

Ancient Greece and the Origins of Science

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This paper was given as a public lecture to open the 2005 Conference of Greek Studies.¹ It presents a case for locating the origins of science with the ancient Greeks. Although this was once a common view, it has come under fire in the latter part of the twentieth century. The main case is presented briefly, along with some new considerations in favour of the Greeks as the originators of science. There is then a discussion of some of the strategies that might be employed to counter some of the objections that have been raised, either relating to some of the weaknesses of Greek science or to some of the methodological issues involved in approaching ancient Greek science.

I want to begin with a bold claim, that the ancient Greeks were the originators of science. Firstly though I will make a case for asking the “origins” question. It is sometimes said that science evolved, or was the work of many hands, and so its origins are diffuse and difficult, if not impossible to pin down.² I take it that at one time there were neither humans, science nor technology, while all those things exist now. If biologists can find the origins of homo sapiens within reasonable temporal and geographical windows, then it should not be beyond philosophers and historians of science to do the same for the origins of science. There is also a great temptation, when confronted with the proposal that a society originated something, to argue that societies preceding them surely had this too. At some point we have to resist this regression. None of this is to denigrate the societies who preceded the Greeks. They produced much marvelous technology, their healing practices were effective, they made accurate observations and predictions of the heavens and were capable of solving equations. So what is it then that is so distinctive about what the Greeks did relative to other ancient cultures? What was it that turned healing practices into medicine, observation and prediction into astronomy, land measuring into geometry?

¹ This paper was written under an AHRC research leave award.

² On this issue see Lloyd (1992).

The School of Athens, 1509. Fresco, Palazzi Pontifici, Vatican.

When and where science began depends to some extent on what we think science is. We define some historical periods, such as the stone, bronze and iron age by the sort of technology possessed. Science is a step beyond technology though, and requires at least the attempt to explain and understand. As a basic minimum we are looking for the following. Science deals with the natural world. So we are also looking for an awareness of a distinction between the natural and the supernatural, and a desire to explain using only natural factors, and not the intervention of the gods. Science is expressed in terms of theories, so we are looking for theories about the world as opposed to the myths or poems typical of some ancient societies. Science is also characterised by the use of mathematics, experiment and observation. It would also be helpful if our candidates as the originators of science were aware of the differences between science and technology.

The break from myth by the early Greek thinkers is well known.³ This is not to say that the Greek populace gave up believing in myths, or that the Greeks did

³ E.g. Cornford (1952), Guthrie (1957), Lindberg (1992).

not give us a marvelous and enduring mythology.⁴ Rather, a small group of people began to think in a different way. There are significant differences between myths and the sort of theories the early Greeks were interested in which allowed them to begin to make rapid progress in both philosophy and science.⁵

Think of how we compare myths and how we compare theories. How do we decide if one myth is better than another? There are criteria which might apply to myths, but not the same sort as apply to theories. Myths might be imaginative, entertaining, or carry some message by means of allegory, etc. So one might prefer the gods of Greek myth to the gods of Norse myth, or Tolkein's *The Hobbit* to *The Lord of the Rings*, on grounds of grandeur. Or one might prefer simplicity to grandeur. These are subjective, rather than objective criteria. There are many ways of telling the story of King Arthur. Is there a right way? If we stick to the historical evidence for Arthur, we get a pretty dull story. So we might embroider some mythology around him. But what do we embroider, and on what grounds?

We can collect evidence and discuss the merits of a theory. We have a good idea of why one theory is better than another. There is a need for theories to be consistent internally, or if we hold a group of theories, for them to be consistent as a group. Theories should also be as general as possible and have no exceptions. So there is a drive to establish a completely general theory. There is no great need for myths to be consistent, either with themselves or with other myths. Myths are compatible with one another in a way that theories are not.

Myths may ask us to believe in a great number of things. A good theory is very mean with what it supposes there to be. A myth on the other hand may be a good myth because it has more or more extravagant magical monsters. The problem is, what criteria do we have for determining how many and what sort of monsters? Ultimately, the difference between myth and theory is this. A good myth may be no nearer the truth than a poor myth. A good theory is. I have no wish to dismiss myths, which are fine examples of human creativity, imagination and ingenuity. Myths have their place, but they also have their limitations, a key one being that they do not generate or drive progress in the way that theories do. The requirements that theories be consistent, cover all the evidence and be as general as possible while being parsimonious mean that it is clear what form a better theory might take.

The Greek use of theory should be considered alongside their idea of the cosmos.⁶ The word *cosmeo* has given us several words in modern English, such as cosmology, cosmogony and cosmetic. The last may seem somewhat surprising, but *cosmeo* meant not only to order or arrange, but also had a sense of good order

⁴ Kirk (1974).

⁵ Frankfort (1946), Kirk (1970).

⁶ Vlastos (1975) Ch. 1.

and beautiful, aesthetically pleasing order. A statement which is deceptively simple, but is in fact of enormous importance for the origins of science is that the Greeks believed themselves to live in a *cosmos*, a well ordered place. The universe to them had an order, and a good and pleasing order at that. The order of the cosmos was something that could be discovered and understood by humans. What is more, the Greeks were the first to recognise a distinction between the natural and the supernatural. They considered the cosmos to be an entirely natural place. Things did not happen at random, or by the caprice of the gods. One can argue that there was no such thing as natural science prior to the Greeks simply because there was no conception of the natural. As Heraclitus insisted, there was a need for an objective account of the cosmos:

This cosmos, the same for all, was made by neither god nor man, but was, is and always will be an everliving fire, kindling and extinguishing according to measure (Fr. 30).

This expression of the idea of an objective, natural and orderly cosmos was typical of the early Greek scientists. He also said that:

For those who are awake the cosmos is one and common, but those who sleep turn away each into a private world. We should not speak and act like sleeping men (Fr. 6).

Once the Greeks formulated the idea of a cosmos, and began to try to explain it in terms of theories, then their science and their philosophy began to progress very rapidly, in a way not seen in previous societies. In particular, where previous societies had sought only observation and prediction of the heavens, the Greeks now began to frame natural theories about the nature of the heavens, and began to try to explain astronomical phenomena in terms of those theories.

There is no doubting that the Babylonians had some effective healing practices and a reasonable knowledge of the human body. However good their healing techniques though, they did not consider diseases to have physical causes. Rather, they saw disease as a punishment from the Gods for some sin committed. Thus the first task of the doctor was to diagnose the sin, and then to work out a means of purification to absolve it. The Babylonian approach was in very sharp contrast to that of the Hippocratics. They believed that every disease had a physical cause and no disease was caused by the intervention of the gods. Epilepsy was known to the Greeks as the "sacred disease". It was commonly thought that epileptic fits were due to possession by the gods. Yet the Hippocratics put their point bluntly in the opening passage of *On the Sacred Disease*:

I do not believe that the sacred disease is any more divine or sacred than any other disease but, on the contrary, just as other diseases have a nature from which they arise, so this one has a nature and a definite cause. Nevertheless, because it is completely different from other diseases, it has been regarded as a divine visitation by those who, being only human, view it with ignorance and astonishment.

In The Science of Medicine their view is crystal clear:

Each disease has a natural cause and nothing happens without a natural cause.

Prior to the Greeks, there had been attacks on individual magicians for being incompetent at their art.⁷ With the early Hippocratics we find something quite new, the first recorded attack on magic in general. Magic and the supernatural simply did not exist, and the world was a purely natural place to be explained by natural means. The Hippocratics opened the heads of goats who suffer from a similar disease, and finding that the brain is foul smelling, concluded that a disease and not a deity is the cause of their epilepsy. Here was the physical basis of the disease.

This is not to say that the early philosopher-scientists were atheists, for assuredly they were not. They did though produce a critical, cosmopolitan and self-aware approach to theology not seen before. Xenophanes says that:

Homer and Hesiod have ascribed to the gods all those things which are shameful and reproachful among men: theft, adultery and deceiving each other... Mortals believe that the gods are born, and that they have clothes, speech and bodies similar to their own... If cattle, horses and lions had hands, and could draw with those hands and accomplish the works of men, horses would draw the forms of gods as like horses, and cattle like cattle, and each would make their bodies as each had themselves... The Ethiopians claim their gods are snub-nosed and black, while the Thracians claim theirs have blue eyes and red hair (Fr. 11–16).

The God of the philosophers was very different from the Gods of myth. The new god was entirely good, behaved in a predictable manner and did not intervene in the world. Aristotle tells us that:

Concerning thunder, lightening, thunderbolts, whirlwinds and typhoons, Anaximenes states that all these come about because of wind. Whenever it is enclosed in a thick cloud and then forcibly breaks out, due to its fineness and lightness, then the bursting makes the noise, and the rent against the blackness of the cloud is the lightning flash (Meteorology 365b6 ff.).

All of these phenomena would have been attributed to the gods, now they are explained by natural means.

It is not surprising, nor is it coincidental that the Greeks developed philosophical logic and geometry as an axiomatised system. Once one has theories, as opposed to myth, one then has to choose which theory to accept. So logic identifies valid argument forms and allows one to identify and reject rhetoric and sophistry in debates about theory choice. If one agrees to the definitions, postulates and axioms of a geometry, then the proofs follow inexorably. Doubtless there was much practical knowledge relating to land measuring prior to the Greeks, and individual

⁷ Lloyd (1979) Ch. 1.

Pythagorean triples were known. It was the Greeks though who formalised this knowledge and created the discipline of geometry, proving the general case from first principles. A consequence of having proper theories is a need for criteria for theory choice. It is not accidental that the Greeks developed philosophical logic and formal geometry.

A society that is in possession of science should be conscious of a distinction between science and technology. We find no such distinction in any of the pre-Greek societies. The Greeks though were conscious of a distinction between *empeiria*, a knack or skill acquired through practice, and *episteme*, knowledge, which required being able to give reasons as to why something was the case. The person having *empeiria* might be able to manipulate the world, but he would not be able to explain why what he was doing should work. A typical example for the Greeks was the difference between someone who knew a few folk remedies for disease, and a doctor who knew the nature of the body and could explain why, how, and in what circumstances those folk remedies would be effective. Plato in particular was keen on this distinction, and contrasted what someone who had a basic empirical or practical acquaintance with a subject was capable of with the theoretical and synoptic knowledge an expert might be expected to have.⁸

Of course there were many weaknesses with Greek science and in a moment we will come to some objections to the Greeks as originators of science. In a short paper I can only indicate general strategies for dealing with some of these weaknesses and objections rather than enter into any detailed discussion.

It is hard to generalise about weaknesses in Greek science, as there are major differences between subjects. So while Greek physics might be criticised for insufficient experiment/observation, one cannot level this objection at their astronomy or medicine. In some subjects there was a fruitful relation between science and technology, or a good use of mathematics, in others not. None of this bears on the Greeks being the originators of science, as long as we do not expect science in its modern form from the originators. Of greater importance than these weaknesses is the fact that the Greeks were very strong in some disciplines, notably geometry, medicine and astronomy. The history of science shows us that many of the ideas we take as obvious today have not always been so. Sometimes these ideas had to be hard fought for. That we should express laws in the form $y = x$ or $y = ax$ (where x and y may be complex functions) is by no means obvious and was not established practice until after Galileo and Newton. Science makes methodological progress, and it is simply unreasonable to expect the instigators to have full methodological sophistication. The weaknesses which afflicted Greek science permeated later science as well, often up to the sixteenth and seventeenth centuries and beyond. If we rule out science in ancient Greece on these grounds, we rule it out for many years after as well.

⁸ Plato Gorgias 500e, Phaedrus 270b.

Of course, there are objections to the case I have put forward. Am I guilty of what Pingree calls Hellenophilia?⁹ That is, have I a form of madness which makes me believe that the Greeks created science, that they did something important in relation to truth and method that we still follow (abandoned myth for theory at least) and that cultures prior to the Greeks had remarkable technology, but no science, when these beliefs, according to Pingree are untrue?¹⁰ I am aware of Pingree's important critique of how the modern classically educated West was predisposed to see itself as the heir of ancient Greek philosophy and science, but I have provided reasoned argument in favour of the Greeks here rather than prejudice or cultural myopia. I do not (I hope) adopt my views out of ignorance of the achievements of other cultures, which I believe to be considerable, but I argue the Greeks did something significant beyond those cultures. If we accept that Kuhn has demolished the idea that there is incremental progress, then we must also accept the possibility that the Greeks did not make incremental progress relative to preceding cultures, but produced something radically new.¹¹ I do not seek to denigrate cultures preceding the Greeks. I come back to a point I made at the start though. If science begins, then there were prior cultures who did not possess science. If we place the origins of science with the Babylonians, or even have multiple origins with the Chinese, Egyptians and Indians as well, does that denigrate the societies prior to them?

Am I guilty of what von Staden calls Hellenocentrism?¹² That is, have I emphasised the affinities between the ancient Greeks and modern science, and passed over the differences, giving the ancient Greeks a position of undeserved privilege in the history of science? Certainly I have sought affinities between the ancient Greeks and modern science, and have, in this short paper, to some extent passed over the less scientific and rational elements of Greek thought and so am guilty of elision. I do not seek to deny that the Greeks generated a mythology, a theology of interventionist gods, or that they practiced magic, mysticism, astrology and alchemy, or that, as Dodds has argued, there were significant irrational features of Greek thought.¹³ Elision should be avoided for both ancients and moderns though. I take it that we, in the twenty-first century, can be said to have science. Yet there are many in our society, even if we restrict ourselves to the West, who believe in astrology, mysticism, faith healing or a God who actively intervenes in the world. We say we have science because there is a significant group within our society who reject these ideas in favour of science. The group of ancient Greeks who do the same may

⁹ Pingree, 1992:555 ff.

¹⁰ "A Hellenophile suffers from a form of madness that blinds him or her to historical truth" Pingree, 1992:555.

¹¹ Kuhn, 1970.

¹² Von Staden, 1992:583 ff.

¹³ Dodds, 1951.

be smaller, but that is only to be expected. I argue the Greeks originated science because for the first time we can isolate such a group in a society.

Is it appropriate to use the word science in relation to the ancient Greeks? Some have argued no, on the grounds that science implies modern methods and purposes which are out of place in describing what ancient natural philosophers were doing.¹⁴ This argument, unchecked, might deny us calling the activities of the nineteenth century science on grounds of different methods and Christian aims compared to the modern secular version. The central question here is whether there is a core of key beliefs which remain common between ancients and moderns, such as the rejection of myth for theory, natural explanation and a lawlike universe. If so, that seems a good place to halt this argument. With due care, it is appropriate to talk of ancient science and modern science, recognising that the latter has progressed relative to the former. I would claim that the criteria offered here for the origins of science are not so broad as to be meaningless yet do separate Greek science from preceding technology.¹⁵

Let me finish with two positive considerations about Greek science. If you are an instrumentalist in the philosophy of science, that is you believe that science can do no more than fit mathematics to data, then you will in all likelihood place the origins of science with the Babylonians. If on the other hand you are more optimistic about science, and you hold that the theories of science tell us something real about the world, then you will place the origins of science with the Greeks. They gave us the first proper theories, and while those theories may have been naive, they believed those theories truthfully described the world.¹⁶

If you are a relativist, if you believe that science makes no real progress, or you believe that the methods and contents of science are no better or worse than any other belief system, then you are likely to believe that all societies have had science (where science is only a world view) or that science only began when the term science was coined. One of the great achievements of Greek philosophy was to reject such relativism. To paraphrase Plato in his *Theaetetus*, you cannot believe that no theory is better than any other theory, because that entails holding that that theory itself is better than others which deny that theory. He also points out that if relativism were true, there would be no real knowledge, no real progress, no real expertise. If you share the Greek optimism that we can generate knowledge and make real progress though, then you ought to locate the origins of science with them.

The ancient Greek philosopher scientists did something distinctive and remarkable, in producing the first recognisable science against a background of myth,

¹⁴ French, 1994:x–xi.

¹⁵ French, 1994:X, cf. Naddaf, 2005:11–37.

¹⁶ Gregory, 2000:8–10.

magic, mysticism and interventionist theology. It is remarkable that they produced such a change relative to the mythologies and theologies of other cultures, even more remarkable that they did this relative to the mythology and theology of their own culture.

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