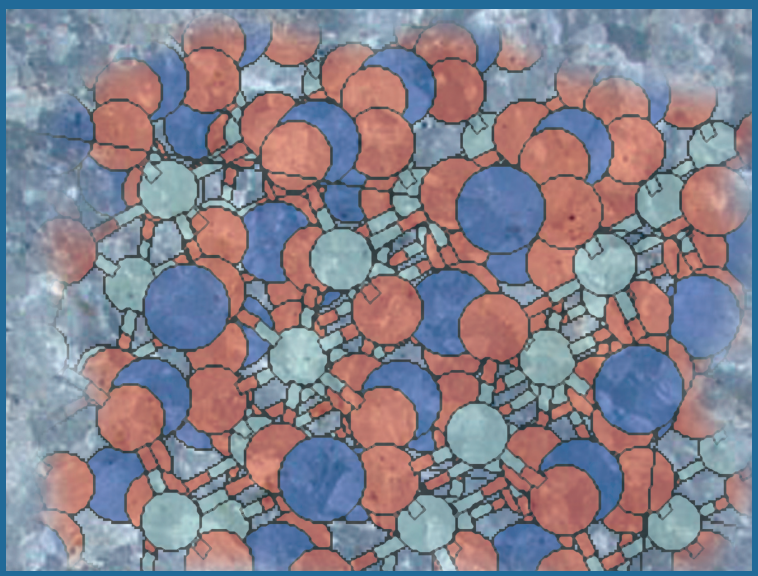
BCH Supplément 51

ASMOSIA VII

Actes du VII[e] colloque international de l'ASMOSIA
Thasos 15-20 septembre 2003



Proceedings of the 7th International Conference of
Association for the Study of Marble and Other Stones in Antiquity
Thassos 15-20 september, 2003

Études réunies par Yannis MANIATIS

BULLETIN DE CORRESPONDANCE HELLÉNIQUE

ASMOSIA VII

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PRÉFACE

L'acronyme ASMOSIA désigne l'*Association pour l'étude du marbre et autres pierres dans l'Antiquité* (Association for the Study of Marble and Other Stones in Antiquity), fondée lors d'un atelier de recherche avancée de l'OTAN qui s'est tenu à l'hôtel Il Ciocco, à Lucca, en Italie, du 9 au 13 mai 1988. L'atelier était intitulé : *Le marbre en Grèce ancienne et à Rome : Géologie, carrières, commerce et artefacts*. Il fut suivi par une cinquantaine de participants qui représentaient de nombreuses professions : des physiciens, travaillant dans le domaine de l'archéométrie, des archéologues, des historiens de l'art et des conservateurs. Il fut organisé par Marc Waelkens et Norman Herz avec le but affiché d'encourager les projets associant scientifiques, historiens de l'art et autres pour une meilleure compréhension des questions relevant de l'usage de la pierre par les Anciens. À la suite de cet atelier, une série de rencontres fut programmée tous les deux ans et demi environ : la seconde rencontre eut lieu du 16 au 20 octobre 1990 à Louvain, en Belgique ; la troisième du 17 au 19 mai 1993 à Athènes, en Grèce ; la quatrième du 9 au 13 octobre 1995 à Bordeaux, en France ; la cinquième du 11 au 15 juin 1998 à Boston, aux États-Unis ; la sixième du 15 au 18 juin 2000 à Venise, en Italie ; la septième du 15 au 20 septembre 2003 à Liménas, sur l'île de Thasos, en Grèce. Cette série de colloques fait partie intégrante de l'association ASMOSIA : ils ont pour objectif de promouvoir la collaboration entre les sciences, l'archéologie et l'histoire de l'art pour une meilleure compréhension de l'exploitation, du transport, du traitement et de l'emploi de la pierre brute dans l'Antiquité.

La publication des actes a été bien accueillie à la fois par les historiens de l'art, les archéologues et la communauté scientifique, comme par les corps de conservateurs; elle a contribué à susciter une coopération interdisciplinaire sans cesse élargie. Dans la mesure où, avant la création de l'association, cette coopération était minimale, ce fut là, en fait, un progrès décisif. Pour la bonne organisation et la publication de ces rencontres, on a également eu la chance de bénéficier du soutien financier d'agences nationales et internationales, comme la fondation Samuel H. Kress Foundation, l'OTAN, etc.

Le nombre de membres de l'association a plus que quadruplé, passant de 50 en 1988 à environ 250 aujourd'hui, représentant 25 pays. En dehors des actes de colloques, ASMOSIA publie également à raison de deux fois par an l'*ASMOSIA Newsletter.*

À ce jour, ce domaine de la recherche a fait preuve d'importantes avancées dans la mesure où les sources matérielles dont on dispose pour l'usage du marbre et des autres pierres dans l'Antiquité ont été largement étudiées et où les matériaux eux-mêmes ont fait l'objet de caractérisations géologiques et physico-chimiques. Les bases de données avec leurs paramètres analytiques se sont développées et les

caractéristiques de différents types de pierres brutes se sont accumulées. Bien des problèmes archéologiques ou relevant de l'histoire de l'art trouvent désormais une meilleure réponse et une meilleure explication par le recours aux analyses scientifiques et aux bases de données, qu'il s'agisse de la provenance, de l'identification, de la diffusion, du traitement, des assemblages et de la préservation d'importants artefacts.

Le 7e colloque international de l'association ASMOSIA s'est tenu à Liménas, la ville principale et le port de l'île de Thasos, en Grèce. Il a été organisé par le laboratoire d'archéométrie-NCSR « Demokritos », l'École française d'Athènes, la 18e éphorie des antiquités préhistoriques et classiques, l'IGME (Institute of Geology and Mineral Exploration). Le comité d'organisation, composé de Y. Maniatis, K. Polikreti, Z. Bonias, S. Papadopoulos, T. Kozelj, M. Wurch-Kozelj et M. Varti-Mataranga, tient à adresser ses remerciements à la Municipalité de Thasos qui a mis à disposition la salle de conférences du « Kalogeriko » et a tout mis en œuvre pour faciliter le bon déroulement du colloque, le ministère grec de la culture et le ministère grec de l'Égée ainsi que l'Association des entreprises du marbre de Thrace et de Macédoine pour leur soutien financier.

Ce volume réunit les contributions présentées au 7e colloque international de l'association ASMOSIA. Les thèmes abordés dans ces communications sont à la pointe du domaine interdisciplinaire où se rejoignent les sciences, l'archéologie et l'histoire de l'art ; ils reflètent un large spectre de la recherche poursuivie sur les pierres grâce à la coopération des sciences et des humanités. En particulier, les thèmes abordés recouvrent presque tous les aspects qui concernent la pierre depuis la carrière jusqu'au produit décoré dans son état final, sans exclure les questions du vieillissement et de la restauration.

Tous les textes soumis pour publication dans ces actes ont fait l'objet d'une révision attentive par un ou plusieurs réviseurs, ce qui en garantit le haut niveau, le caractère innovant et la portée scientifique.

En la matière, nous exprimons nos sincères remerciements aux membres du comité exécutif de l'association ASMOSIA, N. Herz, L. Lazzarini, P. Storemyr, J.J. Herrmann Jr., Ph. Jockey, S. Kane, J. Harrell, ainsi qu'aux members du comité scientifique du colloque qui ont apporté leur concours à la difficile révision des textes présentés dans ce volume.

En outre, nous voulons remercier V. Zatta, secrétaire de l'Institute of Materials Science-NCSR « Demokritos » pour son aide dans le traitement des actes et les étudiants-chercheurs du laboratoire d'archéométrie-NCSR « Demokritos » D. Tambakopoulos et M. Maniati pour leur aide dans l'organisation et la relecture des épreuves.

Nous tenons aussi à exprimer notre plus profonde gratitude à l'École française d'Athènes et, en particulier, à son directeur, le professeur D. Mulliez : l'École française d'Athènes, en effet, a supporté la totalité du coût de fabrication et du travail de publication des actes dans le *Supplément* 51 du *Bulletin de Correspondance Hellénique*. Nos remerciements vont également à Sandrine Huber, ancienne adjointe aux publications de l'École française d'Athènes, et à Catherine Aubert, qui lui a succédé à ce poste, pour la part qu'elles ont prise dans l'élaboration de la publication.

Yannis Maniatis
Président de l'association ASMOSIA

PREFACE

ASMOSIA stands for the Association for the Study of Marble and Other Stones in Antiquity and was founded at a NATO sponsored Advanced Research Workshop held at Il Ciocco, Lucca, Italy, 9-13 May, 1988. The Workshop was entitled, "Marble in Ancient Greece and Rome: Geology, Quarries, Commerce, Artifacts" and was attended by fifty persons representing many varied professions: physical scientists working in Archaeometry, archaeologists, art historians, and conservators. It was organized by Marc Waelkens and Norman Herz with the avowed goal of encouraging collaborative projects among scientists, art historians and others in order to better understand the problems associated with ancient man's use of stone. Following that a series of meetings were held scheduled approximately every two and a half year: the second meeting was held October 16-20, 1990 in Leuven, Belgium; the third May 17-19, 1993, in Athens, Greece; the fourth October 9-13, 1995 in Bordeaux, France; the fifth June 11-15, 1998, in Boston, USA; the sixth June 15-18, 2000 in Venice, Italy; and the seventh in September 15-20, 2003 at Limenas on the Island of Thassos, Greece. These series of conferences form an integral part of the Association for the Study of Marble and Other Stones Used in Antiquity (ASMOSIA) and their aim is to promote the combined scientific, archaeological and art-historical research for a better understanding of the exploration, transportation, treatment and use of stone raw materials in Antiquity.

The publications of the proceedings have been well received by both the art historical, archaeological, and scientific, as well as museum communities and have helped to inspire an ever increasing interdisciplinary cooperation. Since previous to ASMOSIA, such cooperation was minimal, this has indeed been a great accomplishment. We have also been fortunate in receiving financial support for our meetings and publications from national and international agencies, such as the Samuel H. Kress Foundation, NATO etc.

Membership in ASMOSIA has grown over four-fold, from under 50 in 1988 to about 250 now and representing 25 countries. Publications apart from the conference proceedings include the currently twice-yearly *ASMOSIA Newsletter*.

Today, the field has witnessed important advances as the raw material sources for marble and other stones used in Antiquity have been studied to a great extend and the materials have been characterised geologically and physicochemically. The databases with analytical parameters have been expanding and experience with the characteristics of different types of raw stone materials has been accumulating. Many archaeological and art-historical problems can now be better resolved and explained using the advanced scientific methods and databases. Such problems may be related to provenance, identification, movement, treatment, assemblages and preservation of important artifacts.

The 7th International ASMOSIA Conference was held at Limenas, the main town and harbour of the island of Thassos, Greece. It was organized by the Laboratory of Archaeometry-NCSR "Demokritos", the French School at Athens, the 18th Ephoreia of Prehistoric and Classical Antiquities and the Institute of Geology and Mineral Exploration. The Organizing Committee, Y. Maniatis, K. Polikreti, Z. Bonias, S. Papadopoulos, T. Kozelj, M. Wurch-Kozelj and M. Varti-Mataranga would like to thank and acknowledge the Municipal Authorities of Thassos for providing the Conference building "Kalogeriko" and all the necessary facilities in order to make this Conference possible, the financial support of the Greek Ministry of Culture, the financial support of the Greek Ministry of the Aegean and the financial support of the Association of Marble Enterprises of Macedonia and Thrace.

This book contains the papers submitted to the 7th International ASMOSIA Conference. The subjects of the papers represent the state-of-the art in the field and reflect a very broad range of research and applications carried out in cooperation between the sciences and the humanities. In particular, the subjects cover almost everything on stone from the quarry to the final decorated object, including even aspects of weathering and restoration.

All the papers submitted for publication in these proceedings went under a peer reviewing process by one or more reviewers. This guarantees that the papers published in this volume are of high standards, innovative and scientifically sound.

For this, we expresses his sincere thanks to the Executive Committee of ASMOSIA, N. Herz, L. Lazzarini, P. Storemyr, J.J. Herrmann Jr., Ph. Jockey, S. Kane, J. Harrell, and the Scientific Committee of the Conference and also to other professional colleagues who helped with the difficult task of reviewing the papers presented in this volume.

In addition, we want to thank Mrs V. Zatta, the Secretary of the Institute of Materials Science of NCSR "Demokritos" for her help in processing the proceedings and the research students of the Laboratory of Archaeometry-NCSR "Demokritos" Mr. D. Tambakopoulos and Mrs. M. Maniati for their help in organising and proof readings of the papers.

We also expresses his deepest gratitude to the French School at Athens and particularly to its Director prof. D. Mulliez for undertaking the full cost and effort of publication of the proceedings as *Supplement* 51 of the *Bulletin de Correspondance Hellénique*. Thanks are also due to Mrs. S. Huber, former publication officer of the French School, and Mrs. C. Aubert, present publication officer, for organizing the publication.

Yannis Maniatis

Current President of ASMOSIA

HARD STONE QUARRYING IN THE EGYPTIAN OLD KINGDOM (3rd MILLENNIUM BC): RETHINKING THE SOCIAL ORGANISATION

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ABSTRACT

Theories concerning the social organisation of quarry expeditions in the Old Kingdom have generally been polarised between either low-levels of organisation and production being practised in rather an *ad hoc* manner, or, as highly organised enterprises structured along rigid hierarchical lines and involving large numbers of people into several thousands, as the later Middle and New Kingdom (2nd millennium BC onwards) epigraphic sources imply. This paper presents a re-evaluation of these ideas by comparing the archaeological record at two major Old Kingdom quarries, Widan el-Faras and Chephren's Quarry, with a later Middle Kingdom quarry inscription from the Wadi Hammamat. From this comparative analysis it is concluded that Old Kingdom quarry expeditions, outside the Nile Valley, were small-scale campaign-driven operations involving specialists, well-organised through kinship ties and mobilised for specific projects.

KEYWORDS: EGYPT, WIDAN EL-FARAS, CHEPHREN'S QUARRY, BASALT, CHEPHREN GNEISS, HIERARCHIES, OLD KINGDOM, MIDDLE KINGDOM, KINSHIP, INSCRIPTIONS.

INTRODUCTION

The Egyptian Old Kingdom (3rd millennium BC) was an epoch in which the quantities of stone quarried and transported over large geographical areas was not equalled until the Roman Period. However, there is a poor understanding of the social context in which these expeditions

were undertaken, in particular the numbers of people involved and their hierarchical organisation. This situation is partly due to the limited amount of textual sources relating to the Old Kingdom period of stone exploitation, the few which are known only record a presence at the quarries and rarely an indication of numbers or the organisation (EYRE 1987, p. 12). Furthermore, research of ancient quarries in Egypt has, until recently, erred towards descriptions of the empirical data with only minimal interpretation of the archaeological record within a broader social organisational framework. As a consequence, explanations of the size and organisation of quarry labour in the Old Kingdom has often relied upon the later Middle Kingdom (2nd millennium BC) quarry inscriptions, such as those found in the Wadi Hammamat (see map **fig. 1**).

A typical Middle Kingdom quarry inscription associated with the siltstone-greywacke quarries in the Wadi Hammamat, refers to a quarry expedition ordered by 12th Dynasty king Senusret I to procure blocks for sphinxes and statues. The inscription attests to an extraordinary number of people being involved in this expedition, a staggering 18,628 (COUYAT and MONTET 1912, pp. 64-66, pl. 20, no. 87; GOYON 1957, pp. 81-85, no. 61). The titles listed attest to many levels of hierarchies involved in the operation, these comprise scribes, guards, carpenters, palace officials, 20 mayors, and the largest detachment of people comprising 17,000 'recruits of the force' (*op. cit.*). Other Middle Kingdom and New Kingdom inscriptions found in the Wadi Hammamat also adhere to a similar format of long lists of titles and expedition numbers into the thousands. Hence, the social organisational model deduced from these inscriptions implies large numbers of people being involved in the expedition, mostly of unskilled labour, organised within high degrees of social ranking.

Counter positions to this social organisational model have been suggested from more recent assessments of settlement evidence at the Old Kingdom quarry sites of Hatnub (travertine) on the Eastern Desert plateau and at the Umm es-Sawan gypsum quarries in the Northern Faiyum Desert (KEMP 1991; SHAW 1986, 1987) (see **fig. 1**). It has been argued that the 'informal' nature of the settlement features at Umm es-Sawan and Hatnub, these consist of small scatters of dry-stone walled huts, is indicative of quarrying being practised through low-levels of social organisation by small groups of labourers working in a 'primitive' or *ad hoc* manner (KEMP 1991, pp. 246-247, fig. 83). This view has been forwarded when compared against the more 'formal' Middle Kingdom planned quarry settlements, for example at Qasr el-Sagha (ARNOLD and ARNOLD 1979, p. 26; KOZOŁOWSKI 1983, pp. 81-89; KEMP 1991, p. 166).

This paper intends to rethink both these models relating to the social organisation of quarry labour in the Old Kingdom from a reassessment of the archaeological record, recently surveyed and excavated, at two major hard stone quarries: Widan el-Faras (basalt) and Chephren's Quarry (Chephren Gneiss) (**fig. 1**). Exploitation at both quarries peaked during the Old Kingdom with the stone being used specifically for royal and elite purposes. These quarry sites are both located outside the Nile Valley in the Western Desert and therefore, similar to the Wadi Hammamat quarries, required the deployment of expeditionary labour forces to procure the stone.

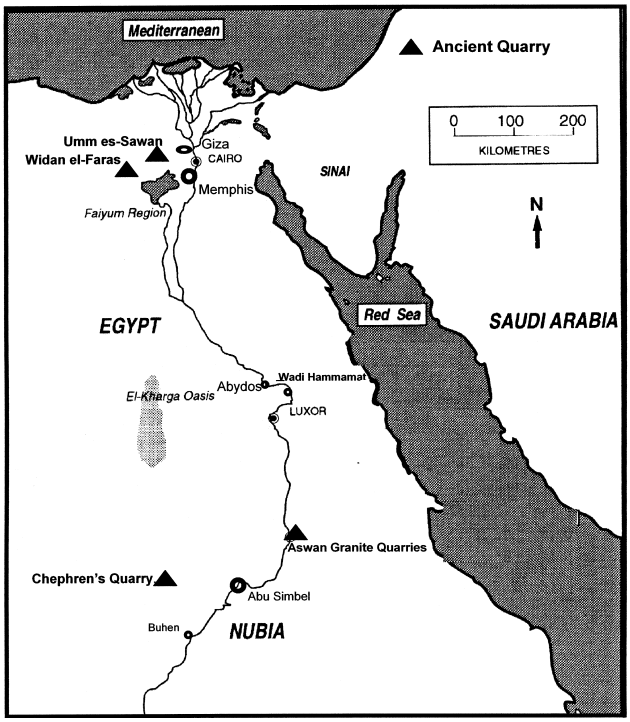

Fig. 1. — Map of Egypt and Nubia showing quarries mentioned in the text.

THE USE OF BASALT AND CHEPHREN GNEISS DURING THE OLD KINGDOM

BASALT

Basalt had a widespread use in Predynastic Egypt for small vessels (ASTON 1994), although it was during the 4th and 5th Dynasties in which the quantities used for monumental purposes remains unsurpassed. Four kings are known to have used basalt for paving and wall linings in their mortuary temples, these being 4th Dynasty king Khufu and 5th Dynasty kings Userkaf, Sahura and Nyuserra (HOFFMEIER 1993; MALLORY-GREENOUGH *et al.* 2000; BLOXAM and STOREMYR 2002). Although account has to be made of poor preservation, basalt use in mortuary temples stops abruptly after the reign of 5th Dynasty king Nyuserra. The use of basalt, certainly for monumental purposes, was a phenomenon of the Old Kingdom as the Middle Kingdom use of the stone was restricted to just small statuettes (ASTON 1994, p. 21; BLOXAM 2003, pp. 139-142). Although there is a renaissance in the use of basalt during the Late Period to Roman Period (evidence for Early Roman quarrying at Widan el-Faras has been observed),

when the stone was used for some statuary, (an example is in the Graeco-Roman Museum in Alexandria, *in* EMPEREUR 2000, p. 11, fig. 13), it is difficult to say if these objects were specifically made from freshly-quarried basalt or from re-used stones.

CHEPHREN GNEISS

Chephren Gneiss was also used exclusively in royal and elite contexts from as early as the Late Neolithic, predominantly for small vessels, the manufacture of which peaked between the late 2nd to late 3rd Dynasties (ASTON 1994; BLOXAM 2003, pp. 133-139). The crucial development in the 4th Dynasty was the use of Chephren Gneiss, (particularly the banded variety), for life-size statuary, as exemplified by the Khafre statues (**fig. 2**). Six Khafre statues are known (CG10-14; BORCHARDT 1911, pp. 9-14), although there could have been up to 24 in the valley temple of the pyramid complex, as placings for this number has been observed (LEHNER 1997, p. 126). By the 6th Dynasty the use of Chephren Gneiss is scaled down to just small dishes, bowls and cosmetic pots (*op. cit.*). After the Old Kingdom its use in elite and royal contexts is significantly diminished and although objects dating to later periods are known, it remains unclear if these were from reworking of earlier objects.

Fig. 2. — 4th Dynasty Khafre statue: Egyptian Museum, Cairo.

WIDAN EL-FARAS

THE BASALT QUARRIES

Widan el-Faras is located in the Northern Faiyum Desert, approximately 80 km south-west of Cairo in Lower/Middle Egypt (see **fig. 1**). The entrance to the quarry is demarcated by distinctive 300 m high twin sandstone peaks which are capped in basalt and which form part of the Gebel Qatrani Escarpment. The highly fractured nature of the basalt has given rise to extensive dark scree slopes (up to 40-50 m high) along the basalt escarpment, explaining the name Gebel Qatrani which literally means 'tar hills' (SIMONS and RASMUSSEN 1990, p. 627). The basalt consists of several individual lava flows of early Oligocene age which cap extensive deposits of sandstone, mudstone and some

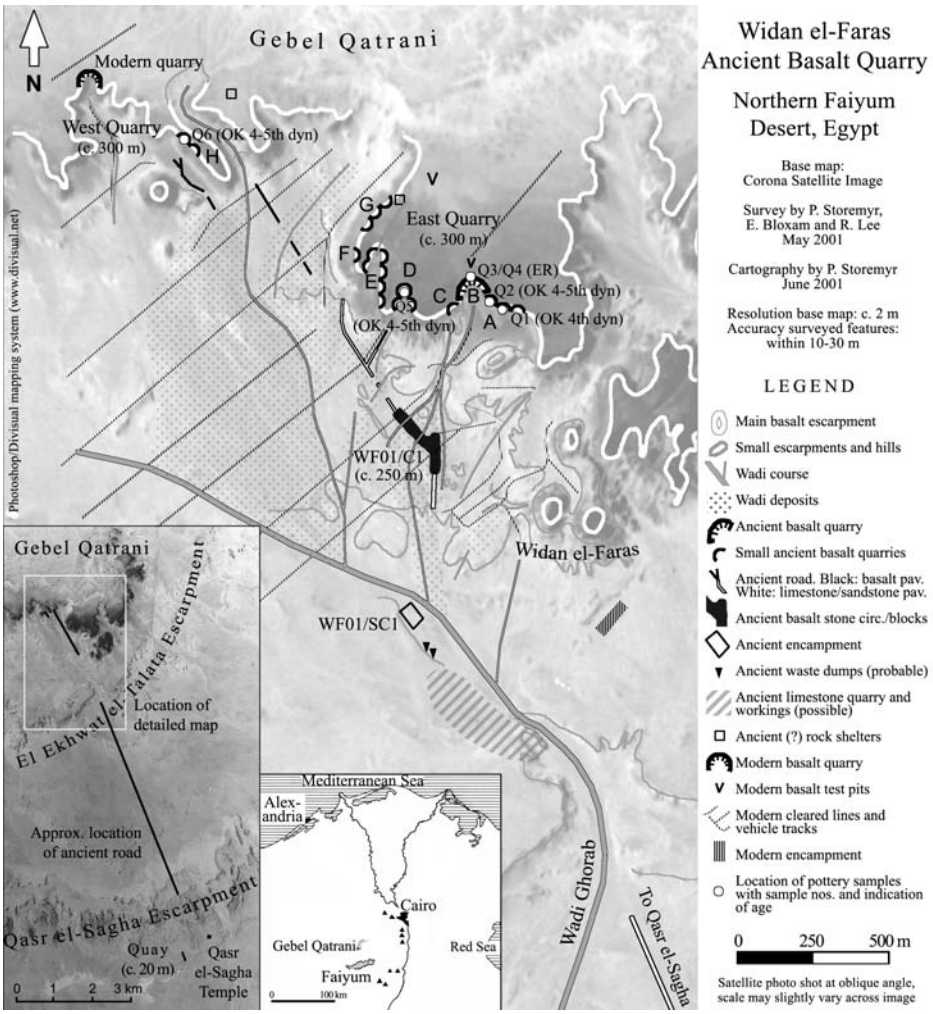

Fig. 3. — Archaeological map of Widan el-Faras (2001).

limestone that form the Gebel Qatrani Formation (BOWN and KRAUS 1988; KLEMM and KLEMM 1993, pp. 413-415; BLOXAM and STOREMYR 2002, p. 24).

The East and West Quarries, located 0.7 and 1.6 km north-west of the Widan el-Faras peaks, represent two areas of basalt workings as defined by HARRELL and BOWN (1995, p. 74). The East Quarry is by far the larger of the two quarries consisting of four main extraction sites, labelled 1 - 4 on the map (see **fig. 3**), which extend for about 800 m along the edge of the escarpment (**fig. 4**). The West Quarry is smaller, covering a 60 m stretch of the escarpment

Fig. 4. — The East Quarries: Widan el-Faras (view to the south-east).

and labelled 5 on the map. Stone tools and small scatters of pottery indicate that all the quarries were exploited during the height of the Old Kingdom (4th and 5th Dynasties), although in the largest Quarry 1 there is evidence from pottery and tool marks of a later Early Roman Period presence (El-Senussi 2001; Bloxam and Storemyr 2002, p. 26).

Due to the highly fractured nature of the basalt it was easy to wedge out blocks, but blocks measuring up to and more than 1 m^3 were difficult to obtain and hence some blocks measuring 5 m^3 found in Nyuserra's (5th Dynasty) mortuary temple could have had another source. However, the average block size generally used appears to have been in the order of 0.25 m^3 or 700 kg, as evidenced by our observations of the pyramid temple floors (Bloxam and Storemyr 2002, pp. 25-26). An assessment of the quantities of basalt used on the mortuary temple floors, in comparison with an estimate of the amounts of basalt extracted from the Old Kingdom quarries, suggests a close correlation between production and consumption rates (Bloxam and Storemyr 2002, pp. 26-27). From this analysis it was concluded that Widan el-Faras was certainly *one* major source of basalt used for monumental purposes during the Old Kingdom.

SETTLEMENT EVIDENCE

The 'Main Quarrymen's Camp'

Fig. 5. — The 'Main Quarrymen's Camp': Widan el-Faras (view to the south).

The present ground surface at Widan el-Faras is highly deflated, due to the action of the constantly prevailing north-west wind, so the archaeological features of the site remain clearly visible on the desert surface. The Main Quarrymen's Camp is exposed as a large area of single-level basalt stone circles, 275 m long by 11 m wide, which span the ancient road immediately below the Gebel Qatrani escarpment (HARRELL and BOWN 1995) (**fig. 5**). THOMAS BOWN (of HARRELL and BOWN 1995, pp. 77-78) estimated (in the early 1990's) that the Main Quarrymen's Camp consisted of 160 stone circles, suggesting that a substantial number of people could have been accommodated here. However, our recent survey conducted in 2001 identified only 24 circles and although consideration has to be given to recent man-made disturbance of the site and periodic flash-floods, there is clearly a major discrepancy between these findings (BLOXAM and STOREMYR 2002, pp. 31-33). One of the problems in determining the number of circles is due to the natural weathering phenomenon of the basalt which has caused the walls of features to collapse into each other, therefore, assessing what constitutes a 'circle' in these conditions is extremely subjective.

The position of the Main Quarrymen's Camp across a wadi and its exposure to the prevailing north wind poses many questions as to the function of this area. As indicated above, the now weathered basalt blocks would originally have been much larger than what is visible today and

seemingly too large for tent footings. Trial excavation of a section of one circle to a depth of 40 cm produced no evidence of a living floor level or discernible entrance. Furthermore, there were no post-holes to support a roof, which would be expected in such an exposed position, or any other artefactual evidence associated with the circle. This feature simply represented a loosely constructed stone circle surrounding a deep depression of medium to coarse grained gravel (BLOXAM and STOREMYR 2002, pp. 31-33). With no evidence seen throughout the camp of hearths, charcoal or any artefact connected with food production, this *absence* of evidence makes it very difficult to support previous suggestions by HARRELL and BOWN (1995, pp. 77-78) that this was the quarrymen's main settlement. With the absence of ceramic evidence it is also difficult to date this area, a few sherds of both Old Kingdom and Early Roman Period pottery (EL-SENUSSI 2001) were found, however, the context is uncertain as these could have been washed down from the quarries above. Until further evidence is provided, we propose that it could have been a block storage area, as also suggested by HARRELL and BOWN (1995, p. 78).

The Encampment

Located 500 m to the south of the 'Main Quarrymen's Camp' (see **fig. 3**), close to the quarry entrance at Wadi Ghorab, is an encampment consisting of 6 stone circles covering an area 60 m long by 36 m wide. Although the basalt blocks have also been subject to weathering, it was clear that the original blocks would have been much smaller than those observed at the 'Main Quarrymen's Camp'. Therefore, the possibility that these blocks supported windbreaks, or were tent footings for temporary dwellings, is a much more feasible proposition. A hearth and plentiful amounts of charcoal were found in the encampment and together with its more sheltered location is generally more in keeping with it being a place of habitation. Dense surface scatters of pottery sherds found across the site dating between the early 4th and 5th Dynasties (EL-SENUSSI 2001) suggest only a single period of occupation in the Old Kingdom, consistent with the peak in exploitation of Widan el-Faras basalt. Although there may be other such encampments yet to be discovered, we have estimated that only between 20 - 25 people could have been accommodated here.

CHEPHREN'S QUARRY

THE QUARRIES

The quarry workings cover an area of approximately 100 km^2 south of the Wadi Tushka and 65 km north-west of Abu Simbel in Upper Egypt (see **fig. 1**). The stone occurs as a patchwork of surface outcrops within Precambrian granite/granitic gneiss bordered to the SE by the Cretaceous Nubia Sandstone formation and separated by sheets of aeolian sand (HELDAL *et al.* 2009; KLEMM and KLEMM 1993, pp. 423-426). The highly characteristic nature of these blue metamorphic rocks means that objects made from the stone can be securely provenanced to this one source. HARRELL and BROWN (1994, pp. 52-53) classified the stone as 'anorthosite

gneiss' for the lighter, blue speckled variety (used mainly for small vessels) and 'gabbro gneiss' for the darker, blue banded variety (used mainly for statuary) (see **fig. 2**). However, the speckling and banding typically occurs together throughout the deposits and therefore the classification 'Chephren Gneiss' (HELDAL *et al.* 2009) is the more generic term that will be used in this paper.

Almost all of the Chephren Gneiss outcrops have been worked to some degree, the few remaining unworked boulders being left because they are penetrated by pink syenitic and granitic veins (STOREMYR *et al.* 2002, p. 26). These veins are also zones of weakness that make the stone more susceptible to fracturing during the stages of final crafting, another reason for them being avoided. Areas of workings where boulders have been removed are now represented by aeolian sand-filled depressions, usually surrounded by spoil heaps consisting of burnt (from fire-setting) and weathered stone chippings. One *in-situ* unworked boulder (abandoned due to syenitic veins) is approximately 5-6 m^3 in size and provides some idea of the size of these boulders prior to removal. Excavation of one boulder extraction site, to a depth of almost 2 metres, also gives an idea of how deep into the bedrock the quarrymen were working to remove one of these large boulders. Refer to HELDAL *et al.* (2009) in this volume for a more detailed description of geology, stone quality and quarrying methods.

SETTLEMENT EVIDENCE

Quartz Ridge

Settlement evidence at Chephren's Quarry is represented by small scatters of ephemeral huts which are mainly concentrated across Quartz Ridge, an exposed quartzite vein approximately 1 km long and rising about 10 m above the desert plateau (ENGELBACH 1933, 1938; MURRAY 1939) (**fig. 6**). These features, 10 in total, are exposed as circular and oval constructions usually comprising between one and three courses of *ad hoc* dry-stone walls with diameters of no more than 4 m. Two of these huts, SP 90 and SP 85, were excavated to a depth of 65 cm to their floor levels and in both instances this level was uneven and rocky suggesting these were not conducive as dwellings. Both features revealed only a small number of artefacts, such as Old Kingdom pottery sherds, and in the absence of hearths and with only this minimal ceramic data, it is difficult to determine the exact function of these huts.

The absence of food production areas at Quartz Ridge is also problematic, as this would be expected if the area was a place of habitation, although it has to be borne in mind that such evidence might yet be uncovered. However, a bakery was located at the Khufu Stele Quarries, about 4 km south of Quartz Ridge. The bakery is enclosed within a shallow dry-stone wall and consists of a thick ashy layer with pits in which intact Old Kingdom (3rd to 5th Dynasty) bread moulds were found (EL-SENUSSI 2003).

The Ancient Track

Fig. 6. — Hut SP 90 excavated: Quartz Ridge, Chephren's Quarry.

The only other settlement features known (to date) in the environs of Chephren's Quarry are two ephemeral camps, Camp 1 and Camp 2. These are positioned 4 km apart along an ancient track which was at least one stone transport route leading from the quarries to the Nile (**fig.** 7). Camp 1 measures approximately 5 m north to south and 10 m east to west and is enclosed within a semi-circular dry-stone wall 1.5 m high by 70 cm thick. After partial excavation, a 2 m^2 area of thick ash with *in situ* bread moulds dating between the 3rd to 5th Dynasties were found lying on the ashy surface (El-Senussi 2003). The camp seems to have principally functioned as a place for bread-baking, but if it was also a dwelling place then it could only accommodate approximately 20 people. The camps along the ancient track also have shallow groundwater wells associated with them, similar to those excavated at Khufu Stele Quarries and at Quartz Ridge. The wells are only to a depth of one metre below the ground surface implying that water, vital for subsistence of the labour force, was easily accessible. This evidence has important implications for the climatic conditions that prevailed during the Old Kingdom exploitation and could be suggestive of seasonally wetter conditions (Haynes 1987, p. 73; Mchugh *et al.* 1989, p. 327; Pachur and Hoelzmann 2000, p. 936).

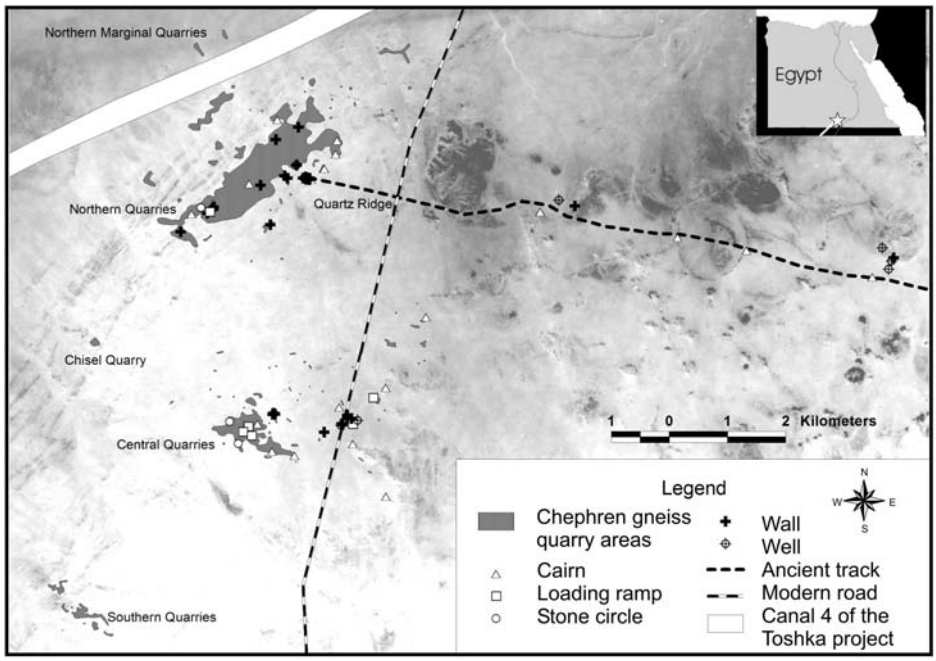

Fig. 7. — Map of Chephren's Quarry showing ancient quarries and ancient track.

DISCUSSION

Despite the limitations of the archaeological record due to previously poor documentation and in some cases poor preservation, it cannot be assumed that stone structures at quarry sites were necessarily dwelling places for the quarrymen. At Chephren's Quarry the stone features at Quartz Ridge amount to only ten, so if these were dwellings, which as suggested above is doubtful, then only a maximum of 50 people could have been resident here at any one time. A similar situation arises at Widan el-Faras, if the large camp is dismissed as a settlement and only the encampment accepted as dwellings, then only 20 - 25 people could be resident here. Observations made within the basalt quarries themselves have further contributed to these small numbers, given that each extraction site could only comfortably accommodate a maximum of 10 people at a time (Bloxam and Storemyr 2002, p. 35). A massive scaling down of the labour force into figures below 100 is likely and, although this is an extremely rough estimate, the relatively small amounts of pottery at both Chephren's Quarry and Widan el-Faras tends to support this much lower figure. There is no archaeological evidence at either of these quarry sites to support numbers of workers being present in their hundreds and certainly not

in their thousands. Furthermore, the absence of hierarchical features within the settlement areas suggests that the organisational framework did not necessarily involve high degrees of social ranking.

Although the settlement features described might imply 'primitive' and *ad hoc* organisation, there are other elements of the archaeological record, at both Chephren's Quarry and Widan el-Faras which suggest highly organised procedures carried out by competent workmen. For example, at Widan el-Faras the meticulous construction of the 11 km quarry road to Lake Moeris with its uniform width throughout and branches into the quarries attests to planned and organised exploitation strategies. Moreover, the layout of the quarries and the deftness employed in laying the temple floors (at the pyramid construction sites) implies that this was the work of skilled practitioners. At Chephren's Quarry the large volume of waste material, discarded 'object' blanks and unworked outcrops left behind due to the presence of unsightly syenitic/granitic veins, strongly implies that visual quality and forethought to the final crafting process were high priorities. The discarded vessel and statue blanks of standard sizes also implies that exploitation was predetermined with specific objects in mind (STOREMYR *et al.* 2002, p. 26).

CONCLUSION: RETHINKING THE SOCIAL ORGANISATION OF OLD KINGDOM QUARRY LABOUR FORCES

The evidence from production and consumption of basalt and Chephren Gneiss during the Old Kingdom implies that large-scale stone procurement was carried out at both quarries, but within small-scale expeditions. This suggests that the social organisational model proposed from the Middle Kingdom textual sources of large numbers of labourers organised along strict hierarchical lines cannot be attested. However, this does *not* mean that Old Kingdom quarry expeditions were organised in an *ad hoc* manner using primitive procurement methods within low-levels of social organisation. Therefore, the quarry data described above has to be interpreted within a different organisational model away from these two extremes.

If the Middle Kingdom Senusret I inscription in the Wadi Hammamat is examined more carefully, it is important to note that the number of people designated with the title 'stoneworkers' is only 100, with another 100 designated as 'quarrymen' (COUYAT and MONTET 1912, pp. 64-66, pl. 20, no. 87; GOYON 1957, pp. 81-85, no. 61). Hence, actual quarrymen is a mere 200 or just above 1% of this enormous (18,628) detachment of people. Whether these quarrymen actually resided at the quarries is not possible to determine from these sources, but if this relatively small number of quarrymen is related to the archaeological record at Widan el-Faras and Chephren's Quarry, the gap between the numbers attested by such an inscription becomes closer to the empirical data. What part the remaining 18,428 people played in the Middle Kingdom quarry expedition is unclear. Even accounting for the transportation of blocks from the Wadi Hammamat, this is an extraordinary number of

people to be organised and provided for. The camp located along the ancient track at Chephren's Quarry implies that even the stone transport process (over 80 km to the Nile) was carried out by small numbers of people, strongly suggesting the use of dray animals for such purposes. The large groundwater wells located along the track could also have served as animal watering places.

The context of the epigraphic record is of course important and with the almost total absence of quarry inscriptions in the Old Kingdom, some caution needs to be applied when making inferences from later Middle Kingdom inscriptions. However, it seems apparent from the majority of quarry inscriptions known that their focus tends to be on the feats or problems overcome in the task, rather than actual practice (BAINES 2000, p. 36). Exaggeration in these inscriptions clearly has to be borne in mind, along with consideration being given to individual self projection or personal aggrandisement of the writer, given that they were etched into the stone for eternity. Therefore, symbolism and ideology might also have been attached to quarry campaigns, particularly by the Middle Kingdom.

The social organisational model that is proposed for hard stone quarrying expeditions to sources outside the Nile Valley in the Old Kingdom is suggested as involving small groups of skilled stone-workers, loosely structured around kinship ties within well-developed social identities, as opposed to large numbers into the thousands of generally unskilled labour organised in a strictly hierarchical fashion. Such a framework might account for the absence of hierarchical settlement features and minimal ceramic evidence at the quarries, and yet explain the organised and expedient production techniques.

Finally, if such a model is implied, then where might these small expeditionary labour forces have resided? Deployment of labour to Chephren's Quarry could have been from a central place in Lower Egypt, with the Faiyum being one possible residence. The Northern Faiyum as a hub of specialist stone workers, already suggested by CATON-THOMPSON and GARDNER (1934, p. 134), is further advanced due to the presence of Chephren Gneiss and other non-local stone tools and blocks which appear *specifically* in the Faiyum quarries, such as at Widan el-Faras and Umm es-Sawan (HARRELL 2002, p. 235). Furthermore, the ceramic evidence at Chephren's Quarry, in particular an intact beer jar found in one of the block extraction sites, has an exact counterpart found in the Umm es-Sawan gypsum quarries (CATON-THOMPSON and GARDNER 1934, pp. 104, 110). Although this hypothesis for the mobilisation of quarry labour forces from a central place still requires more investigation, it is pertinent to mention an analogous organisation of stone workers in present day Egypt. In Luxor, a family-based group of specialist stone-workers with a long tradition in ornamental stone working are well known and these specialists regularly travel all over Egypt to work on specific projects (MOHAMED MADBOULY, a geologist with the Egyptian Geological and Mining Authority, pers. comm. 2003).

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Ce volume comprend les textes des communications d'ASMOSIA VII, 7e conférence internationale de *l'Association pour l'étude du marbre et des autres pierres dans l'Antiquité* (Association for the Study of Marble and Other Stones in Antiquity), qui s'est tenue dans l'île de Thasos, en Grèce. Les thèmes abordés dans ces communications sont à la pointe du domaine interdisciplinaire où se rejoignent la science, l'archéologie et l'histoire de l'art ; ils reflètent un large spectre de la recherche sur les pierres, depuis la carrière jusqu'au produit décoré dans son état final. Les sujets plus particulièrement abordés sont les suivants : (1) *Considérations archéologiques et emploi du marbre* ; (2) *Carrières, techniques d'extraction, géologie et propriétés de la pierre* ; (3) *Identification de provenance et caractérisation : le marbre* ; (4) *Identification de provenance et caractérisation : autres pierres* ; (5) *Techniques et développements* ; (6) *Bases de données* ; (7) *Propriétés de la pierre – Vieillissement –Restauration* et (8) *Pigments et peintures sur marbre.*

This book contains the papers submitted to ASMOSIA VII, which is the 7th International Conference of the *Association for the Study of Marble and Other Stones in Antiquity*. The conference was held in the island of Thassos, Greece. The subjects of the papers represent the state-of-the-art in the interdisciplinary field of Science and Archaeology and Art-History and reflect a very broad range of research and applications on stone, from the quarry to the final decorated object. In particular, the subjects cover: (1) *Archaeological considerations and use of marble*, (2) *Quarries, Quarrying Techniques, Geology and Stone properties*, (3) *Provenance Identification and Characterisation: Marble*, (4) *Provenance Identification and Characterisation: Other stones*, (5) *Techniques and Developments*, (6) *Databases*, (7) *Stone Properties – Weathering – Restoration* and (8) *Pigments and paintings on marble*.

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