

Klontza-Jaklová, Věra

The individual disciplines

In: Klontza-Jaklová, Věra. *What's wrong? : hard science and humanities – tackling the question of the absolute chronology of the Santorini eruption*. First publishing Brno: Filozofická fakulta, Masarykova univerzita, 2016, pp. 28-63

ISBN 978-80-210-8472-8

Stable URL (handle): <https://hdl.handle.net/11222.digilib/136836>

Access Date: 02. 03. 2024

Version: 20220831

Terms of use: Digital Library of the Faculty of Arts, Masaryk University provides access to digitized documents strictly for personal use, unless otherwise specified.

2. THE INDIVIDUAL DISCIPLINES

2.1 'Hard' Science

"Nevertheless, the hard sciences and the social sciences are in closer contact than ever, though this relationship requires a lot of work if it is to continue to open doors between disparate disciplines." (Knappett 2011, 48)

2.1.1 Radiocarbon dating

Radiocarbon dating is, today, the most frequently employed method for determining absolute chronology during the East Mediterranean Bronze Age. However, some of the results appear diametrically opposed to those derived from archaeological and historical dating methods. Simply, the radiocarbon data from the Santorini volcanic destruction and from contemporary strata around the East Mediterranean seem to provide earlier dates than those expected from use of comparative historical and archaeological data. Archaeologists and historians have often argued that the radiocarbon method is not accurate enough, meaning that the chronological intervals provided by physical methods are effectively wider than those provided by historical dating. Furthermore there are too many extraneous factors affecting the results and the ^{14}C 'clock', although based on a well-established physical law (radiocarbon decay), is absolute only in laboratory circumstances and requires detailed knowledge of the ^{14}C content of the atmosphere before the clock of decay started running (i. e. Wiener 2009a, 199; 2009b; 2012; Kutschera 2012, 420).

The humanities and natural sciences approach the problem differently. The archaeologist starts with the event and looks for its date within a 'known' material cultural or historical sequence. Should the answer determined scientifically not be in agreement with such interpretations they tend to assume the method is faulty. Natural scientists usually provide the date and then test if it is unconditionally valid. They do not usually comment on the historical interpretation. However, radiocarbon dating is often the only and, generally,

the most accurate dating method available for most events during the Aegean Bronze Age.

The first efforts to use samples of organic material obtained from archaeological contexts were made in the 1950's. In 1958 it was A. G. Galanopoulos who was the first to use charred wood from the quarry south of Fira on Thera for this purpose. Organic material was collected and analyzed systematically from the earliest seasons of the Akrotiri excavation, which started in 1967. (Friedrich and Heinemeier 2009, 59).

In the 1970s' archaeologists generally expected that the radiocarbon dating method would only prove and confirm the chronological systems previously derived from and based on "stratigraphie comparée" but the radiocarbon dates were earlier than expected (Manning et al. 2006, 565–566). The chronology of Aegean prehistory was connected to the Egyptian historical chronology by cross-checking imports and exports in each region. This method is the basic chronological tool of prehistorians (MacGillivray 2009, 155) and relies on the assumption that single artifacts or groups of artifacts were in use and became part of the archaeological record at the same time in the regions of origin and deposition.

The first results related to the Santorini samples were published years after the samples were collected and it came as a shock when Pennsylvania University in 1977 presented a series of dates from the Aegean calibrating the value of 1500 bc to 1626 BC (Kuniholm 1990, 13; original publications: Michael 1976, 1978; Betancourt and Weinstein 1976; Fishman et al. 1977 ad.). The initial reaction of Aegean archaeologists was that the samples must be contaminated. These objections, however, did not stand scrutiny. P. Betancourt and H. N. Michael (1987) showed that there was a homogenous group of 15 samples, the dates of which had been accurately presented.

By then more laboratories had become interested in the topic and were producing dates: e. g. Simon Fraser University in Burnaby (Nelson et al. 1990) or Copenhagen laboratory, which presented dates in the range between 1690–1610 BC with 89% probability

and 1560–1530 BC with 11% probability. Data from the Oxford laboratory were similar: 1690–1600 BC, $P=71\%$, and 1560–1530 BC, $P=29\%$. (Manning 1999, 32–39). Among all the interested laboratories there was no difference; the results were absolutely consistent. Certainly, by the early 1990s, it had become clear that something more fundamental than a simple error or contamination was happening because not just one but all the laboratories were presenting dates derived from their different Aegean Late Bronze Age samples, which were, from an archaeological/historical viewpoint, ‘unexpected’.

When M. Bietak, at the end of the 20th century, established his first chronological project, there were already more than 30,000 samples, from across the whole Eastern Mediterranean, dated by many different laboratories (Kutschera and Stadler 2000, 70–71; Manning et al. 2006). By then the laboratories were already able to measure the amounts of isotopes in extremely small volumes (Bietak (ed.) 2000, 68–69). High-precision Accelerator Mass Spectroscopy (AMS) radiocarbon laboratories today can measure the radiocarbon content of a single sample to within a 60-year range BP, prior to calibration against a decadal measurement of a tree with rings of a known dendrochronological date. (Manning 2006–2007, 54–60; Wiener 2009b, 280).

Organic material from Cretan sites (Agia Triada, Myrtos Pyrgos and Chania), from Rhodes and from Akrotiri on Santorini, analyzed by the Oxford laboratory, were presented and summarized in Manning et al. 2002. The authors conclude that the period LM IA ends approximately between 1610–1590 BC and not by 1480 BC, as traditionally presented, and that the Santorini event itself dates to 1650–1620 BC. They exclude the period of 1520–1500 BC as a possibility. They date the end of the LM IB period to the late 16th C, 1522–1512 BC. (Manning et al. 2002, 733–744; 2009). S. Manning’s interpretations are criticized by M. Wiener (2009; b) who blames Manning’s team for choosing only those values which prove the high chronology and ignoring the peripheral ranges of the dating intervals.

In 2003 an olive branch, 1m long, was discovered, buried alive in the pumice of the eruption (Friedrich et al. 2006). The layer was a few meters thick, as much as 4–5m over the trees (Friedrich and Sigalas 2009, 97). The researchers describe this event as a “lucky incident” (Friedrich and Heinemeir 2009, 59) because it was the first time we had a “witness” of the event. Dates extracted from it fell in the span 1613 ± 13 BC after Friedrich et al. (2006). Another branch, 183 cm in length and 13–15 cm in diameter, was found by the same team in July 2007, about 9m from the first one. The main stem of the tree has disappeared into the caldera due to erosion of the caldera slope. Both branches were sealed in layers about 150m above contempora-

ry sea level. They were growing close to a man-made Bronze Age wall. A layer of buried leaves and roots was identified under the burnt trees, but it was impossible to sample this as it had been reduced to dust by a hot volcanic blast which hit the south-western part of the island ring in the initial phase of the eruption. As a result, the leaves of the trees instantly dried, fell and were embedded in the white pumice dust covering the surface. The researchers are convinced that the tree was alive at the moment of the eruption. The tree (or trees) had reached an age of at least 72 years before the event. (Friedrich and Heinemeir 2009, 59–61). The branch was therefore not only suitable for radiocarbon dating but also, with more than 70 rings, suitable for dendrochronology (more in chapter 2.1.2). Radiocarbon dating provided a date between 1627–1600 BC and this was supported by dendrochronology. (Friedrich et al. 2006, 509, 548) The findings from those branches provided the impetus to organize a conference in Copenhagen to discuss the absolute chronology of the Santorini eruption from different points of view (Warburton (ed.) 2009). Another conference was held in Halle in 2011 “1600–Cultural change in the shadow of the Thera-Eruption?” (Meller et al. (eds.) 2013). While the conference in Copenhagen gave weight to both opinions, the Halle conference participants tended to concentrate on radiocarbon dating.

In the last 25 years many other projects were established, many sites have been sampled and much data obtained. In general all the dates obtained from samples from Santorini and Crete lead to the conclusion that the Santorini eruption occurred in the last three decades of the 17th century BC. Similar results were provided by cross regional projects. E.g. samples from Jericho (Tell es-Sultan), extracted mainly from carbonated wood, were dated by the laboratory in Groeningen and were compared with samples from Egypt, Santorini and North-Eastern Sinai. Some of the samples could be tested by dendrochronologists at the same time (Bruins, van der Plicht 2003, 35–37).

Large amounts of data were obtained from Egyptian sites. It is presumed that the Santorini eruption left its finger print in Egypt in depositions of pumice, which were mainly in Tell el-Dab^a and connected with the Early Eighteenth Dynasty, up to the reign of Thutmose III. These strata (C/2) are dated by scarabs of Ahmose, Ahmose-Nofretari, Amenhotep I, Thutmose III and early Amenhotep II (Bietak et al. 2009). Even this *terminus ante quem* for the Santorini eruption shows 120 years offset between archaeological data and results of radiocarbon data (Kutschera et al. 2012; Höflmayer 2012; Bietak 2013a).

Today data are available not only from Santorini itself, particularly the short/lived samples from the volcanic destruction level (VDL), but from other regions (Crete, Greek mainland, Anatolia, Near East). This

2. The individual disciplines

dataset provides a consistent series of results, which show that a point in time shortly before the eruption was in the second half of the 17th century BC (e.g. Höflmayer 2012, 36). However, there are authors (e.g. Wiener 2009a; b) who argue that, although the probability of the Low chronology is small, it exists and cannot be excluded simply on the basis of an appeal to the statistics. Some argue that the data obtained from Tell el-Dab'a should be excluded because they disagree with reconstructed historical chronology (Kutcher et al. 2012; contradicted in Manning et al. 2016, 21-22)

Scholarship related to radiocarbon methods is now focused in two directions: examining the method and accuracy of calibrating radiocarbon dates and the problem of environmental factors influencing the ¹⁴C decay process (summary in Wiener 2009a; 2009b; 2012).

2.1.1.1 Calibration problems

The calibration curves currently in use are built up from the dendrochronological sequences which are supported by the series of tree ring of the American sequoias and long living oaks and pines from Ireland and Germany. It can obviously be argued that these regions are very far from the Aegean and that this could have an impact on the accuracy of calibration when applied to Mediterranean or Aegean samples.

A contemporary dendrochronological sequence derived from wood from the site of Porsuk in Anatolia (about 840 km North of Santorini), which seems to be more appropriate to the region [Bietak (ed.) 2000, 71], has lately been specified by use of dendrochronological/radiocarbon dates obtained from other Anatolian sites (Kültepe, Kakahöyük and Acemhöyük) (Manning et al. 2016). Even this is quite distant and the climate in Anatolia is very different from that in the Aegean. Moreover, this scale currently ends at 1573 BC and, therefore, it is impossible to use it for 17th century BC data (Wiener 2009b). Efforts continue to collect remains of wood in order to create local dendrochronological sequences but the deposition circumstances in the East Mediterranean and Aegean are not favourable for wood preservation.

The IntCal calibration model weights the probabilities exhibited around a particular interval. It favours the main trend evident and downplays any odd outlying minor values. (Manning et al. 2009b, 305).

The accuracy of radiocarbon dating is expressed in the shape of the calibration curve. The current internationally accepted radiocarbon calibration curve for the Holocene is IntCal04, built on the data set of dendrochronological dates from Germany and Ireland (Reimer et al. 2004). It uses a combination of old data and new data obtained by high-precision laboratories.

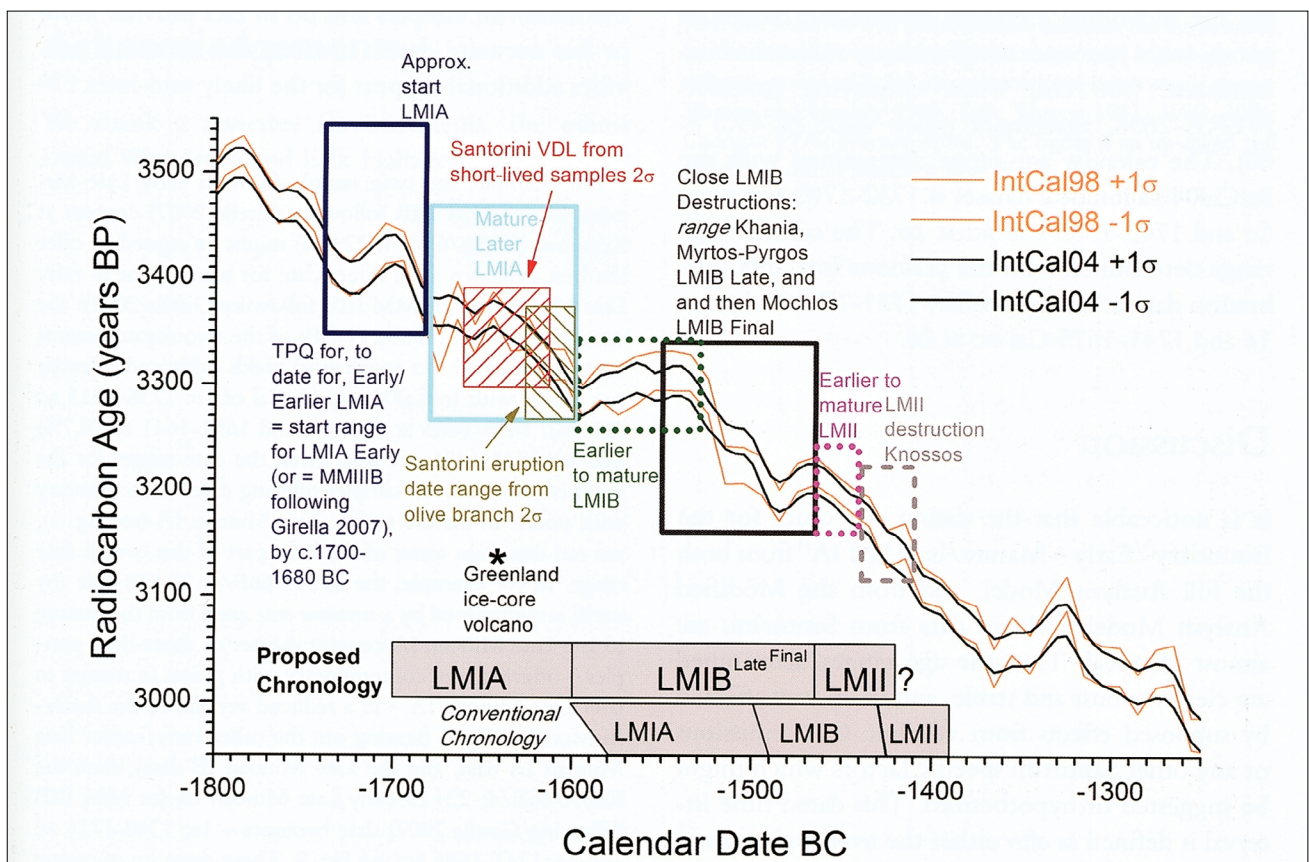


Fig. 22 / Calibration curves IntCal104 and IntCal98 with the major events mentioned in the book. (After Manning and Bronk Ramsey 2009a, Fig. 10)

The previous standard curve was IntCal98 (Stuiver et al. 1998), which was based largely on a similar database, but new data have since been added. The IntCal04 curve (Fig. 22) gives an estimated five-year resolution, employing a sophisticated random-walk model which smooths the inherent noise in the raw calibration datasets. The IntCal98 curve provides ten-year resolution and merely averaged the dates in that interval to achieve a data point for the calibration curve. Thus IntCal04 is a smoother curve (Manning 2006–2007, 54; Wiener 2009b, 283). However, IntCal98 may offer slightly better results in some conditions for some periods before AD 1510. IntCal04 better describes the 16th century BC raw data than IntCal98 but in the 17th century BC there is a question if a real and significant underlying variation in the period 1690–1640 BC exists which IntCal04 is perhaps overly smoothing away. If applied to data from Gordion juniper the curve exhibits some extra variations (Manning et al. 2009b, 305, Figure 5).

There is not a unique agreed calibration curve. The curve most often used was that of Stuiver and Becker (1986). B. Weniger (1990) used his own curve and points out that there are significant differences between single calibration systems. Betancourt and Michael (1987) calibrated their data around 1500bc to 1619 ± 20 BC according to the „bidecade curve“ of Pearson and Stuiver. Then M. Stuiver and B. Becker used the decade curve and got almost the same dating, 1680–1600 BC, as the so called „2σ range“ method, which gave 1687–1575 BC. (Weniger 1990, 219–223)

A calibration curve is sometimes viewed as an a priori perfect fixed and immutable tool but in fact it is a construct permanently “under construction”. S. Manning (1995, 128) points out that it is not really a curve but a probability band.

I would add here some personal doubts about the general accuracy of the calibration curves. I am convinced that global climate fluctuations can be stamped into the annual growth rings of long lived trees and that such anomalies can fix some chronological points to the calibration curve but we cannot exclude the possibility that microclimatic factors cause anomalies in tree rings laid down in a particular affected region (to microclimatic shocks in Mediterranean: Grove and Rackham 2003, 27–29).

2.1.1.2 Contamination by ¹⁴C-deficient carbon

Another question is the purity and rate of possible contamination of tested samples, both past and present. Nowadays efforts are made to test short lived organisms (vegetation or animal bones) in order to estimate in a particular very short interval. However, there can still be anomalies, e.g. wood from a thirty year old oak gave a dating range 1757–1685 BC (Man-

ning and Bronk Ramsey 2003, 112–114), or the plants can be affected by other factors, such as contamination by volcanic CO₂.

One often cited proposition is the possibility of contamination of Santorini vegetation by volcanic CO₂ emissions. It has been experimentally proved that the vegetation growing close to a source of CO₂ can provide very low dates due to the larger than natural amount of so called “old” CO₂. E.g. the data from contemporary vegetation growing directly by a CO₂ source in the Eifel region of Germany showed the same ratio of carbon isotopes as samples dated to 1500 bc but about 100m farther away, where the concentration of CO₂ in the air was normal again, the samples behaved normally. (Hubberten et al. 1990, 180–186; Weninger 1990, 218; 2012, 424).

M. Wiener (2009a; b; 2012) is convinced that so called “old” CO₂ could affect the samples on Santorini although it has been proved that even the plants growing very close to the volcano do not contain any old CO₂ and only those plants growing in the volcano itself have produced higher concentrations of it. (Fernandez et al., *in print*). He says – and we should bear it in mind – that, although the concentrations are now normal, just before the eruption there could have been many more sources of ¹⁴C-deficient carbon open, which could have affected the plants growing then. S. Manning (2012; Manning et al. 2014, 1170) and Kutschera et al. (2012, 419) argue that, if the old CO₂ concentration had been higher in the period of eruption, it would have affected the samples of the plants which died during the eruption and not the plants from the earlier layers or the plants from other regions where such sources are unlikely to have existed, as proved by the experiments of R. Fernandez and his team who have sampled and analyzed annual plants collected across the islands of Santorini and Crete (Fernandez et al., *in print*).

We should also take into account the so called ‘upwelling effect’ of ocean water (Fig. 23) which, at substantial depths, can store CO₂ containing higher concentrations of ¹⁴C-deficient carbon. It is probably one of the reasons why the radiocarbon dates of the southern hemisphere are higher than the dates from the northern. The Mediterranean is virtually a closed basin where the water exchange is very slow and the factor of sea upwelling can play its role (Keenan 2002). As mentioned above it seems that, at least today, it is having little measurable effect (Fernandez et al., *in print*).

Today, there are other smaller projects in progress; e.g. in a project examining the problems of so called old CO₂, dry plants collected in Egypt and stored in herbals of the 19th century were tested for possible old CO₂ contamination. The resulting dates were 19±5 years earlier than the recorded dates. (Dee 2013a)

2. The individual disciplines

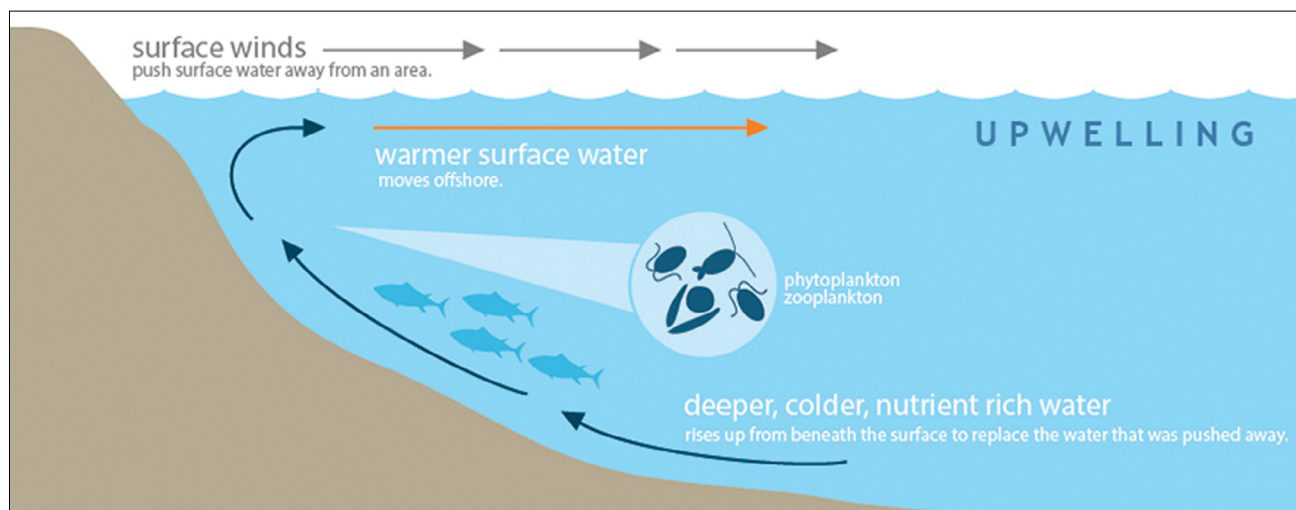


Fig. 23

Upwelling effect. (After National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, <http://oceanservice.noaa.gov/facts/upwelling.html>)

2.1.1.3 Other possible reasons for inaccuracy

Given the large numbers of samples tested it is hardly surprising that there are some anomalies which are difficult to explain; how, for instance, does a sample extracted from one context (such as a sealed vessel containing carbonated figs) provide dates with a range of 200 years (Friedrich et al. 1990, 193–195) and why are the range and standard deviation, which this method provides so large (Nelson et al. 1990, 198–206, Housley et al. 1990, 213–214). The blame, in these cases, is generally attributed to laboratory error.

The accuracy of an individual determination from a single laboratory has, indeed, been blamed quite often (examples in Wiener 2009b, 280–281). It is now common practice that one example is tested in several high-precision laboratories and it is believed that repeated analyses can exclude or, at least, reduce the probability of mistakes and inaccuracies. Short-lived samples, which came directly from the volcanic destruction layer (VDL) of Akrotiri, were tested in different laboratories and provided consistent results for a point of time shortly before the Minoan eruption in the second half of the 17th century (Höflmayer 2012, 436).

Inter-annual variance is another variable sometimes identified as a possible problem. Annual data do scatter around the longer term average trend reflected by the curves and it is fair to suggest this issue could create a little noise. An increase of the sample standard deviation was calculated as 0.1% or 8 ¹⁴C years for single-year samples, before calibration. (Stuiver and Braziunas 1998). In practice, this has no substantive effect since it typically means 0,5 to 1,5 ¹⁴C years' increase in the standard deviation for the relevant samples and has almost no observable impact on the

analyses and outcomes reported. (Manning et al. 2006, 2009). Clearly, the changes are very small and insignificant and merely slightly enlarge the date ranges we reported before.

D. J. Keenan (2002) alleged that Mediterranean ¹⁴C dates in the Bronze Age are some 100–130 years older due to upwelling. Manning believes that this assertion is not supported by any positive evidence (Manning et al. 2009b, 305–306). D. J. Keenan suggested that the Mediterranean Sea, because of its particular mode of formation and development, is very rich in “old” air and water and this probably affects local radiocarbon dating. It is questionable that this could give rise to sufficiently high concentrations of old ¹⁴C in the atmosphere, where plants obtain the majority of their carbon, or, indeed, in the bedrock and water sources.

However, there are differences between calibration curves from the north and south hemispheres and the greater volume of water, and the more intensive upwelling effect in the south, is likely to play a role in this (Manning et al. 2009, 305–306).

2.1.1.4 Radiocarbon data from other regions

The date of the Santorini eruption is not determined solely from samples obtained from the relevant layers in Santorini. Contemporary samples from other regions and from periods which stratigraphically precede and post-date the eruption must also be tested. Layers of volcanic ash and tsunami debris are very good indicators of accurate relative chronology.

Destruction debris of the LM IB period from Chania and Myrtos-Pyrgos in Crete has been tested. The data from Myrtos-Pyrgos gives a 1 σ calibrated age range of 1514–1492 BC (42.5% probability) and 1476–1460 (25.7% probability) and a 2 σ range of 1522–1451

BC. The Chania samples (8 dates from 4 samples) give a more open spread. One of the values is an outlier but the remaining 7 provide an average 1σ calibrated range of 1607–1570 BC (41.5%), or 1560–1546 BC (14.9%), and a 2σ range of 1615–1520 BC. This data set is, however, older than the Myrtos-Pyrgos data. (Manning et al. 2006, Manning et al. 2009b, 308). Jeffrey Soles (1999) expressed an idea, supported by radiocarbon dating, stratigraphical, typological and theoretical studies, that the LM IB destructions proceeded from west to east. These destruction dates cover almost all the 16th century. They clearly represent the *terminus ante quem* for the eruption but some scholars don't accept them as evidence because, if the destructions occurred in the second half of 16th century, there remains time for the eruption to have happened during the 16th century, even in its second half (Wiener 2009a, 203–205; 2009b, 286–288).

However, tsunami debris in Palaikastro gave dates overlapping with the high chronology, which, even though some organic material from tsunami debris could have been old when it became part of the context (Bruins et al. 2008, 207, Table 4; Höflmayer 2012, 437), can be seen as supporting an earlier date for the eruption.

A few samples of charcoal found in Trianda on Rhodes were dated using both radiocarbon and dendrochronology. Their contexts were archaeologically dated to the LM IA period but some argue that they are somewhat earlier and represent the final phase of the Middle Bronze Age. However, the dates obtained from these samples suggest the period shortly after 1736 BC (Manning et al. 2006, Manning et al. 2009b, 307). M. Wiener suggests that it is impossible to pull these samples into the debate because the context is unsecure (Wiener 2009a, 204).

There is also a significant set of radiocarbon data from Egypt. Some 47 seed samples from Tell el-Dab'a, from the strata supposedly contemporary with the Santorini eruption and historically interpreted as from the early period of the reign of Ahmose, have been dated. The dates obtained by radiocarbon methods are about 100 years earlier than Egyptologists expected. (Kutschera et al. 2012, 411–414; Bietak 2013a).

In Central Europe, as mentioned below, authors proposed that the radiocarbon dates obtained from their Early Bronze Age contexts seemed to be too early in comparison with the Aegean conventional chronology and were inclined to conclude that, for some unknown reason, the method was producing errors. However, contemporary radiocarbon dates are not doubted by European prehistorians and many of the data sets are supported by dendrochronological dates, which place a large part of the Central European Early Bronze Age before 2300 BC and shift the beginning of the Middle Bronze Age back to the mid 18th century (Jiráň 2008, 28–29 with other related bibliography; Furmánek et

al. 2015, 15–16). This horizon should be contemporary with the advanced LH I (Klontza-Jaklová and Toth, *in preparation*)

The radiocarbon dates obtained by the numerous laboratories provide a very consistent chronological picture of the dates supposedly contemporary with the Santorini volcanic event. (Höflmayer 2012, 436)

2.1.1.5 Discussion of radiocarbon dating

Up to this day, it seems (I am currently tending towards saying it seemed), the problem with radiocarbon dates lies between 1700 and 1500 BC and that the issue must be more general because it is not only in Santorini and its immediate surroundings that the expected radiocarbon dates and historical archaeological dates fail to match (Manning et al. 2009, 183). Radiocarbon dates for the Middle Helladic period produce a tight and coherent sequence with a good correspondence between absolute and relative dates (Voutsaki et al. 2009, 159). Furthermore, absolute and relative chronology of LH III, the Amarna period, are again in absolute agreement with historical expectations. The Amarna period is the best cross-dated horizon of the Near East and the East Mediterranean Late Bronze Age. Due to the numerous written documents from Amarna and from other Near Eastern archives, a dense network of historical connections has been created and the archaeological stratigraphies, the imported goods, the radiocarbon and dendrochronological dates fit within it almost perfectly (Manning et al. 2009, 181).

Today, we know that the radiocarbon dating method has its limits which are very difficult to define at some points. The method, by its very nature, cannot provide us with a linear function where there is a one to one correspondence between actual and radiocarbon dates. There are also problems with the accuracy of the calibration curve. Its flattening in the interval between (approximately) 1600 and 1500 BC (Fig.23), presumably means something. (But then one wonders why we, the archaeologists, usually approach typology as though it were purely a linear process.) Here, I would like to note, but would ask the reader to bear in mind that what they will read is a just first idea and has not been tested, that the radiocarbon curve seems to flatten, more or less always, before the climate changes to warm. Another clear example can be observed in the period following the Fall of Rome.

We still don't fully understand the process of the break-up of cosmogenic isotopes, or the fluctuation of cosmic rays, but the dating method has been studied and refined intensively for decades. Thus far radiocarbon methods have been subjected to much more intensive criticism than archaeological typology and historical chronological scales.

2. The individual disciplines

If there were a problem in the method itself, it would produce errors in other periods as well. However, radiocarbon outcomes are robust, sample treatment is standardized and contamination of the samples can be almost excluded and laboratories are able to measure very tiny amounts of carbon isotopes with significant accuracy.

It is also clear that the results of both methods contradict each other in the case of 18th – 15th centuries BC.

Although the data obtained by the radiocarbon method are consistent (Höflmayer 2012, 436) they are not universally accepted, especially by Egyptologists (Manning et al. 2016, 21). The problem of the divergence between Egyptian chronology and radiocarbon dates during this period remains largely unsolved.

2.1.2 Dendrochronology

Dendrochronology is able to provide perfectly accurate absolute dating but only if the circumstances are optimal. One obvious difficulty is the geographical limitation of the method but it should be possible to trace some radical global changes across regional systems (LaMarche and Hierschboeck 1984)¹⁸. The crucial assumption is that abnormal volcanic activity, which influences climate over a large region or even globally, must also induce global change in tree growth. The climate after each intensive volcanic event becomes colder during the next few years. This causes growth stresses which can be seen in the tree ring patterns of long lived species. Studies of 4000 year old sequoias¹⁹ looked for growth anomalies around 1500 BC, on the assumption that this was probably very close to the correct date for the Santorini eruption, but no growth stress was found. The first anomalies were found much deeper, at around 1627 BC. (Kuniholm 1990, 7).

A similar acid anomaly, in the interval of 1644 ± 20 BC, was documented by Baillie (1990, 160–166, Baillie, Munro 1988, 344–346) when studying the Irish oaks. Baillie expressed the view that this was the result of a very strong volcanic event.²⁰ Similar data were provided by pines from the White Mountains in California. Indeed, it can be said that all dendrochronological tests of long lived woods provide evidence of growth anomalies between 1626 and 1628 BC. Baillie notes that not all trees react the same way or with the same intensity. Some species are less sensitive or, and this is a key factor, cold weather can be balanced by the richness of the soils where the trees are growing. Trees in regions with very poor soils have stronger, more sensitive reactions to each temperature change or blip.

A European dendrochronological scale has been built on comparison of the scales derived from long lived trees from Ireland, England and Germany. This produces a few gaps between 3196–1682 and 1584–970 BC. J. Hillam has discovered a group of oaks in En-

gland which cover the period between 1687–1362 and there are again acid anomalies around 1620 BC.

In Germany the longest lived tree species grow mainly in regions with very rich soils and the anomalies are less distinctive but, even so, there are anomalies around 1628–1620 BC which suggest a series of cold summers.

Comparisons of the Californian, Anatolian and Fennoscandian tree-rings suggest that the rising temperatures and the increased rainfalls in the late 17th and 16th centuries and the downturn in the 13th and 12th centuries BC were probably global phenomena (Baillie 1998).

It can be accepted as a fact that for some months after the Santorini volcanic eruption global temperatures were lower (Sears et al. 1987). It should also be kept in mind that microclimatic circumstances, fertility of the soil and other factors could have sustained normal tree growth in the short term and the drop in temperature only provoked growth stresses some seasons later. Dendrochronologists, working on a global scale, document that between 1630–1627 BC something short-term and intense happened to the worldwide climate. They have combined their data with glaciological results and blamed the Santorini volcano. (Baillie 1990, 165). *Tilia* had been absent from the Cretan pollen record for 3000 years (Moody 2005, 460–463; MacGillivray 2009, 159) and grows only in temperate zones but its pollen appears within the post-eruption strata in Crete, testifying to a fall in temperature and increase in humidity. Similar results were obtained from Turkey.

M. Wiener (2009b, 280) and J.S. MacGillivray (2009, 159) note that there are also very narrow tree rings on bristlecone pine samples in California and Nevada between the years 1524–1486. As is evident from Irish trees²¹ an event which affected climate occurred between 1530 and 1500 BC.

There are also local dendrochronological scales made for the Eastern Mediterranean. The majority of them are based on Lebanese cedar found in Egypt. The scale is then compared with American sequoias but there is still not continuity from today to the Bronze Age; there are only some sections “floating” in time. We have about 1503 years for the Bronze Age, following on from 570 years for the Neolithic, and the scale is almost continuous from 362 AD to the present (Bietak (ed.) 2000, 12). The development of this scale continues but samples from the 2nd millennium BC are very limited (Cichocki 2003, 43–46).

The most important discoveries for Santorini were made in 2003 and 2007, when the olive branches, mentioned above, were found in the volcanic deposit in the Thera quarry. Friedrich and his team have presented the radiocarbon data and dendrochronological data as being in agreement and dating the event within the interval 1613 ± 13 BC and argue that the

branches were alive at the moment of eruption. (Heinemeyer et al. 2009, 285). These data are subject to doubt, not because of the method but because of the species. Olive trees are not ideal for dendrochronological dating because they don't always grow from one central stem, they tend to rot from the centre and even live trees can keep dead branches for a long time²². (Wiener 2009a, 204–205, 2009b, 280; Cherubini et al. 2014; Cherubini and Lev-Yadun 2014; Kuniholm 2014). Friedrich avoids this problem by using X-ray tomography which allows him to recognize as many tree rings as possible (Friedrich et al. 2006) and H. J. Bruins and J. Van der Plicht suggest that the dendrochronological records of olive wood need not always be viewed so pessimistically (2013).

Recently concluded research, focused on dendrochronological and radiocarbon dating of a bulk series of wood (mainly juniper) samples from Anatolian sites (Kültepe, Karahöyük and Acemhöyük) has provided a very accurate local calibration curve between approx. 2100–1200, and 600 BC. Although the project was not aimed at the “Santorini problem”, it is strongly related. One of the most important results, along with the absolute chronology and the synchronism of Mesopotamian and Anatolian chronologies in the first half of 2nd millennium BC, is an ascertainment that the tree rings anomalies of the Porsuk dendrochronological scale, which were related with Santorini event, are now dated to 1681–1673 BC, with 68.2% probability, which makes them some 20 years earlier than previous assessments. (Manning et al. 2016). This means that the massive Minoan eruption didn't affect the growth rhythm of the Porsuk trees and that this dendrochronological scale is no longer floating in relative time. It also underlines the need to approach dendrochronological scales on a local basis in the first place and to examine all the data we already have through such a prism.

2.1.3 Glaciology (“ice-core” dating)

The principle of this method is based on the way polar glaciers are created. Snow falling onto glaciers doesn't melt and keeps its own particular chemical characteristics, which vary year by year according to climatological and other factors. These seasonal layers can be recognized and their chemical trace measured. The ice blocks are drilled up to 3000m deep, which corresponds approximately to 200.000 years. Drilled-out “carrots” are tested with electrodes to measure changes in resistance and any anomalies are also tested chemically. Higher concentrations of H₂SO₄, SO₂ or SO₃ have an impact on conductivity and reduce resistance. Their presence mirrors their higher concentrations in the atmosphere where they can appear as a consequence of intense volcanic activity. (Friedrich 2000, 91). The Bronze Age Santorini eruption shot

volcanic material rich in sulphur compounds up into the stratosphere and thus enriched stratospheric aerosols in acid elements (Pyle 1990, 68) which fell with the rain or snow to the Earth's surface. These layers, rich in sulphur compounds, were documented in the Greenland glacier and connected to the period following the eruption of the Santorini volcano.

As mentioned above, the glaciologists had already entered into the discussion about the absolute dating of the Santorini eruption in the 1970s' (see also chapter 1) but their first results were later revised and the samples were re-dated, with the acid layers being placed within the interval of 1645 ± 20 BC (Kuniholm 1990, 8).

There are nowadays three glaciological bases in Greenland (GIPS2, GRIP and NORTH GRIP) which have shown the existence of acid horizons and they are in agreement about its absolute dating within the interval of 1623 ± 36 BC. More detailed measurements document two different but chronologically close anomalies (Bietak (ed.) 2000, 30), which complicates their identification with the Santorini event.

The main, or it can be even said the only, source of atmospheric sulphur compounds during the pre-industrial era was volcanic activities, which supply the atmosphere with more than 60% of those compounds.²³ Magma is naturally acidic and can contain 4–7% of sulphuric acid. However, some doubts have been expressed about any simple or automatic connection between the measured anomalies and the Santorini eruption. (Pyle 1990, 167–172)

Not every volcanic eruption has sufficient power to impact the stratosphere, or even the upper atmosphere, and consequently to leave traces within the ice in Greenland. If the volcanic explosivity index (VEI) is higher than 4, an eruption can impact the stratosphere.²⁴ Statistically speaking it would be expected that only one eruption of the 20–30 each century would have a VEI greater than 4 and only one in three of these would have a VEI of 5. (Friedrich 2000, 70).

Using modern parallels, the Santorini eruption's VEI was reconstructed as 6.9, representing a truly exceptional event. (Hammer, Clausen 1990, 175).

Glaciologists C. U. Hammer and H. B. Clausen (1990, 174–179) are convinced that the absolute dating reconstructed by the Danish glaciological base on Greenland (DYE 3) can date particular levels within an accuracy of 10 years. This base doesn't just measure sulphur compounds but also other compounds produced by volcanic activity (e.g. HCl, HF etc.). The Dye3 base was looking for anomalies which could be connected with volcanic activity between the years 1900–1300 BC and has discovered only one sulphur compound record which could be equated with a VEI greater than 6. It was within levels dated to 1645 ± 7 BC and both C. U. Hammer and H. H. Clausen assert that it could result from the Santorini eruption.

2. The individual disciplines

Petrographic analysis indicates that the Santorini volcano was very rich in sulphur.

The approximate difference of 20 years between the samples from the GRIP and Dye3 expeditions are explained by the geologists as either due to a belated reaction of long lived trees to the climatic stress or incorrect measurement by one of those expeditions, though the distance between the volcano and Greenland may also have played a part. The sulphur compounds could have spread in the stratosphere for some time before being deposited as rain/snow. (Manning et al. 2001, 2532–2534; Hammer et al. 2003, 87–92; Muscheler 2009, 276–279).

The initial claim of a rare-earth element, Europium, anomaly in both the Greenland ice around 1645 BC and Thera tephra (Hammer et al. 1987, Hammer et al. 2001) was withdrawn by the investigators (Hammer et al. 2003, 93). Subsequently it became clear that major differences in the bulk components of the Greenland ice and Thera tephra made a common source practically impossible (Keenan 2003) and that the trace elements were not closely comparable (Keenan 2003; Pearce et al. 2004; Wiener 2007)

There is no reason why every Northern hemisphere eruption should leave an acid signal in every square meter of the Greenland ice (Wiener 2003; 2009b, 280) and some glaciologists assumed that the ice-core anomaly was due to another eruption elsewhere, for which evidence had not yet been found or which had left no archaeological or historical trace. This assumption now seems plausible, given the discovery of a contemporary eruption of an Alaskan volcano, Aniakchak, in the Aleutian Chain (Pearce et al. 2004; Denton and Pearce 2008), whose chemical signature is akin to that found in the Greenland ice-core and whose ejecta would have been far more likely to reach Greenland than those from Thera, given the prevailing wind patterns. However, others argue that both anomalies are related to one eruption because the tephra trapped in the ice layers was not only rich in sulphuric acid but also in calcium, which would be expected from a Santorini origin (Vinther et al. 2008).

The case of the Minoan Santorini eruption has also been investigated by calibrating dendrochronological dates, radiocarbon dates and ice-core dating. This method can also be used to cross-check different independent chronologies. The comparison can be done via cosmogenic radionuclides in tree rings and ice cores. Cosmogenic radionuclides are particles produced in the Earth's atmosphere by the interaction of galactic cosmic rays with atoms of the atmosphere. Variations in the galactic cosmic ray flux produce a global signal in cosmogenic radionuclide records that can be used to compare different time scales because contemporary samples must contain the same record of those cosmogenic radionuclides. Isotopes of ^{10}Be and ^{14}C

contained in the branch of olive tree burnt during the Santorini eruption were compared with ice-core samples from Greenland. Due to the influence of climate change on both isotopes a perfect match cannot be expected. However, the method can establish the probable maximum error for each method – radiocarbon and ice-core dating. It seems that each method could have an error no greater than 20 years. After taking into account all the possible error margins and variables, the suggested date for the Santorini BA eruption is 1620 BC. (Muscheler 2009, 275–284).

2.1.4 Other scientific dating methods used in the case of the Santorini eruption

As briefly mentioned in the first chapter, the thermoluminescence dating technique was previously also applied to evidence from Santorini but with not very accurate results. The method's error (of 5–15%) represents a potentially quite large distortion for the Bronze Age. (Schoch 1995; Liritzis et al. 1996).

Palaeomagnetology, which works on the principle that the orientation of the earth's magnetic field is conserved if the medium was heated above 500°C, has also been used but this method cannot provide values which are any more accurate and thus does not help elucidate the problem of the absolute dating of the Santorini Bronze Age eruption. (Taling and Downey 1990, 146–159).

Other methods, such as the decay of cosmogenic isotopes such as Si-32, Cl-36, Ar-39, Ionium-Protactinium, electro-resonance, or measurement of exoelectrical emissions, are also still not sufficiently accurate to contribute to the solution of this particular dating problem.

2.2 Archaeological and historical dating

The pioneers of East Mediterranean prehistory (e.g. Evans, Pendlebury, Marinatos etc.) had, from the outset, correctly identified imports from Egypt present in Cretan palatial contexts as well as material of Cretan provenance found in other regions around the Aegean and Eastern Mediterranean basin. Interpretations of the frequency of such links tend to have been somewhat subjective. Some have asserted that it is sufficient to imply that contacts were systematic and commonplace. (Warren 1995, 1). Others suggested that the chronologically useful Egyptian items in Crete, and any Aegean items in Egypt, are rare (Manning et al. 2014). I would prefer, before drawing inferences from the relative frequencies of such cross cultural finds, to assess the material itself and to consider what its presence actually means. The first, indeed the main, question is, if the method is correct, what the imports say chronologically and how to deal with the disparity

between the moment of production of the particular item, its export/import and finally its deposition.

However, the traditional methods depended on relatively simple assumptions concerning the transfer of objects and stylistic characteristics between regions and these are still quite commonly used. E. g. European pre-historians use dated parallels with the Aegean to date their contexts and, in the same way, Aegean prehistory uses the evidence of exchanges to connect its chronology directly with the chronological systems of regions which have entered the phase of literary history. The procedure does look overly simplistic, particularly in the case of the Eastern Mediterranean, where the archaeological artefacts document a wide contact network between various regions in various combinations. (i. e. Dickinson 1994, 16–17; Cline 2014, 22, 24, 60). These contacts can be traced during the entire Middle Minoan period (e.g. imports of fine polychrome pottery – ‘Kamarese’ wares – in Egypt) but, although there was a later period of intense contact between Crete and Egypt during the Amarna horizon (LM III A – B in Crete) (McGovern 2000, 79; Karetsov and Andreadaki-Vlaziaki 2001), Minoan influence reached its apogee in LM IA. This period was even termed the ‘Minoan Thalassocracy’ (for a comprehensive view to Minoan Thalassocracy see Hägg and Marinatos (eds.) 1983).

This term does not, of course, mirror the real situation at that time but reflects rather the fact that the first excavators in the Aegean tended to interpret history from a viewpoint based in heroic myth. The term was still in use until a few decades ago and the need to re-evaluate it provoked a conference confined to the discussion of this term and its historical conditionality. (Driessen et al. 2002). However, what is clear is that, at least during LM IA, the early Minoan ‘state’ was actively broadening its sphere of interaction and trading. (Klontza-Jaklová and Klontzas, *in print*)

Although efforts to use comparative typology to synchronize, at least in relative terms, the strata from individual regions in the East Mediterranean are very intensive, the issues involved are far from simple. Material was often in use for a long time and it is very difficult to say how long that time was, either for a group of similar or related artefacts or for an individual item. We must also deal with cases which may involve heirlooms, re-creations of elite material culture, past or present, and even ancient forgeries.

The topic of contacts, both physical and conceptual, is often discussed in contemporary archaeology and approaches tend to oscillate between the concept of a network of intensive contacts encompassing a very wide area and an understanding of prehistoric societies as considerably more introverted (for the Aegean compare Bouzek 1985; Kristiansen and Larsson 2005; Dickinson 2006).

2.2.1 Problem of distance in the Bronze Age

The questions most frequently put concern attitudes towards physical distances. The main doubts expressed concern the long distances involved and the slowness of the means of transport (Knapp 1998). It should be recognized that such concerns, rooted in modern attitudes, may not be wholly relevant. It is entirely possible, indeed likely, that people in the past understood distance, space and time rather differently (Klontza-Jaklova 2011). We often say that distances in the Mediterranean or Europe in general, are too great, forgetting that people, without the benefit of modern technology, successfully travelled across the Pacific (Diamond 2005, 120–135). Therefore I think it may prove both meaningful and helpful to attempt to discuss distances in the eastern Mediterranean as a man of the past may have understood them.

Evaluation of the intensity of ‘international’ Bronze Age contacts requires consideration of the ease and speed of the required journeys. A simple and rapid route between two regions greatly increases the potential for intensive connections, influences, contacts and, for archaeological purposes, synchronization of the regions concerned. The main areas we need to consider here are Egypt, Crete and their contacts. Crete is an island and therefore it is crucial to understand how the Cretans could connect to an East Mediterranean network.

Distance is subjective; what may appear far away to some individuals may seem quite close to others. Add to this the fact that attitudes to the sea, in my experience, differ markedly between islanders and mainlanders. For the latter the sea often seems a problem, a boundary or a barrier while to islanders it tends to represent a ‘bridge’ to the wider world.

This duality finds a reflection in the attitudes of Bronze Age archaeologists towards contacts, connections and relations between different regions. One group tends to dismiss the concept of intensive contact because the distances were large, technology poor and journeys risky. The other group takes the view that the peoples of the old world were connected from the Near East and Egypt, or at least from the Aegean, as far as Scandinavia. There is, for example, Baltic amber in Mycenae and Cretan pottery in Egyptian Thebes. It must therefore be possible that people could and did negotiate such distances.

This opens up further questions: Over what distances were the artefacts moved, and in how many stages? How frequent were the contacts? Why were these particular materials traded? To avoid lengthy discussion of topics not directly relevant to the current purpose I propose to accept, for the present, the explanation that the Bronze Age was a period when populations across a wide area were connected by their interest in a few strategic raw materials (mainly copper, tin and

2. The individual disciplines

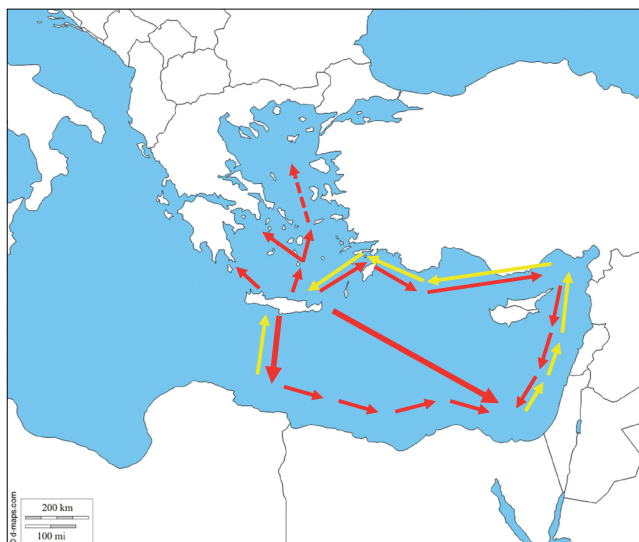


Fig. 24

Map of reconstructed-sea routes of the Bronze Age Eastern Mediterranean. (Illustration by author)

gold). (Kristiansen and Larsson 2005; Kostrhun et al. 2014) In this part of the book we will try to reconstruct how quickly and how far the people of the Bronze Age Mediterranean could travel. This will help to evaluate the information provided by the imported/exported or exchanged items, goods or ideas.

Minoan culture had a tendency to penetrate other regions. There were major centres of civilization surrounding Crete: Egypt, Babylon, the Hittites and the new and growing power of the Mycenaean polities. At the same time there was also a lot of space around the Minoans. Minoans must travel... and they did.

It will not surprise anybody that the Minoans had intensive contacts with other Aegean islands or the mainland. Such traditions must have been present since the Palaeolithic and, even by the early Bronze Age, evidence for these contacts is very clear. It was not difficult to move from island to island in the Aegean.

Evidence for contacts with Egypt and Palestine also exist. We will try to reconstruct the particular routes. (Fig. 24) The shortest way from Crete to the Nile Delta goes from Southeastern Crete directly to the Eastern Delta or South Palestine. There are 560 km of the open sea without island or visible mainland on the horizon. In classical antiquity such distances were dangerous and risky due to difficulties of navigation, orientation and also lack of possible help in case of an accident.

Another option is the route from South Crete to Cyrene. This has less than 300 km of open sea and then a further 500 km eastward along the North African coast to the Delta, making a total journey of some 800 km. Some scholars have inferred use of this route due to the pictures of Libyan fauna in Akrotiri, where, on the south wall of the West House, there was a fresco which

depicted an African landscape and animals which live only in Libya (*antilopa oryx beissa*) (Fig. 24).

It is known that this route was in regular use in Roman times. The Roman consul governed the province of Crete and Cyrene from the south coast of Crete, meaning that practical contact was not only possible, it was a fact. Indeed, in summer the prevailing winds in South Crete are very favourable for such a journey. (Kemp and Merrillees 1980, 268–269). However, we should keep in mind that the marine technology of the Roman period was different and that LBA boats were not able to sail against the wind. (Wachsmann 1998, 253–254), meaning that this route could not then be in year round regular use.

Early writings, mainly using information from classical antiquity, when coastal navigation was preferred, state that the Minoans were not able to cross the open sea between Crete and Palestine or the Delta. What might happen, what troubles might be encountered by anyone who lost his bearings is clearly depicted in Homer's *Odyssey*. On the other hand Cretan fishermen and sailors state that the route to Palestine is the most natural way and the winds and currents direct boats right there. It is possible to sail there in one week or even less. The journey back is difficult because the boat must then go against the wind and currents. It is possible to wait for favourable conditions to go to Libya (Cyrene) and travel northwards from there to the southern coast of Crete. The other options were the journey along the Levant coast to Cyprus, or along Anatolian coasts to the west and then from island to island to Crete or the Greek mainland. Although there is a complete lack of primary evidence, the arts of navigation, meteorological observation and geography must have been well developed. Contacts were probably quite frequent and widespread, as demonstrated by the cargo of the Uluburun shipwreck, the origins of which encompassed almost all regions of the Old World (Manning et al. 2009, 163–164). Secondary sources indicate that knowledge then of how the world looks were quite accurate. The best example of this is probably the so-called 'Navy' fresco from the West House in Akrotiri. The fresco probably depicts Santorini itself (McCoy 2017, Fig. 6). There are plenty of boats depicted and it seems that movement across the sea was an everyday issue. There are also many wrecks known, demonstrating that the technology of boat construction, navigation, meteorology and cargo placement were not always predictable and to travel by sea was still risky.

There is another argument, touched on above, which must be evaluated and that is the security of traveling. The aim was not only to get somewhere but to get there safely and to return. Merchants needed to strike a balance between efficiency (how much cargo, how fast) and security. From this point of view the journey from Crete (ergo the Aegean) to Cyprus, passing the islands of Kassos, Karpathos, Rhodes and

Kastelorizo, to Cape Gelidonia, then along the South Anatolian coast to Cyprus and onward to Syria (Ur) and, finally following the Levantine coast to Palestine and the Delta was the most secure, although long and expensive. This journey was really very long, 1440–1800km, but it would have been possible to engage in other transactions en route and archaeological finds seem to support the theory that this itinerary was in use during the Bronze Age, as well as featuring in literary sources concerning the historical period (Kemp and Merrillees 1980, 274). Similar reconstructions of Bronze Age routes crossing the East Mediterranean basin and connecting the various regions around it are presented by C. Knappett (2011, 25).

There is little information on the speed of the LBA boats but it has been assumed that the journey from Crete to the Delta or to Palestine could be made in 2–3 months if going overland. (Raban 1988, 129; Wachsmann 1998, 254) As in later periods (e.g. Greek, Roman, Byzantine or Viking) overland routes were unlikely to be preferred. They were extremely slow and cargo would have had to be limited, rendering them expensive as well. E.g. for ancient Romans sea cargo was 28–56x cheaper than that transported via land routes (Tainter 2009, 177). The Vikings, for example, were able to transport tons of cargo with 6 or 7 people on board a sailing boat and the Uluburun shipwreck could have been operated by a crew of 4–6 people (Parker 1992, 20).

But contacts between particular regions were not only operated by merchants and were not always pe-

aceful. A wall fresco painted on the north wall of the West house in Akrotiri presents a naval battle and landing of troops in full armour (e.g. Kemp and Merrillees 1980, 217). In general the Neo-palatial period is interpreted as a time of peace. In archaeological contexts there are few finds indicating warfare. In Crete the first period where evidence for combat, attacks and destructions is widely documented is LM IB (see summary of bibliography and contemporary theories in Klontza-Jaklova 2013, 237–295). The first warrior graves in Crete (Isopata) are dated to the latter half of the Neo-palatial period (Younger and Rehak 2008, 172). Nonetheless, it is possible – and the Santorini frescoes seem to support it – that the Minoans could have had significant forces at their disposal.

However, the overall picture presented implies that everyday contact was not generally possible. The interval from the moment of departure to the moment of arrival could be extremely long. As we know from the Vikings, from pirates or even from the seafarers of the 19th century AD, sailors often had to stay in harbour for months awaiting favourable weather. But people and goods were on the move around the Eastern Mediterranean and the people of the region probably had a good grasp of its geography. E.g. Egyptian sources speak about Crete, calling this island Keftiou (Dynasty XVIII) and also they also knew how Cretans looked (Rekhmire's tomb). Sargon I. of Akkad mentions Crete as Kap-te-ra (the biblical Kaphthor) in the 24th century BC. An Akkadian inscription was found on the island of Kythera

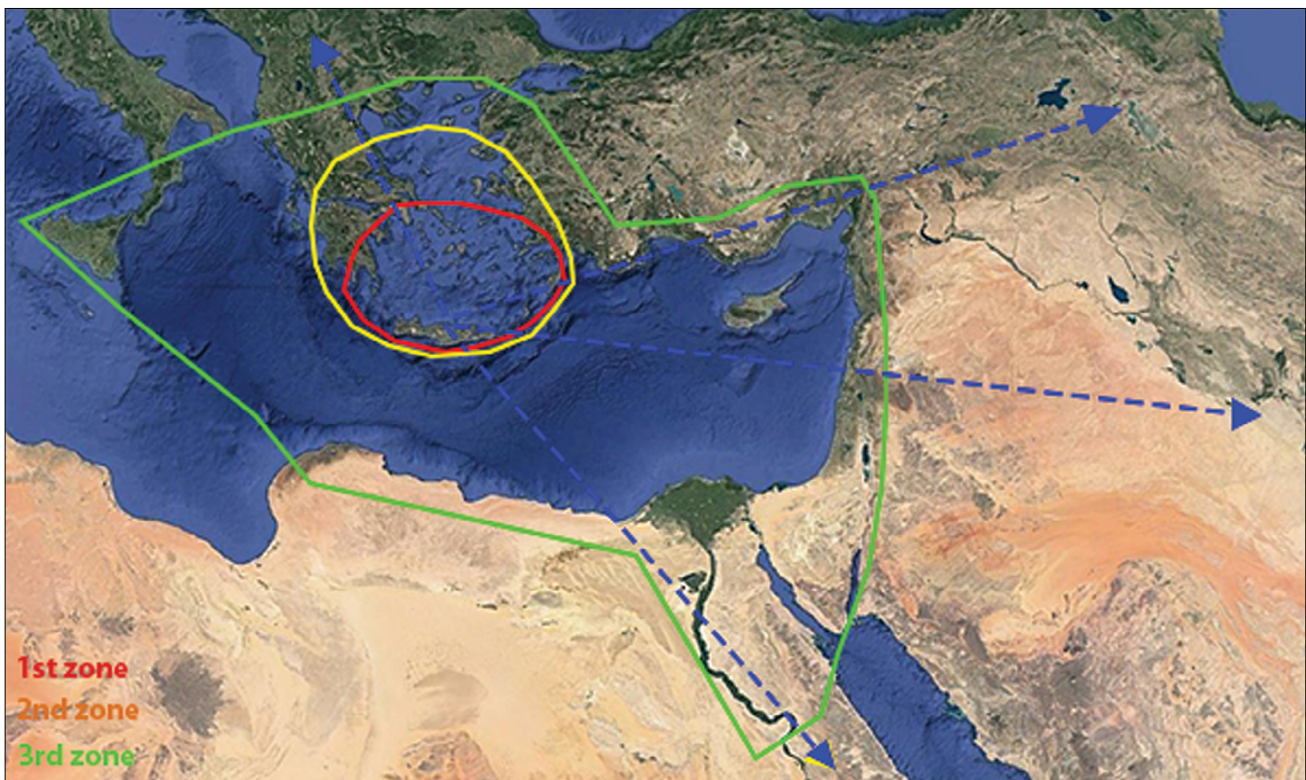


Fig. 25
Map of Minoan impact zones. (Illustration by authors)

2. The individual disciplines

and is dated to the 18th century BC, while in Platanos in the Messara plain a cylindrical seal of the 18th century BC has been found. In the royal archive in Mari there is mention of Crete, as a place where precious metals come from and where an ambassador was delegated. (Raban 1991, 129–147). But these contacts did not automatically mean that everyone had an accurate impression of how distant other regions were. E.g. the king of Mesopotamia complained to the pharaoh that he didn't know that couriers' journeys between their kingdoms took months (E. Cline, *pers. comm.*).

I would also like to underline that we tend to approach the societies we study as something isolated in time and space, as people who must discover everything from scratch, but the people of the Mediterranean, as mentioned before, had knowledge about the space around them. Their knowledge and traditions were inherited from generation to generation for thousands of years.

There has been much discussion about how many direct imports we have in archaeological contexts and how much was transferred by third parties (for statistics from each period: Kemp and Merrillees 1980, 278–279).

It has been widely accepted that Crete (or any other region) operated within three zones, according to the mechanism of the so-called Versailles effect (Wiener 1983; Melas 1988). (Fig. 25)

The first zone can be described as the habitation zone. For Neo-palatial Crete it would comprise the Cycladic islands, Samos, Kythera, some regions of the South Peloponnese, Dodecanese including the island of Rhodes and the southwest coasts of Asia Minor. Within this zone there was probably real Minoan 'colonization'; it could be said that they were the Minoan regions. How Minoan material culture, Minoan identity or even Minoan life style, or the Minoan economic system were transferred and exported is another question. Most scholars regard it as the result of a natural emigration of merchants or craftsmen. It is also possible that these regions adopted and accepted the successful Minoan social and economic models along with the material culture. There is no obvious evidence of the extended wars or dangerous increases in population, which could have led to mass migrations. There is, instead, evidence of trade colonization (e.g. Betancourt 2004, 27; 2008, 217). The hypothesis has been put forward that the limited area of agricultural land in Crete may have played a role in this as the inhabitants could well have needed a means of finding and financing additional food supplies. (Melas 1988, 48–56)

The second zone includes those regions where there were important and direct contacts but which are considerably more distant. Here we would place the regions of South Greece, Laconia, Messenia, Argolid, Attica, Boeotia, Euboea, Thessaly, Aegina, Skopelos, Lemnos and Asia Minor. A dense network of trade and

strong influences of Minoan material culture (imitations, fashion, imports of luxury goods) are archaeologically visible in this zone.

The third zone represents the region of inter-regional contacts and trade. Here we speak of the entire Eastern Mediterranean. The main items traded across this zone would have been luxury goods. Contacts were probably made by transfer and were mediated. Apart from the few most prominent merchants, there were also artists and highly skilled craftsmen, couriers and diplomats who travelled so far afield. This was the scale of distance across which relationships between power centres or even states were brokered (Melas 1988, 56–68) though there may have been 'personal' contacts between rulers (Cline 2014, 25).

The heyday of Minoan culture can be placed in the Neo-palatial period, mainly its first half. The settlement of Akrotiri on Santorini – probably one of the most important emporia – was established at the beginning of the LM period. But, as the latest excavations have documented, the tradition of habitation there goes back to the Early Bronze Age. The island of Santorini and its advantageous position on the route to the Aegean, with the additional benefit of its natural port in the caldera, had been known for many centuries. The expansion of Minoan culture was the background to the origins of the Theseus myth (Melas 1988, 56–68).

The influence of Minoan culture was so pervasive in archaeological contexts of the East Mediterranean that archaeologists, as mentioned above, used to speak of the 'Minoan thalassocracy' and the spread of those influences as a 'conquista'. These terms have now been abandoned and the more neutral expression, 'large zone of influence' has been substituted. (Summary of the topic in Hägg and Marinatos (eds.) 1988)

This extended analysis of the meaning of distance in the Minoan Late Bronze Age provides us with the necessary background against which we can weigh up the relative importance and meaning of cultural parallels, and imports, allowing us to interpret and date them and to evaluate each as the result of its own particular history.

Early in the twentieth century A. Evans and J. Pendlebury were already using imports from Egypt as a basis for their chronological assumptions. They connected the strata containing imports from Egypt with Egyptian historical chronology but, because Egyptian imports were not found everywhere they had to combine this method with theoretical calculations of how many generations were needed for a change in style. (Schoch 1995, 29–49, 52–68) The mass of the layer represented for them the "mass" of time needed for its creation. This method can be used only in very specific situations, as today no archaeologist doubts, but it was still used by M. Popham (1990) almost a century later.

Albeit the majority of publications agree that the Santorini catastrophe broadly coincided with the change from LM IA to LM IB, the question continues to be discussed. This time division was defined according to the appearance of particular signs within the material culture which don't appear at the same time across the wider region. (Niemeier 1980, 80; Betancourt 1985, 122–148). E.g. on the island of Mochlos, under the layer containing the volcanic dust, there is only pottery classified as LM IA material, while on Karpathos and on Santorini itself there is also pottery which on Crete appeared only after the catastrophe, in the LM IB phase. (Soles and Davaras 1990, 89–95; Manning 1988, 21–24, 57; Betancourt 1985, 122–148).

The periodization of the past, and especially of the non-literary past, the division of history in order to separate clearly the archaeological phases, cannot work. It can only assist our endeavours to follow the phenomena, their context and complexity. This system was intensively criticized, e.g. by I. Hodder (1991, 80): *'The usual way in which archaeologists discuss developments over long spans of time is to divide up their data into phases and to discuss the reasons for change between the phases. History is thus a discontinuous process, whether the approach being followed is culture-historical (even the discontinuities are invasions and so on), processual (systemic, adaptive change) or Marxist (change from contradiction and crisis).'* We should bear in mind, when evaluating the chronological data and dealing with periods defined by us, that periods are not pottery styles (MacGillivray 2009, 156). And this truth is appropriate for the Santorini catastrophe, for which is important to know when it happened, in the absolute meaning of time, in order to understand how the world looked at that critical moment and what impact the geological event had. Furthermore, it is important to know which periods pre- and post-dating the event are contemporary, what contacts existed and how they functioned at each point in history.

It can be concluded that the distances of the Eastern Mediterranean basin were not inappreciable. But that to organize such journeys was within the power of the elite strata of each society. For unprivileged people the world was probably much smaller. I would also agree that there were 3 main zones within which people and goods circulated. And it is through such prisms that we should view the imports in each region.

2.2.2 Contacts with Egypt

As mentioned above, the pioneers of Cretan archaeology could not have failed to spot items of Egyptian provenance in Minoan archaeological contexts. Since the first days of Minoan archaeology, the contacts between the regions were scrutinized in order to understand the intensity and the character of those contacts. These connections between Crete and Egypt

are the first evidence for contact between European prehistory and state civilization (although Crete, during LM IA, was exhibiting state-like characteristics and the palaces of the Proto-palatial period were polities; Knappett 1999; 2011; Klontza-Jaklová 2013, 220–236; Klontza-Jaklová and Klontzas, *in print*.) It seems that the Santorini eruption had a direct impact on the crystallization of the state. This process, on Crete, was interrupted (except at Knossos palace) as a consequence of the Santorini volcano eruption. (Driessen and Macdonald 1997, 108; Klontza 2013, 255)

This method of “cross-checking” or the “mirroring” of Minoan archaeological finds in the Egyptian chronology would appear reasonable. The next question is, how accurate is the Egyptian absolute chronology for the period? In what follows the main finds which can help answer such chronological questions and, perhaps, establish the accuracy of the chronological systems for the wider region are presented and analysed.

2.2.2.1 Egyptian absolute chronology (Table 1, 2)

	High chronology (¹⁴ C)	Middle (Conventional)	Low (Historical)	Extra Low
SIP starts	1800–1790	1780–1770	1674–1669	1658–1638, or even 1630
Dynasty XVIII stats	1577–1570	1541–1520	1542/40 –1530	1480

Table 2

Overview of Egyptian chronologies.

Despite all the reservations, Egyptian chronology is the most accurate historical chronological system in the Eastern Mediterranean of the Late Bronze Age. But this system was not given ready-made to the Egyptologists. It is the product of intense and continuous research and is based on a very wide range of sources (Table 3). Thus the results are extremely complex (Shortland 2013).

King lists	Palermo stone (Fifth Dynasty – circa 2400 BC) Hall of records, Temple of Amun, Karnak (Thutmosis III) Temple of Abydos (Seti I – circa 1250 BC) Turin Royal Canon (circa 1200 BC) Tomb chapel of Tjuniuroy (official of Ramesse II) at Saqqara
Other Genealogical Lists	
Archaeological objects	
Synchronism	
Astronomy	Solar eclipses Lunar observations Sothic dates

Table 3

List of sources for Egyptian absolute chronology. (After Kitchen 2013; Shortland 2013)

2. The individual disciplines

Radiocarbon dates for the Second Intermediate Period and Dynasty XVIII are always put to one side because of the significant offset of 50–120 years for this period (Kutschera et al. 2012; Höflmayer 2012; Bietak 2013a, contradicted by Warburton 2009; Manning et al. 2016). The method of combining all historical and archaeological data and thus calculating the absolute chronology is called “dead-reckoning”. This method was borrowed from geography where unknown points are predicted according to their established relationship with a known, fixed point. The counting of years starts with a date which has been established beyond doubt (here 664 BC) and proceeds backwards, deducing other less well established or unknown dates (e.g. Kitchen 2002). The dead-reckoning system offers an absolutely minimal framework based on the count of the pharaohs, high officials and events. (Krauss 1985; Hornung et al. 2006; Krauss and Warburton 2009, 125–126). From this point of view radiocarbon then offers the maximal framework. The periodization of Egyptian history which is currently in use copies the periodization by Manethon of Sebennyt, who, in the first half of the 3rd century BC, wrote the Egyptian history for Ptolemy I Soterus. From this opus, unfortunately, only notes survived – mainly the lists of kings. These notes were repeatedly copied in the works of later, mainly Christian, authors, such as Julius Africanus, Eusebius, Synkellus and Josephus Flavius. Other important sources are the Palermo table from Dynasty V, the List of Karnak written around 1500 BC, the Abydos list from the period around 1300 BC, the Saqqara list from 2 generations later and the Royal Canon of Torino, which seems to be the most complete. This list was copied on papyrus during Ramesses II’s reign from another king list, also written originally on papyrus, but both documents had different formats leading to errors in copying and the state of preservation is also very bad. On the lower edge of the document the names of 6 Hyksos kings could be recognized. This fragment of papyrus is not completely preserved and there are different readings of the length of their reign. The readings range from 108 to 140 years. It can be said with some certainty that the Hyksos king named Apophis ruled for 33 years. (Redford 1986, 1997; Krauss and Warburton 2009, 131) but the period of his reign is floating in the second half of the SIP.

These lists are not complete and don’t provide a perfect match. Egyptologists also work with genealogies, private and public documents, correspondence, synchronisms with rulers of Mesopotamia, Syria and Anatolia, with archaeological typology, radiocarbon dates and astronomical events. (Krauss and Warburton 2009, 125; Wiener 2009b, 278)

The discrepancies are so significant that Egyptologists work with three different scales: The so called high chronology dates the beginning of Dynasty XVIII

to 1577–1570 BC, the medium system about 20 years later and the low chronology goes as far as 1542/40–1530 BC. (Manning 1988, 25; Ward 1992; Weinstein 1995, 85; Warren 2009). The majority of Egyptologists use the scale defined by K. A. Kitchen (1987; 1991; 1996; 2000) who prefers the low data. But there is also a significant group of scholars which prefer the high chronological scale (Weinstein 1995, 85; Höflmayer 2012, 444).

Although Egyptology has plenty of literary sources which refer to very early stages of Egyptian state, these are not complete and in agreement each with other. Also their authors were writing centuries later than the periods they describe. There are further complications which arise from situations such as the presence of different pharaohs in Upper and Lower Egypt, or when there was more than one dynasty or pharaoh contesting the crown over a considerable period. At times it is not known how many years some of the pharaohs ruled. It can be said that the chronology seems to be accurate to within a year from the 7th century BC onward (some authors would say from the Persian campaign in 525 BC – e.g. Bietak; Kopetzky 2000, 22–27; others from 664 BC – e.g. Krauss and Warburton 2009; Kitchen 2013).

The gaps and overlaps of the literary sources are not the only problems of Egyptian chronology. The problems start with how Egyptians understood and counted time. Their month counting and placing of the start of each year were not astronomically perfect. The calendar was created differently. An Egyptian month was 29.5 days long and was counted from each new moon, the observation of which can itself introduce discrepancies or errors. The Egyptian year had 365 days, which means that the quarter of a day, missed in the yearly calendar, caused cumulative discrepancies. (Manning 1999, 369–371; Bietak and Kopetzky 2000, 22–27). The year, for ancient Egyptians, began with the promise of renewed fertility due to the annual Nile inundation. Its harbinger, the star of Sirius, was the brightest body in the sky. Sirius disappeared from the horizon for circa 70 days and, shortly before the flood season, it re-appeared. The day when Sirius was observed in the sky again for first time was the beginning of the New Year. It is obvious that the possibility of perfect measurement was limited and it is astonishing that the Egyptian astronomers were so accurate. An additional complication is caused by the visibility of Sirius differing between Upper and Lower Egypt. Observations from Thebes were not, for example, the same as those from Memphis. Today we can use the models of the visible sky at each moment in time for each part of Egypt in order to correct the historical calendar (Firneis and Rode-Pautzen 2003, 47–85). It is certain that the end/beginning of the astronomical and calendar year were different. When this became

obvious, one extra month was placed in the calendar. This was done by estimation.

The Moon and Sirius meet at one point in the sky once in every 1460 years. This cycle is called the Sothis cycle. The Roman author Censorius informs us that this phenomenon was observable on 20th of July 139 AD. Theon writes that it happened just 1605 years before Diocletian's reign started (29th of August 294 AD). Both these observations agree with the start of a Sothic cycle in the year 1321 BC (Manning 1999, 370–371; Krauss 2003, 175–197). Albeit that Egyptian astronomy was extremely accurate, given the state of their technology, just taking account of possible, and probably relatively small, mistakes in observation, assuming these could occur in 15% of cases, could create an error of 70 years in the date of the Santorini event (Krauss 2003, 175–197; Krauss and Warburton 2009, 133).

We also must bear in mind that the ancient Egyptians had different ways of understanding and approaching time. Our dealings with the calendar are mediated through highly accurate instrumentally measured global time but for ancient societies time was connected to the gods' rhythms and had special and not necessarily absolute meaning. The years were not numbered from one conventionally set year but they were labeled by the number of years reigned by a particular pharaoh. This leaves scope for interpretation; "bad" pharaohs, for example, could be rejected from the record and overlaps, as mentioned above, could cause confusion. The consequent lack of accuracy could, quite simply, be explained as being the will of the gods (Luft, U. 2003, 199–200).

I am not competent to define where there can plausibly be mistakes in Egyptian chronology, (or) if there are any. But it is necessary to provide an overview of the period in which we are interested in order to evaluate the possible level of accuracy.

2.2.2.2 Overview of historical development in Egypt during the Second Intermediate period and early 18th Dynasty, up to Thutmose III

This period represents, perhaps, the most problematic phase of ancient Egyptian history, and not only when speaking about absolute chronology. Some authors describe this period as a dark age of Egyptian history (Redmount 1995, 61). During the SIP the continuity of Egyptian pharaohs was disrupted and the literary sources are extremely limited. Opinions about this period are not fixed but are still being modified and changed in the light of each new research finding (Oren 1997).

The low chronology proposes the year 1795 as the entry point of Dynasty XIII and the year 1479 as the

beginning of Thutmose III reign (Kitchen 2000, 49). The SIP starts with Dynasty XIII, as Manethon's tradition says, when ' *In his reign, for what cause I know not, a blast of God smote us; and unexpectedly, from the regions of the East, invaders of obscure race marched in confidence of victory against our land. By main force they easily overpowered the rulers of the land, they then burned our cities ruthlessly, razed to the ground the temples of the gods, and treated all the natives with a cruel hostility, massacring some and leading into slavery the wives and children of others. Finally, they appointed, as king, one of their number, whose name was Salitis. He had his seat at Memphis, levying tribute from Upper and Lower Egypt, and leaving garrisons behind in the most advantageous positions. Above all, he fortified the district to the east, foreseeing that the Assyrians, as they grew stronger, would one day covet and attack his kingdom*'. (Manethon, *Aegyptiaca*, frag. 42, in Oren 1997, xix). These invaders are referred to by later sources as the *Heka chasut*, meaning "rulers from foreign lands" and today we call them Hyksos (Oren 1997, xix). These days they are not viewed as a nation and their impact in Egypt in this particular period is described as the Hyksos culture, Hyksosian pottery, Hyksosian period etc. The Hyksos must be understood as a foreign dynasty designated as the Dynasty XV and of simultaneous minor dynasties, who took the title *Hq3w H3swt* (Bietak 2010, 139). This was not a homogenous group of people but a conglomerate created from the local Egyptians and different immigrants coming in, generally from the East, whose origin is not clear at all. The Hyksos of Egyptian sources probably were a new elite layer of society, after a violent overthrow of the previous rulers. A few texts describe their entry to Egypt and in a few texts from the period of their reign in Egypt there can be found names of non-Egyptian gods, providing evidence that those who believed in them were not of Egyptian origin. According to those names these groups used Semitic languages, though, as mentioned above, the written sources are extremely limited (summary of them in: Redford 1997). Some of the names may have a Western Semitic origin. Temples, shrines and donkey' burials in Canaan style have been found. (Bietak and Marinatos 2000, 40) It was believed that the elite of Hyksosian period probably originated in Canaan but, after M. Bietak (2010, 150–153, 163), their origin should be sought not in the South Levant but in North Syria, in the regions of Byblos and Ugarit.

During the final phases of the Middle Kingdom people from the Near East were already penetrating to Egypt (Bietak and Marinatos 2000, 40; Bietak 2010, 139–143). The way this process started, why and how they were settling in Egypt, are much discussed topics. The structure of the society, power and politics of the Hyksosian ruling dynasties are unclear and the borders, or even the size, of the region under their control is not certain (Oren 1997, xxi – xxii).

2. The individual disciplines

For many decades, under the influence of ancient sources, the Hyksos were accepted as a homogenous tribe or nation (Redmount 1995, 61–63). But the reality is clearly more complex. A stream of individual migrants and groups, both small and large, travelling from the Near East to Egypt has been documented in the final phases of the Middle Kingdom and it became very intense and probably organized. These groups targeted the Delta, where they created their own state structures (Redford 1992, 101–102).

The result of these migrations is clearly written in the history and archaeology, but it is more difficult to determine the reasons for their decision to move from their original homes. This stream was not a short-lived phenomenon, instead it seems that the people were moving to Egypt, and mainly to the Eastern Delta, at least from late in Dynasty XII (Bietak 2010, 139, 143). The Near East was then passing through a period of significant development, which, logically, would have led to growth of population and competition in access to resources. Part of society was clearly forced to abandon the region. At first this migration was confined to individuals or families but finally the movement became organized, sometimes with the use of armies. It is plausible that Western Asiatic populations were settled in Tell el-Dab'a and some of them may even have served in the Egyptian army (Bietak 2010, 141). The names of the kings of the SIP, written in the Torino list and Manethon, remain Semitic. All later sources speaking about this period contain differences in the lists of kings' names. Manethos, Eusebius, Africanus and Joseph Flavius agree only in some points and their chronological disagreement is between 108–511 years for the government of Hyksos dynasties. Only 6 names of the Fifteenth Dynasty are unambiguously identified and 6 more were discovered by the study of inscriptions on monuments and scarabs. Their names were not Egyptian and they did not even have additional Egyptian names (Redford 1992, 103–111).

The Hyksos had regular contacts with regions in many different directions; those with Cyprus, for example, were intensive. During the 18th and 17th centuries they were organizing expeditions and conquests back into Western Asia. Many king scarabs of this period were found on the way to Nubia as well (Redford 1992, 113). Trade contacts with the Near East were documented too (Oren (ed.) 1997), as were contacts with Crete, which will be discussed further below.

The capital city of Hyksos Egypt was Avaris, probably later Peru Nefer (contemporary Tell el-Dab'a²⁵, more in chapter 2. 2. 1. 3), in the East Delta. Aside from this, other Hyksos centers have also been discovered; e.g. Tell el-Maschúta, close to Tell el-Dab'a, sited on a caravan path crossing the valley of Wadí Tumílát and connecting Sinai with the East Delta (Holladay

1982). Another site is Tell el-Jahudíja located south of both the sites mentioned above.

Due to the almost total lack of literary sources the form of Hyksos rule in Lower Egypt is rather obscure and we also have relatively poor information about Hyksos religion. At the summit of their Pantheon was the Semitic god Baal, meaning The Lord. The equivalent of the Egyptian goddess Hathor, and Baal's female partner, was the so-called Mistress of Two Trees. The traditions of this religion were clearly very strong since they remained visible in much later periods. The Ramses stela (the so-called Stela of 400 years) in Avaris shows evidence of the Baal cult.

Under the pressure of immigrants and expeditions from the East the Egyptian royal dynasties had to retreat south to Upper Egypt and this marked the start of the SIP. During the period of maximum expansion in Hyksos hegemony, clashes with Egyptian royal forces placed in Thebes, fighting for the control over the Delta, started. The first recognized Egyptian pharaoh mentioned in this context was Sekenenre Tao of Dynasty XVII who was in conflict with the Hyksos ruler called Apopi. Sekenenre Tao's successor – probably his son – was Kamose, who reached the fortification wall of Avaris. Hyksos rulers were constantly trying to open a second front to the South by pushing their Nubian allies to attack the Egyptians based in Thebes. But in the period of Kamose all Nubia was under his control already. (O'Connor 1997, 45; Redford 1997, 68–69) As the pressure on the Hyksos continued, it was Ahmose, probably Kamose's brother, who finally managed to overthrow the Hyksos dynasty and reinstate an Egyptian royal Dynasty on the Egyptian throne. Ahmose is understood to be the founder of Dynasty XVIII. Egyptian historiography places this event to 1540 BC (O'Conner 1997, 45, 48–52, 60–63; Kitchen 2000, 44, 49).

The last Hyksos king, according to the Torino Royal Cannon was Khamudi. Avaris must have fallen in year 11 of Khamudi, which is probably equivalent to the 18th/19th year of Ahmose. This date has been reconstructed as 1504 (Table 4; Krauss and Warburton 2009, 137–139).

Last Hyksos King	Early Dynasty XVIII
Khamudi (1515–1504 BC)	Ahmose c. 1524–1499 (or 1–3 years later)
	Amenhotep I c. 1498–1477 (or 1–3 years later)
	Thutmose I c. 1476–1470 (or 1–3 years later)
	Thutmose II c. 1469–1468
	Thutmose III c. April/May 1468–Nov. 1415

Table 4

Overview of the late Hyksos period and early Dynasty XVIII. (After Krauss and Warburton 2009, 138–139, Table 1)

As well as the general historical vagueness of this period the specific chronological problems are obvious too. The absolute chronology of the Middle Kingdom is connected to lunar observation of the 7th year of Senusret's III reign. However, it is not clear where the observation was made; if it was made in Memphis then this year would be dated to 1872 or 1866 BC and the end of Middle Kingdom is then dated to 1801 BC (or a few years later in 1796–1793 BC). The Middle Kingdom finished when the Hyksos took over the capital city Memphis (Krauss 2003, 177–180). The first two pharaohs of Dynasty XIII were sons of the last Dynasty XII pharaoh, known as Amenemheta IV but there is not any certain chronological point for this period. According to some scholars Memphis was captured by the Hyksos king Dudmose II but his name does not appear in all the lists of Hyksos rulers and it is possible that this personality did not actually exist or that his status is hypothetical. Dynasty XIII probably lasted for around one and a half centuries and is dated to 1851–1643 BC (Manning 1999, 367–412) or to 1795–1631/27 BC (Kitchen 2000, 49).

2.2.2.3 Avaris and its stratigraphic sequences

Ancient Avaris, contemporary Tell el-Dab'a, probably also identifiable, under the New Kingdom, as Peru Nefer (c.f. Bietak 2009a, 2009b; 2010, 167; MacGillivray 2009, 165), was discovered near the end of the 19th century (1885) by Swiss Egyptologist Henri Édouarde Naville. Between 1941 and 1942 Labib Habachi, an Egyptian Egyptologist, put forward the idea that the site could be identified with Avaris. Systematic excavation, by the Austrian Archaeological Institute, started in 1966–69 and has continued, with a few short breaks, to this day. The site is within the Eastern Delta and formed a hub for the markets of the region. It was not first established and occupied by the Hyksos as it was already in existence during the Middle Kingdom. There are even finds of Protopalatial pottery from Crete mentioned as having been found there. Its original name should probably be pronounced ***H**a?at-**W**ūrat, Avaris being a Greek name for the city. The Hyksos, however, developed the site and it became a centre for their kingdom. The city is 250ha in area and it was the largest urban center in the Eastern Mediterranean (Bietak and Marinatos 2000) at the time. The site is not only important for the Hyksos period but its chronological framework documents the continuities of Egyptian history from the Twelfth to the Eighteenth Dynasties. (Weinstein 1995, 84). Ultimately, virtually all of the archaeological arguments against the ¹⁴C date of 1627–1600 BC for the Santorini eruption are based on the stratigraphy and finds from Tell el Dab'a (Krauss and Warburton 2009, 139).

The stratigraphy of the site is very complex and further complicated by the fact that the soil is extremely wet and water must be pumped from the trenches. These difficulties have hampered the efforts of the excavators to synchronize chronological and stratigraphic units and there is often reason for criticism (Warburton 2009; Manning et al. 2016). (Fig. 26)

The excavators tend to accept the explanation of Josephus Flavius that the siege of Avaris lasted for a very long time and the inhabitants reached a compromise solution that they should leave the city and go to Southern Palestine. This would then explain the hiatus between the debris from the fall of Avaris and the reoccupation during Dynasty XVIII. (Bietak 1996, 67)

A new royal (Dynasty XVIII) citadel was built on the destroyed Hyksosian strata (Fig. 27a). It was constructed on a platform (Fig. 27b) which incorporated late Hyksosian elements within its structure and even reused parts of the Twelfth Dynasty architecture. (Bietak 1996, 68–72).

A painted wall in Aegean style (Fig. 28) is an important chronological marker for Avaris. It was published as having been found in the strata of the “transition between the Hyksos period and the 18th Dynasty” (Bietak 1995, 23, 26) but later the excavators re-examined that conclusion and connected the citadel's platform to the period following the fall of Avaris (Bietak 1996, 67–68). The most important fresco was found during the excavation of the Citadel, particularly in its west part, in 1992. The fresco fragments were spread through more strata but the main debris seems to be connected with stratum C3 which is now synchronized with Thutmose III or Thutmose II, ergo 1479–1425 BC (Bietak 1997; Bietak and Marinatos 2000). Significant amounts of pumice were also deposited in this layer (Bietak 1995; 1996; Manning 1999, 32) and it is, therefore, looked upon as the layer contemporary with or directly following the moment of the Santorini eruption. Stylistically the fresco was characterized as a wall painting of the LM IA period by the excavators (e.g. Bietak 1995, 1997, 117; Morgan 1995; Bietak and Marinatos 2000, 40–45, 95; MacGillivray 2009, 157) but there is not full agreement on this and an alternative opinion places the fresco later and within the style of LM IB wall paintings. The argument is that the bulls are painted in profile and not “en face” (Niemeier and Niemeier 1998, 90). I am not personally convinced that the evidence for stylistic dating of this fresco, or indeed other frescoes, is other than weak. There are just scattered pieces of frescoes from all of the Late Bronze Age – these are not an LM IA fresco from Knossos. It is also questionable how these fit in with the frescoes of Santorinian Akrotiri. We cannot define how the fresco painting styles developed in the Aegean so any effort to identify close parallels for the

2. The individual disciplines

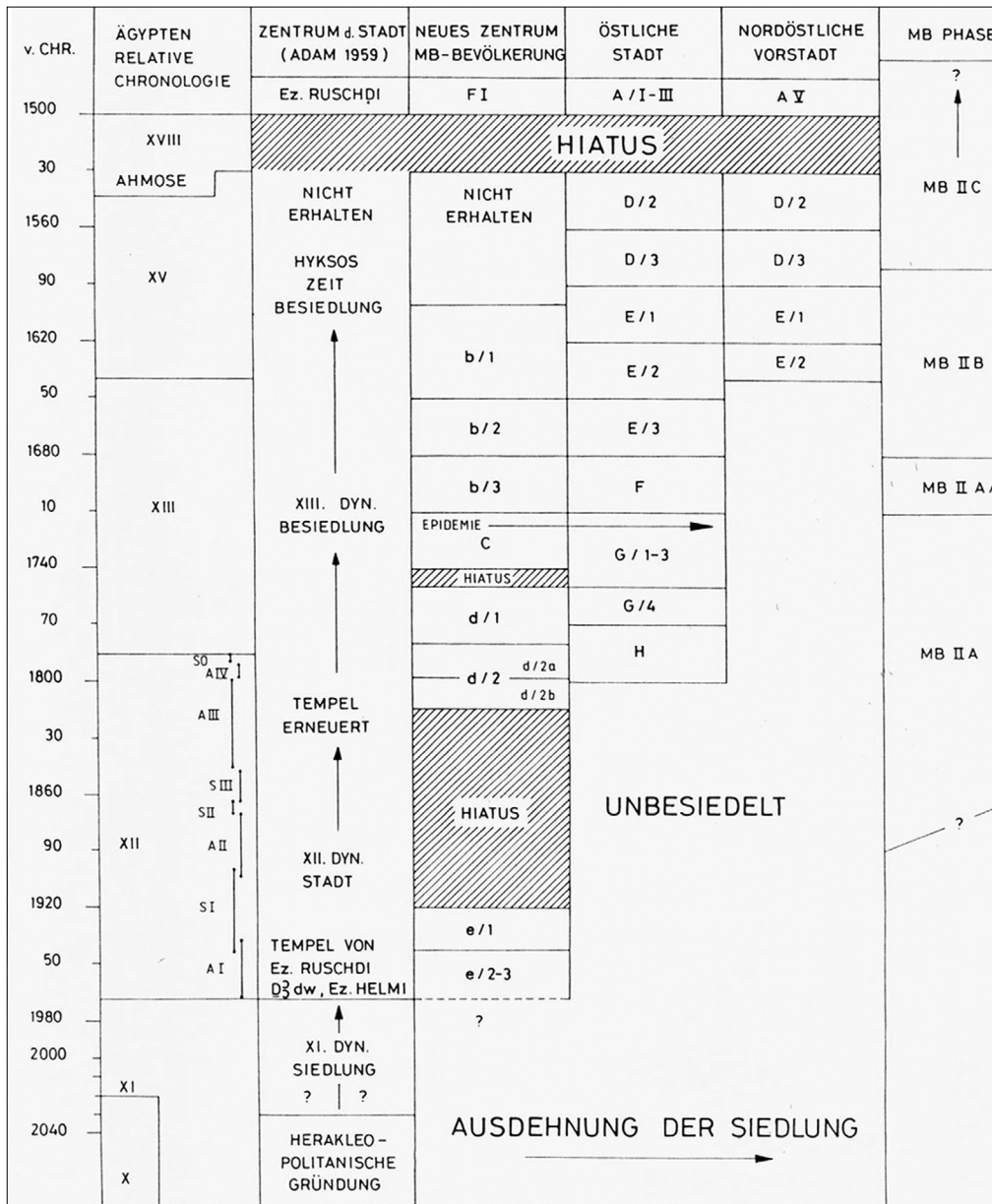


Fig. 26

Chart of Tell el-Dab'a stratigraphy (Bietak 1992, Abb. 1).

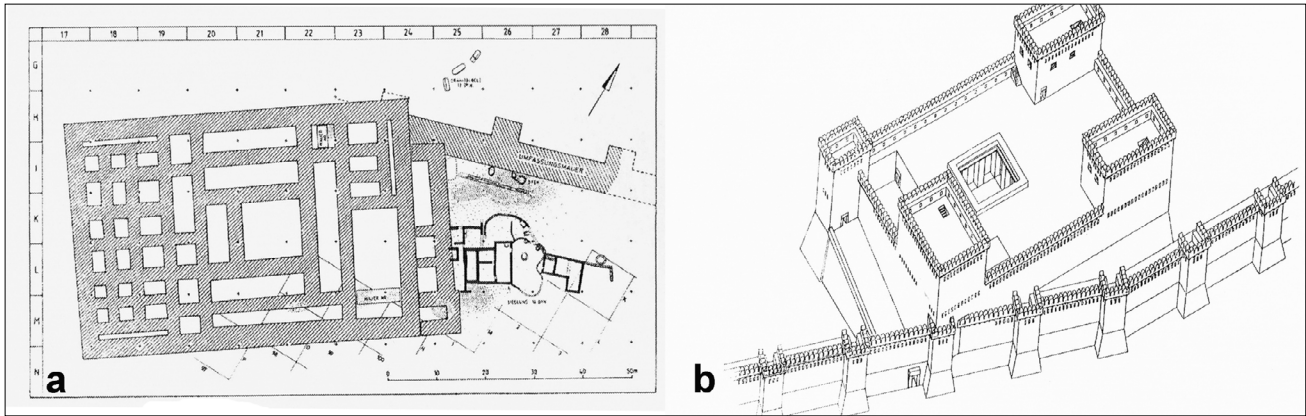
Avaris wall paintings remains somewhat tentative. As the bibliography cited above shows, it is possible to find elements which can be connected with both the earlier and later phases of Neo-palatial Crete.

When the contexts with frescos were found they were originally dated to the Hyksos period and were interpreted as decoration of the Hyksos citadel (Bietak 1995, 1996). Dating and interpretations were revised and the excavators now conclude that the previous stratum, designated D2, belongs to the period when the city of Avaris was taken over by the Egyptian pharaohs (Bietak 1995, 23, 26; Weinstein 1995, 89; Bietak 1997, 115–117; Bietak and Marinatos, 2000, 41–42).

If the fresco was made during LM IB and it was part of Thutmose III or II citadel, then the Santorini catastrophe must have happened in the first half of the

15th century BC, which seems an extremely late date. If the Egyptian chronology is as accurate as we suppose and if the strata where the fresco was found are really Thutmosian, then the fresco cannot be contemporary with the LM IA period.

However, an art object, such as this fresco, evokes questions of forms, characters and the intensity of Minoan / Egyptian contacts. Some scholars propose that the Avaris frescoes were made by an artist who travelled in the train of a Cretan princess, who married the Egyptian pharaoh. (Bietak and Marinatos 1995, 61) M. Bietak himself has expressed the opinion that this pharaoh can be identified. Originally he offered some of the Hyksos kings but later when the chronological and stratigraphical contexts were revised, he identified Ahmose, the founder of Dynasty XVIII (Bietak and

**Fig. 27**

Ahmose's citadel at Tell el Dab'a: a) platform, b) reconstruction. (After Bietak 1996)

**Fig. 28**

Reconstruction of one of the Tell el-Dab'a frescoes. (After Bietak 20013b, Fig. 8)

Marinatos 1995, 61; Niemeier and Niemeier 1998, 95), as the pharaoh in question. We can imagine circumstances which bring about an increased desire for good diplomatic relationships on the highest level. Although it is of course hypothetical, it is possible that Ahmose, faced with some uncertainty immediately after his very recent victory, would have wanted to cement alliances with his potential allies. If this happened in the LM IA period, when Crete was in its zenith and it was one of the most important players on the political scene of the Eastern Mediterranean, then such an alliance would be highly beneficial. LM IB Crete would be a more problematic ally due to destabilization of the situation there then (MacGillivray 2009; Klontza-Jaklová 2013; Klontza-Jaklová and Klontzas, *in print*). Politically speaking, the context seems to make sense and the synchronism of the LM IA early Cretan (Knossian) state with the Egypt of early Dynasty XVIII, exchange between both regions, including diplomatic marriages and travel-

ling artists, could work. The Santorini eruption would have disrupted this picture. The only problem is the radiocarbon dates from LM IA Santorini and Crete were not in accord with dates from Avaris layers D2 and C3, which seem to support the Egyptian historical chronology (Kitchen 2000, 49), but new dates from layers E1–D3 are about 100 years earlier than expected (Kutcher et al. 2012; Bietak 2013a).

There are more objections which must be discussed and borne in mind. The Minoan style fresco fragments in Avaris were scattered over several layers. It has also been shown in Knossos that the frescoes found in destruction levels were much earlier than the destructions themselves. It is logical therefore to pose the questions: When were the frescoes painted? For how long did they, undisturbed, decorate the palace walls? And when did they finally become part of the destruction debris? Pieces contained within layers D2 and C3 could have been part of a fresco created a hundred

2. The individual disciplines

years earlier than the creation of the debris (Krauss and Warburton 2009, 139–140).

However, Avaris has more than just a fresco to help with our chronological conundrum. There was a significant amount of pumice in the excavation areas designated H I, II and III. Pumice found in Avaris was tested using neutron activation analysis, and it proved to have originated in Santorini (Foster Polinger and Bichler 2003, 431–437). It seems that this pumice must have become part of the context after the Santorini event (Bietak 1995, Fig. 1).

How did the pumice get into these Avaris contexts? Clearly the Santorini volcano produced a lot of pumice which not only covered the island but was also left floating on the surface of the sea. According to contemporary observation chunks of pumice can move with sea currents at speeds of 9km per day. Eastern Mediterranean currents and winds in the South Aegean generally move floating objects to either the Palestinian coast or the Nile Delta. Pumice could have travelled from Santorini to Egypt in approximately three months (Foster Polinger and Bichler 2003, 437). Santorini pumice was found not only in northern Egypt but also much further south, in Thebes, Maiana and Kahún, in graves of Dynasty XVIII up to the period of Thutmose's III reign (Foster and Bichler 2003, 433–436). In the graves of the cemeteries at Thebes, Maiana and Kahun, the pumice was found mainly in contexts dated as late SIP or early Dynasty XVIII. The strata in Tell el-Dab'a and in Tell el-Ajjul produced the same picture. Contexts prior to Dynasty XVIII contain pumice of earlier Aegean eruptions, such as Kos, Gialis, Nisyros, and earlier Santorini eruptions but not from the Minoan eruption, whereas many early Dynasty XVIII sites contain Minoan eruption pumice in overwhelming quantities. A simple interpretation of this evidence would be that the eruption occurred at the beginning of the Eighteenth Dynasty, around 1530 BC or even later. (Foster Polinger et al. 2009, 171–175)

Pumice not only moved “passively” on the sea but was a material ‘harvested’ for use both in everyday activities and in ritual. Pumice was used for weaving weights or as fishing net floaters. Pumice could be collected in the Delta and transported south. Santorini is continuously eroding and even today, as I can, myself, attest, there is plenty of pumice washed up on the Cretan coast in stormy weather. It is possible today to ascertain whether pumice found spread around the Mediterranean is or is not from Minoan eruption of the Santorini volcano but not to determine how and when it came to the place, wherein it was finally deposited.

Before turning our attention to the most obvious archaeological find – to pottery – we should discuss the evidence provided by literary sources. One can ask if

the Egyptians mentioned the event in their written documents. As noted above, the eruption was huge and the people must have noticed its effects at the time, e.g. tsunami, ash fall, maybe darkness, storms etc. Later on the disruption of relations with Crete and other regions must have become obvious and there may even have been reports in circulation from those who witnessed the catastrophe. Those, who accept that the eruption occurred in the period of Ahmose, generally believe that the so-called Tempest (or Ahmose) stela reports the event. (Fig. 29, Foster and Ritner 1996, 1–14; Foster Polinger and Bichler 2003, 436; Manning 2012, 469). This stela, which is traditionally dated to 1530 BC, was first connected with the Santorini eruption in the publication of Ellen N. Davis (1990). The inscription on the stela speaks about Ahmose's special abilities to calm even volcanos. The interpretation of the text on this stela is not generally accepted by all scholars. The translation of K. Foster Polinger and M. Bichler (Foster Polinger and Bichler 1996) is not widely agreed and the majority of scholars use the translation of James P. Allen (Wiener and Allen 1998) who does not believe that the stela describes this particular event. A new translation (Fig. 29), was published by R. K. Ritner and N. Moeller (2014) and the authors expressed the view that the document could be describing the Santorini eruption, even though there are some chronological discrepancies.

Ahmose's stela was found in Karnak in 1947–1951 by French Egyptologists and the text was first published in 1967 (Vandersleyen 1967). Aegean archaeologists met the text one generation later (Davis 1990). The main problem with the inscription is that not all the events as described could have been seen from Egypt. It mentions earthquakes, an eclipse etc. and, had the observations been made and written in northern Crete, this would not present any great difficulty. Santorini is 1300km from Egypt and it questionable if such detailed descriptions could have been documented so rapidly. These inscriptions, wherein the pharaoh or other ruler is described as a person with god-like abilities are often used in Egypt, and elsewhere. These are symbolic metaphors underlining the ‘unique’ attributes of each person thus described (summary of opinions in Manning 1999, 192–202). We are unaware of any volcanic eruption which the Egyptians could have observed in their own territory. The only volcanoes which behave that way and are not impossibly remote, are Santorini and the volcanos of Sicily and the Apennine peninsula. The only exception is the so-called Avellino eruption. This occurred most probably in the 20th/19th century BC (Sevink et al. 2011), within a Bronze Age society which was prehistoric, agricultural and exhibits no evidence whatever of any contacts or relationships with the East Mediterranean. Santorini, at the time of the Minoan eruption, was much

Long live (?) the Horus "Great of Manifestations," He of the Two Ladies "Pleasing of Birth," the golden Horus "Who binds the Two Lands," King of Upper and Lower Egypt, Neb-pehty-Ra, son of Ra, Ahmose, living forever.

Now, His Majesty dwelt in the town of Sedjefatawy ("Provisioner of the Two Lands") [in the district just to] the south of Dendera.

Now then, A[mon-Ra, Lord of the Thrones of the Two Lands,] was in Heliopolis of Upper Egypt (= Thebes).

It was His Majesty who went south ("upstream") in order to [give to him bread, beer and everything good and] pure. Now after the offering, [. . .] their(?) [. . .]. Then attention was given in 33 [. . .] this [dis]trict. Now then, the cult image [of this god . . .] [. . .] as his body was installed in (lit. "united with") this temple

while his limbs were in joy.

[. . . Now then,] this great god desired [. . .] His Majesty [. . .] while the gods complained of their discontent. [Then] the gods [caused] that the sky come in a tempest of rain, with [dark]ness in the condition of the West, and the sky being in storm without [cessation, louder than] the cries [lit., "voices"] of the masses, more powerful [than . . .], [while the rain howled] on the mountains louder than the sound of the underground source of the Nile that is in Elephantine.

Then every house, every quarter that they (scil. the storm and rain) reached [. . . their corpses(?)] floating on the water like skiffs of papyrus outside the palace audience chamber for a period of [. . .] days [. . .] while no torch could be lit in the Two Lands.

Then His Majesty said: 'How much greater this is than the wrath of the great god, [than] the plans of the gods!' His Majesty then descended to his boat, with his council following him, while the crowds [on] the East and West had hidden faces, having no clothing on them after the manifestation of the wrath of the god. His Majesty then reached the interior of Thebes, with gold confronting gold of this cult image, so that he received what he desired.

Then His Majesty began to reestablish the Two Lands, to give guidance (or "a conduit") for the flooded territories. He did not fail in providing them with silver, with gold, with copper, with oil and cloth comprising every bolt that could be desired. His Majesty then made himself comfortable (= seated himself) within the palace (life! prosperity! health!).

Then His Majesty was informed that the mortuary concessions had been entered: the tomb chambers collapsed, the funerary mansions undermined, and the pyramids fallen - what had been made rendered non-existent (lit., "what had not been made").

Then His Majesty commanded to restore the temples that had fallen into ruin in this entire land: to refurbish the monuments of the gods, to erect their enclosure walls, to provide the sacred objects in the noble chamber, to mask the secret places, to introduce into their shrines the cult images which were cast to the ground, to set up the braziers, to erect the altars, to establish their bread offerings, to double the income of the personnel, to put the land into its former state. Then it was done in accordance with all that His Majesty had commanded.

closer to Egypt, both physically and in political and economic organization.

Descriptions of such events can survive for a very long time even in the oral tradition. The Indians of Klamath, for instance, maintained a 'myth' about a volcanic eruption, with consistent and credible details, for almost 8000 years (Barber and Barber 2004, 1-15). On the assumption that the people of Bronze Age did not separate "current" time from "past" time, it would follow that they did not have a linear view of history, such as we now have. They had ancestors and shared their space and time with them, meaning that, in their perception, time was organized in a circle (Lévi-Strauss 1962; Eliade 1969; Sádlo et al. 2008, 205; Klontza-Jaklová 2011). Many authors, including most who subscribe to this theory, don't believe in the authenticity of the inscription and warn that it cannot be used as chronological evidence or a primary narrative source (Wiener and James 1998).

Ahmose's stela could be a contemporary report about a particular event, it could be a story which survived from an earlier time or it could even be a literary

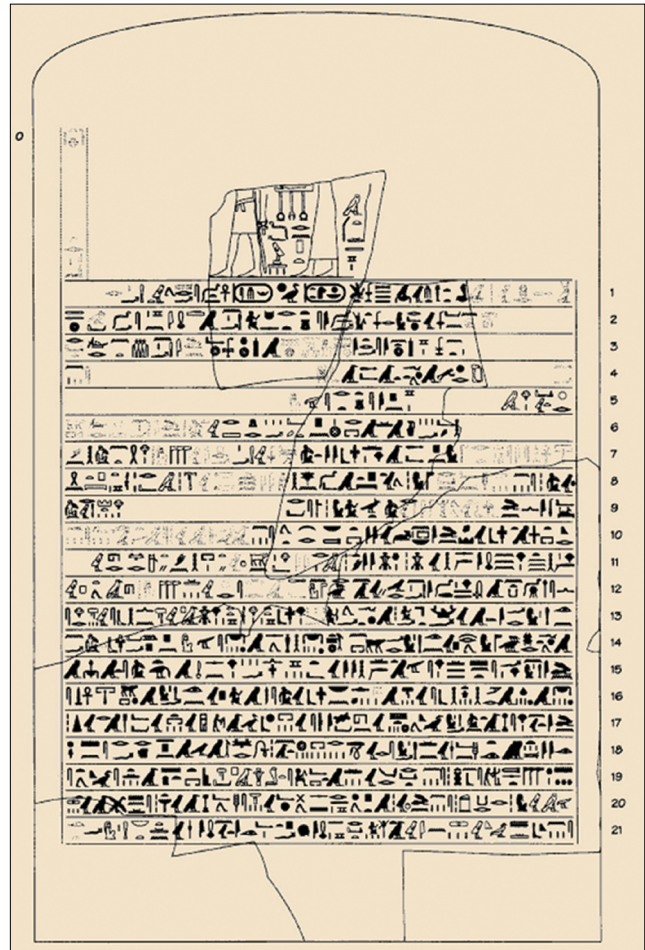


Fig. 29

The Ahmose Tempest Stela and its translation. (After Wiener and Allen 1998)

device, surviving in celebration rituals. Just to indicate how archaeology and history should, in an ideal case, work with other sources: if the stratigraphy, the radiocarbon data and the historical data were in agreement, we would not doubt that the Tempest stela describes the Minoan eruption.

Similar arguments were used by J.A. MacGillivray (2009, 159-161) when connecting one of Hatshepsut's best-known dedications found in the rock-cut temple to the lioness goddess Pakhet near Beni Hasan in Middle Egypt. The inscription is known as the "Great Speos Artemidos Inscription." It was interpreted as a description of the acts of Hatshepsut, which demonstrated her absolute power. According to the inscription she evoked storms and total darkness in the temple. These effects were first connected with the Santorini eruption by H. Goedicke (2004). If the connection made were valid, the eruption must have happened after her accession to the throne, in the second or seventh year of her reign. (MacGillivray 2009, 159). H. Goedicke (1992) connects this inscription with another one, which is placed on the el-Arish shrine, built in the Ptolemaic period (3rd -

2. The individual disciplines

2nd century BC) on the Levantine coast. This refers to an event during Thutmose III's reign saying that, "*there was no exit from the palace for the space of nine days. Now these days were in violence and tempest: none, whether god or man, could see the face of his fellow.*" (MacGillivray 2009, 160). If these stories describe the Santorini eruptions and the darkness created by the clouds of tephra and ash covering almost all the East Mediterranean (Johnson et al 2012) and were recorded by direct witnesses, they would, particularly the latter, be advocating an extremely Low Chronology. My own opinion would be that all of them, by their appearance over such a substantial spread of time, tend to support the theory that these stories were universal, used each time the necessity arose to mark a particular occasion. There are many examples illustrating the use of similar 'model' stories. The el-Arish description was, if not actually fictional, created very much later than the event it described. Darkness during the day can be also explained as the result of a solar eclipse. However, there are other events placed within Thutmose III's reign, such as the Deukalion flood (by Manetho), which has been connected with the tsunami by J.A. MacGillivray (2009, 160–161). He also mentions many other descriptions of different disasters which occurred in Thutmose III's reign and he suggests that the Santorini volcano erupted during his 5th regnal year. As mentioned above, it is extremely difficult to connect such descriptions with particular events, while, on the other hand, a particular event can be memorized and handed down unchanged for years (Bouzek and Kratochvíl 1994; Barber and Barber 2004).

On further consideration of the evidence, I would add another possible interpretation of events, which may support the placing of the Minoan eruption to the SIP. The eruption could have played the same role in Hyksosian Egypt as it did in Minoan Crete, where it seems to have destabilized the fragile Knossian hegemony over the island (Driessen and Macdonald 1997; Klontza-Jaklová and Klontzas, *in print*). The weakening of the not fully centralised power of the so called Hyksosian rulers, could have given decisive advantage to the representatives of traditional Egyptian power. It is possible that Ahmose underwent the volcanic catastrophe but that, at that stage, he had not yet become the pharaoh and Hyksosian power still existed. Although the Minoan eruption didn't affect Egypt primarily, it affected climate, economy, transport, trade and the psychology of people. It must surely have been discussed and passed on as important and shocking news, undoubtedly much exaggerated. So, the Ahmose tempest stela could refer to the Minoan eruption and Ahmose could have been its witness (coeval) but the events could have taken place before he was on the Egyptian throne.

The majority of archaeologists working with finds or in the field use pottery imports and influences in order to

evaluate the contacts between populations, which impact the pottery styles and movement of vessels from region to region and provide criteria which help to re-create the networks of the time. A lot of imported pottery was found in Avaris. The main bulk comprises imports of Cypriot White Slip Ware (chapter 2.2.3.1.1.) (Oren 2001, 139–140, Manning 1999, 325), causing many authors to infer intensive contacts with Cyprus, and Cypriot pottery was found in contexts together with Aegean fresco fragments and pumice.

The other main ceramic group used to synchronize regions is pottery of Tell el-Jahudija type (shortened to TY Ware), which was named after the eponymous site. This pottery was once accepted as typical for its time but today it is clear that the style was very popular and was used for a very long period, from the 12th to 18th Egyptian dynasties in Egypt, the Levant, Syro-Palestine and Cyprus. (Merrillees 1978; Artzy and Asaro 1979; Kaplan et al. 1984; Manning 1988, 27; Redmount 1995).

2.2.2.4 The Pacheia-Ammos-like vessel from el-Lisht and other pottery from the cemetery in Abydos

Other important groups of finds are the ceramic vessels from the cemetery at Abydos in Upper Egypt, an important point on the map of Egypt and a secret place dedicated to Horus, son of Osiris, and from the site el-Lisht (there particularly grave No. 879).

The El-Lisht vessel (Fig. 30), a jug, was decorated in Tell el-Jahudija technique. It has a white encrustation on a dark surface. There were dolphins and pelicans depicted on the vessel, a strong Minoan tradition. The closest parallel for its decoration motive seems to be a jug found in Pacheia Ammos (Fig. 31) on East Crete, which is dated to MMIII – LM IA. Other finds from the grave belong to the Middle Kingdom and to the second intermediate period (Kemp and Merrillees 1980, 220–225). Stylistically, the vessel was also dated to the early Neo-palatial period (MMIII) (Betancourt 1990, 20). The El-Lisht vessel belongs to Dynasties XII and XIII which are dated to 1801–1650 according to the High chronology, 1786–1649 according to the Low chronology and to 1785–1606 according to the extremely Low chronology (Manning 1988, 26).

There were two graves containing Minoan pottery found in Abydos. In grave number 137 was an alabaster painted with black pigment. Unfortunately the shape of the vessel can be dated from LMIA to LMII-IA. The painted motif is very common in the LMIB period. This grave is dated to Dynasties XVIII – XIX.

In grave number 328 a bowl fragment typical of the LM IB period was found. It could also be from the Greek mainland. This was also the grave in which the Abydos stela was found. (Kemp and Merrillees 1980, 226–240).

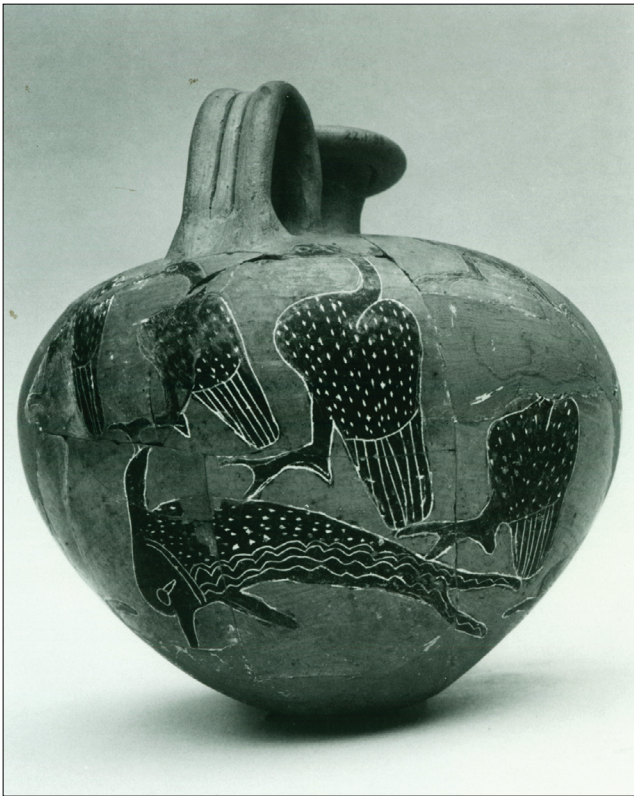


Fig. 30 / El-Lisht: TY Ware jug. (After Kemp and Merrillees 1980)

Aegean pottery was also found in Aníba, Kerma and Sidman. In Grave Number 59 from the Sidman cemetery a vessel decorated with a picture of a reddish-brown octopus was recovered. The shape of the vessel is again common from LMI to LM IIIB and can be from Crete or the mainland. This grave should be dated to the early Ramessian period.

All the listed finds come from old excavations with poor documentation. Grave collections were not stored in one place but spread around different institutions. Some of them cannot be physically located and are known only from filed note books. (Kemp and Merrillees 1980, 238–240)

Kemp and Merrillees (1980, 267) based their chronological conclusions on those finds and first radiocarbon dates and, using the historical data, they offered the following chronology (Table 5):

MM IB	Post 2000 -
MM II	- 1775/1750
MM III	1775/1750-1675/1650
LM IA	1675/1650-1600/1575
LM IB	1600/1575-1500/1475
LM II	1500/1475 -
LM IIIA	- 1375/1350
LM IIIB	1375/1350

Table 5

Absolute chronology of the Minoan Middle and Late Bronze Age. (After Kemp and Merrillees 1980)

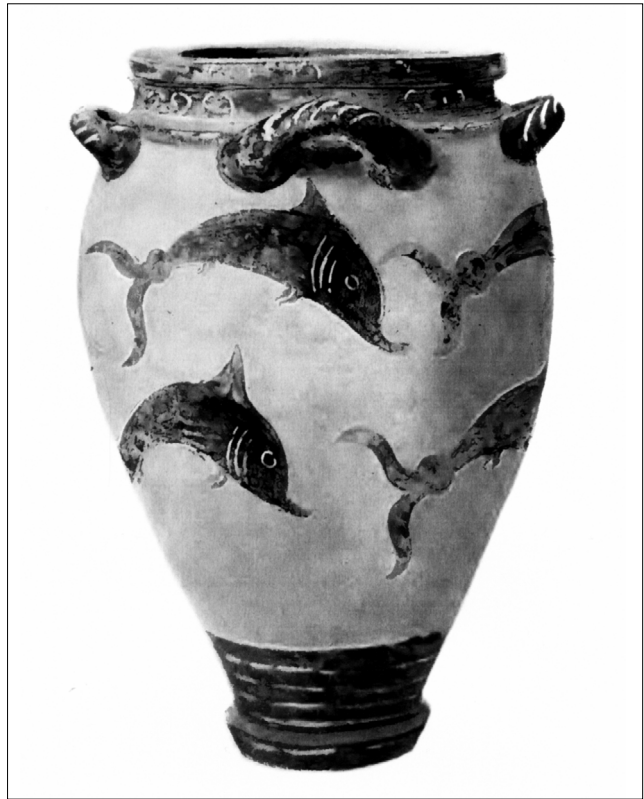


Fig. 31 / Pacheia Ammos MM III – LM IA painted pithos. (After Seager 1916)

TY Ware was recovered in large amounts at Tell el-Dab^ca in strata E/2-D/2. Some of the vessels were decorated with birds and fish (Bietak 1979, 254, 258–259, 262–263). Due to the presence of Cypriot imports in those layers, the synchronism with this island was obvious. Stratum E2/1 was contemporary with the beginning of LC IA and should be contemporary with MMIII/LM IA. Egyptologists date this horizon to 1640–1590.

TY Ware found in Tell el-Dab^ca is parallel to the jug from el-Lisht, mentioned above. The style of these vessels remained highly characteristic of Minoan pottery for the LM IA period from Crete or from Santorini. It seems that the correlation of LM IA and MB IIB periods may be correct or at least highly probable, as stated by S. Manning (1988, 27–29). It seems also to correlate with an Egyptian faience vase found in Knossos in LM IB strata. (Cadogan 1983, 517).

Grave collections must be approached differently from those found in habitation levels. Looked at en masse they can contain obscure mixtures of items from different periods which were kept for generations before being excluded from living culture (Pomerance 1984; Kemp and Merrillees 1980, 253; Manning 1988, 25; Warren 1990, 24–26 etc). The philosophy underlying the creation of such collections and the reason why each was put together in its own particular way are generally not matters we can interpret with any clarity. Obviously the latest item will give us a terminus post quem for each grave context but our knowledge of material cultu-

2. The individual disciplines

re is not that precise, despite its having been studied for such a long time. For instance White Slip Ware, whose dating was once thought of as fixed, was produced for a much longer time than had been supposed. Moreover, even the dates of its initial and final phases are unclear (for more details see chapters 2.2.3.1., 2.2.3.2.). A similar scenario applies to TY Ware. Aspects of pottery dating and its chronological sensitivity will be discussed in Chapter 3 of my final conclusions.

Pottery of TY Ware's style was imported to Cyprus but not, as would be expected, from Syro-Palestine but from Egypt where it was produced from Dynasty XII to Dynasty XVIII (Arzy and Asaro 1979). This type of pottery was very popular throughout the Near East, in Egypt and Cyprus, though not a single fragment was found on Crete or on the Greek mainland. It is obvious that the transformation of parallels can be very dangerous when the region and chronological range is so wide. There were contemporary workshops of TY Ware in Lower Egypt as well as in Syro-Palestine. The presence of this pottery is more important for tracing a common cultural area or zone of close contact than for chronology.

2.2.2.5 Cartouche of Khajan (Fig. 32, 33)

An alabastron disc, 103 mm in diameter with inscription: “*Good god Seuserenre, son of Re, Khajan*“, was found at Knossos in 1901. A. Evans has said about this find that “*No discovery made in the whole course of the excavations at Knossos can rival in historic interest the finding of this record of the king who seems first to have united the*



Fig. 32 / Cartouche of Khajan. (After Karetsou 2000; 2001)

whole of Egypt under the Hyksos dynastic sceptre“ (Evans 1921–1935: I, 420). He was right and the dating of the context where the disc was found would prove crucial for synchronizing the two regions. Unfortunately information from the field note book is not in agreement with the contextual material with which the disc is stored. The original note book speaks about a stratum which dated the artifact to MMIII but today the item itself is stored with material from a context which also contains sherds dated to LMIIIA. (Betancourt 1990, 20–23; 1997, 430), (original report: Evans 1921–1935: I, 419, fig. 304 a, b). However, the date in the MM III period has largely been accepted (Macdonald 2005, 134; Manning et al. 2014, 1171) because dating it to LM IIIA (ergo the Amarna horizon) renders it impossibly late.²⁶ Khajan seals were found in layers D = E/1 and D3 in Tell el-Dab'a and they should be comparable with the Late Babylonian Kingdom (with 100–150 year discrepancies in its dating as well; Manning et al. 2014, 1171; 2016, 1).

This cartouche could have been part of a diplomatic gift from a Hyksos ruler to his Knossian partner (Bietak 1994, 207; Niemeier, Niemeier 1998, 97).

2.2.2.6 Closing notes to contacts between Crete and Egypt

Contacts between both regions were obvious to students of Aegean archaeology from the outset and their later confirmation has not come as a surprise but their frequency and intensity in each period are less clear and interpretation of single finds can be somewhat



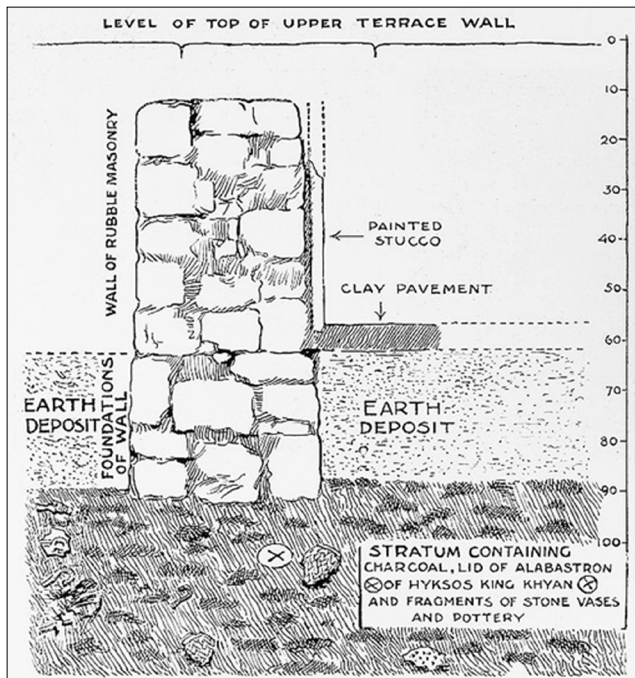


Fig. 33 / Find spot of the Khajan cartouche: in the base layers of the lustral area. (After Evans 1928-1935, 1st volume, p. 418)

hypothetical. They cannot be relied upon too heavily. In the 1980's many scholars realized that not only the general approach but also the individual finds must be reviewed. P. Betancourt (1987, 45-49) pointed out that synchronism is often supported by finds whose production and use phases were very long. He was the first who said that the synchronism of LM IB with Thutmose III is impossible, and placed the Santorini catastrophe into the SIP and deduced the following chronological sequence (Table 6):

Crete	Greek mainland	Absolute chronology	Egypt
LM IA	LH IA	c. 1700 -1610	
LM IB	LH IIA	c. 1610-1550	
LM II	LH IIB	c. 1550-1490	
LM IIIA:1	LH IIIA:1	c. 1490-1430/10	Amarna horizon
LM IIIA:2	LH IIIA:2	c. 1430/10-1365	Ahkenaten
LM IIIB	LH IIIB	c. 1365-1200	

Table 6

Synchronism of the Aegean Late Bronze Age and Egypt. (After Betancourt 1987)

Imports from Egypt in Crete and Cretan imports in Egypt and other evidence of contacts between the two regions are more frequent in the MM period and during the advanced Dynasty XVIII and Amarna horizon in Egypt and the Cretan Neo-palatial period (Driessen and Macdonald 1997, 80-82; Karetsou and Andrea-

daki-Vlazaki 2001) The link between numbers of imported artefacts found and intensity of contacts is, of course, open to question. Some, e. g. Phillips (2008, 220), would take the view that the low absolute number of imports implies that contacts were very limited. The alternative view, that contacts were much more intensive and we have either found only a tiny proportion of the imports or media other than imported artefacts were more important, is taken by some other authors (e.g. Karetsou, A. and Andreadaki-Vlazaki 2001; MacGillivray 2009; Marinatos 2010; Cline 2014, 19, 22, 59). This topic was, and still is, approached very individually and the research field remains much more a forum of pros and cons. One method which could help introduce more objectivity to interpretation of the data is the reconstruction of networks (e. g. Knappe 2011).

It is eminently feasible that we are still missing contexts in Egypt which would confirm or document the precise moment of the Santorini eruption. However, our current efforts to synchronize both regions hit the following difficulties:

- 1) Deviations in Egyptian absolute chronology for the end of the Middle Kingdom, SIP and New Kingdom,
- 2) Grave assemblages which contain chronologically insensitive pottery and pottery from different periods,
- 3) Pottery from settlements with long term duration and different times of use and deposition.

These discrepancies allow us to create more or less probable models but, for the moment, none of the evidence is unambiguous. The radiocarbon dates, despite all their uncertainties, remain the most scientific we have and are thus less subject to interpretive bias. E.g. M. Bietak, according to Tell el-Dab'a stratigraphic levels, strongly suggests that the period MM IA is contemporary with the Early Middle Kingdom, MMIB with Dynasties XII and XIII and LM IA with Dynasty XV to early Dynasty XVIII, which latter is then contemporary with the LM IB period (Bietak 1995, Fig. 1).

S. Manning (2002, 742) synchronizes both regions differently, deeper in time. He asserts that LM IA cannot be connected with Dynasty XVIII but only with Hyksosian SIP. He supports his assumptions by using the radiocarbon dates and suggests that LMIA lasted from 1689/1680 to 1610/1590 and not to 1480 BC.

The stratigraphic sequences in Avaris support the classical dating and a different overlap of the single phases of both regions. It is generally true that Minoan archaeologists and European prehistorians tend to accept the deeper (high) radiocarbon dates while Egyptologists prefer the conventional (younger, low) ones.

We also cannot place excessive reliance on the imports from the Aegean into Egypt and Egyptian items in Crete. Although they prove that there was contact between elites, and it is especially important for Crete,

2. The individual disciplines

the Aegean was at the periphery of Bronze Age state civilization. Contacts between Egypt, the Near East and Cyprus were much more intensive and those regions effectively formed one cultural *koine* as can be inferred from the intensity of interchange of artefacts. Even so, the synchronism of these regions is not as simple as it may look. There are methodological problems; how to evaluate the imports, how to understand the forms and intensity of the contacts, how to consider their dating (more about the method in Chapter 3). Here, I would like to mention the opinion of Prof V. Kruta who is facing similar problems with dating single items placed in Celtic graves. He considers that it is necessary to date the cemeteries as a general context because each item bears witness to something different, had a different pathway into the grave context, and it is reasonable to assume that the people who placed all the items into the graves were not necessarily directed by the age of the things. The meaning, the importance, the sense of each item lay in different spheres for them.

I also agree with the opinion, expressed in Manning et al. 2014, 1165, that chronologically useful Egyptian items are, in fact, very rare in the Aegean during the relevant period.

2.2.3. Minoan contacts with Asia Minor and the Near East

H. Kantor (1947) first raised questions concerning second millennium contacts between Eastern Mediterranean regions. Following in her footsteps, more than half a century later, the topic was explored at a number of international meetings (Cline and Harris-Cline 1998; Mynářová 2010; Mynářová et al. 2015). However, evaluations of the intensity and importance of such contacts tend to be rather subjective. There is a limited number of definitively Minoan objects in the Near East (Sørensen 2009, 267), and objects of Near Eastern origin are even more rare in the Aegean region, despite appearing as early as the MM period (Betancourt 1998, 7). However, it seems that the Minoans dominated Aegean trade with the Near East and Egypt during the Second Millennium B.C. (Bass 1998, 184–185; Cabet 1998, 106–108). The character of those contacts is still defined mainly on hypothetical and theoretical criteria. Items which have survived in archaeological contexts were probably very rare objects from the trade between East Mediterranean and Aegean elites. They were moving, trading and exchanging items related to the metal industry, from raw materials to elaborate objects, and other luxuries, such as textiles and musical instruments. At the same time, non-material values, such as symbols, aesthetics and ideas, and people, especially skilled craftsmen, artists, astronomers, engineers etc., also moved around the

trade routes. However, only a very small section of society, including couriers, merchants and maybe even artists, actually travelled regularly (Betancourt 1998, 8; Barber 1998, 16; Cabet 1998, 106–108). The existence of an international fashion, iconography and also language, shared by the local elites of the region, may be presumed (Betancourt 1998, 7; Cabet 1998, 109–110). Crete was probably mentioned in Mesopotamian archive records (Niemeier 1991, 199 with references to original sources in *supra* 89–92).

The evidence for these contacts once again provides an opportunity to investigate the potential for synchronization of the regional chronologies in order to find some chronologically fixed points.

Mesopotamian chronology is conventionally based on texts, eponym lists, king lists, dated documents, synchronism with other regions and royal inscriptions. The Near Eastern texts are less accurate before 1000 BC and the absolute chronology is based on assumption and deduction. Two different systems were created and both are in use – a high and a low chronology with quite large discrepancies, e.g. the dates for the reign of Hammurabi of Babylon, according to the high and low chronologies, are about 150 years apart²⁷ (Hunger 2009, 145–149).

The experts working in the field agree that there is conflicting evidence for Mesopotamian chronology. Pottery development, as we understand and interpret it, suggests a relatively low chronology, dendrochronology a higher and astronomy a very high one. For the moment, it is impossible to decide which is correct and why (Hunger 2009, 152).

The reference chronological system for all the Near East is the Babylonian absolute chronology. The Babylonian calendar was built according to observations of the planet Venus, which couldn't always be absolute or perfect and it is necessary to deal with even larger deviations than for Egyptian chronology. Discussion about the accuracy of Near Eastern chronology is still ongoing, which is not surprising given that, for some periods the difference between the high and low chronology can reach as much as 200 years.

As mentioned above (Chapter 2.1.1), a new dendrochronological/radiocarbon project has recently been published. The authors conclude that the Middle- and Low-Middle Mesopotamian chronological scale is correct. They place the death of Šamši Adad I in 1776–1768 BC (Manning et al. 2016).

Where the general chronological difficulties of the second millennium BC relate directly to the problem of determining an absolute date for the Minoan eruption, there are two sites cited as crucial or, at least, very important: these are the palace of Alalakh in South Asia Minor (contemporary Turkey) and the urban center of Tel Kabri (contemporary Israel) where frescoes and painted floors of Aegean style were recovered.

2.2.3.1 Palace of Alalakh

Fragments of frescoes of Minoan style (Fig. 34) were found by the excavation of the site Tell Atchana in South Turkey on the Syrian border, which was identified as the ancient Alalakh. Excavations there started quite early. Leonard Woolley excavated the site from 1936–1939 and from 1946–1949 but the quality of field work and final publications were affected by the events of World War II (a preliminary report was published in the *Illustrated London News*, 2. 12. 1939/833; Woolley 1953, 1955). Much later, in the late 20th century, a team sponsored by the University of Chicago started surveys again and has conducted excavations, led by K. Aslihan Yener, in the early 21st century. She is now leading work sponsored by Mustafa Kemal University and the Turkish government (http://www.alalakh.org/intro_alalakh.html).

The palace of Alalakh was situated on the periphery of the Hittite Empire but was not a part of it. However, the location was favourable not only for permitting but also for facilitating contacts with Hittites, Cyprus and the Aegean. Alalakh was mentioned in many literary sources produced in other centres but significant literary documents were also found on the site itself. One of the most important sources is the so-called Alalakh Codex found in strata IV and VII which belong to Near Eastern LBA – MBA (Gates 1987, 60; Niemeier and Niemeier 1998, 69–71; Manning 1999, 341–360).

Very fragmentary frescoes were found in LBA contexts of strata IV and VII. The frescoes of stratum VII are made in Aegean style (Fig. 14) and are traditionally classified as Cretan LM IA style painting but efforts to date wall paintings accurately seem to be futile due to the fact that only a few small fragments were found. The problem of destruction horizon dating, or the dating of the moment when the frescoes were consigned to the archaeological record, is usually quite clear, at least on a relative scale²⁸, but the moment of a fresco's creation is a huge problem. Firstly, for how long was each fresco displayed? They could be repaired and/or repainted several times, as were the Knossos Throne Hall frescoes. We also do not have a sufficiently large collection of well dated frescoes to be sure that we can date according to the stylistic features presented on them. It is certainly more correct to say that the Alalakh frescoes reflect the Minoan wall painting style of MMI B – LM II periods rather than to date them accurately (Niemeier and Niemeier 1998, 69–70; Blakolmer, *pers. comm.*). The frescoes in the palaces documented the wealth, prestige and power of their owners. (Brysaet 2008; Cline et al. 2011) I am, therefore, convinced that we cannot assume that they were only used for a short time.

However, it is not only the frescoes which make stratum VII so important for the synchronism of the Near East and Aegean, literary documents were also found there.

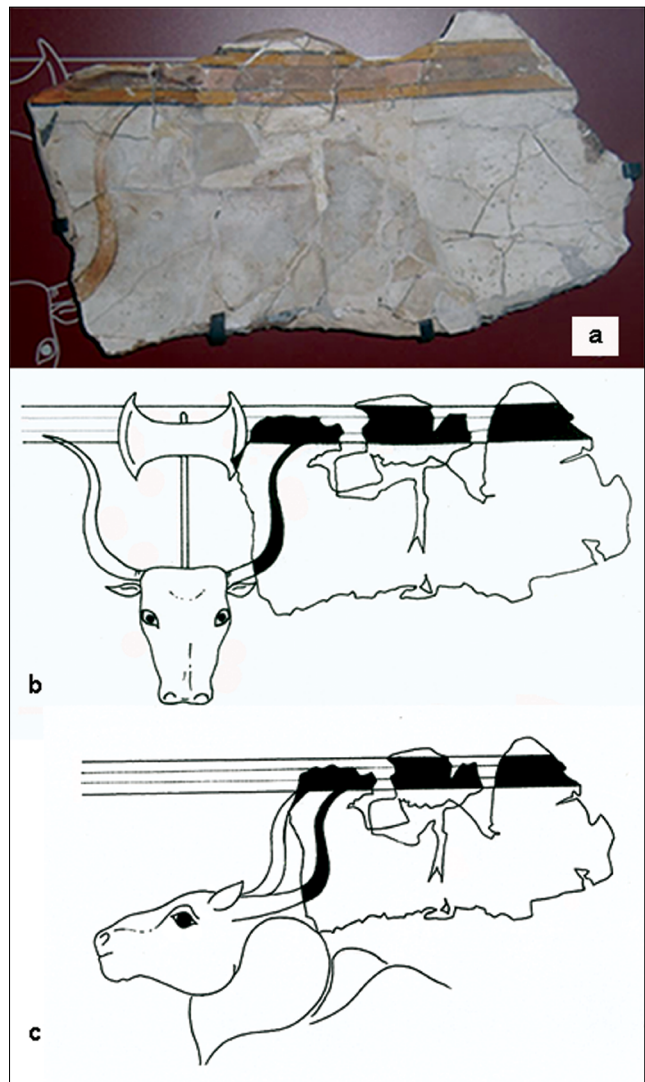


Fig. 34 / Possible reconstructions of an Alalakh Aegean style fresco: a) fragment as found, b) Niemeiers' reconstruction (Niemeier and Niemeier 1998), c) other possible reconstruction. (Illustration by author)

How, then, can these strata be dated? A combination of typological and historical dating methods has been used to try to place the Alalakh stratigraphy within the historical frame of the region. L. Woolley dated stratum VII to 1780–1730 BC, ergo to the period of the 1st Babylonian dynasty's reign. But it seems today that he was probably wrong and this dating would be too early (Niemeier and Niemeier 1998, 69–70).

The name of Yarim-Lim, who was probably a grandson of Yarim-Lim I of Yamhad, appears in the cuneiform records of Alalakh stratum VII as ruler. This dynasty can be chronologically compared with the Babylonian King Hammurabi and Zimri-Lim of Mari but both of these are at least one generation earlier.

A seal of King Šamshi Adad I, which is likely to be contemporary with Phase IB of the period of Waršama of Kültepe, was found at the site of Sarikaya in Turkish Acemhöyük. The palace of Sarikaya was built around

2. The individual disciplines

1725 and the Waršama palace in Kültepe around 1810 BC. These dates broadly overlap with the range of possible dates for Hammurabi of Babylon's accession to the throne in 1848 (high chronology), 1792 (middle chronology) or 1728 (low chronology) BC. According to literary sources, lists of kings, genealogies and archaeological comparisons, dates for the reign of Šamshi Adad I are 1864–1832 or 1808–1776 or 1744–1712 BC. New re-dating of the second millennium BC in Anatolia and Mesopotamia based on radiocarbon and dendrochronological cross dating suggests that Šamši Adad I died between 1776–1768 BC (Manning et al. 2016, 22). The sources inform us that he was on throne for 33 years and his last year in power was contemporary with the 17th year of Hammurabi's reign. The cuneiform tables from Kültepe fix the date of his 1st year on throne to 1810 BC. The historical evidence makes it almost certain that Hammurabi of Babylon was a contemporary of Zimri-Lim of Mari, Šamshi-Adad I of Assyria and Yarim-Lim I of Yamhad. The latter's successor was Hammurabi I of Yamhad and he was succeeded by Abba-El I who was a contemporary of but slightly older than the Yarim-Lim of Alalakh VII, who was probably his brother (Manning 1999, 350, Fig. 65).

The synchronism of the various Near Eastern regions is a complex issue and efforts to determine the correct absolute chronology via dendrochronology have been made (Manning 1999, 345). General syntheses for the Near East try to combine historical and archaeological dates with astronomical observations (Gasche et al. 1998).

King lists and genealogies seem to indicate that Yarim-Lim ruled at Alalakh from 1681/1651 to 1657/1619 BC, giving a terminus post quem for Alalakh stratum VII, which, according to L. Woolley, represents 50 or, at most, 75 years (Woolley 1955, 385). Other writers seem to accept a similar timespan: i.e. 1661–1591 or 1637–1559 BC (Gasche et al. 1998) but some would extend it beyond 75 years to as much as a century (Niemeier and Niemeier 1998, 70).

This information can be compared with sources of Hittite provenance which document that the Hittite king Hattusilis I destroyed Alalakh and later on invaded Syria. The dating of those events has not been generally agreed and we should bear in mind that Hittite chronology is under revision to this day (Müller-Karpe 2003, 383; 2009). The reign of Hattusilis I was dated approximately to 1595–1550 (Kühne 1987) but. T. Bryce (1998) uses a chronological system which shifts it to about 3 generations earlier: 1650–1600 BC.

It should be underlined that the events which resulted in stratum VII lasted for a long time and the frescoes could have been made at any time during this period (Cline et al. 2011, 256–257), and that the different scales of Mesopotamian chronological frames and scales are floating within 150 years.²⁹

The historical dates can be combined with chronological scales, deduced from archaeological evidence of typological progression and stratigraphy, which confirm the relative chronology and sequences of the single phase and support the connections mentioned in the literary sources.

There is characteristic burnished pottery, the so called Bichrome Ware, imported from Cyprus, within Alalakh's stratum VII.

The typological phases of Bichrome Ware on Cyprus have been worked out in detail. The first phase of Bichrome Ware production can be placed in the Middle BA with an overlap into the Late BA. This type of pottery was also present in deposits of stratum D/2 in Tell el-Dab'a. This would make Alalakh VII contemporary with the Hyksos period in Egypt, probably with the last century of Hyksosian hegemony over the Lower Egypt. It could, therefore, be expected that White Slip Ware would also be present in stratum VII but it is totally absent, as is TY Ware. Only in stratum VI were two atypical fragments found and there was one rhyton fragment in stratum VII. The ceramic assemblage of Alalakh VII can be dated to the Syrian MB II period on a relative basis (Gates 1987, 66).

This means that the absolute dating of stratum VII in Alalakh remains open. S. Manning (1999, 341 and farther) tried to fix the ceramic sequences using Cypriot ceramic chronology and concluded that Alalakh VIA which follows stratum VII, should be contemporary with the end of LC IA and early IB. He worked mainly with Red Slip Ware and Bichrome Ware. In absolute chronology we can settle on the end of the 17th C after Manning (1999, 341 and farther).

Stratum Alalakh VIA was assumed to be contemporary with Syrian MBII and Alalakh VII with the late phase of MBII. Syro-Palestinian MB II should align with LCIA and LM IA (Gates 1987, 66–71; Manning 1999, 341–366).

It is extremely difficult to synchronize the Near Eastern chronology with Hittite chronology, where there are also several chronological systems in use, from High to Low, as is the case throughout the region, e.g. the options for Hattusilis I's reign range from 1575–1540 BC (e. g. Kühne 1987) to 1650–1610 BC (Bryce 1998, summary of opinions Müller-Karpe 2003, 383–394, spec. Fig. 1)

Scarabs of Hyksos kings were found in stratum VI at Alalakh, which further corroborates synchronization with the Hyksos period, ergo SIP. (Gates 1987, 80).

Finally the fresco found in stratum VII, mentioned above, was dated stylistically as characteristic of the Neo-palatial fresco style and the absolute dating of this stratum was put at 1650–1575 BC (Niemeier and Niemeier 1998, 70). This option appears possibly to have been chosen in order to support the early dating of the LMIA period and the Santorini catastrophe. It is

a possible date, but for the moment there is little real evidence. The chronologies of all the kingdoms and other polities of the region are still quite “fluid”, their chronological systems have serious “plasticity”, or are not actually fixed in time at all. It can be concluded that, till now, all the regions mentioned are “fighting” with the absolute chronology of the 17th and 16th centuries BC. It seems reasonable, therefore to conclude that, far from the Alalakh stratigraphy providing help with absolute dating of the 17th – 16th centuries BC in the Eastern Mediterranean, the dating of the Alalakh stratigraphy is itself in need of help.

2.2.3.2 Tel Kabri

The site of Tel Kabri (Kempinski et al. 2002, Cline et al. 2011), a city, placed in a prominent position, which was a gateway community and the most powerful polity in northern Canaan, can be compared with Hazor or even Tell el-Dab‘a (Cline et al. 2011, 258) and may be one of the most important elements for synchronism and absolute chronology of the 17th and 16th centuries BC in the Eastern Mediterranean. Tel Kabri is placed in West Galilee and it is possible to identify it with Biblical Rehob. It lies on an important trading route later known as the Via Maris. The first fortified urban center is dated to the MBA and already was about 32 ha. in area. It was destroyed and abandoned in Palestinian LBA IIB.

Painted floors imitating floor tiles were recovered in the central yard of the palace. (**Fig. 35**) The fresco technique was used and the decorative pattern is made in red, yellow, brown, grey, black and blue colours. Analogous decorative motifs, colour ranges and techniques are known from Crete and Santorini and spectrographic analyses have shown that the pigments have the same composition. The floor surface was significantly disturbed but some parts were still well preserved or could be reconstructed. The painted squares, imitating ceramic tiles, are circa 40 × 40 cm. Yellow and white tiles are placed as on a chessboard. The earliest such painted floors are known from the ‘Room of the Loom Weight Deposit’ in Knossos and are dated to MMII – III. Painted floors were recovered in Aktrotiri as well, where they are dated to LM IA and, in Knossos dates of LM IB are quite usual. The floors found in Tel Kabri belong to the destruction horizon of MB IIB. Motifs used there – crocuses or lilies – were very popular as late as the LM IA period. It is unlikely that such a similar combination of technique, motifs, colour range and composition would be the result of just simple inspiration or imitation; a more probable explanation would be that the floor was made directly by Cretan artists (Niemeier 1991, 196–199; Niemeier and Niemeier 1998, 72–73).

During the excavations in 2008 and 2009, more than 100 new fragments of wall and floor plaster

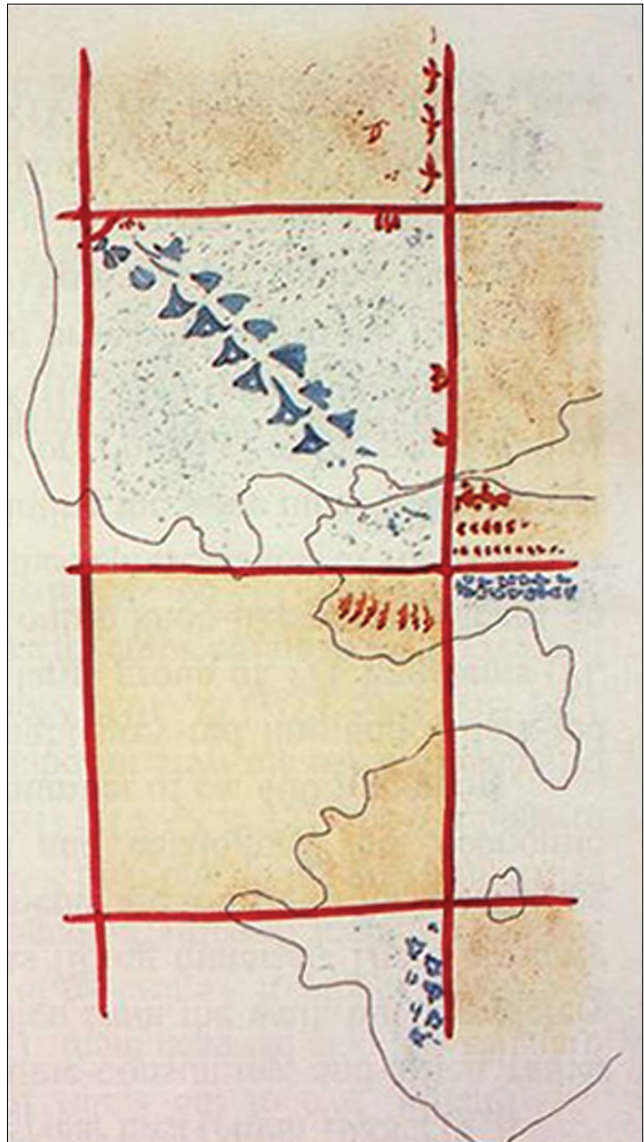


Fig. 35 / Reconstruction of painted floor from from Tel Kabri. (After Niemeier 1991 and <https://digkabri.wordpress.com/excavations/>)

were uncovered (Cline et al. 2011). The first group, which was found in the area D-West, comprises small fragments covered in green and brown paint. The excavators suggest that they come from the depiction of a hilltop within the landscape illustrated in a miniature composition and that they follow the Aegean conventions for depicting landscapes. They correlate them with Theran art. Other fragments from area D-South are also covered by multi-coloured painting, done with great precision. The authors of the painting were excellent artists, who used the real fresco technique, with multiple layers of colours “just as would have been done in the Aegean”, according to the excavators (Cline et al. 2011, 251). They recognize parallels in Knossian frescoes. The fragments covered in blue paint may have originally come from a picture of a griffin, wing of a bird, flying fish or hand with long fingers and nails. Some of the fragments were

2. The individual disciplines

painted in various colours, outlined in black, which is a characteristic element for Aegean depictions of architecture. (Cline et al. 2011, 252–256). Unfortunately, the Kabri fragments in blue are too fragmentary to be read with certainty but their finding is very important in relation to the chronological framework. Fragments found in the D-West area, the north part of the palace, appear to have been found in situ but not in their original position. They too are fragmentary and some are lying with the painted side down. They were probably reused as a temper within mudbrick material during the rebuilding of the last palace. As we know, this last palace was undecorated and its final destruction occurred in the later MB II phase (Kempinski et al. 2002, 120). The plaster fragments were accompanied by a fair amount of Cypriot White Painted ware, typical for the MB period, but the frescoes cannot be dated to the final phase of the palace (after Kempinski et al. 2002 phase 3c). Instead, all belong to a preceding phase (Kempinski's 3b), at the end of which an extensive renovation program took place. The frescoes were made during the 17th century BC. (Cline et al. 2011, 254–257)

The questions remain if it was possible that Cretan artists came to Tel Kabri palace and, if so, how, why and when they came. Literary sources seem to be very helpful in this point. Around 1800 BC the king of Ugarit sent one of his “young men” to Mari with reports about a spectacular palace of Zimri-Lim, which was decorated with frescoes (Niemeier 1991, 199). In Zimri-Lim's palace similar floors were also found (Niemeier 1998, 73; original publication: Parrot 1958, 109).

Ugarit was known to Cretans. They obtained tin there, according to tales from Mari, which also spoke of metal vessels and weapons manufactured on Crete. Such luxury goods were mentioned in the time-frame encompassing the reign of Zimri-Lim to the Mesopotamian kings. (Niemeier 1990, 120–124; 1991, 195–196).

Cretan imports were found on many sites of the Near East: e.g. two silver chalices in Byblos, Proto-palatial polychrome pottery in Ugarit, Quatna, Hasor and Byblos (Niemeier 1991, 196)

The Ugarit mythology speaks about the great fame of the Cretan artists. The goddess Anat is said to have sent a courier called Cadesh a Amur from Byblos on a long overseas journey to find the god of craftsmanship – Koshar a Chasis – and to invite him to decorate the palace of the god Baal with the most special artistic items. Koshar a Chasis was supposed to have reigned in the land of *KPTR*, read as Kaphthor, which is usually identified as Crete. The tablets where this story was written are later in date, from the first half of the 14th century BC, but the myth can be significantly earlier. The god's name Koshar a Chasis has been translated as Master Builder and Caster. (Niemeier 1991, 199 with references to original sources in supra 89 – 92).

This personality could be connected to the myth about the Cretan Talos, the iron man destroyed by Theseus, according to Greek classical mythology.

It seems that Cretan artists and craftsmen had an international reputation due to their abilities and there is plenty of information in literary sources about the traveling artists, who were sent from king to king to provide their services. These exchanges were part of diplomatic contacts (i. e. Niemeier 1991, 199–202; Bietak 2008; Cline et al. 2011).

Tel Kabri, according to its excavators, was finally destroyed and abandoned shortly before 1600 BC and the floors must surely have been painted before that date (Niemeier 1990, 120–126; Niemeier 1991, 197), or, more probably, in the preceding phase (3b), as indicated by the new excavations, cited above.

Does this chronology for the Kabri frescoes have an impact on Aegean chronology at all? The answer should be yes. Kabri is to date the only site in the ancient Near East that continues to yield Aegean style frescoes dating to the Middle BA. The LB AI stratum in Kabri predates the advent of the New Kingdom in Egypt. The frescoes must have been made deep in the 17th century BC. (Cline et al. 2011, 257–258). Kabri is one of the key sites for the synchronism of Aegean, Asia Minor's, Near Eastern and Egyptian Bronze Age chronology. However, it cannot add primary data to the problem of the absolute dating of the Santorini eruption. This event left no traces in palace of Kabri. W.-D. Niemeier (Niemeier and Niemeier 2002, 266–267) is convinced that the Kabri stratigraphic sequences support the high chronology, though some other authors are more wary, saying that it is too early to answer that question (Cline et al. 2011, 259).

2.2.3.3 Closing notes on Aegean – Near East contacts and chronology

Frescoes found in many of the Near Eastern palaces are very important, albeit their chronology remains significantly uncertain and spreads over a lengthy timespan.

Allow me to repeat here that the Tell el-Dab'a frescoes decorating palace F and part of palace G, in their early palace phase C/3 (stratum d) were made in the Aegean style and are now dated by the excavators to the early part of the reign of Thutmose III, ergo 15th century BC (Bietak 2007a, 38).

Frescoes in Quatna were made in both Aegean and local styles and belong within the Late Bronze Age; in absolute chronology the 16th and 15th centuries BC (Bietak 2007b, 280–282; Brysbaet 2008, 99–100, Pfälzner 2008a, 2008b, 2008c).

Only the Alalakh – stratum VII frescoes can possibly be contemporary with those at Kabri. It is very difficult to match the historical and archaeological records

in order to reach a close fitting absolute dating for those frescoes (Manning 1999, 349).

However, the frescoes do help to synchronize the chronological systems of Crete and the Near East and this may eventually be used to establish an absolute chronology for the Santorini eruption. It is impossible to date them perfectly but all can be classified as frescoes of MMIII – LM IB style (Neo-palatial; Cline et al. 2011, 259, 280). It should be kept in mind that artistic styles and fashions could have survived for a long time, while the different abilities of each individual artist and the probable lengthy display of each fresco make accurate dating extremely difficult. However their presence demonstrates the existence of a relatively stable network of power elites across a large region. Knowledge of how societies were operating and co-operating helps to evaluate the relative chronological options and instead – and mainly so – establish the absolute chronological frame, which is necessary if we want to compare the different entities directly.

The chronological synchronism and the character of connections between Crete, the Aegean, Asia Minor and the Near East are crucial to our understanding because they created the circumstances from which the Iron Age societies of the region arose. Unfortunately, even nowadays, these correlations remain “very shaky” (Cline et al. 2011, 259).

2.2.4 Cyprus

Cyprus was one of the main players in the second millennium East Mediterranean. Intensive contacts are traceable in all directions from this island, which enjoys a strategic location in the basin of the Eastern Mediterranean, and, although it is not, strictly speaking, central, the majority of sea routes must cross it. Cyprus was rich in raw copper which gave it an economic advantage and fixed its pre-eminent position in the international trade network, on what was then a ‘global’ level, during the entire Bronze Age. Cyprus was constantly in contact with Asia Minor, the Near East, Egypt, the Aegean and also the Western Mediterranean.

Despite the position of Cyprus within the inter-regional trade network in raw materials, there are relatively few items of foreign provenance found in Cyprus and not many exported artifacts from the island have been found in other regions: there are certainly fewer than expected and those which have been found are not chronologically sensitive at all, despite the great hopes attached to special types of Cypriot pottery, called White slip ware and Bichrome ware, and their imitations and derivatives. These pottery types connect Cyprus with Egypt and the Near East and have been found on almost all excavated centres throughout the Eastern Mediterranean. However, in the Aegean and on Crete there were literally only a few fragments, on

Santorini one complete bowl, as mentioned below (Wiener 2003, 367 with further bibliography mentioned in *suprae* 11, 16, 17). The largest collections outside Cyprus were found in Tell el-Dab‘a (Avaris) (Maguire 1995) and in in Tell el-Ajull (Fischer 2009) but there are about 40 sites in Levant and Egypt where Cypriot pottery was imported during the Middle and Late BA (Maguire 1990, 92).

On the other hand pottery from Egypt and the Near East was found in Cyprus (Manning 1999, 323–325). Bilateral contacts existed during the entire MC III – LC IB period (~ LM IA – II, LH I – LH IIB, Dynasties XII – XVIII, Syro-Palestinian MB IIB – LB).

Until quite recently the chronology of Cypriot pre-history was very vague and also extremely complicated. Only a limited number of stratified settlements had been recognized and excavated and the political situation in Cyprus has prevented intensive research in the north for a long time. Despite the continuing political problem, the archaeological situation is now changing. A large settlement, i. e. Maroni-Vournes (Cadogan et al. 2001, 75–88), and the shorter period settlements of Enkomi and Toumba tou Skourou (Eriksson 2001, 61) have been excavated and studied. Comparative studies with sites in the Delta (Tell el-Dab‘a), the Sinai (Tell el-Ajjul) and the Hittite Empire have been undertaken. The need for a detailed Cypriot chronology and synchronism with other regions remains very real. Methodologically, Cypriot luxury pottery from the wider region is placed within relative chronological scales, absolutely dated from the contexts in Egypt and the Near East, wherein it was found, these data are applied to parallel material in Cyprus and then the Cypriot absolute chronology is again used to cross-check Egyptian and Near Eastern chronological scales. This reduces the methodology to a circular argument and renders it, or at least the final step in it, useless. The Cypriot pottery can be only used as an indicator of relationships in the wider frame of relative chronology.

2.2.4.1 Specifics of White Slip Ware and related pottery types

The main characteristic of this pottery type is dark painting on a light surface, which was a common fashion of Aegean painted pottery of the Late Bronze Age. White painted ware, the precursor of WSW, is characteristic of the Middle Bronze Age and belongs to a pottery family, which, on Crete, is called Light-on Dark, with which it is contemporary. WSW, which is the same as Dark-on-light Aegean pottery, concludes in the mid 12th century BC. WSW is very uniform throughout its existence. The main vessel type is a semi-globular bowl, around 20cm in diameter, with horizontal chicken-breast shaped handles. From the earliest phase, the vessels were covered in white or buff slip and painted

2. The individual disciplines

with orange, red and, later, brown linear ornaments 'hanging' from the rim and, later, in vertical bands. WSW of the early phases (Proto-WS) was fired at a relatively low temperature and was quite porous. WSW I and II pottery was instead fired very high (1080 °C). Experimental evidence indicates that this was probably pottery used for serving food. The porous matrix absorbs liquids and even the well fired vessels cannot retain liquid for more than 7 hours. Moreover, their size seems to be more convenient for eating than drinking. (Karageorghis 2001, 9–11). These bowls are usually found in large numbers in public rooms, together with bones of birds, fish, sheep and goats. In later phases other shapes were also made: these were craters and jugs which were then either used as burial goods or were used during funeral drinking rituals, in the same way as the craters and jugs of Mycenaean culture (South and Steel 2001, 65–69).

WSW has been divided into three phases: Proto-WS, WS I and II. Proto-WS ware was defined by V. Karageorghis (1965), but this pottery was already known in the 1930s when the Swedish archaeologist E. Gjerstad studied the transition phase between White Painted and WSW obtained during excavations in Pendaria and Akhera. Proto-WSW is known from cemeteries in the Paphos region (Anarita and Kedare).³⁰ It should be dated to LC IA:1 with an overlap into LC IA:2 when WSI starts to appear (Åström 2001, 49–50).

One of the most important sites related to WSW is Sanidha lying on the slopes of the Trodos Mountains circa 520m a.s.l. in central South Cyprus. Evidence for the manufacture of WSW II was actually found in Sanidha. (Todd and Pilides 2001, 27–41).

This pottery was very popular and often exported but was produced for a very long time. There is also some question as to how this pottery was distributed and produced in Cyprus itself. S. Manning believes that the island can be divided into two regions with different development during the Bronze Age. East and South Cyprus were more developed due to intensive contacts to the East and the trade in copper. The North and West parts of the island were more isolated and retarded. (Manning 1999, 323–325; Wiener 2003, 368). According to him, when Enkomi was established, WSW was in regular use in North Cyprus. Enkomi was probably one of the trade centers facilitating contacts between the Near East, the Delta and Cyprus. (Manning 1999, 119–129, 125). However, there is no stratigraphic evidence to show that one region was producing pottery earlier than another and the explanation of a two-speed regional development remains merely a theoretical model. It is hard to believe that sites circa 80km apart, albeit divided by a mountain, would maintain a completely different material culture for 4 or 5 generations. (Wiener 2003, 368) but it cannot be excluded as impossible.

It seems, at least, to have been well established by stratigraphic sequences in Egypt and Cyprus that Proto-WS is contemporary with the Hyksos period and WS I with the early New Kingdom. (Bietak and Hein 2001, 174–191; Wiener 2003, 369)

2.2.4.2 White Slip Ware from Tell el-Dab^a (Avaris)

Proto-WSW was found, sporadically, in Tell el-Dab^a (Avaris) but mainly in poorly defined or disturbed contexts. One fragment was found in area A II, in grave 1. This was a child's pithos burial which should be contemporary with stratum D/2. (Eriksson 2001, 59–60). The most significant concentration of WSW was documented in stratum D/3. It was defined as WS I style and it should be correlated with LM IA (Bietak 2003, 23–27). The Cypriot pottery in Tell el-Dab^a is not represented by WSW only. Other Cypriot ceramic types were buried within the Avaris stratigraphic sequences, particularly Red-on-Black Ware, plain wares, Cypriot Bichrome Ware and their imitations. (Maguire 1990; 1995, 54)

2.2.4.3 White Slip Ware from Tell el-Ajjúl

Tell el-Ajjúl, probably the Canaanite "Sharuhén", lies in Sinai and was first excavated in 1930–1934, by W. M. F. Petrie, and later, in 1952, by E. H. Mackenzie and M. A. Murray. A new excavation campaign started in 1999 but this lasted for only 2 seasons because of the political situation in the Gaza region. (Fischer 2009, 253)

The site produced the greatest number of scarabs from anywhere in the Levant. It also yielded a very large number of various imports, particularly from strata H1–8, where 941 ceramic imports, which document contacts with Mesopotamia, Cyprus, the Levant and even with the Aegean, were found. Pumice, shown by neutron activation analyses to be probably from Santorini, was identified on the site mainly in strata H1–5 with the most significant concentration being in H5, below which it is entirely absent. H5 can be therefore be accepted as the period during which the eruption almost certainly occurred.

Radiocarbon dates were obtained from each layer and the layer predating the eruption, stratum H6, was dated before 1600 BC. Also the dates obtained from stratum H6 (ends around 1600), H5A (mid 16th century), H4/3 (around 1500) agree fairly well with radiocarbon dates from the Minoan sites. They are about one generation earlier than we would expect when using Egyptian historical scale. (Fischer 2009, 263)

Red and Black Slip, Bichrome Wheel Made and, White Painted wares were found in stratum H6. When synchronizing with other regions we are dealing here with the end of MC and very early LC IA:1 and the

period around Dynasty XV of the Hyksosian domination during the SIP.

The H5 stratum contained the largest quantity of Cypriot imports (87% of all imports are Cypriot). There are WSW, Bichrome Wheel Made Ware, Black Lustrous Wheel Made Wares, Chocolate-on-White Ware, ergo pottery of LC IA:2 phase. If this stratum dates the eruption, the high chronology seems again, to be more probable. There are, inevitably it would seem, discrepancies in the classification of stratum H5, which is classified as Hyksosian by some scholars or as contemporary with Thutmose III. (Fischer 2009, 265).

There is a very long tradition of Palestine Cyprus contacts documented covering, at least, the entire Hyksos period up to Dynasty XVIII (Bergoffen 2001, 145–155; Fischer 2003, 263–290; 2009, 253–265).

2.2.4.4 White Slip Ware from other sites of Asia Minor and the Near East

Pottery of Cypriot provenance was found on Alalakh mainly in strata XII – VII but has still not been published (Bergoffen 2003, 395–396).

A large collection of Proto-WSW was found in Megiddo in stratum X (Eriksson 2001, 60–61) and on other Canaan sites (all of them are listed in Oren 2001, 127–136).

WSW was also found in Cannatelo on Sicily, in a settlement of Thapsos culture, where even fragments of Aegean pottery were deposited among the local wares (Vagnetti 2001, 101–103).

As far as I know, none has, to date, been found on Crete.

2.2.4.5 White Slip Ware bowl from Santorini

An optimist would expect then that Cypriot pottery in Aegean contexts would be found in sufficient quantity for the pieces of the puzzle to fall into place. Whatever the reasons, see discussion below, this is not the case, though there are a very few outstanding exceptions. One complete bowl, classified as WSW I, was found

at Akrotiri, in the volcanic destruction layer (Fig. 36). Unfortunately, the bowl has not survived and, not only has it been lost but much of the information about its discovery is also missing. The bowl was first described by A. Dumont in 1872 and illustrated by J. Chaplain when they visited the French School in Athens. Other illustrations were made by the director of the French School E. Burnouf (in 1878) and by F. A. Fouqué (in 1879). Also in this year a photograph was taken by Adolf Furtwängler and Georg Loeschcke and they were the first to document its size: h = 11.7 cm. Maximal diameter = 23.7 cm, Rim diameter = 22.8 cm).

After World War II the bowl was never seen again (Merrillees 2001, 89–93).

R. Merrillees also discovered another WSW bowl, which was, plausibly, claimed to have been found on Santorini and was given to the Cairo museum. The bowl should have arrived at the museum in 1904 but today it too can no longer be found. Having consulted the surviving drawings in the museum catalogue R. Merrillees thinks that the bowls were not the same and that the Cairo bowl is stylistically of WSW II type.

The finding of the Santorini WSW bowl appears, potentially, to be very helpful for regional synchronization. The bowl was repaired in antiquity, meaning that it was probably in use for a considerable time and was treated as a special and valuable item (Merrillees 2001, 90). The bowl was classified as a very early import from Cyprus (Manning 1999, 119–129). However, although it fits into the relative chronological synchronism, it doesn't help with absolute chronology. A similar bowl was found in Hyksos stratum D/3 in Tell el-Dab'a but it was the later strata, containing pumice, which were thought to be associated with the Santorini eruption. If the bowl was in use for a rather long time, then synchronism between LM IA and early Dynasty XVIII cannot be excluded either.

Other fragments of WSWI were found in Phylakopi on Melos (Eriksson 2001, 61).

Considerable efforts have been made to find Cypriot pottery in Cretan contexts but without success. The

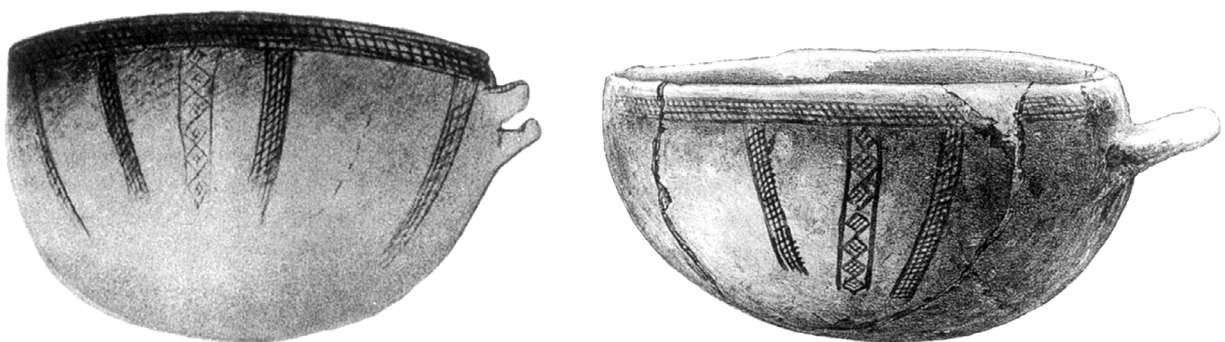


Fig. 36 / White slip ware bowl from the Akrotiri Volcanic Destruction Layer. (After Kemp and Merrillees 1980)

2. The individual disciplines

author has personally seen a small fragment of, possibly, Cypriot WSW among pottery from LMIA Pappadiokampos. Even if this fragment proves to have come from Cyprus, it would represent an exception. It seems that Cretan pottery was traveling more to the North, to Mycenae, and that the contacts between Crete and the Eastern regions were accompanied by other goods: e.g. ingots etc. (Betancourt 2008, 218).

2.2.4.6 Chronological conclusions from the Cypriot pottery

Today it seems that, after a long period of intensive research, the relative chronology has very probably been firmly established. The Proto-WSW period of LC IA:1 equates with stratum D/2 in Tell el-Dab'a, stratum X at Megiddo and the SIP in Egypt. The absence of WSW I in the Aegean is connected with the disruption of naval connections in the period following the Santorini eruption. (Eriksson 2001, 60–64; Oren 2001, 139–140; Bergoffen 2001, 155, ad.)

Minoan imports in stratum Ic on the Maroni-Vournes settlement are accompanied by WSW I pottery, which supports the same synchronism: MM III ~ Proto WSW, LM IA ~ WSW I) (Cadogan et al. 2001, 78).

In the period when the Proto-WSW first appeared, contacts between Cyprus and Syro-Palestine already existed. It is also the period when the first real Cypriot urban centres started a rapid development (MC/LC), agricultural society became stratified and a class of rich merchants became established. Their wealth was created through a very profitable trade with the Near East and Delta. The main goods traded were probably Cypriot copper and timber. In the MC III period, centres such as Enkomi and Toumba tou Skourou were established, whose contexts provide evidence for contacts with Hyksosian rulers (Eriksson 2001, 52–53).

Another phenomenon of this period in Cyprus is the building of fortifications, which implies increased competition, a need to display both position and capabilities and the presence of dangerous rivals. That this period was probably dangerous may be inferred also from the presence of mass graves and the frequent appearance of weapons in archaeological contexts (Knapp 1986, 71).

Cyprus went through a period which mirrors that of the Mycenaean centres at exactly the same time. These transformations may have been brought about by influences from other regions but the results were the same.

The sparsity of evidence for Cypriot-Cretan contacts in LM I – II, mentioned above, is a very real problem. Cretan merchants were still using Cypriot copper during the Late Bronze Age but the Laurion quarries were probably the preferred source (Stos-Gale and MacDonald 1991; Stos-Gale and Gale 1992; Driessen and MacDonald 1997, 80; Gale et al. 2009)

2.2.5 Possible responses to the Santorini eruption from other regions

If the Santorini eruption had a global impact on climate then catastrophes would have arisen as a consequence of the eruption, which were certainly not perceived by the local populations. There is some information about particular effects and phenomena from even very far distant regions which could, at least in theory, be connected with the Santorini eruption. For example the so-called Bamboo Annals of the Chinese Emperor Chieh's period tell of disastrous hydrological events accompanied by very weird phenomena, such as dry fogs, dimming of the sun, frost in summer and abnormal cooling of the waters. There followed famines, crop failures, intense rainfall and floods. Many cities collapsed and, even 7 years later the level of water in the rivers was much lower than normal. These phenomena were supposedly observed 24 generations before 841 BC. If we allow 25 years for each generation, we would get a date of 1441 BC but climatologists set the date at 1600 ± 30 BC (Kuniholm 1990, 17; Friedrich 2000, 81). It is, of course, impossible to be sure that these phenomena can be connected directly with Santorini events and it stretches co-incidence to have a 200 year gap between historical dating and dating via natural science in China as well as the eastern Mediterranean.

The Santorini eruption and its consequences plausibly became part of some more or less contemporary, mythological stories. It is possible to identify the eruption and subsequent events with the prelude of the Exodus (i. e. Galanopoulos and Bacon 1969; Harris 2013) or as the driving force for the chain of events culminating in the departure of Hebrew populations from Egypt (i. E. Manning and Sewel 2002). The Santorini eruption has often been mentioned as a possible inspiration for the legend of Atlantis (Friedrich 2000; 2009). Such explanations have frequently in the past been employed by the authors of fantastic literature, popular culture, tabloid journalism and assorted mystics, cultists or even extremists, who have little knowledge of or respect for serious scientific topics. But both legends, the Biblical exodus and the Egyptian legend reproduced by Plato, are part of the narrative tradition of ancient East-Mediterranean populations. The Bible was designed to convince the reader that the information which it contains is true and it has, in many cases, been confirmed that the events described were based in real contexts. Plato told the story about Atlantis around 360 B. C. The origin of the story according to the myth was in Egypt, where it was written down by a priest and was later read by Solon, who was the source for Plato.

The most common arguments against connecting the Santorini eruption with Exodus or the Atlantis myth usually say:

1. Events described in legends and myths are usually represented much more dramatically and as more catastrophic than they actually were. Thus they are not real descriptions of particular events because they are not objective, true and realistic. It is true that people often do describe natural events as total disasters. They usually describe what could have happened rather than what really happened. Their narratives are also full of fear and reflect deep-seated concerns. People have always feared nature, especially in times when little was known of how or why natural phenomena occurred. This was one of the prime motives for the creation of civilization, which appeared to establish control over and banish the vicissitudes of nature and its potential catastrophes. Mythology is full of stories about natural phenomena destroying civilization, i. e. floods, volcanos, winds, huge waves, marauding animals, diseases etc. (Torrence and Grattan 2002).

2. Events presented by legends or myths are usually applicable to any natural disaster and their chronological connection to any particular one is not possible. This argument could be applied to the description of catastrophes on the Ahmose Tempest Stele.

However, I am convinced that we generally do not work properly with mythology. The modern expectations of factual reporting providing answers to the questions of what, how, when and why are deeply ingrained and, when the expected data are not clearly presented, we doubt the entire concept. But such expectations are clearly inapplicable and legends and myths cannot be approached as “black and white”. They are true but the truth is presented differently, understood and approached differently. The stories are not documentaries, they serve as metaphors, salutary and beneficial for the members of the society sharing them (Barber and Barber 2006). In the way the events are presented is displayed the way people understood time. It was a relative and transitory value and there was thus no necessity to place events precisely on a linear time scale. This approach to time is noticeable also in ancient treatments of the words of people, both alive and dead, the agricultural cycle of time and the creation of calendars etc. (Klontza-Jaklová 2011; Kruta 2015, 29–31, 174–184).

Certainly we can assume that the eruption of the Santorini volcano, as stored in the collective memory of the Late Bronze Age Mediterranean population, was a model of disaster, which was used in a whole series of admonitory stories indicating the consequences of ‘incorrect’ behaviour. Unfortunately, this topic, albeit both substantial and interesting, must be left aside because, at least for now, it cannot help elucidate our current concern with the absolute chronology of the event in question.

2.2.6 Correlation with other European regions.

Accurate dating of the Santorini eruption and with it the accurate dating of the LM IA and LHI periods has a very wide significance and is important for a large region. It is not a single, isolated problem within one small region but has impact on historical interpretations in the region of the Eastern Mediterranean and Aegean and thence to Central Europe (Makkay 1996). LM IA (~LHI), the period when the eruption happened, follows the horizon of the shaft graves in Mycenae, which represents the main connection point of European and Aegean Bronze Age chronologies. Mycenaean culture had a significant impact on a very large area from the Balkans to Central Europe, and even as far as Scandinavia (Gimbuntas 1965; Harding 1984; Bouzek 1985; Kristiansen and Larsson 2005; Kostrhun et al. 2014), and the absolute chronology of those regions is almost entirely built on the Mycenaean chronological system. If we shift the date of LM IA and LHI one century deeper in time, we must then do same for the whole European Early and Middle Bronze Age. It is certainly notable that the monographs and synthesis of Moravian prehistory published in 1993 mention that the traditional dating of the Moravian Bronze Age was not supported by radiocarbon dates which are older (earlier) than expected (e.g. Únětice culture: Cezavy by Blučina: 1750–1600 BC, Věteřov culture: Buškovice: 1880–1530 BC, Blučina 1670–1660, 1640–1510; Velké Pavlovice: 1690–1590 BC and 1570–1530 BC). The authors of that book exclude these dates as wrong and prefer “fixed” Aegean absolute chronology. They explain the radiocarbon data as a statistical mistake and refuse to accept them at all (Podborský 1993, 237). The situation was similar in Slovakia where the authors of a similar monograph expressed the opinion that the radiocarbon dating method could not be attested or approved for this period because the dates were too early for the fixed Aegean chronology (Furmánek et al. 1991; 1999). In the latest volume summarizing the Bronze Age in Bohemia the authors accept the radiocarbon dates which were obtained from Early Bronze Age contexts and place the occurrence of the Early Bronze Age into the period 2350/2400–1750 BC. They ignore the archaeo-historical dates and clearly prefer the radiocarbon dates (Jiráň 2008, 28–29; the same applies to the last synthesis of Slovak Bronze Age: Furmánek et al. 2015, 15–16).

The simplified transfer of parallels from Mycenae to other European regions is not possible (Makkay 1996, 219–220, 225). Direct imports of items of Mycenaean origins are extremely rare in the Carpathian basin and Central Europe. Evidence is inferred from the possible transfer of technologies and ideas about the structure of power through mythological stories which are later observable in the use of symbols. (Kristiansen and Larsson 2005, Klontza-Jaklová 2012b)