DOI: 10.1478/AAPP.932C1

AAPP | Atti della Accademia Peloritana dei Pericolanti
Classe di Scienze Fisiche, Matematiche e Naturali
ISSN 1825-1242

Vol. 93, No. 2, C1 (2015)

A SCIENTIFIC APPROACH TO PLATO'S ATLANTIS

MASSIMO RAPISARDA*

ABSTRACT. The myth of Atlantis is hard to die. This attempt to use scientific evidence to give it the final smash ends up with the doubt that it might not be totally unsubstantiated. The time of the supposed existence of Atlantis (around twelve thousand years ago) was, in fact, characterized by technological revolutions, acknowledged by archaeology, and abrupt climate changes, documented by geology. In principle, it cannot therefore be ruled out that some of those dramatic events left a memory, later used by Plato as a basis for its tale. The climate changes involved the majority of the northern hemisphere, thus all the ancient civilizations (Egyptian, Mesopotamian, Indian and Chinese) could have preserved reminiscence, but it is clear that the events occurring closer to Greece would have been more accessible to Plato. Among the Mediterranean sites that experienced the cataclysms of the beginning of the Holocene, a good candidate to host a primordial civilization might have been the archipelago then existing in the Strait of Sicily, a natural maritime link between Tunisia and Italy, prized by the presence of an obsidian source at Pantelleria. Eleven thousand five hundred years ago, a sudden sea level rise erased the archipelago, submerging the possible settlements, but Pantelleria obsidian ores are still there and could provide a significant clue. In fact, the potential discovery of artefacts, originating from a source now submerged by the sea level rise, would imply that the collection of the mineral took place when it was still emerged, namely at the time of Atlantis. Even if such discovery would not be sufficient to prove the existence of the mythical island, it would be enough to shake up the timeline of the human occupation in the region.

Introduction

The legend of Atlantis derives from two Dialogues of Plato (Timaeus and Critias), in which the philosopher wrote of a powerful empire dominating the Mediterranean about twelve thousand years ago, before being defeated by the primordial Athenians and then destroyed by a cataclysm.

For several good reasons, historiography has never taken seriously the authenticity of the legend, which has been largely considered a gimmick of political propaganda. The historians' conclusion is plausible, but the curious coincidence between the alleged date of the Atlantis destruction and the Meltwater Pulse 1b (MWP 1b), a sudden increase in sea

Figure 1. Europe shoreline at the peak of the ice age (map from GLOBE 1999).

level geologically well-known (Fairbanks 1989) (E. Bard, Hamelin, and Fairbanks 1990) (Liu and Milliman 2004), which took place at the end of the Ice Age, suggests the bizarre hypothesis that, in writing the legend, Plato could have taken the cue from an existing myth, linked to the memory of that ancient cataclysm.

The end of the Ice Age was, in fact, characterized by different climatic upheavals, whose traces geology has found. The heating was not gradual, but marked by sudden leaps, which triggered migrations and changes in lifestyle. It is not by chance that during the same period archaeology too has recorded several modifications in human habits.

Today we do know how much ice was stored on the continental shelves in the last hundred thousand years, and thus the sea level trend since the last ice age, almost century by century. In other words, we can say which seabeds were emerged, and which ones were not, ten or twenty thousand years ago. In practice, those interested in tracking down Atlantis, which, according to Plato, was submerged about eleven thousand five hundred years ago, should simply look for the sea beds most fitting the geographical description made by the philosopher.

This article will try to summarize the archaeological and geological knowledge relative to that period, so that the reader can form his own opinion about the meaningfulness of the Atlantis myth. Inevitably, the subject embraces different disciplines. Whenever possible, the subjects have been grouped by theme, but sometimes the narrative requested to mix the issues, to privilege the overall understanding.

The origin of the myth

Plato was an educated and bright aristocrat, capable of writing entire books on topics he barely knew, while giving explanations so fascinating to be believed for centuries by

generations of readers.[1] The story of Atlantis is told in two of his last Dialogues, Timaeus and Critias, which summarized his cosmogonic vision and his political testament.

During his youth Plato had been tempted by political life, but soon realized that, to be successful, he had to become rather callous. More reflexive and honest than the politicians that raged in the city, he preferred to develop an ideal political system (the Republic) that, if applied, would have returned Athens to its former glory.

Much to his chagrin, the Athenians did not follow his advices so, when he was called to educate Dionysus the younger, the future tyrant of Syracuse, Plato believed that his moment had come: at last he could forge a philosopher-king according to his magisterial teachings. Unfortunately, he soon realized that not only Dionysus was made of the same stuff of the politicians he knew, but that the tyrant was even an authentic parvenu. Disappointed and fallen in disgrace, Plato hardly fled from Syracuse and returned to teaching in Athens, an activity that still gave him some satisfaction, albeit academic.

At seventy, he thought it was time to explain how the universe was born, and how good it was at the time of the ancient Republic. To do it, he narrated how the primordial Athens, (which was fantasized, but scarcely known by his fellow citizens) had defeated the empire of Atlantis, cramming the tale with all the unverifiable details that could bring grist to his mill.

The story was told in a more concise form in the Timaeus (the equivalent of two A4 pages) and more in detail in the Critias (about six pages in a total of seven). The two Dialogues do no show contradictions between them. Disregarding all irrelevant niceties, the interesting points for a possible location of the site are summarized in the following section. The Platonic text analysed in this article is the translation by W. R. M. Lamb (*Plato in Twelve Volumes* 1925).

The gist of the story. Since Athena, besides being the founder of Athens, had been also the founder of Sais, Solon had gone to that ancient city on the Nile delta to gather news about the origin of his own city. There, the priest of the local temple welcomed him with great honours and told him that the Goddess had founded Athens nine thousand years before[2] (Tim. III 23.e), (Crit. III 108.e); one thousand years ahead of Sais, as resulted from the official records. The priest added that those ancient Athenians were the noblest among men, because they had defeated Atlantis, the most powerful empire of that time.

Back then the Atlantic Sea was navigable (not as in their times when shoals and marshes rendered it dangerous)[3] (Crit. III 109.a) and, in front of the Pillars of Hercules (Tim. III 24.e) there was an island larger than Libya and Asia combined. This island was close to other islands and, hopping through these, one could reach the continent that enclosed

[1] To believe that the ancients told less crap than the contemporaries seems to be an innate characteristic of humanity, a phenomenon that science has not yet been able to explain.

[2] According to the transcript, it says nine thousand years in both Critias and Timaeus.

[3] Plato uses the term Atlantic Sea indistinctly for an enclosed sea near the island-capital (no longer bounded in Plato's times for the sinking of the islands that used to surround it and no longer navigable for the presence of marshes and shallow waters) and for a large open sea, surrounded by the continent dominated by Atlantis. If, as it appears from the context, Atlantis is to be placed in Plato's known world, both the Western Mediterranean and the Tyrrhenian Sea could correspond to the description of the open Atlantic Sea. (Tim.: III 24.e, III. 26.d).

the vast ocean.[4] The "capital" of this empire was a small island, which ruled over the entire archipelago. It was a sort of Venice made of white, black and red stones[5] (Crit. VIII 116.a), built on three concentric circles of land and water and connected to the sea through a channel. On the continent, Atlantis ruled in Europe up to Thyrrenia[6] and in Libya (Africa) from the Pillars to the border of Egypt (Tim. III 25.b).

The main island of the archipelago had a large plain, three thousand stadia (approximately, 550 km) long and two thousand stadia (approximately 350 km) wide, surrounded by northern mountains and by a southern channel that ended in the open sea[7] (Crit. X 118.b), with rivers, lakes, mountains and marshes, two harvests per year[8] (Crit. X 118.e), elephants[9] (Crit. VI 114.e) and exotic fruits[10] (Crit. VI 115.b).

Its first king had been Atlas[11] (Crit. VI 114.b), who had perfectly organized the country, following commendable political principles, second only to those of Athens. But when Atlantis wanted to conquer Egypt and Athens, the heroic Athenians resisted and defeated it, freeing Egypt too, that in the meantime had been subjugated. A little later, a violent earthquake and a flood destroyed Atlantis in a day and a night, leaving an impenetrable swamp in place of the island (Tim. III 26.d); Athens perished in the cataclysm too.

---

[4]Like today, twelve thousand years ago Sicily and Sardinia were by far the largest islands in the Mediterranean, both enclosed in a group of smaller islands. For both of them the continent beyond the sea was Europe. To dominate Libya (West Africa) and Europe, both Sicily and Sardinia were in a good logistic position.

[5]The detail of white, black and red stones could mean that, in addition to limestone, common in almost all the Mediterranean islands, also lava rocks, usually black, but often coloured, had been quarried, implying that the city was built on volcanic soil. A deduction reinforced by the circular rings of land, recalling the edges of a partially submerged caldera.

[6]Identifiable with the Tyrrhenian side of central Italy.

[7]The dimensions of the plain of Atlantis are certainly not those of a continent, in contradiction with the statement "Libya and Asia combined", whose size Plato was certainly aware of. To this extent one point should be clear: twelve thousand years ago (or even twenty thousand, at the glacial maximum) in no part of the world there was an emerged seabed the size of a continent. The bottom of the Atlantic Ocean is thousands of meters deep and no portion of it ever emerged following a drop of the sea level of just 120 metres. From a geological point of view, twelve thousand years is a pittance, ten thousand times shorter than the movements of continental plates: those invoking the continental drift demand movements occurring over tens or hundreds of millions of years and not in thousands of years. Days when men simply did not exist: our species (Anatomically Modern Humans) is about one hundred and fifty thousand years old, Homo erectus a couple of million and the hominids from which we descend, four or five. Going back to the dimensions of the "Atlantic" plain, near Gibraltar there is nothing like that, but glacial Sicily had a large southern plain (bounded by northern mountains). In the Strait of Sicily there was an even wider one east of Tunisia. Also the Adriatic sea floor could contain such a plain, as well as the Gulf of Odessa and the Sea of Azov in the Black Sea. A more detailed analysis will follow in the ensuing sections.

[8]Two crops a year, thanks to rain in winter and irrigation channels in summer, imply that the Atlanteans knew farming, which was then being born in the Middle East. They also indicate a subtropical region, excluding the lowlands of northern Europe, at the time mostly covered by permafrost. Also the Sea of Azov and the Gulf of Odessa were too cold for two harvests.

[9]The only place in Europe where (dwarf) elephants used to live is Sicily. Too bad that they became extinct twenty thousand years before Atlantis.

[10]The most suitable regions for two crops, as well as for producing fruits "difficult to keep", were evidently the warmer ones.

[11]If Atlas gave its name to the Atlas Mountains, extending from Tunisia to Morocco (giving, in turn, their name of the Atlantic Ocean), it seems plausible to seek his kingdom near the mountain chain, that is, along the Mediterranean coast stretching from the Strait of Sicily to Morocco.

The credibility of Plato. Unlike the legends of Troy or Mycenae, often cited by the Atlantis fans as examples of academic arrogance refuted by the genius of an amateur archaeologist (Schliemann), the tale of Atlantis is not present in the Greek traditional mythology. The difference is not negligible: Homer put on paper the oral tradition of Greek epics four or five hundred years old, Atlantis is instead the story of an empire of nine thousand years before, told for the first time by an aristocrat fond of philosophy. It is hard to deny that, compared to Troy and Mycenae, the absence of traditional mythological references strongly undermines its credibility.

The gist of the story of the previous section summarizes only the information needed to locate the geographical position of Atlantis. But Plato wrote the Dialogues mainly for reasons of political propaganda: to demonstrate the perfection of his utopian Republic, based on the political system of archaic Athens, and to convince his fellow citizens to adopt it. Thus the Dialogues are peppered with minutiae regarding the organization of the lost state, obviously irrelevant for the quest of a possible location.

To take the philosopher words at face value is risky in itself.[12] Descending from the first kings of Athens by his father's side, and related to Solon by his mother's side, he had obvious reasons to glorify the nobility and the virtues of the city founding fathers. Not to mention that philosophers should have governed his ideal Republic and he just happened to be a philosopher.

---

[12]To get an idea of his way of arguing, these are the final paragraphs of the Timaeus (the evolution of species, according to Plato) (*Plato in Twelve Volumes* 1925):

> (Plat. Tim. 91d) *And the tribe of birds are derived by transformation, growing feathers in place of hair, from men who are harmless but light-minded men, too, who, being students of the worlds above, suppose in their simplicity that the most solid proofs about such matters are obtained by the sense of sight.*
>
> (Plat. Tim. 91e) *And the wild species of animal that goes on foot is derived from those men who have paid no attention at all to philosophy nor studied at all the nature of the heavens, because they ceased to make use of the revolutions within the head and followed the lead of those parts of the soul which are in the breast. Owing to these practices they have dragged their front limbs and their head down to the earth, and there planted them, because of their kinship therewith; and they have acquired elongated heads of every shape, according as their several revolutions have been distorted by disuse.*
>
> (Plat. Tim. 92a) *On this account also their race was made four-footed and many-footed, since God set more supports under the more foolish ones, so that they might be dragged down still more to the earth. And inasmuch as there was no longer any need of feet for the most foolish of these same creatures, which stretched with their whole body along the earth, the gods generated these footless and wriggling upon the earth.*
>
> (Plat. Tim. 92b) *And the fourth kind, which lives in the water, came from the most utterly thoughtless and stupid of men, whom those that remoulded them deemed no longer worthy even of pure respiration, seeing that they were unclean of soul through utter wickedness; wherefore in place of air, for refined and pure respiring, they thrust them into water, there to respire its turbid depths. Thence have come into being the tribe of fishes and of shellfish and all creatures of the waters, which have for their portion the extremest of all abodes in requital for the extremity of their witlessness.*
>
> (Plat. Tim. 92c) *Thus, both then and now, living creatures keep passing into one another in all these ways, as they undergo transformation by the loss or by the gain of reason and unreason.*

In short, it seems evident that Plato wrote the story to celebrate his ancestry and to advertise the political utopia of the "Republic". Just one doubt survives: did he invent everything from scratch or did he modify an existing story, inserting in the plot the details useful for his propaganda?[13] The technique to modify an established legend, adding invented variations is widespread and consolidated among men: it helps to convince others to believe the crap they say. There are illustrious examples: the "Aeneid" and the "Orlando Furioso", to name just two prominent ones, modified popular legends to glorify the ancestry of the commissioners.[14] Could it be the case of Atlantis, too?

The main obstacle to the hypothesis of a pre-existing legend is the apparent absence of references in previous literature, particularly in the Egyptian one, which was connected to the myth in the tale. The reluctance to carve in stone the details of a defeat may be understandable, but the war with Atlantis and its catastrophic destruction should have been two episodes worth of memory: it is hard to believe that neither of them has found a place in that vast literature. To examine Egyptian literature is beyond the scope of this article, but the analysis of the temporal consistency is essential: to be conquered by Atlantis, Egypt must have at least existed. The point will be checked in one of the next sections, after summarizing other references to Atlantis in classical literature.

Diodorus Siculus. In Greek literature there are no references to Atlantis before Plato, with the exception of a quotation by Herodotus, which will be examined in the next section. After Plato, the authors who dealt with the matter basically reworked the philosopher text, rendering essentially superfluous to analyse their writings. All but one, a Sicilian fixed with universal history, who, in the first century BC, wrote the *"Library of History"* in forty books (*Diodorus of Sicily* 1935).

According to Diodorus (this was the name of the Sicilian), many generations before the Trojan War, the Atlanteans, the most civilized people of their time, became subjected to the Libyan Amazons (*Diodorus of Sicily* 1935, Book III, 54, 1). In fact, long before the Amazons of the classical tradition (who lived along the river Thermodon, on the southern coast of the Black Sea), other Amazons had lived in Libya, originating from an island of the lake Tritonis[15] (Book III, 53, 4) from which they dominated the surrounding regions (Fig. 2).[16]

---

[13]The author's opinion is that the story is the result of a syncretism that blended mythological legends and impressive events, placing them in the period most compatible with the beliefs of the time. The myth of a flood hitting a society grown too much in power and wickedness to deserve the divine punishment was common among several ancient cultures, including the Greek one. Note that the fellow citizens of Plato had also a vague feeling of their great past, witnessed by the mysterious cyclopean walls still visible on the acropolis, and had been shocked by the earthquake and tsunami that cancelled the city of Helice in the Gulf of Corinth in 373 BC. (Paus. 7.24.12) (Pausanias 1918). The material for a good tale was certainly not lacking and the possibility that the story might have been assembled from previous myths in fact strengthens it: Plato would have simply acted as a booster of existing myths and Atlantis would have been the name chosen for the lost civilization.

[14]Virgil's Aeneid attributes the origin of the gens Julia (the family of Caesar and Augustus) to Aeneas of Troy. In Ariosto's Orlando Furioso, a poem dealing with the Carolingian cycle, Bradamante and Ruggero are supposed to be the founders of the Este family.

[15]Identifiable with the vast Saharan depression south of the Atlas Mountains, which was actually a lake several thousand years ago.

[16]The source, quoted by Diodorus, is Dionysius, almost certainly Scytobrachion, a mythographer of Mytilene who lived and taught in Alexandria in the second century BC.

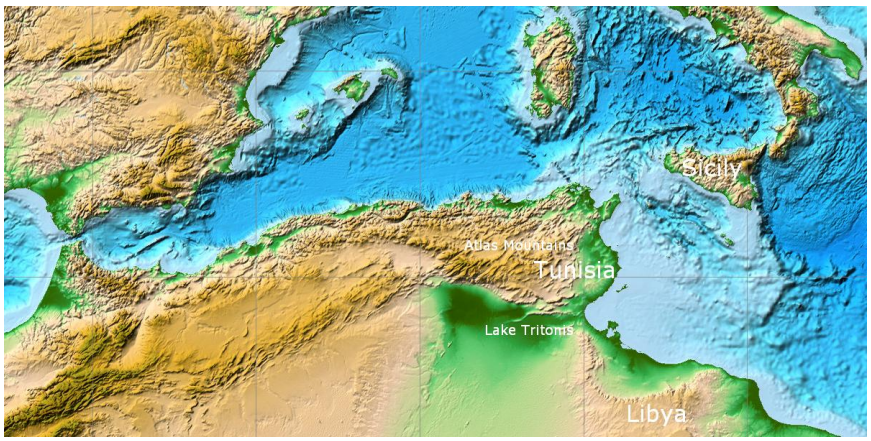

Figure 2. The places of the Atlanteans, according to Diodorus (map from *NOAA/NESDIS* 2015).

The Atlanteans surrendered en masse to the Amazon queen Myrina, when Cernê, the only city of theirs that had tried to resist, was completely destroyed (Book III, 54, 5). According to Diodorus, the Atlanteans, who owned many cities and lived in a fertile region on the edge of the sea (Book III, 56, 2), were a people extremely refined and pious, because the Gods had been born among them. Their first king had been Uranus, a God who had elevated them from the bestial state and had taught them agriculture (Book III, 56, 3).

Uranus had several wives, including Titea, who, before being called Gaea, gave him eighteen children: the Titans. One of these, Hyperion, succeeded his father and, at his death, the kingdom was divided between his brother Kronos and his nephew Atlas (son of another brother, Iapetus). Atlas took the coastal and the mountainous regions, giving its name not only to the mountains, but also to the inhabitants of the whole kingdom (Book III, 60, 1). According to the Cretans, Kronos reigned over Sicily, Libya and Italy (Book III, 60, 3).

This is, in summary, what Diodorus said of Atlantis. Not a word about its conquest of Egypt or about the time and circumstances of the cataclysm that should have destroyed it. And, obviously, with no political ambitions in mind, not a mention of the wonderful organization of its state. In short, although Diodorus almost certainly knew the Platonic Dialogues, it does not seem to have drawn from them. For him Atlantis was essentially the birthplace of the Gods and of the innovations they donated to men.

From the context it can be sensed that the Atlanteans conquered by the Amazons were the descendants of the ancient rulers of the world and that, although the reported wars were very ancient (many generations before the Trojan War), they were not primordial and certainly posterior to the cataclysm claimed by Plato. If, as it seems, Dionysius Scytobrachion was Diodorus main source about Atlantis, it is indeed possible that in Egypt really circulated a legend about the western birth of the Gods and of the civilization, from which Dionysius could have drawn (living in Alexandria).

One thing, nonetheless, is quite clear from the account of Diodorus: the location of the Atlanteans: between the Atlas Mountains and the lake Tritonis, mostly concentrated in the

then fertile Tunisian coast. In practice, the most favourable place to control Libya, Sicily and Italy, as claimed by both Diodorus and Plato.

Herodotus. The Histories of Herodotus (Herodotus 1890) are the only text, prior to the Plato's Dialogues, to include a reference to Atlantis.

Born half a century before Plato, Herodotus quoted as Atlanteans a people living on the slopes of Mount Atlas[17] (Book IV, 184-185), not far from the lake Tritonis (IV, 186), using the name Atlas to designate the mountain range of North Africa. Other than the name, the people portrayed had little in common with the complex society described by Plato. On the other hand, Herodotus talked of a population of his days, which could have nothing to do with that of nine thousand years before, except, perhaps, living in the same area.

To refresh the geographical awareness of the time, it is worth remembering that in Book 1 (202) Herodotus also named the Atlantic sea, to indicate the sea beyond the Pillars of Hercules (which he placed on the Strait of Gibraltar). For the Greeks, the accessible world ended at the Pillars of Hercules, but Herodotus in some way knew that the Atlantic sea was connected to the Eritrean Sea (maybe trough the river Ocean that, according to widespread beliefs, surrounded all the landmass).

In addition to naming the Atlanteans, the Mount Atlas and the Atlantic sea (which took its name from the mountain range), Herodotus wrote at length about Egypt, which, as we

[17]Herodotus, Book IV, tr. G. C. Macaulay, London, 1890:

> 184) *From the Garmantians at a distance again of ten days' journey there is another hill of salt and spring of water, and men dwell round it called Atarantians, who alone of all men about whom we know are nameless; for while all taken together have the name Atarantians, each separate man of them has no name given to him. These utter curses against the Sun when he is at his height, and moreover revile him with all manner of foul terms, because he oppresses them by his burning heat, both themselves and their land. After this at a distance of ten days' journey there is another hill of salt and spring of water, and men dwell round it. Near this salt hill is a mountain named Atlas, which is small in circuit and rounded on every side; and so exceedingly lofty is it said to be, that it is not possible to see its summits, for clouds never leave them either in the summer or in the winter. This the natives say is the pillar of the heaven. After this mountain these men got their name, for they are called Atlantians; and it is said that they neither eat anything that has life nor have any dreams.*
>
> 185) *As far as these Atlantians I am able to mention in order the names of those who are settled in the belt of sand; but for the parts beyond these I can do so no more. However, the belt extends as far as the Pillars of Heracles and also in the parts outside them: and there is a mine of salt in it at a distance of ten days' journey from the Atlantians, and men dwelling there; and these all have their houses built of the lumps of salt, since these parts of Libya which we have now reached are without rain; for if it rained, the walls being made of salt would not be able to last: and the salt is dug up there both white and purple in colour. Above the sand-belt, in the parts which are in the direction of the South Wind and towards the interior of Libya, the country is uninhabited, without water and without wild beasts, rainless and treeless, and there is no trace of moisture in it.*
>
> 186) *I have said that from Egypt as far as the lake Tritonis Libyans dwell who are nomads, eating flesh and drinking milk; and these do not taste at all of the flesh of cows, for the same reason as the Egyptians also abstain from it, nor do they keep swine. Moreover the women of the Kyrenians too think it not right to eat cows' flesh, because of the Egyptian Isis, and they even keep fasts and celebrate festivals for her; and the women of Barca, in addition from cows' flesh, do not taste of swine either.*

know, was closely connected to the story of Atlantis. On the subject, his narrative is so detailed that it is difficult to think he had not actually visited the region. In Book II (142-144) he says that at Thebes the priests of the temple of Zeus showed him the 341 wooden statues of the high priests (piromis, sons of piromis) that had ruled the temple during the human kingdoms of Egypt.[18] Like other peoples, in fact, also the Egyptians believed that the Gods had initially governed them.[19]

According to Herodotus' own calculations, done by placing three generations per century, the human kingdom was already 11,340 years old at the time of his visit to Egypt . Although the historian pretends to believe the priest's tale, some sort of make-up must have taken

[18]Herodotus, Book II:

> 142) *So far in the story the Egyptians and the priests were they who made the report, declaring that from the first king down to this priest of Hephaistos who reigned last, there had been three hundred and forty-one generations of men, and that in them there had been the same number of chief-priests and of kings: but three hundred generations of men are equal to ten thousand years, for a hundred years is three generations of men; and in the one-and-forty generations which remain, those I mean which were added to the three hundred, there are one thousand three hundred and forty years. Thus in the period of eleven thousand three hundred and forty years they said that there had arisen no god in human form; nor even before that time or afterwards among the remaining kings who arose in Egypt, did they report that anything of that kind had come to pass. In this time they said that the sun had moved four times from his accustomed place of rising, and where he now sets he had thence twice had his rising, and in the place from whence he now rises he had twice had his setting; and in the meantime nothing in Egypt had been changed from its usual state, neither that which comes from the earth nor that which comes to them from the river nor that which concerns diseases or deaths.*
>
> 143) *And formerly when Hecataios the historian was in Thebes, and had traced his descent and connected his family with a god in the sixteenth generation before, the priests of Zeus did for him much the same as they did for me (though I had not traced my descent). They led me into the sanctuary of the temple, which is of great size, and they counted up the number, showing colossal wooden statues in number the same as they said; for each chief-priest there sets up in his lifetime an image of himself: accordingly the priests, counting and showing me these, declared to me that each one of them was a son succeeding his own father, and they went up through the series of images from the image of the one who had died last, until they had declared this of the whole number. And when Hecataios had traced his descent and connected his family with a god in the sixteenth generation, they traced a descent in opposition to this, besides their numbering, not accepting it from him that a man had been born from a god; and they traced their counter-descent thus, saying that each one of the statues had been piromis son of piromis, until they had declared this of the whole three hundred and forty-five statues, each one being surnamed piromis; and neither with a god nor a hero did they connect their descent. Now piromis means in the tongue of Hellas "honourable and good man".*
>
> 144) *From their declaration then it followed, that they of whom the images were had been of form like this, and far removed from being gods: but in the time before these men they said that gods were the rulers in Egypt, not mingling with men, and that of these always one had power at a time; and the last of them who was king over Egypt was Oros the son of Osiris, whom the Hellenes call Apollo: he was king over Egypt last, having deposed Typhon. Now Osiris in the tongue of Hellas is Dionysos.*

[19]At the end of the Neolithic, being ruled by the Gods was a widespread belief among peoples who were subjugated by foreign tribes in possession of the novel metallurgical technologies (believed magical powers).

place. Today it is difficult to swallow that the sun reversed its course four times during those eleven thousand years (as recorded by the priests), as well as that the wooden statues could withstand for such a long time without deteriorating. On the other hand, which priest does not add a bit of embellishment while talking about the antiquity of his religion?

Disregarding the accuracy of the numbers, let us consider the two beliefs related to Atlantis: the Egyptians thought to be incredibly old and to have been initially governed by the Gods in person. In other words, like other peoples at later times, they hold the tradition that some foreigners possessing magic powers had dominated them during a "divine" time extremely remote.

This extreme Egyptian antiquity was acknowledged also by the people in contact with them (including the Greeks, as Herodotus shows) and had an obvious mythological consequence: any legend concerning the country's origins should have respected it. This requirement brings us back to one of the most controversial points of the Atlantis legend: the date of nine thousand years before Solon.

The probability that a tradition may last orally for such a long time is virtually zero. To survive, the story of Atlantis should have been written for most of those nine thousand years, for example, carved on some monument, of which, however, there is no trace. The date is so far away that the supporters of the Atlantis-Thira hypothesis can invoke a text error and interpret the time frame as nine hundred years (or nine thousand months), thus reaching a more manageable era (that of the Thira eruption).

The problem is that the text says nine thousand years in both Dialogues, meaning that the error should have been repeated. But the strongest objection is that nine hundred years would make the story more credible to us, but much less to the Greeks. And Plato did not want to convince posterity, but his fellow citizens (to accept his utopia and be governed by him), who believed that the Egyptians were extremely old.

Nine hundred years would have been even more amazing in the mouth of the Egyptian priest. If eleven thousand years sound a lot, remember that, according to the expanded version of Manetho chronology, the birth of Egypt dates back to more than thirty thousand years ago. Why would a priest have shortened its antiquity? But the strongest point is that, in Solon's days, regardless of all traditions and myths, Sais had already at least four thousand years archaeologically documented (Wilson 2006).

In the end, it is not plausible to think that Plato originally wrote nine hundred, that became nine thousand for a transcription error. It is certainly possible that the philosopher invented the tale of Atlantis from scratch, but in doing so he would have placed it in a timeframe consistent with the beliefs then in vogue, without worrying too much about today's opinions. Eleven thousand five hundred years ago may be a date too remote for the trustworthiness of the story, but it is around that time that we should start the search for confirmations.

The antiquity of the Egyptians. The first pharaoh reigned five thousand years ago[20], but Egypt's history is much older. When the legendary Menes (or Narmer) unified the country, the Egyptians had been living in the region since immemorial time. The tribes that had

[20]Five thousand years ago (3000 BC) is the date today taken for granted, but it has not been always so. The extreme antiquity of the Egyptians has been a common belief for long: the average Egyptologist of the nineteenth century estimated the beginning of the early dynastic period at around 6500 years ago (Champollion even 8000 years ago).

initially occupied Egypt were then grouped into the kingdoms of the North and of the South, which Menes unified in one state, initiating the so-called dynastic period.

The dynastic period was preceded by a three thousand years period, called, without much imagination, pre-dynastic, which is conventionally divided into "early" (about two thousand years, during which the Badarian culture was the most representative), and "late" (the last thousand, characterized by the three cultures Naqada I, II and III), during which the kingdoms of the North and South already existed. The pre-dynastic period was, in turn, preceded by several Palaeolithic cultures, whose remains date back to tens of thousands of years ago. In many ways, the pre-dynastic period is to be considered historic almost as the dynastic. To the eyes of the Egyptians, it certainly was, since the kings' names of the North and South reigns[21] were recorded in several documents of their traditional chronology.

Rebuilding Egyptian history using their sources is complicated. Handing down their history, the Egyptians (like everybody else before Herodotus) mixed facts, myths and rituals (Shaw 2000, p. 4). Their documents, from the iconography on the temples to the sacred papyri, had essentially the task of celebrating the pharaoh in office and reported only the events suitable for the purpose (the importance of controlling the media is an old story). In practice, each temple hosted the depiction of the heroic deeds of the builder's dynasty, but none of its defeats and very little regarding the previous dynasties. Rightly, modern historians are rather sceptical on the objectivity of these inscriptions, which, nevertheless, often are the only sources available and, in any case, formed the basis of the Egyptian beliefs of their time.

With all the necessary caveats, it has been possible to recreate several partial chronologies, which, fitted together, have allowed longer timelines. In the reconstruction of the general chronology, a fundamental role has been played by the so-called King Lists, among which three are the most comprehensive and important.

The King Lists. In the third century BC Manetho, a priest living at the court of the Ptolemies, compiled the history of the Egyptian dynasties that preceded his rulers. His Aigyptiaka (History of Egypt) is the most extensive king list known, but also the one most accused of chronological unreliability.[22] Nevertheless, it is the epitome of Egyptian history of his times. The Aigyptiaka attributed the unification of the Egyptian state to Menes. After him, thirty dynasties followed, up to the Ptolemies; before him, Egypt, divided in two kingdoms, had been ruled by another multitude of kings, among which the earliest ones had divine nature.

Modern historians do not accept the extreme antiquity resulting from the Aigyptiaka. Criticism to Manetho concerns mainly three points: claiming too many kings before Menes, ruling out the possibility of overlap in the succession of kingdoms (Shaw 2000, p. 11) and having extended the duration of some kingdoms by multiples of ten years (for example attributing 16 or 26 years to the reign of a pharaoh instead of the 6 resulting from other sources).

[21] Distinguishable from those of the successive unified kingdom, because depicted with only one of the two royal crowns.

[22] The Aigyptiaka, whose text is accessible only through quotations by other authors (Josephus, Africanus, Eusebius and Syncellus), is best known through "Contra Apionem", a polemical book by Flavius Josephus, written to demonstrate the greater antiquity of the Jewish religion with respect to the Greek one.

Figure 3. The Royal Canon of Turin (Museo Egizio, Turin, Italy); photo from http://www.ancient-egypt.co.uk.

No one will ever assess the contribution of Manetho's (or Josephus') imagination, but the chronology of the Aigyptiaka was certainly in line with the tradition of its time. To compose it, the author surely drew from previous sources, trying to avoid contradictions with them. Among the sources that probably were available to him, two have come down to us, although damaged: the Royal Canon of Turin and the Palermo Stone.

The Royal Canon of Turin (Gardiner 1959) (Fig. 3) is a hieratic papyrus found in Luxor in 1820 and sold to the Egyptian Museum of Turin in 1824, after a trip that badly damaged and deprived it of the initial and final parts. Dating back, almost certainly, to the time of Ramses II (XIII century BC), it lists the nineteen dynasties that preceded its compilation.

The interesting thing about the list is that it is not written on the recto of the papyrus, but on its verso. The recto contains the list of taxable resources of people and institutions; thus, originally the papyrus was an administrative document, probably used for tax purposes (Ryholt 2005). It is likely that, once it became obsolete, its back was then used to write the king list. This detail makes it remarkable: unlike the temples inscriptions, which had clear promotional purposes, the papyrus of Turin had not an explicit propaganda goal. A proof of this is the mention of the foreign conquerors Hiksos, inserted at the time of their rule over Egypt, a reference otherwise systematically absent on the temples. In other words, the list seems to be some sort of memo, maybe for officials or priests, to be used for composing official histories or calendars of events, a purpose that gives the Canon of Turin a historical objectivity that other public inscriptions do not have.

The most important document for the early history of Egypt is the Palermo Stone (Hsu 2010), the largest and most readable fragment of seven, all apparently belonging to the same stele. The stele, known as the Royal Annals of Ancient Egypt (Wilkinson 2000), was probably a single stone two meters long and a half meter high (Fig. 4), placed in an unidentified temple during the Fifth Dynasty (ca. XXIII century BC), which reported year

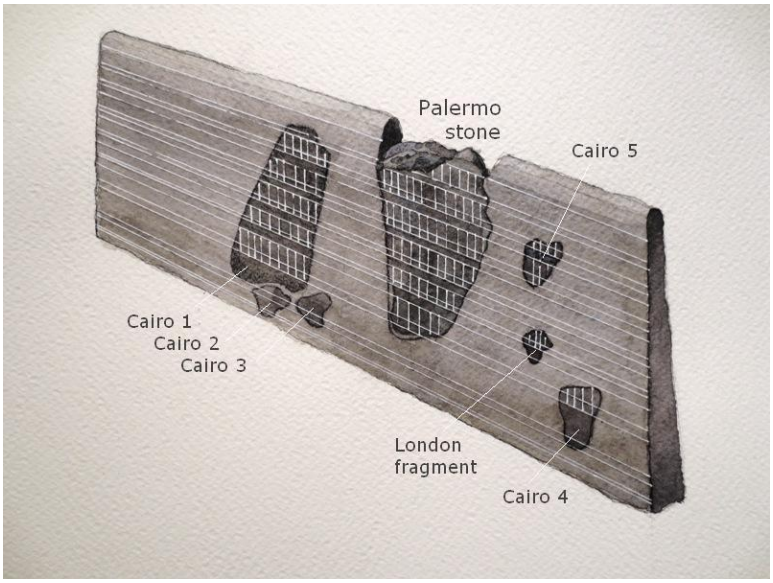

Figure 4. Pictorial rendition of the Royal Annals stele containing the Palermo Stone and the other six fragments, derived from Helck (1987, p. 125). The existent fragments are depicted in darker grey and named from the museums presently hosting them (watercolour by Nieves Gil).

by year, along eight rows engraved on it, the height of the Nile flood and the events to be remembered. The rows are composed of rectangular boxes, whose widths vary little along the same row, but much from a row to another (Fig. 5). The annals of the fourth and fifth dynasty, closer to the time of the recording, show larger boxes and a greater wealth of detail than the first three. Like the list of Turin, the Royal Annals include all previous dynasties preceding their making and seem to have had a more practical than apologetical function. The annual registration of important events and the height of the Nile flood (which determined the incidence of taxation), suggests also in this case an administrative or religious function.

The Annals too, as the Aigyptiaka, show a long series of pre-unitary kings, whose alleged number, obtained dividing the length of the stele by the width of the boxes, would push the pre-dynastic period at least a thousand years earlier than currently estimated. Note that the first kings were Gods also according to the Royal Annals. The seven fragments have been translated, interpreted and reinterpreted by generations of Egyptologists in the hope, so far unsuccessful, to shed light on the early Egyptian history.

From the brief and rough analysis made so far, it is clear that the Egyptians believed that their origin dated back to several millennia before the dynastic period, in line with Herodotus' citation of the 341 hereditary piromis of the temple of Zeus, which, with a more realistic generation gap of twenty-five years would have pushed the foundation of Thebes to around 8,500 BC. The date proposed by Plato for Atlantis was therefore perfectly in line

Figure 5. The Palermo Stone, recto-side (from Schäfer 1902, Taf. I), at the archaeological museum of Palermo, Italy.

with the Egyptian chronology of his time and to shorten it by ten times would have had the sole effect of rendering the story far-fetched.

It is equally clear that, according to the Egyptians, their civilization followed the arrival of foreigners endowed with magic powers (a polite way to describe a conquest by more technologically advanced strangers). Plato's legend of the Atlantean invasion of Egypt could therefore simply derive from the myth of the birth of the Egyptian civilization, a "gift" from the divine founders coming from West.

The main incongruity remains the time gap between this traditional date and the one credited by historians, for whom the pre-dynastic period began only eight thousand years ago (and the royal one just six thousand). A three thousand years gap is not negligible. To silence the detractors of the "official science", often inclined to believe the ancient legends and to overstate the remoteness of antique civilizations, it is then necessary to list the archaeological findings that support modern historiography.

Archaeological finds of Atlantis' times

The Egyptian prehistory. Egypt has been inhabited for long time. The remains of numerous Palaeolithic industries show that it was already steadily occupied five hundred thousand years ago, but it is likely that the region had been visited by hominids even earlier.

In Egypt the late Palaeolithic ended about twelve thousand years ago; in the region the conventionally accepted sequence of the different phases is the following (K. A. Bard 1999, p. xxvii):

- Lower Palaeolithic c. $500,000 - 200,000$ BP [23]
- Middle Palaeolithic $200,000 - 45,000$ BP
- Upper Palaeolithic $35,000 - 21,000$ BP
- Late Palaeolithic $21,000 - 12,000$ BP

As will be seen in the chapter on geological evidences, also the Egyptian Palaeolithic was marked by the transition from the ice age to the interglacial period. While along the coast the drive was obviously the displacement of the shoreline, in the interior it was the alternation between dry and wet periods to force modifications to the living habits.

Temperature changes had not trivial consequences on the humidity of the Sahara. In fact, they modified the temperature and pressure gradients with the result that, for long periods, the humid winds from the Indian Ocean managed to reach the desert and water it with rain. To simulate how far the monsoons could penetrate in the past, scientists have developed climate models, which, taking into account a number of experimental data (e. g. the presence of particular pollens in different sediment layers), have reconstructed the wind patterns over the centuries.

These models have confirmed what was already supported by the geological, palaeo-botanic, palaeo-zoological evidence and by the numerous rock paintings found in desert areas today uninhabitable: the climate of the Sahara has been really characterized by the alternation of dry and wet periods (and will probably do the same in the future).

During the late Palaeolithic, we know, for example, that around the Last Glacial Maximum (LGM) it was dry roughly as today (Gasse 2000). Then, as now, life in Egypt would have been concentrated along the Nile and on the coast. A clear indication of this is provided by Fig. 6A showing Palaeolithic sites from 22,000 to 10,500 BP. The sites thicken along a stretch of the Nile, but are absent both on the coast, and on the delta of the river. Why? Did not the ancient Egyptians, unlike their contemporaries, enjoy living by the sea or on the most fertile territories? Not necessarily, recalling that the ancient coastline is today offshore (we should have looked for sites underwater) and noting two things:

a) The structure of today's Nile delta is not the same of eleven thousand years ago: many branches of the river have changed position.
b) Usually in the Nile delta archaeologists avoid to dig layers deeper than those corresponding to about 7,000 years ago, because they get flooded almost immediately.

In practice, the absence of late Palaeolithic sites along today's coast and in the Nile delta might not be ascribed to the lack of ancient inhabitants, but, more probably, to the improper search of the sites.[24]

10,500 years ago (corresponding to 8,500 BC) things changed. The monsoons were able to penetrate the desert and most of Egypt turned into a savannah, with hills covered with shrubs and even trees (Ritchie and Haynes 1987). Its depressions hosted a large number of lakes, even some huge ones, and its valleys were crossed by large wadis flowing into the Nile from the west. The Nile grew in flow, but also in irregularity, due to the torrential character of the wadis. Its floods became more extensive and unpredictable and its wetlands extremely vast.

[23] BP: Before Present

[24] The northern Nile is devoid of settlements too. Along the final stretch of the river, however, the frequent and ruinous floods that took place during the following humid millennia might have erased the traces.

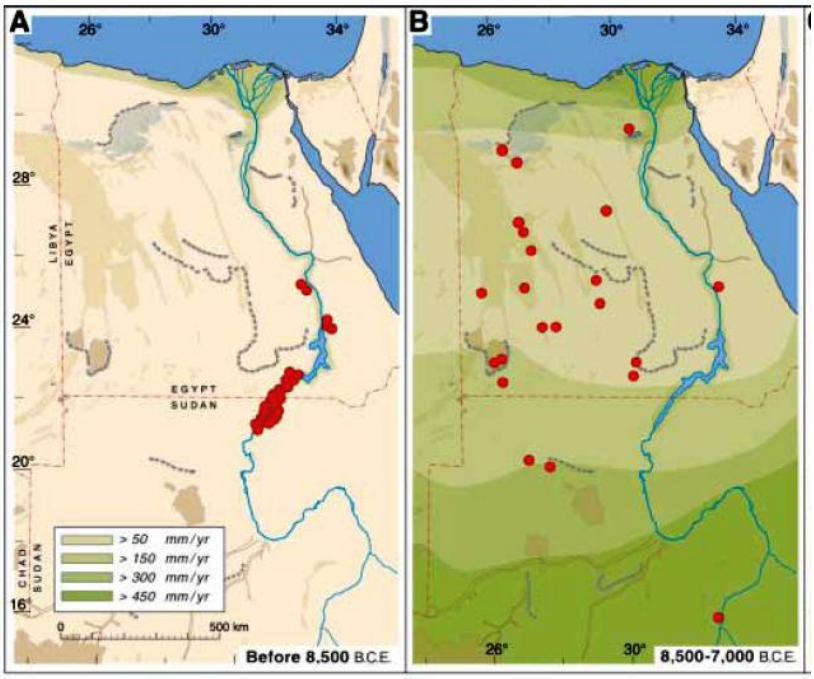

Figure 6. Location of archaeological sites in different periods of Egyptian prehistory; note that 8,500 Before Calendar Era (BCE) corresponds to 10,500 BP (from Kuper and Kröpelin 2006, reprinted with the permission of AAAS).

"Climate-controlled occupation in the Eastern Sahara during the main phases of the Holocene: red dots indicate major occupation areas; white dots indicate isolated settlements in ecological refuges and episodic transhumance. Rainfall zones are delimited by best estimate isohyets on the basis of geological, archaeozoological, and archaeobotanical data. (A) During the Last Glacial Maximum and the terminal Pleistocene (20,000 to 8500 BCE), the Saharan desert was void of any settlement outside of the Nile valley and extended about 400 km farther south than it does today. (B) With the abrupt arrival of monsoon rains at 8500 BCE, the hyper-arid desert was replaced by savannah-like environments and swiftly inhabited by prehistoric settlers. During the early Holocene humid optimum, the southern Sahara and the Nile valley apparently were too moist and hazardous for appreciable human occupation." (Kuper and Kröpelin 2006)

Living along the river became difficult, it was much simpler to stay in the oases around the lakes, taking advantage of easy hunting and, perhaps, of pastoralism. In fact, Fig. 6.B shows the vanishing of sites along the Nile and the appearance of new sites in today's desert, distant enough from one another to suggest independent communities.

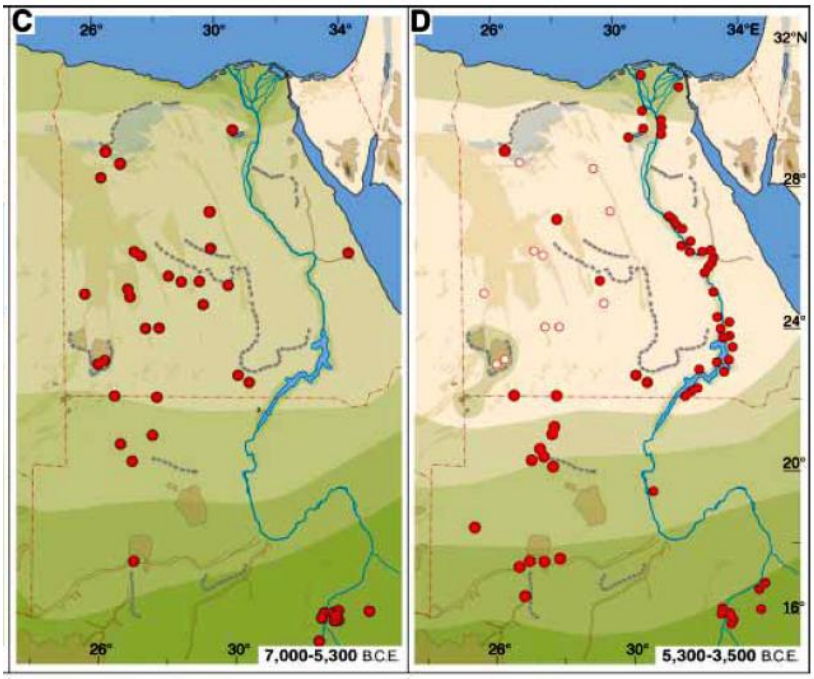

Figure 7. Location of archaeological sites in different periods of Egyptian prehistory (from Kuper and Kröpelin 2006, reprinted with the permission of AAAS).

"(C) After 7000 BCE human settlement became well established all over the Eastern Sahara, fostering the development of cattle pastoralism. (D) Retreating monsoonal rains caused the onset of desiccation of the Egyptian Sahara at 5300 BCE. Prehistoric populations were forced to the Nile valley or ecological refuges and forced to exodus into the Sudanese Sahara where rainfall and surface water were still sufficient. The return of full desert conditions all over Egypt at about 3500 BCE coincided with the initial stages of pharaonic civilization in the Nile valley." (Kuper and Kröpelin 2006)

The humid period lasted up to 7,300 years ago (5,300 BC) while the occupation of the "desert" became more and more stable, probably favoured by sheep farming, whereas the banks of the Nile remained still largely uninhabited (see Fig. 7.C).

But 7,300 years ago the savannah started desertifying again and another exodus began. The northern regions were abandoned more quickly, while the south, towards Sudan, maintained some residual moisture and continued to harbour life. The Nile, reduced in flow but more regular, became the only source of water in northern Egypt. The attraction exerted was irresistible and many tribes, which for millennia had lived apart, were forced to come into contact. Contacts might have not been idyllic, but had to be. For historians this phase coincides with the start of the pre-dynastic period. Over the following 1,700 years the

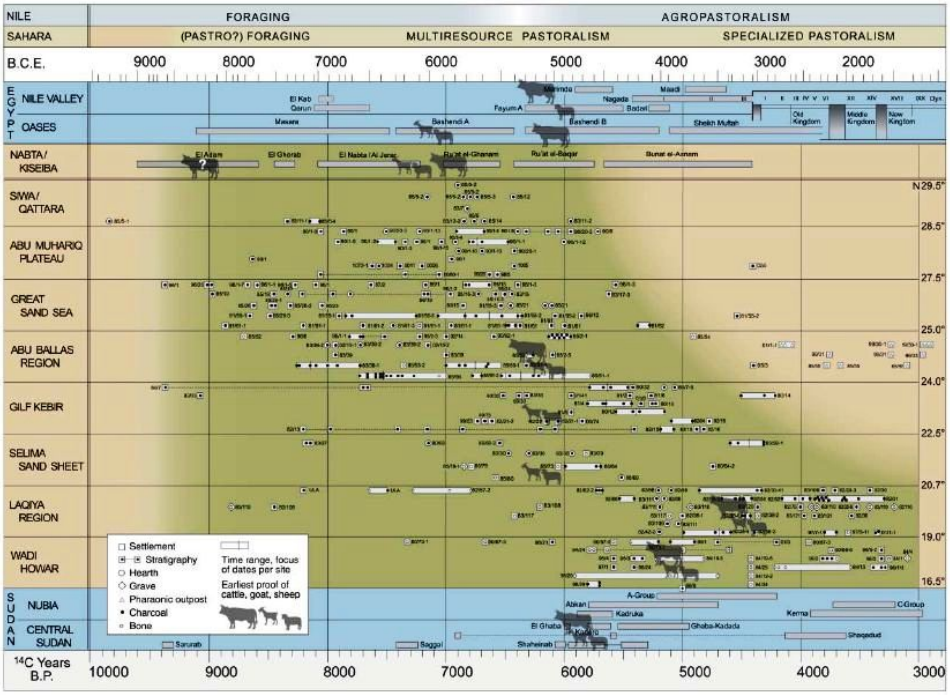

Figure 8. Distribution of Egyptian archaeological sites from north to south (from Kuper and Kröpelin 2006, reprinted with the permission of AAAS).

"Radiocarbon dates from early and mid-Holocene occupation sites in the Eastern Sahara. The graph is arranged from north to south and based on almost 500 radiometric results from our excavations of non-oasis prehistoric sites, with condensed chronologies for the Egyptian sites of Jebel Nabta and Bir Kiseiba (4), and the Egyptian and Sudanese Nile valley and oases (16-18). The data show the clear trend of southward shifting occupation driven by the retreat of monsoon rainfall, and the contrasting economies in the Nile valley and the Sahara. Green shading marks humid conditions; symbols of domesticated cattle demonstrate the spread of pastoralism." (Kuper and Kröpelin 2006)

progressive desertification turned the Nile in the sole source of life, all tribes settled on its banks and ended up grouped into two kingdoms.

The earliest sites found in the river delta date to this period (Fig. 7.D). As mentioned before, this antiquity is essentially dictated by technical reasons: in the delta excavations "deeper" than seven/eight thousand years ago are avoided because, being the corresponding quotes well below the river level, they become flooded almost immediately. Put yourself in the shoes of an archaeologist: with all the good stuff you have already found in the upper layers, would you spend precious time digging further, while your colleagues publish?

In practice, the deduction that the delta was not inhabited before seven thousand years ago is not correct. In fact, the opposite is probably true. Kuper and Kröpelin (2006) have

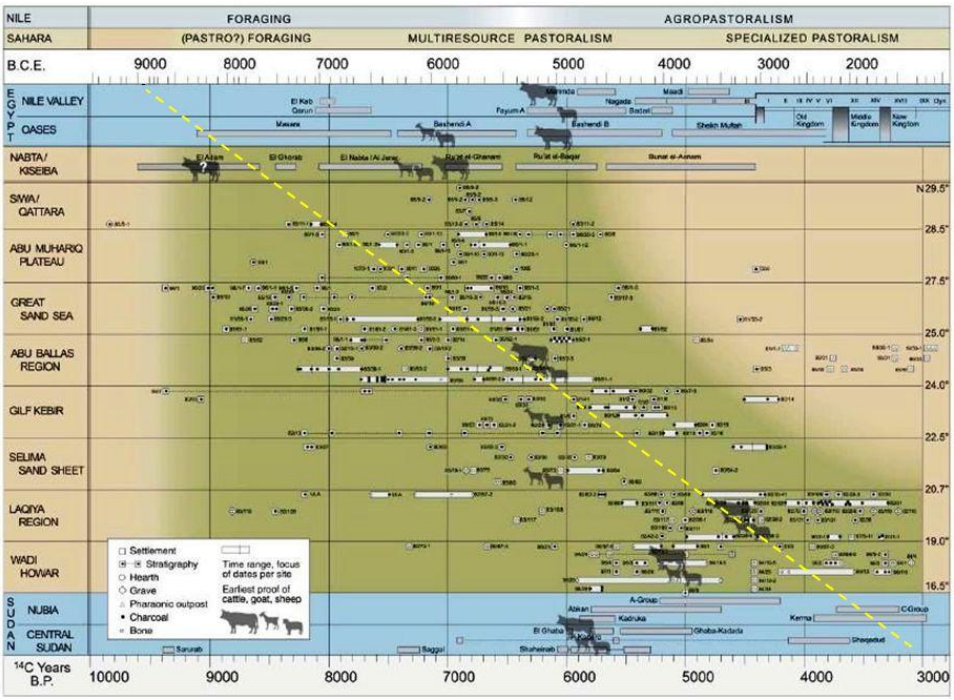

Figure 9. That's where you end up listening to physicists. Mathematicians say that two points are enough to define a straight line, but experimental physicists are coarser: for them even a cloud of points defines a straight line. Looking at figure 8) a physicist would have few doubts and would trace one, as in figure 9). He would say that, even if the upper left there are no data, the trend is evident, and would conclude that not only the Nile delta was inhabited eleven thousand years ago, but that even the new technologies were already there. Of course, to heed to physicists . . . (underlying picture from Kuper and Kröpelin 2006, reprinted with the permission of AAAS)

catalogued about 500 ^{14}C datings, collected in 150 prehistoric sites throughout Egypt, and have ordered them from north to south (Fig. 8).

The striking thing is the diagonal pattern of the findings. That is, as time went on, settlements and technologies spread from north to south. However, in the top left corner, the cloud of findings rarefies and disappears: in the delta and on the coast, before eight thousand years ago, there are no finds. But we know why: no one has actually searched them!

How large is the probability that the coast and the delta were really uninhabited at the end of the Palaeolithic? Not too high: it would have gone against a housing trend that had very few exceptions over the millennia, all of them justified by concrete reasons.

Although we have looked for archaeological data to disprove the extreme remoteness claimed by the ancient Egyptians, we have not reached conclusive evidence. Actually,

although the birth of the pre-dynastic period coincided with the forced grouping of the tribes along the Nile, providing a solid foundation for its dating, we must admit that, with respect to northern Egypt, we just lack the data. Moreover the Mediterranean coast and the Nile delta were the contact areas with the "fertile crescent" where, in the same period, agriculture was being born and the technological innovations of the Middle East were appearing.

Being the land closer to the sources of innovation and, at the same time, the one through which innovations spread to the rest of Egypt (the diagonal cloud), may be not enough to draw a decisive conclusion, but the suspicion that someone not only lived there, but was also aware of the new agricultural, building and maritime techniques then appearing in Palestine (see the following sections) is strong.

To exaggerate, even the opposite might not be ruled out: that the Palestinian innovations were actually born on the Nile banks and spread in the Middle East from there. It is a hypothesis beyond the archaeological licit, quoted only because that was exactly the time (according to Plato) of the Atlantis conquest of Egypt, which brought there all its new technologies.

But let us stick to the facts. At the time of the alleged invasion of Atlantis, Egypt was inhabited and was emerging from the Palaeolithic. No artefacts from that period have been found along the northern Mediterranean coast and in the Nile delta (the areas that might have more easily come into contact with possible sea conquerors), but they have not been properly searched. On the other hand, the chronological picture of the overall findings suggests that the Egyptian civilization did spread from north to south. In other words, while the absence of archaeological finds cannot prove that the Nile delta was not inhabited at the time of Atlantis, the distribution of findings in the rest of Egypt suggests that it should have been (Fig. 9).

The birth of the civilization. One of the things that baffles most people's common sense is the flowering period of Atlantis. Twelve thousand years ago the Palaeolithic was in full swing, agriculture had yet to be born, and only few tribes in the Middle East were engineering a better way to work stone. Anyone who has studied prehistory knows that it was too early for the refined civilization described by Plato.

Those kept informed of the archaeological discoveries of the last fifteen years should have noticed, however, that some relatively recent findings have moved the birth of agriculture, the beginning of the Neolithic, and the ability to build large buildings some thousand years earlier than it was thought at the end of the last century, right up to the presumed time of Atlantis.

This curious coincidence is the rationale of this article: is it conceivable the existence of a mythological tradition recalling the revolutionary innovations of the Neolithic period (from which Plato could have borrowed to build Atlantis legend)? Later, a similar mythology systematically accompanied the birth of metallurgy (Vaccarino 2001). An Atlantis much less sophisticated than the one described in Plato's Dialogues, but simply a mere carrier of agricultural, building and probably social innovations, would require no distortion of the accepted chronology, leaving open only the question of how to hand down a legend for so long.

Before outlining the framework of that interesting period, it is wise to clear up a couple of common misconceptions about the human ability to socialize and to navigate. Anatomically

modern humans (our species, also known as sapiens sapiens) appeared in the Horn of Africa towards the end of the penultimate ice age,[25] more than a hundred thirty thousand years ago[26] (Stringer 2000).

What led to the emergence of our species we do not know, but it is a fact that today's young man, who uses Facebook to pick up girls, is not genetically different from the troglodyte that, a hundred thousand years ago, used the club for the same purpose. Equipped with an iPhone and trained to use it, the troglodyte too would have posted a profile blatantly false. If more complex social patterns appeared only in the Neolithic, it was not because the Palaeolithics were genetically unable to adopt them, but because the smaller number of tribe members and the food procurement methods did not require them.

A little more than one hundred thousand years ago humans settled on the shores of the Red Sea, starting to appreciate fish and seafood and using obsidian (a volcanic glass) to produce tools for the first time (Walter *et al.* 2000). That last interglacial period[27] lasted about twelve thousand years (E. Bard, Antonioli, and Silenzi 2002) and then, during the following ice age (the last one), men began migrations to Asia, Europe and the south of Africa (at least according to the most accepted model).

The art of navigation dates back to the ice age too. Our forefathers showed their ability to sail at least fifty thousand years ago, colonizing Australia by sea (Stringer 2002). In the Mediterranean, sailing dates back to about thirty thousand years ago (Broodbank 2006), since, albeit in rudimentary form, it was necessary to colonize the islands and to catch fish in open sea (remains of deep-see fish, dated 28,000 years ago, are present in the cave of Üçagizli in Turkey) (Greaves and Helwing 2003).

The novelties of the Younger Dryas. The ice age peaked about twenty thousand years ago and then the temperature began to rise (Clark *et al.* 2009). During the transition phase sailing spread throughout the Mediterranean and became more sophisticated. Seventeen thousand years ago it allowed the colonization of Sardinia (Broodbank 2006) and deep-sea fishing, as documented by the remains found in the caves of Mentone (Cleyet-Merle 1990, p. 26). But it was thirteen thousand years ago, at the beginning of the Younger Dryas[28] that two events showed a quantum leap in Mediterranean navigation: the colonization of Cyprus (Fig. 10), which involved crossing forty nautical miles (Ammerman *et al.* 2006), and the establishment of "regular" sea routes for shipping obsidian from Melos to Argolis (Renfrew and Aspinall 1990).

[25]The climate has not always been the same. For example, we know today that in the last half a million years there have been four ice ages, interrupted by four, much shorter, interglacial periods (EPICA 2004). The last ice age, the most famous, began about one hundred and twenty thousand years ago and ended ten thousand years ago. Our species appeared during the penultimate ice age, has endured an interglacial period of about ten thousand years, then the whole last ice age, and finally the present interglacial, which, if lasts as the others, should be now winding down.

[26]Some recent finds, not mentioned by Stringer and partially controversial, would move this date to 200,000 years ago, close to the appearance of Neanderthal man, who began his existence about 250,000 years ago and disappeared about 30,000 years ago.

[27]The last interglacial period is not the current one, which is called "present", but the one that preceded the last ice age.

[28]The Younger Dryas was a period of intense cold that interrupted for about 1300 years the trend of general warming of the end of the Ice Age (Alley 2000).

Figure 10. The cradle of civilization (map from d-maps.com).

At the same time, although apparently being still hunters/gatherers, men were able to coordinate enough their efforts to build and decorate with bas-reliefs a large stone temple at Göbekli Tepe in Turkey (Dietrich *et al.* 2013). A little further south (Fig. 10), in the western tip of the Fertile Crescent, other men began to select the grains to grow (Purugganan and Fuller 2009), giving the official start to farming. In fact, although wild cereals already formed part of the human diet since the last glacial maximum (Kislev, Nadel, and Carmi 1992), before thirteen thousand years ago we cannot determine if they were planted or spontaneous, since domestic species appeared only then. Just a little further south, between current Lebanon and the Sinai, in the arc of time between the two Meltwater Pulse 1a and 1b,[29] men became sedentary for the first time. In fact, the first stone houses appeared in the Natufian villages (Bar-Yosef 1998), containing tools and ornaments[30] never seen before (Bar-Yosef Mayer and Porat 2008).

In practice, from the Aegean Sea to the Sinai, various revolutionary innovations, both marine and terrestrial, altered the life of men shortly after MWP 1a. It is hard not to attribute the changes in lifestyle to the abrupt climate change: the average temperature rose at today's

[29]Between 14,500 and 11,500 years ago. The Meltwater Pulses (MWP) were sudden warming episodes which caused a swift ice melting on the poles and therefore an equally rapid rise in sea level. During the deglaciation phase the most important MWP were two, classified as MWP 1a and 1b.

[30]*The use of beads and other personal ornaments is a trait of modern human behavior. During the Middle and Upper Paleolithic periods, beads were made out of shell, bone, ivory, egg shell, and occasionally of minerals. During the transition to agriculture in the Near East, stone, in particular green stone, was used for the first time to make beads and pendants. We observed that a large variety of minerals of green colors were sought, including apatite, several copper-bearing minerals, amazonite and serpentinite. There seems to be an increase with time of distance from which the green minerals were sought. Because beads in white, red, yellow, brown, and black colors had been used previously, we suggest that the occurrence of green beads is directly related to the onset of agriculture. Green beads and bead blanks were used as amulets to ward off the evil eye and as fertility charms.* (from Bar-Yosef Mayer and Porat 2008)

level, all of a sudden summers became hotter and precipitations varied in intensity and frequency.[31]

Longer summers and calmer seas extended the navigation season, allowing the refinement of the maritime techniques. Perhaps in southern Turkey the wild grain did not grow spontaneously anymore and it was necessary to irrigate the soil or to select the lands where to grow it. But for sure, the resources were not lacking a little further south, where a people, the Natufian, could become sedentary for the first time.

The Natufians cannot boast of having invented agriculture, because they did not select the cereals they grew, but, according to the Israeli Bar-Yosef (1998), their region was the first place in the world where the geo-climatic conditions for the domestication of cereals existed. Archaeology often triggers national pride; it is easy to predict that soon some Chinese or Indian archaeologists will instead discover that the cradle of agriculture had been respectively China or India.[32]

The problem is that, worldwide, such a hot weather had not being seen for fifty thousand years (Siddall *et al.* 2003). Everywhere people must have thought: better a pizza or a rice salad rather than the usual hot stew. Necessity is the mother of many inventions and the hypothesis that innovations were the response to the changed climatic conditions is plausible, but why have we found them only in the Middle East? Where are the tracks of sharpened ingenuity in the rest of the world?

To answer this question we must remember another effect of the higher temperatures: the rise of the sea level. During the transition from glacial to interglacial many coastal areas were flooded by the sea and had to be abandoned. In other words, the human tendency to live near the sea had an obvious consequence on the location of archaeological sites: it is likely that many areas inhabited during the ice age lie on the sea floors that constituted the coast of the time (Bailey and Flemming 2008). It follows that the revolutionary handicrafts possibly made between the two Meltwater Pulses should lie today under the sea, providing a good explanation for the lack of findings.

In summary, around thirteen thousand years ago navigation was perfected in the Aegean Sea (driven by the request of obsidian, then precious stuff) and agriculture was born in the Middle East (selecting the cereals to grow). A little further south, in today's Israel, a people began to build permanent homes, having found enough local resources to become sedentary, while in Turkey, another population became organized enough to build a large temple in stone.

The flourishing of navigation (favoured by longer summers and calmer sea) and the density of the huts in the Natufian villages (much higher during the earlier warm period than in the subsequent cold one, according to Munro (2003), suggest that changes were more probably an adaptation to the warm Bølling-Allerød period rather than to the cold Younger Dryas.[33]

---

[31]Bølling-Allerød is the name of the warm period that followed the MWP 1a and lasted about fifteen hundred years. In Europe, many forests became populated, having turned into favourable hunting grounds.

[32]In the meantime they are getting closer: according to Zhao (1998), rice was domesticated ten thousand years ago along the Yangtze, whereas, according to Gupta (2004), the same happened to wheat in India eleven thousand years ago.

[33]*The Younger Dryas, an intense cooling and drying event of global proportions, has been attributed a major causal role in the adoption of agricultural economies in the southern Levant. Here, the impact of the Younger Dryas*

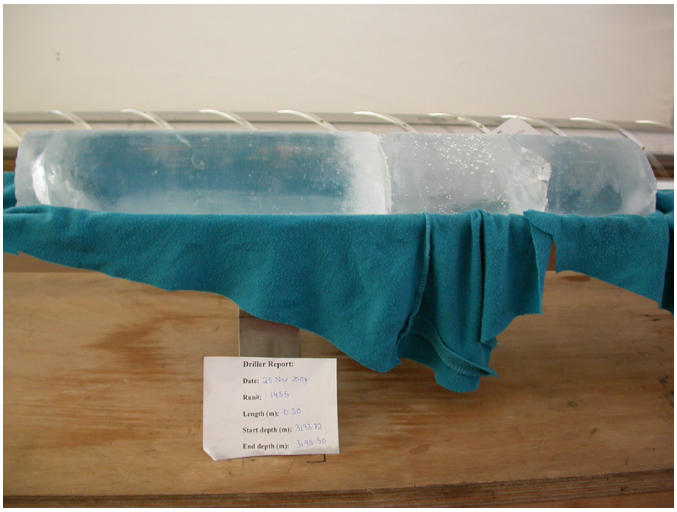

Figure 11. Ice core of eight hundred thousand years ago, drilled at Dome C, Antarctica (photo by Mario Pillon): excellent with well-aged whiskey, some Americans would say.

In other words, it is likely that it was the arrival of the heat to cause the cultural revolution and not the onset of the following cold. But are these climatic changes really known with such precision?

Geological clues of the Atlantis cataclysm

How do we know that the sea level suddenly soared at the time of Atlantis? There is a simple method, based on the fact that the natural oxygen largely consists of two isotopes: O^{16} and O^{18}. The water containing O^{16} is lighter, evaporates more easily and is therefore present in greater proportion in the clouds, from which it falls as rain or snow. When large amounts of snow remain trapped on the continental glaciers, the content of O^{16} in the oceans decreases. Since some marine organisms such as foraminifera, fix the oxygen of sea water to form calcium carbonate in their skeleton, their shells record the ratio O^{18}/O^{16} at the time of their lives.

---

on human adaptations is evaluated using a small game index that measures the efficiency of human foraging as a proxy for site occupation intensity. The study examines faunal assemblages spanning the agricultural transition and dating to the Early and Late Natufian and Pre-Pottery Neolithic periods (ca. 14,500 to 11,000 Cal. BP). The small game index and other supporting evidence document major fluctuations in human site occupation intensity across this critical phase. Site occupation reached an unprecedented high during the Early Natufian, but quickly reverted to pre-Natufian levels with the onset of the Younger Dryas in the Late Natufian phase. By decreasing site occupation intensity and increasing mobility, the Late Natufians implemented effective demographic strategies to cope with changing resource distributions. In contrast, there is no evidence for intensified resource use or food stress in the Late Natufian, at least in comparison to the Early Natufian phase. Although, it is tempting to assign the Younger Dryas a causal role in the adoption of agricultural economies, support for this hypothesis (in the form of food stress and resource intensification) does not currently exist. (from Munro 2003).

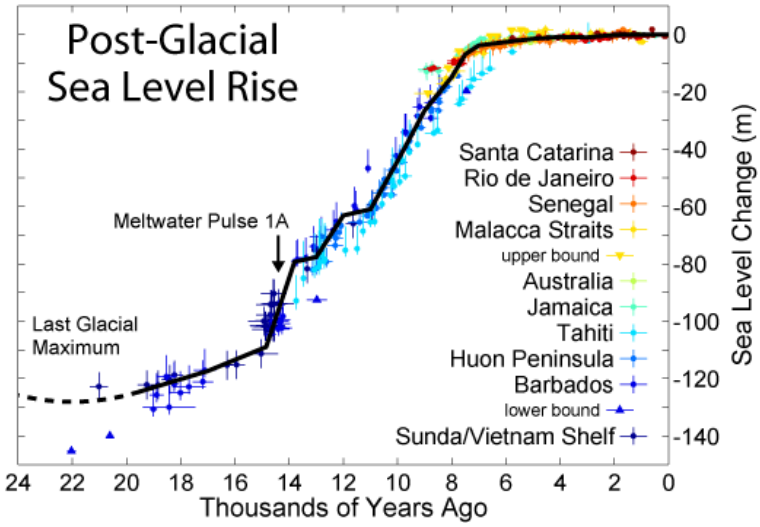

Figure 12. Sea level rise from the Last Glacial Maximum to today, based on data from K. M. Fleming (2000), K. Fleming *et al.* (1998), and Milne, Long, and Bassett (2005) (image created by Robert A. Rohde / Global Warming Art).

In practice, the remains of foraminifera, stratified on the ocean bottom, give us guidance on the size of the glaciers up to five million years ago (Lambeck, Esat, and Potter 2002). From these layers it results that, after two million years largely peaceful, around three million years ago the temperature on earth began to swing between glacial periods (commonly called ice ages) and interglacial ones, generating the epoch called Pleistocene.

There is another method for determining the ratio O^{18}/O^{16} of the oceans. Figure 11 shows an eight hundred thousand years old piece of ice, photographed at Dome C in Antarctica. The Antarctic cold does not allow the snow to melt, thus snow deposits in frozen layers, one above the other. Since seasonal variations characterize each annual layer, it is possible to distinguish one year from the other, just like the annual rings of a tree trunk. Obviously, the layers corresponding to warmer periods are richer in O^{16}. In some places of Antarctica these deposits of pressed snow are nearly 4 km deep; since the average annual thickness is about 4 mm, it follows that the snow at the bottom of these deposits fell almost a million years ago.

Actually, the succession of ice ages indicated by foraminifera has been confirmed by the measurements of O^{18}/O^{16} trapped in Antarctic ice (EPICA 2004) for the last 800,000 years, and, in the Arctic ice (NGICP 2004) for the past 120,000. Obviously, the details increase as we approach the present day, thus the temperature trend in the period comprising the penultimate interglacial (120,000 years ago), the last ice age (from 110,000 to 10,000 years ago) and the present interglacial period (which began about 10,000 years ago) is known with thorough precision. There is also a broad agreement between the Antarctic and the Arctic data, confirming that the largest climatic events regarded always the whole planet (EPICA 2006).

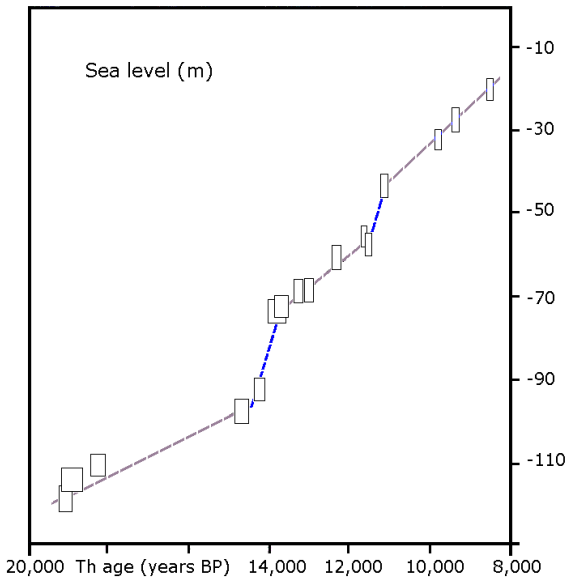

Figure 13. MWP 1a and 1b. Sea level in function of the ^{230}Th age, inferred from Barbados coral reefs. The U-Th age errors are quoted at 2σ level (from E. Bard, Hamelin, and Fairbanks 1990).

The change in average temperature between glacial and interglacial periods (which could reach 10 °C) was not the only difference between the two climatic periods. The water accumulated in the continental glaciers was obviously missing from the oceans, which were then more void: at the glacial maximum the sea level was 120 metres lower than today (Fig. 12). As a result the coastline was another one, several sea floors were emerged and men, who always tend to live by the sea, dwelled in them. And since the territorial occupation followed the drift of the shoreline, the sea level rise had repercussions also on those living further inland. In short, since the last ice age, the climate change has been cause of conflicts, migrations and aggregations among human populations.

The end of the Ice Age. At the Last Glacial Maximum[34] (LGM) northern Europe was almost uninhabitable (Williams *et al.* 1998), while the Mediterranean basin had a relatively temperate climate. The North-Western Sahara, however, was as dry as today, apart from the coastal strip from Morocco to Tunisia, which enjoyed the Mediterranean climate (Gasse 2000).

Eighteen thousand years ago, the temperature began to rise and, in the ensuing ten thousand years, the melting of glaciers raised the sea level of about 120 meters, up to the current value (Lambeck, Esat, and Potter 2002). The rise of the sea level was not uniform, but characterized by sudden increases, including the two episodes already mentioned: the

[34]Around twenty thousand years ago.

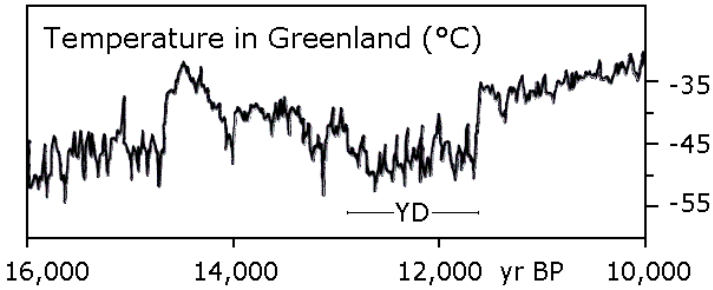

Figure 14. The temperature in Greenland during the "thaw". Note the sudden increase at the end of the Younger Dryas, in correspondence with the MWP 1-b (from Alley 2000).

MWP 1a and 1b. Fairbanks (1989) recorded an extensive evidence of the two pulses in the Barbados. Their ^{14}C timing was corrected a year later by E. Bard *et al.* (1990) with U-Th measurements. The two Meltwater Pulses were later confirmed in China by (Wang *et al.* 2001) with data from the Hulu cave.

According to these observations, during MWP 1a (around 14,300 years ago), the sea level rose from -90 to -70 metres, while during MWP 1b (about 11,500 years ago) it rose from about -60 to about -45 metres with respect to the present value. Liu and Milliman (2004), who reviewed the Caribbean data of Fairbanks (1989) and E. Bard, Hamelin, and Fairbanks (1990), stated that the MWPs were fast phenomena, happening in less than two hundred years. Even faster according to Steffensen *et al.* (2008), who later examined the Greenland ice, and claimed that the Pulses had rise times comprised between three and ten years.

MWP 1a is often considered the indicator of the end of the Ice Age, because in the following Bølling-Allerød period temperatures were much higher and similar to the current ones. However, thirteen thousand years ago, the cold suddenly came back and for about thirteen hundred years, in the period known as the Younger Dryas, the temperatures were glacial again (Alley 2000). The Younger Dryas ended abruptly too, with the MWP 1b, which marked the beginning of the Holocene (Fig. 14).

For reasons still under investigation, just before the MWP 1a the Sahara became suddenly moist (Otto-Bliesner *et al.* 2014). Forests filled the Atlas Mountains, while prairies and savannahs covered the Western Sahara (Gasse 2000). The former desert became populated by gazelles, elephants and lions (Prentice, Jolly, and BIOME 6000 participants 2000) and men followed soon after. This wet period, known as African Humid Period (AHP) ended suddenly about six thousand years ago (Cole *et al.* 2009), much later than the onset of the Holocene.

Fig. 15 summarizes the climatic conditions of the Mediterranean basin before fifteen thousand years ago. The coastline, calculated by the National Geophysical Data Center (GLOBE 1999) for the glacial maximum, was still roughly valid, giving an idea of which territories were most suitable to be inhabited. It is likely that among them there were several

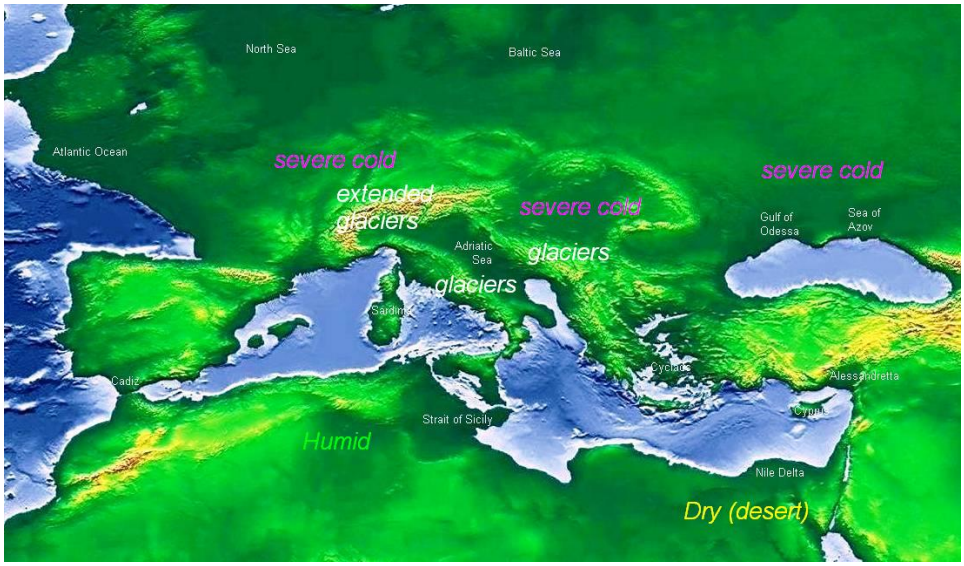

Figure 15. The climate of the Mediterranean basin before MWP 1a (modified map from GLOBE 1999).

emerged sea floors (Bailey and Flemming 2008). In the northern hemisphere, common sense suggests that the preference went to the more fertile southern plains (populated by herbivores to hunt), to coastal areas and to territories linking different regions (for instance the straits).

This depiction was valid before the MWP 1a, that is, until the sea level was at least 90 meters lower than today. Then the sea level rose fast and people had to move quickly. As long as they could, they just went more inland, but when the sea radically changed the geography, for example sinking an inhabited island, they had to leave.

Where? Hard to say, given that the National Geophysical Data Center does not provide maps at -70 and -50 meters and that the reconstruction of the coastline is not a straightforward procedure.

The coastline of the past. To determine the coastline in function of the sea level seems trivial, but it is not. At first glance one might think that it is like adding water in a sink: the water rises and reaches different levels. Thus, knowing the shape of the sink, one should be able to tell which level corresponds to a certain amount of water.

The idea is correct, but there is a problem: the sink often deforms. The landmasses are the highest part of the continental crust, floating like rafts on the fluid Earth's mantle. The ground height of the tectonic plates depends on their weight and on their interaction with adjacent ones. In practice, the sea level does not depend only on the amount of water contained in the oceans (eustatic factor), but also on the level of the soil, which can rise or drop for glacial-hydrostatic and tectonic reasons. As a result, the contributions of these other two factors must be taken into account:

Figure 16. *Strombus bubonius*

a) The glacial-hydrostatic factor, due to the weight of ice and seawater pressing the tectonic plate. That a glacier renders heavier the plate on which it rests is intuitive. Less intuitive is that the plate edge usually does not coincide with the coastline, but extends into the sea. This means that the total weight resting on the plate must be assessed by adding also the weight of the water insisting on the submerged part of the plate. The total weight, thus calculated, determines the "waterline" of the plate on the fluid mantle.
b) The tectonic factor, due instead to the fact that, along the faults, the plates can collide or slip one under the other. In the first case there is a generalized increase of the height of the soil; in the second, the soil of the first plate drops, while that of the second one goes up.

To take all three movements into account is complicated, but in certain conditions the contributions of the different factors can be separated. For example, since we know that one hundred and twenty thousand years ago (during the last interglacial) the amount of water in the oceans was about the same as today, the eustatic factor between then and now is zero. Thus, once identified the coastline of that time, its shift from today's is due to the other two factors only.

In geology, the position of the shoreline of one hundred and twenty thousand years ago, corresponding to the last interglacial, is called Marine Isotope Stage (MIS) 5.5, and can be inferred from some marine organisms which, living only on the shoreline, leave their shells to indicate it. In the Mediterranean, the preferred marker is the *Strombus bubonius* (Fig. 16), a mollusc that normally lives on the tropical coast of West Africa, but during the warm interglacial periods crosses the Strait of Gibraltar to colonise our sea. The dual characteristic of living within a few meters from the sea level and to be absent during the ice ages make it a perfect witness of the shorelines of one hundred and twenty thousand years ago.

To make a concrete example, let us examine what happened in the central Mediterranean. Along the coasts of Tunisia and Libya in the Strait of Sicily, the average height of the MIS 5.5 is limited to about ten meters from the sea level of today (Fig. 17). The same value has been detected in Sicily between Erice and Mazara (Ferranti *et al.* 2006).

In Lampedusa, in the middle of the Strait of Sicily, the MIS 5.5 is at sea level, while the markers along the southern coast of Sicily have not been found, possibly due to the friability of the coast itself, which prevented preservation (Antonioli *et al.* 2006).

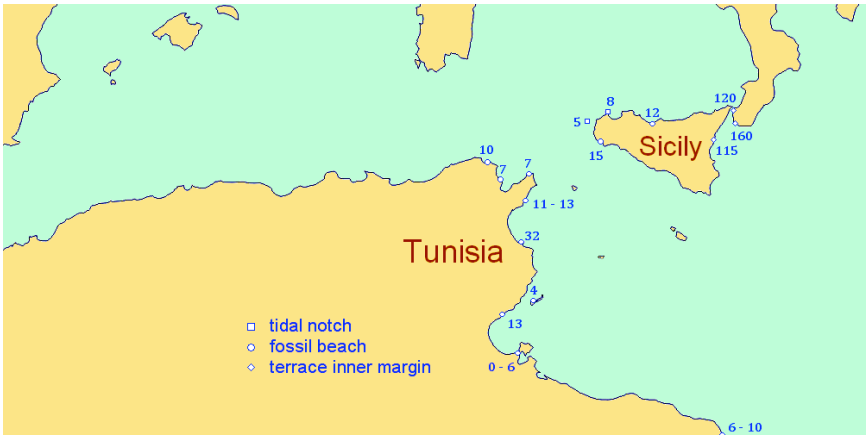

Figure 17. Elevation distribution of the MIS 5.5 markers in the Strait of Sicily. Only representative sites and site elevation (metres a.s.l.) are shown (from Ferranti *et al.* 2006) (modified map from d-maps.com).

Antonioli's hypothesis is plausible, but according to Ferranti *et al.* (2006), the lack of finds visible on Fig. 17 is instead due to a phenomenon of local subsidence. Subsidence means that, along the southern coast of Sicily, between Mazara and Gela, the seabed has sunk and therefore the last interglacial shoreline is not the same of the present one, but underwater, further offshore. How far offshore? Hard to say: in case of a sinking speed similar to the rising speed of Eastern Sicily (1 mm/year), twelve thousand years would imply the sinking of twelve meters. This would mean adding twelve meters to the isobath chosen to draw the southern coast of Sicily maintaining only the eustatic equilibrium.

Since the Strait of Sicily stayed without glaciers even at the glacial maximum and since its local tectonic plates have presumably not changed in the last hundred thousand years, also the glacial-hydrostatic factor should be equal to zero. Thus any shift in the shoreline is to be attributed to tectonic movements. Therefore the lack of noticeable shifts of the MIS 5.5 relative to the present indicates the substantial tectonic tranquillity of Tunisia and western Sicily (apart from the possible subsidence of the southern stretch between Mazara and Gela suggested by Ferranti *et al.* (2006).

Eastern Sicily and Pantelleria are a different case. The Ionian coast of Sicily is subject to considerable tectonic uplift, which complicates the isolation of the individual factors. Fortunately, the high values of the MIS 5.5 on the Sicilian Ionic side do not affect the Strait of Sicily, because the eastern part of the island is separated from the southern one by the fault of Scicli.

Pantelleria, instead, is a volcano and, therefore, is subject to its own local motions, often rather complicated (De Guidi and Monaco 2007). However, the area affected by its movements is mainly limited to the volcanic building and its influence to the surroundings is usually negligible outside the volcanic perimeter.

In short, except Pantelleria and the other submerged volcanoes, the region of the Strait of Sicily was hydrostatically and tectonically rather quiet during the last ice age, meaning

Figure 18. Floating as tectonic plates.

that the coastline shifted essentially for eustatic effect. Apart the stretch from Mazara to Gela (subject to subsidence) the Strait of Sicily is thus a lucky accident: it has remained fairly stable and one can reconstruct the ancient coastlines using only the bathymetric map. Because, as Monsieur de la Palisse would have stated: when the sea level was one hundred meters lower, anything shallower than one hundred meters was dry.

Eruptions and tsunami. As in many science fiction B-movies, the flooding that marked the end of the Ice Age did not come alone, but accompanied by terrible volcanic eruptions. It was not bad luck, but the result of the dynamics of continental plates: when the ice deposited on a plate melts, the lower weight over the plate can generate instability. The continental plates, which float on the Earth's mantle, can be likened to a row of boats moored side by side (Fig. 18). If the occupant of a boat dives into the water, the boat bounces up, varying its distance from the neighbouring boats. Similarly, the edges of two adjacent plates move during the settlement following the melting of a glacier.

Because of these tensions along the plates boundaries, the layer of the earth's crust can deform up to crack, allowing the underlying magma to find a passage towards the surface and generate new volcanoes. For their part, the volcanic eruptions themselves cause climatic variations. For example, they usually disperse ash in the stratosphere, increasing the reflection of sunlight and causing a cooling, but sometimes they can emit methane or CO_2, increasing the greenhouse effect and producing a warming.

The cause and effect relation between climate and eruptions is very complicated, but it is well known that the planet climate changes have always been accompanied by an increase in volcanic activity. This correlation has been observed during the Quaternary (Bray 1977; Hall 1982), and has been confirmed in the central Mediterranean (Paterne, Guichard, and Labeyrie 1988). It should not have been an accident that the beginning of the Holocene was accompanied, 11,300 years ago, by a terrible eruption, witnessed by the largest peak of SO_4 (Fig. 19) found in Greenland during the last twenty thousand years (Zielinski *et al.* 1996).

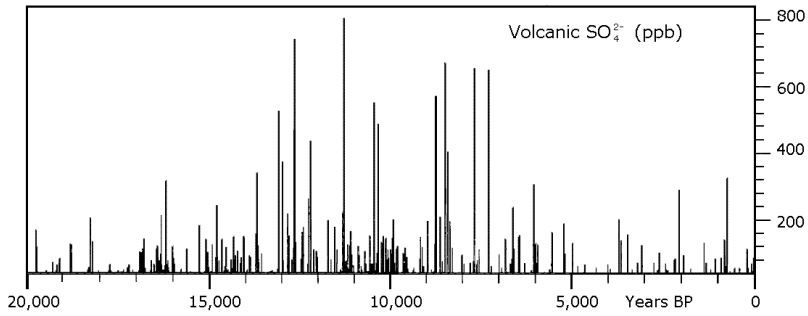

Figure 19. Volcanic $SO_4 > 40$ ppb in the past 20,000 yr (from Zielinski *et al.* 1996); data from the Greenland Ice Sheet Project 2 analysed through an empirical orthogonal function decomposition method (Mayewski *et al.* 1994). Note the high density of episodes between fifteen and eight thousand years ago.

In fact we know something more: it is the explosive activity that is related to the climatic changes, as shown by Zielinski *et al.* (1996) examining the data of the last hundred thousand years. For example in the Mediterranean basin only, in coincidence with the largest sea level variations, the number of large explosive eruptions tripled, reaching the frequency of three per millennium (McGuire *et al.* 1997).

Looking for a fitting place

The climatic changes that occurred between fifteen and eleven thousand years ago regarded the entire world. In temperate regions, men were forced to adapt to the new climate, migrating and/or changing their lifestyles. Pushes for innovation were present almost everywhere, but in order to understand when and where they were the strongest it helps to follow the sequence of climatic events.

Before MWP 1a, the weather was not too different from that of the ice age. As far as we know, humanity was everywhere in the late Palaeolithic, hunting and gathering as always, not feeling any need to change its habits. The weather was much colder than today thus, besides the equatorial strip, men preferred the tropical and subtropical regions, where the climate was temperate and fruits, grass and herds of herbivores abounded. Where possible they lived by the sea, which were already able to navigate, for fishing and for trading (or raiding) other tribes' goods.

When the sea level was about one hundred meters lower than today, several emerged seafloors were probably considered an optimal habitat. Figure 20 shows the aspect of the ancient world landmasses during the Last Glacial Maximum. Note the vast floodplains created by the debris of the great Asian rivers (Fig. 21).

More than ten thousand years ago, along three of these rivers (Yangtze, Indus and Tigris-Euphrates), agriculture emerged independently (Zhao 1998) (Gupta 2004) (Purugganan and Fuller 2009). Some time later, the same floodplains hosted the oldest human civilizations. It is hard to imagine that these events were uncorrelated and that the corresponding coastlines, today submerged, had not been inhabited. According to the conservative assumptions of

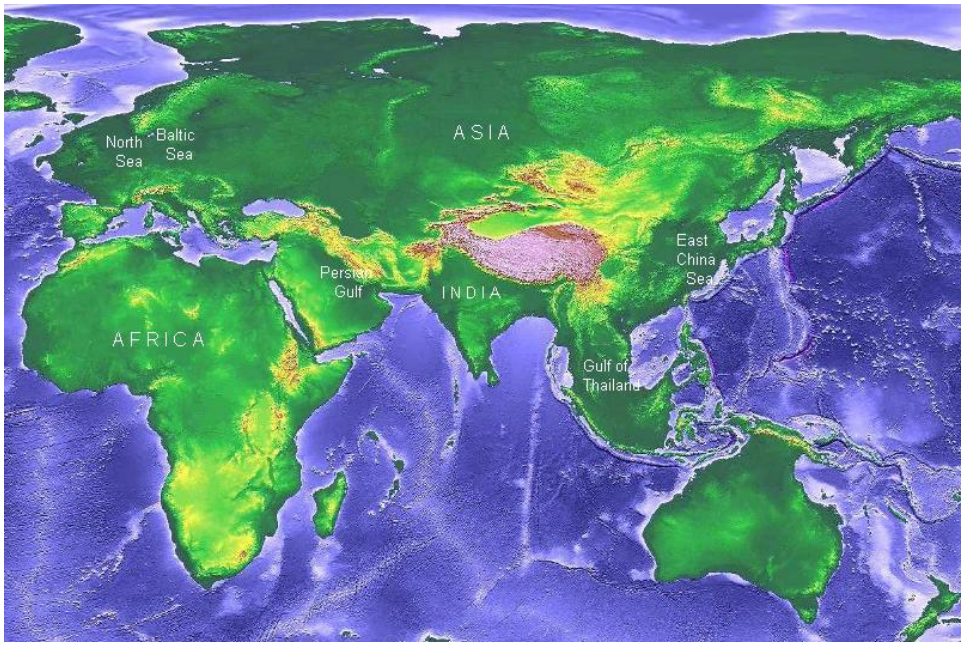

Figure 20. The ancient world at the Last Glacial Maximum (modified map from GLOBE 1999).

Figure 21. The great Asian rivers (modified map from d-maps.com).

Bailey and Flemming (2008) on human occupation during the Palaeolithic, several sites should have existed on various sea floors in the world. The future progress of underwater archaeology will probably lead to the discovery of submerged settlements that, each time, will push the newspapers to headline: Atlantis![35]

[35]At last some Atlantologists will get their overdue satisfaction.

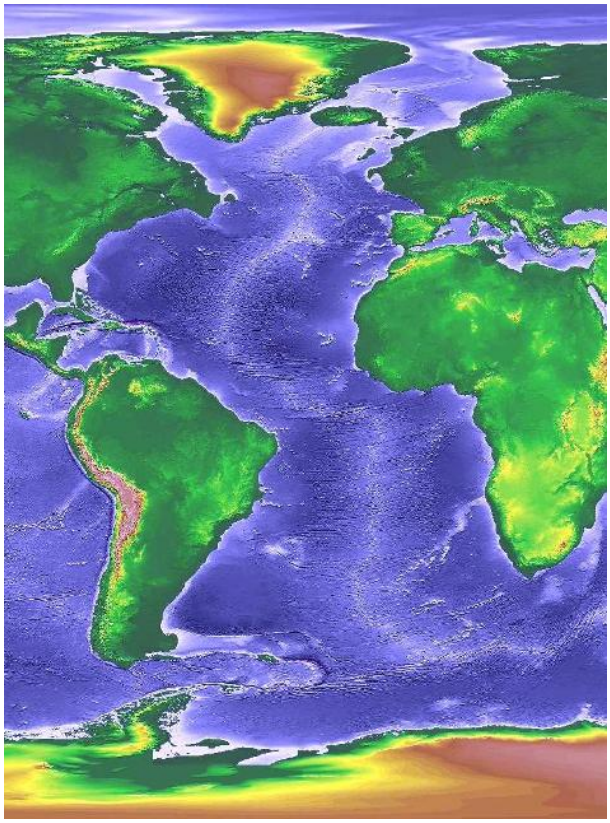

Figure 22. The Atlantic Ocean at the peak of the ice age (modified map from GLOBE 1999).

Which relationship would have these Atlantis with Plato's myth? As far as we know, links between Chinese and Indian civilizations were absent until the Neolithic and also those between Indian and Mesopotamian civilizations were very sparse. It is therefore very unlikely that the news of an ancient eastern flood could have reached Greece or Egypt.[36] On the other hand, if almost every ancient people experienced its own catastrophic flood, what was the point of recalling the neighbours' legends to build its own mythology?

In other words, it is fairly likely that, in the future, underwater archaeology will find the remains of various submerged "civilizations", each one claiming the title of Atlantis, but few will qualify to be Plato's one. The "real one", in fact, should be found in an area connected to Egypt, the only region able to hand down the legend to the philosopher.

This requirement restricts the search to the Mediterranean region. Before examining this area, however, it is worth to clear up a recurring prejudice by observing the glacial map of the Atlantic Ocean (Fig. 22). It is evident that no significantly extended territory

[36]To be rigorous, however, the possibility that the myth had been handed down locally for millennia and passed to neighbours only in "recent" times in principle should not be excluded.

Figure 23. Europe during the ice age (modified map from GLOBE 1999).

materialized during the ice age. Its seafloors, on average kilometres deep, never surfaced during the past glaciations, therefore the hope to find Atlantis on the seafloor of the Atlantic Ocean has no geological foundation. Remember that the time when the ocean began to open up, dividing Africa from America, dates back to about one hundred million years ago, four orders of magnitude earlier than the sinking of Atlantis.

The best places to live in Europe. The glacial map of Europe, shown in Fig. 23, gives a rough indication of the sea floors that were emerged during the Younger Dryas hosting large floodplains, a reasonable pre-requisite for the birth of agriculture.

In northern Europe, the vast sea floors of the Atlantic Ocean, North Sea and Baltic Sea were on the whole dry and accessible. Too bad that they were mostly covered by permafrost: not the most suitable type of soil to stimulate the emergence of an agricultural civilization.

Further south, the two northern basins of the Black Sea (at that time a lake), the Gulf of Odessa and the Sea of Azov, were two plains, but their proximity to the Siberian steppes (covered by permafrost most of the time) must not have gifted them with an easy climate, especially in winter.

Relatively milder was the climate of the Adriatic Sea, then an extension of the Po Valley, twice as large and ten degrees cooler than today's plain, crossed by rivers coming down from the Apennine, Alpine and Balkan glaciers.

At the centre of the Aegean Sea the Cyclades were grouped in one island (maybe even connected to the mainland by a land bridge), but lacked a significant plain. Note that at the time, whoever wished to collect obsidian from Melos, did not have to deal with dangerous sea voyages.

To the northeast of Cyprus, in today's Gulf of Alexandretta, a relative large flood plain at the mouth of the Seyhan and Ceyhan rivers marked the western end of the Fertile Crescent, where agriculture was about to be born (Purugganan and Fuller 2009).

To the south of Cyprus, another fertile plain, the delta of the Nile, three times larger than today's, stretched into the Mediterranean Sea, surrounded by a desert as arid as today (Gasse 2000).

To the east of Tunisia, at about the same latitude of Cyprus, another flood plain, even wider than those mentioned before, formed by the rivers then coming down from the Atlas Mountains, had reduced the Strait of Sicily to two narrow passages connected by an inland sea. To the west of this plain, the vast depressions of today's Tunisian desert, then humid for the frequent rains, formed huge lakes (deMenocal *et al.* 2000).

To end the list of the best locations, the delta of the Guadalquivir, in the Gulf of Cadiz, is to be mentioned, since, although not very large, it was still at the right latitude to promote agriculture.

A more detailed timeline. The map shown in Fig. 23 gives a picture of the landmasses valid before fifteen thousand years ago, that is, until the sea level was about one hundred meters lower than today.

Then came the first major climate upheaval (MWP 1a), the temperature rose suddenly and the sea flooded many lands that were inhabited. The new shoreline drew a different geography. The tribes living along the coast that survived the catastrophic floods had to resettle in inner regions or migrate away. Naturally, when the changes in climate and land did no longer allow the old methods of procuring food, they had to strive to find new ones. The heat lasted about fifteen hundred years, during which people adapted to the new climate. The glaciers continued to melt and the sea to rise, albeit rather gradually.

But, thirteen thousand years ago, a backlash of the Ice Age (the Younger Dryas) brought the cold back for another thirteen hundred years. The cold old days returned: the glaciers started to grow again and the sea level stopped its rise. People readapted to the cold, but equipped with the new survival techniques invented in the meantime.

Suddenly another climatic cataclysm (the MWP 1b) arrived to raise the temperature again. This time the sea submerged also the lands spared by the previous upheaval. New dismissals and migrations followed. This happened eleven thousand five hundred years ago, the time of the supposed destruction of Atlantis. A curious coincidence, indeed.

The flourishing of the Middle Eastern novelties dating back to the Younger Dryas (thirteen thousand years ago) suggests that the innovations were induced by the first heat wave brought by MWP 1a. However, the environmental change was an urge in all temperate regions: it should not be surprising to find that men made, independently, a "quantum leap" in the process of modernization in India and China too.

Maybe also the second sudden heating (the MWP 1b) resulted in a further "evolutionary leap", but for sure it had another effect: to sweep away the coastal civilizations born thanks to the previous heating. In other words, all around the world, the MWP 1b may have sunk the civilizations that the MWP 1a had helped to create!

Plato's recommendations. In practice, eleven thousand five hundred years ago, there might have been several Atlantis (authors proposing them in diverse distant places may

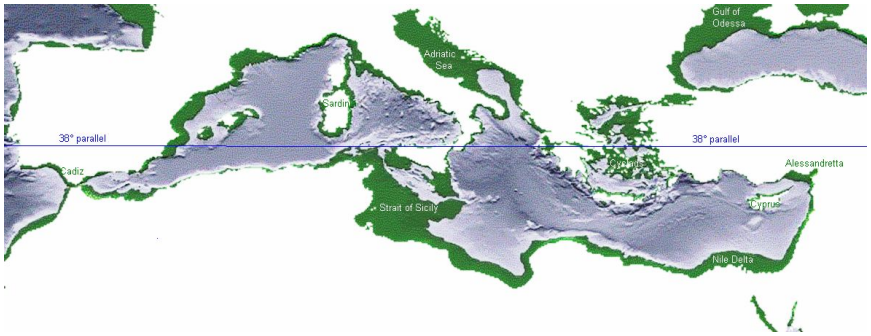

Figure 24. The thirty-eighth parallel in a map evidencing the Mediterranean seafloors emerged during the Last Glacial Maximum (in green).

actually be right). The point, however, is another one: could one of them have inspired Plato?

If we believe that, in composing the legend, the philosopher used existing material, we may assume that he did not change the details irrelevant to his propaganda message, such as the geographical features. Thus, comparing the geography of twelve thousand years ago with Plato's description could provide significant clues.

The maps shown in the previous sections give a rough indication, but are too imprecise for a detailed comparison. What would be needed is the profile of the Mediterranean before MWP 1b (and not simply the shoreline at LGM), but this would require a considerable effort. To lighten it, better to select the best candidate places, already meeting the most reasonable requirements, and try to reconstruct the detailed geography only of these. In doing this, let us highlight a first obvious result: during the ice age no seabed vast as a continent ever emerged, anywhere in the world. If we do believe that such magnitude is a necessary requirement, the quest ends here: eleven thousand five hundred years ago Plato's Atlantis did not exist and the sceptics are right.

If, however, we accept that that magnitude was a hyperbole and limit the size requirement to the extent of the fertile plain at the heart of the main island, things change. Three thousand by two thousand stadia (something more than five hundred kilometres by three) are roughly compatible with all regions identified in the previous section, except the two gulfs of Alexandretta and Cadiz and the combined Aegean island.

As we have seen, the vast sea floors of the Atlantic Ocean, North Sea and Baltic Sea could have easily included it, but, being mostly covered by permafrost during the Younger Dryas, they did not possess any of the other features. The cold weather cut out the Gulf of Odessa and the Sea of Azov too, whose size were barely adequate. More appropriate was the Adriatic Sea, surrounded by mountains and with a slightly milder climate, although not enough to allow two crops a year or the growth of exotic fruits.

In practice, the candidates thoroughly acceptable were the regions south of the 38th parallel, from the Gulf of Cadiz to that of Alexandretta (Fig. 24). Territories sufficiently

temperate and fertile for cultivation, except, perhaps, the large island grouping the Cyclades in the Aegean Sea, which lacked a vast plain.[37]

Although too small to include plains long three thousand stadia, the gulfs of Alexandretta and Cadiz were fertile enough to permit a florid agriculture. They missed, however, the archipelago and the inland sea mentioned in the Timaeus, features possessed instead by the Aegean island.

The Aegean island hosted also several volcanoes and therefore could provide black and reddish stones (lava) in addition to white ones (limestone) diffused in the entire Mediterranean. However, the archipelago, the enclosed sea and the volcanoes were to be found also in the Strait of Sicily. Moreover, besides being a western region close to the Atlas Mountains (like the Gulf of Cadiz) the Strait of Sicily divided two large plains. The southern plain was the delta of the river then descending from the Atlas Mountains, while the northern one included the seafloors extending southern Sicily and was, among other things, limited to the north by a mountain range (Madonìe, Nebrodi and Peloritani). Not negligibly, the northern plain, although smaller than required, was the only one located on an island, among all the regions examined.

In short, the seabed of the Strait of Sicily had all Plato's requirements, except to be near the Pillars of Hercules. Obviously, should this be an essential feature, Cadiz would be the only choice.[38]

All this from a purely geographic point of view, but there was another prerogative that perhaps was not entirely fictional: the dominion of Africa up to Egypt and of Europe up to Tyrrhenia. Resized, it could have meant controlling two sides of the Mediterranean Sea. To do it, the more comfortable position was definitely the Strait of Sicily. In principle also the Straits of Gibraltar could have allowed it, although Cadiz was really far away to dominate the Tyrrhenian Sea.[39]

A suitable place. Among the likely candidates for hosting Plato's Atlantis, the seabed of the Strait of Sicily seems to best meet the requirements, therefore it is right to focus on it. We saw that, for some lucky circumstances, it is possible to reconstruct the past shape of its coastline, taking into account only the eustatic factor. In other words, just add water and the isobath associated to a certain sea level will indicate the shoreline.

That helps a lot, but a delicate step remains: which level should we choose? E. Bard, Hamelin, and Fairbanks (1990) estimated that before MWP 1b the oceans level was about sixty meters below today's. Lambeck *et al.* (2004), through a complex geological model

[37]Willing to believe the powerfulness of Atlantis, a large and fertile plain was probably a pre-condition for supporting a population with imperialist ambitions.

[38]In reality, it is not inconceivable that the Pillars of Hercules had been an operative limit, rather than a geographical one. That is, they could have indicated the stretch of sea that the Greeks should not have trespassed to avoid dangers. If so, their location could have changed over time. Remembering that at the beginning of the Greek western expansion both sides of the Strait of Sicily were occupied by Phoenicians, an initial placement of the Pillars of Hercules between Sicily and Tunisia may not sound totally odd. Later, when Sicily was almost totally conquered and the Greeks installed colonies in Spain, the operative limit could have shifted to the Strait of Gibraltar (which was still controlled by Phoenicians). To be the limit of the safe and not of the known world would also comply with Herodotus knowledge of the sea surrounding Africa, situated beyond the Pillars of Hercules.

[39]Also Sardinia and Corsica, then combined, were in a good position to exercise such control, but against them there was the climate, significantly colder than in Tunisia during the Younger-Dryas.

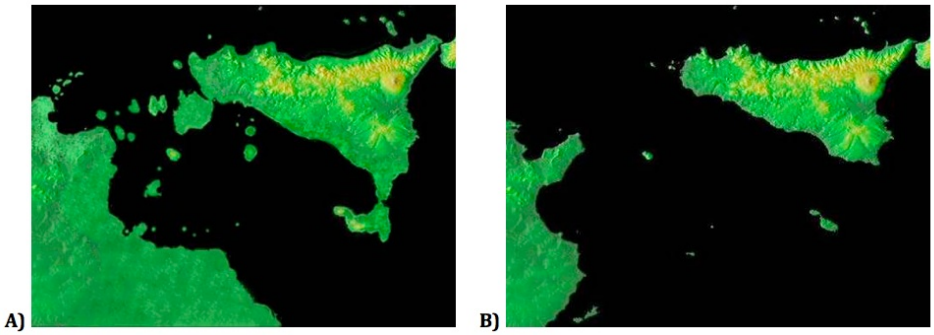

Figure 25. A) The Strait of Sicily at the time of MWP 1a (map from Rapisarda 2008); B) The Strait of Sicily today.

valid for Italy, later concluded that that level was valid also for the Mediterranean Sea.[40] Still, Lambeck, as Ferranti *et al.* (2006), considers likely a marked subsidence of the southern border of Sicily, a factor that should add about a dozen meters to the eustatic value of the seabed near the southern coast of Sicily (leading the value of the isobath to choose in proximity of Sicily to around -70 metres).

With a pinch of salt, Fig. 25 A) depicts a profile not very different from what might have been the Strait of Sicily during the Younger Dryas, showing an intriguing feature that would have remained even choosing different quotas. The feature is the presence of an archipelago, which would have made it possible to navigate between Tunisia and Sicily with land always in sight. An archipelago that a ten or twenty metres rise of the sea level would have modified, but not deleted.

The benefit of occupying the maritime link between two continents was an evident plus in a period that saw navigation rapidly progressing. Regular routes were being born in the Aegean Sea to supply Melos obsidian to the mainland and here, in the middle of the Strait of Sicily, there was the obsidian of Pantelleria. Moreover in Sicily (and Italy) there were men, animals and timber to raid.

Apart from Atlantis, whoever would have chosen to occupy the Strait of Sicily, in addition to a fertile land and a sea teeming with fish, would also have controlled Pantelleria obsidian and the traffics between Africa and Europe. It is unlikely that those living in the neighbourhoods would not have noticed it. Knowing navigation, they would have settled in spots easy to defend and to abandon: for example a small island near the mainland, the kind of outpost that, millennia later, Greeks and Phoenicians systematically chose for their colonies. Obviously, the appearance of sites with these features depends strictly on the selected isobath.

Not far from Mazara, in the south western corner of Sicily, the large shallow seabed named Avventura bank, has been over the time a peninsula and then an island, right on the path from Tunisia to Sicily. Before MWP 1a the Avventura bank was a broad peninsula,

[40]Very recently Lambeck *et al.* (2014), summarizing a great deal of measures carried out in the Indian and Pacific Oceans, confirmed that the sea level variation due to eustatic factor, with respect to twelve thousand years ago, should be of about sixty meters.

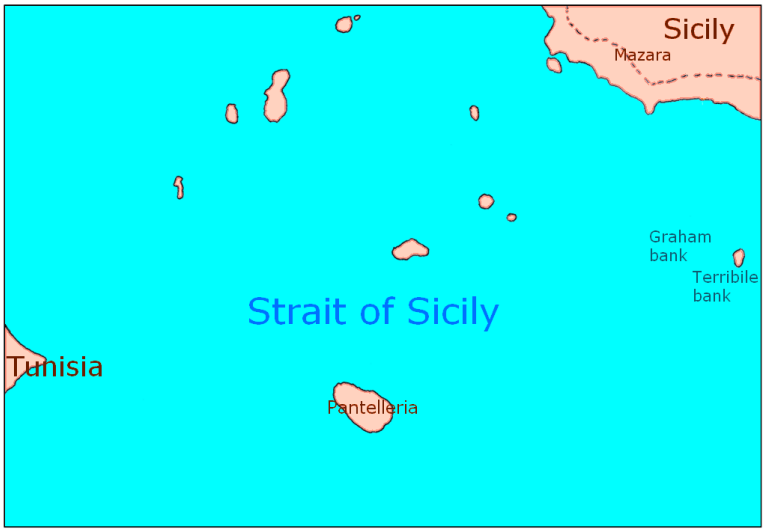

Figure 26. Map of the Strait of Sicily obtained from the −50 m isobath provided by *EMODnet* (2015), a European software allowing to explore the depths of the Mediterranean Sea. The dotted line indicates the present Sicilian shoreline; notice the presence of the small island closing a small gulf near Mazara.

connected to Sicily by an isthmus (Fig. 25 A). In front of it Tunisia stretched into the sea with a large floodplain that included Lampedusa (then attached to the mainland). Portions of this plain survived the sea level rise of MWP 1a and experienced the warming of the Bølling-Allerød period. A few millennia later, at the end of the Younger Dryas the geographical situation had changed. With a sea level about fifty metres lower than today, most of the Avventura bank had been submerged, but an archipelago had remained to warrant the maritime connection between the two continents and an easy route to Pantelleria obsidian (Fig. 26). Whoever occupied the Strait would have controlled the maritime traffics between Sicily and Tunisia (Rapisarda 2008). Its strategic importance is hard to deny and if the region was inhabited it is unthinkable that its most convenient spots were not, like for instance, the island closing a small southbound gulf near Mazara (Fig. 27), or some of the islets on the route to Pantelleria.

Unfortunately, the Avventura bank is surrounded by volcanoes, subject to their local geological movements, thus the complex exercise to reconstruct the exact coastline is left to those really willing to start the quest for Atlantis. While waiting for the beginning of the investigations, it is worthwhile to take a look at one of these underwater volcanoes, lying, scary, only thirty miles away from the Avventura bank.

Graham Island. Graham bank is a submarine volcano, located about thirty miles from Sciacca. For most of the time it is entirely submerged, but during its occasional eruption it may manage to emerge (to be called Graham Island or Isola Ferdinandea). The last time it did it was in 1831 and nearly triggered a war for its possession between the Britons, the

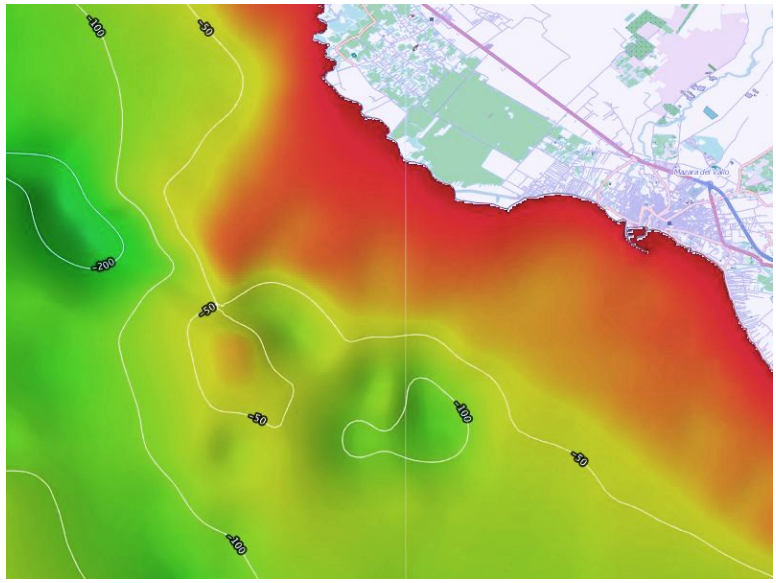

Figure 27. The islet appearing at −50 near Mazara (Trapani), playing with *EMODnet* (2015).

Figure 28. Left panel: the birth of the Graham Island (or Isola Ferdinandea, according to the Bourbons) in 1831; right panel: the result of the survey of the seabed made on December 2002 by the Italian Navy.

French and the Neapolitans. However, before the start of hostilities, it had the good taste to sink and the dust settled.

On the17th and 18th December 2002, the Hydrographical Institute of the Italian Navy made a survey of the Graham Bank, to measure the height of the seabed. The right side of Fig. 28 shows the results of the survey.[41] The volcano is classified as explosive and inspecting its activity is part of the regular practice of monitoring.

[41]Marina Militare Italiana: http://www.marina.difesa.it/idro/graham/htm (visited on 19 October 2005; on the date of publication of this article the web page was no longer accessible online).

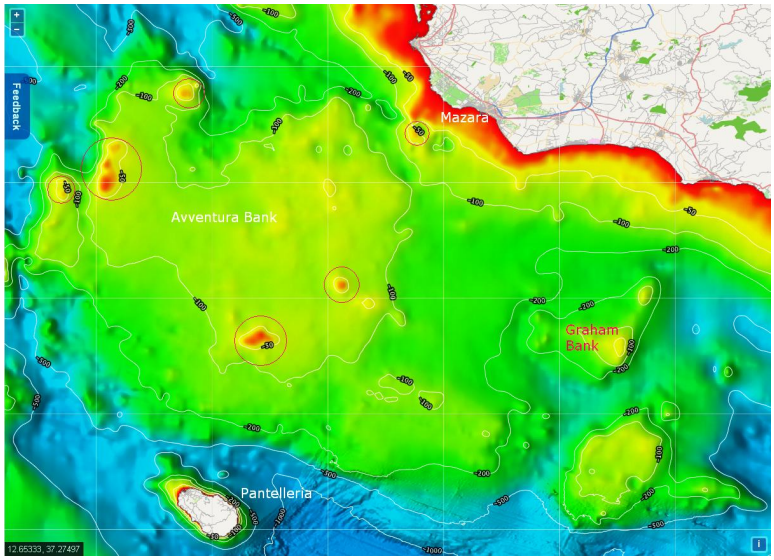

Figure 29. The bathymetry of Avventura and Graham banks. In the red circles six islets that existed at the end of the Younger Dryas and had to face the upheaval of MWP 1b (map from *EMODnet* 2015).

Graham bank (Fig. 29), however, is not an isolated, small volcano, as for a while it was believed, but one of the summit cones of a much larger submarine volcanic building, named Empedocles, located at 37° 10' N, 12° 43' E (of which the Terribile bank is another cone, for the moment quiet, see Fig. 26). In fact, the Strait of Sicily is dotted with volcanoes, submarine and not (Pantelleria and Linosa are two emerged examples), and even vast areas of the Avventura Bank are made of volcanic rocks (Colantoni 2011).

Returning to the islets mentioned in the previous section, an explosive eruption a few tens of miles away, possibly accompanied by an earthquake and a tsunami, would have been a dramatic way to end their existences (precisely in the manner described by Plato). Especially if, as in an Agatha Christie mystery, several suspects might have been questioned of having committed the crime.

The Strait of Sicily in the Palaeolithic. The Pindaric flight about the islets is fascinating. Eleven thousand years ago, explosive eruptions were not uncommon. Those occurring in the sea caused devastating tsunami too. The archipelago of the Strait of Sicily, inserted in the volcanic zone separating Tunisia from Sicily, was in a perfect position to be destroyed by a cataclysm. Considering that most of its islands are now totally submerged, it is not surprising that the possible remains of lost settlements are well hidden.

In short, the potential killer and the murder weapon are there but, without a corpse, the usual practice is to file the case. Yet the claimed ancient occupation of the Strait of Sicily should have left some traces. How could it be reconciled with the absence of chronologically odd findings on the Tunisian or Sicilian coasts? Dominators are always careful to take

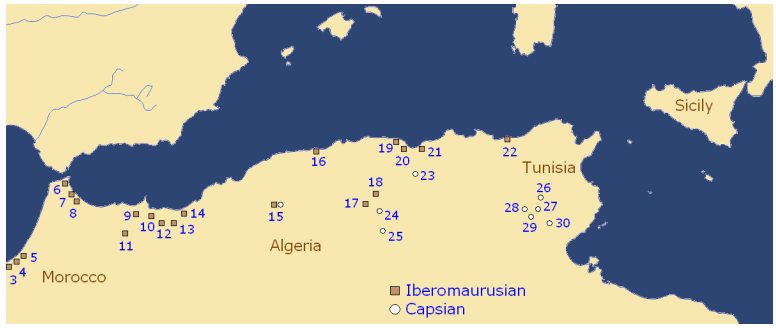

Figure 30. Distribution of major Iberomaurusian and Capsian sites in the Maghreb from Barton and Bouzouggar (2013): 3. Contrebandiers; 4. El Harhoura II; 5. Dar es-Soltan I; 6. Ghar Cahal; 7. Kehf El Hammar; 8. Hattab II; 9. Ifri El Baroud; 10. Ifri n'Ammar; 11. Kifan Bel Ghomari; 12. Taforalt; 13. La Mouillah; 14. Rachgoun; 15. Columnata; 16. Rassel; 17. El Hamel; 18. El-Onçor; 19. Afalou; 20. Tamar Hat; 21. Taza; 22. Ouchtata; 23. Medjez II; 24. Dakhalat es-Saâdane; 25. Aïn Naga; 26. Khanguet El-Mouhaâd; 27. Aïn Misteheya; 28. Relilaï; 29. Kef Zoura D; 30. El Mekta (modified map from d-maps.com).

advantage of the subjugated hiding their superior technology, but it is unlikely that nothing at all escape their control.

The Maghreb, the likely homeland of the occupants of the Strait, stretching from Morocco to Tunisia, has been inhabited since the early Palaeolithic. At Brezina, in Algeria, Mousterian artefacts dated from sixty to one hundred and ten thousand years ago have been found (Aumassip 2001, p. 49). The region has not been yet exhaustively investigated (Le Quellec 2014), but it seems clear that eleven thousand five hundred years ago it was the theatre of the transition from the Upper Palaeolithic to the Epipalaeolithic (Linstädter *et al.* 2012). Evidently, the climatic change was felt there too.

Iberomaurusian is the name given to the characteristic technology present in the Maghreb between about twenty thousand to ten thousand years ago (Barton and Bouzouggar 2013), which was followed, in Tunisia and Algeria (the lands attributed by Diodorus and Herodotus to the Atlanteans) by the Capsian, a culture marked by a visible change in customs and habits, albeit remaining a hunter-gatherer Epipalaeolithic one (Rahmani 2004).

The Capsian showed a particular dietary propensity for land snails (Lubell 2004), testified by the presence of thousands of escargotières[42], whose sizes and locations near springs or passes indicated a prevalently sedentary population. This penchant for such a delicacy of the French cuisine is indeed a mark of their superior civilization, but it is doubtful that escargots per se can be taken as a proof of Atlantis: something more unambiguously Neolithic is probably necessary.

Meanwhile, across the Strait, Sicily too was in the late Palaeolithic. In the island the concentration of Palaeolithic remains, mainly western (Fig. 31 A), is different from the Neolithic one (mostly eastern) (Fig. 31 B), suggesting in fact a former colonization of North

[42]Artificial mounds made up of snail shells.

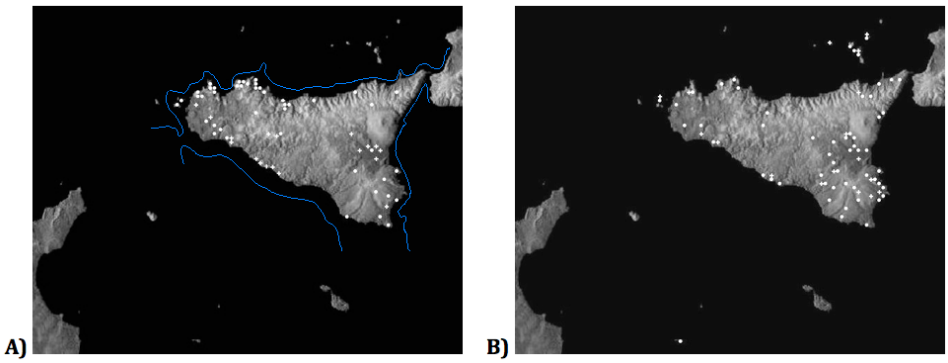

Figure 31. A) Distribution of the early faunal and human populations in Sicily (between circa 18,000 and 8,000 years ago): (o) Upper Palaeolithic / Mesolithic sites; (+) Bifacial and pebble tools (from Leighton 1999, p. 23). The blue line represents the shoreline at the LGM. B) The first farming societies in Sicily (after circa 8,000 years ago) Early-Middle (o) and Late (+) Neolithic sites (from Leighton 1999, p. 53).

African origin, rather than coming across the Strait of Messina (as the following Neolithic colonization).

The hypothesis that the first Sicilians might have come from the Maghreb is reinforced by the observation that the Palaeolithic remains on today's south-western coast are in reality in the ancient hinterland, far from the coastline of the time, allowing the presumption of a larger number of them along the actual shoreline, today submerged (the blue line in Fig. 31 A) (Rapisarda 2008). The remark that the sailing routes between Tunisia and Sicily were shorter and easier before MWP 1b (for the presence of numerous islands), to become longer and without visual cues in the later Neolithic period, further favours the supposition.

The presence of settlements on the two shores of the Strait and the guess of an African colonization of Sicily suggest a contemporary occupation of the existing archipelago because, apart from Atlantis, some safe harbours along the route would have been an important aid to the maritime travel. However, as far as we know, the colonization of the islets of the Straits of Sicily occurred only eight thousand years ago. The oldest settlements on Malta and Lampedusa belong to that period (Leighton 1999, p. 73). Even more recent was the occupation of Pantelleria, belonging to only five thousand years ago, but Pantelleria is a peculiar case, justified by its rough shores and by the absence of natural harbours, which made it an inhospitable place even while its obsidian was being exploited and traded in the entire basin. The other islands, made of limestone, contain instead several sheltered fiords suitable for safe docking.

The Maltese islands lie a hundred km south of Sicily, to which they were united before MWP 1a, and from which they were well in sight up to MWP 1b. The graffiti found on the Tarxien South Temple, representing boats of various shapes, show the kind of ships the ancient Maltese knew (Trump and Cilia 2002, p. 214). Malta hosts several megalithic temples that, before the unearthing of Göbekli Tepe, were believed the oldest buildings

ever erected (Trump and Cilia 2002, p. 11). The Maltese temples, normally attributed to the Sicilian colonizers who came to inhabit the archipelago before seven thousand years ago, have a characteristic plan, repeated in numerous examples throughout the two major islands. They are considered the fruit of an autonomous culture (there is no trace of similar buildings in the supposed motherland Sicily) and are estimated to be almost six thousand years old (Trump and Cilia 2002, p. 10).

More puzzling is the late colonization of Lampedusa, which was part of the African littoral before MWP 1a. Eight thousand years ago, in exceptional conditions, Malta could be seen from the mainland, but the flat Lampedusa was too far from everywhere to be spotted. The reasons for delaying its colonization until it become something in the middle of nowhere are unclear, considering that Lampedusa remained close the African coastline at least until MWP 1b.

For the mentioned islands (as well as for the smaller and for the submerged others) an earlier colonization may be not unthinkable. For them, the same suspicion expressed for the southern coast of Sicily is valid: settlements older than Neolithic should be searched offshore, along the shoreline of the corresponding time. Above all remembering that they were probably harbour structures.

If traffics between the two sides of the Strait were a regular feature, the Maltese islands, the strategic eastern gate, were unlikely to be left out. The same reasoning is valid for Lampedusa, a prominent outpost on the African coast, which should have been manned to ensure at least the safe cabotage. There could be traces of human occupation along the sea floors surrounding them. On the seabeds near Malta structures recognition could be facilitated by the characteristic plan systematically used in building the temples. More in general, assuming that the settlers had developed a megalithic architecture, the quarries could be recognized, as well as the docking structures. Today, bathymetric measurements campaigns are routinely made and exploring sea floors shallower than a hundred meters is not particularly difficult. Most natural structures are basically fractal, but quarries and docks usually show right angles: to treat bathymetric data with an algorithm able to spot straight edges and right angles in a fractal landscape should not be too difficult (Rapisarda 2008).

A "Neolithic" clue: obsidian. Obsidian is a volcanic glass formed by the sudden cooling of lava rich in silicon. The possibility to chip it creating sharp edges, its hardness and its shine made it a material suitable for crafting tools, weapons and jewellery, turning it in one of the most wanted asset of the prehistoric age.

Since its macroscopic characteristics (colour, homogeneity, hardness) are typical of each specific lava flow, archaeologists have always tried to establish the geographical origin of obsidian artefacts found in sites far from the sources. Naturally, since also their chemical composition depends on the characteristics of the original lava flow, the idea of using chemical analysis to ascertain the specimens provenance was born together with the analysis techniques (Cann and Renfrew 1964).

As a rule, obsidian composition is fairly uniform within a flow, while being different from that of the flows nearby. This means that often one can distinguish not only among different volcanoes, but also among different flows of the same volcano (Glascock, Braswell, and Cobean 1998, p. 17).

Being possible to establish the geographical origin of its crafts, it is an excellent tracer of ancient trade: if a blade made by Pantelleria obsidian is found in Malta, somebody must have brought it. Since nineteen seventy it has been known that four islands (Sardinia, Palmarola, Lipari and Pantelleria) provided all the obsidian found in the western Mediterranean (Ammerman, Matessi, and Cavalli-Sforza 1978). Handicrafts from these islands have been found in the Neolithic settlements of France, Italy, Sicily, Malta and Tunisia. Logically, Sardinia and Palmarola supplied the North, while Lipari and Pantelleria the southern basin, including Sicily and Tunisia.

In the Western Mediterranean its systematic exploitation began about eight thousand years ago (Tykot 1996). In Sicily the use of obsidian is associated with the spread of Neolithic, a coincidence feebly put in doubt by the discovery of some artefacts in Mesolithic layers, unfortunately in the presence of disturbed stratigraphy, and of a Liparian blade found at Perriere Sottano (Catania) and dated 9500 BP cal. (Aranguren and Revedin 1998).

Although further excavations (Chilardi *et al.* 2012; Nicoletti and Tusa 2012) have confirmed the absence of obsidian in Palaeo/Mesolithic layers, the discovery of two blades at Favignana (Trapani) dated between 9500 and 9800 BP cal. (Martini *et al.* 2012) has renewed the doubt of possible anomalies in the timeline of the obsidian exploitation in Sicily.

The Neolithic timing is valid also on the other side of the Strait. The date of 8000 BP for the first use of obsidian is, for example, confirmed in Tunisia, although the results of the researches are reported as "preliminary" (Mulazzani *et al.* 2010).

Obsidian in Sicily. Besides the chemical composition, also the age of the lava flow that formed the obsidian can be determined, by counting the microscopic fission tracks generated by radioactive impurities after its fusion. According to these measurements, Lipari is a very recent source: its oldest flow dates back to eight or nine thousand years ago and is much younger than those of Pantelleria (Oddone and Bigazzi 2003).

In other words, before nine thousand years ago there was no obsidian in Lipari. Its eruption coincided with the start of obsidian collection in the western Mediterranean (Tykot 2002) and with the spread of agriculture in the region. All in all, it is a belated beginning, as obsidian had been already exploited in the Horn of Africa one hundred thousand years ago (Walter *et al.* 2000). Apparently, in the Mediterranean basin it needed the sophisticated Neolithic culture to be appreciated.

The distance from the sources determined its geographic spread. Sicily was essentially divided into two market basins: the northeastern served by Lipari and the southwestern, by Pantelleria. In some sites, situated along the hypothetical border between the basins, both islands provided the stuff: in the village of Mandria di Serra del Palco (Caltanissetta), which has been continuously inhabited during prehistory, the percentage of Pantelleria material progressively went reducing during the Neolithic period, in comparison to that from Lipari (Nicoletti 1997). A similar replacement of supply happened in Cava dell'Uzzo (Trapani) (Leighton 1999) and at Skorba (Malta) (Trump and Cilia 2002, p. 67), where also obsidian cores of both types were found.

The obsidian diffusion process in Sicily appears a bit peculiar. It seems that it was Lipari eruption to advertise the existence of the precious mineral (which was already available in Pantelleria) in harmony with the accepted timeline of its diffusion. It is somehow odd that,

Figure 32. Schematic map of the eruptions pre and post green tuff, from Rapisarda (2007), based on the Pantelleria geological map of Orsi (2003). The flow of green tuff is shown in turquoise, while magenta indicates the surface affected by all successive lava flows. The areas in blue are the coastal zones where the layers prior to green tuff are accessible, because the sea erosion that created the cliffs tore the cover.

although the stuff from Lipari, more glassy and shining, was always the favourite, many ran initially to Pantelleria to collect the material over there. Only later, people progressively chose Lipari to gather it.

As observed, the timeline suggests that the appreciation of obsidian was indeed a Neolithic feature, but how conceivable is that Pantelleria obsidian had not been prised before? The doubt is licit, considering that some objects have been undeniably found in layers deeper than the Neolithic ones, and that many finds of the past century have been unearthed not respecting the correct stratigraphic protocols, resulting in reality not datable.

The future stratigraphic studies of undisturbed sites will probably clarify the question. Meanwhile it might be useful to classify the different flows of Pantelleria with care, since some artefacts, found in the island and chemically analysed, are not attributable to any of the known sources (Giannitrapani 2005; Vargo *et al.* 2001). As a matter of fact, only a small part of the found artefacts is routinely chemically analysed and the flows of Pantelleria have not been systematically catalogued. There could be ample room for a classification work, which might bring interesting surprises.

Pantelleria obsidian. Pantelleria is the emerged part of a volcanic building, high overall about 1,500 meters. The geological history of the island is marked by the flow of green tuff (still covering about a third of its surface) which encased Pantelleria almost completely around forty-five thousand years ago (Fig. 32), dividing all its eruptions in pre or post green tuff (Civetta *et al.* 1984).

Figure 33. Aerial image of Pantelleria from the south (photo by Frank Pamar, from Google Earth). In the foreground the sea cliff that, from Punta della Polacca to Balata dei Turchi, interrupts the flow of green tuff. On the left, on the west side, two other cliffs at Cala delle Pietre Nere and at Cala di Licata are visible.

Figure 34. The layer of green tuff on the cliff of Punta della Polacca. The stratification of more ancient lava flows is visible under the layer, including the obsidian flows.

The obsidian flows identified in Pantelleria are traditionally five: three layers almost horizontal at Balata dei Turchi and two deposits at Bagno dell'Acqua and Gelkhamar (Francaviglia 1988). The Gelkhamar source looks like a usual lava flow, similar to those of Lipari; the deposit at Bagno dell'Acqua is fragmented and scarce; but the conformation of the three lava flows of Balata dei Turchi is rather peculiar, although consistent with the orography of the southern part of the island (Rapisarda 2007). Because of the limited slopes and of the absence of pronounced valleys, the southern part of the island is characterized by lava flows that extend almost uniformly around the volcanic cone. The green tuff flow,

Figure 35. Cala delle Pietre Nere, near Scauri (enlarged detail on the photo to the right). In the cliff (about 150 meters high) the obsidian flows are clearly visible, inserted among the layers of yellowish pumice. The landslide, containing large blocks of obsidian, is partially emerged and partially submerged. In these conditions, the collection of the material from the sea does not require landing on the island, rather difficult everywhere, but only approaching the landslide with a boat and serving oneself.

which enclosed almost the whole island (Orsi 2003), well displays this feature (Figs. 33 and 34). The obsidian flows most exploited for the manufacture of prehistoric crafts were the southern ones, from Salto la Vecchia to Balata dei Turchi. This prevalence, well known among the Sicilians finds (Tykot 1996), has been preliminarily confirmed in Tunisia too (Mulazzani *et al.* 2010).

The landslide at Cala delle Pietre Nere (Scauri), which dragged obsidian blocks of the above vein into the sea, suggests a practical method of collecting the mineral: skirt the shore with a boat and pick up what you need (Fig. 35). It does neither require to dock on the island, dangerous almost everywhere, nor to climb the cliff, even more hazardous. The method favours the collection of the raw material as it is, leaving the refining process for later, once returned home. Such collection method could explain both the absence of industries for processing the mineral in the island (Leighton 1999, p. 73), both the progressive reduction of its gathering in favour of Liparian supplies, due to the sinking of the debris caused occasionally by sea storms, and systematically by the sea level increase.

On the other hand, the possible existence of submerged obsidian sources suggests an interesting clue for dating the gathering of the material, taking into account that Palaeolithic men would hardly have dived in depth to pick it up. There could be several submerged obsidian landslides under the Pantelleria cliffs, landslides that had been an easy source of supply, before being sunken by the sea level rise. It is evident that finding an underwater source of obsidian, exploited to craft tools, would imply that the collection of its material dated back to the time of its emersion, deducible from the current depth of the source (Rapisarda 2007). This date would almost surely precede eight thousand years ago (when the sea level differed very little from the present one) and could go significantly further back, even beyond the Melt Water Pulse 1b (the time of the destruction of Atlantis) showing that in Sicily somebody had already the "Neolithic taste" to prize obsidian. In other words, finding an exploited underwater obsidian source would imply an occupation of the Strait

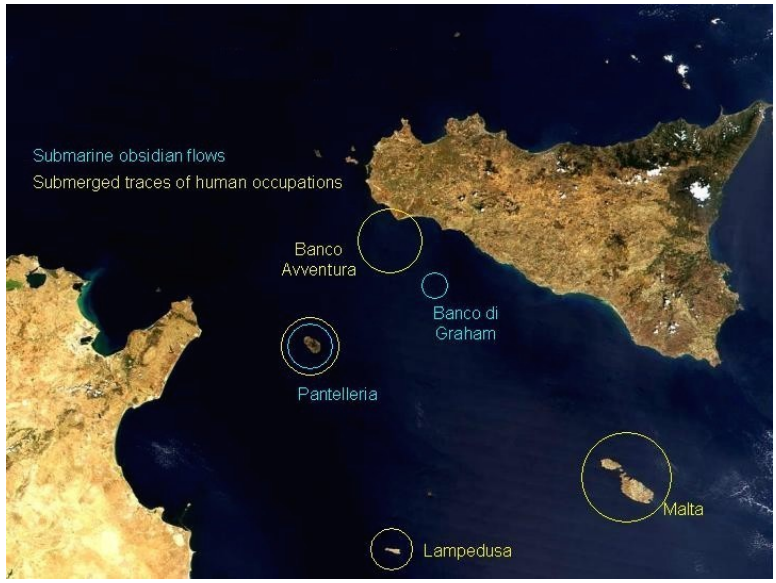

Figure 36. Areas of the Strait of Sicily whose shallow seabeds may be explored, after a bathymetric investigation, to search for submarine obsidian sources (turquoise circles) or for remnants of ancient settlements (yellow circles) (from Rapisarda 2008).

of Sicily much older than today assessed (Rapisarda 2008), suggesting also the maritime colonization of Sicily from the Maghreb.

A campaign for classifying the obsidian flows of Pantelleria would not be groundless, especially after the recent discovery of a pre-Neolithic processing site near Punta Tracino at an underwater depth of about twenty meters (Abelli *et al.* 2014) has shown that the hypothesis of a submerged obsidian source is not entirely far-fetched. All in all, even the search for not natural structures or megalithic relics could be justified, after restricting the areas of interest with a meticulous bathymetric study. Figure 36, from Rapisarda (2008), summarizes the most promising seabeds to be investigated in view of a search campaign.

Conclusions

The coincidence of climatic upheavals and technological revolutions that occurred eleven thousand five hundred years ago with the alleged destruction of Atlantis authorizes the suspicion that the legend of Plato may contain a grain of truth. The climate change regarded the whole northern hemisphere and several areas of the ancient world could have hosted a so to speak "advanced civilization" later erased by the subsequent rise of the sea level.

Intriguingly, the regions most subject to those dramatic events were those located in the delta of the largest rivers, the same that would have hosted, shortly afterward, the birth of the oldest civilizations. It is also singular how the chronological distribution of the

archaeological remains in Egypt cannot exclude for sure an occupation of the Nile Delta in the days of Atlantis.

Thanks to its centrality in the Mediterranean Sea and to its function of maritime link between two continents, the archipelago that then stood in the Strait of Sicily might be the most fitting site among those complying with Plato's legend. Traces of a precursor of the Neolithic Revolution in the Strait of Sicily at the time of Atlantis are today weak but, after the discovery of the pre-Neolithic processing site, finding also a submerged obsidian source around Pantelleria would reform the timeline of its exploitation.

By itself, this finding would not be enough to demonstrate the existence of Atlantis, which would require at least the identification of a submerged settlement, but would nevertheless show that the Strait of Sicily was inhabited much earlier than believed today, a considerable archaeological result by itself.

NOTE ADDED IN PROOF

The discovery of a submerged Mesolithic monolith in the Strait of Sicily (Lodolo and Ben-Avraham 2015), published after the submission of the present article, provides new stimuli for a research campaign in the Strait of Sicily. Placed at 40 metres under the sea level, in proximity to three semi-circular ridges, inserted in a cove protected by a rectilinear dam and situated on the Avventura bank (the seabed suggested, a few pages before, to have hosted Atlantis), the monolith may be not enough to establish the existence of the lost city but, perhaps, perhaps, perhaps ...

Acknowledgments

The author would like to thank Prof. Paolo V. Giaquinta for his encouragement and patience, and Dr. Francesca Bombarda, Dr. Luca Fiorani and Dr. Giorgio Maddaluno for their precious suggestions during the revision of the manuscript.

References

Abelli, L., Agosto, M. V., Casalbore, D., Romagnoli, C., Bosman, A., Antonioli, F., Pierdomenico, M., Sposato, A., and Chiocci, F. L. (2014). "Marine geological and archaeological evidence of a possible pre-Neolithic site in Pantelleria Island, Central Mediterranean Sea". In: *Geology and Archaeology: Submerged Landscapes of the Continental Shelf*. Ed. by J. Harff, G. Bailey, and F. Lüth. Vol. 411. Special Publications. First published online September 19, 2014. London: The Geological Society. DOI: 10.1144/SP411.6.

Alley, R. B. (2000). "The Younger Dryas cold interval as viewed from central Greenland". *Quaternary Science Reviews* **19**(1), 213–226. DOI: 10.1016/S0277-3791(99)00062-1.

Ammerman, A. J., Flourentzos, P., McCartney, C., Noller, J. S., and Sorabji, D. (2006). *Two new early sites on Cyprus*. Report. Cyprus: Department of Antiquities, pp. 1–22.

Ammerman, A. J., Matessi, C., and Cavalli-Sforza, L. L. (1978). "Some new approaches to the study of the obsidian trade in the Mediterranean and adjacent areas". In: *The Spatial Organisation of Culture. New approaches in archaeology*. Ed. by I. Hodder. University of Pittsburgh Press, pp. 179–190.

Antonioli, F., Kershaw, S., Renda, P., Rust, D., Belluomini, G., Cerasoli, M., Radtke, U., and Silenzi, S. (2006). "Elevation of the last interglacial highstand in Sicily (Italy): a benchmark of coastal tectonics". *Quaternary International* **145**, 3–18. DOI: 10.1016/j.quaint.2005.07.002.

Aranguren, B. and Revedin, A. (1998). "Il giacimento mesolitico di Perriere Sottano (Ramacca, CT)". *Bollettino di Paletnologia Italiana* **89**, 31–79.

Aumassip, G. (2001). *L'Algérie des premiers hommes*. Vol. 3. Méditerranée-Sud. Paris: Maison des sciences de l'homme : Ibis press.

Bailey, G. N. and Flemming, N. C. (2008). "Archaeology of the continental shelf: marine resources, submerged landscapes and underwater archaeology". *Quaternary Science Reviews* **27**(23), 2153–2165. DOI: 10.1016/j.quascirev.2008.08.012.

Bard, E., Antonioli, F., and Silenzi, S. (2002). "Sea-level during the penultimate interglacial period based on a submerged stalagmite from Argentarola Cave (Italy)". *Earth and Planetary Science Letters* **196**(3), 135–146. DOI: 10.1016/S0012-821X(01)00600-8.

Bard, E., Hamelin, B., and Fairbanks, R. G. (1990). "U-Th ages obtained by mass spectrometry in corals from Barbados: sea level during the past 130,000 years". *Nature* **346**, 456–458. DOI: 10.1038/346456a0.

Bard, E., Hamelin, B., Fairbanks, R. G., and Zindler, A. (1990). "Calibration of the ^{14}C timescale over the past 30,000 years using mass spectrometric U-Th ages from Barbados corals". *Nature* **345**, 405–410. DOI: 10.1038/345405a0.

Bard, K. A. (1999). *Encyclopedia of the archaeology of ancient Egypt*. London: Routledge. URL: https://archive.org/details/EncyclopediaOfTheArchaeologyOfAncientEgypt (visited on 09/13/2015).

Barton, N. and Bouzouggar, A. (2013). "Hunter-gatherers of the Maghreb: 25,000-6000 years ago". In: *The Oxford handbook of African archaeology*. Ed. by P. Mitchell and P. Lane. Oxford: Oxford University Press, pp. 431–443.

Bar-Yosef Mayer, D. E. and Porat, N. (2008). "Green stone beads at the dawn of agriculture". *Proceedings of the National Academy of Sciences* **105**(25), 8548–8551. DOI: 10.1073/pnas.0709931105.

Bar-Yosef, O. (1998). "The Natufian culture in the Levant, threshold to the origins of agriculture". *Evolutionary Anthropology: Issues, News, and Reviews* **6**(5), 159–177. URL: http://dx.doi.org/10.1002/(SICI)1520-6505(1998)6:5%3C159::AID-EVAN4%3E3.0.CO;2-7.

Bray, J. R. (1977). "Pleistocene volcanism and glacial initiation". *Science* **197**(4300), 251–254.

Broodbank, C. (2006). "The origins and early development of Mediterranean maritime activity". *Journal of Mediterranean Archaeology* **19**(2), 199. DOI: 10.1558//jmea.2006.v19i2.199.

Cann, J. R. and Renfrew, C. (1964). "The Characterization of Obsidian and its application to the Mediterranean Region". *Proceedings of the Prehistoric Society (New Series)* **30**, 111–133. DOI: 10.1017/S0079497X00015097.

Chilardi, S., Copat, V., Mannino, M. A., and Zampetti, D. (2012). "Nuovi dati sul Paleolitico superiore nel territorio di Erice: la Grotta del Maltese e la Grotta San Francesco". In: *Dai ciclopi agli ecisti. Società e territorio nella Sicilia preistorica e protostorica*. Atti della XLI Riunione Scientifica. (San Cipirello (PA), Nov. 16–19, 2006). Firenze: Istituto italiano di Preistoria e Protostoria, pp. 403–414.

Civetta, L., Cornette, Y., Crisci, G., Gillot, P. Y., Orsi, G., and Requejo, C. S. (1984). "Geology, geochronology and chemical evolution of the island of Pantelleria". *Geological Magazine* **121**(06), 541–562. DOI: 10.1017/S0016756800030703.

Clark, P. U., Dyke, A. S., Shakun, J. D., Carlson, A. E., Clark, J., Wohlfarth, B., Mitrovica, J. X., Hostetler, S. W., and McCabe, A. M. (2009). "The last glacial maximum". *Science* **325**(5941), 710–714. DOI: 10.1126/science.1172873.

Cleyet-Merle, J.-J. (1990). *La préhistoire de la pêche*. Collection des hespérides. Paris: Éd. Errance.

Colantoni, P. (2011). *Rischio Vulcanico. Progetto Offshore Ibleo*. Sealine Panda–Argo–Cassiopea. Tech. rep. ENI - Div. E&P.

Cole, J. M., Goldstein, S. L., Hemming, S. R., Grousset, F. E., *et al.* (2009). "Contrasting compositions of Saharan dust in the eastern Atlantic Ocean during the last deglaciation and African Humid Period". *Earth and Planetary Science Letters* **278**(3), 257–266. DOI: 10.1016/j.epsl.2008.12.011.

De Guidi, G. and Monaco, C. (2007). "Deformazione verticale tardo-olocenica lungo le coste dell'isola di Pantelleria". In: *Rendiconti della Societá Geologica Italiana, Nuova Serie*. Vol. 4, pp. 212–214. URL: http://www.socgeol.info/cerca.php?act=see&type=Rendiconti&y=2007&v=4&f=.

deMenocal, P., Ortiz, J., Guilderson, T., Adkins, J., Sarnthein, M., Baker, L., and Yarusinsky, M. (2000). "Abrupt onset and termination of the African Humid Period: rapid climate responses to gradual insolation forcing". *Quaternary Science Reviews* **19**(1-5), 347–361. DOI: 10.1016/S0277-3791(99)00081-5.

Dietrich, O., Köksal-Schmidt, C., Notroff, J., and Schmidt, K. (2013). "Establishing a radiocarbon sequence for Göbekli Tepe. State of research and new data". *Neo-Lithics. The Newsletter of Southwest Asian Neolithic Research* (1/13), 36–41.

Diodorus of Sicily (1935). *The Library of History. II*. Trans. by C. H. Oldfather. 12 vols. The Loeb Classical Library 303. Cambridge, Mass.: Harvard University Press. URL: http://www.loebclassics.com/view/LCL303/1935/pb_LCL303.i.xml.

EPICA community members. Augustin, L., Barbante, C., Barnes, P. R. F., Marc Barnola, J., Bigler, M., Castellano, E., Cattani, O., Chappellaz, J., Dahl-Jensen, D., Delmonte, B., Dreyfus, G., Durand, G., Falourd, S., Fischer, H., Flückiger, J., Hansson, M. E., Huybrechts, P., Jugie, G., Johnsen, S. J., Jouzel, J., Kaufmann, P., Kipfstuhl, J., Lambert, F., Lipenkov, V. Y., Littot, G. C., Longinelli, A., Lorrain, R., Maggi, V., Masson-Delmotte, V., Miller, H., Mulvaney, R., Oerlemans, J., Oerter, H., Orombelli, G., Parrenin, F., Peel, D. A., Petit, J.-R., Raynaud, D., Ritz, C., Ruth, U., Schwander, J., Siegenthaler, U., Souchez, R., Stauffer, B., Peder Steffensen, J., Stenni, B., Stocker, T. F., Tabacco, I. E., Udisti, R., Wal, R. S. W. van de, Broeke, M. van den, Weiss, J., Wilhelms, F., Winther, J.-G., Wolff, E. W., and Zucchelli, M. (2004). "Eight glacial cycles from an Antarctic ice core". *Nature* **429**(6992), 623–628. DOI: 10.1038/nature02599.

EPICA community members. Barbante, C., Barnola, J. M., Becagli, S., Beer, J., Bigler, M., Boutron, C., Blunier, T., Castellano, E., Cattani, O., Chappellaz, J., Dahl-Jensen, D., Debret, M., Delmonte, B., Dick, D., Falourd, S., Faria, S., Federer, U., Fischer, H., Freitag, J., Frenzel, A., Fritzsche, D., Fundel, F., Gabrielli, P., Gaspari, V., Gersonde, R., Graf, W., Grigoriev, D., Hamann, I., Hansson, M., Hoffmann, G., Hutterli, M. A., Huybrechts, P., Isaksson, E., Johnsen, S., Jouzel, J., Kaczmarska, M., Karlin, T., Kaufmann, P., Kipfstuhl, S., Kohno, M., Lambert, F., Lambrecht, A., Lambrecht, A., Landais, A., Lawer, G., Leuenberger, M., Littot, G., Loulergue, L., Lüthi, D., Maggi, V., Marino, F., Masson-Delmotte, V., Meyer, H., Miller, H., Mulvaney, R., Narcisi, B., Oerlemans, J., Oerter, H., Parrenin, F., Petit, J. R., Raisbeck, G., Raynaud, D., Rothlisberger, R., Ruth, U., Rybak, O., Severi, M., Schmitt, J., Schwander, J., Siegenthaler, U., Siggaard-Andersen, M. L., Spahni, R., Steffensen, J. P., Stenni, B., Stocker, T. F., Tison, J. L., Traversi, R., Udisti, R., Valero-Delgado, F., Broeke, M. R. van den, Wal, R. S. W. van de, Wagenbach, D., Wegner, A., Weiler, K., Wilhelms, F., Winther, J. G., and Wolff, E. (2006). "One-to-one coupling of glacial climate variability in Greenland and Antarctica". *Nature* **444**(7116), 195–198. DOI: 10.1038/nature05301.

EMODnet (2015). *European Marine Observation and Data Network*. URL: http://www.emodnet.eu/ (visited on 05/14/2015).

Fairbanks, R. G. (1989). "A 17,000-year glacio-eustatic sea level record: influence of glacial melting rates on the Younger Dryas event and deep-ocean circulation". *Nature* **342**(6250), 637–642. DOI: 10.1038/342637a0.

Ferranti, L., Antonioli, F., Mauz, B., Amorosi, A., Dai Pra, G., Mastronuzzi, G., Monaco, C., Orrù, P., Pappalardo, M., Radtke, U., Renda, P., Romano, P., Sansò, P., and Verrubbi, V. (2006). "Markers of the last interglacial sea-level high stand along the coast of Italy: Tectonic implications". *Quaternary International* **145–146**, 30–54. DOI: 10.1016/j.quaint.2005.07.009.

Fleming, K. M. (2000). "Glacial rebound and sea-level change: constraints on the Greenland ice sheet". PhD thesis. Australian National University.

Fleming, K., Johnston, P., Zwartz, D., Yokoyama, Y., Lambeck, K., and Chappell, J. (1998). "Refining the eustatic sea-level curve since the Last Glacial Maximum using far- and intermediate-field sites". *Earth and Planetary Science Letters* **163**(1), 327–342. DOI: 10.1016/S0012-821X(98)00198-8.

Francaviglia, V. M. (1988). "Ancient obsidian sources on Pantelleria (Italy)". *Journal of Archaeological Science* **15**(2), 109–122. DOI: 10.1016/0305-4403(88)90001-5.

Gardiner, A. H. (1959). *The Royal Canon of Turin*. Oxford: printed for the Griffith Institute by the Oxford University Press.

Gasse, F. (2000). "Hydrological changes in the African tropics since the Last Glacial Maximum". *Quaternary Science Reviews* **19**(1), 189–211. DOI: 10.1016/S0277-3791(99)00061-X.

Giannitrapani, E. (2005). *Considerazioni preliminari sul popolamento preistorico dell'isola di Pantelleria*. URL: http://archeoclub.pantelleria.it/considerazionibugeber.html (visited on 06/23/2005). On the date of publication of this article the paper by E. Giannitrapani was no longer accessible online.

Glascock, M. D., Braswell, G. E., and Cobean, R. H. (1998). "A Systematic Approach to Obsidian Source Characterization". In: *Archaeological Obsidian Studies*. Ed. by M. S. Shackley. Vol. 3. Advances in Archaeological and Museum Science. Springer US, pp. 15–65. DOI: 10.1007/978-1-4757-9276-8_2.

GLOBE Task Team and others. Hastings, D. A., Dunbar, P. K., Elphingstone, G. M., Bootz, M., Murakami, H., Maruyama, H., Masaharu, H., Holland, P., Payne, J., Bryant, N. A., Logan, T. L., Muller, J.-P., Schreier, G., and MacDonald, J. S., eds. (1999). *Global Land One-km Base Elevation Project*. Version 1.0. National Oceanic and Atmospheric Administration, National Geophysical Data Center, 325 Broadway, Boulder, Colorado 80305-3328, U.S.A. URL: http://www.ngdc.noaa.gov/mgg/topo/globe.html (visited on 09/11/2015). Digital data base on the World Wide Web and CD-ROMs. Maps displayed in Figs. 1, 15, 20, 22 and 23 were exported from http://www.ngdc.noaa.gov/mgg/topo/pictures/GLOBALsealeveldrop110m.jpg.

Greaves, A. M. and Helwing, B. (2003). "Archaeology in Turkey: The Stone, Bronze, and Iron Ages, 2000". *American Journal of Archaeology* **107**(1), 71–103. URL: http://www.jstor.org/stable/40026567.

Gupta, A. K. (2004). "Origin of agriculture and domestication of plants and animals linked to early Holocene climate amelioration". *Current Science* **87**(1), 54–59. URL: http://www.currentscience.ac.in/Downloads/download_pdf.php?titleid=id_087_01_0054_0059_0.

Hall, K. (1982). "Rapid deglaciation as an initiator of volcanic activity: An hypothesis". *Earth Surface Processes and Landforms* **7**(1), 45–51. DOI: 10.1002/esp.3290070106.

Helck, W. (1987). *Untersuchungen zur Thinitenzeit*. Ägyptologische Abhandlungen Bd. 45. Wiesbaden: Otto Harrassowitz.

Herodotus (1890). *The history of Herodotus*. Trans. by G. C. Macaulay. 2 vols. London: Macmillan. Online translations at Project Gutenberg: Vol. 1, Vol. 2.

Hsu, S.-W. (2010). "The Palermo Stone: the earliest royal inscription from Ancient Egypt". *Altorientalische Forschungen* **37**(1), 68–89. DOI: 10.1524/aofo.2010.0006.

Kislev, M. E., Nadel, D., and Carmi, I. (1992). "Epipalaeolithic (19,000 BP) cereal and fruit diet at Ohalo II, Sea of Galilee, Israel". *Review of Palaeobotany and Palynology* **73**(1), 161–166. DOI: 10.1016/0034-6667(92)90054-K.

Kuper, R. and Kröpelin, S. (2006). "Climate-controlled Holocene occupation in the Sahara: motor of Africa's evolution". *Science* **313**(5788), 803–807. DOI: 10.1126/science.1130989.

Lambeck, K., Antonioli, F., Purcell, A., and Silenzi, S. (2004). "Sea-level change along the Italian coast for the past 10,000 yr". *Quaternary Science Reviews* **23**(14), 1567–1598. DOI: 10.1016/j.quascirev.2004.02.009.

Lambeck, K., Esat, T. M., and Potter, E.-K. (2002). "Links between climate and sea levels for the past three million years". *Nature* **419**(6903), 199–206. DOI: 10.1038/nature01089.

Lambeck, K., Rouby, H., Purcell, A., Sun, Y., and Sambridge, M. (2014). "Sea level and global ice volumes from the Last Glacial Maximum to the Holocene". *Proceedings of the National Academy of Sciences* **111**(43), 15296–15303. DOI: 10.1073/pnas.1411762111.

Le Quellec, J.-L. (2014). "Prehistory in North Africa after the Middle Palaeolithic". In: *The Cambridge World Prehistory. Africa, South and Southeast Asia and the Pacific*. Ed. by C. Renfrew and P. Bahn. Vol. 1. Cambridge: Cambridge University Press. Chap. 1.10, pp. 151–164.

Leighton, R. (1999). *Sicily before history. An archaeological survey from the Palaeolithic to the Iron Age*. Ithaca, USA: Cornell University Press.

Linstädter, J., Eiwanger, J., Mikdad, A., and Weniger, G.-C. (2012). "Human occupation of Northwest Africa: A review of Middle Palaeolithic to Epipalaeolithic sites in Morocco". *Quaternary International* **274**, 158–174. DOI: 10.1016/j.quaint.2012.02.017.

Liu, J. P. and Milliman, J. D. (2004). "Reconsidering melt-water pulses 1A and 1B: Global impacts of rapid sea-level rise". *Journal of Ocean University of China* **3**(2), 183–190. DOI: 10.1007/s11802-004-0033-8.

Lodolo, E. and Ben-Avraham, Z. (2015). "A submerged monolith in the Sicilian Channel (central Mediterranean Sea): Evidence for Mesolithic human activity". *Journal of Archaeological Science: Reports* **3**, 398–407. DOI: 10.1016/j.jasrep.2015.07.003.

Lubell, D. (2004). "Prehistoric edible land snails in the circum-Mediterranean: the archaeological evidence". *Petits animaux sociétés humaines. Du complément alimentaire aux ressources utilitaires*: *XXIV^e rencontres internationales d'archéologie et d'histoire d'Antibes*, 77–98.

Martini, F., Lo Vetro, D., Colonese, A., Di Giuseppe, Z., Forzisi, V., Giglio, R., Ricciardi, and S., T. S. (2012). "Primi risultati sulle nuove ricerche stratigrafiche a Grotta di Oriente (Favignana, Tp). Scavi 2005". In: *Dai ciclopi agli ecisti. Società e territorio nella Sicilia preistorica e protostorica*. Atti della XLI Riunione Scientifica. (San Cipirello (PA), Nov. 16–19, 2006). Firenze: Istituto italiano di Preistoria e Protostoria, pp. 319–332.

Mayewski, P. A., Meeker, L. D., Whitlow, S. l., Twickler, M. S., Morrison, M. C., Bloomfield, P., Bond, G. C., Alley, R. B., Gow, A. J., Meese, D. A., Grootes, P. M., Ram, M., Taylor, K. C., and Wumkes, W. (1994). "Changes in atmospheric circulation and ocean ice cover over the North Atlantic during the last 41,000 years". *Science* **263**(5154), 1747–1751. DOI: 10.1126/science.263.5154.1747.

McGuire, W. J., Howarth, R. J., Firth, C. R., Solow, A. R., Pullen, A. D., Saunders, S. J., Stewart, I. S., and Vita-Finzi, C. (1997). "Correlation between rate of sea-level change and frequency of explosive volcanism in the Mediterranean". *Nature* **389**(6650), 473–476. DOI: 10.1038/38998.

Milne, G. A., Long, A. J., and Bassett, S. E. (2005). "Modelling Holocene relative sea-level observations from the Caribbean and South America". *Quaternary Science Reviews* **24**(10–11), 1183–1202. DOI: doi:10.1016/j.quascirev.2004.10.005.

Mulazzani, S., Le Bourdonnec, F.-X., Belhouchet, L., Poupeau, G., Zoughlami, J., Dubernet, S., Tufano, E., Lefrais, Y., and Khedhaier, R. (2010). "Obsidian from the Epipalaeolithic and Neolithic eastern Maghreb. A view from the Hergla context (Tunisia)". *Journal of Archaeological Science* **37**(10), 2529–2537. DOI: doi:10.1016/j.jas.2010.05.013.

Munro, N. D. (2003). "Small game, the Younger Dryas, and the transition to agriculture in the southern Levant". *Mitteilungen der Gesellschaft für Urgeschichte* **12**(4), 47–71.

NOAA/NESDIS (2015). *National Centers for Environmental Information*. National Oceanic and Atmospheric Administration. URL: http://maps.ngdc.noaa.gov/viewers/wcs-client/ (visited on 09/11/2015). Boulder, Colorado, U.S.A.

Nicoletti, F. (1997). "Il commercio preistorico dell'ossidiana nel Mediterraneo e il ruolo di Lipari e Pantelleria nel più antico sistema di scambio". In: *Prima Sicilia. Alle origini della società siciliana*. (Albergo dei Poveri. Palermo, Dec. 18–22, 1997). Ed. by S. Tusa. Vol. 1. Siracusa: Arnaldo Lombardi Editore, pp. 259–273.

Nicoletti, F. and Tusa, S. (2012). "Nuove acquisizioni scientifiche sul Riparo del Castello di Termini Imerese". In: *Dai ciclopi agli ecisti. Società e territorio nella Sicilia preistorica e protostorica*. Atti della XLI Riunione Scientifica. (San Cipirello (PA), Nov. 16–19, 2006). Firenze: Istituto italiano di Preistoria e Protostoria, pp. 303–318.

North Greenland Ice Core Project members. Andersen, K. K., Azuma, N., Barnola, J. M., Bigler, M., Biscaye, P., Caillon, N., Chappellaz, J., Clausen, H. B., Dahl-Jensen, D., Fischer, H., Flückiger, J., Fritzsche, D., Fujii, Y., Goto-Azuma, K., Grønvold, K., Gundestrup, N. S., Hansson, M., Huber, C., Hvidberg, C. S., Johnsen, S. J., Jonsell, U., Jouzel, J., Kipfstuhl, S., Landais, A., Leuenberger, M., Lorrain, R., Masson-Delmotte, V., Miller, H., Motoyama, H., Narita, H., Popp, T., Rasmussen, S. O., Raynaud, D., Rothlisberger, R., Ruth, U., Samyn, D., Schwander, J., Shoji, H., Siggard-Andersen, M. L., Steffensen, J. P., Stocker, T., Sveinbjörnsdóttir, A. E., Svensson, A., Takata, M., Tison, J. L., Thorsteinsson, T., Watanabe, O., Wilhelms, F., and White, J. W. C. (2004). "High-resolution record of Northern Hemisphere climate extending into the last interglacial period". *Nature* **431**(7005), 147–151. DOI: 10.1038/nature02805.

Oddone, M. and Bigazzi, G. (2003). "Studi di provenienza delle ossidiane del bacino del Mediterraneo: Caratterizzazione delle fonti naturali di materia prima italiane". *Journal of Intercultural and Interdisciplinary Archaeology* (1), F/01 [16 pages]. URL: http://v01.jiia.it/JIIA.it/Sezione_II/JIIA_01/Oddone-Bigazzi_F01/Articolo_F01/Oddone-Bigazzi_pag1.html.

Orsi, G. (2003). "Geology and volcanism of Pantelleria". In: Annual Workshop of the Working Group of the European Seismological Commission, Seismic Phenomena Associated with Volcanic Activity, Field Trip. (Sept. 23–28, 2003). Pantelleria, Sicily.

Otto-Bliesner, B. L., Russell, J. M., Clark, P. U., Liu, Z., Overpeck, J. T., Konecky, B., deMenocal, P., Nicholson, S. E., He, F., and Lu, Z. (2014). "Coherent changes of southeastern equatorial and northern African rainfall during the last deglaciation". *Science* **346**(6214), 1223–1227. DOI: 10.1126/science.1259531.

Paterne, M., Guichard, F., and Labeyrie, J. (1988). "Explosive activity of the South Italian volcanoes during the past 80,000 years as determined by marine tephrochronology". *Journal of Volcanology and Geothermal Research* **34**(3–4), 153–172. DOI: 10.1016/0377-0273(88)90030-3.

Pausanias (1918). *Description of Greece with an English Translation by W. H. S. Jones, Litt. D., and H. A. Ormerod, M. A.* 4 vols. Cambridge, Mass.: Harvard University Press. Available online at Perseus Digital Library: http://www.perseus.tufts.edu/hopper/text?doc=Perseus%3Atext%3A1999.01.0160.

Plato in Twelve Volumes (1925). Vol. 9, translated by W. R. M. Lamb. The Loeb Classical Library. Cambridge, Mass.: Harvard University Press. Available online at Perseus Digital Library: http://catalog.perseus.org/catalog/urn:cts:greekLit:tlg0059.

Prentice, I. C., Jolly, D., and BIOME 6000 participants (2000). "Mid-Holocene and glacial-maximum vegetation geography of the northern continents and Africa". *Journal of Biogeography* **27**(3), 507–519. DOI: 10.1046/j.1365-2699.2000.00425.x.

Purugganan, M. D. and Fuller, D. Q. (2009). "The nature of selection during plant domestication". *Nature* **457**(7231), 843–848. DOI: 10.1038/nature07895.

Rahmani, N. (2004). "Technological and cultural change among the last hunter-gatherers of the Maghreb: the Capsian (10,000–6000 B.P.)" *Journal of World Prehistory* **18**(1), 57–105. DOI: 10.1023/B:JOWO.0000038658.50738.eb.

Rapisarda, M. (2007). "L'età dell'ossidiana di Pantelleria". *Atti della Accademia Peloritana dei Pericolanti. Classe di Scienze Fisiche, Matematiche e Naturali* **85**(2), C1C0702001 [21 pages]. DOI: 10.1478/C1C0702001.

Rapisarda, M. (2008). "The hypothesis of an Ice Age settlement in the Straits of Sicily". In: *SOMA 2005. Proceedings of the IX Symposium on Mediterranean Archaeology*. (Chieti, Italy, Feb. 24–26, 2005). Ed. by O. Menozzi, M. L. Di Marzio, and D. Fossataro. Vol. 1739. BAR International Series. Oxford, England: Archaeopress – Publishers of British Archaeological Reports, pp. 267–274.

Renfrew, C. and Aspinall, A. (1990). "Aegean obsidian and Franchthi cave". In: *Les industries lithiques taillées de Franchthi (Argolide, Grèce). Les industries du mésolithique et du néolithique initial*. Ed. by C. Perlès. Vol. 2. Excavations at Franchthi Cave, Greece. Bloomington, Indiana (USA): Indiana University Press, pp. 257–270.

Ritchie, J. C. and Haynes, C. V. (1987). "Holocene vegetation zonation in the eastern Sahara". *Nature* **330**(6149), 645–647. DOI: 10.1038/330645a0.

Ryholt, K. (2005). "The Turin King-List". *Ägypten und Levante* **1**(14), 135–155. DOI: 10.1553/AEundL14s135.

Schäfer, H. (1902). *Ein Bruchstück altägyptische Annalen*. Philosophische und historische Abhandlungen. Berlin: Königlich Preussische Akademie der Wissenschaften.

Shaw, I., ed. (2000). *The Oxford history of ancient Egypt*. Oxford: Oxford University Press.

Siddall, M., Rohling, E. J., Almogi-Labin, A., Hemleben, C., Meischner, D., Schmelzer, I., and Smeed, D. A. (2003). "Sea-level fluctuations during the last glacial cycle". *Nature* **423**(6942), 853–858. DOI: 10.1038/nature01690.

Steffensen, J. P., Andersen, K. K., Bigler, M., Clausen, H. B., Dahl-Jensen, D., Fischer, H., Goto-Azuma, K., Hansson, M., Johnsen, S. J., Jouzel, J., Masson-Delmotte, V., Popp, T., Rasmussen, S. O., Röthlisberger, R., Ruth, U., Stauffer, B., Siggaard-Andersen, M.-L., Sveinbjörnsdóttir, Á. E., Svensson, A., and White, J. W. C. (2008). "High-resolution Greenland ice core data show abrupt climate change happens in few years". *Science* **321**(5889), 680–684. DOI: 10.1126/science.1157707.

Stringer, C. (2000). "Palaeoanthropology: Coasting out of Africa". *Nature* **405**(6782), 24–27. DOI: 10.1038/35011166.

Stringer, C. (2002). "Modern human origins: progress and prospects". *Philosophical Transactions of the Royal Society B: Biological Sciences* **357**(1420), 563–579. DOI: 10.1098/rstb.2001.1057.

Trump, D. H. and Cilia, D. (2002). *Malta Prehistory and Temples*. Malta: Midsea Books.

Tykot, R. H. (1996). "Obsidian procurement and distribution in the central and western Mediterranean". *Journal of Mediterranean Archaeology* **9**(1), 39–82. DOI: 10.1558/jmea.v9i1.39.

Tykot, R. H. (2002). "Geochemical analysis of obsidian and the reconstruction of trade mechanisms in the Early Neolithic of the western Mediterranean". In: *Archaeological Chemistry. Materials, Methods, and Meaning*. Ed. by K. A. Jakes. Vol. 831. Washington, DC: American Chemical Society. Chap. 11, pp. 169–184. DOI: 10.1021/bk-2002-0831.ch011.

Vaccarino, C. (2001). *Da Zeus ad Agamennone*. Palermo: Sellerio.

Vargo, B. A., Tykot, R. H., Bliss, J., Colella, V., Tosi, M., and Tusa, S. (2001). "The characterization of obsidian from Pantelleria (Italy): The archaeological significance of multiple island sources". In: 66th Annual Meeting of the Society for American Archaeology. (New Orleans, Louisiana, USA, Apr. 18–22, 2001).

Walter, R. C., Buffler, R. T., Bruggemann, J. H., Guillaume, M. M. M., Berhe, S. M., Negassi, B., Libsekal, Y., Cheng, H., Edwards, R. L., Cosel, R. von, Néraudeau, D., and Gagnon, M. (2000). "Early human occupation of the Red Sea coast of Eritrea during the last interglacial". *Nature* **405**(6782), 65–69. DOI: 10.1038/35011048.

Wang, Y.-J., Cheng, H., Edwards, R. L., An, Z. S., Wu, J., Shen, C.-C., and Dorale, J. A. (2001). "A high-resolution absolute-dated late Pleistocene monsoon record from Hulu Cave, China". *Science* **294**(5550), 2345–2348. DOI: 10.1126/science.1064618.

Wilkinson, T. A. H. (2000). *Royal annals of ancient Egypt. The Palermo Stone and its associated fragments*. Studies in Egyptology. London and New York: Kegan Paul International.

Williams, M., Dunkerley, D., De Decker, P., Kershaw, P., and Chappell, J. (1998). *Quaternary environments*. 2nd ed. London: Arnold.

Wilson, P. (2006). "Prehistoric settlement in the western Delta: a regional and local view from Saïs (Sa el-Hagar)". *The Journal of Egyptian Archaeology*, 75–126.

Zhao, Z. (1998). "The Middle Yangtze region in China is one place where rice was domesticated: phytolith evidence from the Diaotonghuan Cave, Northern Jiangxi". *Antiquity* **72**(278), 885–897. DOI: 10.1017/S0003598X00087524. URL: http://journals.cambridge.org/article_S0003598X00087524.
Zielinski, G. A., Mayewski, P. A., Meeker, L. D., Whitlow, S., and Twickler, M. S. (1996). "A 110,000-yr record of explosive volcanism from the GISP2 (Greenland) ice core". *Quaternary Research* **45**(2), 109–118. DOI: 10.1006/qres.1996.0013.

---

* ENEA
Centro Ricerche di Frascati, C.P. 65
00044 Frascati (Roma), Italy

email: massimo.rapisarda@enea.it

The present work was not written under an ENEA assignment.

Communicated 23 February 2007; manuscript received 27 July 2015; published online 30 September 2015;
minor typos amended 16 December 2015.