

Polybius on the Pontus:

A tale of geological time

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The Greek historian Polybius (c. 202-c.118 BC) first entered public life in a rather unpromising way, as an official Greek hostage in Rome, but he achieved an illustrious career as a Roman ambassador and diplomat, and an apologist of the Roman empire as well as a major historiographer. The extant books of his *Histories* or *Universal History* cover approximately the period of formation of the Roman empire (under the Republic) between the years 220-145 BC. This is a fascinating work, relevant in many respects to our understanding of the events he describes, of Polybius' own time, and of historical and political processes generally, even to the present day (García Landa 2007a). In the *Universal History*, Polybius is not just a historian: he has been read as a political theorist attentive to social, historical, cultural and political processes. He develops an elaborate theory of the processes of formation and decadence of states and societies, half-way between anthropology and political theory, so insightful as to make him a proto-evolutionist, at least in the sense of cultural evolution.¹ As a political thinker, he is a precursor of Machiavelli, a disillusioned skeptic and a

¹ García Landa (2012a). The reference list includes other notes and articles of mine on various aspects of Polybius' historical and evolutionist perspective, among them an earlier paper in Spanish on his geological observations.

possibilistic pragmatist (García Landa 2012b). He has been seen as a forerunner of Locke's and Montesquieu's constitutionalist theories in his analysis of the ideal balance of powers in the state (with the Roman republic praised as an ideal pattern). As a historiographer, his narration of specific events and observations on historical processes are complemented by an acute methodological awareness as to the nature of his discourse—that is, by insightful reflections not just on history, but on historiography as well. Oscar Wilde (1879) saw in Polybius the culmination of the development of a critical perspective on history among Greek historians (García Landa 2013a).

Polybius considers peace as one of the highest goods of mankind, but not the highest: sometimes wars have to be fought in order to avoid servitude. War is often waged in Polybius' *Histories*, rather more than would seem to be strictly necessary, and the book is an eye-opener on the real nature of classical Greece—rife with the most appalling brutality and barbarity, and very far from the philosophical paradise of artists and thinkers idealized by a whole tradition of Western classicism. Polybius considered that the Roman dominion around the Mediterranean (the First Globalization, as one might put it) was the crucial event in recent history, and a major step in the progress of humankind.

There is this analogy between the plan of my History and the marvellous spirit of the age with which I have to deal. Just as Fortune made almost all the affairs of the world incline in one direction, and forced them to converge upon one and the same point; so it is my task as an historian to put before my readers a compendious view of the part played by Fortune in bringing about the general catastrophe. It was this peculiarity which originally challenged my attention, and determined me on undertaking this work. (*Histories*, 1889: 1.4)

Polybius devoted his work to the analysis of this major development, emphasizing that the very existence of a universal history (and the possibility of its telling) rests on the historical fact of a world-encompassing political order.

The severity of the Roman rule and its obvious exploitative dimension might lead us to question the virtues Polybius sees in it (quite apart from the obvious reason that he became one of its beneficiaries). But one must keep in mind the long nightmare of the age of wars preceding it, the permanent conflicts, lootings and massacres described by Polybius as the ordinary state of affairs among the hundreds of peoples, tribes, races, city-states, fortified towns and micro-kingdoms in the period immediately preceding the Roman expansion. The quasi-Hobbesian state of permanent war pictured in the *Histories* brings home a vivid sense of the meaning of progress. Polybius shows how the *pax romana* was a beneficial factor of social integration and a positive development for the Mediterranean region, in spite of its being achieved *manu militari*.²

Polybius writes of course as a man of his times, the spokesman for a culture based on slavery. As he notes in Book IV,

The Pontus therefore being rich in what the rest of the world requires for the support of life, the Byzantines are absolute masters of all such things. For those commodities which are the first necessities of existence, cattle and slaves, are confessedly supplied by the districts round the Pontus in greater profusion, and of better quality, than by any others: and for luxuries, they supply us with honey,

² In his materialist theory of imperialism, Gustavo Bueno (2000: 465-66) usefully distinguishes between *generative empires* and *predatory empires*. One might argue that these are ideal poles, but Bueno emphasizes the generative nature of the Roman (or the Spanish) empire, mixing races, promoting commerce and spreading the language, the laws and the civilising institutions of the metropolis.

wax, and salt-fish in great abundance; while they take our superfluous stock of olive oil and every kind of wine. (Ch. 38, "Byzantium")

Slaves, like cattle, are necessities, not luxuries (Walbank 1999: 487). Without slaves, there is no Rome, without Rome there is no *pax romana* or Polybius, and no History to tell. So it goes, and universal history is not universally pleasant.

A man of his times indeed; but Polybius was a man with an understanding of events far superior to his contemporaries. Here we must leave aside his insightful examinations of military campaigns, and his influential views on the reasons of the Roman dominion (Book VI), which according to him was based the strength of the Roman constitution and its balance of powers—an account which is one of the milestones of Western political theory. We will not go into his wide-ranging reflections on anacyclosis, according to which all cultures go through formative phases, followed by growth and development, splendor and power, decadence and a return to either chaos or subordination to another dominion.³ We will focus now on another of his great intuitions (in the sense of penetrating and *reasoned* insights).

One might say that these intuitions are far in advance of his times, were it not the case that Polybius moves his times forward with them. I will refer now to his notion of geological time, and his suggestions on how one might attempt its measurement. If it makes sense to say that Polybius, a man of his times, is ahead of his times, it is because his understanding of phenomena, the interpretive analyses he offers, and the explanations and corollaries he suggests, are valuable in themselves, but are usually left

³ In (2012a) I comment further on Polybius as an early theorist of cultural and political evolutionism, a classical precursor of Vico.

isolated and undeveloped by a consistent intellectual tradition, and are ignored even by those who (in a certain sense) retake a similar line of reasoning.

Polybius writes in the wake of the explorations in natural philosophy of the Peripatetic school—notably Aristotle's *Meteorology* (I.i) and the oceanographic writings of Strato of Lampsacus (see Walbank 1999: 486; Roller 2010: 51-52, 130-1), as well as seafarers' narratives and other geographical accounts (some of them known to us through Strabo's *Geography*). Polybius takes Aristotle's and Strato's reasoning one step further, to emphasize the importance of collecting data in a more scientific way, something which is possible *now*, he says, with what we might call the "information highway" provided by universal history and by the universal empire. This shows a high awareness of the political and institutional foundations of knowledge. And, interestingly, Polybius suggests a mathematical method of calculation, once these data are available, which may be used to predict future developments within a uniformitarian evolutionary paradigm.⁴ This insight has no parallel or progeny, to my knowledge, for many centuries. Actually, it is only with the scientific revolution in the 17th century, with Edmund Halley's reflections on deep time and the saltiness of the oceans, that we find once again an advanced scientific reasoning on this matter that can be matched with the

⁴ Geological uniformitarian theories such as Lyell's (1832) provide a reasonable analogue to the Aristotelian paradigm of endless time and continual change assumed by Polybius. There are of course inconsistencies in which Aristotle and Polybius incur, as the evolutionary insights in their theories are ultimately inconsistent with the assumed eternity of the world (stated for instance in Aristotle's *Met.* II.iii, rejecting universal evolution). But such inconsistencies are present also in modern science; only think, at a different scale, of Newton's or Einstein's static universes lacking a historical development.

scientific proposals of Polybius, and take them one step further.⁵ Between Polybius and Halley there are many intervening centuries of Biblical narrative which, providing as it did an authoritative and "satisfactory" explanation of the history of the world and its dynamics, did not incite much further reflection on the subject. Religious authorities did not encourage scientific inquiry or speculation; they often discouraged such research, and sometimes suppressed discordant doctrines violently — witness Giordano Bruno or Miguel Servet.

Nevertheless, there is no sharp dichotomy between prescientific and scientific conceptions, as every age has its own science—and indeed most science is scientific in its own time and obsolete science in subsequent periods. In the Bible we find an influential philosophy of time, or at least a map of time or a template of temporal thinking which can be summarized in the image of an *arrow of time*. Human (and natural) history is conceived as a sequential process of unique events between the Creation and the Apocalypse. This conception is potentially in contrast not so much with Greek cosmogonies, which are also mythical and therefore basically narrative and sequential, but rather with the teachings of the philosophical schools of Greece, which were more attentive to the observation of cycles and regularities—for instance in the influential Aristotelian formulation, which emphasized the eternity of the cosmos and of the Earth.

Stephen Jay Gould wrote a magnificent book (*Time's Arrow, Time's Cycle: Myth and Metaphor in the Discovery of Geological Time*, 1987) on the

⁵ Halley (1714). Stephen Jay Gould (1994) sees in Halley the first scientific approach to the problem of deep time and its measurement through an experimental study of the salinity of the seas. Halley's theory, however, ignores certain cyclical aspects relative to the deposition of salts (as noted by Gould), and his contribution is not therefore much more exact or elaborate than that of Polybius. See also McGillivray (2005).

complex dialectics between *the arrow of time* and *the cycle of time*, and he emphasizes the complex dynamics of both of these principles in any approach to natural history. Thus, for instance, we can find in Ecclesiastes, in the Bible itself, a cyclical hydrographical observation: "All the rivers run into the sea; yet the sea *is* not full; unto the place from whence the rivers come, thither they return again" (1.7; King James Bible)—clearly related to the book's dominant emphasis according to which all phenomena follow a recurring cycle and there is nothing new under the sun.

Polybius himself proposed, on the one hand, an *anacyclosis* of political societies, involving a recurring pattern of civilizations being slowly built up from the catastrophic ruins of previous civilizations. But, on the other hand, his vision of nature gives a prominent role to the change, slow but constant, of landscapes and geographical features. It is this notion that brings him close to the theories of deep time—geological time—and evolutionary gradualism, at least in matters of geology, while in matters of human history his thought tends towards abstractive anthropology and cyclical thinking. Both dimensions, cyclical returns and slow but irreversible change, are present in his thought, at the human and the natural level too.

One must therefore be attentive to the complex dynamics of evolutionary thinking, and to its cross-currents, in Polybius and elsewhere. Gould points out, with regard to Halley's reasoning on the age of the Earth, that his great contribution to modern geology originated not just in his fight against the Biblical literalism of Creation and its concomitant chronology—a brief cosmic history of *circa* 7,000 years—but also, quite significantly, in his opposition to the Aristotelian doctrines regarding the cyclical eternity of natural processes. In order to counter this Aristotelian notion, it was

necessary for Halley not just to propose the existence of a long and deep temporal scale, and reasonings which would also overturn the Biblical narrative, but also to find a mode of geological measurement capable of measuring a constant but limited development. His explanation had to combine the extremely lengthy duration and slowness of geological processes with the notion of a duration which is, in the last analysis, a limited one. This dialectic between cyclical and constant processes on the one hand, and unique and unrepeatable processes on the other, results in a kind of conciliation between the one-directional paradigm of Biblical history and the cyclical thought of the Greek philosophers. Gould also finds some elements of this conciliation, and therefore a significant contribution to geological thought, in a work which has been most discredited by geologists as it is animated by a more direct Biblical literalism—the quite obviously obsolete *Telluris Theoria Sacra* (1681-89) by Halley's contemporary Thomas Burnet.

A comparable will to conciliate or at least make compatible cyclical processes with one-directional historical processes is perceptible in Polybius—in the sense that, for him, limited and observable geological cycles result at length in vast transformations of the landscape which are only to be understood and made evident through a deductive and comparative reasoning. And, conversely, apparently singular and unrepeatable events in human history (those constituting the history of battles and empires) can be perceived from the superior reasoning of the historian as episodes of a cyclical process which escapes the perception of those who live the experience of those events. Perhaps Polybius was not fully satisfied with Aristotelian notions about the eternity of the world, as they may appear to be incompatible with the geological processes that may be deduced from observation. Or perhaps he was only trying to conciliate

that cyclical thinking with other philosophical theories more favourable to a natural history of singular events—for instance the Stoic notion of a final conflagration which would consume the world. Be as it may, his thought evinces the dialectical restlessness which leads the natural philosopher to go beyond evident phenomena, in order to perceive historical cycles which are invisible to recorded history, and, conversely, to deduce gradualistic geological processes of enormous length, in contrast with the apparently cyclical and recurrent patterns of natural phenomena.

The geological reflections of Polybius appear in a digression of Book Four of the *Histories*—on the occasion of a description of Byzantium and its strategic importance. He comments on the geographical grounding of this strategical situation on the Bosphorus, going into details which show why, because of the configuration of the coast and the direction of the currents, a city on the western shore of the Bosphorus has a strategic situation from the standpoint of navigation which is lacking in another city facing it on the eastern shore. All through the *Histories*, Polybius shows, in his analyses of campaigns and his descriptions of battles, a highly conscious attention to the configuration of the terrain, its peculiarities and accidents, and the consequences they have for human action. His firsthand experience, coming from his extensive journeys, complements his knowledge of previous writers, and goes together with truly exceptional capacities for observation and reasoning.

The geostrategic analysis of the situation of Byzantium is fascinating enough in itself because of its originality, but all the more so once we consider the geological reflections it leads to. Of course there are several limitations and inaccuracies in Polybius' account. Walbank (1999: 490) cites research from 1872 (by Commander W. J. C. Wharton, of the Royal

Navy) to conclude that although Polybius' observations on the continuous flow of water from the Black Sea to the Aegean can be confirmed, his explanation for it is not wholly adequate: while the excess of water received from the large rivers draining into the sea of Azov and the Black Sea does play a part, other concurrent factors must be taken into account, and that overall "the prevalence of north-east winds the the Black Sea . . . was the most important factor" (Walbank quotes the 7th ed. of *Black Sea Pilot*, 1920). More recent research (in the 1980s-1990s) revealed a major circumstance ignored by Polybius and by his commentators, including Walbank: the superficial current of the Bosphorus flowing from the Black Sea (Pontus Euxinus) to the Sea of Marmara (Propontis) and thence to the Aegean is compensated to a large extent by a submarine current, invisible to navigation, flowing in the opposite direction, from the Sea of Marmara to the Black Sea.⁶

It may seem strange that Polybius does not allude to the tradition, mentioned by his probable source Strato of Lampsacus, to the effect that

the Pontus originally had no outlet, but eventually the water piled up and forced a passage through at the Bosphorus in a catastrophic episode (for a Samothracian legend about this cf. Diod. V.47.3-4); similarly at the Pillars of Hercules".⁷

The rationale behind this legend would seem to be quite consonant with his theory, but it is worth noting that although *the opposite* theory (i.e. the

⁶ "A high velocity surface current with relatively fresh Black sea water overlies a current running in the opposite direction, which transports the more saline bottom water of the Sea of Marmara which is of Mediterranean origin to the Black Sea" (Di Iorio 1997: 1). See also Wikipedia, "Bosporus". This submarine current has a riverlike structure, creating an underwater delta on the Black Sea shelf (Di Iorio 1997: 29), and further contributing to the silting of the Black Sea—but it still holds that the overall flow of water runs from the Black Sea to the Mediterranean, as assumed by Polybius. See also Flood et al. (2009).

⁷ Walbank (1999: 490). Strato's theory reaches us through Strabo's *Geography*, 1.3. For Diodorus Siculus' account, see his *Library of History*, V, 47-84:

http://penelope.uchicago.edu/Thayer/E/Roman/Texts/Diodorus_Siculus/5D*.html

Mediterranean flooding the Black Sea region through the Bosphorus) has also had much support from some modern geologists as well as Biblical scholars, the evidence is not conclusive (see Flood [sic] et al. 2009). Polybius' disregard of this tradition may stem from its catastrophic overtones—as he tends to emphasize the slow but continuous gradualism of phenomena in a long period of geological time. As a skeptical naturalist, he emphasizes throughout his distrust of tales and legends, and his reliance on observation of phenomena which are active *now*:

These are the true causes of the outflow of the Pontus, which do not depend for their credit on the stories of merchants, but upon the actual observation of nature, which is the most accurate method discoverable. (*Histories*, 1889: 4.39)

In 4.40 Polybius draws an opposition between the state of information and knowledge in the past, when one had to rely on improbable tales of doubtful authority (he quotes Heraclitus to this effect), and the wealth of information available in his own time thanks to present communications and to his proposed paradigm of universal history.

ἐπεὶ δ' ἐπὶ τὸν τόπον ἐπέστημεν, οὐδὲν ἀφετέον ἀργὸν οὐδ' ἐν αὐτῇ τῇ φάσει κείμενον, ὅπερ οἱ πλεῖστοι ποιεῖν εἰώθασιν τῶν συγγραφέων, ἀποδεικτικῇ δὲ μᾶλλον τῇ διηγήσει χρηστέον, ἵνα μηδὲν ἄπορον ἀπολείπωμεν τῶν ζητούμενων τοῖς φιληκόοις. (*Historiae*, 1893: 4.40.1)

Foucault's translation of this passage is more adequate here than Shuckburg's "my object is rather to give information":

Puisque nous nous sommes arrêté sur ce point, il ne faut rien laisser en friche, ni nous contenter de la simple affirmation, comme ont l'habitude de le faire la plupart des historiens, mais il faut plutôt avoir recours à un exposé appuyé sur de bonnes preuves, afin de ne laisser de côté aucun problème dans l'esprit de ceux qui s'intéressent à nos recherches. (Polybius, *Histoires: Livre IV*, 1972: 78).

A trustworthy exposition providing proof, based on reliable information and ascertainable data should be the aim of the historian.⁸ It is this reliance

⁸ For some textual problems concerning this passage see Foucault (Polybius, *Histoires: Livre IV*, 1972: 78 n.2). On Polybius' theory of knowledge see further Díaz Tejera's

on present observations and ascertainable facts that can provide the basis for reliable historiography and a true science of nature:

πειρατέον δὲ δι' αὐτῆς τῆς ἱστορίας ἱκανὴν παριστάναι πίστιν τοῖς ἀκούουσι.
(*Historiae*, 1893: 4.40.3)

Shuckburgh's translation of a key phrase, "I must try to make my narrative in itself carry conviction to my readers", is again perhaps less forceful than Roussel's, "Il nous faut essayer au contraire de faire en sorte que l'exposé même des faits engendre la certitude dans l'esprit de nos lecteurs" (Polybius 1970: 325) or Foucault's: "mais il nous faut essayer de donner aux lecteurs par le canal de la seule histoire une confiance suffisante" (Polybius 1972: 40). This is a call for critical rationalism which encompasses both the reliability of historical accounts and the scientific description of their geographical setting.

While Strato of Lampsacus is an obvious source for Polybius' hydrographic theories, it is worth noting that Polybius seems to place somewhat more emphasis on uniformitarianism. Lyell (1832: 21) recognizes a classical precedent for his uniformitarian theory in Strabo, but he does not perceive that affinity in Strato (quoted through Eratosthenes in Strabo's passage in question, concerning the change in the level of the seas). While Lyell does not refer to Polybius, the development of a uniformitarian paradigm may well be indebted to this passage in the *Histories*, given that Polybius seems to play down the catastrophic element in Strato, as well as in the received myths, in order to emphasize the constant action of causes which may still be seen at work in the present. As a matter of fact, the passage in Strabo quoted by Lyell as a precedent "to derive our explanations from things

introduction to the Spanish edition of *Historias* (1981-82). Walbank notes that Polybius uses *apodeiktikós* "to mean 'supported by full reasons, tracing cause and effect' (cf. iii. 31. 1), and opposes 'apodeictic' narrative to an account consisting of mere assertions (iv. 40. 1)" (1999: 216).

which are obvious, and in some measure of daily occurrence" goes on to list a series of rather catastrophic and relatively infrequent events, "such as deluges, earthquakes, volcanic eruptions, and sudden swellings of the land beneath the sea" (Lyell 1832: 21), rather than the constant, everyday and almost imperceptible effects of rivers, sea currents and silting stressed by Polybius as major agents of geological transformation.

And, in fact, it is evident that it is already taking place. The Maeotic lake is already so much choked up, that the greater part of it is only from seven to five fathoms deep, and accordingly cannot any longer be passed by large ships without a pilot. And having moreover been originally a sea precisely on a level with the Pontus, it is now a freshwater lake: the sea-water has been expelled by the silting up of the bottom, and the discharge of the rivers has entirely overpowered it. The same will happen to the Pontus, and indeed is taking place at this moment; and though it is not evident to ordinary observers, owing to the vastness of its basin, yet a moderately attentive study will discover even now what is going on. (*Histories*, 1889: 4.40)

Polybius goes on to suggest a way in which the length of these processes might be measured, alluding to the low saltiness of the Sea of Azov ("the Maeotic lake"), which he sees as a kind of small scale model of the Black Sea, in a more advanced phase of evolution through silting.⁹ The Black Sea shows an incipient stage of the same—and Polybius stresses the proportional relationship between these phenomena:

ἐξ ὧν δῆλον ὡς, ὅταν ὁ χρόνος, ἐν ᾧ πεπληρῶσθαι συμβαίνει τὴν Μαιώτιν, τοῦτον λάβη τὸν λόγον πρὸς τὸν χρόνον, ὃν ἔχει τὸ μέγεθος τοῦ κοιλώματος πρὸς τὸ κοίλωμα, τότε συμβήσεται καὶ τὸν Πόντον τεναγῶδη καὶ γλυκὸν καὶ λιμνώδη γενέσθαι παραπλησίως τῇ Μαιώτιδι λίμνῃ. (*Historiae* 1893: 4.42.4)

As noted by Walbank,

⁹ Compare Gould's comment on Halley's theory: "The cleverness of Halley's argument lies in his recognition that lakes, properly classified and divided, serve as smaller systems representing the same process he proposed for oceans" (1994: 171).

the phrase πρὸς τὸν χρόνον is essential to the sense: 'from this it is clear that when the time required to fill the Palus Maeotis bears the same relation to the time <then> that the size of its basin bears to <that of> the basin <of the Pontus>, then the Pontus too will become, like the Palus Maeotis, a shallow freshwater lake'. In the phrase πρὸς τὸν χρόνον the last word indicates the period of time up to (and measured by) the moment indicated by ὅταν. (1999: 494)

This proportionality seems to be essential to Polybius' insight on geological time, and to our claim that he should be seen as a precedent to Lyell's uniformitarianism. The major causes that lead to the formation and transformation of phenomena are not exceptional or catastrophic (though catastrophes do happen), but rather slow, constant and unendingly at work. This might make them invisible at the human scale, but similar phenomena at different degrees of development, or at different sizes, may be usefully compared in order to ascertain the long-term operation of these constant causes. Thus the annual swelling of small rivers in Greece (*Histories* 41.9) can be used as an analogy for the effect of larger bodies of water, or the Palus Maeotis (Sea of Azov) may be seen as a small-scale model of the Black Sea at another stage of development.

Polybius stops short of proposing mathematical calculations to measure these effects and try to make predictions, but his emphasis on a mathematical proportion and relative size (or proportional salinity) is nonetheless insightful and intellectually daring—providing a foretaste of much later attempts at a mathematical naturalism and the scientific measuring of geological time, such as we find in Halley. Without going so far as to claim this emphasis on mathematical proportion as a fully worked-out plan for an experiment (possibly doomed to failure anyway) it still remains that geological phenomena, while extremely slow, are conceived by Polybius to be observable in their transformations, although observation is indirect and based on reasoning rather than direct observation,

establishing analogies between different phases of development of ongoing phenomena:

though it is not evident to ordinary observers (...) yet a moderately attentive study will discover even now what is going on (*Histories*, 1889: 4.40)

This mode of reasoning is to be seen, as well, in his explanation of the formation and different situations of sandy deposits in front of river mouths, with the Danube and the Black Sea sandbanks ('the Breasts') as a prominent example (*Histories*, 1889: 4.41.1-6).¹⁰

In sum, Polybius' explanation is not only innovative—with due allowance of the precedents in Aristotle and Strato—and clarifying; it is also a *theory*, a term which should be understood here as pointing not so much to the possibility of experimental and predictive testing based on measurements (something which is merely adumbrated in Polybius' formulation), but mainly to a high degree of methodological self-consciousness as to principles and general laws, which allow general and encompassing explanations of similar phenomena. His awareness in this respect extends to an assessment of the value of hypotheses as they relate to observations guided by the theory itself, and a critique of non-systematic and *ad hoc* explanations based on doubtful or legendary sources.

But I have another and higher object also in thus speaking: which is to prevent our ignorance from forcing us to give a childish credence to every traveller's tale and marvel related by voyagers; and that, by possessing certain indications of the truth, we may be enabled by them to test the truth or falsehood of anything alleged by this or that person. (*Histories*, 1889: 4.42)

Polybius is aware that he is explaining phenomena in a different, non-traditional, more elaborate way—an elaboration which is made possible by

¹⁰ The fact that, as noted by Shuckburgh, the Breasts which posed such hazards to ancient navigators have long since disappeared shows the complex dynamics of geological processes, however cogent the explanations of the main forces underlying them.

the new and expanding networks of communication and the access they enable to a wealth of information made possible by his great all-embracing topic, the growth of a Mediterranean world order under the Roman Empire. This awareness of the historicity of knowledge and science, and their reliance on networks of information and communication, and, ultimately, on a world-encompassing political order, is a major contribution to critical history and to the philosophy of science. His glimpses into the long span of geological processes and the possibility of a scientific approach to their study provide a striking instance of the solidity of his outlook on what can be achieved through this systematization of knowledge—valuable insights both on the possibility of reliable knowledge of natural phenomena, and on the intellectual and historical circumstances that make such scientific knowledge possible.

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References

- Aristotle. (1994-2009). *Meteorology*. 350 BC. Trans. E. W. Webster. Online text at *The Internet Classics Archive*.
<http://classics.mit.edu/Aristotle/meteorology.1.i.html>
(Retrieved March 10, 2019)
- Wikipedia. (2019). "Bosporus." Online text. *Wikipedia: The Free Encyclopedia*.
<https://en.wikipedia.org/wiki/Bosporus>
(Retrieved March 10, 2019)
- Bueno, Gustavo. (2000). *España frente a Europa*. 3rd ed. Barcelona: Alba. Online facsimile at *issuu* (1 May 2014).
https://issuu.com/eltrujaman/docs/gustavo_bueno_espa_a_frente_a_euro
(Retrieved March 19, 2019)
- Di Iorio, Daniela, and H. Yüce. (1997). "Observations of Mediterranean Flow into the Black Sea." (SACLANT Undersea Research Centre Report SR-269). Online text. San Bartolomeo: NATO SACLANT Undersea Research Centre. Online at *ResearchGate*.
DOI: 10.1029/1998JC900023
<https://www.researchgate.net/publication/235020103>
(Retrieved March 10, 2019)
- Flood, R. D., Hiscott, R. N., and Aksu, A. E. (2009). "Morphology and evolution of an anastomosed channel network where saline underflow enters the Black Sea". *Sedimentology* 56(3), 807–839. Online text at Wiley:
<https://doi.org/10.1111/j.1365-3091.2008.00998.x>
<https://onlinelibrary.wiley.com/doi/full/10.1111/j.1365-3091.2008.00998.x>
(Retrieved March 10, 2019)
- García Landa, José Angel. (2007a). "Lecciones de Polibio." Online text. In García Landa, *Vanity Fea* 26 Jan. 2007.
<http://garciala.blogia.com/2007/012603-lecciones-de-polibio.php>
(Retrieved March 10, 2019)

- _____. (2007b). "Benefit of Hindsight: Polibio, Vico, Wilde y el emergentismo crítico / Benefit of Hindsight: Polybius, Vico, Wilde, and Critical Emergentism" Online text. *Social Science Research Network* 9 November.
<http://ssrn.com/abstract=1027923>
(Retrieved March 10, 2019)
- _____. (2012a). "Evolución, anaciclosis y dialéctica social de la historia." Online text. In García Landa, *Vanity Fea* 5 Sept.
<http://vanityfea.blogspot.com.es/2012/09/evolucion-anaciclosis-y-dialectica.html>
(Retrieved March 10, 2019)
- _____. (2012b). "Maquiavelismo religioso en Polibio. Y el triunfo de la demagogia." Online text. In García Landa, *Vanity Fea* 27 Oct.
<http://vanityfea.blogspot.com.es/2012/10/maquiavelismo-religioso-en-polibio-y-el.html>
(Retrieved March 10, 2019)
- _____. (2013a). "Retroperspectiva y perspicacia: El emergentismo crítico de Polibio a Wilde." In *Otium cum dignitate: Estudios en homenaje al profesor José Javier Iso Echegoyen*. Ed. J. A. Beltrán et al. Print. (Monografías de Filología Latina, 16). Zaragoza: Universidad de Zaragoza. 677-88.
- _____. (2013b). "Anclaje narrativo y círculo hermenéutico en un texto de Polibio." Online text. In García Landa, *Vanity Fea* 5 Jan. 2013.
<http://vanityfea.blogspot.com.es/2013/01/anclaje-narrativo-y-circulo.html>
(Retrieved March 10, 2019)
- _____. (2015). "Lógica de la narratividad según Polibio." Online text. *Social Science Research Network* 29 Nov. 2015.
<http://ssrn.com/abstract=2695867>
(Retrieved March 10, 2019)
- _____. (2015). "Polibio y el tiempo geológico." Online text. *ResearchGate* 29 Jan. 2015.
<https://www.researchgate.net/publication/271515661>
(Retrieved March 10, 2019)
- Gould, Stephen Jay. (1987). *Time's Arrow, Time's Cycle*. Print. Cambridge (MA): Harvard UP.
- _____. (1994). "On Rereading Edmund Halley." In Gould, *Eight Little Piggies: Reflections in Natural History*. Print. Harmondsworth: Penguin. 168-80.

Halley, Edmund. (1714). "A short Account of the Cause of the Saltness of the Ocean, and of the several Lakes that emit no Rivers; with a Proposal by help thereof, to Discover the Age of the World." *Philosophical Transactions of the Royal Society* 29 (issue 344, 1 Jan.): 290-300. Online PDF (1 Jan. 1997).

<https://royalsocietypublishing.org/doi/pdf/10.1098/rstl.1714.0031>

<https://doi.org/10.1098/rstl.1714.0031>

(Retrieved March 10, 2019)

Lyell, Charles (Sir). (1832). *Principles of Geology, Being An Attempt to Explain the Former Changes of the Earth's Surface by Reference to Causes Now in Operation*. 3 vols. 2nd. ed. London: John Murray. Vol. 1. Online text at Google Books:

https://books.google.es/books?id=mmIOAAAAQAAJ&redir_esc=y

(Retrieved March 10, 2019)

McGillivray, Ryan. (2005). "Ocean Salinity as a Failed Scientific Clock." In *The Age of the Earth and the Formation of the Universe* (Timothy H. Heaton Honors Seminar website).

http://apps.usd.edu/esci/creation/age/content/failed_scientific_clocks/ocean_salinity.html

2019

"Polybius." *Wikipedia: The Free Encyclopedia*. Online text.

<https://en.wikipedia.org/wiki/Polybius>

(Retrieved March 10, 2019)

Polybius. (1893). *Historiae*. Greek text. Ed. Theodorus Büttner-Wobst after L. Dindorf. Leipzig. Teubner. 1893-. Online text at *Perseus Digital Library*, Tufts University.

<http://www.perseus.tufts.edu/hopper/text?doc=Perseus%3atext%3a1999.01.0233>

(Retrieved March 10, 2019)

_____. (1889). *Histories*. Trans. Evelyn S. Shuckburgh. 1889, rpt. 1962. Online text. *Perseus Digital Library*, Tufts University.

<http://www.perseus.tufts.edu/hopper/text?doc=Perseus:text:1999.01.0234>

(Retrieved March 10, 2019)

_____. (Polybe). (1970). *Histoire*. Ed. and trans. Denis Roussel. Print. (NRF - Bibliothèque de la Pléiade). Paris: Gallimard.

- _____. (Polybe). (1972). *Histoires: Livre IV*. Bilingual ed. Ed. and trans. Jules de Foucault. Print. (Collection des universités de France). Paris: Les Belles Lettres.
- _____. (Polibio). (1981-82). *Historias*. 3 vols. Introd. A. Díaz Tejera. Ed. and trans. Manuel Balasch Recort. Print. Madrid: Gredos.
- Roller, Duane W. (2010). *Eratosthenes' GEOGRAPHY: Fragments Collected and Translated, with Commentary and Additional Material*. Online text. Princeton and Oxford: Princeton UP.
<https://www.temehu.com/imazighen/berberdownloads/eratosthenes-geography.pdf>
(Retrieved March 10, 2019)
- Strabo. (1903-1906). *Geography*. Ed. and trans. H. C. Hamilton and W. Falconer. Online text. *Perseus Digital Library*.
<http://www.perseus.tufts.edu/hopper/text?doc=Perseus%3atext%3a1999.01.0239>
(Retrieved March 10, 2019)
- Walbank, F. W. (1999). *A Historical Commentary on Polybius. Volume 1: Commentary on Books I-VI*. Print. New York: Oxford UP.
- Wilde, Oscar. (1879). *The Rise of Historical Criticism*. Online text (1997-2009) at *Celt (Corpus of Electronic Texts)*.
<http://www.ucc.ie/celt/published/E800003-001/>
(Retrieved March 10, 2019)