

**Bertman, Stephen.**

*The Genesis of Science: The Story of Greek Imagination.*

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The title of the book reviewed here is very clear and accurately expresses what the volume achieves: in a masterly way it leads us through the history of Greek science and the search by ancient philosophers to explain the cosmos that surrounded them.

As the author says in the *Acknowledgements*, ‘this book was inspired by the simple question “Who invented science?”’ (p. 11). He starts the book with an initial approach to the problem, briefly discussing a conception of science that, according to him, is linked to the cosmos-vision developed by the ancient Greeks in order to understand nature.

According to Bertman, the poor quality of Greek soil, as compared with Egypt and other Near-Eastern countries, the ancient Greeks to find clever ways of getting the land to produce food and for that they started to look more carefully their surroundings, and caused the development of their special way of looking at the cosmos. The acceptance of that challenge lead them to develop a full confidence on the human being and his capability to control their cosmos. In his words: ‘The rationalism of the Greeks was combined with humanism, a pride and confidence in their own human potential’ (p. 18).

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This character of the Greek vision of the world was unique, and for the author it works as the main thread for the book. The book focuses on exploring Greek achievements in science. Science at a certain level did exist before the Greeks, but elaborated science needs an adequate writing system in order to be recorded, and using these records, to allow for the reconsideration and changing of perspective on ideas and development of complex, abstract thinking. The Greek alphabet provided such a writing system. Therefore, any knowledge developed before the alphabet was pragmatic, serving mainly for survival and religious purposes and rarely venturing into the abstract.

After briefly discussing about what he calls the 'Neolithic Revolution' (p. 22-3), Bertman moves on to a short chapter (Chapter 2) about science before the Greeks, where he outlines the achievements of the ancient Egyptians, such as their solar calendar, which was linked to the Nile and its behaviour. Bertman explains that the Egyptians achieved a good level of knowledge of chemistry, due to their interest in the afterlife and care taken during the mummification process. He also describes their knowledge of anatomy and how it, too, was connected to the mummification process. He says that Egyptian mathematics was very basic, a consequence of their need for farming large areas of land. Their mathematics, and its development, contrasts strikingly with the more abstract Greek mathematics.

Mesopotamian civilization, for its part, handed down many different achievements. Among them, we can include the sexagesimal counting system, the seeder plow and the principle of the lever. They also used geometry, but not as abstract knowledge. There is evidence of the use of '... apparatus for filtering, distilling and extracting various chemical substances' (p. 35). They also had good knowledge of the stars and of medicine.

In Chapter 3, called 'The Language of the Universe', Bertman establishes that the main difference between the ancient Greeks and their neighbours was the set of assumptions that the ancient Greeks had about the cosmos. For Bertman, 'Greek science was based upon three fundamental assumptions: that behind all natural phenomena there exists order, that this order is intrinsic and not arbitrary, and that it can be discovered by the human mind' (p. 43).

With that affirmation in mind, he shows in the second part of the book, called 'Exploring the Universe', how this set of philosophical axioms work and that it is behind the whole of Greek scientific development.

Chapter 4 is dedicated to optics. In Bertman's words '...they singled out the sense of sight as learning's primary organ, for in the ancient Greek "to know" (*idein*) meant "to have seen"' (p. 49). Because of this interest, the Greeks studied the nature of vision, developed technology for the use of lenses and mirrors, and understood well the process of optical illusion, which would culminate in its maximum splendour with the design of the Parthenon.

The next step in Bertman's survey is the study of acoustics (Chapter 5). For the Greeks, music was fundamental, intrinsically associated with Greek language itself. It is not an accident that musical instruments were associated to deities like Apollo or Pan. The study of harmony led them to discover the mathematical ground for music itself. As a consequence of their advanced knowledge of acoustics, we still have the marvellous Theatre of Epidaurus, whose astounding acoustics have never been fully understood. Bertman discusses briefly the explanation of Declercq for the extraordinary acoustic of this theatre, which is based on the layout of the seats (p. 73).

Chapter 6 is about mechanics. The author attributes to Greek curiosity, to their desire to test their intrinsic limits and to their fascination with power, the main reasons for their developments in mechanics, in both practice and theory. Those achievements include an understanding of the laws of movement and inertia, as well as the principles of fluctuation and the lever. On the practical side, that knowledge allowed the Greeks to construct war machines and ships. They designed and used pumps and, like the legendary Daedalus, they believed that man might somehow fly. The use of machines for entertainment gave us the expression *deus ex machina* and the moving parts of a theatre stage.

The development of chemistry and alchemy (Chapter 7), for their part, is linked to the origins of the Greek philosophical thought. The first philosophers were known as *physikoi*. In this area, according to this brief chapter in Bertman's book, the interests of the *physikoi* in the transformations of substances led to the development of knowledge in chemistry and alchemy, including the understanding and use of distillation devices.

Chapter 8, whose title is 'Geography and Geology', describes the travels of Greek sailors to foreign places and their interest in putting in graphic form what they had seen. The Greek stories on travelling and visiting other lands seem to indicate that they visited far away destinations such

as the British Isles. They knew quite well the Mediterranean, the Aegean the Levantine zone, and the Black Sea countries. The descriptions of Herodotus are a great contribution to this area. Bertman adds to the monumental work of Herodotus the no less monumental work of Strabo. Cartographic knowledge induced the Greeks to try to understand orography, and ultimately the shape and size of the earth. From Homer to Eratosthenes, via the Ptolemaic scientists, they achieved values very close to those which we are able to determine with more precise instruments and advanced technology today.

The short Chapter 9 shows in a glance Greek knowledge on winds and seasons, and suggests that it was part of a pragmatic and necessary knowledge for the Greeks. To finalise Section I of Part II of the book, Bertman offers us a brief chapter on astronomy, including the mapping of constellations and descriptions of their movements. Bertman links Greek interest in the study of the universe with early philosophical speculation and the emergence of concepts such as 'infinity'.

After Section I, called 'The World Outside', the author initiates a second section called 'The World Within' which deals with the Greek development in the fields of biology, medicine and psychology. According to Bertman, Greek humanism, where the human being as a whole was admired, directed the Greeks to pay less attention to other forms of life, such as animals and plants, unless they played a role in human life or formed part of literary or mythological stories. In this sense, from Hesiod to Ovid, the role of study of the perfection of the human body and its harmony was crucial in all Greek culture, which celebrated a cult of the body's perfection. The author also makes the point, notwithstanding the perspective just described, that Aristotle dedicated part of his work to the study of animals and plants, and developed a taxonomy that included insights, which we could connect with the theory of evolution.

Chapter 12 deals with the medicine. The study starts with a reference to medicine in the *Iliad* and Asclepius, to arrive immediately at Hippocrates, and it mentions the treatises written by Theophrastus on fainting, fatigue, sweat and other related affections. From Theophrastus, Bertman jumps to Galen, making the point that Galen was a Hellenistic man trained in the Eastern Mediterranean. Bertman includes in this chapter the use of instruments found in Pompeii for physical examinations and surgery (p. 163). He does not neglect to mention Thucydides' description of the

plague that struck Athens during the siege of Sparta. The last chapter of this section is dedicated to what Bertman calls 'psychology'. The author is referring to the relevance that philosophers gave to the study of emotions, such as wrath and love.

Part III of the book ('From Ancient Greece to the Modern World') traces the process of transmission of Greek knowledge through the ancient Roman world, the Byzantine period and Middle Ages to the Modern Age. This last part deals with a brief introduction to the development of ancient science beyond the Mediterranean, making reference to pre-Columbian Central American cultures, Stonehenge and science in ancient China.

To this excellent work, the author adds an epilogue to close the journey through the Greek scientific world. He also includes a diachronic list of Greek thinkers, starting with the mythic Daedalus in the 15<sup>th</sup> century BCE and ending with Hypatia and Ptolemy in the 4<sup>th</sup> – 5<sup>th</sup> centuries CE.

If we compare this book with others in the history of science, such as 'Early Greek Science: Thales to Aristotle'<sup>1</sup> and 'Science after Aristotle'<sup>2</sup> by Sir Geoffrey Ernest Richard Lloyd, we can cite two virtues in this work. The first one is the broader temporal line that it shows, extending from the almost mythic period to the late antiquity (4<sup>th</sup> – 5<sup>th</sup> centuries CE), covering in one book the temporal range that Lloyd covered in his two books, but with a more extensive and detailed description of examples. I believe that covering 'the whole' period of time in one book Bertman shows us, in a clear way, how the Greek science until that later period continues to answer to the same original questions: 'why the cosmos exists?' and 'how can we know it?' The second virtue is the comparison with modern and contemporary science, and how contemporary science is still in debt of some of the insights of Greek science. Comparing Bertman's book to 'The Beginnings of Western Science: The European Scientific Tradition in Philosophical, Religious, and Institutional Context, Prehistory to A.D. 1450'<sup>3</sup> by David Lindberg, we find that, Lindberg's book covers a period that ends in the Late Mediaeval Age, showing a continuity between Greek and medieval science. Bertman's and Lindberg's books share a common interest showing the strong links between Greek science and Near-Eastern science, a very welcomed point nowadays when the line

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<sup>1</sup> Geoffrey Ernest Richard Lloyd, 'Early Greek Science: Thales to Aristotle', (New York, 1970).

<sup>2</sup> Geoffrey Ernest Richard Lloyd, 'Greek Science after Aristotle' (New York, 1973).

<sup>3</sup> David Lindberg, 'The Beginnings of Western Science: The European Scientific Tradition in Philosophical, Religious, and Institutional Context, Prehistory to A.D. 1450', 2<sup>nd</sup> edition, (Chicago, 2007)

that separated East and West in Ancient times is becoming more blurry and showing itself to be mirage.

To sum up, Bertman's book is very impressive, due in part to the amount of information concentrated in fewer than 300 pages, and in part to the striking flowing discourse through time. The intention of the author is to offer us a journey, and in this I believe he has been successful. This is a beautiful book that introduces a broad and rich subject. It will certainly break some of the barriers around the subject of the history of science in ancient Greece by transmitting the author's enthusiasm to students and scholars who wish to begin study of this subject and have a global vision of it.

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