The Origins of Science

Part I: Thales' Leap

Gangan Prathap

Science is arguably the most revolutionary social activity known to us. It has transformed us and our environment in ways unimaginable three thousand years ago. If we are healthier, wealthier and wiser (but maybe not happier?) than our forefathers, it is largely due to modern science. Unfortunately, not many of us stop to reflect on how this unique social activity originated. In this essay in two parts, I hope to offer an account that is representative rather than comprehensive or definitive. It reflects and is limited by my own reading on this subject but I hope that it may persuade the reader to enquire further into the nature of the origins of science. Part I deals with the period leading to the great intellectual leap made by the Ionian philosopher Thales. Part II, which will appear in a future issue will complete the study of the Greek odyssey into philosophy immediately after Thales.

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Roots of Science on Greek Soil

The most beautiful account of the origins of science that I have read so far is presented by H D F Kitto in his classic study of Greek civilization titled *The Greeks*. I therefore unashamedly draw copiously from it for this essay on the origins of science, for science took root, only once in history, and that on Greek soil. Kitto advances the argument that the Greeks were the first to show "what the human mind was for." Kitto admits that "the older civilizations of the East were often extremely efficient in practical matters and, sometimes, in their art not inferior to the Greeks, yet they were intellectually barren." The Egyptians, the Chinese and the Indian civilizations are excellent examples of cultures which flowered for thousands of years without recording a major inquiry into the nature or working of the universe in

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terms that could be called a scientific approach. Many of these civilizations were in advanced stages of development; they had invented agriculture and domesticated animals, built vast irrigation works, laid roads, organized themselves into villages, towns, cities and even networked these into empires, administered through systems of laws and government.

For millennia therefore, millions lived rich and varied lives, but died, failing to transmit through the written word, the experience of each generation beyond their own. The Dark Ages, wrote Robert M Pirsig, was merely the resumption of a natural way of life that had been momentarily interrupted by the Greeks.

The Greeks were among the earliest to create and perfect literature in forms other than religious or love poetry. Epic poetry, history and drama, philosophy from metaphysics to economics, mathematics and many of the natural sciences all originated with the Greeks. Here, says Kitto, was a literature which distilled, preserved and enlarged the experience of a people and began nearly three thousand years of modern human civilization. We can now understand why Goethe could make that cruel comment about the poverty of the philosophically illiterate that "he who does not draw from three thousand years is living from hand to mouth."

Kitto declares that the most typical feature of the Greek mind is a sense of the fundamental unity in nature and of a wholeness of things - holism describes this frame of mind. We can see this in Homer, says Kitto, where 'particular detail' and 'individual character' are firmly fixed into a 'universal frame'. The modern intellectual tradition is to divide, to specialize and to think in categories or assign to pigeon-holes (we call it reductionism now, or more simply, splitting) whereas the Greek instinct was to do exactly the opposite, to take the widest view and to see things as an organic whole (or lumping). Thus, even today, our scientific traditions can be split down the middle with one half being the lumpers and the other half being the splitters. Lumpers group together as many things as possible; splitters do not hesitate to create new categories whenever they see significant differences.

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This Greek instinct for seeing things as a whole was joined by two other fashions, the firm belief in *reason*, and the search for what is *imperishable* in the affairs of men. Before this, all descriptions of the workings of nature were purely speculative, mythological or of the poetic imagination; what was imperishable was that which was transmitted to us by the Gods through the myths. This was true of all civilizations, Greek or otherwise. Kitto describes this well by relating the story of a Chinese philosopher who was asked what the earth rested on. "A tortoise", said the philosopher. "And what does the tortoise rest on ?" "A table." "And what does the table rest on?" "An elephant." "And what does the elephant rest on?" "Don't be inquisitive".

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From Mythos to Logos

The Greeks were the first to show us that the old Greek myths were only imaginative creations of the inventive mind. They began to glimpse that another level of myths could be discovered through reason and abstraction, which could replace the old myths. Let us now spend some time on this very transcendental leap from 'mythos' to 'logos'. Sociologists and anthropologists will tell us that in every culture the conventional means for structuring any kind of experience is the use of myths. The Greek word *mythos* means *word* - in the sense that it is a decisive or definitive statement on the subject. It can be taken to be the sum total of all early and prehistoric myths of all cultures and civilizations, Greek, Hebrew, Nordic, Vedic, to name a few. It could include superstitions and legends and these have in untold and immeasurable ways informed our present understanding of the world. A myth is always taken as received, from some authority, be it teacher or text and as an authoritative account of the facts or ordering of experience; it is not to be challenged or questioned.

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The Greeks were to challenge all this. As opposed to *mythos*, the Greeks offered us *logos*, the Greek word denoting our rational understanding of the world. By rational, we mean that we attempt to arrive at an account of truth that can be demonstrated, discussed and debated using the instrument of reason. However, we

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cannot altogether dispense with myth-making. As the philosopher of science, Sir Karl Popper pointed out, all science is also myth-making, just as religion is, but with an important difference. In science, we deal with myths of a special type, in a special way - scientific myths are testable, change with experience and critical debate. Science, says John L Casti, is myth with discipline. This is the stage known as *positivism*. The value of observation and experiment is now seen and used to challenge myths and not merely accept them because they were received from authority.

The Triumph of Logos Over Mythos

Let us now return to how the Greeks brought about this triumph of *logos* over *mythos*. The Greeks believed that the universe was not built on caprice or chance. They were certain that it obeyed certain laws and that these immortal principles could be discovered and explained. Even in human affairs, as a study of Greek tragedy will show, there is the implicit belief that it is not chance but a universal and inexorable law reigns. There is design, even in what may seem to be the complex but apparently fortuitous chain of events that regularly are the substance of Greek tragedy. The philosopher Whitehead went so far as to say that the Greek tragic poets, rather than the early Greek philosophers, were the true founders of scientific thinking. Thus, we see in the Greek mind, the elements of poetic imagination melding with the elements of reason. As we will see later, these are the first two steps of the full scientific process. There is one more step that was to become part of the scientific tradition only many centuries later - the beginning of the experimental or empirical tradition as an instrument of criticism by which the poetic metaphors could be refined until they gave a more unified and coherent understanding.

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The Greek Philosopher Thales

Going back to the early Greek speculation about the origin and nature of the universe our attention is drawn to a remarkable figure, Thales (625?-546? B.C.) of Miletus in Asia Minor (see

Miletus, Chaldea and Egypt

Miletus was an important port and the richest market in Ionia and traded extensively with many countries in the region. It is not surprising that Thales was a merchant who travelled widely and learned a little of Egyptian mathematics and Chaldean astronomy. Chaldea was a region of ancient Babylonia in what is now south eastern Iraq. The early Chaldean (or Babylonian, as they are often remembered) astronomy between 700 and 500 B.C. was built up for the very practical business of regulating their calendar and for making predictions; astrology and astronomy, until very recently, were inextricably mixed. They kept detailed astronomical records and could make accurate predictions of the sun and the moon. The Chaldeans also contributed to what could be called *commercial arithmetic,* and the Egyptians developed a sophisticated form of practical geometry (Greek for Land-measuring).

box), the first of the great Ionian thinkers. He is the earliest known Greek philosopher, and was to found what is known as the Ionian school. He is remembered as the first scientist on Aristotle's authority because he is acknowledged as the first who expressed his ideas in concrete but logical, and not mythological, terms. Little that he wrote came down directly to us and what we know of him is through accounts by later Greek historians and philosophers. It is Aristotle who tells us that Thales was the first person to ask searching questions about the underlying material source of all things.

Greek thought so far was confined to grappling with moral, religious and social problems, and their speculative adventures remained restricted to how the universe came into existence rather than how it worked. Thales was to change all this. He was the first Greek philosopher to have predicted the total eclipse of the sun during the year 585 B.C. The Babylonians and Egyptians used mathematics and geometry as tools in practical life. Thales turned these tools into science. Some typical propositions that students are introduced to in their earliest encounters with geometry are believed to have originated with Thales: that a circle is bisected by a diameter, or that the angle inscribed in a semicircle is a right angle. He applied geometrical principles to the problem of measuring the distance of a ship at sea, informa-

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tion which is vital to trade and commercial interests. He was therefore a very practical man in some ways but in other ways more typical of an absent-minded philosopher. Thales often 'wasted' time on idle pursuits.[1]

[1] The usual story of the absent-minded Professor is told of Thales, that on a walk he was so intently looking up into the heavens that he tumbled into a well; but a story of the other kind is related by Aristotle — himself something of a philosopher and therefore not disinterested. Thales was reproved for wasting his time on idle pursuits. Therefore, noticing from certain signs that the next crop of olives would be a large one, he quietly brought an option on all the wine-presses of Lesbos, so that when the large crop came and everyone wanted to make his oil at once, they all had to go to Thales for a press. So he demonstrated that a philosopher can make money enough, if he thinks it worth doing. (From H D F Kitto, *The Greeks*.)

One of these idle tasks that engaged him rather delightfully was the simple question: What is the world made of? *The important leap here is the mere asking of the question.* This was typical of the Ionian Greeks; they had a passion for asking useless questions in a purely disinterested way. Also, they assumed that such questions were capable of being answered. And they knew, as if by a newly developed instinct, that what they were going to find would confirm their faith in a unifying principle that underlies all material forms in nature. Going back to the question Thales asked, he believed, incorrectly as we now know, that this substance was water. Note that Thales preferred to choose something as concrete and tangible as water as his universal substance or immortal principle, and expressed it in terms which were at once ready for objective and critical discussion and for experimental verification. Mythology and theology were giving way to science.

It was a curious answer, but he must have had some reasons for arriving at it. Water is everywhere, on land, surrounding the land, coming down from the clouds, gushing out of springs and wells. It can in turn be solid, liquid, or gas. Thales' answer was therefore based both on abstract reasoning and the observational evidence gathered through the senses. The most significant implication of Thales' answer was that in spite of the diversity of appearances, Thales was sure that the world consisted of one single element. This is one of the most influential ideas to emerge from Greek thought: that "the universe is not only rational, and therefore knowable, but also simple" (in Kitto's words).

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There is also some irony in the fact that throughout history, philosophy and metaphysics have oscillated from complexity, multiplicity and pluralism (the world is a manifestation of an

Occam's Razor

William of Occam (also Ockham, Ockam) lived from 1285 to 1349 A.D. He formulated the principle we now know as Occam's razor - *Entia non sunt multiplicanda praeter necessitatem* - "Entities are not to be multiplied beyond necessity", implying that explanations should never be more complicated than they need be. This has come to be regarded as the fundamental organizing principle for all scientific theorizing - although nature itself may not be simple, the laws describing its working may be constructed from simple principles. More precisely, Occam's razor states that if many explanations are offered, the simplest, that is, the one which makes the fewest assumptions, is often the one that is the most useful and the most likely to be true. Scientific explanations must be simple and useful. This is the very basis for science.

indefinite number of things) to simplicity and monism (the belief that all things are constituted from one single thing, making no distinction even between mind and matter). Thus, as Kitto points out in his book, had Thales met a nineteenth-century chemist and been told that there are sixty-seven elements, he would have objected that this was far too many. Had he come sometime earlier this century and been told by a physicist that these elements were combinations of a fundamental building block, he would have rejoiced and exclaimed, "That's what I've always said".

A few things stand out about this extraordinary leap that Thales made. First, his conjectures and analyses were totally free of any form of religious mysticism. His metaphors were free of mythological symbolism. He was the first person to break away from the usual mythological and supernatural explanations and look for natural causes using a scientific approach. By this, we mean that he tried to combine reason with observation in trying to ask and answer questions about life and the universe. Secondly, we must admire the boldness of his ideas. As Kitto says, "It is as if the human mind for the first time took its toes off the bottom and began to swim, and to swim with astonishing confidence."

Suggested Reading

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