove of, and once that or they are labelled sick, it follows that treatment is needed, cures that will involve the removal of peccant, pathogenic items, to restore the body politic to health.

Among ancient authors, Plato is particularly prone to developing such ideas. Dealing with what he calls the ‘purging’ of undesirables, or as he puts it ‘incurables’, from the state, in the *Laws* 735e, he comments that the best variety of treatment, ‘linking justice with vengeance’, will not just be painful (‘like all medicines of a drastic nature’) but will involve exile and capital punishment to avoid damage to the state. He goes on to describe a ‘milder form of purge’, to be used when civil disturbance occurs when through lack of food the poor show signs of being prepared to attack the property of the wealthy. Here the lawgiver ‘regarding all such as a plague inherent in the body politic, removes them abroad as gently as possible, giving the euphemistic title of “emigration” to their evacuation’. The gruesome modern echoes of such a policy are obvious.<sup>10</sup> The surprising thing is the pervasiveness of some appeal to medical analogues in an attempt to justify the punishment of political opponents. Yet the common feature of such appeals is clearly to give a veneer of objectivity to judgements about the threat those opponents presented.

Here the temptation is to dismiss all such talk as mere metaphor, as persuasive definition or as pure political rhetoric or ideology, but two considerations should give us pause. If we reflect on the range of the vocabulary of well-being, this is an area where it is particularly hard to be

<sup>9</sup> I reviewed the evidence for this in a wide variety of Greek and Roman sources in [Lloyd 2003b](#). For a comparison between the Greek and the Chinese uses of this trope, see [Lloyd and Sivin 2002](#): 221ff. The early Chinese evidence was surveyed by Sterckx in an as yet unpublished talk to the China Research Seminar Cambridge on 6 November 2019.

<sup>10</sup> One such parallel is how, long before the Nazis arrived at the policy of the extermination camps and their ‘final solution’, they planned to exile the Jews from Germany to Israel.

at all confident as to where to draw any firm line between primary and secondary uses. Obviously what biomedicine classes as pathogens threaten well-being. But so too do emotional states, including whenever we register misfortune or unease. Is not our well-being affected by our feelings about the society in which we live? Would we say that anyone can be truly happy living under a dictatorship, or even in any society that does nothing to alleviate inequality or suffering? After all the term 'suffering' itself in ordinary usage evidently spans psychological disaffection as well as physical pain.

To that we may add a reminder that in practice the boundaries between the sick and the criminal are still highly contested. When can the mental state of an individual be invoked in mitigation for what will otherwise be described as criminal behaviour (Hacking 1995)? Nowadays we have different professionals dealing with different aspects of this question, police and judges responsible for law and order, as well as health workers and psychiatrists there to give their expert opinions on the mental states of the agents in question. Yet as Luhrmann (2001) extensively documented, those different types of authorities themselves often disagree on whether the case in hand falls within or outside their particular jurisdiction – where it is not just issues about the patients' own well-being that are at stake, but the prestige and status of the different medical authorities themselves. And if the experts themselves differ, ordinary lay persons may find it hard to make up their minds, even when called upon to do so as members of criminal juries.

We have, then, a spectrum. At one end there are physical conditions diagnosable as cases of tuberculosis, influenza, malaria, jaundice or whatever, even though some of those diagnoses are generic rather than fully determinate. At the other we have behaviour that society disapproves of as offensive by whatever criteria that society chooses to appeal to (not that everyone in any society will agree fully on those). Throughout, some conception of what is normal or what is 'natural' is being appealed to, openly or not, in order to arrive at some judgement concerning the abnormal. The slide between the descriptive and the normative uses of 'natural' is particularly striking, for as the regular product of 'natural' causes diseases are themselves natural, yet they demand measures to restore health, where it is the healthy that is natural and disease as its opposite unnatural. Moreover in the social domain tricky questions of responsibility are at stake. In China and some other ancient societies, when a crime has been committed, it is not just a single individual but the whole family or group to which he or she belongs that suffers the consequences. Does

responsibility stop at the point where human agents are no longer involved? In ancient Greece and later in Europe animals were sometimes brought to trial for what they had done. Provision for this is made in Athenian law (MacDowell 1978: 117–18): it figures in Plato's *Laws* (873de) no less, and we find similar ideas persisting in the European Middle Ages (Evans 1906).

We may start with cases where healers in different cultures may think that all that is needed is a dose of medicine or some reassuring words. But we end with issues that call into question the fundamental values by which a society lives. For historians of medicine (as we call ourselves) it is as well not to limit our gaze to the purely medical end of the spectrum even though that is precisely what some of the dominant forces of modern biomedicine encourage us to do. Health and well-being have been used by many societies as useful tools to think about other matters. It is important to recognise the very different issues that may be at stake, even while as we have observed the boundaries between different discourses are fluid and permeable. While these are topics on which manipulation, rhetoric and ideology have often been prominent, we may reflect that our own deployment of that vocabulary is still not immune to such.

We have here, then, a prime example of both the challenges and the benefits of cross-cultural comparison. The challenge lies in charting the commonalities and the divergences in the ways in which health and disease, illness and well-being, have been conceptualised, explained and treated. The positive outcome is hopefully a greater understanding of issues that cannot fail to be important to humans wherever and whenever they have lived. For all the differences between individuals and groups on the essential values to live by, we discern a recurrent appeal to a set of medical images to articulate notions of such values, all serving to cloak the subjective with a measure of claimed objectivity. We are all inclined to place more or less trust, with greater or less reservations, in those whom our particular community sets up as established authorities on the matter of physical or mental health, where the boundaries of such trust are nevertheless liable to constant contestation. But when it comes to values, it is as well to recognise the dangers inherent in any construction or appropriation of the status of expertise on the issue of how life is to be led. The widest possible comparative study of the history of medicine may serve as an antidote to the tendencies we would do well to resist.

*Mind, Body, Heart, Brain, Soul, Spirit*

We have remarked that the key articulating dichotomy in Descola's fourfold taxonomy of ontological regimes was that between interiority and physicality. The former covers notions of selfhood, the latter those of body. For sure we all recognise that as the human beings we are we have a sense of ourselves as individuals capable of making decisions and implementing them, with our own quite particular set of subjective experiences and so on. Equally we recognise physical stuff, whatever account of that we prefer (where we have examined some of the problems in [Chapter 8](#) above). Descola's regimes diverge on the question of the continuity or the discontinuity experienced on those two axes, of interiority and physicality, in particular on whether humans and other animals are held to share or not to share the same niche on those axes. Naturalism, to recall, corresponds to an adherence to the assumption that everything is made of the same basic stuff (physicality is shared) but humans differ from other animals in having distinct interiorities. The obverse of naturalism is animism according to which bodies differ, but all creatures share the same interiority.

The first question this chapter sets itself relates not to the different takes on interiority and physicality but to whether those two are indeed robust cross-cultural universals and if so how they are to be characterised. Descola is of course well aware of the convoluted history of speculations on what we still call the mind–body problem. Once again for Europeans that history took a distinctive turn during the early development of philosophical reflection in ancient Greece. So it will be as well to rehearse some of the divergent views that were entertained on that subject during that development.

In the earliest extant Greek literature, in Homer and Hesiod, a variety of cognitive, conative and affective faculties are associated more or less closely with particular parts of the body, though there is some divergence over which parts control which functions (see especially [Onians 1951](#)). The usual view is that decisions are taken and emotions are felt in the *kardiē* or *kradiē*,

that is the heart (in the *Odyssey* 20.13–16, when Odysseus sees the misbehaviour of the women servants in his palace, his heart ‘snarls’ within him). But while another term for an organ associated with cognition, namely *phrenes*, came later to be used for the diaphragm, in Homer it applies rather to the physical organ we would call the lungs. We can infer this from a text that describes a wound to the chest in which the *phrenes* prolapse when a spear is withdrawn (*Iliad* 16.481ff., 502–4): that could never happen to the diaphragm (Lloyd 1983: 152). This is poetry, not anatomy, to be sure, but an indication as to how the *phrenes* were imagined.

The view that Snell (1953 [1948]) put forward, namely that the Homeric poems have no clear sense of the individual as a locus of agency, is nowadays generally discounted (Padel 1992, Williams 1993, cf. Bremmer 1983). But it is correct to say that those texts do not deploy a single clear and distinct vocabulary for the mind as such. The key term that came to be used of the soul, namely *psuchē*, is used for life in humans and animals (e.g. *Od.* 14.426, Lloyd 1966: 201) but also for what survives death. But in the latter context this ‘ghost’ is not incorporeal, but rather a wraith-like figure. In Odysseus’ encounter with the ghosts in Hades they lack any cognitive capacity until they drink the blood that he provides them with from a sacrifice that he performs.

The significance of later Greek developments is clear. It took some time for the term *sōma*, originally used of the corpse, to be applied to bodies in general (inanimate as well as animate). Conversely the idea of a radical contrast between physical body and incorporeal mind only gets to be clearly formulated with Plato. He was to be sure influenced by earlier, especially Pythagorean, beliefs. But he marks a distinctive step in mounting an argument that mind and body are ontologically distinct, the latter visible and subject to coming to be and passing away, the former invisible and not so subject, gifted with immortality indeed (*Phaedo* 79a ff.). He certainly drove a very firm wedge between physicality and interiority, though as we shall see not all his fellow Greeks agreed with his views on the topic.

This brief survey of earlier Greek beliefs is already enough to show that a radical dichotomy between mind and body cannot be held to be their universal assumption, nor the obvious default position that is adopted on questions to do with cognitive capacities. But more importantly that dichotomy poses obvious problems. Ryle famously pointed this out in his *Concept of Mind* (1949) where he attacked what he called Descartes’s Myth, that of the Ghost in the Machine. How, the argument went, if mind is incorporeal, can it conceivably interact with the body? This ghost-like

entity was quite unable to produce any physical effects. Its immortality, in other words, had been bought at the price of perfect incapacity.

Such objections told not just against Descartes but against Plato too, whose account of the soul did not persuade his own immediate pupil, Aristotle. He claimed that it is as inappropriate to ask whether the soul and the body are one as it would be to ask the same question about the wax and the shape given to it by a signet ring (*On the Soul* 412b6f.). The relation between body and soul is analogous to that between an axe and what makes it an axe – its capacity to chop (*On the Soul* 412b11ff.). What Plato had held to be a separate entity from the body was no such thing. Soul was more correctly understood just as the activity of the living body, or more strictly the potentiality for such activity. ‘Suppose the eye were a living creature: sight would have been its soul, for sight is the substance of the eye that corresponds to the definition . . . Once sight is removed the eye is no longer an eye except in name’ (*On the Soul* 412b18–21).

In the period after Aristotle both main positive philosophical sects in the Greco-Roman world, the Epicureans and the Stoics, maintained a monistic view of the soul, denying its incorporeality. For the Epicureans it consisted of atoms of a particular shape endowed with particular types of motion. While the Stoics allowed that time, place, the void and ‘sayables’ (*lekta*) are incorporeal, they did not include soul in that category. Both schools come close to anticipating Ryle’s argument that what is incorporeal can have no effect on what is corporeal. Epicurus states as much in the *Letter to Herodotus* 67 (Long and Sedley 1987: 65–6): ‘Those who say that the soul is incorporeal are talking nonsense. For if it were like that it would be unable to act or be acted upon in any way.’ For the Stoics, Sextus Empiricus (*Against the Mathematicians* VIII 263, Long and Sedley 1987: 272) reports similarly that ‘according to them the incorporeal is not of a nature either to act or to be acted upon’. So on these views soul had no distinct ontological status. Interiority, one might say, was not just not sharply distinguished from physicality, but even reduced to one of its properties or manifestations.

The long-drawn-out history of Greek ideas on the soul and on the seat of cognition depended in part on advances in anatomical and physiological understanding, in part on the attitudes adopted on religious and moral issues. In the former area there were long-lasting disputes as to whether the seat of the control centre in the body, what came to be called the *hēgēmonikon*, is the heart (as Aristotle held) or the brain (a view that goes back to a fifth-century BCE writer called Alcmaeon). Ideas on that subject were in turn connected with what was known, or at least claimed, about the

main vessels that were commonly held to convey various substances round the body. The usual term used for these was *phlebes* but while some, the majority, held that these carried blood around the body, others considered their role to be to circulate air or other humours. Meanwhile some quite speculative accounts were attempted concerning their courses. In his *History of Animals* III 2–3 Aristotle reports a series of these, criticising them for their inaccuracies, in particular their exaggerated assumptions of bodily symmetry and their failure to recognise the heart as the source. These early theories were based, he tells us, in part on the dissection of animals, in part on observation of the surface of the bodies of emaciated humans,<sup>1</sup> to which we may add that some conceptions appear to have been inferences derived from common therapeutic practices. Because blood was taken from the right arm to help alleviate liver complaints it was assumed there must be a physical connection between the two, a vein that was given the name *hēpatitis* (‘liver-vein’) to register that supposed fact (Lloyd 1991: ch. 8).

Aristotle himself by contrast championed dissection as the proper method of investigation in anatomical matters, and in the late fourth and early third century this technique was extended controversially from other animals to humans, indeed to live human subjects, by two investigators working in Alexandria, namely Herophilus and Erasistratus (von Staden 1989, 2000). The appeal to these techniques led to some crucial discoveries, especially that of the nerves (Solmsen 1961). Whereas the Greek term from which ours is eventually derived, namely *neuron*, had originally been used indiscriminately of sinews and tendons as well as what we call nerves, Herophilus and Erasistratus distinguished the latter and further spotted the difference between sensory and motor nerves. The source of the nerves came to be identified as the brain, which accordingly took over from the heart as the control centre in the body.

Yet that was still not a unanimous view among Greek doctors and philosophers (cf. Gill 2006, 2010, Sorabji 2006, Hankinson 2006, King 2006, Long 2015). In particular, some Stoics working both before and after Herophilus’ discoveries continued to follow the heart-centred view of the

<sup>1</sup> It is clear therefore that Aristotle was not the first Greek to investigate these problems empirically. In *History of Animals* 511b13–23 he criticises both methods as used by his predecessors: ‘The reason for their ignorance is the difficulty of carrying out observations. For in dead animals the nature of the most important blood vessels is unclear because they especially collapse immediately the blood leaves them . . . And in living animals it is impossible to investigate the nature of the blood vessels because they are internal. And so those who have examined dead bodies by dissection have not observed the principal sources of the blood vessels, while those who have examined very emaciated living men have inferred the sources of the blood vessels from what could then be seen externally.’



seat of cognition. Moreover while both Herophilus and Erasistratus agreed that arteries should be distinguished from veins, they continued to disagree on the question of the contents of the former. Erasistratus knew that when an artery is cut, blood flows. But he considered that that seeped into the arteries from the veins by way of tiny invisible passages – capillaries (though that term may be misleading in that in Erasistratus' view blood flowed from veins to arteries, not the other way around). What the arteries, on this theory, normally contained was air alone – which he could argue was up to a point supported by the difference in colour between arterial and venous blood and the pressure under which the former exits the body in a lesion.

This sequence of theory and counter-theory is standardly held up as an example where the introduction of a new empirical method – dissection – led to a redefinition of the problems and to advances in their solutions. That is indeed to some extent the case. But once again we need to be careful not to exaggerate claims for radical breakthroughs. Dissection itself continued to be a disputed method: some asserted that it provided nothing useful for medical practice and many objected to vivisection – of humans as well as animals – on moral grounds (Lloyd 1991: ch. 8).<sup>2</sup> Confusion over the referent or referents of the term *neuron* continued, and so too did the controversies over where precisely the control centre of the body is to be located.

More importantly still we have to pick up the point that Greek ideas about soul often had a very different focus. Notions of rebirth and the transmigration of souls after death go back long before Plato and some such belief appears in one of our earliest sources for what may be the views of Pythagoras himself (Xenophanes, Fragment 7).<sup>3</sup> Here the idea was that the type of living creature into which you would be reborn in your next life reflected how you had behaved in this one. You might find yourself

<sup>2</sup> In Celsus' *History of Medicine* (I Proem 23f.) Herophilus and Erasistratus are said to have practised human vivisection on condemned criminals obtained out of prison from the kings (viz. the Ptolemies, rulers of Alexandria) and Celsus rehearses the moral as well as the epistemological objections that were voiced against this, some time before Christians such as Tertullian (*On the Soul* ch. 10) condemned it in outspoken terms as butchery. In ancient China we have no records of any human vivisection and only exceptional ones of human dissection. One example was the report in the second great dynastic history, the *Han Shu* (99B: 4145–6), that the first century CE emperor Wang Mang ordered the dissection of the body of a political rival, supposedly to contribute to useful medical knowledge. However, we may speculate that one reason for reporting this was to illustrate Wang Mang's shocking behaviour, even though our source does not make that point (cf. Yamada 1991: 39, Kuriyama 1995, 1999: 155).

<sup>3</sup> Admittedly Xenophanes is there mocking any such belief. He represents one person telling another to stop beating his dog, for he recognises his bark as the voice of a (now dead) friend.

reincarnated as some other kind of animal or even as a plant. Empedocles in the generation after Pythagoras even suggests a sort of hierarchy among different living genera. As a plant you could progress up the scale to become a laurel, as an animal to become a lion (Fr. 127). If you behaved well as a human being, you would be reborn as human and if that continued through several rebirths your ultimate salvation would be to escape the 'dire cycle' of rebirth altogether. Some such view finds many parallels of course in the ethnographic literature.

This is both more and less than a moral theory. It is more than one since it encompasses every kind of living creature, including some who may not be thought to be capable of good and evil. But it is less than one insofar as the focus is not on morality as such but rather on ritual purity with all its ramifications (cf. Douglas 1966, Parker 1983 in a line of scholarship that stretches back to Frazer 1890 and Harrison 1903). Empedocles discusses all of this in a work called the *Purifications* (*Katharmoi*), where we may recall our discussion of the belief that certain diseases need such purification that is attacked in the Hippocratic treatise *On the Sacred Disease* (above, Chapter 1). But in Plato ideas of the subsequent fate of the soul are more firmly tied to a notion of the rewards and punishments that await you as a consequence of your living or not living a morally good life. However, in the *Timaeus* 90e–92c he combines that idea with a more traditional version of transmigration in which the first degeneration from male human beings who have been cowardly and unjust is for them to be turned into females.<sup>4</sup> The next degeneration turns certain males into birds, again as a punishment for misdemeanours, while the next two produce wild land animals and water animals.

Thus far I have presented these cross-currents using our contrast between what is empirically grounded and what reflects religious belief. Yet I now have to underline where that oversimplifies the situation. It is not just Plato who straddles all three modes of inquiry as we might distinguish them, natural philosophy, moral philosophy and religion. Aristotle does too. His wide-ranging researches into animals led him to many anatomical and physiological discoveries as we would call them. Yet his notions of cognitive faculties carry important moral and religious implications. Humans are distinguished from other animals by possessing *nous*, a capacity for abstract reasoning (practical intelligence, *phronēsis*, is shared

<sup>4</sup> The ramifications of the idea found in several male Greek authors, from Semonides onwards, according to which females form a separate genus, family or race from males, have been explored especially by Loraux 1993 [1984] (cf. Vegetti 1979: 122ff.).

by humans and many other creatures, Lloyd 2013). But if we ask what is the highest form of human happiness or well-being, the answer lies in the cultivation of the activity of the most divine part of us, namely theoretical reasoning or 'contemplation'. In the *Ethics* he picks up a point Plato had already made in the *Theaetetus*, the moral injunction that we should 'so far as possible' immortalise ourselves, *eph' hoson endechetai athanatizein* (*Nicomachean Ethics* 1177b30–4). Faced with the problem of saying what god or the gods do (for they cannot just spend their immortal lives in idleness) he uses his notion of *nous* to support the view that they must engage in abstract contemplation. What do they contemplate? Well that must surely be the best of all possible things. So we come to the conclusion that god's activity is self-contemplation. Their existence inspires the movements of the heavenly bodies in their constant circlings. But while astronomy gives us access to the movements of celestial beings (the sun, moon and planets are divine) the whole system depends on Unmoved Movers who move not as efficient causes (pushing those heavenly bodies) but by being the objects of their contemplation – and their love. The heavenly bodies are thus living beings capable of moving themselves when motivated by love.

By the time we have reached this point it has become obvious just how far away from the ordinary beliefs of Aristotle's fellow Greeks we have travelled. They agreed that the sun, for instance, is divine, but Aristotle's idea of an Unmoved self-contemplating Supreme Being had zero impact beyond the circle of his immediate followers. Similarly the learned disputes about the courses and contents of the nerves, arteries and veins were just that, learned disputes between rival claimants to superior knowledge. But ordinary folk remained unaffected. Greeks and Romans had rich if at times conflicting ideas on feelings and reasoning, on the source of life and what makes for a good life and well-being (as we saw). They engaged in a variety of practices celebrating and placating the gods whose characters and dispositions they generally represented in vivid terms more or less directly derived from human experience. Yet they were not usually concerned to give some account as to how all these ideas fitted together and whether indeed they did so. The six items picked out by the title of this chapter formed no single coherent map for the Greeks, rather an indeterminate, overlapping and shifting complex of psychic faculties and their physical correlates.

My next task is to examine whether features of the ancient Greek experience are paralleled in other historical or contemporary cultures and what this may tell us about cross-cultural commonalities or exceptionalities. Once

again ancient China offers a wealth of relevant data.<sup>5</sup> Once again a little basic lexicography is in order. Four key terms used somewhat differently in different texts from the Warring States and Qin-Han periods, that is down to the end of the second century CE, are *mai* (or *mo*) 脈, *jing* 經, *xin* 心 and *shen* 神.

The first of these, conventionally translated ‘blood vessels’, refers to pulsating vessels more generally. There is an extant treatise entitled *Mai Shu* (the *Book of Pulsating Vessels*) recovered from a tomb that dates from the second century BCE, and a little after the end of the Han we have a canonical work, the *Mai Jing*, by Wang Shuhe (third century CE). As with Greek *phlebes* there was some indeterminacy both about the courses of these vessels in the body (their anatomy, in our anachronistic terms) and about their contents, whether this was *qi* 氣 (air/breath/energy) or blood (*xue* 血) or combinations of both. Again there is a similarity with the Greek situation in that many ideas relating to the *mai* were related to, in some cases derived from, therapeutic practices. We have an extensive source for this in the biography of the second-century BCE physician Chunyu Yi in the *Shiji* (ch. 105), where he is represented as recording his training and apprenticeship with other doctors, as well as aspects of his own medical practice, including several individual case histories which we have mentioned before (Sivin 1995c, Hsu 2010).

From this text it is clear that Chunyu Yi had access to a variety of books, not just one called *Mai Shu*, but others dealing with other aspects of diagnosis, by means of the ‘five colours’ for instance, and discussing anomalies of yin and yang. Indeed one of Chunyu Yi’s own teachers, called Yangqing, speaks of having access to books that were attributed to the Yellow Emperor himself and to the legendary healer Bian Que who was reputed to have brought the dead back to life (his exploits are also recorded in the same chapter of the *Shiji*). The theory or rule of the Pulse, *Mai Fa*, provides the key element in Chunyu Yi’s own methods of diagnosis. Although he does not claim infallibility in treating the sick, his individual

<sup>5</sup> The scholarly literature on Chinese ideas of the self, mind, body and spirit, drawing not just on textual evidence but on the mortuary practices brought to light by archaeology, is immense. See, for example, Seidel 1982, Yu Ying-shih 1987, Poo 1990, Ames 1993, Brashier 1996, Harper 1998, Goldin 2003, Csikszentmihalyi 2004, Despeux 2007, Lo 2008, Yu Ning 2009, Slingerland and Chudek 2011. Some studies pay explicit attention to the similarities and differences between Chinese, Greek and later European ideas (Kuriyama 1999, King 2006, Slingerland 2013, Raphals 2015). However, the very complexity of the data concerning the explicit or implicit theories adopted, ranging from ontologically based dualism to monistic or holistic conceptions, entirely rules out any simple opposition between Greek and Chinese cultures.

case histories all present cases where his diagnosis, based on the pulse, proved (he claims) to be correct.

The main routes by which a variety of substances travelled around the body were the *jing* 經, circulation tracts (the same term is also used of canonical writings). The key idea here was that flow through these should be unimpeded. Blockage spelt disease in the body just as free flow meant health, and that then served as a powerful image for well-being in the political state and the cosmos as a whole. But while what flowed round the body included blood and air especially, what those substances flowed between were not so much organs as functions. One view we find in the *Huangdi neijing* (*Inner Canon of the Yellow Emperor*)<sup>6</sup> was that there were no less than twelve distinct internal systems, each with its analogue in the state. Thus ‘the cardiac system is the office of the monarch: consciousness (*shenming* 神明) issues from it. The pulmonary system is the office of the minister-mentors: oversight and supervision issue from it. The hepatic system is the office of the general, planning and strategy issue from it’ and so on (Sivin 1995b, Lloyd and Sivin 2002: 221).

In the late third-century BCE compendium, the *Lüshi chungiu* (20.5), there is an even more elaborate complex of microcosm–macrocosm analogies, where stagnation in the body, in natural phenomena more generally, and in the state, that is the political organisation, is a sign of disease or its analogue, while free flow signifies health and good order. Thus for example ‘when the stagnation of a state abides for a long time, a hundred pathologies arise in concert’ – where the text has just explained that ‘when the ruler’s vital power does not flow freely and the wishes of his people do not reach him, that is the stagnation of a state’ (Lloyd and Sivin 2002: 224).

Our classical Chinese texts disagree on many details of the picture of the human body that they give, and they certainly have a lot to say about intangible entities and processes. But none presents a sharp dichotomy between the realm of the incorporeal and that of the corporeal, of soul or mind on the one hand, contrasted radically with the body on the other. Our classical texts are concerned with processes where physical and psychic functions (as we might distinguish them) are often combined. They associate, to be sure, as we have just seen, the ‘cardiac system’ with ‘consciousness’ (*shenming*: a binome combining ‘spirit’ and ‘brilliance’). The term *xin* 心 picks out that system or set of functions, yet the

<sup>6</sup> This is our prime source for Chinese medicine of the Han period. The basic text dates from the first century BCE, though we rely on three later recensions, the *Lingshu*, *Suwen* and *Taisu*: cf. Sivin 1995c. The text I cite is from *Suwen* 8 *Ling Lan Mi Dian Lun*.

identification of that with the anatomical organ, the heart, is unstable, as the conventional translation often adopted for it, namely ‘heart-mind’, indicates. *Shen*, spirit, on its own is made to play multiple roles, especially in the predominantly medical texts (Raphals 2015: 145ff.), but it too is linked on the one hand to the viscera, on the other to the emotions and cognition.<sup>7</sup> When it comes to classical Chinese views about what survives death, that is described as a wraith-like entity called *hunpo* 魂魄, or occasionally two separate components, *hun* and *po*, but it or they do not have an incorporeal existence like Plato’s soul (or at least his *nous*) (Brashier 1996, cf. Poo 2004, Puett 2018).

This excursus on ancient ideas relating to the six items in my chapter title serves to underline several important points. First and foremost the ideas that we are able to document from ancient societies are enormously diverse and the same can be said of those reported from modern ones in the ethnographic literature. In part the lack of a stable consensus reflects the general difficulty humans have faced, in the past and still outside anatomy schools today, of acquiring some clear idea, if not reliable knowledge, about the internal functionings of the human body, about how perception works and where reasoning can be said to occur. Yet that did not prevent ancient writers from conjecturing associations linking cognitive, conative and affective faculties with different body parts or processes. We note a recurrent tendency, and not just in ancient texts, to have *some* physical, as we should say anatomical or physiological, locus for what were seen as the important faculties of thinking, desiring, feeling and the like, even though the particular loci chosen differed so widely.

We may confirm that last point with reference to the ethnographic literature, where once again we may cite Lewis’s careful discussion of ideas among the Gnaou. We reviewed in Chapter 7 what he had to say about *malet*, the term that covers both ‘spirit’ and ‘myth’. But both in that context and in his discussion of Gnaou ideas of *wuna’at* (‘the vital centre’) he makes points that are germane to my overall argument, in particular the Gnaou tendency to localise the activities associated with those terms. *Malet* has different manifestations and associations with different sites, objects

<sup>7</sup> Thus in the *Suwen* recension of the *Huangdi neijing* 23 (*Xuanming Wu Qi*) *xin* 心 (here the heart) stores *shen* 神, while the lungs and the liver store *po* and *hun*. Dire effects injuring the *shen* stem from fear, reflection and anxiety (*Lingshu* 8 *Ben Shen*). Again in the cosmological compendium *Huainanzi* ch. 8.226, while the heart (*xin*) rules the body (*xing* 形), spirit (*shen*) is the treasure of the heart (Raphals 2015: 145ff., 152). The way in which precisely the same terminology is given quite different interpretations in rival contemporary Chinese medical traditions is well brought out by Hsu (1999).

such as plants, and illnesses (Lewis 1975: 164ff. sets out a table of the distribution of responsibilities among spirits).

As for *wuna'at* Lewis starts his account (1975: 208) by observing that it is at the front of the body, rather than the back; 'it lies centrally just below the breastbone, at the epigastrium'. If it is 'observably inert the man is dead. But if he was cut open one would not see something to call the *wuna'at*, but a heart, lungs, blood and so on.' Yet as well as being the vital centre, *wuna'at* is the centre of thought and emotion. Thus 'your *wuna'at* speaks' can be glossed as 'it is your wish or desire'. Expressions for forgetting, remembering, being ignorant of, not thinking of doing something and disliking are all collocations in which *wuna'at* appears.

So unlike Plato's rational soul, but like Homeric *psuchē* and Chinese *hunpo*, the Gnaou view the vital centre not as something strictly incorporeal, but rather as something insubstantial. Lewis concludes with some remarks on where Gnaou ideas differ from our own (1975: 211):

Our thought and language are imbued with the duality of mind and body: our intellectual traditions include subtle bewildering debate of the relation between consciousness, self-awareness, the individual's spirit or soul and its link to or independence of the body. The duality of mind and body is not shown in Gnaou language as it is in English.

We may agree that some idea of consciousness is universal across all human populations. But what idea that is varies hugely.

Now it was certainly no part of Descola's thesis to suppose that ideas of either interiority or physicality are uniform across the four ontological regimes he distinguished. Quite to the contrary those regimes are to be distinguished precisely by the different attitudes adopted towards the interiorities (plural) and physicalities (plural again) that exist or are assumed between humans and other animals. It is the variation in either the continuities or the discontinuities postulated or experienced between different kinds of living beings that provides the differentiae by which his ontological schemata are established.

But if Descola's chief concern was with the relations between humans and other animals and the consequences that different views on that subject have for many aspects of human life and indeed for ontologies, the actual diversity we have discussed here, like that we revealed in Chapter 8, cuts across that concern. The contrast our analysis brings to light is not, or not just, one between the interiority, or the physicality, exemplified on the one hand by humans, on the other by other animals. Rather what we find good evidence for is a contrast *within* the views held on the interiority

as well as on the physicality of human beings themselves (before any differences between us and other animals come into play). The chief resource available to deal with the evident difficulty of talking about psychic functions is to appeal to analogies with more concrete domains of experience, whether physical or social, and this is true both of speculative theorists and of the assumptions embedded in ordinary language. Yet that is not to say that such talk commits the users to an analogistic regime that should be held to stand in sharp contrast to the naturalism of modernity.

The cardinal difference our sources point to is between a basic dualism in the account of mind (or soul) and body on the one hand, and on the other, various versions of a monistic view that close that gap and deny or erase any radical ontological difference between the two sides. The dualists we encounter in our sources, especially fully articulate ones such as Plato and Descartes, do indeed operate with a clear distinction between the two axes of interiority and physicality, firstly where human beings are concerned and then too on questions about what marks us out from the other animals. But the monistic views we have discussed tend to undermine the contrast between interiority and physicality themselves insofar as interiorities are themselves located in or features of physicalities. This may be a matter of insisting on the role of physical organs, whether the heart or the brain, in mental activities, or, in Aristotle's case, of denying that soul or mind are distinct incorporeal entities and elaborating an alternative theory according to which soul is, as he put it, just the activity of the living individual.

The anthropological controversy over Descola's schemata is ongoing. But so too, we may notice, is the debate about where precisely cognitive science now stands on the issue of the nature of consciousness, on the emergent or supervenient properties of mind, on its relation to the body, and notably on the similarities and differences between the cognitive capacities of humans and other species of animals.<sup>8</sup> The tools that we can use to further those investigations are very different from those available in ancient civilisations or in modern indigenous ones. Yet for all our deployment of fMRI scans, DNA analysis and the results of the human genome project, it is, for sure, not the case that all the problems now can be seen to have been resolved. In particular, questions to do with how humans relate to other animals, starting with our relationship with our nearest ancestors

<sup>8</sup> The literature on the topic is enormous. [Ginsburg and Jablonka 2019](#) summarise current opinion, combining a comprehensive and judicious review of the results of experimental investigations on the nature and development of what they call the sensitive soul with particular reference to the historical origins of the debate. Cf. especially [Dennett 1991](#), [Humphrey 1992, 2011](#), [Luhmann 2020](#).



in the story of evolution, continue to exercise us, from a moral as well as a cognitive point of view.

We have seen that many of our predecessors have reflected on similar issues in highly value-laden terms and in support of some preferred view as to how we should conduct ourselves in relation to our fellows – to other humans and to other sentient beings – and to our environment. We are led to suggest that even those who nowadays would have it that ethics has nothing to do with natural science may have something to learn from an examination of the ways in which the views taken on mind, body, heart, brain, soul and spirit can have important repercussions on our self-understanding.

Of course one reaction to the situation of fundamental disagreement that we have described is to say that most of those diverging opinions are simply mistaken, that there is one correct standard by which other earlier or contemporary speculations should be judged and generally found wanting. We do not believe in ghosts and we may suspect that some culturally sanctioned ideas about the need to worship ancestors or spirits may be little more than covert attempts to bring deviant individuals into line. Yet the idea that positive science is now in a position to deliver the truth across the board does not wash. It is not just that many scientists and philosophers believe in god or otherwise entertain views that depend on faith rather than on robust empirical evidence. More generally if we recognise the limits of our own current understanding we shall be more ready to accept that there is something to be gathered from what ethnography and ancient history combine to tell us about how others have tackled problems that are evidently continuous with those with which we still grapple.

Although we have only scratched the surface of the problems, our study has brought to light something of the extraordinary diversity in the ways in which mind, spirit and the rest have been talked about by human populations in different times and places, in different societies and sometimes within just a single such group. But to that our response should be not to dismiss all too swiftly whatever we find strange or not to match our preconceptions of how to go about fruitful inquiry. Rather we should expand our remit, as historians, to make the most of the variety in the approaches we find adopted to the challenge of understanding our cognitive, conative and affective faculties, the methods of investigation employed and the implications imagined for ways of navigating experience. This rejoins, to be sure, Descola's explorations of what he called interiority, but with the

caveats that we have suggested, for the plethora of views we have surveyed shows up some of the limitations of its use in ontological classification. My final study will accordingly aim to survey the lessons we can draw from this and our other endeavours to broaden the horizons of the history of science.

## *Conclusions*

In surveying, as we have, even if very cursorily, a great variety of systems of beliefs, cosmologies and suggestions as to how to understand specific phenomena or the world as a whole, we have come to recognise not just that the methods adopted by different groups differ but so too do their assumptions about the goals to be achieved. We have used the rubrics cosmology, ontology and science as place-holders for the fields whose history we have been investigating. But we have seen that we need to keep an open mind about what those terms may cover and how they should be cashed out in different contexts. That does not mean abandoning the task of interpretation on the grounds that the sheer opacity of the vocabulary in which it is conducted renders it impossible. Rather, the difficulties that that task encounters present an opportunity and not a threat, though the opportunity is not one for the faint-hearted. That confrontation with divergent systems is the occasion for us to expand our horizons, reviewing our assumptions about what needs explaining and the modes of explanation appropriate for that, recovering more of the past and viewing where we are today with due circumspection. The mode of comparative history of science that we advocate eschews the idea that the goal should always or even usually be a single definitive set of answers to problems where the implicit ideal is that both problems and solutions should be expressible as well-formed formulae to which straightforward judgements of truth or falsity apply.

It is time now, in conclusion, to take stock of where this inquiry of ours has taken us, concentrating on the two main issues of what I have called the multidimensionality of reality and the pervasiveness of values. First, however, there is a question to do with the very terms in which we conduct our investigation. We have, we suggest, good reason to reject certain common opinions about the semantics of any natural language. The still often used appeal to a contrast between the literal and the metaphorical senses of terms can be dangerously misleading, and attempts to circumvent this by

collapsing the literal into the metaphorical and saying that metaphor is all-pervasive are unsatisfactory. The radical proposal I pick up from earlier studies is to suspend the dichotomy. What replaces it is the suggestion that every term displays, across contexts, a degree of what I call semantic stretch. Though Aristotle was the first to make explicit the contrast between the literal and the metaphorical, to which he attached so much importance, it can be argued that semantic stretch offers the basis of a better account of a key feature of his own philosophical vocabulary as well as one of our own. Indeed he comes close to admitting as much when in his discussion of actualities and potentialities (*Metaphysics* 1048a35–b4) he allows that those terms cannot be given a univocal definition: rather we should learn to grasp the analogous relationships between the potential and the actual that we find in different contexts. Nevertheless when, as often, he demanded univocity, that served among other things to police the boundaries between science and philosophy on the one hand and rhetoric on the other. Substituting semantic stretch is an important step towards restoring the polyvalence of the fields thus bounded.

We have acknowledged, to be sure, that translation (within as well as between natural languages) is always difficult, always imperfect, and we have rehearsed the problems that surround claims to understand the radical Other, that is what initially appears to be quite alien to us. But against that we have insisted that a degree of comprehension is attainable as can be confirmed most simply where pragmatic tests can be applied. However, we have also pointed out how that understanding often involves the revision of the concepts we start out with. Our observers' categories need to be modified to get a better match with those of the actors whom we are investigating. We discover that for those concepts to be cross-culturally applicable we need, in fact, to pay more attention than we originally imagined to their semantic stretch, and that is true not just of such terms as 'person', 'agency' and 'causation' but also of the key terms for intellectual disciplines and endeavours that we customarily use, including 'philosophy' and 'science' themselves.

Then on the question of what is there to be explained, we have argued against accepting too straightforwardly that what we have to deal with is a single, simple, well-defined object, or even a set of such, in favour of allowing for the possibility that reality is, as we said, multidimensional. We have suggested some of the difficulties in our common presupposition that nature or natures are there for natural science (as we call it) to uncover, thereby providing unambiguous tests for the success or failure of our efforts. This does not mean, to be sure, that any account that we or anyone

else offers will do, or be as good as any other. But we cannot afford to assume that we necessarily know at the outset exactly what any one such account is supposed to be good for. Different aspects of the problems may require different approaches yielding different reflections or conclusions, all of them capturing (even though not definitively) some feature of the phenomena.

Is this policy still open to the objection that it tends to undermine the single-minded ambition of science to provide unequivocal, robust, repeatable results that can further serve as the basis of attempts to exploit and manipulate the phenomena? Yes, if by that we mean to suggest that those are not the only valid ambitions of inquiry. But no, if that is to ignore that each reflection or conclusion needs to withstand the appropriate scrutiny. Multidimensionality underscores the point that different types of account may be rewarding and legitimate. One example we have used is that not all comments and explanations aim to give causal accounts of actions or the phenomena, for we have seen that many target rather the criterion we have labelled felicity. But multidimensionality applies also within investigations that all share the ambition to give causal explanations, for, as we have seen, varying views can legitimately be entertained on the types of cause to be sought and on the key effects that the phenomena present for explanation. We use the term 'data' for what we believe to be given: but what we hold to be given is always already subject to, indeed the product of, interpretation.

This takes me to the final and maybe most important point, concerning values. We are used to cordoning off ethics from cosmology and natural science. We are right to guard against moving from descriptions of what occurs to conclusions relevant to human interests, to how we should conduct ourselves, from statements about what 'is' the case to those that concern how we 'ought' to behave. Certainly such inferences have often been dangerously misleading. Yet we have found reason to question the impermeability of those boundaries. Success is sometimes to be judged by the greater clarity in understanding that it can deliver, by the correctness of prediction and a proven ability to control and exploit the phenomena. But some investigations into aspects of the world around us – those we undertake and others that our fellow human beings do or have done – can and do serve as food for thought about our place as members of the societies we live in, as well as that of humans in general in a world we all in some sense share even though our experiences may differ widely.

There are, to be sure, nowadays plenty of signs that suggest that the scientific and industrial juggernauts are more or less unstoppable. Many individuals and institutions devote huge efforts to promote what they

claim or assume to be unequivocal progress. Yet the concerns that are coming to be increasingly expressed on the negative effects that may have, on the dangers of the impact of human intervention on the environment on which we all depend, as well as on such matters as the disenfranchisement of many peoples who have so small a share in modernity, those concerns may serve as a reminder that we need all the resources we can muster as antidotes to the hegemonic assumptions that have so often punctuated the history of human endeavours to impose a certain understanding of our predicament.

Whatever may have been assumed or claimed in the past and even in certain quarters maybe still is today, we were not sent into the world to conquer, control and use it in any way that suits us, whether that 'us' means all humans or – as more often in the history of human exploitation – some section of them, the members of some chosen race or just some group within it, or even just some of the adult males. The grosser versions of such elitism may be relatively easy to diagnose and hopefully avoid. However, we still need to exercise self-criticism where residual manifestations of such tendencies continue to lurk, in the notions, for example, that some of us have a privileged vantage point from which everyone else can be assessed, or even the still common view that what counts as science is uniquely the product of Western modernity.

We should take on board the full consequences of the principle that no account can be theory-neutral, none is value-free. We have to leave behind the idea of being content just with the security of customary modes of scientific verification and with the thought that the only criterion that counts is such verifiability. The fact that values are always implicated demands a different mode of judgement, not one that dictates agreement, *per impossibile*, with every view and mode of behaviour we encounter, but one that does start from the assumption that they are to be taken seriously. Whereas the traditional history of science often turned into one of the successive correction of errors in the onward and upward march towards today's confident knowledge, my aim has been to recapture more of the problem situations of those who did not have the benefit of such hindsight, and that includes more of how those actors themselves diagnosed and reacted to the mistakes they recognised in themselves and others. That does not negate or deny progress, but it makes it more complicated to trace and to contextualise.

That does not mean we have to or even can sign up to others' beliefs ourselves. But conversely we should allow that revisability goes all the way down, including challenging both our own provisional assumptions and

the conclusions they seem to suggest, indeed especially those we identify as ours, as well as those that we ascribe to others. The perspective of the jaguar who quaffs beer and socialises with other jaguars is not one we can identify with. But we can certainly learn from pondering the consequences of the belief that the Achuar or the Araweté or the Wari<sup>3</sup> entertain that that is how jaguars live their lives.

Our own thinking about animals, plants, the environment, evolution can thus draw on resources that stretch all the way from the work of cognitive scientists, ethologists, psychologists, biologists, geologists, cosmologists, to the insights that have come from the members of societies who lay no claim to belong to the mainstream of science as defined in the West, but that are important insights nevertheless that we would be wildly irresponsible to ignore. The truly ecumenical comparative history of science expands its remit far beyond its traditional frontiers, certainly to include the knowledge of both ancient peoples and indigenous contemporary ones. Meanwhile we need to recognise that the boundaries that currently exist between our modern academic disciplines can be a serious obstacle to a more comprehensive understanding of the problems. This is perhaps especially true of those between social anthropology and cognitive science, at least when the former takes its task to be the uncovering of divergence while the latter tends to discount human diversities and sets its sights on universals.

The principle that has driven my investigation is the need to examine critically whatever understandings are attempted, on the basis of whatever assumptions, with whatever successes and failures. We cannot and should not expect the efforts of those whom we study to be value-free: nor are our own. But embracing that fact, we can turn that to our advantage to expand our appreciation of the values and understandings that we find worthwhile. It is in that spirit that I have undertaken these inquiries and made these suggestions concerning how a more ecumenical construal of the comparative history of science may be able to offer insights that might otherwise be missed.

They include not just particular knowledge of this or that item in the physical world, but also the potential for plural understandings that we have insisted upon. Of course we do not need to travel to Amazonia to appreciate the merits of considering problems from several points of view (as we say). But the differences that anthropological perspectivism challenges us to explore ([Chapter 2](#)) offer dramatic examples of how far-reaching they may be, for there we are not talking of different opinions about a single stable reality, but of different, that is multidimensional,

realities. Once again a balance has to be struck. Even while we recognise that the quest for total objectivity is an unattainable ideal, we should evidently not totally abandon the principle that drove that quest, the need to guard against the purely arbitrary elements that may warp subjective judgement. On the other hand, the search for some 'view from nowhere' is bound to prove just as mistaken. There can be no such Archimedean point. But conscious that we are always speaking from some location, we can learn to uncover its specificity by comparing and investigating other voices from other times and places.

So how should we sum up the expansion of the horizons of the history of science that this book has set as its aim? The first key move is to allow for comparability across different traditions. The ways in which investigations of the physical world proceeded differed and continue to differ at different times and places, as too did ideas about what 'the physical world' comprised, and that includes not just notions of 'stuff' but also of the very cognitive faculties that we as humans use to make sense of our experience. Yet the commonalities we can detect in the aims and use of certain methods and procedures still allow us to recognise a family resemblance between them. The rubric 'history of science' is still legitimate even when the histories and the sciences diverge.

One recommendation that deserves underlining is the need to enlarge the scope of the 'science' whose history we are studying beyond what is pursued in university departments of 'natural science' to include other endeavours where observation, classification, measurement, prediction, verification are brought to bear to describe, explain and control aspects of the physical world including the very means we possess to understand it. As we have acknowledged, we immediately encounter our own problems of translating and understanding, where we find that our initial concepts and assumptions often require revision to be fit for purpose, most notably perhaps on the key issue of the viability of the notion of 'nature' itself. We are faced indeed with a multiplicity of ideas and practices both on the question of what there is to be understood and on how that is to be achieved. But in assessing those – as indeed assessment is inevitable – we are not limited to the values and preconceptions we start out with and that continue to dominate Western modernity. Ecumenical comparative history of science provides, on the interpretation here proposed, the best way to challenge those assumptions and to move towards a more even-handed appreciation of human endeavours to understand and make sense of lived experience.



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