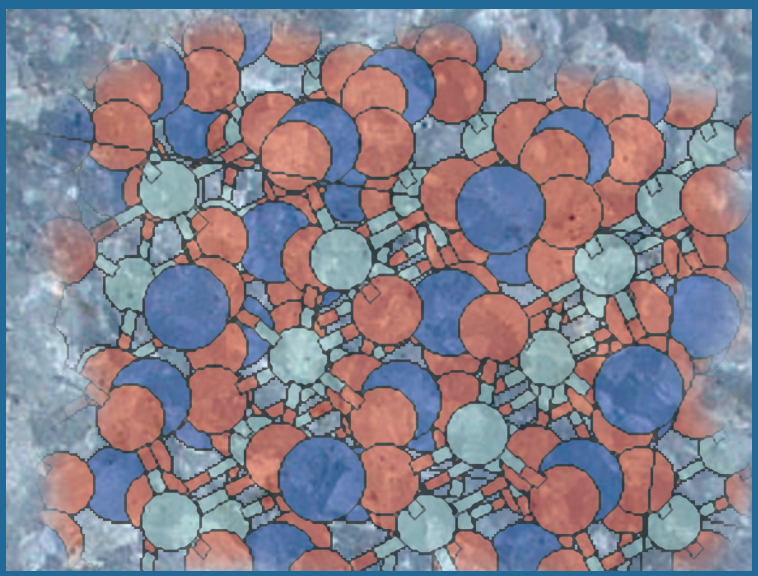
BCH Supplément 51

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

ANCIENT STONE QUARRIES: VULNERABLE ARCHAEOLOGICAL SITES THREATENED BY MODERN DEVELOPMENT

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ABSTRACT

Examples from Egypt and Norway show that many ancient stone quarries and quarry landscapes are at high risk from modern quarrying, as well as from urban, industrial and agricultural development. From a preservation perspective, one of the greatest problems seems to be the lack of knowledge of the values of such landscapes. Also cultural heritage authorities are often unaware of the values, and consequently they are unable to aid the proper land use planning in areas with ancient quarries. Thus, the most important contribution to protection of ancient quarry landscapes is to get them on the maps; both on physical and digital maps and on "mind maps" used in daily cultural heritage management.

KEYWORDS: ANCIENT STONE QUARRIES, ARCHAEOLOGY, CULTURAL LANDSCAPES, EGYPT, NORWAY, RISK ASSESSMENT, PROTECTION, MANAGEMENT

ANCIENT QUARRIES AS AN INTEGRAL PART OF THE LANDSCAPE

Unimpressive, vulnerable and neglected, many ancient stone quarries belong to a group of archaeological sites in danger of destruction, damage and decay. This is the destiny that one of the oldest of all industries shares with unimposing cultural heritage of any period, from Paleolithic work areas to recent industrial landscapes and dwellings. Usually, it is only the most "monumental" quarries in a given region that enjoy public attention, solid legal protection and some kind of management, whereas hundreds and thousands of less visible ones may be left to the forces of nature, or to become victims of modern quarrying, urban and industrial expansion, development projects and the traditional looting and vandalism.

Having entered the inventories of cultural heritage authorities, other problems facing the quarries include the difficulty of enforcing regulations and that focus is regularly set on the actual quarry faces and the immediate environs. This ignores the fact that a quarry comprises a set of distinct, but often much less visible, features spread out in the local, and sometimes regional, landscape; such as waste heaps, work and storage areas, ateliers, smithies and tools, settlements, houses, ruins and shelters, places of worship, rock inscriptions, wells, cairns, footpaths, tracks, roads and harbours. Such features, recognised by "quarry scientists", are as important as the extraction areas, insofar as they give invaluable information on the totality of ancient technologies and living conditions. Moreover, ancient – and not so ancient – quarries may have greatly contributed to actually forming the landscape observed today, which is beautifully demonstrated by Peter STANIER (2000) in his recent book on the stone quarry landscapes and industrial archaeology of quarrying in England.

The distribution of quarries throughout the world follows geological and topographical features. However, traditions, trade relations, available technology and infrastructure, fashions and power may also have strongly contributed to their location in a specific area, as e.g. shown by PEACOCK (1992) for Roman quarries in Egypt. Likewise, once established, a quarry area was in different ways related to the buildings, places or markets at which the stone was used or sold, and to other local, regional or more distant quarries (e.g. BLOXAM *et al.* 2009). Quarry landscapes must thus be viewed as an integral part of larger physical, socio-cultural and ideological contexts and networks.

Taking a *physical landscape perspective*, in which the context of the quarry is as important as the quarry itself, this paper explores the destruction and risks facing ancient quarries in Egypt and Norway. These are two very different countries, but, perhaps surprisingly, having rather similar problems with regard to destruction, protection and management. The paper is primarily based on our own observations and experience with mainly building and decorative stone quarries over the last 10-12 years, but is probably relevant for larger parts of the world in terms of destruction and threats: Reading papers from earlier *ASMOSIA* congresses, in a great deal of the quarry descriptions, especially related to the Mediterranean, one can frequently find distressing phrases like "unfortunately destroyed by modern quarrying."

Some would mean that an ancient quarry landscape ought to be considered a destroyed natural landscape rather than a valuable and vulnerable cultural landscape to be protected and managed. Such conflicting views are particularly pronounced with regard to 19th century and younger quarries, as they have often left a great impact on nature due to the use of machinery. Circumventing the debate on this issue, this paper will concentrate on quarries and quarry landscapes, which can clearly be considered part of the archaeological and/or industrial heritage, whether ancient, relatively recent or both. The paper concludes by asking what can be done in terms of protection and in order to contribute to a balanced development, in which ancient quarry sites are seen as an integral part of the landscape and considered in land use planning.

EGYPT: FROM LOOTING TO "MEGA PROJECTS"

Travellers and scholars have taken interest in the famous ancient Egyptian quarries since the early 19th century and today they are among the world's best investigated and described quarries – many of which would easily qualify as World Heritage Sites. Nonetheless, in practically all areas of the country, quarry landscapes are now at high risk due to rapid population growth, urban expansion and development projects in formerly remote desert areas. This development naturally not only threatens ancient quarries, but also the archaeological heritage at large, a fact that has been duly recognised by the Egyptian Supreme Council of Antiquities (SCA), which recently established the Egyptian Antiquities Information System (EAIS, www.eais.org.eg) in order to cope with this problem. However, considering the shear amount of archaeological sites in Egypt, it comes as no surprise that many sites, including most ancient quarries are not officially listed and thus remain virtually unknown as far as national, regional and local land use planning is concerned.

The distribution of ancient quarries in Egypt follows the country's topographical and geological features (**fig. 1**). Limestone quarries constitute the largest number (c. 100 sizeable quarry areas, including alabaster, HARRELL URL [Website]) – located mainly along the Nile from the Cairo-Giza area to Luxor and Esna in Upper Egypt. Along large parts of this stretch, truly spectacular gallery quarries overlook the Nile, having significantly contributed to forming the landscape over the last 4-5 millennia. This whole quarry landscape is still reasonably well preserved, but close to major urban centres, particularly the Greater Cairo district, modern quarrying and development leaves an increasingly destructive impact (e.g. Mokattam, Helwan, Tura) (cf. KLEMM and KLEMM 1993). Recent observation (2005) shows that urban development has also completely destroyed the famous Gebel el-Ahmar silicified sandstone quarries by Heliopolis in Cairo.

As Nubian sandstone replaces limestone between Edfu and Kom Ombo, extensive sandstone quarry areas (34, according to HARRELL URL) can be traced all the way down to the Second Cataract and the Sudanese border. Used for the

Fig. 1. — Satellite image of Egypt with known ancient quarries (white dots, after HARRELL URL) and places mentioned in the text.

Fig. 2. — Gebel el-Silsila: A typical quarry landscape along the Nile. Huge ancient waste heaps and quarries in the background.

important temples in Upper Egypt, especially in the New Kingdom and Ptolemaic and Roman periods, some of these quarries are quite undisturbed (cf. KLEMM and KLEMM 1993), and in the largest sandstone quarry landscape, on both banks of the Nile by Gebel el-Silsila (**fig. 2**), a "tourist path" was even recently established. However, more than 1/3 of the Nubian sandstone quarries were, together with numerous other archaeological sites, lost during the construction of the High Dam, the subsequent submergence of Lower Nubia and the establishment of Lake Nasser in the 1960s and 70s.

The third major ancient quarrying region in Egypt covers thousands of square kilometres in the Central Eastern Desert between the Nile and the Red Sea. In this arid mountainous landscape, all sorts of Precambrian hard stone, as well as some soft stone, can be found. Partially exploited since the Early Dynastic period period (3rd millennium BC), e.g. Manzal el-Seyl (HARRELL *et al.* 2000), and throughout the Pharaonic period, e.g. Wadi Hammamat (ASTON *et al.* 2000), the c. 30 registered quarry areas (KLEMM and KLEMM 1993; HARRELL URL) were essentially put in use during the Roman period. The Romans did not only leave extensive quarry sites, but in addition a widespread network of roads, forts and wells, which also secured the access to the Indian Ocean and supported the gold-mining areas worked since the Predynastic period and re-established in the Graeco-Roman period (MEREDITH 1958; KLEMM, *et al*. 2001; PEACOCK 2000, and references therein). Only two major archaeological surveys and excavation projects have been carried out related to quarry landscapes in the Eastern Desert: the excellent studies of Mons Claudianus (PEACOCK and MAXFIELD 1997) and Mons Porphyrites (MAXFIELD and PEACOCK 2001). Although heavily influenced by natural hazards

such as flash floods, as well as by looting and increasing tourist pressure related to the extreme expansion along the Red Sea Coast, these sites, and many others in the Eastern Desert, are still well preserved. Exceptions exist, though, particularly in the areas by Wadi Hammamat and Wadi Barramiya where modern quarrying and mining are rapidly evolving. At least one quarry has been destroyed (Gebel Rokham marble quarries), and a few others are threatened, not least by the increasing gold prospecting.

Modern quarrying is also a major cause of destruction in the ancient granite quarries of Aswan, which covers an area of about 15 square kilometres along the east side of the First Cataract and literally within the heart of Aswan city. The Aswan quarries have been the subject of many rather brief geological, archaeological and technological investigations and descriptions (e.g. RÖDER 1965; KLEMM and KLEMM 1993; cf. ASTON *et al.* 2000). In the 1920s Engelbach undertook the first excavation of the showpiece of the quarries, the famous New Kingdom Unfinished Obelisk, which has recently been excavated and mapped by the SCA. Simultaneously, a modern visitor's centre has been built beside the Obelisk. Behind this façade, things look quite different, though. Quarrying of granite resumed in the late 19th century (RÖDER 1965) and has gradually taken over the ancient quarry landscape (**figs 3, 4**). Moreover, following the construction of the

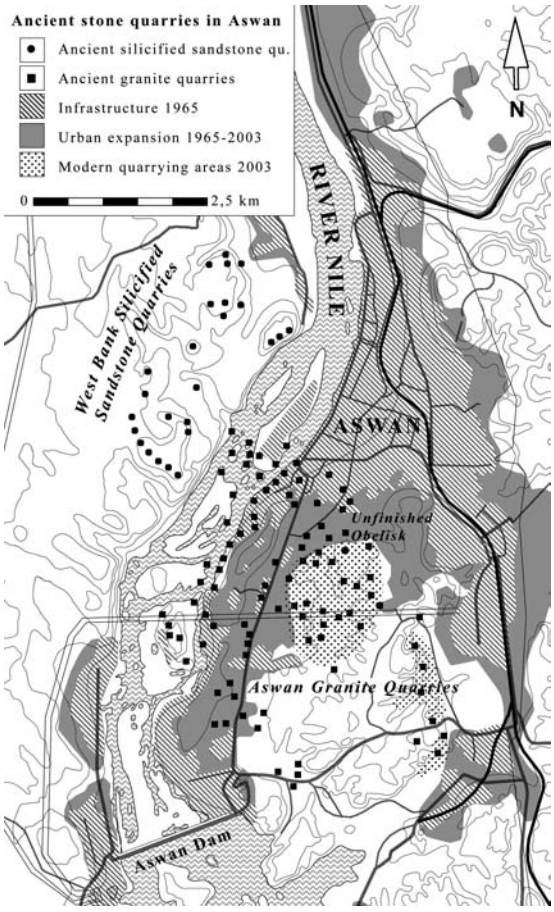

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Fig. 3. — Aswan: Map of quarries (after ASTON *et al.* 2000) and urban expansion 1965-2003. Compiled from US declassified satellite image (1965), IKONOS satellite images (2001), topographic maps (1990s) and observations.

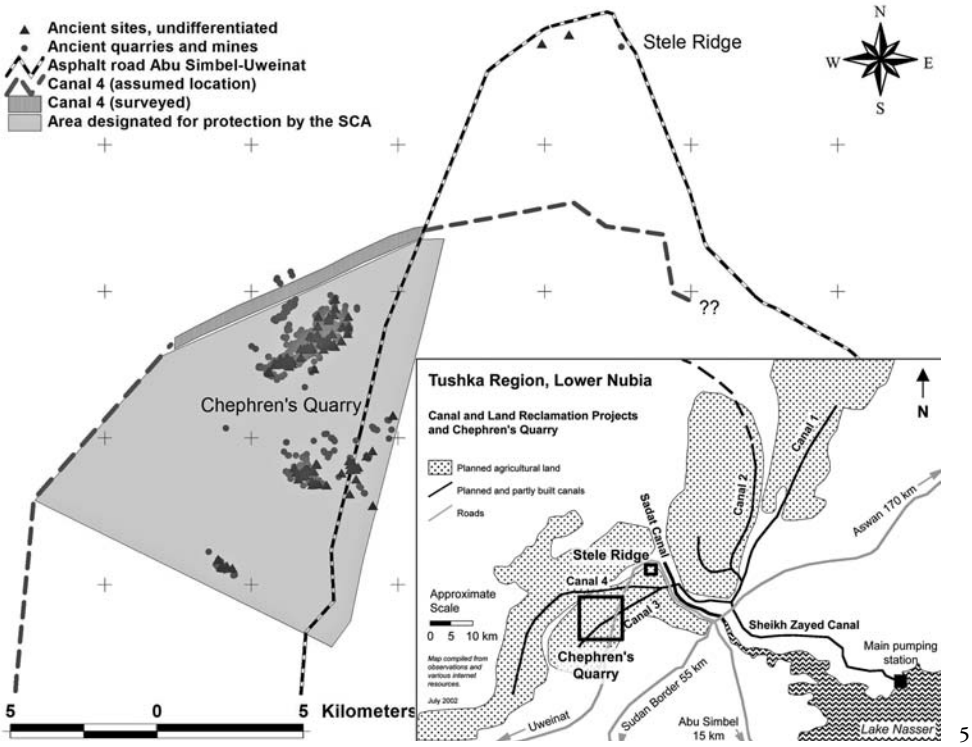
Fig. 4. — Aswan: Modern granite quarry and residential area close to the ancient quarry landscape.

Aswan High Dam in the 1960s and the massive relocation of people from the submerged areas in Lower Nubia, Aswan nearly tripled its population from 48.000 in 1960 to 127.000 in 1966. Since then the population has doubled, reaching 250.000 in 2002 (UNIVERSITY LIBRARY UTRECHT URL). Clearly, people has to live and work somewhere, and with the limited space in the Aswan area, parts of the quarries have since long been developed as residential areas. The Aswan case is problematic, insofar as there is evidently a need for housing and urban expansion, but at the same time decades have gone without proper archaeological investigation of the quarries. Hopefully, recently started SCA rescue surveys will remedy some of this loss of important archaeological information.

On the West Bank of the Nile at Aswan, a new city is currently emerging to cope with the population growth in the area. However, the new city is located close to and partially within known and newly discovered ancient silicified sandstone quarries (KLEMM and KLEMM 1993; HELDAL *et al.* 2005). Rescue surveys are currently undertaken in order to protect the quarries and to regulate the urban development.

The Aswan High Dam is the ultimate reason for another, possibly sad, quarry landscape story. Together with many vulnerable prehistoric sites, Chephren's gneiss quarry in the Western Desert, some 100 km west of Abu Simbel, is about to become the victim of one of the world's largest land reclamation projects, the so-called "South Valley Development Project", better known as the "Toshka project". Celebrated and criticised, this "Mega Project" aims at pumping surplus water from Lake Nasser into thousands of square kilometres of the hyper-arid Western Desert in order to raise food production and create the basis for new villages. Canal building is well underway, one canal is cutting through a marginal part of Chephren's Quarry, another may be planned to run directly through 100 square kilometres of Predynastic to Old Kingdom flat, boulder quarry landscape, the side effects possibly being bulldozing and covering with new top soil of the entire landscape (**figs 5, 6**). Since several years archaeological survey and excavation have been undertaken. Following the latest fieldwork (STOREMYR *et al.* 2002; HELDAL *et al.* 2009, references to earlier works therein), the SCA has taken action, and hopefully the quarry landscape can thus be saved from complete destruction.

Another of Egypt's remotely located hard stone quarries, the Widan el-Faras Old Kingdom basalt quarry in the Northern Faiyum Desert, including the 12 km long oldest paved road in the world, was until recently also in good shape (HARRELL and BOWN 1995; BLOXAM and STOREMYR 2002). Then geophysical exploration and vehicle traffic commenced, destroying parts of the vulnerable quarry landscape. Modern basalt quarrying companies moved into the area in 2001-2002 and they continue to leave a huge impact. However, also here efforts are undertaken in order to try to minimise the damage, as part of the considerations to nominate the Northern Faiyum as a World Heritage Site (STOREMYR *et al.* 2003).



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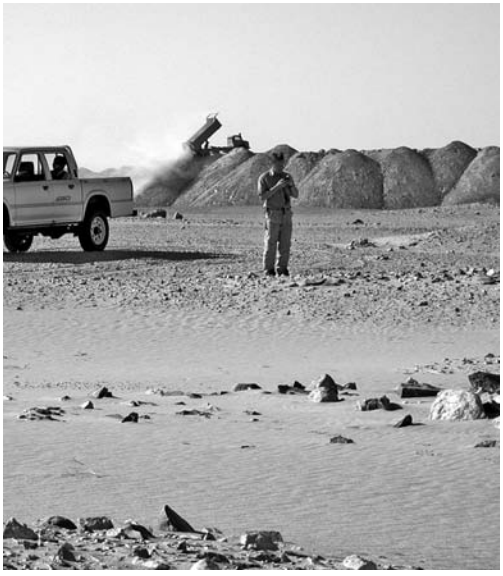

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Fig. 5. — Chephren's Quarry: Map of built and planned features of the "Toshka Project" and the area designated for protection by SCA.

Fig. 6. — Chephren's Quarry: Surveying quarries while canal building is going on in the background.

NORWAY: THE STORY REPEATS ON A MORE MODEST SCALE

Although no complete records exist, in terms of actual number of ancient stone quarries, Norway possibly outweighs Egypt. Most quarry areas are, however, much smaller, much less ancient, less visible in the wooded inland or rugged coastal landscape and less spectacular; and there are no advancing "Mega Projects" threatening the quarries. Contrary to Egypt, in Norway many ancient quarries are also registered with the Directorate for Cultural Heritage, and if not, they are automatically protected when containing archaeological remains older than from 1537, the "official" year of the Reformation. Nevertheless, destruction is still going on.

As for the distribution of quarries in Norway (**fig. 7**), Viking Age (700-1000 AD) and medieval (1000-1537 AD) soapstone production generally took place along the coast from the Precambrian areas in the southern part of the country and continued up the rugged west coast in partly Caledonian and partly Precambrian areas. In addition, there was a fairly large soapstone industry from the Viking Era to the post-Reformation period in the Caledonian interior of South Norway. Marble deposits were generally, but not exclusively, quarried along the coast from Bergen to Middle Norway in the Middle Ages, whereas granitic- and other hard stone deposits in the SE-part of the country were generally not exploited on a larger scale until the 19th century.

Despite strong interest on a very local level, Norwegian quarry landscapes are, from a scientific perspective, very poorly investigated and described. Some relatively fragmented overviews exist, though, starting with the ancient soapstone and slate industries (HELLAND 1893), the marble industries (VOGT 1897) and the 19th century granite industries (OXAAL 1916). For the numerous Viking Age and medieval soapstone vessel quarries scattered throughout the country, SKJØLSVOLD (1961) gives a good review and in STOREMYR and HELDAL (2002) one can follow the soapstone craft and industry from the Bronze Age until modern times. A few regional studies on building stone have been undertaken, first of all in the Bergen district (HELDAL and JANSEN 2000), but also in the Trondheim area (STOREMYR 2003) and around Oslo (e.g. BOE 1980). Otherwise, detail studies have been undertaken in some few smaller Stone Age tool quarries, a whetstone quarry, a large baking plate quarry and some post-Reformation schist and slate quarries – and in many Viking Age and medieval soapstone vessel quarries. Recent examples of more detailed investigations and excavations include two soapstone vessel and building stone quarries (STOREMYR *et al.* 2002; ØSTERAAS 2002) and a large millstone quarry (BAUG 2002).

As in Egypt, modern quarrying has traditionally posed the greatest risk to ancient Norwegian quarries. However, after the golden era of the stone building industry in the Middle Ages, for various reasons, in this country of wooden buildings stone did not become popular again as a building material until the 19th century. This second heyday saw the reopening of many medieval quarries and lasted until concrete took over for building purposes in the early 20th century (e.g. STOREMYR and HELDAL 2002). Since the second heyday was fairly short-lived, and since the quarrying technology remained rather manual until the late 19th century, the medieval quarries were rarely completely destroyed. This peculiarity also implied that today a

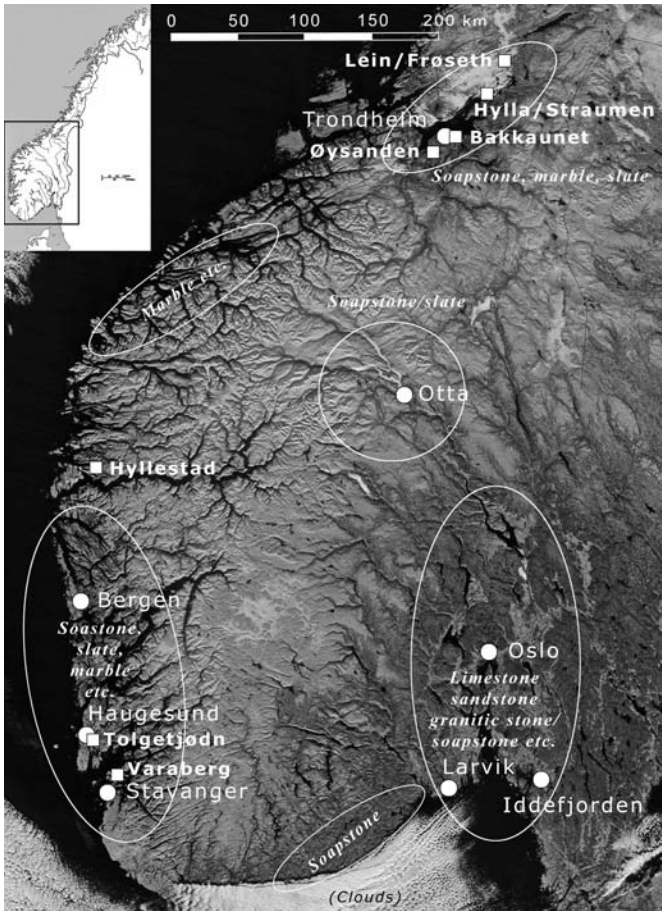


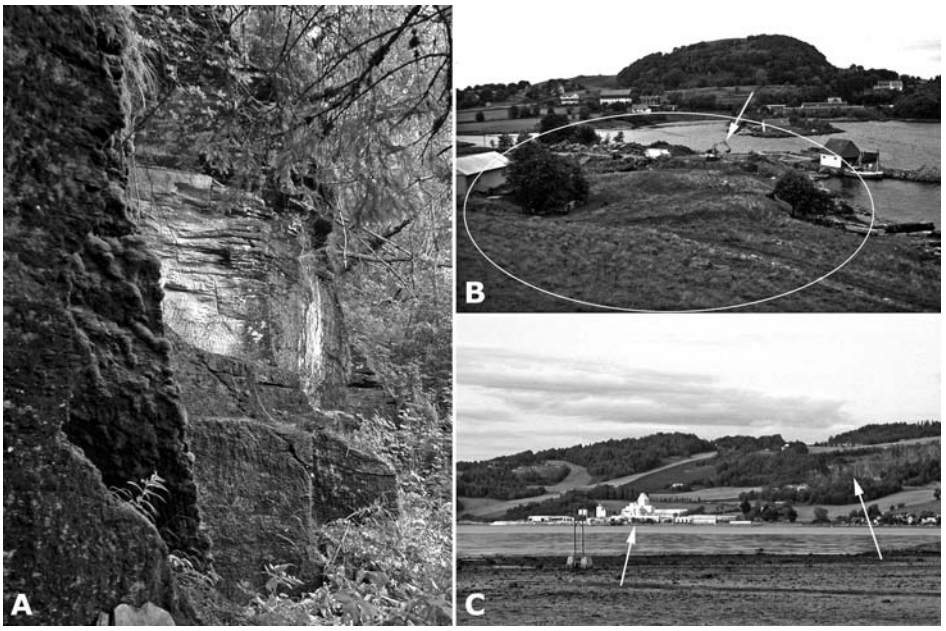
Fig. 7. — Satellite image of Southern Norway with traditional quarrying provinces and places (circles)/quarries (squares) mentioned in the text.

combined medieval and 19th century quarry landscape is often considered a cultural heritage entity. Nonetheless, some regions have seen the almost complete destruction of ancient quarries due to modern operations. A few examples include the many marble quarries along the west coast and in Central Norway, which were often used for lime- and later for concrete production (e.g. Hylla and Straumen north of Trondheim, **Fig. 8C**) and the soapstone vessel and oven quarries in South-Central Norway, which are situated in an area still heavily exploited by modern means for ovens and fireplaces (e.g. in the Otta district).

In addition to modern quarrying, following the rapid economic growth after WW2, urban and industrial expansion has also destroyed many ancient quarries and quarry landscapes. The worst examples can probably be found in the Haugesund-Stavanger region, in which a lot of soapstone vessel and building stone quarries have become victims of road and house building. The largest medieval soapstone quarry in Haugesund city (Tolgetjødn) was completely levelled a couple of decades ago, whereas a huge waste dump has been established in an adjacent ancient quarry area. The destruction does not seem to stop; in 1997 another listed quarry area closer to Stavanger (Varaberg, **Fig. 8B**) was, just as we undertook survey work, being treated with dynamite in order to make room for a new building (cf. STOREMYR 2000).

Other examples can be found in the Trondheim region, e.g. close to Sparbu where an important marble quarry landscape (Lein/Frøseth) has been partially destroyed by agriculture and in more recent times by building of a highway directly across one of the quarry pits. Moreover, in the large listed Øysanden medieval quarry landscape (soapstone and greenschist), a factory built in the 1980s, as well as road building, have made a great impact (HELDAL and STOREMYR 1997). And in the most famous medieval quarry in Trondheim, the listed Bakkaunet quarry close to the city centre (**fig. 9**), building of apartments has started. This quarry had been partly destroyed by former house building, but, as archaeological excavations have shown, it still contains many remains of the ancient operations and is situated within a still "readable" ancient quarry landscape. Nevertheless, the regional and national cultural heritage authorities did not consider these facts important enough to stop the new building project (cf. STOREMYR 2003). It should, however, be underlined that Bakkaunet is one of only two quarries in Norway, in which archaeological rescue excavations have ever been carried out. The first rescue excavation took place already in the 1960s at Kvikne (SKJØLSVOLD 1969), a remote pre-Roman Iron Age soapstone quarry which then was exploited for restoration of the Nidaros Cathedral, the most important medieval monument in the country. In the 1990s conflict again arose concerning the exploitation of the quarry – a conflict in which two parts within the cultural heritage sector stood against each other: The Restoration Workshop of Nidaros Cathedral and the responsible archaeological authorities. The Workshop drew the short straw and had to abandon further extraction activities. An example of cooperation between archaeological authorities and the Restoration Workshop has been given in STOREMYR *et al.* (2002).

Similar to Egypt, some very few ancient Norwegian quarries have been developed as outdoor museums, adapted for visitors by the establishment of footpaths or are visited by regular guided tours. The best example is perhaps the Hyllestad millstone quarry landscape (BAUG 2002),



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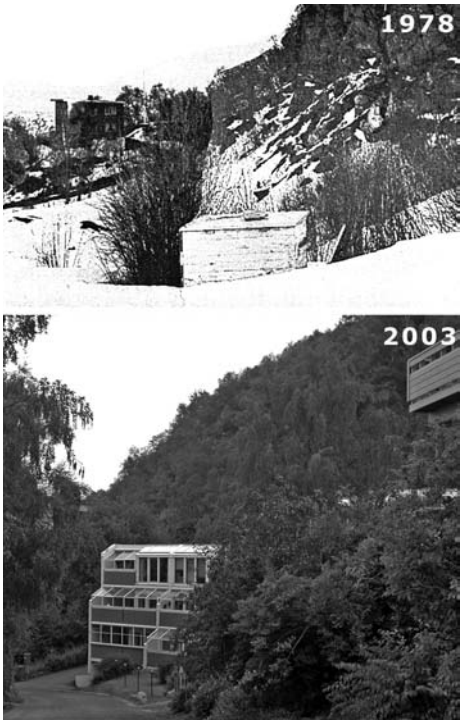

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Fig. 8. — Typical Norwegian quarry landscapes. A: Overgrown medieval greenschist/soapstone quarry at Øysanden by Trondheim. B: Varaberg medieval soapstone quarry by Stavanger. The quarry is located under the field (circle) and was recently partly destroyed by modern construction works (arrow), although presumably the most important quarry for Stavanger Cathedral. C: Hylla marble quarry by Trondheim. Established in the Middle Ages, the quarry has been used for lime production and more recently concrete production (arrows).

Fig. 9. — Trondheim: Bakkaunet medieval soapstone quarry 1978-2003. Another large apartment block will be built shortly. (1978 photo: *Adressseavisen*).

proposed by locals as a World Heritage Site. Interestingly, in several younger quarrying districts, especially in areas where large-scale exploitation commenced in the 19th century and is still going on, the local population show a great concern for the older quarries and quarrying traditions. In the Iddefjorden, Larvik and Otta districts (and elsewhere) there are quite a few examples of small outdoor museums, exhibits in established museums, footpaths, regular guided tours and the use of quarries for outdoor concerts and performances. This shows that still living traditions and local commitment is a most significant factor in preservation and protection work.

WHAT CAN BE DONE?

Ancient quarry landscapes are rarely destroyed or damaged because of malicious intents. They are damaged due to the need for land and resources and because developers usually have little or no knowledge of their archaeological significance – or even of their existence. According to our own experience and the examples in this paper, the same often goes for the cultural heritage authorities. When the authorities are unaware of the treasures they are set to manage, they are consequently unable to aid the appropriate land use planning and management in an area with ancient quarries. As seen on this background, as well as considering the European Convention on the Protection of the Archaeological Heritage (COUNCIL OF EUROPE 1992) and the European Landscape Convention (COUNCIL OF EUROPE 2002), there are several challenges ahead:

Recognition and communication

Ancient quarry landscapes need to be properly recognised and communicated as an important contribution to the archaeological heritage and cultural landscapes. Although still being damaged, some quarries in Egypt, Norway and elsewhere certainly enjoy such recognition, but in other regions, ancient quarry areas are still seen – in the worst case – as a source of raw materials. Communication must take place at several levels; in established scientific forums, towards cultural heritage authorities, the many NGOs working with cultural heritage, the stone industry – and, perhaps most importantly, towards the people living in or close to an ancient quarry landscape.

Inventory, including condition and risk assessment

Official and less official inventories of ancient quarries and quarry landscapes exist, but by and large they are, as in Egypt and Norway, fragmented and not including solid information on history, significance, extent, legal status, condition and risks. Thus, inventory standards, international or adapted to certain regions, need to be worked out and the cultural heritage authorities encouraged to undertake the necessary fieldwork and other investigations. Moreover, it has to be secured that inventories enter the official heritage lists; they rarely help in practical cultural heritage management when remaining within scientific works.

Rescue survey methods for quarries at risk

When observation indicates that a quarry area is seriously endangered, there is, in addition to normal archaeological rescue excavation, a need for rapid and accurate *overall* survey and documentation methods that can quickly aid responsible cultural heritage authorities, land use planners and developers. Given the particular character of many ancient quarry landscapes, special survey methods may have to be developed (see example in HELDAL *et al*. 2009). As in other cultural heritage fields, methods for site conservation, management and monitoring also need to be addressed.

Research

Much fundamental research has been carried out on themes like quarrying techniques and provenance of stone. In comparison, meticulous, long-term archaeological site research, considering the "whole" quarry landscape, is relatively infrequent. There is definitely a need for more studies having the interdisciplinary character of the works at Mons Claudianus (PEACOCK and MAXFIELD 1997) and Mons Porphyrites (MAXFIELD and PEACOCK 2001). In the long run it is above all such studies that will help in recognising, understanding and appreciating ancient quarry landscapes – and thus form the basis for protection of such landscapes at large.

CONCLUDING REMARKS

It is neither possible, nor desirable to preserve all traces of human activity. However, ancient quarry landscapes have been treated with probably more ignorance and neglect than few other fields of cultural heritage: Heritage values of such landscapes are frequently lost without even knowing they are there. Thus, it is our hope that this paper – and good future projects and programmes recognising the values of such landscapes – may contribute to a more balanced development.

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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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