ANALECTA
PRAEHISTORICA
LEIDENSIA 45

PUBLICATION OF THE FACULTY OF ARCHAEOLOGY
LEIDEN UNIVERSITY

EXCERPTA ARCHAEOLOGICA LEIDENSIA

EDITED BY
CORRIE BAKELS AND HANS KAMERMANS

LEIDEN UNIVERSITY 2015

‘Set in Stone’? Technical, socio-economic and symbolic considerations in the construction of the Cyclopean-style walls of the Late Bronze Age Citadel at Tiryns, Greece.

Ann Brysbaert

Western views about both human and material resource usage dominate how we tend to believe that these were employed in the past too. In particular, non-western communities, just as certain past societies, often do not see minerals and, therefore, stones as exploitable commodities or passive materials to be manipulated for pure economic or utilitarian reasons, as we most often do. Stones may carry deeply interwoven symbolic meanings linked to their ritual powers as well as their economic, material, social, cosmological, mythical, spiritual aspects of life. This paper explores the nature of the stones employed in the various sections of the Tiryns citadel over time, and their multiple meanings as building materials and markers of social practices played out by the inhabitants of Tiryns in and with their socio-political landscape. Through the reassessment of geological and other literature on the topic of Tirynhian building stones, it is revealed how stones were very specifically chosen for various properties and reasons. These specific stone choices in terms of both their properties and their locations show conscious actions of creating and maintaining social memories of Tiryns’ Early Bronze Age ‘Rundbau‘ users, inhabitants, workers, builders and elite, thus linking themselves to a deep ancestral past through the long-term building efforts conducted during the Late Bronze Age. At the same time, it is argued that the stones chosen brought the local surrounding landscape together in one building complex in order to indicate, confirm and negotiate socio-political alliances between groups present in and near Tiryns, and that in a period during which Mycenae must have played an overall dominant political role in the region, a factor also played out in the stone use at Tiryns. I argue that both local and regional strategies embedded in the stones are not competing with each other but can be manipulated and played out at the same time for different but complementary reasons.

1 Introduction

‘Minerals remain irrevocably linked to power, wealth, and both local and global inequality’ (Boivin 2004, 1). In an important volume on mineral materials such as rocks, metals, certain pigments and clays, Boivin indicates how mineral-based technologies always fulfilled a central role in human trajectories over time as they were crucial in the creation of pyramids, palaces and monumental constructions. Non-western communities, just as certain past societies, often do not see minerals as exploitable commodities or passive materials to be manipulated, as we do (Boivin 2004, 4). In non-western contexts, minerals, and in extension stones and rocks, are often not separate from living or even divine matters. They may carry deeply interwoven symbolic meanings linked to their ritual powers and their economic, material, social, cosmological, mythical, spiritual aspects of life. In some contexts gender roles are embedded *in* the minerals, not only represented *by* it. For example, earth is often seen as female due to its fertile capacities, while stones as a mobile and hard matter are often understood as male. Bringing them together then in such activities as building may amplify the powers that each may already contain separately into one very powerful being of ancestral power (Taçon 1991, 204-5).

Various papers in the volume (Boivin and Owoc 2004) illustrate through world-wide case studies how a wide range of single or often combined properties of stones and minerals make up their values (see also Scarre 2009, 4-5). External to their intrinsic values is the value connected to the ritual journeys that these materials may have undergone. The very presence of these materials in specific locations was proof of people having undertaken these often long and dangerous routes to collect them and may have been part of rituals to initiate younger members of communities into adulthood or their entrance into specialized craft groups (see Adams 2009 on East Indonesia). Also the original location from where the materials were extracted, whether the quarry itself or the entire landscape, may have been imbued with value and power. The act of deciding to bring stone from afar, especially in stone-rich areas, indicates a specific intentionality which cannot be ignored, whether the materials are studied from an economic, utilitarian, aesthetic, or symbolic or combined perspective.

The aim of this paper, which is part of the larger ‘Set in Stone’ project, is to investigate one particular aspect of the architectural study of the overall project (see below), namely the nature of the stones employed over time in the various sections of the Tiryns citadel, and their multiple meanings as

building materials and markers of social practices played out by the inhabitants of Tiryns in and with the socio-political landscape.

The overall aim of the 'Set in Stone' project, in which this paper is embedded, is to assess how monumental building activities in Late Bronze Age (LBA) Greece impacted on the political and socio-economic structures of the Mycenaean polities in the period between 1600 and 1100 BC, and how people responded to changes in these structures. Veritable building programmes took place in the Argive Plain from *c.* 1400 to 1200 BC, but especially in the 13th *c.* BC, and resulted in awe-evoking citadels, burial monuments, waterworks (*e.g.* Balcer 1974), roads and bridges (Jansen 2002). The density of these demanding building programmes must have mobilized substantial material resources (such as multi-tonne blocks) and labour forces over sustained periods of time (*e.g.* Wright 1987).

Since agriculture and animal husbandry were the predominant subsistence strategies for most people in the Greek LBA, such intensive and prolonged building efforts, requiring a consistent amount of human and material resources, may have affected local economies profoundly. Some scholars have expressed the detrimental nature of mobilising these workforces (resource exhaustion) to the sustainability of the socio-political structures toward *c.* 1200 BC (*e.g.* Galaty and Parkinson 2007). The human impact on dwindling resources and also climatic changes have been seen as contributors to the Mycenaean socio-political collapse (*e.g.* Fuchs 2007 with earlier references).

Despite such attempts to explain the Mycenaean LBA crisis or even collapse *c.* 1200 BC in these terms, the extremely complex nature of many impacting factors causing these societal upheavals is still poorly understood in the Aegean and beyond. Equally, the factors which caused the 'collapse' itself are hotly debated (Tainter 1988; Diamond 2005; McAnany and Yoffee 2010) since this phenomenon was much wider spread than in the Mycenaean world alone. The Mycenaean polities were part of the Mediterranean system in which multiple regional units interacted and co-depended on each other (recently: Cline 2014). The hypothesis that massive building programmes may have been detrimental to the LBA Mycenaean societies thus deserves to be revaluated even though it is likely that each region suffered case-specific internal features of this global prehistoric 'collapse' (*e.g.* Liverani 1987 for Syro-Palestine), and that many different configurations of combined factors affected each region differently (Cline 2014). Almost 20 years ago, Shelmerdine (1997, 566) stated that in order to understand the complexity of the Mycenaean system collapse, the effects of monumental building programmes from 1300 BC onwards need to be investigated, and the interdisciplinary 'Set in Stone' study investigates several combined factors through addressing the following key questions:

What were the minimum levels of human and material resources input in the prolonged building programmes (see *e.g.* DeLaine 1997; De Haan 2009)? Did these building programmes deplete the available human and environmental resources in the regions under study, and if so, to which degree?

What other subsistence activities did people undertake in the centuries leading up to the Mycenaean collapse *c.* 1200 BC and which resources did they have at their disposal?

If the 'misuse of these huge workforces' contributed to the Mycenaean collapse, how does this local Mycenaean phenomenon relate to societal 'collapse' in other regions of Greece and the East Mediterranean which also suffered major setbacks even though they did not undertake major building programmes?

Attempting to contribute to all these questions falls well beyond the scope of this paper. Apart from one short geological study (see below) and the use of different types of limestone and conglomerate at Tiryns (*e.g.* Küpper 1996, 5-6), hardly any consideration has been given to the 'DNA' of the Mycenaean citadel, its building blocks (but see Maran 2006b on the meaning of conglomerate, see also Müller 1930). This paper thus aims to contribute to this specific issue by reconsidering the different stones used, their location of origin, their location of placement and what the biographies of these stones may have meant in people's daily social interactions there over time. It is, therefore, important to be aware of the technological processes of acquiring, transporting, and constructing monumental cultural commodities, and trace the builders' communicative and logistical strategies. Since many technical aspects of building on such a prolonged and monumental scale benefits from a bottom-up approach and cannot, therefore, be divorced from their socio-political implications involving the labour, craft specialists, elites and food providers alike, a brief overview of earlier work on technical aspects of monumental building and their interpretations in the context of Mycenaean citadels in the Argolid and beyond follows below. This then sets the scene for the rest of the paper by highlighting the importance of taking the stones themselves into account since these actively impacted on the day-to-day activities of building and the social-political interactions of people at different time-levels.

2 Overview of earlier work

Monumental architecture as an expression of power by the ruling class over their subjects has been well argued for the prehistoric Mediterranean (Kilian 1988a; Maran 2006a; 2006b; Thaler 2006; Fischer 2009), and equally for other

cultural settings (*e.g.* Inka imperial architecture: Alconini 2008, esp. 64, 66-67). Furthermore, cross-cultural studies have compared and assessed similarities and differences in early states employing monumental architecture as one of several criteria (*e.g.* Englehardt and Nagle 2011, 367-8 with refs, 376-77). At Tiryns, Joseph Maran (2006a; 2006b; 2012) has focused on the performative space of Mycenaean Bronze Age palatial structures, thereby choosing a holistic approach to the phenomenon of the constructed environment that emphasises the dialectical relation between social practices and architectural spaces. Similar conclusions were reached by T. Mühlenbruch for the usage and meaning of the LH IIIC dated Building T at Tiryns (Mühlenbruch 2007; see also Maran 2009).

The social role of power and symbolism in relation to built mortuary contexts in the Argolid, specifically at Mycenae but also beyond have also been studied (Mylonas 1966; Mee and Cavanagh 1984, 1990; Darque 1987; Wright 1987; 2006; Voutsaki 1999, 2010; Wright 2006; Mason 2007; Fitzsimons 2011). With the highest concentration of tholos tombs and the most spectacular ones in terms of size anywhere in the Mycenaean context, Jim Wright (1987) emphasized the importance of looking into the energy expended and the time needed to construct tholos tombs since such undertakings must have required some very specific labour force organisation. This latter fact was also pointed out by Dörpfeld (1886) and Müller (1930) when they investigated Tiryns architectural wonders more generally, and specifically the citadel structures. An early interest, including the technical know-how and building techniques, into socio-economic discussions of the extant power institutions existed but was not pursued as a strand of research until much later (see *e.g.* Wright 1978 and Küpper 1996). Kurt Müller (1930) discussed early observations on building techniques and the relations between the wall constructions of the different areas. He usefully remarked on the style of construction in relation to the way the stones were worked, which types of stones were employed, and how these were/were not coursed in the different areas of the citadel (*e.g.* the Main Gate area, the Tower: Müller 1930, 55). Whereas his three-phase understanding of the citadel building has been corrected since (Wright 1978: 207; Kilian 1988b), the detailed observations he made are of very high quality and, as such, crucial to the content of this paper, see below.

Wright's earlier suggestions (1987) on investigating labour input figures for Mycenaean tholoi was taken further by Fitzsimons (2011) who calculated, in terms of labour input, the amount of fill that had to be excavated in preparation for the construction of each of different tomb type in and near Mycenae. His study, based on published data, showed that, over time, an increasing amount of labour input was required and he linked these results to the changing socio-political structures of the Mycenaean mainland in the Argolid. His abbreviated version of employing architectural energetics, however, dealt mainly with the labour input of soil digging while the tholoi and certainly the massive stone-based Mycenaean citadel complexes involved quite a bit more work and joint, organized efforts than soil removal alone.

Such systematic fieldwork was carried out for the first time on Tiryns citadel as part of the 'Set in Stone' project, now in its third year (Brysbaert 2013, 2015; Brysbaert *et al.* in preparation). In these studies were the stones themselves and their quarry sources were taken into account from a transport costing perspective. These same stones, seen also beyond their transport issue, now form the focus of this paper.

3 Tiryns in context

Recent overviews of Tiryns's archaeological research provide useful detail (Papadimitriou 2001; Maran 2010). Occupied since the Neolithic period, Tiryns was a crucial settlement in the EH II-III period and later evolved into one of the largest Mycenaean palatial centres on the Greek mainland, with a major harbour, a still working dam (13th *c.* BC: Balcer 1974), and two tholoi (Müller 1975: 15th *c.* BC; one is unpublished). A multi-phase palace with two *megara* occupied the Upper Citadel and the last phase of the cyclopean fortifications around the entire hill was constructed around the middle of the 13th century BC (Grossmann 1967, 1980). An extensive palatial and post-palatial settlement existed (Kilian 1978) and investigating its multi-period boundaries is ongoing under the direction of Professor J. Maran. These data play a crucial role in understanding the Tiryns's socio-political system within the wider Argive Plain in these periods. Early contributions to Tiryns's architectural research (Dörpfeld 1886; Müller 1930) are still pivotal but neither construction techniques nor building materials are covered in the necessary detail for the current project, so Tiryns still awaits full-scale architectural investigations.

In order to contribute towards a full-scale investigation of its many architectural features, especially the overall economics, I initiated the 'Set in Stone' project at Tiryns in the course of 2011 and this has received funding in 2012 through the Senior Marie Curie – Gerda Henkel Research Fellowship held at Leiden University (2013-2015) and through a collaborative training field school (directed by Dr. J. Pakkanen, Finnish Archaeological Institute) set up during the summer of 2014.

Homer eternalised Tiryns describing it as 'walled Tiryns' (Papadimitriou 2001, 6), while Pausanias (II: 25, 7-9) made a colourful exaggeration in that not even a pair of mules could have moved the smallest of the blocks employed there. However, it does bring the point home that for the masses of larger stones, some serious labour input would have been required and likely over sustained periods of time. At least

during the palatial period, skilled and unskilled labour, specialised knowledge, advance planning, and mobilisation of work forces, probably co-ordinated by local palatial staff of architects/engineers, and the many supportive human and other resources that worked alongside the construction activities, were likely the driving *collaborative* powers in the Argive Plain that achieved these exceptional constructions (see Brysbaert 2013, 2015; Brysbaert *et al.* in preparation).

However, especially the *complexity* of the practical human *and* material involvements in *monumental* and megalithic Mycenaean architecture remain unstudied with notable exceptions in the very useful study on labour input on the construction of the Atreus tomb in a paper by Cavanagh and Mee (1999). They also consider the architectural phenomena as more active 'participants' in socially interactive groups. Equally, the paper by Santillo Frizell (1997-1998) on the effect such monumental building may have had on the people involved directly and indirectly stand in contrast to those in which architecture is seen as mere 'theatrical backdrops' against which the scenes developed. However, since these papers focus solely on Mycenae, it is, perhaps, less perplexing that we know so little of what made Tiryns, a World Heritage Site, so famous: (1) the building processes *and* their people: builders, architects and engineers alike (most recently Brysbaert 2013), (2) and the logistics and infrastructure required to make these admirably solid vestiges, (3) the stones themselves and how they got there.

Finally, geological research (Varti-Matarangas *et al.* 2002) conducted in Tiryns and surroundings demonstrated that the building stones employed on the Tirynthian acropolis belong to 12 lithofacies. While this study is a welcome addition to our knowledge of the building materials employed at Tiryns, it is not without its problems (see below) and as a study it stands very much on its own. This paper assesses and brings together the information from geological papers and other sources on the stones used at Tiryns.

4 Interdisciplinary approach

Both the *chaîne opératoire* and cross-craft interaction approaches allow detailed studies of people's technical processes and social practices within architectural contexts. They may show how people's movement along pathways *changed while* they worked together, and how these pathways became hubs of technical and social interaction. "Buildings, like other environmental structures, are never complete but continually under construction, and have life-histories of involvement with both their human and non-human habitants" (Ingold 2000). In this way, the focus of this paper falls on the many processes involved in building itself as a series of *activities*, on both the human and material resources, and the forces involved in the decision-making and the creation of the citadel complex. In investigating the stones themselves, the paper addresses issues of the interwoven nature of human and environmental resources active in and around Tiryns, the pathways of communication, along which orders from elites to workers and knowledge-transfer between builders took place. Finally, it addresses how the resources and lines of contact impacted on each other within the builders' task-scape (Ingold 2000) and within the local and regional political economies (on prehistoric economy: *e.g.* Halstead 2001; Sjöberg 2004; Voutsaki 2010; Pullen 2013).

Practically, documenting stone-by-stone of each construction via extensive 3D reflectorless total station surveys results in fully compatible data sets for statistical purposes (Pakkanen 2009). These fieldwork data are next analysed in a CAD programme to derive the dimensions from which masses and volumes of the building materials are calculated. These results are then used to calculate cost-estimates per construction task per material and combined with labour time-units invested, i.e. expenditure of human energy: man-days. This method of extracting econometric data is very well-suited together with the *chaîne opératoire* and cross-craft interaction approaches since it forces us to think of each possible process involved in the building procedures. The cost-estimates (human and animal labour) form the minimum expenditure required from the population to realise these constructions, while also continuing other aspects of life (*e.g.* agriculture). After having carried out test runs in November and December 2013, we conducted two successful field campaigns in 2014. During the 2014 field school (three weeks of six working days), students were paired up with experienced fieldworkers in using architectural survey equipment at the Tiryns citadel. Additionally, a first large-scale and detailed photographic campaign was undertaken on site of all sections of the walls, both inside and outside. These are now being studied in detail and similar work is planned for the summer of 2015 and future years. Especially the newly taken photographs are compared with many much older sets taken before too much extensive conservation work was carried out (Dörpfeld 1886; Müller 1930). Several sets also serve for photogrammetric studies and are being processed at the moment of writing. The combination of the photographic study, combined with earlier captured econometric data and the geological information collected, form the basic data for this paper.

5 Tiryns's building blocks reconsidered (Table 1)

At Tiryns 12 lithofacies were employed: 7 different limestones and 1 type of dolomite, mostly used for construction; 2 types of conglomerate and 2 types of sandstone were employed as decorative stones (Varti-Matarangas *et al.* 2002). Below, the most important

Lithofacies	Category of stone	Employment at Tiryns	Quarry information
A	Biomicrite-Biopelmicrite with orbitolina (limestone)	Constructive: cycl walls, internal bldgs Acropolis	Acropolis basement
B	Biosparite (limestone)	Constructive: cycl walls, internal bldgs Acropolis	-
C	Turbiditic limestone	Constructive: bathroom floor, palace staircase	-
D	Biomicrite with mixed biota/fauna	Constructive: bldgs of lower Acropolis	Profitis Ilias
E	Red/brown biomicrite	Constructive: walls Decorative: in palace	Aria, hill adjacent to Profitis Ilias
F	Beige biomicrite with calcispheres	Constructive: walls	Aria, hill adjacent to Profitis Ilias
G	Dolomicrite (mudstone)	Constructive: acropolis walls but rare	Not possible to determine
H	Conglomerate	Decorative: entrances, also Mycenae	Moudanies, N of Mycenae, near Nemea
I	Polymictic conglomerate	Decorative: see H	See H, of different stratigraphic horizon
J	Very coarse litharenite with nummulites (sandstone)	Decorative: sparse use	-
K	Lithic arkose-litharenite (sandstone)	Decorative	-
L	Oocalcarenite (‘porolithos’, limestone)	Decorative	-

Table 1 Overview of the lithofacies recognised at Tiryns (based on Varti-Matarangas *et al.* 2002 only)

lithofacies descriptions are reviewed and assessed towards a better understanding of their location, both that of their origin and where they were used in the citadel, and their use(s) and meaning within the citadel itself. Several lacunae in the literature are revealed and, where possible, additional information is provided to reconstruct a more comprehensive picture of the blocks employed. It is, for instance, not clear wherefrom precisely the samples were taken that form the basis of the geological sourcing of the stones employed at Tiryns, and no analytical data are provided in the paper itself. They studied 70 thin sections but it is unclear how many of these were geological versus archaeological (Varti-Matarangas *et al.* 2002, 478). Equally, matching the individual lithofacies recognised and analysed at Tiryns to the specific locations of their uses is not described in sufficient detail for archaeological purposes when looking at the stones’ value beyond being building blocks. XRD analyses were carried out on the insoluble residues from the dissolved samples (sample size unknown) that underwent treatment in a 10% acetic acid solution in order to be able to separate soluble from insoluble matter from which the qualitative mineralogical composition could be determined. The dissolution allowed the percentage calculation of this insoluble residue but it is unclear how many and which geological and archaeological samples were treated this way since no analytical data was provided in the paper. Finally, a number of typos in the geological names of stones and formation processes are corrected which allows an easier geological follow-up study of the literature for archaeologists with such interests.

5.1 Lithofacies A (limestone): biomicrite – biopelmicrite with orbitolina (Wackestone-Packstone)

Varti-Matarangas *et al.* (2002, 479) stated that this lithofacies was used in the “Cyclopean” walls and the internal buildings of the Acropolis. It should be recognisable as a beige colour on recently revealed surfaces and a light colour on older exposed surfaces. Porosity is almost non-existent and the degree of weathering is very low to negligible. Likely based on the thin-sections showing specific benthic (i.e. from the sea bottom) foraminifera (Varti-Matarangas *et al.* 2002, fig. 4 where they are called ‘benthonic’, but see any geological dictionary), the geologists could source stones of the locations mentioned to the lithological formation of the Tiryns outcrop, the low hill on which the citadel is constructed. This hill sits at its highest point about 20-25 m above current sea level. No colour descriptions they provide, however, are munselled, no details are given about what they consider to be ‘recent surfaces’ and it is difficult to capture when the study was being carried out (possibly in 1991 or

1997 as figs 6 and 10 seem to suggest). I assume they refer to freshly excavated sections, possibly under K. Kilian in the Lower Citadel. More importantly, a much more detailed description of which sections of the Cyclopean walls and which internal buildings of the Acropolis were constructed with this stone would have been helpful. Müller's account (1930, 177) on the materials used referred in the first place to a dark grey limestone. He does not suggest any extraction location in relation to this stone but it seems, to him, the most used stone from the earliest construction phase of the citadel onwards.

What we can be entirely sure of is that the Tiryns outcrop formed a quarry to extract blocks from for various areas and throughout the construction time of the citadel, especially on the west side of the Acropolis where, as has been observed a long time ago already (Dörpfeld 1886; Müller 1930), various quarry zones can be recognised in the diagonal rock partitions (fig. 1). It would be logical and cost-effective for the builders at Tiryns to pry as many of these stones away from their parent rock beds as possible since it reduces substantially any transport operational efforts (Brysbaert 2013 on transport costs at Tiryns). However, stones of several tonnes as many are (esp. Brysbaert 2013), still need to be moved from where they are extracted to the actual wall or feature in which they are placed (Brysbaert: 2015; Brysbaert *et al*: in preparation). Of interest too is that the Western Staircase and its massive 7 m thick curved outer wall, one of the last features constructed in the 13th century BC (Maran 2010, 726), was partially if not entirely built inside the Tiryns outcrop quarry zone, thus inside the zone of lithofacies A. At least several of its steps are cut out in the bedrock while others were assembled as steps of the same and/or other stone types (see also under 'lithofacies C' below). As such, an (exhausted) quarry became a building locale.

5.2 Lithofacies B (limestone): biosparite (Greystone-Packstone)

This lithofacies is described as light beige to beige and grey with a low porosity but higher than lithofacies A, and its

Figure 1 Tiryns west side of the citadel: diagonally bedded limestone outcrops used as quarry for lithofacies A

weathering is as low as for lithofacies A. It was used in the walls and the palaces (Varti-Matarangas *et al.* 2002, 480). Also this lithofacies consists of several types of foraminifera (including orbitolinidae, as in lithofacies A). Without thin sections, thus based on the colour description and the location of where these stones were used, it is, in fact, impossible to distinguish between lithofacies A and B. Importantly, A matches the local outcrop while B has not been sourced at all. One can thus easily, based on visual inspection alone, mistake B for A and ascribe more stones to the outcrop than necessary. Müller may have referred to lithofacies B in describing a dark grey, very hard limestone as the main building stone since his grey colour description matches at least in part that of the geologists for lithofacies B. The easily confused lithofacies A and B suggest that it would have been very useful if the geologists had carried out a thorough fieldwork campaign in order to be able to suggest rough percentages of each stone type 'visible' in the built elements of the citadel (see also lithofacies F, below). Such work has now been undertaken in the 'Set in Stone' project and the detailed photographic survey will aid in a first step to get a better understanding of the ratio between lithofacies A and B. In the future, we hope to complement our observations with systematic sampling from several areas of the citadel in order to obtain a comprehensive image of the locations and patterns of usage between lithofacies A and B, also chronologically. Likely, the west quarry side of the outcrop must have been considered exhausted or in need for abandonment *as a quarry* when the western staircase and its curved outer wall were constructed and could, therefore, not have been the source for that entire part of the complex once building started (see below). Logically, stones could have been extracted from nearby parts of the outcrop for this staircase (some of its steps are) and curved wall, but it is still worth testing whether all courses were in fact built up from the actual outcrop or not.

5.3 Lithofacies C (limestone): dark grey turbiditic limestone with breccia texture

This stone type is dark grey with a brecciated texture and cross-cut by white veinlets (fig. 2) (Varti-Matarangas *et al.* 2002, 480), some being quite long and running across large sections of the stone. The stone was used for the bathroom floor and the palace staircase according to the geologists but there is no further indication which staircase is meant. There are several candidates: (1) the monumental Western Staircase; (2) on the same side but further north is the small staircase through thickness of the fortification wall located between the Middle and Lower Citadel; (3) a shallow stepped staircase leading from the Middle Citadel to the suite of rooms east of the Great Megaron towards the bathroom; (4) the stairs leading from the outer court (nbr 56, Papadimitriou 2001, fig. 19) to the entrance of the East Galleries; and (6) another one within the complex of the South Galleries. The most likely candidate meant is the Western Staircase but several of its steps are carved out of the actual outcrop (thus lithofacies A, see above) and others have been restored. A more precise description would be very helpful to identify the usage of lithofacies C which has also not been sourced yet. The bathroom floor, recently discussed in great detail (Shaw 2012, but see Dörpfeld 1886, 231; Müller 1930) was a *c.* 23 tonne monolith and cannot have been easily brought into the citadel.

Figure 2 Tiryns upper citadel: white veinlets on lithofacies C of the bathroom floor

5.4 Lithofacies D: biomicrite with mixed fauna

This stone is described as beige to reddish containing plenty of micro to macrofossils and was used in the buildings of the lower Acropolis, but where exactly is not clear. The degree of weathering is medium and the stone has been sourced to the hill of Profitis Ilias (Varta-Matarangas *et al.* 2002, 480-1), *c.* 1 km distance east from the citadel (based on Zangger 1993, fig. 43). This stone may be easier to recognise macroscopically due to the large amount of fossil inclusions, rather than by its colour descriptions.

5.5 Lithofacies E: red-brown biomicrite (Wackestone - Packstone)

Varti-Matarangas *et al.* (2002, 481) sourced this red-brown limestone to the hill adjacent to Profitis Ilias (i.e. *c.* 2 km away from the Tiryns citadel) and was, according to them, used in the Cyclopean walls, the Acropolis monuments, and as decorative stone in various parts of the palace, with no further details mentioned. The nodular look, clearly noticeable at Tiryns by macroscopic observations, is formed by veinlets that run perpendicular to or across the stylolites, further emphasised by chert inclusions (Varti-Matarangas

et al. 2002, 481), again macroscopically visible (fig. 3). Benedicto and Schultz (2010, 1250-51) describe clearly how stylolites nucleate around local heterogenous inclusions in a very similar Italian limestone rock (in the Tiryns case the named chert inclusions), and how stylolites in limestone relate to the contractual strain in the stone versus the stone surface's capillary forces. While they do not form structural fractures, stylolites may thus indicate, by their (growing) length, the (growing) level of contractual strain on the stone, and that this increasing contractual strain in the host rock increases the length of the stylolites (Benedicto and Schultz 2010, 1255). This, in turn, may indirectly suggest potential stone weakening, *already* within the geological outcrops of the stone, since it is also accompanied by mass-loss alongside the actual stylolites, until a certain point is reached. Bell (1990, 1871) and Benedicto and Schultz (2010) describe the mechanisms by which limestones of less dense porosity allow greater movement of water in its cells which, in turn, encourage both mass-loss of specific constituents which are diffused by means of such water-assisted movement, and stress of water in the rock when under pressure. Also Varti-Matarangas *et al.* (2002, 481) suggest endogenous decay as the result of a high percentage of insoluble residue, mineralogical composition of the stone and especially the presence of veinlets, chert inclusions, stylolites and swelling clay minerals, the latter which are most likely to be shifted by the fluid-drive action (see above). The stylolite phenomenon is especially well documented in figs. 1a, 2a, 2c (Benedicto and Schultz 2010, 1251-52) showing the stone disintegration patterns that are very similar to what I observed on several stones of this lithofacies in Tiryns. Of interest here is the fact that these stylolites and their accompanying stone weakening may occur *within* the geological outcrop (also details in Labaume *et al.* 2004) as well as in stone blocks used in the context of building (fig. 4).

Müller (1930, 55-56) mentioned the overall use of a solid grey limestone *while red blocks were occasionally used too*

Figure 3 Lithofacies E block showing inclusions of chert and a nodular look caused by veinlet running perpendicular to the stylolites, giving the stone its less robust character

Figure 4 Tiryns east side of citadel, main entrance with Great Ramp showing badly flaked lithofacies E blocks

and were always carefully chosen (my emphasis). His keen and detailed observations of the use of different stone types, especially the role of the red stone, and construction differences in several sections of the walls, were linked by him to different chronological phases (but see Wright 1978; Kilian 1988b). However, he equally mentioned the possible impact of the different master builders in choosing specific stones, especially for his 'second' phase (Müller 1930, 57). In his 'third' building phase, which seems to correspond in large parts to the second half of the 13th century BC additions to the citadel complex, he emphasizes not only the frequent usage of the red stone at the outer south wall of the south galleries, but also his amazement over the pure massive character of the wall constructions; a point I come back to later.

Wace (1949, 137) saw the reason for using the red stones in Tiryns as aesthetic because he considered that the stone could take a good polish. Such usage of this lithofacies was noted, for instance, on the Acropolis as the upper of the two steps between the Central Court and the Great Megaron Complex where the red seems to be used to contrast with the duller sandstone (fig. 5), a fact already noted by Müller (1930, 195) and Dörpfeld (1886, 238). Also Maran (2006b, 82-83) mentions this fact and questions whether any symbolically charged meaning may be behind this variegated stone usage. He also refers to the red stone used for all the column bases in the Great Megaron, although Küpper (1996, 113-114), in Maran's view, has convincingly argued that these were plastered over. I come back to this below.

5.6 Lithofacies F: beige biomicrite with calcispheres (Wackestone)

This stone is beige with subconchoidal fracture patterning and its particles are biogene containing mainly fossils (see also previous lithofacies) and fragments of thin shells and calcite crystals are present. Porosity is absent and almost no weathering was noted. The stone employed in the walls and possibly also other parts of the Acropolis monuments can be sourced to the hill adjacent to Profitis Ilias, where ancient quarrying is evident (Varti-Matarangas *et al.* 2002, 481). As with lithofacies B it remains impossible to distinguish

Figure 5 Tiryns upper citadel: (1) lithofacies E (red limestone) and (2) lithofacies J or K (sandstone) low steps leading into the Great Megaron complex

lithofacies F from both lithofacies B and A based on the macroscopic descriptions while this stone was sourced and lithofacies B was not. This stone type, therefore, falls under the same discussion as made for lithofacies B in relation to A (see above).

5.7 Lithofacies H and I: Conglomerate and polymictic conglomerate respectively

Both lithofacies are treated together here since Varti-Matarangas *et al.* (2002, 482) consider both potentially of the same lithological formation but of a different stratigraphic horizon while the different lithofacies features may help in sourcing the latter. The weathering of conglomerate is considerable and the decay factors are inherent to the stones' mineralogical make-up. This is clearly visible, for example, at the almost 'layered peeling' of the right door jamb at Tiryns Great Gate (fig. 6).That conglomerate can vary in quality, both visual and strength-wise, corresponds with Cavanagh and Mee (1999, 95-96) who discuss two different qualities of conglomerate available in the Mycenae area: the stronger material is to be found 1.5 km away from the building site of the Treasury of Atreus and forms the main material used in the construction. As discussed before (Brysbaert 2013, 51), this opposes both Fitzsimons (2011) and Wright (1978, 229, n. 329) who refer to local conglomerate only, i.e. the weaker material in the middle of which beds the construction of the Treasury of Atreus took place. In fact, both stone types may have been used at the Treasury of Atreus (to my knowledge no geological work has been carried out there), and may have had their respective uses at Mycenae and possibly also at Tiryns. In describing lithofacies H, Varti-Matarangas *et al.* (2002, 482) determined its source at Moudanies, near the town of Nemea, north of Mycenae. This location could not be found on any map of the area, several archaeologists working in the region did not know about it either, and most archaeologists (e.g. Wace 1949, 136; Wright 1978, 229, 242-43) referred to the conglomerate outcrops at the construction site of the Treasury of Atreus, at the Panagia and Kalkani ridges, or a little beyond (Cavanagh and Mee 1999, 95-96). Müller (1930, 177-78) refers to the conglomerate from the Dervenaki valley and towards the Heraion east, and Dörpfeld (1886, 289) mentioned the vicinity of Mycenae near the village of Charvati as its place of origin.

Because of its distant source location, Müller suggested that conglomerate was much more valued at Tiryns than at Mycenae and thus only used for thresholds, column bases, or antae blocks and for the Great Gate. Varti-Matarangas *et al.* (2002, 482) mentioned that lithofacies H was used as decorative stone at the entrance of the Acropolis (the Great Gate is meant) and also lithofacies I was used as decorative stone (no location specified, possibly the antae and column bases were meant, see Maran 2006b, figs 12-13). The decorative value of lithofacies I would certainly be enhanced due to the fact that the conglomerate was polymictic, i.e. its clasts were of various different stone types, thus bringing out its multiple colouring as the result of several stone inclusion sizes and shapes that would become a beautiful mottled pattern after a good surface polish. It is very likely that the antae stones sitting at either end of the flat steps between the Central Court and the entrance to the Great Megaron Compex were of this type (fig.7).

Figure 6 Tiryns east side of the citadel, Great Gate: badly flaking conglomerate upright post

5.8 Lithofacies J: very coarse litharenite with nummelites

Varti-Matarangas *et al.* (2002, 482) consider this dark grey sandstone as rather rarely used at Tiryns. Both lithoclasts and crystalloclasts are densely packed and moderately sorted, containing especially nummelite fossils. Due to its heterogeneous structure, mineralogical composition and the presence of swelling clay minerals, its weathering is considerable. The authors (2002, 484) consider this stone used as decorative (see their conclusions) but no details are given about its whereabouts.

5.9 Lithofacies K: coarse lithic arkose-litharenite

This sandstone is light green-yellow and considered a building stone at the Acropolis monuments with no further specifications (but see conclusions: Varti-Matarangas *et al.* 2002, 482 vs 484). Also this stone weathers considerably and both this and lithofacies J are not sourced.

Müller (1930, 177-188, esp. 178-179) refers to the selected and limited use of sandstone which he and H. Lehmann source back to Mycenae as being located between the layers of conglomerate. Müller suggests (see also Dörpfeld 1886, 289) that the sandstone was used sparingly but mainly for some antae blocks, *e.g.* at the entrance to the Small Megaron (Dörpfeld 1886, 317), the building courses of Court 16 (in front of the Small Megaron [17-18] and the Megaron-plan building [20-22], Papadimitriou 2001, fig. 19), the lowest courses of the Great Megaron (also Dörpfeld 1886, 289), the small staircase from the palace to the Middle Citadel and its connecting 'Plattenweg', the stones of the round altar in the Main Court and the gutter stones of the drains (not further specified). Müller considered these features of a nature that needed a specific shape and were thus hard to create in other stone types. However, we know that several other walls were built in the available limestone types discussed above, that several antae were executed in conglomerate (Müller 1930, fig. 85; Maran 2006b) which is the most difficult stone type to work, or in limestone (Müller 1930, 183, figs 86-87; see also Dörpfeld 1886, 300), and that the run-off spout of the bathroom floor was done in limestone as part of the monolithic slab.

Overall, in comparing Müller's detailed observations with the much more recent geological report, though, it is clear that neither Müller's nor Dörpfeld's work were consulted. This is a pity because these could have been helpful in providing more detailed descriptions of the use of several lithofacies, in the sourcing of the sandstone and in verifying whether these may have originated from the Mycenae region as the conglomerate did, or whether other sources are present and accessed nearer to Tiryns.

6 Discussion

The simple fact that many different stone types were employed in the Tiryns citadel goes against the least cost – maximum benefit approach, since the closest quarry is the outcrop of Tiryns itself and this was not used for all the stone material as shown above. Instead, the intentional choices of materials were important for various, and often combined, reasons: economic, utilitarian, but also aesthetic and symbolic. Table 2 shows all discussed lithofacies against four categories of usage and several fit in multiple categories. Specific lithofacies may have been chosen for ease of access (*e.g.* lithofacies A, D, F) which may indicate an economic least-cost factor, while other choices reflect exactly the opposite (lithofacies C?, E, H-I, J-K?). Even when considering lithofacies A versus D and F, three types with very similar properties, their individual choice as material was likely not just dictated by ease of access because that would urge people to take *only* blocks from the outcrop itself.

Figure 7 Tiryns upper citadel: conglomerate sawn antae block, left from the low steps leading into the Great Megaron complex

Lithofacies	Economic	Aesthetic	Symbolic	Utilitarian
A	X			X
B				X
C		X	X	
D	X		X	X
E		X	X	X
F	X			X
H-I		X	X	
J	?	X?	X	X?
K	?	X?	X	X?

Table 2 The different lithofacies placed against different use values

Previous studies have pointed out that the conglomerate use in Tiryns, for instance, expresses its political alliance to Mycenae. Maran (2006b, 82) describes the route that people entering the citadel would take through the Main Gate on the east side passing via several liminal points expressed in architectural cues of doorways, corridors, light and dark passages and porticos which provided constant contrasting experiences. Certain of these liminal points were expressed in the specific local use of conglomerate (contra Küpper 1996, 113-118, esp. 114-115 and fig 220.2, who thought all were conglomerate). Conglomerate which sat both at the Main Gate and at the entrance of the Great Megaron was not there by accident. The fact that the stone came from Mycenae may have meant that the journeys and large efforts

involved in getting these blocs to Tiryns may have had additional ritual connotations and may have formed a rite of passage for younger members of the builders communities (see comparatively: Adams 2009). An additional link to Mycenae is visible in the size and shape of the Great Gate at Tiryns which is almost an identical copy of the Lion's Gate at Mycenae (Dörpfeld 1886, 218; Müller 1930, 70-73; Maran 2006b, 81). Only the closing system of the gate is different which is logical: no two houses are supposed to have the same key and this may even indicate some independence from each other too. These observations indicate the following: it is likely that the same architects (Müller 1930, 70-73) and engineers were at work in both Mycenae and Tiryns (Maran 2006b). Possibly also similar groups of builders were working the conglomerate in both locales since they knew where to find the stone, extract it and work it effectively to be useful and aesthetic too, once polished properly. Wright (2006, 59) states that: … "the evidence of the deployment of the conglomerate masonry style abundantly illustrates how a local style of craftsmanship can be used to make powerful statements of control."

I argued previously (Brysbaert 2013; 2015) that if a distance of 10 km is hypothetically postulated for the yet unsourced bathroom floor block of *c.* 23 tonnes, its transport would have needed either 25 oxen yokes with ox guides and would have taken a minimum of two full days to get the block to Tiryns if loaded onto a wagon, possibly longer if placed on a sledge over rollers. If, on the other hand it was brought over on a sledge over rollers and pulled by pure manpower, this would have taken 200 men about 17-33 days, based on existing experiments. A lubricant and evened-out roads would have been a pre-requisite to make this feasible. As far as the conglomerate blocks used in various locations on the Upper Citadel and on the way there are concerned, Table 3 summarizes the information per block; their locations are indicated in figure 8 (several other smaller ones are not calculated here, but are indicated on plate 12, Maran 2006b). If well-organised, transport with multiple oxen yokes at a rate of 1.67-2km/hr, with a distance of *c.* 18 km between Mycenae and Tiryns would have taken 4 oxen 10.7-9 hours (a full working day) to bring over 3.5 tonnes of material, for example 2 blocks of *c.* 1.6-1.7 tonnes each. However, the trip may well carry over into a second day in order not to exhaust the animals. The two 12-yoke (24 oxen) transports of the Great Gate posts of *c.* 10 tonnes each would be done quite a bit slower and thus certainly be spread over two days. In total, a minimum estimation of 24 days, employing minimally 4 and up to 24 oxen per caravan (each oxen yoke with ox guide), would have brought the large conglomerate blocks to Tiryns. That large and performative efforts went into getting these blocks from their source to final location is undeniable through these examples alone, and for those reasons these stones were already imbued with non-economic values of power expressions and communal efforts (conglomerate: Maran 2006b; Wright 2006; bathroom floor: Brysbaert 2013; 2015), in addition to their aesthetic qualities.

Of great interest here is the reddish stone, lithofacies E, which is not the strongest of all. The significance of the distance between the quarry and the construction site plays a major factor in calculating the transport efforts of the stones to the site. Crucial in understanding the use of this reddish stone so typical for Tiryns alone, is that it identifies Tiryns *specifically.* Considering its geology (see above), however, it must have been known as a weaker stone, even at its source location *before it was extracted*. Yet, people still travelled 2 km to collect this weaker material, often in blocks of multiple tonnes!, while strong material was abundantly present on the outcrop itself (lithofacies A) and at 1 km distance (lithofacies D, F). Despite the likely ancient knowledge of this stone's weakness, it was still used at various *structural* points in all chronological phases of the Tiryns citadel *(e.g.* Müller 1930, 57). What is more, it continued to be in use after the large earthquake that struck Tiryns at the start of the 13th century BC (on earthquakes in 13th century Tiryns: Kilian 1996), in various parts of the galleries, the Lower Citadel wall, the Western Staircase and on the Upper citadel, for both decorative and structural purposes, the capstone of the Western Staircase entrance vault being a point in case of combined purposes. While the red stone used for the column bases in the Great Court were plastered over and thus invisible (Küpper 1996, 113-114; Maran 2006b, 82-83) that does not mean that the use of red stone there was not known and intentionally chosen for this specific purpose and location. Moreover, plastering may not have taken place immediately. Additionally, it may thus well be due to the internal stone faulting of lithofacies E that wall deformations and bulging came about later on at several places on the Tiryns Citadel, rather than being caused by earthquakes.

From a pure utilitarian and economic perspective, the choice of lithofacies E was a rather irrational one and thus needs to be explained differently. Wace's (1949) mentioning of the red stone being polished for aesthetic usage moves in one direction but only explains the stones used at the low steps between the Great Court and the Great Megaron porch. While Maran (2006b, 83) agrees with Kilian (1984, 46) that the entrance via the West Staircase was not staged as the east main entrance and therefore was a private entrance, I beg to differ for the following reasons. First, the curve of the wall alongside it is an extraordinary construction in its own right, marks a clear-cut division between outside and inside, and thus forms a liminal point, together with various other places (*e.g.* ritual character of the bathroom), along that route up/down and in/out. Second, an *intentional* creative colour play is visible on the Western Staircase starting at the actual

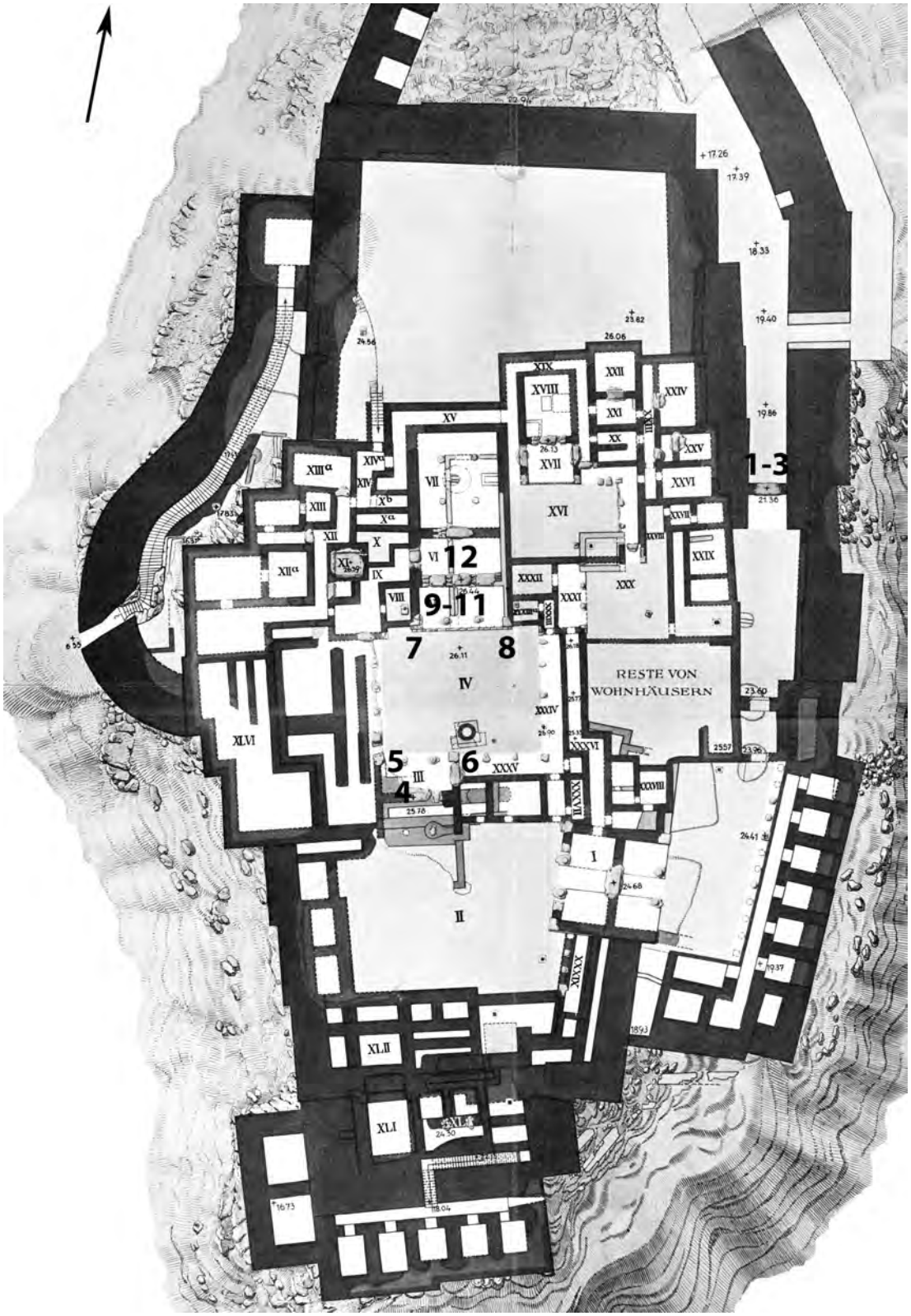

Figure 8 Tiryns upper citadel indicating the most important conglomerate blocks (after Müller 1930: plate 1), together with Table 3

Block nbr	Height (m)	Width (m)	Length (m)	Volume (m^3)	Mass (tonnes)	Oxen yoke(s)
1-2	3.20	1.40	0.95	4260	9.60	12 x 2
3	0.36	1.45	5.00	2610	5.87	6
4	0.20?	1.40	3.50	980	2.20	3
5-8	0.60	1.40	1.40	1180	2.65	3 x 4
9-11	0.20?	1.55	2.30	715	1.60	2 x 3
12	0.20?	1.25	3.00	750	1.70	2

Table 3 Summary of the major conglomerate blocks employed at Tiryns and their transport considerations

doorway, where the red stone plays both a constructive role as capstone of the vaulted entrance *but also* a decorative role. This is visible in the alternative placing of both red and grey stones, symmetrically on both sides of the doorway as it forms a closed vault with the red capstone at the top (fig. 9). Darvill (2013, 238-239) uses historical semantics and historical phonology of the Proto-Indo European languages to explain the juxtaposition of red with dark colours as expressing the passage of life and death. Whether similar explanations would be tenable for why certain colours were employed in Tiryns remains to be seen and will be investigated in the near future.

Play with colour in building materials is also known from the green stone use for the semi-columns of the Atreus Treasury at Mycenae (Higgins and Higgins 1996, 57; Wright 2006), and sometime later in intentionally decorative patterned use of differently coloured mudbricks in the geometric building at Lefkandi (Coulton 1993, 38, 55, 57, with references to the same situation at Kalapodi). At Tiryns, as one ascends through the entrance, stone steps from the outcrop are mixed with other ones (now possibly impossible to reconstruct due to subsequent restorations), possibly even containing lithofacies C stones (see section lithofacies C). As one arrived at the top of the stairs, the 'Plattenweg' and low steps running from the Middle to the Upper Citadel were in sandstone (Müller 1930; lithofacies J-K) which, eventually, allowed access via a narrow corridor, into the bathroom complex with a unique lithofacies C floor slab. In my view, none of the stone choices along this west entrance route are coincidental either. Especially the red stone can be seen both as aesthetically pleasing but equally as an identity marker for Tiryns. It is even conceivable that its 2 km away quarry may have formed a boundary marker for its territory in that direction and may have also represented the people who lived in that area for generations, possibly even the landowner of where the quarry was located if that was not the palace administration itself (for similar arguments: Bukach 2003, 30; Scarre 2009).

The use of the sandstone, independent from its source location, indicates a strong level of axiality and interconnectedness at the most important part of the entire citadel: the area of the Great Megaron and its immediate surroundings. Müller (1930, 178-79) mentions its use (we do not know whether lithofacies J and/or K are implied) in the altar of the Great Court, stone courses of the Great Megaron and the Small Megaron area, antae in the court before the Small Megaron and adjacent room complex, and the low steps and 'Plattenweg' between the Middle and Upper Citadel. Again, independent from its source of origin, this stone use may *physically* link the important *symbolic* link between the Great and the Small Megaron, already pointed out by Müller (1930) and Maran (2006b) as expressing the alliance between Tiryns and Mycenae, with Mycenae being the dominant faction. If then the sandstone may also *originate* from the region of Mycenae, as Müller and Lehmann suggested, the dominance of Mycenae may be symbolically expressed at the actual architectural heart of the residing powers atop the Upper Citadel, by forming the physical foundations of its two Megara. Moreover, a ritual importance is clear from the axial link to the altar too. At the Great Megaron and Great Court area we can see the sandstone use connecting up to the route in/out to the west of the citadel along the bathroom, the flat flight of stairs to the Middle Citadel and its 'Plattenweg',

Figure 9 Tiryns Western Staircase indicating intentionally alternating employment of lithofacies E with at least one grey limestone; B=grey, R=red

and up/down the Western Staircase (as mentioned above). It is possible that this route was equally ritualised as the eastern entrance route and thus formed ways of including and excluding. In following M. Douglas's seminal work (1966) thresholds, entrances and physical boundaries may mark a duality between sacral and secular places and could have been unstable and dangerous places once ritualised and initiated. In order then to protect both people and places from pollution, such places could only be entered through specific ritualised ways, maintaining that duality, which can in itself be employed as a tool of power by the initiated. The Western Staircase entrance route into the palace until the Great Megaron is reached manifests several such liminal places.

Each and every type of stone thus transported one or more specific meanings embedded in their incorporation of the citadel. Their individual properties such as their colour and texture may have been important active players in structuring socio-technical activities at the extraction and building sites. Several, s.a. lithofacies A blocks, may have linked the extraction source of the LBA stones to the social memory of ancestral presences, powers, mythical beginnings, there in the deep past. The EH II 'Rundbau' was, in the end, constructed on the hilltop and was to be found partially underneath both the Great Megaron (under but *between* the red column bases and *under* the throne: Papadimitriou 2001, fig. 8), and the Small Megaron. Maran (2006b, 84) argues against the socio-political power institutions in Tiryns built upon ancestral presence, as is done at Mycenae as rulers of the region because he sees Tiryns as secondary to Mycenae, which it likely was. However, this only considers the relation between both locales in the 14th-13th century BC. In the same paper Maran (2006b, 79) does mention certain associations between the EH II 'Rundbau' and the Great Megaron because both are located at the highest point on the outcrop and can thus be seen as landmarks from the sea, especially from the south. That landmark and thus strategic point obviously remained important through time, possibly referring to very early mythical descent, and likely independent of the changing relations between Tiryns and Mycenae over time. The people at Tiryns were very likely aware of the presence of the 'Rundbau' when they remodelled the Upper Citadel; what is not visible anymore is not necessarily forgotten. While all the *outer* signs – through stone use and other symbols – showed the alliance to Mycenae, one could understand that *inside*, the people and rulers of Tiryns may have felt strong enough about their *own* identity and past, expressed through specific other stone uses and its location: the 'hidden' 'Rundbau', the 'hidden' red stone for the Great Megaron column bases, the bathroom floor slab unique to Tiryns, the various locally quarried blocks. The accessed quarry locations in and near Tiryns may have linked significant inter-local alliances by extracting from all of these and joining their resulting blocks through joint efforts, thus materialising these efforts in one citadel complex. Any alliance to Mycenae does not need to exclude local alliances nor their self-awareness and identity and their deep-rooted link (literary!) to each other and their ancestral important places. In the end, the Tiryns ruler still had his own territory to look after as well. As Mason (2007, 49) argued for Mycenae's Treasury of Atreus, the power of the owner of the tomb did not just express status as ruler over Mycenae through the architectural grandeur of the tomb *alone* but also *through its very position in that landscape*, which was full of meaning, too (my emphasis; also Wright 2006). Therefore, the continuity of building on this *same* outcrop in EH II, LH IIIA-B and also LH IIIC (Building T) may show the presence of powerful lineages that were manipulated to get the work done on the *most central part* of the complex in *each* period, representing, most likely, the centre of power in each period (fig. 10). This may have been emphasized by the use of the red column bases even though they were not visible at all times. It has been noted in other cultural contexts that specifically coloured stones formed the means of communication between worlds (Darvill 2013 with references), as a sort of portal. The red stone in Tiryns may have been doing exactly that, especially atop in the Great Megaron and at the Western Staircase and Eastern entrance systems. Lefebvre (1991, 221) wrote: "[B]y building in monumental terms, people attempt to physically embody eternal and imperishable social orders, thus denying change and therefore transmuting 'the fear of passage of time and anxiety about death, into splendour".

7 Conclusions

A pure economic perspective of having to do the least effort and maximum output or a strategic perspective due to its high-point location overlooking the bay is not enough to explain large-scale building at Tiryns. Outcrop quarrying may well have carried more symbolically-laden values (see Scarre 2009, 9) as shown above. Several types of knowledge transfer, involving dexterity, memory and endurance in order to become a member of a group *(e.g.* like a guild), must have taken place over long periods of time. Knowledge about the sources of stones, their associated qualities, powers and meaning, the actual production processes involved in long-term monumental construction, and possibly long-standing sacred topography of the Tiryns outcrop which was perfect for ideological manipulation through claiming ancestral lineage to the place itself in the later phases, must have been well-understood and practiced at all social levels (*e.g.* Brysbaert and Vetters 2010).

Studies elsewhere (Huffman 2009; Huffmann 2013: pers. comm.) show how people's world views on sacred places and their inherent power shifted over time. The 13th century

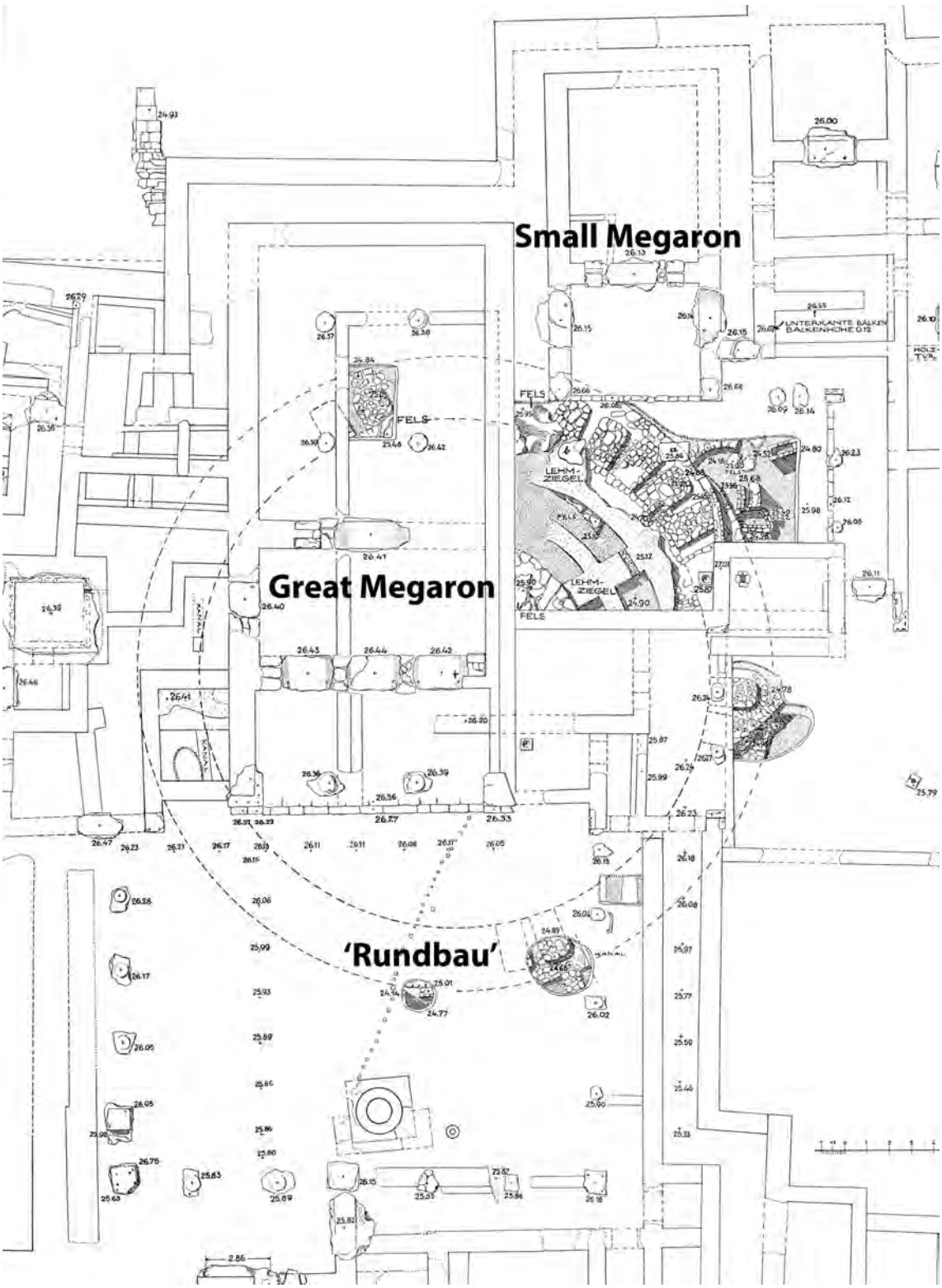

Figure 10 Map of the Great and Small Megaron area showing the 'Rundbau' traces underneath (after Müller 1930: plate 5)

AD king in the Mapungubwe region chose to build his palace exactly on top of the former ritual place, the mountain top, used in previous phases by the sacred leader in their community, the 'rain maker', who himself was a commoner. The king thus appropriated this sacred place in order to secure his opportunistically self-obtained power over the entire community. In a similar way, Great Zimbabwe was built on a rainmaking hill from which the king controlled a large territory through a hierarchically set up bureaucracy while he was both a political and sacred leader (see Maran 2001 for Mycenaean dual leadership). He established a new social order and his sacred power by talking to the gods through the medium of the ancestors of the hill. The hill, thus, as a material feature of sacral topography, brought the gods in contact with the king through the ancestors who dwelled on that hill top, which became even more accreted with importance over time and through its reuse as a chosen seat for power or sacrality (for similar arguments elsewhere: Scarre 2009, 9). In his dual capacity, the Great Zimbabwe king could be approached only by climbing zigzag up the hill, not directly. This is not unlike the complex entrance route described so well by J. Maran (2006a; 2006b) from the East entrance to the Great Megaron, or Western Staircase along the bathroom to the Great Megaron, in order to reach the ruler at Tiryns.

As such, I argue that long-term revisited locales are in fact active members in the process of rulers' power appropriation to specific places. Through activities of both quarrying and building and various combinations and mixtures of these, as the Western Staircase illustrates, leaders show that they can even remodel ancestral sacred locales (such as the Tiryns outcrop) to their new tastes and needs in the built shape of the citadel complex. Combining this with the fact that it must have taken organised labour forces of specific sizes to construct for prolonged periods of time and at such a large-scale (Brysbaert 2013; 2015; Brysbaert *et al.* in preparation) – we should not forget several other constructions undertaken during the second half of the 13th c BC in the same region – the intensity of the work is also visible in how the stones were placed. This was far from a random activity or a degradation of building techniques from the masoned building style (stated by Fitzsimons 2011). Instead, while cutting and preparing masoned stones takes time, they are much easier to construct with. Unworked rough boulders need careful fitting and balancing, and employing these types of building blocks will have taken considerably longer than employing masonry and much more know-how of the materials' capacities. The rough sight of often irregular rows of blocks, combined with their massive sizes, some of which were needed for static reasons, and a real mixture of grey and red stones, makes Müller suggest that: …"Vielmehr hat man sich ihrer gefreut und die ausserordentliche Arbeitsleistung, die Transport und Versetzen erforderten, nicht gescheut, ja man wird gerade besonders stolz auf die Mauern gewesen sein" (Müller 1930, 59). In constructing the magnificent vaults with gigantic irregular boulders, dating to the latter part of the 13th century BC, Müller (1930, 60-61) sees strong leadership, well-trained workers, careful stone selection and strong forward planning; I cannot agree more. When combining such building strategies with the variegated stone choices for their intrinsic meaning and value, and their colour play, it becomes obvious that not much was left to pure coincidence, at least for certain parts of the citadel.

These observations also have important implications for our overall understanding of monumental building of these citadels: picking out each stone for its place of origin, size, shape and its colour has human resource implications all the way back down the *chaîne opératoire* to where these were quarried, transported and subsequently built into the structure. It illustrates well-thought technical choices made by the builders and sponsors and it may even imply their active individual and/or group-made decisions in showing their creativity and know-how of their craft. In some way, one could see these as group/individual mason marks but at a larger scale, implemented by people who consciously left their, possibly competing, stamp on the building for millennia to come, if we care to notice them. If Grossmann, Dörpfeld and Müller are correct in observing that the 350 m long Lower Citadel wall was done in 'one go', several groups of builders must have been at work at the same time, possibly each under the direction of a master builder. Such situations must have created high levels of trust between the builders: they had to rely heavily on each other to make this work and to stay safe throughout all construction work. But certain levels of competitiveness may well have occurred regularly and may have been played out in their building activities (for similar arguments: Bukach 2003, 31). Whether all the builders had access to the same stones or whether specific local relationships or alliances allowed access to one or another stone is impossible to extract. Moreover, the suggestion that builders from Mycenae were involved in relation to the conglomerate stones is certainly tenable. To what extent, however, were Mycenaean builders involved in Tiryns, did they have the monopoly over handling the conglomerate, or were Tirynthians involved too, and were both also involved in working the other stones too? The evidence points strongly towards Mycenaean specialists at work in Tiryns the way the Main Gate is constructed, but the rest may have been in local hands, based on local know-how and the socio-political connections between them.

The relationship, then, between the original physical conception of these constructions, the intentional choices of stone and the location of their placement, their execution,

and their ultimate physical, social and symbolic purposes became materialised in their individual configurations and shapes, such as the various parts of the citadel complex. These were, furthermore, determined by their natural topography, by their socio-political contexts, and by people's access to the necessary local and regional material and human resources (skill, know-how) to get them constructed as impressively as they are.

Acknowledgements

I like to thank Professor Joseph Maran for his decades-long support in my work in Tiryns, and Dr. Alkesti Papadimitriou for facilitating practical access to the site. For various stimulating discussions on the topic, I would like to thank Dr. Jari Pakkanen. This work was carried out while I held a Senior Marie Curie Fellowship from the Gerda Henkel Foundation (programme M4HUMAN) at the University of Leiden. I wish to thank both institutes for facilitating this research and I like to thank especially the colleagues in the Material Culture group chaired by Professor Annelou van Gijn who has been a wonderful host and collaborator over the last few years. Finally, I like to thank professor Corrie Bakels for her patience with a late submission.

References

Adams, 2009 R.L. Transforming stone: ethnoarchaeological perspectives on megalith form in Eastern Indonesia. In: C. Scarre (ed.), *Megalithic Quarrying. Sourcing, Extracting and Manipulating the Stones. UISPP. Proceedings of the XV World Congress (Lisbon, 4-9 September 2006)*. (BAR-IS 1923), Oxford, 83-92.

Alconini, S. 2008. Dis-embedded centers and architecture of power in the fringes of the Inka empire: New perspectives on territorial and hegemonic strategies of domination, *Journal of Anthropological Archaeology* 27, 63–81.

Balcer, J.M. 1974. The Mycenaean dam at Tiryns. *American Journal of Archaeology* 78, 141-49.

Bell, F.G. 1990. Engineering geology and building stones of historical monuments: construction materials; geological origin; quarries. In: P.G. Marinos and G.C. Koukis (eds), *The Engineering Geology of Ancient Works, Monuments and Historical Sites. Proceedings of an International Symposium Organised by the Greek National Group IAEG, Athens, 18-23 September 1988*. Rotterdam, 1867-1874.

Benedicto, A. and R.A. Schultz 2010. Stylolites in limestone: magnitude of contractional strain accommodated and scaling relationships, *Journal of Structural Geology* 32, 1250-1256.

Boivin, N. 2004. From veneration to exploitation. Human engagement with the mineral world. In: N. Boivin and M.A. Owoc (eds), *Soils, Stones and Symbols. Cultural Perceptions of the Mineral World*. London, 1-29.

Boivin, N. and M.A. Owoc 2004 (eds). *Soils, Stones and Symbols. Cultural Perceptions of the Mineral World*. London.

Brysbaert, A. 2013. Set in Stone? Socio-economic reflections on human and animal resources in monumental architecture of Late Bronze Age Tiryns in the Argos Plain, Greece, *Arctos* 47, 49-96.

Brysbeart, A. 2015. Set in stone? Constructed symbolism viewed through an architectural energetics' lens at Bronze Age Tiryns, Greece. In: C. Bakels and H. Kamermans (eds), *Excerpta Archaeologica Leidensia, Analecta Praehistorica Leidensia* 45, 91-105.

Brysbaert A. and M. Vetters 2010. Practicing identity: a crafty ideal? *Mediterranean Archaeology and Archaeometry* 10(2), 25-43.

Brysbaert, A., Pakkanen, J., Papadimitriou, A. and J. Maran (in preparation). The 3D documentation and quantification of the newly excavated area north of the Main Entrance and Great Ramp at Tiryns, Greece. In: J. Pakkanen (ed.), *Greek Building Projects. International Conference, Held at the Finnish Institute at Athens, May 22-24, 2014*. Helsinki.

Bukach, D. 2003. Exploring identity and place: an analysis of the provenance of passage grave stones on Guernsey and Jersey in the Middle Neolithic. *Oxford Journal of Archaeology* 22(1): 23-33.

Cavanagh, W.G. and C.B. Mee 1999. Building the Treasury of Atreus. In: P.P. Betancourt, V. Karageorghis, R. Laffineur and W.-D. Niemeier (eds), *Meletemata: Studies in Aegean Archaeology Presented to Malcolm H. Wiener,* Liège and Austin, 93–102.

Cline, E.H. 2014. *1177 B.C. The Year that Civilization Collapsed.* Princeton.

Coulton, J. 1993. The Toumba building: its architecture. In: M.R. Popham, P.G. Calligas, L.H. Sackett, J. Coulton and H.W. Catling. *Lefkandi II. The Protogemetric Building.* Part 2. *The Excavation, Architecture and Finds*. Athens, 33-70.

Darcque, P. 1987. Les tholoi et l'organisation sociopolitique du monde mycénien. In : R. Laffineur (ed.), *Thanatos. Les coutumes funéraires en Égée à l'âge du Bronze*. Actes du colloque de Liège (21–23 avril 1986). (Aegaeum 1). Liège and Austin, 185–205.

Darvill, T. 2013. Fifty shades of red: the basic colour category red in the monuments and material culture of Neolithic and Bronze Age communities in Atlantic Northwest Europe. In: H. Meller, C.-H. Wunderlich and F. Knoll (eds), *Rot. Die Archäologie bekennt Farbe. 5. Mitteldeutscher Archäologen-tag vom 04 bis 06 Oktober 2012 in Halle (Salle).* Halle, 229-241.

De Haan, H.J. 2009. Building the great pyramid by levering. A mathematical model, *PalArch's Journal of Egyptology* 6(2), 1-22.

DeLaine, J. 1997. *The Baths of Caracalla: a Study in the Design, Construction, and Economics of Large-Scale Building Projects in Imperial Rome*. Portsmouth.

Diamond, J. 2005. *Collapse. How Societies Choose to Fail or Survive*. New York.

Dörpfeld, W. 1886. Die Bauwerke von Tiryns. In: H. Schliemann and W. Dörpfeld 1886. *Tiryns: die Prähistorische Palast der Könige von Tiryns*. Leipzig.

Douglas, M. 1966. *Purity and Danger: an Analysis of Concepts of Pollution and Taboo*. London.

Englehardt, J.D. and D.M. Nagle 2011. Variations on a theme: dual-processual theory and the foreign impact on Mycenaean and Classic Maya architecture, *American Journal of Archaeology* 115(3): 355-382.

Fischer, K.D. 2009. Elite place-making and social interaction in the Late Cypriot Bronze Age, *Journal of Mediterranean Archaeology* 22(2), 183-209.

Fitzsimons, R. 2011. Monumental architecture and the construction of the Mycenaean state. In: N. Terrenato and D.C. Haggis (eds), *State Formation in Italy and Greece: Questioning the Neoevolutionist Paradigm*. Oxford, 75-118.

Fuchs, M. 2007. An assessment of human versus climatic impacts on Holocene soil erosion in NE Peloponnese, Greece, *Quaternary Research* 67, 349-56.

Galaty, M.L. and W.A. Parkinson 2007 (eds), *Rethinking Mycenaean Palaces II*. Los Angeles.

Grossmann, P. 1967. Zur Unterburg Mauer vom Tiryns, *Archäologischer Anzeiger* 1967, 92-101.

Grossmann, P. 1980. Arbeiten an der Unterburg Mauer von Tiryns in den Jahren 1969, 1971 und 1972, *Archäologischer Anzeiger* 1980, 477-98.

Halstead, P. 2001. Mycenaean wheat, flax and sheep: palatial intervention in farming and its implications for rural society. In: S. Voutsaki and J.T. Killen (eds), *Economy and Politics in the Mycenaean Palace States.* Cambridge, 38-51.

Higgins, M.D. and Higgins, R. 1996. *A Geological Companion to Greece and the Aegean.* Ithaca.

Huffman, T. 2009. Mapungubwe and Great Zimbabwe: the origin and spread of social complexity in southern Africa. *Journal of Anthropological Archaeology* 28, 37–54.

Ingold, T. 2000. *The Perception of the Environment: Essays in Livelihood, Dwelling and Skill*. London.

Jansen, A.G. 2002. *A Study of the Remains of Mycenaean Roads and Stations of Bronze Age Greece*. Lampeter.

Kilian, K. 1978. Ausgrabungen in Tiryns 1976. Bericht zu den Grabungen, *Archäologischer Anzeiger* 1978, 449-70.

Kilian, K. 1984. Pylos. Funktionsanalyse einer Residenz der späten Palastzeit, *Archäologisches Korrespondenzblatt* 14, 37-58.

Kilian, K. 1988a. The emergence of wanax ideology in the Mycenaean palaces, *Oxford Journal of Archaeology* 7, 291–302.

Kilian, K. 1988b. Ausgrabungen in Tiryns 1982/83. Bericht zu den Grabungen, *Archäologischer Anzeiger* 1988, 105-151.

Kilian, K. 1996. Earthquakes and archaeological context at 13th century BC Tiryns. In: S. Stiros and R.E. Jones (eds), *Archaeoseismology*. (Fitch Laboratory Occasional Paper 7). Athens, 63–68.

Küpper, M. 1996. *Mykenische Architektur. Material, Bearbeitungstechnik, Konstruction und Erscheinungsbild*. Espelkamp.

Labaume, P., Carrio-Schahauser, E., Gamond, J.-F. and F. Renard 2004. Deformation mechanisms and fluid-driven mass transfers in the recent fault zones of the Corinth rift (Greece), *Comptes Rendus de l'Academie des Sciences Series II* (336), 375-383.

Lefebvre, H. 1991. *The Production of Space*. Trans. D. Nicholson-Smith, Oxford.

Leroi-Gourhan, A. 1943-45. *Le Geste et la Parole*, 2 vols. Paris.

Liverani, M. 1987. The collapse of the Near Eastern regional system at the end of the Bronze Age: the case of Syria. In: M. Rowlands, M. Larsen and K. Kristiansen (eds), *Centre and Periphery in the Ancient World*. Cambridge, 66-73.

Loader, N.C. 1998. *Building in Cyclopean Masonry with Special Reference to Mycenaean Fortifications on Mainland Greece.* Göteborg.

Maran, J. 2001. Political and religious aspects of architectural change on the upper citadel of Tiryns. The case of Building T. In: R. Laffineur and R. Hägg (eds*), Potnia. Deities and Religion in the Aegean Bronze Age. Proceedings of the 8th International Aegean Conference, Göteborg University, 12-15 April 2000*. Liège-Austin, 113-122.

Maran, J. 2006a. Architecture, power, and social practice: introduction. In: J. Maran, C. Juwig, H. Schwengel and U. Thaler (eds), *Constructing Power: Architecture, Ideology, and Social Practice*. Hamburg, 9-14.

Maran, J. 2006b. Mycenaean citadels as performative space. In: J. Maran, C. Juwig, H. Schwengel and U. Thaler (eds), *Constructing Power: Architecture, Ideology, and Social Practice*. Hamburg, 75-91.

Maran, J. 2009. The crisis years? Reflection on signs of instability in the last decades of the Mycenaean palaces, *Scienze dell' Antichità, Storia Archeologia Anthropologia* 15, 241-62.

Maran, J. 2010. Tiryns. In: E. Cline (ed.), *The Oxford Handbook of the Aegean Bronze Age*. Oxford, 722-34.

Maran, J. 2012. Architektonischer Raum und soziale Kommunikation auf der Oberburg von Tiryns. Der Wandel von der Mykenischen Palastzeit nach Nachpalastzeit. In: F. Arnold, A.W. Busch, R. Haensch and U. Wulf-Rheidt (eds), *Orte der Herrschaft. Charakteristika von Antiken Machtzentren*. Rahden, 149-62.

Mason, D.J. 2007. The location of the Treasury of Atreus, *Oxford Journal of Archaeology* 26(1), 35-52.

McAnany, P.A. and N. Yoffee 2010. Why we question collapse and study human resilience, ecological vulnerability, and the aftermath of empire. In: P.A. McAnany and N. Yoffee (eds), *Questioning Collapse. Human Resilience, Ecological Vulnerability and the Aftermath of Empire*. Cambridge, 1-21.

McGovern, P.E. 1989. Introduction. In: P.E. McGovern, M.D. Notis and W.D. Kingery (eds), *Cross-Craft and Cross-Cultural Interactions in Ceramics*. Westerville, 1-11.

Mee, C.B. and Cavanagh, W.G. 1984. Mycenaean tombs as evidence for social and political organisation, *Oxford Journal of Archaeology* 3(3), 45–64.

Mee, C.B. and W.G. Cavanagh 1990. The spatial distribution of Mycenaean tombs, *Annual of the British School at Athens* 85, 225-43.

Mühlenbruch, T. 2007. The post-palatial settlement in the Lower Citadel of Tiryns. In: S. Deger-Jalkotzy and M. Zavadil (eds), *LH III C Chronology and Synchronisms II. LH III C Middle*. Proceedings of the international workshop held at the Austrian Academy of Sciences at Vienna, October 29th and 30th, 2004. (Österreichische Akademie der Wissenschaften, Philosophisch-Historische Klasse, Denkschriften 362). Vienna, 243–251.

Müller, K. 1930. *Die Architektur der Burg und des Palastes*. (Tiryns III). Augsburg.

Müller, K. 1975. *Forschungen und Berichte. Das Kuppelgrab von Tiryns*. (Tiryns VIII). Mainz am Rhein.

Pakkanen, J. 2009. Documentation and computer reconstruction strategies in the study of architecture at the sanctuary of Poseidon at Kalaureia, Greece. In: W. Börner and S. Uhlirz (eds), *Archäologie und Computer. Kulturelles Erbe und Neue Technologien.* Vienna.

Papadimitriou, A. 2001. *Tiryns. A Guide to its History and Archaeology*. Athens.

Pullen, D.J. 2013. Crafts, specialists, and markets in Mycenaean Greece. Exchanging the Mycenaean Economy, *American Journal of Archaeology* 117, 437-45.

Santillo Frizell, B. 1997–98: Monumental building at Mycenae: its function and audience, *Opuscula Atheniensia* 22–23, 103–16.

Scarre, Ch. 2009. Stony ground: outcrops, rocks, and quarries in the creation of megalithic monuments. In: Ch. Scarre (ed.), *Megalithic Quarrying. Sourcing, Extracting and Manipulating the Stones. UISPP. Proceedings of the XV World Congress (Lisbon, 4-9 September 2006).* (BAR-IS 1923), Oxford, 3-20.

Shelmerdine, C.W. 1997. Review of Aegean prehistory VI: the palatial Bronze Age of the southern and central Greek Mainland, *American Journal of Archaeology* 101(3), 537-85.

Sjöberg, B. 2004. *Asine and the Argolid in the Late Helladic III Period: a Socio-Economic Study*. Oxford.

Tainter, J.A. 1988. *The Collapse of Complex Societies*. Cambridge.

Thaler, U. 2006. Constructing and Reconstructing Power: The Palace of Pylos. In: J. Maran, C. Juwig, H. Schwengel and U. Thaler (eds), *Constructing Power: Architecture, Ideology and Social Practice*. Hamburg, 93-111.

Voutsaki, S. 1999. Mortuary display, prestige, and identity in the Shaft Grave era. In: I. Kilian-Dirlmeier and M. Egg (eds), *Eliten in der Bronzezeit: Ergebnisse zweier Kolloquien in Mainz und Athen*. Mainz, 103-118.

Voutsaki, S. 2010. From kinship economy to the palatial economy: the Argolid in the second millennium BC. In: D. Pullen (ed.), *Political Economies of the Aegean Bronze Age. Papers from the Langford Conference, Florida State University, Tallahassee, 22-24 February 2007*. Oxford, 86-111.

Wace, A.J.B. 1949. *Mycenae. An Archaeological History and Guide*. Princeton.

Wright, J.C. 1978. *Mycenaean Masonry Practices and Elements of Construction*. (PhD thesis, Bryn Mawr).

Wright, J.C. 1987. Death and power at Mycenae: changing symbolism in mortuary practices. In: R. Laffineur (ed.), *Thanatos. Les Coutumes Funéraires en Egée a l'Age du Bronze*. Liège, 171-84.

Wright, J.C. 2006. The social production of space and the architectural reproduction of society in the Bronze Age Aegean during the 2nd millennium B.C.E. In: J. Maran, C. Juwig, H. Schwengel, and U. Thaler (eds), *Constructing Power: Architecture, Ideology and Social Practice.* Hamburg, 49-73.

Zangger, E. 1993. *The Geoarchaeology of the Argolid*. (Argolis II). Berlin.

Ann Brysbaert
Faculty of Archaeology
Leiden University
Post Box 9514
2300 RA Leiden
The Netherlands
a.n.brysbaert@arch.leidenuniv.nl