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'.[1] 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.[2]

[1] 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.

[2] 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'.

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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.[3]

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

[3] 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.[4] 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.[5]

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.

[4] 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.'

[5] 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.