The Organisation, Transportation and Logistics of Hard Stone Quarrying in the Egyptian Old Kingdom: A Comparative Study

Volume I: Text

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Abstract

Widan el-Faras and Chephren's Quarry are two major hard stone quarries located outside the Nile Valley in the Western Desert of Egypt. Both quarries were exploited during the Old Kingdom exclusively for royal and elite purposes when hard stone consumption was at its peak during the 4th and 5th Dynasties. Basalt from Widan el-Faras was used for paving temple floors and Chephren Gneiss from Chephren's Quarry for royal statuary and vessels. The thesis presents a new approach to the interpretation of archaeological data from these quarries by using a comparative methodology that encompasses cross-cultural theoretical models of stone procurement. From such an approach significant insights can be made into the social context of these practises which have hitherto been poorly understood.

From examination and interpretation of fresh quarry data collected from recent survey and excavation of Widan el-Faras and Chephren's Quarry, it is proposed that Old Kingdom quarry expeditions, outside the NileValley, were small-scale campaign-driven operations involving specialists, well-organised through kinship ties and mobilised for specific projects. Comparative analysis of ceramic evidence and stone tools has also highlighted connections between quarries across a diverse geographical range. Furthermore, a comparison of quarry inscriptions with settlement and ceramic data implies that the numbers of people involved in remote source quarry expeditions are fewer than the written sources suggest.

Water-borne transport of stone and environmental conditions played an important part in the logistics of monumental stone acquisition from remote sources and cessation in exploitation may be linked to changes in these conditions and lower Nile floods by the 6th Dynasty. The discovery of ancient shallow groundwater wells providing water for domestic and production purposes and new concepts relating to methods of stone transport are presented. Changes in production and consumption of certain stones can also be measured against political, economic and ideological transformations over time.

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Chapter 1

Introduction

Pharaonic Hard Stone Quarries: A Summary of Past Research

Exploration and documentation of quarry sites exploited during the Pharaonic period in Egypt received little attention until the late 19th and early 20th century. Archaeologists and geologists such as Petrie and Currelly (1906), Weigall (1910, 1913), Petrie and Mackay (1915), Timme (1917) and Hume (1934, 1937) investigated some ancient quarries as part of larger geological or archaeological expeditions, although archaeological approaches specific to production techniques were not undertaken. Engelbach (1922, 1923) was the first archaeologist to pioneer the study of hard stone[1] quarrying methods in the Aswan (granite/granodiorite) quarries; he focused particularly on the 'Unfinished Obelisk' and how such objects were transported from the quarries in the New Kingdom.

It was not until 1932 that the exact whereabouts of the quarries for the famous 'Chephren Diorite' became known when an Egyptian army patrol, travelling through the south-western desert, got lost in a previously unsurveyed part of the desert between the Dunqul and Dakhleh oases (Engelbach 1938: 369). The patrol had inadvertently stumbled upon some 'lost quarries' which had remained until this point undiscovered for almost four thousand years. This discovery was reported to Engelbach, then Keeper of Antiquities at the Egyptian Museum in Cairo, who made an immediate connection between these 'lost quarries' with the possible source of 'Chephren Diorite'. Engelbach organised an expedition to the quarries together with topographer G. W. Murray. The first season took place in 1933 and a second in 1938 (**Pl. 1**). The majority of artefacts discovered from these expeditions to what was named the 'Chephren Diorite Quarries' are now housed in the Egyptian Museum in Cairo and the Nubia Museum in Aswan.

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[1] See Volume II Appendix B 1 for list of stones classified as either 'hard' or 'soft'.

Although Engelbach and Murray conducted a partial excavation of one loading ramp, only random surface surveys were undertaken during the production of an overall site map. Engelbach (1933, 1938) and Murray's (1939) accounts of these expeditions give generalised descriptions of the quarries and stone structures, with vague suggestions about the social context of these operations. Nevertheless, these are compelling narratives and their investigations, although somewhat *ad hoc* in their use of field techniques, produced comprehensive reports given the short time they spent at the quarries (**Pl. 2**). Their mapping of the quarries was accurate and to the present day has provided a reliable basis for initiating fresh archaeological survey, given the difficulties in locating structures across featureless terrain with high deposition of aeolian sand.

Caton-Thompson and Gardner belonged to the same generation of archaeologists and explorers and are generally associated with their pioneering work in the Faiyum. During the 1920's and 1930's they investigated the levels of Lake Moeris from analysis of Neolithic settlements along the extinct shorelines of the lake, as published in their seminal 1934 volumes. These included the archaeological survey and excavation of the Umm es-Sawan gypsum quarries and excavation of the nearby Old Kingdom settlement of Kom IV. To the present day, this work represents the only published material on both these exceptional archaeological sites. Although they visited Widan el-Faras and made observations of the ancient road, they did not survey or excavate this site.

Sixty years elapsed before Chephren's Quarry (or Chephren Diorite Quarries as it was then named) and Widan el-Faras were revisited by geologists Harrell and Brown (1994) and Harrell and Bown (1995) respectively. Harrell's interest in ancient stone quarries is from a geological perspective, particularly the provenance of stone artefacts and the rectification of past errors in stone classification. Harrell and Brown's (1994: 53) petrological analysis of the characteristic gneiss from Chephren's Quarry established the terms *'gabbro gneiss'* for the blue banded gneiss from which the 4th Dynasty Khafra statues are made, and *'anorthosite gneiss'* for the speckled variety, from which stone vessels and statuettes were produced.

Research Objectives

A broad base of knowledge has been accumulated about ancient Egyptian hard and soft stone quarry sites. This relates particularly to general locational mapping, stone production technologies and estimating periods of exploitation. However, the social context and logistics of hard stone quarrying from *remote* sources, or outside the Nile Valley, in the Old Kingdom still remains poorly understood, despite this period representing an epoch when the quantities of hard stone transported over distances in excess of 1,000 kilometres were not equalled until the Roman Period.

The new approach taken in this study is to address the social context and logistics of remote source Old Kingdom hard stone quarrying from a range of empirical data at quarry sites, and to compare this with quarries over a range of archaeological contexts inside and outside Egypt. The broader objective of this research is to demonstrate how a comparative methodology can provide fresh insights into the social context of these activities, particularly in the absence of reliable epigraphic sources. The thesis also aims to establish if connections can be observed between Old Kingdom quarry sites, despite their wide geographical separation. Inter-quarry links could provide fresh insights into the organisation and mobilisation of labour forces, connections that might be overlooked when studying quarries individually.

Research Questions

The thesis is constructed around two fundamental aspects of Old Kingdom (remote source) hard stone quarrying activity: logistics (stone procurement and transport) and social context (social organisation and mobilisation of labour). These areas of inquiry involve the following specific questions:-

Stone Procurement and Transportation:-

i. Can the explosion in elite consumption of remote source hard stones be characterised from production evidence at the quarry sites?

The presence of ancient basalt quarries in the vicinity of Widan el-Faras had been known for at least a century (Beadnell 1905; Caton-Thompson and Gardner 1934). However, the first serious geological description and differentiation between the east and west quarry areas of Widan el-Faras was undertaken by Harrell and Bown (1995). This work produced the first comprehensive map of the site, with detailed analysis of the ancient quarry road and its branches into the quarries at Widan el-Faras.

Harrell (1989, 1992, 1995, 2002) has made a major contribution to the mapping and geological surveying of many known and previously unknown hard and soft stone ancient quarries, particularly in the Eastern Desert. Rosemarie and Dietrich Klemm have also contributed enormously to the task of surveying and documenting ancient Egyptian hard and soft stone quarries; Klemm and Klemm (1993) provide a comprehensive geological overview of Egyptian quarries with good maps. Like Röder (1965), they endeavoured to produce a tool-mark chronology, but avoided discussion of the techniques of stone transportation or organisation of labour forces.

Röder's (1965) seminal paper about the Aswan (granite/granodiorite) quarries still remains the most comprehensive geological survey of these quarries. This is principally because the quarries are still being worked and as a consequence, many of the ancient quarries have disappeared under modern quarrying. Röder attempted to identify a chronology of stone extraction technology from analysis of 'wedge-splitting' techniques. The spaces between the wedge-marks were used to determine a chronology, which rather predictably deduced that the wider apart and less organised arrangement of wedge-marks represented the earliest developments, and so on. Although this technique is an unreliable way to establish a chronology, it is nevertheless a useful contribution to understanding the range of extraction techniques used in the quarries (Röder 1965: 517, Fig. 29). Röder (1965: 517) concluded from this study that Roman Period quarrying was the most represented of all the wedge-splitting techniques found. Although red granite consumption in the Roman Period was unsurpassed, Röder (1965: 550-1) calculated that red granite used in Old Kingdom pyramid complexes came quite a close second.

Upwards of 100,000 cubic metres of red granite was extracted from the quarries during the Old Kingdom, a figure not equalled in the rest of the Pharaonic period.

From a purely archaeological perspective, the study of ancient quarry sites has been the focus of recent investigations by Shaw, and Peacock and Maxfield. Peacock and Maxfield have focused intensive survey and excavation at two major Roman hard stone quarry sites in the Eastern Desert: the Mons Claudianus granodiorite quarries (Peacock and Maxfield 1997) and the Imperial Porphyry quarries at Mons Porphyrites (Maxfield and Peacock 2001). Whereas Ian Shaw's work has been predominantly on survey and excavation of Pharaonic period quarry sites such as Hatnub (1986, 1987) and Chephren's Quarry (1998, 1999, 2001) and mining sites in the Eastern Desert at Sikait Zubara and Wadi el-Hudi (1994, 2002, Shaw and Jameson 1993). Shaw (1986, 1987, 1994) has discussed some aspects of the social context of stone quarrying, particularly in relation to the Hatnub travertine quarries, but these have generally focused on observations of settlement evidence and textual sources. In particular, Shaw identified how settlement patterns and pottery assemblages can provide evidence to determine if stone extraction at a site was a sporadic or a more prolonged activity. Ian Shaw and the author are currently co-directing excavations at Chephren's Quarry.

ii. Is it possible to observe, from production evidence and transportation infrastructure, the influence of a well-organised and proficient central administration on procurement strategies?

iii. How sensitive to Egypt's regional influences/control was stone procurement from *remote* sources, and does this suggest monopolies/ownership over these sources?

iv. To what degree were stone procurement strategies linked to the annual Nile flood and access to a source of water for transportation?

v. How accurate is the textual and iconographic record in explaining how raw materials were transported over large distances from quarries?

vi. Was the cessation of remote source hard stone procurement associated with a change in climate and environment or due to changes in the demands of the state connected with political decentralisation?

The Organisation and Mobilisation of Labour Forces:-

i. Does the archaeological record at quarry sites support the textual evidence associated with the size of quarry labour forces?

ii. Can settlement evidence and data relating to food production attest to seasonal or permanent exploitation?

iii. Does the organisation of quarry labour forces in a complex society directly compare with those in a range of differing archaeological contexts, and what might these comparisons contribute to the overall understanding of the processes of raw material acquisition in state and non-state societies?

iv. Were there regional bases for exploitation or were the quarrymen who worked in Upper Egyptian quarries mobilised from quarries in Lower Egypt during the 4th and 5th Dynasties?

v. Were systems of exchange in stone tools operating between quarrymen?

vi. Were quarry labour forces only mobilised by state coercion?

Sources of Evidence

The data sources being analysed fall into four main categories:-

i. Fresh archaeological data collected from recent survey and excavation of two Old Kingdom quarry sites: Chephren's Quarry and Widan el-Faras.
ii. Published sources: supplemental data from archaeological and geological investigations of other Old Kingdom quarry sites.
iii. Stone consumption at Old Kingdom royal pyramid complexes and for elite status objects.
iv. Textual and iconographic sources.

i. The Archaeological Record at Old Kingdom quarry sites: Chephren's Quarry and Widan el-Faras

The fresh archaeological data being analysed has been collected during five seasons of survey and excavation at Chephren's Quarry (Chephren Gneiss) in Lower Nubia between 1997 and 2003, and during two survey seasons at Widan el-Faras (basalt) in the Northern Faiyum Desert, in 2001 and 2002 (**Fig. 1**). For clarification, the nomenclature 'Chephren Diorite Quarries' previously used for this location is technically incorrect because these are not diorite quarries (see Chapters 2 and 4), therefore 'Chephren's Quarry' is the title that will be used throughout this thesis. Chephren's Quarry and Widan el-Faras have been selected for fresh research because the stone from both these remote sources, meaning in this context *outside* of the Nile Valley, was exploited specifically for elite status items in the 4th and 5th Dynasties. Basalt was chosen as paving and wall linings in royal mortuary and valley temples, whereas Chephren Gneiss was used for royal statuary and small vessels. A study of the empirical data from both these quarries forms the central dataset for comparative analysis and interpretation. The infrastructure and material culture remaining in the archaeological record at these quarries comprises these basic elements:-

i. roads and ramps
ii. settlement/stone features
iii. pottery assemblages
iv. stone production evidence relating to extraction and partial working of stone
v. stone tool assemblages

Furthermore, in relation to understanding the logistics of transporting stone from these remote sources, their contrasting geographical and geomorphological settings present an opportunity to study how technologies might have been adapted to overcome specific topographical irregularities.

ii. The Archaeological Record: published sources for comparative analysis

Although Widan el-Faras and Chephren's Quarry are the focus of new research and the collection of fresh data, it is important to include the Old Kingdom quarries at, Hatnub, Aswan and Umm es-Sawa, in order to produce a broader base for an overall comparative framework. The comparative data from these quarries comes from published material and from field observations made at Umm es-Sawan during the Widan el-Faras survey season in 2001. Elements of the archaeological record at all these sites provide varying degrees of comparative data comprising:-

i. roads (only Hatnub and Aswan)
ii. production evidence
iii. settlement (only Umm es-Sawan and Hatnub)
iv. pottery (only Umm es-Sawan and Hatnub)
v. tools

Furthermore, given that Hatnub and the Aswan quarries are located inside the Nile Valley, a comparative study could identify any significant differences in infrastructure between sites inside and outside the Nile Valley. In addition, other ancient quarry sites in Egypt are discussed at relevant points and also those from Aegean and Mesoamerican contexts.

Pharaonic Quarries in Egypt: Published Sources

The published sources used in this study cover a range of geological and archaeological research of Pharaonic period quarries in Egypt, specifically:-

Widan el-Faras:	Caton-Thompson and Gardner (1934), Harrell and Bown (1995), Bloxam and Storemyr (2002)
Chephren's Quarry:	Engelbach (1933, 1938), Murray (1939), Harrell and Brown (1994), Shaw and Bloxam (1999), Bloxam (2000, 2002), Storemyr *et al.* (2002)
Hatnub:	Shaw (1986, 1987)
Aswan:	Engelbach (1922, 1923), Clarke and Engelbach (1930), Rŏder (1965)
Umm es-Sawan:	Caton-Thompson and Gardner (1934), Harrell (2002)
General sources:	Clarke and Engelbach (1930), Lucas (1962), Arnold (1991), Klemm and Klemm (1993), Aston *et al.* (2000)

iii. Stone consumption in Old Kingdom royal pyramid complexes and for elite status objects

The study of stone consumption in the Old Kingdom is focused particularly on the use of Chephren Gneiss and basalt, to match the new archaeological research. The consumption of travertine, Aswan granite and granodiorite are included in this study because these stones were also used in a variety of elite contexts during the Old Kingdom. Data for this study is collected from three main sources:-

i. The Petrie Stone Vessel Corpus housed in the Petrie Museum of Egyptian Archaeology at University College London.

ii. Field observations made at the main 4th and 5th Dynasty pyramid fields at Giza, Abu Roash, Saqqara and Abusir.

iii. Review of published sources that have identified stone use in antiquity for monumental architecture, vessels and statuary.

Published Sources of Stone Use: Predynastic to First Intermediate Period

The published sources examined come from some of the earliest excavations of Old Kingdom pyramid complexes by Petrie (1883), Borchardt (1907, 1910, 1913), Reisner (1931), Firth and Quibell (1935), along with more recent works by Fakhry (1969), Edwards (1991), Lehner (1997) and Verner (2002). Sources specific to the study of stone use for statuary and stone vessels come from Reisner (1931), Lucas (1930), Petrie (1937), El-Khouli (1978) and Aston (1994), with additional data from museum collections in Borchardt (1911), Spencer (1980), Arnold and Pischikova (1999) and Grzymski (1999).

iv. Textual and iconographic sources

Past research at quarry sites has taken a less critical approach to textual sources as explanations of the social context and logistics of Old Kingdom quarrying. In an Old Kingdom context textual and inscriptional sources specific to the quarries being studied in detail are either absent (Widan el-Faras) or just comprise stelae (Chephren's Quarry) which record a presence. Hence, these sources can only make a limited contribution as a reliable dataset to explain aspects of organisational and logistical processes that are invisible in the archaeological record. Therefore, the epigraphic sources selected for study have had to come from quarry and mining expeditions in both Old Kingdom and Middle Kingdom contexts as follows:-

- Inscriptions at quarries: 5th - 6th Dynasties at Hatnub (Anthes 1928); 6th and 12th Dynasties at Wadi Hammamat (Couyat and Montet 1912; Goyon 1957)
- Inscriptions at mining sites of the 3rd - 6th Dynasties: the Sinai Inscriptions at Wadi Maghara (Breasted 1906; Gardiner *et al.* 1955)
- Stelae in Chephren's Quarry: 4th - 5th Dynasties (Rowe 1938)
- Middle Kingdom stelae relating to Chephren's Quarry (Rowe 1938, Simpson 1962b, 1963)

- Graffiti or mason's marks: stone blocks at pyramid construction sites (Reisner 1931; Verner 2002)
- Iconography 5th Dynasty: Unas causeway, Ptahshepses mastaba (Verner 1986; 2002)
- Narrative accounts 6th Dynasty: autobiographies of Weni and Harkhuf (Breasted 1906; Anthes 1928; Eyre 1987; Trigger *et al.* 1983)

Methodology

FIELDWORK

The principle dataset on which this research is based comes from the analysis and interpretation of fresh archaeological evidence collected during survey and excavation of two Old Kingdom quarry sites: Widan el-Faras and Chephren's Quarry. The challenge that both these sites presented to the application of field survey and excavation techniques, was devising a methodology compatible with the spread of the quarries and archaeological features over a very wide area. At Chephren's Quarry the archaeological site covers an area of approximately 100 km² and at Widan el-Faras (not including the area across which the ancient road spans) approximately 4 km². As a consequence, the survey methods used had to be flexible in order to maximise the effectiveness of site recording under these specific conditions. The following is an outline of the methods used and objectives of these fieldwork seasons to document these sites.

Archaeological Survey at Widan el-Faras: 2001 and 2002

The Widan el-Faras Project was an archaeological survey carried out in May 2001 under the aegis of the SCA and mainly sponsored by the Egypt Exploration Society Centenary Award 2000. The survey team, directed by the author, included geologist Dr Per Storemyr, ceramicist Ashraf el-Senussi and field archaeologist Richard Lee. The survey concession area at Widan el-Faras included these key elements of the site:-

i. the east and west quarry workings
ii. 'Main Quarrymen's Camp' and small encampment
iii. ancient paved quarry road

The objectives of the survey were as follows:

i. to produce an overall archaeological map of the site
ii. to analyse pottery to secure a date for the various elements of the site
iii. to identify and record stone tools

iv. to produce plans of the two ancient settlements from the surface survey

v. to photograph and document the entire site

vi. to make field observations at the nearby gypsum quarry of Umm es-Sawan and at the terminus of the ancient quarry road at Qasr el-Sagha, since both these sites were outside the official concession area, a detailed survey was not possible.

The 11.7 km long section of road from the quarry to Lake Moeris has already been surveyed in detail, but this work remains unpublished (Cornero 1996/7). However, Harrell and Bown (1995) had made another detailed survey of the ancient road, therefore the objective of the 2001 survey was to reinvestigate the layout of the road branches into the quarries for the purposes of mapping onto the overall site plan.

Archaeological Ground Survey, May 2001

Widan el-Faras in 2001 was an archaeological site that revealed remarkably good preservation due to its location outside the Nile Valley in a region of the Northern Faiyum Desert that is infrequently visited. Although parts of the ancient road near Qasr el-Sagha have been damaged from vehicles inadvertently driving across it, damage to Widan el-Faras in 2001 was due more to natural processes, such as periodic flash-floods, than human interference. The present ground surface at Widan el-Faras is highly deflated due to the action of the constantly prevailing north-west wind and as a consequence, the archaeological features of the site are clearly visible on the desert surface. Pottery and stone tool assemblages lie as intermittent, but small, surface scatters within the quarries and settlement areas. The quarries are located at an elevation of 320 metres a.s.l. along the top of the Gebel Qatrani escarpment and are generally well preserved despite later Roman quarrying, which is only evident in one of the extraction sites.

The mapping area was restricted to 2 x 2 km and the archaeological features were plotted onto a scanned Corona Satellite Image [2] with a resolution of c. 2 m. The archaeological

[2] This was taken in the 1960s at a slightly oblique angle and was kindly provided by Prof James Harrell through the U.S. Geological Survey website: www.usgs.gov

features and quarries at Widan el-Faras were plotted onto the base map with an accuracy of between 10-30 metres. Although the accuracy is relatively low and a better map could be produced using a total station or differential GPS, this would have been too time consuming. Furthermore, the objective of this first field season was to produce an overall archaeological map of the site that illustrated the spatial distribution of archaeological features. The resulting map (**Fig. 2**) produced using Adobe Photoshop/Divisional Mapping System (undertaken by Storemyr), is now the most detailed and accurate archaeological map of the site.

Planning of the exposed settlement features, as represented by groups of single-level basalt stone circles, was undertaken manually using the triangulation survey method. This method was used because the weathering of the basalt into a range of pebble sizes made it difficult to define one circle from another because the walls had collapsed into each other. Therefore, accurate planning could only be successfully achieved using a manual field surveying technique, including careful scrutiny with the naked eye. Bearing in mind that the actual size of both settlements is reasonably small, such a method was not too time-consuming. The plans were digitised by the author using Auto-CAD and downloaded into Arc View to produce overall settlement plans.

Pottery sherds and a few stone tools lie as surface scatters and these areas of artefact distribution are concentrated mainly within the small encampment. Given the undisturbed nature of the site, they provide a datable context. These concentrations of pottery sherds and tools were recorded and mapped onto the plan of the encampment via field-walking using the transect survey method, based on the model undertaken by Cherry *et al.* (1988) in Greece. The aim of recording and mapping these concentrations was to establish a spatial patterning of activity areas and to determine if the encampment revealed single or multiple periods of occupation. In the main settlement artefact scatters are almost negligible and, given the location of the stone features across a wadi subject to periodic flash floods, negated the viability of using the transect survey method in such a disturbed context.

Scatters of pottery are also found in small concentrations in the quarries, and these were analysed in the field, photographed and plotted onto the overall map using GPS. The SCA concession only permitted a ground survey, with no artefact collection, and hence pottery was examined, drawn and dated on-site by ceramicist Ashraf el-Senussi (2001).

Geological Survey, June 2002

In 2002 under the aegis of the Egyptian Geological Survey and Mining Authority (EGSMA), a second short survey season was conducted at Widan el-Faras with geologists Prof. James Harrell, Dr Per Storemyr and Tom Heldal. The objective was to review some of the observations made in 2001 with James Harrell. In the one year since the first survey season, modern quarrying had already destroyed some of the Old Kingdom quarries; a problem further discussed in Chapter 11. During this short season some of the quarries were re-mapped using differential GPS and geological samples of stone tools, previously undetected, were taken for geological analysis by Harrell. The 2001 archaeological map was updated to include these new findings.

Survey and Excavation at Chephren's Quarry: 1997-2003

Chephren's Quarry covers an area of approximately 100 km² 65 km north-west of Abu Simbel in the Western Desert. As a consequence of the quarry's remote location, distant from the Nile Valley, the site has not been subjected to over-building or destruction from agriculture and, hence, in the early seasons of work showed remarkably good preservation. The present day environment is essentially flat hyper-arid desert consisting of gebels, deflated playas and sand sheets. The sand sheets or 'desert pavement' are made up of interbedded coarse sands armoured by fine pebbles providing a hard and compact surface. However, areas of high aeolian sand deposition can be observed which accumulate around elements of the quarry infrastructure such as the loading ramps and stone features which lie partially exposed. Pottery and stone tool assemblages tend to be visible as surface scatters. Further evidence of good site preservation is demonstrated from scatters of objects left from Engelbach and Murray's expeditions in the 1930s. Beer bottles, sardine cans and petrol cans, in some cases with the labels still clearly legible, can be found amongst the remains of their camps (**Pl. 3**).

Field Survey Season, April 1997

The primary objective of this first short (4-day) season of archaeological survey, directed by Dr Ian Shaw, was to locate the amethyst mines at Stele Ridge in the northern environs of the quarry, as described by Engelbach (1933, 1938) and Murray (1939). However, this objective was not realised due to the construction of the Abu Simbel-Uweinat road in 1995 which had cut straight through this part of the quarry, rendering it negligible for research. The secondary objective of the season was to make a limited EDM survey of one quarry and to take GPS readings of the main elements of infrastructure associated with the site in preparation for the following season of survey and excavation. During these investigations a photographic record was produced and an evaluation of the geology was undertaken by Dr Judith Bunbury.

Archaeological Survey and Excavation, April 1999

In 1999 a multi-disciplinary survey and excavation team undertook a one-month season at Chephren's Quarry. The team was directed by Dr Ian Shaw with the author as deputy director, and included specialists Dr Judith Bunbury (geologist) and Deborah Darnell (ceramicist). The objectives of this season were to undertake the first systematic survey and excavation of key elements of the site's infrastructure to determine the periods of exploitation, methods of stone transport and nature of the settlement. This was achieved through a fieldwork season that undertook the following:-

i. partial excavation of two stone-built loading ramps at Khufu Stele Quarries
ii. partial excavation of settlement/stone features at Quartz Ridge
iii. EDM survey of the immediate environs of Quartz Ridge and Khufu Stele Quarries

iv. documentation and planning of excavated features

v. full photographic record

vi. pottery analysis and collection.

Excavation of the stone features was only partial given the high deposition of aeolian sand and time restrictions. Pottery analysis was conducted in the field and diagnostic sherds were collected and stored with other artefacts in the SCA magazine in Aswan. To date further analysis of faunal and floral remains collected has not been undertaken, although a full study season is to be arranged with the SCA in 2004.

Archaeological Survey and Excavation, April 2000

The second major season of survey and excavation occurred in April 2000 with the same team and specialists as in 1999. As explained above, up until this point Chephren's Quarry was relatively undisturbed, apart from the northern environs around Stele Ridge. However, the road construction in the area had then been eclipsed by the Tushka Hydrological Project; the ramifications of this development on the site are fully discussed in Chapter 11. Damage to the site had started after the 1999 season, and on returning there in 2000, parts of the settlement at Quartz Ridge had been ransacked. This vandalism resulted in the almost total loss of an extraordinary cache of 23 intact 12th Dynasty storage vessels (found in 1999) amongst other ceramic objects and stone structures. This situation was the result of an increasing human presence in the region associated with the hydrological project.

The objectives set for the 2000 season therefore suffered a severe set-back, as continuing excavation of the Quartz Ridge settlement area, where the 12th Dynasty storage vessels were found, became non-viable. Hence, excavations were concentrated on other elements of the site:-

i. continuing excavation of loading ramp at Khufu Stele Quarries

ii. full excavation of two circular stone features located at Khufu Stele Quarries and

Quartz Ridge

iii. partial excavation of settlement area in Khufu Stele Quarries

iv. continuing EDM survey of the environs of Quartz Ridge and Khufu Stele Quarries.

As in the 1999 season, artefacts collected were put into storage in the SCA magazine at Aswan. A report concerning the pottery analysis undertaken during this season was produced, stressing the urgency of initiating a study season at Aswan. Although the 1999 and 2000 seasons produced geological analyses, planning of excavated features and a full photographic record, the production of site maps from this work did not take place. Site maps for this work were not produced and so another survey season was organised in June 2002 to produce an overall map of the site.

Geological Survey Season, June 2002

This short season, directed by the author, included geologists Dr Per Storemyr, Tom Heldal and Abdou Salem and was executed under the aegis of the Egyptian Geological Survey and Mining Authority. It became apparent from the survey conducted at Widan el-Faras that although the EDM survey method is useful for the detailed survey of archaeological features, it is not an appropriate tool for producing site maps over such a large geographical area. The method is simply too time-consuming to gather the required information that is spatial relationships between the quarries, areas of production, settlement and transport routes. This information can be gained by using differential GPS and was particularly appropriate in Chephren's Quarry and Widan el-Faras because complex structures that are multi-level and multifaceted are *not* present.

The objectives of the June 2002 season were as follows:-

i. to produce an overall site map that included the distribution of quarries and archaeological features

ii. a detailed survey of the main extraction sites at Khufu Stele Quarries and at

Chisel Quarry

iii. geological analysis of the quarries

The survey was undertaken using differential GPS to make survey points with an accuracy of five metres. The survey data was converted into map formats using Arc View (produced by Tom Heldal). This method enabled the production of a site map and detailed plan of two of the main extraction areas within a short space of time. The accuracy of these maps and plans is considered entirely adequate for documenting a quarry site that not only comprises numerous quarries, but has archaeological features spread over a wide area. This method is particularly useful when manpower and time are both limited.

The production of an overall site map was also crucial to determining the boundaries of this enormous site. The map was submitted to the SCA in a report about the imminent threat to the site posed by the Tushka Hydrological Project (see Chapter 11).

Archaeological Survey and Excavation, January 2003

During the 2002 survey season the rapid advancement of the canal network associated with the Tushka Hydrological Project and the immediate impact this would have on Chephren's Quarry became obvious. Subsequent enquiries through the SCA revealed that the project would be completed within the next two years and hence, given the urgency to fully document the site, a larger joint British-Norwegian team returned to Chephren's Quarry in January 2003 under the directorship of Ian Shaw and Tom Heldal, with the author as deputy director. This project was designed to undertake these initiatives:

i. detailed mapping of all the ancient quarries and archaeological features in the area, including the Nile-Chephren's Quarry track
ii. photographic recording of the surviving remains of Chephren Gneiss quarries, as well as surviving traces of the track leading from Chephren's Quarry to the Nile

iii. classification of the different working areas according to chronology, type of quarrying operation and archaeological infrastructure
iv. the completion of planning and excavation of areas of settlement at Quartz Ridge
v. excavation of a Chephren Gneiss extraction site
vi. excavation around an unfinished statue block in the central quarries
vii. pottery surface survey across the site as a whole.

This season of survey and excavation was executed under the aegis of both the SCA and EGSMA and comprised a multi-national, multi-disciplinary team including geologists Dr Per Storemyr and Tom Heldal, with Egyptian participation by geologist Abdou Salem and ceramicist Ashraf el-Senussi. The Norwegian input into the project was to map all the quarries and archaeological features using differential GPS. Corona satellite images with two-five metre resolution were used as background for the maps and geological interpretations. GPS point registrations and other observations were transferred to Excel tables and converted to map formats (Arc View GIS shape files). The geological observations and maps of larger features were drawn directly in the field using a Compac Ipaq pocket computer connected to a GPS using Arc Pad software. The use of GPS-aided digital collection data made it possible to compile and finish maps in the field, ready for integration directly into spatial land management systems. This part of the project was undertaken by Tom Heldal and Dr Per Storemyr.

The British input into the project concentrated on spot archaeological excavation, planning, recording and photographing features and locating one of the main stone transport routes from the quarry to the Nile. GPS readings were taken of all the archaeological features located during this season and downloaded into the databases compiled of the quarries by the Norwegian team. This system has now produced a range of comprehensive thematic maps of the site, some of which are used in this thesis. However, given the lateness (and unexpectedness) of this season in regard to the impending submission date of this thesis, only preliminary analysis has so far been made of these new findings.

STUDY OF STONE CONSUMPTION

The Petrie Stone Vessel Corpus: The Petrie Museum of Egyptian Archaeology, UCL

The objectives of this study and methodology used are as follows:-

i. To identify and count Chephren Gneiss vessels in the collection dated to Predynastic to First Intermediate Period.
ii. To produce a proportional estimate of the number of Chephren Gneiss vessels in relation to other hard and soft stones used for vessels, with the aim of detecting trends in hard stone use over time.
iii. To ascertain from the physical analysis of the collection problems in stone nomenclature and classification in Petrie (1937).

The results of this analysis were compiled into a set of tables and graphs to show the percentage ratio of hard and soft stone use between the Predynastic and First Intermediate Period, specifically highlighting the use of Chephren Gneiss, basalt and travertine. These findings were then compared with other published studies of stone vessel collections (see above) and the information compiled into similarly formatted tables and graphs. The objective is to produce a more representative overview of stone consumption for vessels as the basis for interpretation of trends in stone use over time.

Field Observations at Old Kingdom Pyramid Complexes

Over the period of this research project, each expedition to Egypt has included a visit to the main Old Kingdom pyramid fields to specifically identify basalt use. Although published sources about the pyramids generally mention the varieties of stones used in monumental construction, there are often errors in classification. For example, the term basalt is often mistakenly applied to greywacke, black granodiorite and/or black limestone. With geologists Dr Per Storemyr and Tom Heldal, several field studies were made to identify the use of basalt in Old Kingdom royal pyramid complexes and to identify the average block size of basalt used as paving on mortuary temple floors and as wall linings. An additional objective of this study was to produce an estimate of the volume of basalt use in Old Kingdom pyramid complexes to compare against the extraction volume of basalt from the quarries at Widan el-Faras. From this study it should be possible to measure basalt consumption against production at one site and to discuss whether Widan el-Faras was the primary source of basalt used in Old Kingdom pyramid complexes.

Comparative Analysis

The data collected from these sources of stone consumption is summarised in two tables that relate to royal monumental architecture and royal funerary objects. The tables are restricted to the use of basalt, Chephren Gneiss, Aswan granite, granodiorite and travertine. From these tables it is then possible to gain an overview of stone use and to compare the ebb and flow of royal stone preferences between the 3rd and 6th Dynasties. The objectives of this analysis are to:-

i. establish connections between consumption and production at quarry sites
ii. to indicate if stone preferences can be related to theological changes during the Old Kingdom
iii. to establish if changes in stone use can be measured against political and/or ideological changes which may have occurred at the beginning and end of the Old Kingdom
iv. to explore the use of skeuomorphs, or facsimiles of hard stones in soft stones, and the insights this might give in relation to changing political, ideological and economic conditions.

STUDY OF TEXTUAL AND ICONOGRAPHIC SOURCES

Elements of these epigraphic sources will be compared against the archaeological record with the objective of drawing connections between them in relation to: labour organisation, quarry expeditions as campaigns for specific objects, labour deployed from central 'residences' and the role of the state. It is also important to formulate a critical analysis of these textual and iconographic sources and to identify areas which contradict the archaeological record. This is particularly relevant to Middle Kingdom iconographic and textual sources that are *specific* to quarry expeditions and provide far more detail than those of the Old Kingdom. The 12th Dynasty depiction of the Djehutihotep statue being transported from the Hatnub quarries comes under especial scrutiny, as well as inscriptions relating to quarry expeditions into the Wadi Hammamat and to Chephren's Quarry. Although there are dangers in comparing Old Kingdom quarries against Middle Kingdom texts, these are still relevant if cautiously used. It is important to examine and analyse from these sources the hierarchical make-up of a quarry expedition and the number of people involved: such references are generally absent in Old Kingdom epigraphic sources.

THEORETICAL METHODOLOGY

As the discussion of past research in Pharaonic period quarries has suggested, these published works tend to be descriptive accounts of the geology and archaeology rather than explaining quarry data within an explicit theoretical methodology. However, the phenomena of monumental construction and the acquisition of raw material cannot be satisfactorily understood under one over-arching theoretical approach. Hence the application of an eclectic theoretical methodology, from both archaeological and anthropological sources, is necessary to understand the micro-level empirical data at the quarry sites and yet reveal the macro-level forces of power and ideology through which these expeditions were ordained.

Therefore, the approaches to the central questions being asked of the empirical data at Widan el-Faras and Chephren's Quarry have aimed at producing discursive conceptual frameworks, while questions surrounding labour organisation and mobilisation on a macro-level will be put in the context of recent developments in social theory. In addition, a more broadly-based theoretical methodology incorporating cross-cultural and cross-level studies of obsidian quarries, in contexts such as the Bronze Age Aegean and Classic Period Mesoamerica, can provide an opportunity to explain quarry data from a range of theoretical perspectives that have not been applied to ancient Egyptian quarries to date. Such an interpretative methodology can produce significant new insights into the social context of these operations and help to overcome some of the inherent difficulties in dealing with a fragmentary archaeological record and limited textual sources. These ideas are in Chapter 5.

Historical Context

Given the large number of hard and soft stone sources exploited during the Pharaonic and Roman Period in Egypt, it is important to point out that this study had to narrow its data field specifically to quarries exploited during the Egyptian Old Kingdom (3rd to 6th Dynasties). The comparative published sources are generally specific to quarries exploited during the Old Kingdom; however, references to quarries outside of this historical context have been included where necessary, (but still within the Pharaonic period). This is also the case in some areas of the study of stone consumption, because it is important to see trends in stone preferences over an extended period, particularly prior to dynastic Egypt (4th millennium BC) and into the Middle Kingdom (2nd millennium BC). Furthermore, deposition of stone objects outside of Egypt's geographical boundaries, in the Levant and Aegean between the Early and Late Bronze Age, are necessary to include as indicators of connections between countries through trade/gift exchange networks. Widan el-Faras and Chephren's Quarry were both exploited, although to a much lesser extent, during the Early Roman Period and Middle Kingdom respectively, and although discussion is made of the evidence relating to both these later periods of exploitation, it is necessary to point out that this is couched in more broadly-based terms.

The application of cross-cultural comparisons that also cross societal levels can be theoretically enlightening in any disciplinary context and is therefore an important part of the hypothesis-building in relation to the social context of quarrying. Although these comparisons relate principally to obsidian quarries in the Aegean and Mesoamerica, such studies are important to include because theoretical approaches to them have produced effective conceptual models that can be applied to Old Kingdom quarry data.

Organisation of the Thesis

Volume I

Volume I is organised into three parts:

Part 1: ***Background (Chapters 2-5)***

Chapters 2 and 3 construct the physical environment and historical background to this study respectively. Chapter 2 aims to reconstruct the physical environment in which the quarries being researched are placed, in relation to the geomorphology, climate, environment (including subsistence) and levels of the Nile in the 3rd millennium BC. Geological analyses of the stones specific to this research are discussed, including the characterisation and provenancing of specific stone sources with manufactured objects. A glossary of geological terms used in the thesis is appended in Volume 2.

Chapter 3 presents a summary of society, culture, population and the spread of regional towns and cities in the Old Kingdom. It also summarises the nature of Egypt's relations with Nubia, as this would have significant ramifications on the exploitation of Chephren's Quarry. Ideas about kingship and the role of pyramid construction within theology are also addressed in this chapter, as the backdrop to the study of stone consumption contained in Chapter 4. Chapter 4 presents an overview of stone consumption, particularly focusing on basalt and Chephren Gneiss use for monumental construction purposes in royal pyramid complexes as well as for funerary objects during the Old Kingdom. Also presented in this chapter are the results of a case study into Chephren Gneiss use for vessels, specific to the Petrie stone vessel collection housed in the Petrie Museum. In Chapter 5 a range of theoretical perspectives on monumentality, power, ideology and the mobilisation of labour is discussed. Theoretical approaches to the empirical data at quarry sites look at a range of cross-cultural and cross-level conceptual models that have been developed elsewhere, and their relevance to this study. A large body of theory exists in relation to value, exchange and consumption of objects; however, these form a smaller part of this discussion given that such aspects are not the main objectives of this research. The chapter ends with a discussion of the theoretical methodology that will be applied to this study and the reasons why this particular approach is relevant to the archaeological record at quarry sites.

Part 2: The Archaeological Record at Quarry Sites: Stone Procurement and Transportation (Chapters 6-7)

Chapter 6 is in two parts; the first contains a detailed examination of the archaeological record at Widan el-Faras and Chephren's Quarry in relation to stone production, including an overview of similar evidence at Hatnub, the Aswan quarries and Umm es-Sawan. It also provides an examination of tools and extraction technologies and produces an estimate of volumes of basalt extracted from Widan el-Faras in relation to consumption of the stone, as discussed in Chapter 4. The second part of the chapter describes the transport infrastructure remaining at Widan el-Faras and Chephren's Quarry and what this might reveal about the logistics of transporting stone from these sites. Transport vehicles from a range of other data sources, such as iconography, are discussed, including observations of the archaeological record in a variety of quarry and construction sites that have features associated with water and overland transport of materials.

To reconstruct production and transport systems from Old Kingdom quarries in relation to the research questions being asked of this data, Chapter 7 interprets the archaeological record at Widan el-Faras and Chephren's Quarry using theoretical models applied to Aegean and Mesoamerican obsidian quarries. In addition, consumption evidence is analysed against production evidence at Widan el-Faras and Chephren's Quarry to produce hypotheses relating to the connection (or not) between political decentralisation and changes in stone procurement from remote sources.

Part 3: The Archaeological Record at Quarry Sites: Organisation and Mobilisation of Quarry Labour Forces (Chapters 8-9)

Chapter 8 is in two parts; the first examines settlement evidence at Widan el-Faras and Chephren's Quarry in terms of what this data implies about the organisation of quarry expeditions from perspectives such as hierarchies, numbers involved and whether these were short-term/seasonal endeavours. Comparative Old Kingdom settlement evidence is discussed against fresh data from contexts such as quarries, mines and settlement sites where similar stone features are observed. The chapter also discusses the concept of specialist towns in relation to the Middle Kingdom, in particular how these relate to the 12th Dynasty presence at Chephren's Quarry and to ideas about changes in the organisation of such expeditions in later historical periods. The second part of the chapter discusses a range of textual sources that relate to labour organisation in the Old Kingdom and introduces a framework for understanding the organisational aspects of quarry expeditions to remote sources.

Chapter 9 returns to the specific research questions being asked of the archaeological record in relation to the social organisation of quarry expeditions and produces hypotheses using interpretative models from cross-cultural approaches to this subject. The issue of labour mobilisation to remote stone sources and how this was maintained throughout the Old Kingdom is theorised by using new approaches in social theory to specific classes of data found at quarry sites.

Conclusions reached in this thesis are summarised in Chapter 10, after which follows a discussion of the methods used and outline of future research in Chapter 11. In addition, Chapter 11 expands upon the brief mention above concerning the threat to both Widan el-Faras and Chephren's Quarry from current land development schemes and the efforts that are currently underway to protect these important archaeological sites.

Volume II

Volume II contains all the illustrations and plates as listed at the beginning of Volume I. This is followed by appendices which contain a glossary of geological terms, a table categorising stone types mentioned in this thesis as either hard or soft stones and detailed tables relating to stone use in royal pyramid complexes for monumental purposes, statuary and other objects. The bibliography appears at the end of this volume.

PART 1

BACKGROUND

Chapter 2

Egyptian Quarries in the Third Millennium BC: the physical environment

Introduction

The logistical and organisational processes of quarrying, particularly from remote sources (outside the Nile Valley), is dependent upon an understanding of the geological, geomorphological and environmental conditions that prevailed at the time. It also involves assessing the impact that any notable variations in climate and levels of the Nile flood would have on quarry exploitation in the Old Kingdom. This is particularly relevant to quarries outside the Nile Valley and more specifically to the environs of Widan el-Faras (Northern Faiyum Desert) and Chephren's Quarry (Arba'in Desert, Western Desert).

There have been several studies of the palaeoenvironment in Egypt including the Faiyum and the Arba'in Desert, which are relevant to understanding the archaeological record at Widan el-Faras and Chephren's Quarry. This chapter provides a framework for understanding how moister climatic conditions and high Nile floods impacted on the logistics of stone exploitation from remote sources during the Old Kingdom.

Geology and Geomorphology

Egypt can be divided into two distinct morphological regions that are dissected by the Nile: to the east a dissected plateau draining to the river; to the west, a series of unconnected depressions (Ball 1939: 2; Said 1990: 9). Ball (*op.cit.*: 3) gives seven geographical sub-divisions of Egypt, three of which, the Nile Valley, Faiyum and Western Desert, are described in this chapter. The quarries of Aswan and Hatnub fall within the Nile Valley and adjacent Eastern Desert, Widan el-Faras in the Faiyum and Chephren's Quarry in the Western Desert (**see Fig. 3**). The map (**Fig. 1**) shows the geographical location of the quarries discussed below and also the geological occurrence of relevant rock outcrops to which reference is subsequently made. Definitions of the geological and geomorphological terms used in this chapter are contained in the glossary (**Appendix A**) in Volume II.

THE NILE VALLEY AND ADJACENT EASTERN DESERT PLATEAU: THE HATNUB TRAVERTINE QUARRIES AND ASWAN (GRANITE) QUARRIES

The current course of the Nile tends to occupy the eastern side of the valley, so the cultivable lands west of the river are much wider than those on the east (Butzer 1976: 16; Said 1990: 10). After Aswan, the valley gradually broadens and after 280 km the sandstone cliffs give way to limestone, rising to a height of over 300 m at Qena. Today, the Bahr Yusef branch of the Nile diverges from the main river near Dairut (close to the Hatnub travertine quarries) in Middle Egypt and takes a westerly course towards the Faiyum.[1] The cliffs on the western side of the valley become much lower than those on the east until the Nile Valley finally opens out to the delta (Said 1990: 10; Butzer 1976: 16; Midant-Reynes 2000: 19).

The Hatnub Travertine Quarries (27° 33' N 31° 1'E)

The most important travertine quarries lie within a 120 km zone, east and west of the

[1] This is described in detail under 'The Nile and Levels of Nile'.

Nile between modern Minia and Asyut in Middle Egypt (Shaw 1986: 189-91; Klemm and Klemm 1993: 216-9). The Hatnub quarries located 18 km south-east of the el-Amarna plain in the Eastern Desert are the main source of this stone and the quarries were exploited from the Old Kingdom over a period of 3,000 years. Travertine was also quarried during the Old Kingdom at Wadi Gerrawi, 11 km south-east of Helwan, but to a lesser extent (Shaw 1986: 189-91; Klemm and Klemm 1993: 216-9) (**see Fig. 1**).

Travertine or 'Egyptian Alabaster' is a relatively soft, sedimentary rock and occurs in caverns and fissures in the Eocene limestone of the Mokattan, Samalut and Minia formations (**Fig. 4**). These deposits fall mainly within the Nile Valley or on the adjacent eastern plateau (Klemm and Klemm 1993: 218-9; Harrell *et al.* 1996: 26; Aston *et al.* 2000: 59-60). The rock is dense and non-porous, consisting largely of calcite. The classification 'travertine' is the geologically-correct terminology for this rock, not alabaster, as there is no gypsum content (**Fig. 5**).

There are two types of travertine used for objects in antiquity (mainly small vessels): a translucent calcite (calc-sinter) that is pale brown to yellowish-orangish-brown with faint layering, and the strikingly banded calcite (Aston *et al.* 2000: 59-60). Provenancing travertine to a particular quarry might be possible using carbon and oxygen isotopes, although such a study has yet to be undertaken (Harrell pers. comm. 2002).

The terrain surrounding Hatnub is undulating and crossed by wadis that descend from the eastern high desert to the Nile. It is across this terrain that a 17 km stretch of ancient quarry road was constructed to not only bridge the wadis, but to smooth out geomorphological irregularities and steep gradients, particularly during the crucial descent to the Nile (Shaw 1987: 162). The road is thought to terminate at a harbour which would have been adjacent to Hag Qandil (Shaw, forthcoming).

The Main Quarry Areas

The extraction sites (or quarries) at Hatnub were labelled into zones P, R and T by Petrie (1894) (**Fig. 6**). Zones R and T represent the Middle and New Kingdom workings, and Zone P the Old Kingdom site. Zone P is dated to the Old Kingdom exploitation from ceramic evidence (Shaw 1986, 1987 and forthcoming) and from inscriptions on the quarry walls. The inscriptions provide an account of Old Kingdom exploitation, particularly during the reign of 4th Dynasty king Khufu. The quarry was probably at one time a subterranean extraction site prior to the roof collapsing, the site consisting of an open circular pit with vertical sides, approximately 70 m across by 16 m deep, entered via a sloping passage from the north. The entire area is surrounded by huge spoil heaps consisting of travertine chippings and small dry-stone walled shelters or windbreaks that represent the Old Kingdom presence (Petrie 1894 in Shaw 1986: 191, Shaw 1994: 112). Determinations of the volume of stone removed from Zone P are so far undocumented.

The Aswan (granite) Quarries (24° 3' N 30° 37' E)

Aswan granite and granodiorite form part of the First Cataract at Aswan, principally on the east bank of the Nile, while on the west bank there are the extensive quartzite quarries (Klemm and Klemm 1993: 305-53; Aston *et al.* 2000: 16, 35-7) (**Fig. 7**). Due to the close proximity of the quarries to the Nile, the whole area is traversed by a network of roads and ramps designed to facilitate the transport of stone to the river bank. On the east bank there is a long road running north-south through a wadi which is parallel to the river and likely to have terminated at a harbour (Aston *et al.* 2000: 20). But in comparison to the quarry roads at Hatnub and Widan el-Faras, the roads at Aswan are comparatively short, as there was clearly no need to transport the stone over any great distance.

The granite and granodiorite deposits on the east bank of the Nile extend approximately 6 km south from Aswan to the el-Shellal district, and approximately 3 km to the east of the Nile. Deposits also occur on the islands that straddle the Nile at Aswan (Klemm and Klemm 1993: 305-10; Aston *et al.* 2000: 16) (**Fig. 8**). These outcrops are almost continuous across the east bank of the Nile, with evidence of ancient quarrying scattered throughout, but in varying degrees of concentration. The tightest concentrations occur close to the Nile immediately south of Elephantine Island and east to Gebel Ibrahim Pasha. Extraction sites become less concentrated in the southern environs, the majority being located at Gebel el Nugu and Gebel el Ganite (Aston *et al.* 2000: 16).

The granite mass protrudes above the Nubian sandstone and weathering of the massif has produced 'woolsack' type formations surrounded by ravines (Röder 1965: 470). These woolsacks are found mostly on the islands of the First Cataract and on the slopes of the east bank of Nile, having fallen from the larger masses. Röder (1965: 550-1) suggests that the Early Dynastic to Middle Kingdom extraction areas would have concentrated on removal of those more easily-attainable woolsacks that were closest to the Nile for easy transport.[2] However, establishing exactly where the Old Kingdom quarry areas might have been is difficult, since the Aswan granite and granodiorite have been quarried almost continuously from the Early Dynastic period to the present day.

Aswan Granite and Granodiorite

Two types of plutonic igneous rocks were quarried at Aswan, commonly known as 'pink or red granite' (coarse-grained) used in monumental construction and sculpture, and 'grey or black granite' the less commonly used, finer-grained, light greyish or pinkish variety (Brown and Harrell 1998: 33-4; Aston *et al.* 2000: 35). Brown and Harrell's analysis of these two rock types established the classification of 'Aswan granite' (usually pinkish or reddish) and 'Aswan granodiorite' (usually greyish or blackish). This classification distinguishes these granites and granodiorites from the compositionally similar rocks quarried by the Romans in the Eastern Desert (Brown and Harrell 1998: 36). As with the characteristic gneisses from Chephren's Quarry, objects

[2] Extraction methods in all the quarries under this study are discussed in more detail in Chapter 6.

manufactured from Aswan granite and granodiorite can be provenanced mineralogically to this one source. As a consequence, this makes the task of investigating the quarry's long history of exploitation easier.

Although the mineral composition of both varieties of Aswan granite and granodiorite are similar, consisting of quartz, microline, oligoclase and biotite plus hornblende, the fine-grained variety often exhibits foliation of the biotite flakes (**see Fig. 5**). The distinctive colour of Aswan (red/pink) granite is dependent upon the amounts of biotite present; when these amounts are small the rock has a pinkish or occasionally reddish appearance, and when large, takes on a black and pink mottling (Aston *et al.* 2000: 35). The naturally occurring fractures in the rock could aid the quarrymen, but if these were not parallel, splitting would occur at an angle, making extraction of large blocks impossible. The 'Unfinished Obelisk' is one of the finest examples of the stone cracking in the wrong place and being discarded by the New Kingdom quarrymen. This geological feature could also explain why the medium to finer-grained Aswan granite was rarely used, due to its extensive fractures (Engelbach 1923; Arnold 1991: 37; Aston *et al.* 2000: 36).

'Aswan granodiorite' or the often-termed 'monumental black or grey granite' is mainly medium-grained granodiorite to occasionally granite with quartz, alkali feldspar (microline and minor orthoclase), biotite and hornblende plus minor accessory minerals (Aston *et al.* 2000: 36-7). The rocks' dark colour comes from the abundant biotite and hornblende, plus the minerals ilmenite and magnetite. The rock is often mistaken for basalt and/or dolerite, especially when the light coloured phenocrysts are absent (*op. cit.*).

THE NORTHERN FAIYUM DESERT: THE ENVIRONS OF WIDAN EL-FARAS

The Faiyum is dominated by the Faiyum Depression which lies approximately 60 km south-west of Cairo in the Western Desert at latitude 29° N (**see Fig. 1**). The Faiyum Depression is a roughly triangular wind-eroded depression, sculpted out of the limestone plateau of the Libyan Desert during the Pleistocene (Ball 1939: 179; Bown and Kraus 1988: 8). The depression covers an area of approximately 1,200 km², its floor sloping downward in a north-westerly direction from a level of 32 m a.s.l. Within the lowest part of the depression, -44 m a.s.l. are situated the brackish waters of lake Birket Qarun, (formerly ancient Lake Moeris) which occupies an area of 220 km² and was connected with the Bahr Yusef branch of the Nile via the Hawara channel (Said 1990: 10; Simons and Rasmussen 1990: 627).

The most striking general observation about the topography of the Faiyum Depression, succinctly expressed by Caton-Thompson (1927: 327), is the 'antagonism' between the lush cultivated land to the south of the Depression and the 'naked' desert escarpment of its northern boundary. It is within this northern boundary, or the Northern Faiyum Desert, that Widan el-Faras is situated.

The main geomorphological and topographical features of the northern shores of Birket Qarun lake are the lacustrine deposits that make up a series of graded terraces or beaches, between 44 m a.s.l. and -44 m a.s.l. (Little 1936: 205; Ball 1939: 179; Wendorf and Schild 1976: 161) (**Pl. 4**). These terraces of the northern shores have been subjected not only to the erosive action of the wind, but also to occasional flash-flooding. Today, the terraces have relatively level surfaces scattered with gravel or 'desert pavement' (Simons and Rasmussen 1990: 627). Situated on one of these terraces is the early second millennium BC Qasr el-Sagha temple that overlooks a natural inlet (**Pl. 5**).

Within the natural inlet or harbour, approximately one kilometre southwest of the temple, are four natural promontories consisting of lacustrine sediments rising to an elevation of 22 m (Wendorf and Schild 1976: 220). These promontories have been artificially reinforced with limestone and sandstone slabs to form buttresses or harbour defences (Wendorf and Schild 1976: 199) (**Pl. 6**). Behind these is another natural promontory at the same elevation, 311 m long by 19 m wide, which is strewn with discarded blocks of basalt (**Pl. 7**). This feature has already been interpreted as a quay, which in turn acts as the terminus of the ancient quarry road from Widan el-Faras (Wendorf and Schild 1976: 220; Arnold and Arnold 1979: 25; Harrell and Bown 1995: 86).[3]

Heading in a north-easterly direction from the ancient lake shoreline are three rising escarpments: the Qasr el-Sagha Escarpment, the El-Ekhwat el-Talata Escarpment and the Gebel Qatrani Escarpment that reaches an elevation of 320 m a.s.l. The Qasr el-Sagha Escarpment, rising directly behind the Qasr el-Sagha temple, forms the northern boundary of the Faiyum Depression. To the south-east, a low desert ridge 5-12 km wide separates the Faiyum Depression from the Nile Valley, terminating after approximately 40 km at Beni Suef (Bown and Kraus 1988: 8).

The three escarpments span a distance of 10 km from Qasr el-Sagha to Widan el-Faras and are separated by a series of plateaus covered in gravel or 'desert pavement'. In places the plateaux are punctuated by round hills, scatters of silicified wood and exposed segments of an ancient paved road (Simons and Rasmussen 1990: 627; Harrell and Bown 1995: 78). The southern approaches to the Gebel Qatrani Escarpment can be traversed via the Wadi Ghorab that cuts a channel through the El-Ekhwat el-Talata Escarpment. The landscape surrounding the Gebel Qatrani Escarpment is dominated by the 300 m high twin sandstone peaks called Widan el-Faras, or 'the ears of the horse' in Arabic (Ismail, pers. comm. 2001). These prominent landmarks demarcate the entrance to the basalt quarries and, similarly to the rest of the escarpment, are capped by the basalt flow (**Pl. 8**).

[3] The terminus to the quarry road at Qasr el-Sagha is discussed in detail in Chapter 6.

Widan el-Faras

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 (**Pl. 9**). These features consist of a large area of basalt stone circles that span the ancient road immediately below the escarpment and are thought to represent the 'Main Quarrymen's Camp' (Harrell and Bown 1995). Located 500 m to the south, close to the quarry entrance at Wadi Ghorab, is a smaller encampment, constructed with much smaller blocks of basalt.[4] Several small wadis cut across the desert plateau below the escarpment, these converging to the south at the Wadi Ghorab (**see Fig. 2**). Periodic flash-floods have transported weathered basalt fragments along these wadis and hence the desert pavement has a black overlay of basalt in sizes ranging from small blocks to pebbles. This phenomenon of water-transported basalt fragments is also seen at the Gilf Kebir in the South-Western Desert, where flash-floods have transported blocks over kilometre-scale distances (Garvin 1982: 271).

Widan el-Faras Basalt

The Widan el-Faras tholeiitic flood basalt is thought to be the source of stone used predominantly for Old Kingdom mortuary temple floors. The basalt consists of several individual lava flows of early Oligocene age (c. 30 m.y.), capping extensive deposits of sandstone, mudstone and some limestone that form the Gebel Qatrani Formation (Klemm and Klemm 1993: 413-5; Storemyr 2001: 5). The highly fractured nature of the basalt has thus 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 1990:627; Bloxam and Storemyr 2002: 24) (**Fig. 9**). The combined thickness of the basalt flows that have been worked at Widan el-Faras is up to 12-15 m, but is usually not more than about 5-8 m (Bloxam and Storemyr 2002: 24).

[4] These are discussed in detail in Chapter 8.

Due to the large amount of scree along the escarpment it is hard to differentiate the individual lava flows, but the 'proper' basalt or very dense basalt, that would have been quarried, generally lies between vesicular or amygdaloidal flows. The 'proper' basalt is visually fine-grained, slightly porphyritic (due to large plagioclase crystals) and mineralogically a normal basalt, although often wrongly referred to as 'dolerite' (Harrell and Bown 1995: 76; Storemyr 2001: 8) **(Fig. 5)**.

The difficulty with Widan el-Faras basalt (as with travertine) is differentiating it mineralogically and chemically from other basalt deposits, particularly those in Lower Egypt located at Abu Zabal and Abu Rowash (Harrell and Bown 1995: 76). Although it is highly likely that Widan el-Faras basalt was specifically used for Old Kingdom mortuary temple floors, it is impossible to be certain, although Storemyr suggests (2001: 8) that isotope or trace element data could be used to provenance the stone since Bown and Kraus (1988: 42-9) report that Widan el-Faras basalt has older K/Ar dates than the Abu Zabal basalt.

The East and West Quarries (29° 39' N 30° 37' E)

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: 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. 2)** which extend for about 800 m along the edge of the escarpment **(Pl. 10)**. The West Quarry is smaller, covering a 60 m stretch of the escarpment labelled 5 on the map **(Pl. 11)**.

Within each main extraction site in both the East and West Quarries are '...a series of shallow swales and benches cut into the upper part of the basalt layer...typically...to a depth of 3-5 m below the original surface and 5-10 m back into the hillsides.'(Harrell and Bown 1995: 74). The swales are either oval or rectangular in shape, reaching lengths of 10-12 m (Bloxam and Storemyr 2002: 24). Due to each of the extraction sites being well defined, it is possible to produce estimates of the volume of basalt removed from each. [5]

Limestone Quarries at Widan el-Faras

Limestone quarries associated with the construction of the road have been located in the environs of Widan el-Faras (**see Fig. 2**). The limestone forms a sequence within the Gebel Qatrani Formation, where it is tabular and thin-bedded, reaching a thickness of 1-2 m. These sources occur close to the Wadi Ghorab where it enters Widan el-Faras on top of the El-Ekhwat el-Talata Escarpment, and on the desert plateau 150 m south-west of the Gebel Qatrani Escarpment (Bown and Kraus 1988: 39, Storemyr 2001: 28). The nature of these deposits makes them ideal for road paving, as they would require minimal secondary production to form a flat surface.

There are also two limestone chip quarries located close to the Wadi Ghorab opposite the encampment and it is probable that these sources were also exploited during construction of the road. It is interesting that the chip quarries are less than 100 m from where the road would have required some kind of embankment or levelling to overcome its descent into the Wadi Ghorab. This section of the road might also have required numerous repairs, due to traffic, and it is unfortunate that the section of the road down into the wadi has been washed away.

Gypsum

Gypsum deposits are common constituents of many mudstones and sandstones of the Gebel Qatrani Formation in the Northern Faiyum Desert (Bown and Kraus 1988: 36). At Widan el-Faras the gypsum deposits are scattered in the western environs and occur as crystals in a firm mass that is about 1 cm thick (Storemyr 2001: 29-30). Gypsum was also found under some road slabs and although Harrell and Bown (1995: 78-9) dismissed the idea of the road having any foundation or being mortared, relatively thick layers (1 cm) of gypsum were clearly visible, particularly under the road sections within

[5] These calculations appear in Chapter 6.

Widan el-Faras (**Pl. 12**). However, it is difficult to state whether the gypsum found underneath the road slabs at Widan el-Faras is natural or artificial, since the surface at the site contains much natural sulphate and calcium (Bloxam and Storemyr 2002: 29-30). This requires further investigation, although gypsum has been used as a stabilising substance on ancient road surfaces, an example being the 12th Dynasty haulage track found at the Lisht pyramid field (Lehner 1997: 203; see Chapter 6).

The Umm es-Sawan Gypsum Quarries (29° 42' N 30° 53' E)

Larger amounts of gypsum occur at Qasr el-Sagha where the deposits underly the Qasr el-Sagha Formation and it is here that some working of the gypsum can be seen south-east of the Qasr el-Sagha temple (Bown and Kraus 1988:37). Fine-grained gypsum or alabaster occurs as 30 cm-thick vertical seams at the Umm es-Sawan gypsum quarries, located 20 km north-east of Widan el-Faras (Caton-Thompson and Gardner 1934: 107-8; Aston *et al.* 2000: 22) (**see Fig. 1., Pl. 13**). The gypsum was quarried here from the Early Dynastic period to the 4th Dynasty for small vessels and also for mortar and plaster. It is important to note the presence of non-local stone here, such as Widan el-Faras basalt, Chephren Gneiss (from Chephren's Quarry), diorite and quartzite (**Pl. 14**). These stones occur throughout the quarry workshops as either worked or unworked small blocks and their possible significance in relation to the connections between various Old Kingdom quarries is an important theme that is discussed further in Chapters 8 and 9 (**Pls. 15a, 15b**).

THE ARBA'IN DESERT (WESTERN DESERT): THE ENVIRONS OF CHEPHREN'S QUARRY

The Western Desert province stretches west from the Nile Valley to the Libyan border, an area of approximately 681,000 km² (Ball 1939: 9-10; Said 1990: 10). This area of plateau desert is an expanse of rocky ground interspersed with numerous enclosed depressions, within which three sub-provinces can be distinguished (Ball 1939: 9-10; Haynes 1982; Said 1990: 10). Chephren's Quarry lies within the southern sub-province of the Arba'in Desert and therefore the discussion will only pertain to just this area (**see**

Fig. 1).

The 'Nubia Formation' or Nubian Sandstone forms one consistent geomorphological unit and this sub-province has been singled out from other Egyptian geomorphic provinces because of its Quaternary history (Said 1990: 12; Klitzsch and Schandelmeier 1990: 249). Quaternary lacustrine and associated deposits expand over huge areas which relate to fluctuations in climate and to the rise and fall of the water-table (Issawi 1982: 61). As Haynes (1980b: 370) points out '...geomorphic development of the Western Desert is a product of the alternation of drastically different climatic regimes:..one pluvial or wet period (arid or semiarid)...and soil formation took place, and one hyperarid during which wind stripped the land of irregularities...'. Therefore, the present geomorphology of this region may now bear no resemblance to that of the Old Kingdom because of heavy sand deposition.

The landforms of the area consist of gebels, differentially eroded bedrock, hamadas (stony deserts), deflated playas and sand sheets (Haynes 1980b: 354). The vast sand sheets or 'desert pavement' that are superficial deposits produced by weathering, represent one of the main features of the Arba'in Desert today (Said 1990: 12). The sand sheets are made up of interbedded coarse sands armoured by fine pebbles (Haynes 1980b: 360). This surface is hard and compact with a thickness of up to 20 m in places, meaning that cars can travel over it with ease.

Laterite and Calcrete

The nature of the Old Kingdom ground surface is an important consideration in relation to the methods of transporting stone from such a remote source to the Nile, particularly if this was overland. Hence, superficial deposits which can form from weathering under extreme conditions, such as laterite (L. *later*, a brick), would provide an ideal hard surface (Holmes 1965: 401). The presence of laterite in higher latitudes of Africa up to 22° N (the latitude of Chephren's Quarry) is known. Sandford (1935: 367-70) located ancient and denuded masses of lateritic material between 18° N and 22° N in a region which is absolute desert today. More recent studies of red sands and soils in the Arba'in Desert have observed the high percentage of quartz sands (40%) with red coatings of haematite, which has been formed in lateritic soils and transported to the desert basins (El-Baz and Prestel 1982: 175-6). Evidence of a lateritic ground surface existing in the Old Kingdom in the quantities that Sandford found in the northern Sudan is so far unproven. However, as the geological section shows **(Fig. 10)**, playa deposits formed the Old Kingdom ground surface at Chephren's Quarry, suggestive of wet-dry monsoon conditions whereby pedogenesis (soil formation) facilitates the formation of lateritic and related soils. Haynes' (1980b: 365) analysis of spoil at Chephren's Quarry did reveal '...significant pedogenesis'.

To investigate the possibility of a lateritic or hard surface existing during the Old Kingdom at Chephren's Quarry, two soil samples were collected in the 1999 season of survey and excavation from the Old Kingdom surface. Using x-ray diffraction analysis, quartz and calcium carbonate were found to be the most abundant minerals in what was originally a playa mud or siltstone, which on exposure and desiccation produced a hard surface crust, possibly calcrete (Bunbury pers. comm. 1999). Calcrete is also known as 'duricrust' and similar to laterite, forms a very hard surface (see Appendix A - Glossary). Calcreted sand dunes have also been found near shallow basins in the Arba'in Desert at Bir Tarfawi, 100 km west of Chephren's Quarry, these extending over considerable distances within shallow depressions (Haynes and Haas 1980: 708). A test pit (Pit 1) dug at Chephren's Quarry located a calcrete level at a depth of 50 cm and continuous to the limit of hand-digging at 1 m below the surface. The hardness of the calcrete surface prevented further investigation without the aid of a mechanical excavator.

Chephren's Quarry (22° 48' N 31° 13' E)

Chephren's Quarry defines an area of quarry workings that cover approximately 100 km² south of Wadi Tushka and 65 km northwest of Abu Simbel **(Pl. 16)**. A passage from Murray's diary describing the approaches to Chephren's Quarry is perhaps the best account of the landscape and quarries:

> '...the first appearance of our landscape was a little disappointing. The cliffs of the scarp had disappeared below the northern horizon and we were left in a plain with only the slightest of features. There were neither hills nor definite quarry-faces to look at - only heaps of boulders emerged from the sand...quarries is almost too dignified a word for these Egyptian workings.' (Murray 1939: 105-7)

The central topographic feature within Chephren's Quarry is Quartz Ridge and from here two distinct geomorphological features can be seen within the immediate environs: 15 km to the east is an exposed basement (Nubian sandstone) inlier rising to an elevation of 264 m named Gebel el-Asr; and 15 km to the north-east lies the prominent depression of the Wadi Tushka. This depression connects with the Kiseiba-Dungul Depression, an internally drained basin about 17,000 km² in area at an elevation below 180 m (Haynes 1980: 68). In 1998, due to the level of Lake Nasser exceeding 178 m, excess flood water was introduced into the Wadi Tushka via a connecting spillway (Sadat Canal) (**Fig. 11**). The introduction of water along the canal was the beginning of the Tushka Hydrological Project to irrigate this area of the desert (see Chapter 11).

Ball (1927: 21) speculated that the Wadi Tushka once formed a tributary system to the Nile, draining from the inland playas or basins of the Dakhla and Kharga depressions from the late middle Pleistocene. Haynes' (1980a: 69) recent borings along the Wadi Tushka confirmed that Ball's suggestion was indeed correct, the Wadi Tushka thus being attributed to the overflow of ancient lakes occupying the depressions. Haynes (1980a: 69) also established that the Wadi Tushka was graded to a lower Nile at 118 m at Tushka, given that the deepest contact with the bedrock is below 123 m.

Drainage networks would have extended head-ward of the Wadi Tushka and the inverted wadis of the Nabta region, 70 km southwest of Chephren's Quarry, could represent this stage (Haynes 1980a: 70). It therefore seems probable that the small wadi which passes north-west of the Quartz Ridge area of Chephren's Quarry could also be the remnants of a drainage channel connected with the Wadi Tushka. A detailed survey has yet to be made of this small wadi, and as explained in the previous chapter, investigations in this region are now severely impaired because of the construction of Canal 4 in this region. However, on the basis of preliminary investigations made in April 2000, it seemed highly probable that the wadi and Wadi Tushka were connected in the past. [6]

There is a striking difference between the landforms to the north of the quarry, with its slightly undulating plains dipping towards the Wadi Tushka depression, compared to those in the south, where the Nubian sandstone basement is topographically more elevated (Klitzsch and Schandelmeier 1990: 251). Although the mesas are recent geomorphological developments, the other geomorphological features would have been present in the Old Kingdom landscape. Hence, the positioning of an overland route to transport stone from the quarry to the Nile required accurate surveying to avoid these features. Engelbach (1938) and Murray (1939) describe an animal-worn track, approximately 6 km south-east of Quartz Ridge, as perhaps one of several overland transport routes to the Nile.

During the 2003 season a 10 km section of this ancient route was rediscovered emanating from the Quartz Ridge quarry region (see Chapter 6) **(Fig. 12)**. However it is relevant to mention here, in relation to landforms, that the quarrymen had surveyed and demarcated a route across the lowest elevations of the plateau via clear sight-lines marked with cairns. Parts of the route traversed playa basins and it is here that groundwater wells were sunk and ephemeral camps set up (see Chapter 8).

[6] A basalt dyke dissecting the wadi appeared to have been partially removed (Bunbury pers. comm. 2000).

The Chephren Gneisses

The quarry is situated in a metamorphic basement window mainly surrounded by the Cretaceous Nubia Sandstone formation (Klemm and Klemm 1993: 423-5; Harrell and Brown 1994: 53; Storemyr *et al.* 2002: 26; Heldal and Storemyr 2003: 18) **(Fig. 13)**. The highly characteristic nature of these blue metamorphic rocks was first noted by Little (1933) and because these stones have only one known source in Egypt at Chephren's Quarry, objects made from these blue gneisses can be securely provenanced to this one source. The gneisses are derived from the metamorphism and partial melting of basaltic material to produce the dark and light banding of amphiboles and feldspars respectively (Harrell and Brown 1994: 54; Bunbury 1999: 1; Heldal and Storemyr 2003: 18). Harrell and Brown (1994: 52-3) classified the stones as 'anorthosite gneiss' for the lighter, blue speckled variety (used mainly for small vessels) **(Pl. 17)**, and 'gabbro gneiss' **(see Fig. 5)** for the darker, blue banded variety (used mainly for statuary) **(Pl. 18)**.

Anorthosite gneiss and gabbro gneiss were in the past, and in some cases still are, incorrectly classified as 'diorite' or 'Chephren/Khafra diorite' (Aston 1994: 62; Harrell and Brown 1994: 33). The use of 'diorite' is incorrect because Chephren Gneisses are metamorphic, not igneous stones (Little 1933: 78; Harrell and Brown 1994: 52-3). The use of both these incorrect classifications has caused considerable confusion when these gneisses are referred to as 'diorite' in early excavation reports. The speckling and banding that distinguishes anorthosite gneiss from gabbro gneiss typically occurs together throughout the deposits. Therefore, the classification 'Chephren Gneiss' (Heldal and Storemyr 2003: 18) is the more generic term that will be used throughout this thesis to describe both these stones.

The Chephren Gneiss deposits are exposed as a patchwork of surface outcrops, occurring as large and small inclusions in granitic rocks (Heldal and Storemyr 2003: 18). The outcrops are separated by sheets of aeolian sand and those remaining visible resemble the Aswan granite 'woolsacks' (Richter and Schandelmeier 1990: 197).

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: 26) (**Pl. 19**). 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 (Heldal pers. comm. 2003). Areas of workings where boulders have been removed are now represented by aeolian sand-filled depressions, usually surrounded by spoil heaps consisting of burnt stone chippings (**Pl. 20**). 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 (**Pl. 21**). During the 2003 season one boulder extraction site was excavated to a depth of almost 2 m, giving an idea of how deep into the bedrock the quarrymen were working to remove one of these large boulders.[7]

The Quarry Areas

Because the environs of Chephren's Quarry cover such a large area, Engelbach (1933, 1938) designated the main areas of the quarry into 4 regions: 'Khufu Stele Quarry' (where the Khufu stele was found), 'Quartz Ridge', 'Chisel Quarry' and 'Stele Ridge'. The first three regions are mainly Old Kingdom Chephren Gneiss quarries; Stele Ridge is an area of predominantly Middle Kingdom amethyst and carnelian mining. However, since the 2002 and 2003 survey and excavation seasons many more quarries have been discovered and it has become simpler to re-designate these quarries into five larger geographical zones: Northern Chephren's Quarry, Northern Marginal Quarries, Central Chephren's Quarry, Chisel Quarry, Southern Chephren's Quarry (Heldal and Storemyr 2003: 19) (**Fig. 14**). These five zones represent a total number of 700 small extraction sites, 40 larger quarries and 100 ancient infrastructure sites. The ancient infrastructure sites comprise stone features, ramps and wells and these elements are described in detail in Chapters 6 and 8.

[7] This extraction site is discussed in greater detail in Chapter 6.

A further classification within these geographical zones, as shown in the table **(Fig. 15)**, distinguishes between quarries which were exploited mainly for small vessels, as opposed to large blocks. The block quarries tend to be concentrated within the Central quarries, such as: Khufu Stele Quarry, Loading Ramp Quarries and the Unfinished Statue Quarries. The Central quarries also contain most of the archaeological infrastructure known at Chephren's Quarry and have therefore been the focus of the most detailed archaeological investigations.

Chisel Quarry, a large vessel quarry, is different from the major quarry zones, as unlike all the other quarries, it has no satellite quarries. Quartz Ridge, on the southern boundaries of Northern Chephren's Quarry, is another area of mainly vessel quarrying with associated infrastructure and hence a second major quarry region that has been subject to more detailed investigations. The rest of Northern Chephren's Quarry includes two important vessel quarries discovered in 2002 called 'Pounder Quarries' and 'Cairn Quarries' **(Fig. 16)**. The Northern Marginal Quarries and Southern Chephren's Quarry were discovered in 2003 and consist of small scattered vessel quarries with little associated archaeological infrastructure. Dating of all these quarries is the subject of more detailed discussion in Chapter 6.

Other Stones at Chephren's Quarry

Various intrusive granitoids, dykes of dioritic composition and plugs of Tertiary basalt, surround the Chephren Gneiss throughout the environs of Chephren's Quarry (Richter and Schandelmeier 1990: 197; Harrell and Brown 1994: 54; Heldal and Storemyr 2003: 19). These stones were generally used as tools and were therefore ideal *in-situ* 'toolboxes' for the quarrymen. They were also used for stelae that were found at the quarry, most notably those of Khufu and Sahure found by Engelbach and Murray (Engelbach 1933; Richter and Schandelmeier 1990: 197; Harrell and Brown 1994: 54; Heldal and Storemyr 2003: 19) **(Pl. 22a, 22b)**. Occasional deposits of pinkish/orange trachyte occur; this stone was also exploited for vessels and used for the Nyuserra stele **(Pl. 23)**. Deposits of white opaque quartz also occur and at Stele Ridge, in the northern environs of the quarry, carnelian and amethyst were mined (Little 1933: 79-80; Harrell and Brown 1994: 54; Heldal and Storemyr 2003: 18).

Climate and Environment

The climate in Egypt today is hyperarid with an average precipitation of about 1 cm a year, falling mainly in the higher latitudes along the Mediterranean coast (Ball 1939: 2). The climate is influenced by the annual mean position of the ITCZ (Intertropical Convergence Zone) to the south and polar front to the north (Ball 1939: 2; Grove 1980: 11, Said 1993: 84). In winter both these systems move south, bringing rain to Lower Egypt and in the summer the situation is reversed, with rain falling in the region of the Nile headwaters (Said 1993: 84). The latitudinal shifts of these two fronts over the last two millennia have been relatively stable, but micro-fluctuations can occur. In the 20th century there were two 30-year periods of either extreme wet or dry, peaking in 1929 and 1984, when movement of the two fronts increased between 200 and 300 km from their normal position (Nicholson 1980: 191, Said 1993: 85).

During the early and mid-Holocene dramatic northward shifts occurred in the monsoonal ITCZ, to such an extent that prolonged wet phases or pluvials changed the palaeoenvironment in Upper Egypt from desert (hyperaridity) to dry savanna (semi-aridity) over a period of 4,000 years (Nicholson 1980: 174; Pachur and Hoelzmann 2000: 929; Damnati 2000: 260). This period is termed the Holocene Wet Phase. By the Late Palaeolithic and Neolithic there was a northward migration of the Sudano-Sahelian savanna into Upper Egypt, with Lower Egypt affected by the Mediterranean pre-Saharian steppe (Thorweihe 1990: 605). Because Upper and Lower Egypt were affected by different palaeoclimatic regimes, the following discussion deals with these regions separately.

UPPER EGYPT/LOWER NUBIA

The Arba'in Desert (Western Desert): the environs of Chephren's Quarry

The pluvial phases of the early to mid-Holocene in Upper Egypt were probably the result of the southern monsoon rainy zone (ITCZ) reaching much further north than it does today (Wendorf and Schild 1980: 241; Wendorf and Schild 1984: 407; McHugh *et al.* 1989: 326; Damnati 2000: 260). There were three major pluvial events, as based on studies of lake and shallow basin sediments, which occurred at approximately 9300 BP, 8350 BP and 7220 BP, with a final phasing out at 4090 ± 500BP (Wendorf and Schild 1980: 236; Haynes 1980b; Pachur and Hoelzmann 2000: 936).

Estimates of the volume of rainfall that occurred during these pluvials differ from > 600 mm to <300 mm for the period *c.* 8000-3000 BC (McHugh *et al.* 1989: 327). These pluvial events were so intense that favourable, semi-arid conditions may have persisted from 9300 to *ca* 4500 BP. Even after the final phasing of the last pluvial, it is probable that saline lakes would have remained in the main basin of the Arba'in Desert until after 4000 BP (Haynes 1987: 73; Pachur and Hoelzmann 2000: 936). Thus from latitude 15° N to 21° N lakes, wetlands and alluvial areas would have exceeded 15% of the total area in comparison to the < 1% today. It is clear from abundant Neolithic sites at the playas of Nabta, Kiseba and Dakhla that these conditions allowed permanent settlement (Wendorf and Schild 1980, 1984; McHugh *et al.* 1989: 333).

Groundwater in the Arba'in Desert

Groundwater migration along palaeovalleys enabled Neolithic groups to subsist year-round in areas of the Arba'in Desert away from the playas and oases (McHugh *et al.* 1989: 334). Shuttle Imaging Radar (SIR-A) data of the Arba'in Desert has added to the growing body of knowledge about the existence of major subjacent stream valleys, a few metres or less below the surface (McCauley *et al.* 1982: 1017). Groundwater migration is perhaps the singularly most important result of the Holocene pluvial events discussed above, because the increased rainfall recharged near-surface aquifers that acted as buffers when the final wet phase ended (Pachur and Hoelzmann 2000: 936). Therefore, human populations could subsist after the final pluvial phase, post 4090 ± 500BP. This body of groundwater is known as the Nubian Aquifer System of the East Sahara which is bonded to the west near the Libyan border, south into north Sudan and just below latitude 29° N in Egypt (Thorweihe 1990: 601). The Wadi Howar in north Sudan was a major recharge area of the Nubian aquifer which has a northward migration. This might explain why sediment analysis of four shallow basins in the Arba'in Desert suggests groundwater-supported lakes preceded actual rainfall in the early Holocene (Haynes 1987: 76-7).

Exploitation of this shallow groundwater via 'walk-in' wells, less than a metre below the surface, would remove the dependence upon pluvial lakes in the early post-pluvial Holocene, thus sustaining human occupation into the third millennium BC (Haynes and Haas 1980: 706; Wendorf and Schild 1984: 252-6; Pachur and Hoelzmann 2000: 936). Even today, groundwater is close to the surface; at Bir Tarfawi (100 km west of Chephren's Quarry) it can be reached at a depth between 1-2 m (Haynes 1987: 69; McHugh *et al.* 1989: 321). At the Selima oasis (approx 150 km south of Chephren's Quarry) groundwater can be reached at 1 m below the surface and tamarisk still grows here in numerous localities (McCauley *et al.* 1982: 1012; Haynes 1987: 69).[8] Analysis of water samples taken from wells in the Arba'in Desert using carbon-14 levels, dates the groundwater to the early Holocene pluvials, with some later recharge in the late Holocene post-pluvial (Haynes and Haas 1980: 705, 708).

Groundwater wells at Chephren's Quarry

There is archaeological evidence from recent excavations revealing four wells at Chephren's Quarry, that groundwater from the Nubian aquifer was being accessed at less than 1 m below the Old Kingdom surface. Two groundwater wells located at Khufu Stele Quarries (Well 1) and at Quartz Ridge (Well 2) were excavated in the 2000 season, and another two (Well 3 and Well 4) were excavated in the 2003 season along the ancient transport route to the Nile. Although there are interesting structural differences between the wells along the track and those in the quarries (explained below), what is common to them all is their shallow depth of approximately one metre or less.

[8] It is not known how deep below the surface the Nubian aquifer now lies in the environs of Chephren's Quarry.

Well 1 and Well 2 within the quarries are exposed on the surface by circular (single-level) stone walls, with diameters of 1.75 m and average Old Kingdom subsurface depths of 1.2 m **(Pls. 24, 25)**. These features show meticulous construction and are entered from the north via a sloping pathway. The base of each feature contains two artificially-cut channels 20 cm wide by 30 cm deep, suggesting that the groundwater permeated up into these channels from where it was scooped out **(Pls. 26, 27)**. An Old Kingdom (4^{th} - 5^{th} Dynasty) spouted pouring vessel found *in-situ* in one of these channels in the Quartz Ridge well, tends to support this theory **(Pls. 28a, 28b)**. There is no evidence to suggest that the wells were covered and it is probable that they were constructed to limited dimensions to reduce the amount of surface evaporation of water resting in the channels. The north-facing entrances would also have facilitated the convection of the cooler prevailing north wind into them.

There is the strong possibility that these features in the quarries are 'walk-in' wells, similar to those identified by Wendorf and Schild (1984: 252-6) at Bir Kiseiba (70 km south-west of Chephren's Quarry) and also by Haynes (1980b: 370) in the regions of Nabta Playa. The wells within the quarries were probably constructed for human rather than animal use, as there are no visible animal tracks on the pathways leading into them. Furthermore, their small size means that they can only accommodate one individual at a time. The wells would have been an essential requirement, not only for drinking water, but for bread-baking, given the discovery of a nearby bakery at Khufu Stele Quarries. [9]

The wells along the ancient track (Well 3 and Well 4) are approximately 4 km apart and situated at the lowest elevations on the desert plateau **(see Fig. 17)**. These wells also appear to have been connected with bread-baking, evidence for which was found in the associated ephemeral camps. Structurally, both these wells are much larger than the 'walk-in' wells in the quarries. They are rectangular, as opposed to circular features,

[9] The bakery at Khufu Stele Quarries is discussed in detail in Chapter 8.

enclosed within shallow perimeter walls averaging 40 m x 50 m (**Pl. 29**). There are two hypotheses as to the function of these large enclosures: first, that they were barriers to protect the well from flood water contamination, or second, that they functioned as animal corrals. The theory that these were defences to stop outside contamination gains further support from similar features, recently located along an Eastern Desert caravan route between Korosko in Lower Nubia and Kurgus in Upper Nubia, which were suggested as having such a function (A. Castiglioni pers. comm. 2003).[10] The absence of an enclosure wall around the walk-in wells in the quarries tends to suggest that these were less subject to external contamination from flood-water. Recently located Old Kingdom shallow wells in the wadi floor close to Bir Mueilha in the Eastern Desert showed evidence of having covers. The covers would have provided protection against filling with sediment as a result of local flash-flooding (Rothe *et al.* 1996: 77). Excavation of these large enclosure walls is planned for the next season at the quarry and should provide more evidence to substantiate one of these hypotheses.

Another difference between the track wells and those in the quarries is their much larger internal size, which leads to suggestions that these were also animal watering places. Well 4, associated with Camp 2, comprises a separate solidly-constructed rectangular enclosure wall 5 m x 5 m and 65 cm high, with an entrance leading from it down to the well itself (**Pl. 30**). Even though there was only time for partial excavation of the well itself, there was no evidence to suggest that it had any enclosure wall around it (**Pl. 31**). Similar to the other wells, its depth was very shallow; just below one metre. Determining the function of the inner walled enclosure requires more investigation, but it can be hypothesised that it acted as a place for water storage to supply animal as well as human traffic along the route (**Pl. 32**).

Well 3 also has a solidly-constructed rectangular inner wall, 3.8 m x 4 m by 80 cm, but

[10] From a recent lecture given by Alfredo and Angelo Castiglioni at the Sudan Archaeological Research Society annual colloquium, May 2003.

this surrounds the actual well with no evidence of a separate storage area (**Pl. 33**). The depth of the well is again rather shallow at less than one metre (**Pl. 34**). The absence of pottery at Well 3 could suggest animal skins were used as water carriers/storage devices. Such carriers are still used in the Sudan for similar purposes. At Well 4 two sherds of an egg-shaped jar which date to the 12th Dynasty were found close to the storage area (El-Senussi 2003: 3). However, dating of both Well 3 and Well 4 to the Old Kingdom is suggested due to the immediate proximity of the ephemeral camps which reveal only an Old Kingdom pottery assemblage dating between the 3rd to early 4th Dynasties (*op. cit.*).[11] In addition, these camps were also bakeries, given the presence of bread moulds dating to the Old Kingdom, such food production would require an immediate water source. The few Middle Kingdom sherds at Well 4 could therefore suggest a re-opening of the well and perhaps construction of the storage area was a later addition to the original Old Kingdom well. Clearly further investigations are required, however, these preliminary findings are highly significant in relation to climate and environment at the quarry and for developing theories concerning subsistence practices here during the Old Kingdom.

Vegetation

With the onset of hyperarid conditions at around 4050 BP, approximately by the 5th Dynasty, studies over the last decade in the Lower Wadi Howar at latitude 17°-18° N show fluvial deposits and a favourable palaeoenvironment up to 2000 years ago (Kröpelin 1993: 561; Said 1993: 138). This study suggests that the current aridification reached the Wadi Howar about 3000 years ago (1st millennium BC), placing the desert limit then at 22° N, 700 km north of its present limit. Chephren's Quarry is situated on this latitudinal transition zone suggesting, as Murray (1951: 431) also infers, that the earlier Old Kingdom environment could have supported a savanna type vegetation, similar to the present environment at latitude 16° N in north-west Sudan. Even after the cessation of regular rainfall, Murray (*op. cit.*) suggests that larger desert trees, acacias,

[11] The camps are described in detail in Chapter 8.

tamarisks and dom-palms would have obtained sufficient moisture to live from the air and groundwater, but their seeds would not have matured. With groundwater so close to the surface in the Old Kingdom, as evident from the shallow wells, this theory now seems quite probable.

Findings from the 1999 season revealed an Old Kingdom surface at Khufu Stele Quarry of pale reddish-brown playa silts containing fine rootlets and gastropod shells (Bloxam 1999: 21). However, to further determine if the Old Kingdom ground surface at Chephren's Quarry showed evidence of organic material, concomitant with a savanna type vegetation, investigations were made of the soil stratigraphy. Two test pits were dug, Pit 1 at Khufu Stele Quarry, Pit 2 at Quartz Ridge, to establish if a gastropod level was continuous across the Old Kingdom ground level. In both areas, a stratigraphical unit of gastropod shells and fine rootlets occurs between 30 - 45 cm below the present surface, beneath laminated silty sand. [13] At Pit 2, fragments of worked Chephren Gneiss coincide with the gastropod level between 30-45 cm, which, as our previous investigations suggest, is likely to represent the Old Kingdom surface (**see Fig. 10**).

Epigraphic evidence of past environment

Indirect evidence of an environment in the Arba'in Desert that supported wild game such as lions and gazelles between the 1st and 5th Dynasties comes from rock drawings at Uweinat and Gebel Rahib (Hume 1937: 915). Rock art in the Western Desert depicts abundant fauna, such as elephant, giraffe and ostrich, certainly into the Predynastic Period (Hoffman 1991: 234). Old Kingdom rock drawings at Tushka also depict cattle and giraffes still in the region of Upper Egypt (Dunbar 1941). The author and Dr Storemyr located some previously undocumented rock drawings, similarly depicting cattle and giraffes, in the Gebel Gulab silicified sandstone quarries on the west of the Nile at Aswan (**Pl. 35**). According to Huyge's (2002: 195) chronology, these would

[13] Dr J. Bunbury provided the analysis of the stratigraphy in both the 1999 and 2000 seasons. Organic samples collected are in the SCA store at Aswan awaiting permission for analysis.

date between the Early Dynastic to late Old Kingdom.

Tomb depictions dating to the 5th Dynasty, such as those in Ptahhotep's tomb, show a low desert landscape with sycamore and smaller bushes that do not appear in later reliefs (Said 1993: 140; Stanley *et al.* 2003: 397). The 6th Dynasty funerary autobiography of Weni at Abydos also hints at a favourable climate in Nubia as he mentions the commissioning of Nubians to build boats from acacia wood of Wawat, this being a confederate Nubian chiefdom that encompasses Chephren's Quarry (Lichtheim 1973). Prior to the construction of Lake Nasser, the environs around Tushka appear to have been almost semi-tropical, as this account of the region made in 1963 by Kazimierz suggests:-

> '...the road led by a narrow path through a densely submerged palm forest amid profuse, almost tropical flora...mosquitoes buzzing round our heads completed the sense of being in a humid forest of Central Africa.'

Translation of the inscription on the stele of Khufu might also point to the environs of Chephren's Quarry being savanna/oasis-like. The upper register of the stele shows the cartouche of Khufu which is compounded with the district name accorded to the quarry in the lower register (**see 22a**). According to Rowe (1938: 394-5), the glyph in the district name is the Egyptian word 'to catch fish' and he interpreted the district of the quarry as being an 'oasis' bearing the name 'Place-of-the-Fisher' or even 'Place-of-Catching-Birds.' Coincidently, an Old Kingdom inscription at Elephantine Island uses the name 'Fishing-net of King Khufu' (Seidlmayer 1996: 119-20) which Rowe (*op. cit.*) interprets as strong indicators of the fertility of the region in the 4th Dynasty.

Subsistence at Chephren's Quarry

The demands on floral resources such as wood for both domestic and industrial purposes further suggests that trees were situated here. Fire-setting of Chephren Gneiss boulders for the purposes of block trimming (this is described in Chapter 6) and fuel to assist in bread-making, in at least three bakeries, which are associated with the Old Kingdom presence at the quarry. If, as proposed above, the Old Kingdom environment resembled that of present day Sudan, west of Khartoum at 16° N 32° E, then subsistence during the most intensive phases of exploitation at Chephren's Quarry (3rd - 5th Dynasty), would be possible utilising locally-available resources on a semi-permanent basis. Baking of bread also suggests that cereals such as barley, wheat or sorghum (domestic or wild) were locally available. The numerous Neolithic sites at Nabta Playa (50 km south-west of Chephren's Quarry) have revealed a wide range of macrobotanical and macrofaunal remains that include some domesticates (Wendorf and Hassan 1980: 416-18).

The environmental impact of over-exploitation of local non-renewable floral resources would have greatly accelerated the process of ground surface deflation when hyperarid conditions were established by the 6th Dynasty. It could be suggested that the cessation of Chephren Gneiss exploitation by the late 5th Dynasty was less to do with '...failure of the wells...' (Murray 1951: 432) than with the denudation of the vegetative environment.

LOWER/MIDDLE EGYPT

The Northern Faiyum Desert: the environs of Widan el-Faras

The palaeoclimatic conditions affecting Egypt during the early to mid-Holocene were not uniform in Egypt. During the Holocene Wet Phase, the rains of the ITCZ were concentrated in southern parts of Egypt, with the north remaining almost consistently arid, with an annual rainfall of around 25 mm (Hassan 1986b: 67). Periods of intense flash-flooding occurred particularly between the mid-late Holocene 5500-3500 BP (*c.* 4500 - 2200 BC) as evident from the transport of materials south from the desert into Lake Moeris and by the rapid dissection and filling of wadi channels on the northern fringes of the lake (Wendorf and Schild 1976: 225; Kozolowski and Ginter 1993: 330).

Groundwater

As mentioned previously, the northern limit of the Nubian aquifer lies south of the Cairo-Bahariya uplift (south of latitude 29° N), hence the Faiyum at 29° N is little affected by this groundwater. Any occurrence of groundwater in the environs of Widan el-Faras would have to be accessed through an artesian system of wells, substantially deeper than the Nubian aquifer (Boulos 1990: 76, 80). Therefore, Lake Moeris was not supported by groundwater or rainfall, as were the playa lakes in Upper Egypt, but principally fed by the Nile and little affected by local rainfall (Hassan 1986a: 493; Kozolowski and Ginter 1993: 333).

Vegetation

Surface investigations carried out in 2001 around the harbour features and basalt quay at Qasr el-Sagha found petrified tree stumps and large quantities of petrified wood, probably Pharaonic period in age (Storemyr pers. comm. 2001), strewn across what would have been the Old Kingdom lake bed (see also Wendorf and Schild 1976: 218-22) (**Pl. 36**). Although detailed discussion of the Old Kingdom settlements comes in Chapter 8, it is appropriate to mention here a late 3rd to early 4th Dynasty title from a private tomb which refers to the 'Overseer of all the acacia trees of the Southern Lake', the name of the Faiyum at this time (Ćwiek 1997: 19).

The contrast mentioned earlier between the lush southern environs of present Birket Qarun lake and the Northern Faiyum Desert is perhaps a way to visualise the Old Kingdom environment. The only significant difference in the Old Kingdom landscape would be the size of ancient Lake Moeris with its waters reaching Qasr el-Sagha, and the northern fringes of the lake bearing vegetation. The desert behind Qasr el-Sagha towards Widan el-Faras is likely to have looked much as it does today, the surface being one of increasing deflation and sand accumulation. In fact, a study of diatoms in the north of the Faiyum depression suggests that the water temperature of Lake Moeris and rainfall in the Old Kingdom would have been quite close to that of today (Wendorf and Schild 1976: 221, 226).

Subsistence

Human subsistence in the Faiyum was based on a set of variables predominantly influenced by the level of the Nile flood, rather than direct dependence on local annual precipitation. The Faiyum has been aptly described as a '...bounded cultural unit...all human life directly dependent on the lake...' and the area is essentially a record of how people adapted to the resources of the lake (Wenke and Lane 1983: 25). The Faiyum indeed offers the oldest and fullest record of the Neolithic period in Egypt. The relationship between the ancient shore-levels of Lake Moeris with periods of permanent occupation have been subject to research by Caton-Thompson and Gardner (1934), Ball (1939), Wendorf and Schild (1976), Wenke and Lane (1983), Hassan (1986a) and Kozolowski and Ginter (1993).

Faiyum Neolithic sites along the northern rim of Lake Moeris span more than a thousand years from 5230 ±50 cal BC to 4000 BC, the largest being at Kom W (**see Fig. 18**) (Wetterstrom 1993: 204). Subsistence was principally dependent upon shallow water resources, such as catfish, and the hunting of wild game. Domesticates both faunal and floral are also evident, but as an addition to a predominant forager subsistence base in seasonally re-occupied camps, rather than sizeable sedentary communities (Caton-Thompson and Gardner 1934: 89; Brewer 1989: 129-30; Wetterstrom 1993: 204).

The Old Kingdom site of Kom IV investigated by Caton-Thompson and Gardner (1934: 97-103) (**see Fig. 18**) was found to be a more permanent settlement, with the highest density of artefacts dating between the 4th and 5th Dynasties. The faunal remains were mostly fish bones and the floral remains were mainly charcoal of tamarisk wood, suggesting food dependence on the lake. However, the site's location 3 km north of the northern limit of Lake Moeris, overlooking Basins K and L is rather puzzling and could suggest that higher rainfall during the 4th and 5th Dynasties was collected in these basins (Caton-Thompson and Gardner 1934: 97-8). Wendorf and Schild's (1976: 218-22) work in the immediate environs of Qasr el-Sagha revealed cultural layers dating to the

Old Kingdom containing casts of plants, lacustrine snails, fired brick and charcoal. The faunal assemblages contained many fragments of the crocodile *Crocodylus niloticus*, ox, sheep, domestic cattle (*Bos*) and small wild cattle (Gautier 1976: 371-5).

Unlike the evidence found at Chephren's Quarry of *in situ* food production, such as bread-baking that could have been supported from local resources, there is no evidence of similar food production at Widan el-Faras. Faunal and floral remains were negligible, with only one hearth being located at the encampment, 500 m south of the main quarry. Furthermore, the Old Kingdom pottery corpus is dominated by vessels associated with food storage rather than production, and there is an absence of bread moulds (El-Senussi 2001: 1-3).

This evidence suggests two things; first, that subsistence would have come from the immediate environs of the lake at Qasr el-Sagha and/or Kom IV; second, the harshness of the environment at Widan el-Faras presupposes an ephemeral presence here, the latter being the theme of a more far-reaching discussion in later chapters. So in essence, subsistence at Widan el-Faras would be dependent on the levels of Lake Moeris, and thus the Nile flood associated with higher rainfall in Upper Egypt and beyond, rather than on the immediate local environment.

Flash-Floods

Minor fluctuations in the climate would still have occurred at this latitude and as mentioned earlier, there might be reason to suggest increased rainfall during the 4th and 5th Dynasty, although short-lived. Unfortunately there is no way of knowing this for certain, but it is noteworthy that, even today, Widan el-Faras is still subjected to flash-floods that could mirror those of earlier times. Indeed, within the last few years the area has seen increased rainfall, the evidence coming from discrepancies between our 2001 observations of remaining archaeological infrastructure at Widan el-Faras, and those of Harrell and Bown's work during the mid to late-1990s (see Chapters 8 and 11). Evidence of increased humidity in this region is further signified by large quantities of lichens adhering to the basalt on the west-facing scree slopes of the Gebel Qatrani escarpment (**Pl. 37**).

If the environmental and climatic conditions of the Old Kingdom are similar to those of today, it is puzzling that the 'Main Quarrymen's Camp' is located across a broad wadi channel that would receive water from flash-floods running off the Gebel Qatrani escarpment. The questions arising from the location of the 'Main Quarrymen's Camp' across the wadi are discussed in more detail in Chapter 8, however, this situation suggests that the stone circles were not intended as dwellings. In addition, the soil stratigraphy on which the stone circles of the 'Main Quarrymen's Camp' rest is made up from soft laminated sands, both wind and water-borne, containing fragments of weathered basalt (Storemyr pers. comm. 2001). This further suggests that the wadi was active in antiquity.

The Nile and Levels of the Nile: Third Millennium BC

Periods of high and low flood levels have been linked respectively to periods of economic prosperity and decline in Egypt. The collapse of centralised government at the end of the 6th Dynasty (*c.* 2152 BC) has often been cited as a direct consequence of repeated failure of the Nile flood (see Chapters 3 and 7) (Butzer 1984; Hassan 1997). The importance of this inter-relationship between the Nile flood and the economy is demonstrated by the meticulous recording of flood levels since *c.* 3090 BC on the 5th Dynasty basalt stele, the Palermo Stone (Hassan and Stucki 1987: 37; Said 1993: 134). There is general agreement that Nile flood levels during the early-mid third millennium BC, in accordance with the Palermo Stone, were low between the 1st and 2nd Dynasties but increased between the 3rd and 5th Dynasties. A catastrophic decline in the flood is suggested between *c.* 2220-2002 BC, commencing during the reign of Pepi II of the late 6th Dynasty, a hypothesis which has been recently substantiated from studies of sediment cores collected in the Nile delta (Stanley *et al.* 2003: 395-402). The study concluded that considerable changes in both the annual flood and baseflow of the Nile were simultaneous with the end of the Old Kingdom (Stanley *et al.* 2003: 401). Generally low Nile floods followed until the 12th and 13th Dynasties which saw a significant rise in the flood level, coinciding with a slightly moist interval in the Sahara (Butzer 1984: 107; Hassan 1997: 5-6).

Research into Nile flood levels in antiquity and their correspondence with the inscriptional evidence have particularly focussed on the levels of Lake Moeris. This is due to the unique record of extinct shorelines and associated archaeological data still remaining here. Authors such as Ball (1907), Caton-Thompson and Gardner (1934), Little (1936), Shafei (1960), Butzer (1968, 1976, 1998), Said (1993), Hassan (1981, 1986a, 1987, 1997), Wendorf and Schild (1976), Krzyżaniak and Kobusiewicz (1984) and Jeffreys and Tavares (1994) have produced seminal works on this subject. A brief synthesis of those findings which are relevant to this discussion follows, paying particular attention to the Bahr Yusef and Bahr Libeini channels of the Nile, Lake

Moeris and recorded flood levels in Upper Egypt.

The Bahr Yusef and Bahr Libeini

The modern named Bahr Yusef channel is the best-known natural branch of the Nile diverging from the main river (in antiquity) between Asyut and Manfalut (and now near Dairut), close to the Hatnub quarries. Today, all the water for irrigating the Faiyum is supplied by this channel, artificially connected to the depression via the Lahun regulator (Ball 1939: 225, 228). The Bahr Yusef has an average width of 100 m and average depth of 4 m and meanders for 280 km along the western margins of the floodplain (Little 1936: 203; Butzer 1976: 16). It has been suggested that, during the Old Kingdom, the Bahr Yusef actually extended north of the Faiyum and into Memphis via the Bahr Libeini (Shafei 1960: 199; Jeffreys and Tavares 1994: 155). The Bahr Libeini is possibly a relic of an earlier course of the river that might give credence to Herodotus' version of events, that the river had once flowed close to the desert edge and gradually moved east (Jeffreys and Tavares 1994: 155).

The Bahr Libeini has indeed moved significantly to the east since the Old Kingdom and today it bisects an area of high ground 2 km east of the desert edge at North Saqqara (Jeffreys andTavares 1994: 155, 159). During the 3rd Dynasty, when high floods recommenced, it is thought that the Bahr Libeini was re-established, feeding the marginal lakes at Middle Saqqara and Abusir and serving the Unas and Abusir valley temples, either on a seasonal or perennial basis. The Bahr Libeini and these marginal lakes seem to have been fully exploited for funerary and other ceremonial purposes after the 4th Dynasty, when for logistical reasons, the 5th Dynasty pyramids and solar temples were located much closer to the edge of the plateau (*op. cit.*). Mathieson *et al.* (1999: 35) resistivity work at Saqqara, east of the 5th Dynasty valley temple of Unas, similarly indicated that a harbour was probably located here (see Chapter 6).

Lake Moeris and the connection with the Nile

Lake Moeris provides a direct correspondence with Nile flood levels because it was once naturally fed from the Bahr Yusef via the Hawara channel at Lahun (Little 1936: 219; Said 1993: 80). The Hawara channel lies at -17 m a.s.l. or 28 m above the lowest point of the depression and is a 10 km-long alluvium-filled channel that cuts through the Faiyum-Nile Valley limestone divide. The flow of water through the channel could only occur during exceptionally high floods, breaching the sill that separates the Bahr Yusef from the Faiyum depression. Borings made across the channel have provided a record of high and low floods (Little 1936; Ball 1939; Shafei 1960). The connection between the Bahr Yusef and the lake was established around 9000 BC and since then it has gone through repeated phases of severing and re-establishment (Little 1936; Shafei 1960; Said 1993: 81). The connection was re-established at about 3000 BC and Shafei (1960: 193) makes particular reference to this occurring during the reign of Khufu in the 4th Dynasty when the ordinary flood levels reached 24.2 m a.s.l. This flood level could fill the lake to 21 m a.s.l. giving a holding-capacity of approximately 6 million cubic metres of water, more than the present Aswan Dam (*op. cit.*). The depth of the lake now (Birket Qarun) is at -45 m a.s.l. (Shafei 1960: 198).

There were two periods of interruption of flow (around 2000 and 1200 BC) until the Hawara channel was regulated by man in Ptolemaic times (Said 1993: 81). The foundations of an original dam and weir constructed by Ptolemy I or Ptolemy II during the period of Faiyum reclamation still remain (Ball 1939: 226). Artificial means of regulating this flow of water through the Hawara channel might go back even further, to the 4th Dynasty (Shafei 1960: 206-7).

Levels of Lake Moeris

The flow of water through the Hawara channel from the Bahr Yusef into Lake Moeris was thus a crucial aspect of the interplay between the Nile flood and the levels of Lake Moeris in antiquity. Four phases of high lake levels are known to have occurred from 9000 BC into the third millennium BC, but contextualising the historical events and exploitation of Widan el-Faras basalt with the Old and Middle Kingdom occupations of the northern shore at Qasr el-Sagha is still controversial.

The current debate is whether a high lake level of +23 m a.s.l. occurred in the Old Kingdom or only in the Middle Kingdom. Shafei (1960), Butzer (1976), Wendorf and Schild (1976) and Hassan (1986) agree that this occurred in the 4th Dynasty (**see Fig. 19**), but Kozolowski and Ginter (1993: 33) disagree with the chronology previously used and suggest that the highest level occurred in the 12th Dynasty. Butzer (1998: 166) has recently re-examined the argument for a high lake level in the third millennium BC and suggests that although there is more archaeological evidence for a high level in the 12th Dynasty, the existence of the Old Kingdom basalt quay and nearby 'Eastern Settlement' at Qasr el-Sagha suggests a high level up to at least 22 m a.s.l. to allow the stone from the quarries at Widan el-Faras to be shipped across the lake (*op. cit.*).

It should also be noted that the only stratified pottery sequence in the immediate environs of the Qasr el-Sagha harbour dates to the Old Kingdom, at an elevation of 22 m a.s.l. (Wendorf and Schild 1976: 220). Investigations made in the 2001 season around the harbour area also showed large amounts of Old Kingdom pottery impacted into sediment surrounding the northern shore of the ancient lake, and Old Kingdom pottery on the harbour features (El-Senussi 2001:1-3). Although Middle Kingdom pottery is extensive at Qasr el-Sagha, the evidence for basalt use at this time remains unclear and is only known for small statuettes (Aston 1994: 21). Hard stone use in the Middle Kingdom for monumental construction appears to have been limited to red granite (often re-used from Old Kingdom pyramids) and quartzite (Lehner 1997: 168-83; see Chapter 4). Hence, the consumption of basalt in the Old Kingdom outweighed that of the Middle Kingdom and furthermore the quarries at Widan el-Faras show no evidence of Middle Kingdom working (see Chapter 6).

Upper Egypt and Nubia

Due to the construction of the Aswan dams and Lake Nasser in the 20th century, the cataract region from the First Cataract at Aswan to the Second Cataract at Semna in northern Sudan, bears no resemblance to the floodplain of the third millennium BC (Fourtau 1905: 3). Crucially, any evidence of Old and Middle Kingdom settlements in the region of Tushka on the west bank of the Nile, 80 km south-east of Chephren's Quarry, is now submerged under Lake Nasser. Engelbach (1938) and Murray (1939) believed that Tushka was the main embarkation point for quarrying expeditions and thus stone from the quarry, although no evidence of a depot or harbour were found (Engelbach 1938: 389). At Tumas, 40 km north of Tushka, inscriptions from 6th Dynasty kings Teti and Pepi I only record an ephemeral presence here (Emery 1967: 176). Unlike in the northern Faiyum, there has been little opportunity for recent research into flood levels or for a search for more evidence of harbours or permanent settlement along this stretch of the Nile.

There has therefore been heavy reliance on inscriptional evidence of flood levels in Upper Egypt and Nubia during antiquity, the majority of which date to the Middle Kingdom and are associated with the Second Cataract fortresses at Semna. The position of inscriptions dating to Amenemhet III suggest that either the Nile has lowered its channel approximately 8 m since this time, or that the Middle Kingdom floods were exceptionally high (Ball 1939: 72; Bell 1975; Said 1993: 55). Said (1993: 55) suggests that the phenomenon of very high floods in the Middle Kingdom resulted from new sources of water entering the river, rather than a dramatic lowering of the Nile channel since the New Kingdom. These new sources of water into the Nile were suggested to be due to the northward penetration of the ITCZ that activated the dry wadis of north Sudan and Upper Egypt (*op. cit.*).

A situation similar to that evidenced for the Middle Kingdom high floods can be envisaged for the Old Kingdom at the end of the last Holocene pluvial. High floods during the 4th - 5th Dynasties coincident with the high level of Lake Moeris at this time support this. Whether the Wadi Tushka could have been active at this time can only be speculation, although the concurrence of exploitation of the stone with periods of high floods might imply the use of a close water source for transportation.

Clearly the discharge of the river, particularly during the Holocene Wet Phase, would have been many times greater than today. The Nile was a far mightier river at that time and the sheer volume of water discharged through the First Cataract means that it in no way resembled its present form (Fourtau 1905: 3; Said 1993: 129). The position of inscriptions relating to the armies of Senusret III on Sehel Island at Aswan firmly suggests a higher river level and the need to build up to six canals to navigate boats through the cataract (Fourtau 1905: 3). A clear level of Nile sediments, approximately 8 m above the current (highest) Nile level, can be seen in areas of New Kingdom quarrying on the east bank of the Nile at Aswan. Furthermore, the early 6th Dynasty autobiography of the noble Weni mentions the cutting of a canal at the First Cataract as part of great works associated with the exploitation of the Aswan quarries (Grimal 1992: 83). The implications of the failure of the flood and suggestions of political decline and decentralisation by the late 6th Dynasty are discussed in later chapters.

Summary

The evidence for moister climatic conditions in the Arab'in Desert during the early to mid-third millennium BC is well attested and it seems probable that the environs of Chephren's Quarry would have supported at least a savanna-type vegetation. Subsistence, both faunal and floral, could have been locally available, although non-renewable, with groundwater easily accessible within a metre below the ground surface. The presence of a bakery and thus substantial burning of wood for both domestic and industrial purposes is further testament to this.

There is a strong possibility that the Old Kingdom ground surface (possibly calcrete) at Chephren's Quarry could have supported vehicles transporting stone, without the need for purpose-built roads or tracks. Unlike the evidence at Widan el-Faras where a purpose-built road had to be constructed across the sand and gravel surface to Lake Moeris, no such infrastructure is known at Chephren's Quarry. A section of one ancient route located in the 2003 season is an animal-worn track and is described in Chapter 6, however, this seems to be associated with the transport of small blocks. A role for Wadi Tushka in the transportation of large stone blocks from the quarry in the Old Kingdom is still open to conjecture. However, geomorphological constraints to the transportation of large blocks south-east to the Nile at Tushka would have been quite considerable, particularly in time and human resources. It is important to stress that the distance between Chephren's Quarry and the settlement at Tushka is 80 km, but to Wadi Tushka it is only 15 km. Minimising the transportation of stone overland is a crucial aspect in understanding how the exploitation of stone from remote sources reached its acme during the Old Kingdom.

The coincidence of high Nile floods with the peak of monumental stone construction in the 4th and 5th Dynasty, coupled with the use of stone from remote sources, is a theme to be developed subsequently. It is important to emphasise the probable role that the Bahr Yusef and Bahr Libeini channels of the Nile would have played in transporting stone, not only from Widan el-Faras to the pyramid fields on the Giza Plateau and at

Abusir, but also from the quarries in the Nile Valley and Chephren's Quarry. The presence of non-local stone at Umm es-Sawan, particularly Chephren Gneiss, suggests a highly organised network of quarry exploitation between Upper and Lower Egypt involving mobile labour forces. The mobilisation of labour for such tasks forms the backdrop for understanding the political and ideological forces that operated during the height of the Old Kingdom state.

Chapter 3

Egypt in the Third Millennium BC: an Overview of the Old Kingdom (3rd to 6th Dynasties)

Introduction

The previous chapter provided an environmental framework against which the logistics of stone exploitation can be understood. However, this cannot be divorced from the cultural and historical context in which the enormous quantities and varieties of stone were extracted and transported over large distances. The radical shift to large-scale monumental construction in stone that becomes dramatically visible for the first time in the 3rd Dynasty with king Djoser's funerary monument was part of a complex transformation associated with the political and ideological position of the king in the emerging state. The following overview of Egyptian society, culture and administration summarises the period of rapid state centrality from the 3rd Dynasty that created a relatively stable period in Egyptian history.

Egypt's economic relations, particularly with Nubia, are also an important part of the equation; the dynamic of these relations is crucial to understanding the political conditions under which they operated. These economic relations have a bearing on assessing the forms of control that centralised government had over remote source stone acquisition and the impact that the increasing decentralisation of government during the 6th Dynasty might also have had. The barometer for these activities parallels the changes in monumental architecture, such as location and style, with changes in the concept and practice of kingship. Thus, understanding the cultural context within which the capability to organise and mobilise labour for monumental construction projects was achieved *par excellence* in the Old Kingdom, will also explain why this capability eventually became unsustainable.

Society, Culture and Administration

Predynastic to Early Dynastic Period

Although this chapter centres on the Old Kingdom, it cannot be fully understood without reference to the Predynastic and Early Dynastic Periods (*c.* 3500 - 2700 BC) when the foundations of a centralised state emerged. This is particularly relevant to understanding the antecedents for the art, architecture and religious beliefs that had evolved with such overwhelming power, by the Old Kingdom period. Bard (2000: 88) suggests that Egypt's sociopolitical, ideological and economic transformation stems from a strong agricultural base coupled with organisational ability and a highly-developed institution of kingship. Stratified burials rich in exotic grave goods appear as early as Naqada II and reflect the aggrandizement of Upper Egyptian polities within the spheres of long-distance trade and the control and distribution of exotic raw materials (*op. cit.*, 61).

The three major Predynastic centres in Upper Egypt were at Naqada, Abydos and Hierakonpolis, attested by the presence of elite burials in these centres and also by the material culture of Lower Egypt being derived from Upper Egypt, replacing the earlier Maadian culture (Bard 2000: 62-3). The importance of Hierakonpolis within the emerging Egyptian state is particularly relevant to the exploitation of Chephren's Quarry from the Predynastic to the 3rd Dynasty. This importance is explored in later chapters.

The events that led to the final unification of Upper and Lower Egypt by Dynasty 0 still remain controversial. The suggestion of military conquest by the Upper Egyptian kings rests on the interpretation of the Macehead of King Scorpion and the Palette and Macehead of King Narmer found in the Horus Temple at Hierakonpolis by Quibell and Green (Trigger *et al.* 1983: 44; Grimal 1992: 35-9; Bard 2000: 65). Although there is no archaeological evidence of warfare in Lower Egyptian sites, the scenes on these palettes and maceheads point to subjugated people and the acquisition of booty. Although the processes through which Upper and Lower Egypt became unified under a single ruler by *c.* 3000 BC remain largely invisible in the archaeological record, social stratification and the emergence of a powerful elite were well in place prior to Dynasty 0. Dynastic political control extended from the Delta to Elephantine Island, a distance of 1000 km, centrally controlled from the Memphis region (Bard 2000: 67). Tombs of 1st Dynasty high officials at North Saqqara are juxtaposed with those of 1st Dynasty kings buried at Abydos which suggests Memphis as the administrative centre and Abydos continuing to be the cult centre (*op. cit.*, 69).

The institution of kingship is clearly manifest from the royal tombs at Abydos, coupled with the emergence of specialisation within lines of work, controlled by scribes and bureaucrats (Trigger *et al.* 1983: 67). This demonstrates the highly-stratified nature of social organisation by the 1st Dynasty and, importantly, the means which enabled an elite class to call on the labour of subordinates. The consolidation of the Egyptian state, resulting in sociopolitical and ideological institutions unified under one king, was the most significant transformation, corollary to a period of relative stability in Egypt for 800 years.

Old Kingdom: 3rd to 6th Dynasties

Throughout the Old Kingdom the capital was at Memphis, concomitant with the royal burials grounds moving from Upper Egypt to Lower Egypt, most notably the funerary complex of 3rd Dynasty king Djoser at Saqqara (Kanawati 1977: 62; Trigger *et al.* 1983: 80; Malek 2000: 90). A metamorphosis in monumental construction, principally replacing mud-brick architecture with stone, distinguishes this epoch from any other in ancient Egyptian history. Stadelmann (1995: 733) concludes that mastery of stone was first discovered and put into practice in the Old Kingdom pyramid age. The impact of these changes in funerary architecture were revered throughout Egyptian history as illustrated by Djoser's architect, Imhotep, being deified as the 'patron saint' of scribes in the Late Period and his cult surviving even into Arab tradition (Wildung 1977), although, as Kemp (1991: 106) understands it, Imhotep was revered not exclusively for his architectural achievements, but more simply as a great official and 'wise' man.

The operation of the state administrative machine during this period is very difficult to determine since few administrative documents have survived and none pertaining to a central administration (Trigger *et al.* 1983: 80; Leprohon 1995: 278). However, it has been suggested that Old Kingdom administrative organisation could be roughly divided into three departments: treasury, agriculture and labour, these departments remaining in place throughout ancient Egyptian history, run by officials many of whose titles changed little over the millennia (Leprohon 1995: 278). The vizier (*tjaty*) had over-riding authority in most areas of government and over an administrative machine that probably expanded, particularly at the outset of building more elaborate funerary monuments. As a consequence, the central state probably had to act as a buffer between the demand on resources needed to support an increasing number of non-producers (Trigger 1984: 104; Malek 2000: 102). The concomitant evolving hierarchical structures to manage all this become evident from the increase in burials of officials with numerous titles, but it is unclear whether these titles are just indicators of rank rather than job descriptions, for example, titles such as 'elder of the portal' (Leprohon 1995: 278).

Below the king, in the hierarchy were the literate men or scribes who controlled the doorkeepers, soldiers and quarrymen (although difficult to determine as a separate permanent group, as discussed in Chapter 8), with peasantry at the bottom (Trigger *et al.* 1983: 81). There is no account of how much time would be spent persuing these roles, but payment in a pre-monetary society would have taken several forms, including land as well as basic necessities. Although issues surrounding the economy of the Old Kingdom remain speculative due to scarce evidence, payment in kind is suggested as having been complex and perhaps indicative of a redistributive system. This system has been proposed as being divorced from closed government control, particularly in relation to internal trade within officials' estates where there was presumably a form of '...opportunistic bartering...' for surplus produce (Trigger *et al.* 1983: 81; Müller-Wollermann 1985: 121-68; Malek 2000: 105). There is little known about land ownership in the Old Kingdom, however, it has been speculated that land transferred to an official as payment for duties undertaken may have reverted back to the king after the term of office had expired (Malek 2000: 105).

It is suggested that 'free enterprise' operated within the overall political and ideological framework, with government being more interested in the collection of resources and revenue to secure its projects than anything else (Trigger *et al.* 1983: 82). The Palermo Stone demonstrates this preoccupation by the meticulous recording of the annual to biennial census of cattle, implying that it was a key periodic event of the reign. Revenue was even assessed on the basis of '...canals, lakes, wells, waterbags (perhaps animal skins?) and trees...' (*op. cit.*).

By the early 4th Dynasty the office of 'Overseer of Works' was a title normally held by royal family members and was two-tiered, held by both viziers and non-viziers. However, there appears to have been no centralised office of works during the 4th Dynasty and bodies of men were likely to have been put together when the work was needed (Strudwick 1985: 237-50). A hierarchy of titles clearly emerges by the 5th Dynasty reign of Sahure when these offices were organised on a more systematic basis and the title 'Overseer of Works' changed to 'Overseer of All Royal Works' (*op. cit.*; Leprohon 1995: 279). Under the expansive reforms of the 5th Dynasty, particularly within the office of works, titles become tripartite including higher, middle and lower titles, these positions now being awarded outside the royal family (Kanawati 1977: 38; Strudwick 1985: 238-9). By the end of the 5th Dynasty this broadening of hierarchical structures is reflected in the ability of even middle ranking officials to construct their own tombs (Kanawati 1977: 39). Tombs of officials bearing the title 'Overseer of the Mountainlands' or 'Caravan Leaders' appear in Upper Egypt at this time and this marks the appearance of private tombs in the provinces, although their titles still connect them with the Memphite capital (Kanawati 1977: 43).

Pyramid Towns and the Abusir Papyri

Old Kingdom pyramid towns perhaps provide a good example in the archaeological record of evolving bureaucratic organisation within an urban infrastructure associated with the maintenance of the necropolis and funerary cults. Pyramid towns of the 4th - 6th Dynasties are known to have existed in the major necropoli of Dahshur, Abusir and the Giza Plateau (Kemp 1991: 144-7). The 'Dahshur decree' attests to the existence of pyramid towns associated with 4th Dynasty king Snefru's 'Red' and 'Bent' pyramids, till the 6th Dynasty (Alexanian and Seidlmayer 2002: 5). These towns appear to have been well planned with joining rectangular rooms, and even into the reign of Pepi II, the Valley Temple of Menkaura and the tomb of Queen Khentkawes on the Giza Plateau were still officially-designated the pyramid town of Menkaura (Kemp 1991: 144-7).

Recent drill cores taken at Dahshur located the pyramid town associated with Snefru's Red pyramid, most of which is now under housing and gardens. What is interesting to note is the town's size of 200 m x 130 m, within the size range of an Old Kingdom provincial town (Alexanian and Seidlmayer 2002: 5). Kemp (1991: 149) suggests these are classic examples of deliberate town planning by the state and are perhaps the antecedents of the larger 'planned' towns of Kahun and Qasr el-Sagha which appeared in the Middle Kingdom. This theme is returned to in Chapter 8.

A rare insight into the organisation, economy and daily life of a pyramid town has come from the 'Abusir Papyri' found in the mortuary temple of king Neferirkare. The archive relates to the servicing of the kings' funerary cult from the 5th Dynasty reign of Djedkara Izezi to Teti of the 6th Dynasty and contains duty tables, inventories, accounts, lists of personnel (about 30), records of inspection and letters (Posener-Kriéger and De Cenival 1968; Kemp 1991: 112-3, 143; Posener-Kriéger 1997). The temple staff were organised into groups or 'phyles' working on a monthly rota system, suggesting that the personnel did not reside at the town permanently, and indeed the presence of only nine houses seems to support this. The highly-bureaucratic nature of the daily workings of the temple stresses the inevitable drain on resources that must have occurred in maintaining the king's cult over such a long period. Indeed there is the strong suggestion of relative poverty and decay in the later documents that, although still meticulously kept, record dwindling deliveries of supplies (Posener-Kriéger and De Cenival 1968: 16).

Kingship

Behind all the above administrative positions was the monarchy itself that by the 3rd Dynasty had developed theological dimensions concomitant with king Djoser adopting the title 'Golden Horus'. The title 'Son of Ra' first appeared during the reign of Djedefra in the 4th Dynasty and was systematically used by the reign of 5th Dynasty king Neferirkare and linked kings with a specific priesthood, dependence on which served to reinforce the centralisation of power (Grimal 1992: 89-90; Hornung 1999: 26). The kings' divine right to rule was based on his ability to mediate between the gods and the people, this being manifest through ritual locally delegated to priests (Malek 2000: 99-100). Centralisation of the state and control of the developing hierarchy was the king's power base, coupled with the predilection for even greater funerary monuments to sustain the focus of his religious cult.

There is a general consensus that the king's role was to take on the responsibility for, or be the guarantor of, order embraced by the concept of *ma ʿat* (Trigger *et al.* 1983: 74; Leprohon 1995: 274; Malek 2000: 100). This apparent establishment of order extended to the changing of the seasons, the annual innundation and safety from external threats. Support for this system is suggested as being widespread and could explain why neither a police force nor indeed slavery existed in the Old Kingdom (Malek 2000: 101-2). In fact, as Wilson (1951: 79) pointed out, the concepts of 'state' or 'government' are modern, and for Old Kingdom Egypt the terms 'kingship' and 'rule' are applied by Egyptologists. The 'Instruction' of the vizier Ptah-hetep, composed in the Middle Kingdom, encapsulates the relationship between order (*ma ʿat*) and a just society:

> 'Justice (*ma ʿat*) is great, its value enduring. It has not been disturbed since the days of him who created it. He who transgresses the laws is punished.' (Trigger *et al.* 1983: 76).

Continuity and order of kingship was a stabilising ideological concept and it is manifest in practically every iconographic and textual source. The New Kingdom Turin king list is a good example in which rigid linearity of time implies a static system with few internal divisions (Redford 1986; Kemp 1991: 24). The known periods of instability during antiquity and the realities of everyday life are obscured under this utopian ideological mask. However, any understanding of Egyptian society and culture operating beneath the ideology surrounding divine kingship is still problematic due to the lack of Old Kingdom settlement evidence. Perhaps recent excavations at Elephantine, Hierakonpolis and Ayn Asil, and settlement evidence in quarries (described and discussed in Chapter 8) will help to counterbalance the textual data.

Grimal (1992: 90) suggests that although the king was '...theoretically in charge of everything...in practice [he] only dealt with the military and religious affairs.' The incumbent of the office 'Chancellor of the God' was the person chosen directly by the king to undertake specific tasks (such as quarry expeditions) of which he was the general or admiral (*op. cit.*, 91). This again raises the question of whether quarry expeditions called on a regular pool of labour under a specific administrative structure, or whether they were amassed in more *ad hoc* fashion. This is explored in more detail in Chapter 8, but it is pertinent to mention here Wilson's (1951: 75, 90) suggestion that a rigid system could not have survived if it was not flexible in practice, and allowed individuals to rise through the ranks. The idea of a looser relation of personnel to hierarchy operating under the king is perhaps expressed through the 6th Dynasty autobiographical text of Nekhebu (Dunham 1938: 1-8):

> 'Now when I accompanied my brother, the Foreman of Construction Work..., I acted as clerk, I carried the scribe's palette. When he was appointed journeyman builder, I carried his measuring-rod. When he was appointed master builder, I accompanied him. When he was appointed Royal Constructor and Builder, I ruled the (workman's) city for him...'

The archaeological record might further support degrees of upward mobility amongst certain individuals in the 5th and 6th Dynasty, as recently revealed by excavations at Dahshur associated with the pyramid towns (Alexanian and Seidlmayer 2002: 4). The tomb of an official who would have serviced the funerary cults of older elite mortuary complexes had a surprisingly rich burial containing a limestone sarcophagus, unusual for this societal level. Alexanian and Seidlmayer (*op. cit.*) explain this as either a successful career leap, or a son reaching a high position, allowing him to request such a fine sarcophagus for his father.

Kinship

A hidden element in the social system is the role of family and kinship ties. The manipulation of kinship ties has been speculated upon as a major integrating factor in social, economic and political life, particularly by the nomarchs of Middle Egypt in the 12th Dynasty (Trigger *et al.* 1983: 305-6; Trigger 1993: 36)). Epigraphic sources in relation to kinship tend to be vague, because the ancient Egyptian vocabulary is limited when distinguishing between the kinds and degrees of kinship (Andreu 1997: 75). However, sources from later periods suggest that the concept of kinship implies a powerful bond of mutual support and solidarity (Trigger *et al.* 1983: 305). There is also the strong sense of the individual who was connected to family members in an extended network of relationships. The idea of the individual as body parts, as represented in iconography, is interpreted by Meskell (1999: 116-7) as the artist depicting the human body as a series of related concepts rather than a realistic portrayal and hence resulting in a unitary composition. The individual is also depicted as connected to family members, thus tied to parents and children as an extension of self; this is especially expressed in kin-based social interactions (*op. cit.*). The New Kingdom tomb workers' village of Deir el-Medina further attests to kin groups being resident here by the 19th Dynasty. A concomitant shift in burial structures from individuals to generational structures could be indirectly linked, these tombs become more standardised and less ranked, housing successive generations as well as extended family (*op. cit.*, 147).

Trade and Economy

The consolidation of trade networks, particularly between Upper Egypt and Nubia with Lower Egypt, commenced with the expansion of Naqada culture into Lower Egypt during the Predynastic. The importance of Elephantine Island in Upper Egypt in the control of the southern trade routes is attested from its oldest occupation dating to Naqada II (Seidlmayer 1996: 111). The development of these linear trade networks is concomitant with the development of the technology needed to construct large boats to fully utilise the Nile river, as is shown in the depiction of barges conveying obelisks on the causeway of the 5th Dynasty Unas pyramid complex (Aston *et al.* 2000: 18; Bard 2000). The implications of such technological development forms the basis for the theoretical discussion of power manifest in control of transport routes in Chapter 5.

The archaeological record in the Predynastic site of Maadi in Lower Egypt attests to these trade routes and might suggest the association of Chephren's Quarry with a 4th millennium BC exchange system. A storage cellar at Maadi was found to contain well-made stone jars and vases from stone such as 'gneiss', granite and 'Faiyum basalt', along with carnelian beads (Hoffman 1991: 203). Hoffman (*op. cit.*) suggests that fancy stone vessels were investments to back up a system of exchange, so if his reference to 'gneiss' means Chephren Gneiss, then an argument for trade connected with Chephren Gneisses has some feasibility. The data from these earlier excavations in the northern part of the settlement at Maadi that Hoffman refers to, was collected by Menghin and Mustafa in the early 20th century but was unfortunately never published. However, Caneva *et al.* (1989) also concluded from their excavations at Maadi in 1984 that the site reveals marked craft specialisation, including stone vase production using imported stone as an integral part of a trade network. These themes are picked up later in the following chapter.

The reign of early 4th Dynasty king Snefru sets the scene not only for the deep involvement of the royal family in the administration of government, but also for expansionist military campaigns into Nubia and the Levant in the quest for exotic raw materials (Grimal 1992: 67-9; Hornung 1999: 28). Raw materials were acquired from Nubia and Sinai - cedar from Lebanon was also especially sought after and used in the construction of three funerary monuments during his reign, one at Meidum and two at Dahshur. Snefru had a long reign and the cult of Snefru flourished in the Middle Kingdom, perhaps as naked political ambition and/or a more complicated web of political and ideological factors (Wildung 1969; Trigger *et al.* 1983: 95; Grimal 1992: 67-9).

Egypt's Relations with Nubia in the Old Kingdom

Egyptian interests in Nubia were in essence commercial and there is the suggestion that the decline of Nubian A-Group in the Old Kingdom was due to Egypt's previously 'symbiotic' relationship with Nubia changing to one of dominance (Trigger 1965: 79; Manley 1996: 26; Seidlmayer 1996: 112). Adams (1977) and O'Connor (1993) both concur that probably as early as the 1st Dynasty, as the Predynastic antecedents suggest, Egypt dominated Lower Nubia in order , not only to control the flow of exotic items from Upper Nubia, but also to procure rich mineral resources, particularly gold. Whether this control was forced on the the Nubians is unclear, although Trigger (1976: 48) suggests that Nubians who were given official titles by the 5th Dynasty may have been descendants of captives taken by Snefru in the 4th Dynasty.

The archaeological record at Elephantine Island further supports a change in attitude and a re-organisation of trade relations with Nubia after the 1st Dynasty. This is implied by the imposition of territorial frontiers and the building of a fortress here on Egypt's southern border (Seidlmayer 1996: 111-3). A seal impression of a 'Lower Egyptian seal bearer' of the *pr-njswt* or royal domain, dating to the late 3rd Dynasty, suggests Lower Egyptian control at this time (*op. cit.*, 120-1). There was no evidence for the consumption of luxury items or refined furnishings at the fortress, the sphere of domestic consumption was via storage vessels, including tens of thousands of beer jars and bread moulds. These vessels date from the second half of the 3rd Dynasty to the beginning of the 4th Dynasty and imply the distribution of rations from a central place concomitant with the establishment of an economic and administrative presence (*op. cit.*, 121). Seidlmayer (*op. cit.*, 127) relates this to national intervention on a military, economic and ideological footing to serve state projects on an episodic basis.

Buhen (located at the Second Cataract and now submerged in Lake Nasser) might also have played an important role in foreign relations with Nubia during the 4th and 5th Dynasty, given that 95 % of the pottery found here was Egyptian (Emery 1967: 116-8). Although this could imply trade in these items, it seems probable that a permanent presence was initiated here by Snefru to secure the southern trade routes from Dongola in the Sudan (Trigger 1976: 46; Trigger *et al.* 1983: 125). Copper working at Buhen has been attested and recent excavations at Elephantine discovered Old Kingdom copper furnaces (Emery 1963; Adams 1977; Seidlmayer 1996: 111). The copper chisel dating to the Old Kingdom found at Chephren's Quarry (now in the Egyptian Museum in Cairo) (**Pl. 38**), could have been manufactured at one of these places. Furthermore, Adams (1977) suggests that systematic prospecting for minerals must have been undertaken even beyond Lower Nubia given the discovery of Old Kingdom inscriptions at Kulb, in the Batn el Hajar (Upper Nubia). These inscriptions were made by a 'Scribe of the Prospectors' and two 'Overseers of the Prospectors' *sš,* and *imj-r smntjw* respectively, suggesting that mineral exploration might have been a state-organised enterprise (Hintze 1965: 14; Adams 1977).

Emery (1967: 116-8) speculates that quantities of jar sealings and ostraca bearing the names of the kings Khafra, Menkaura, Userkaf, Sahura, Neferirkara and Nyuserre, are evidence for a well organised despatch service operating from Buhen during the 4th and 5th Dynasties. It is interesting to note that these reigns are contemporary with exploitation of Chephren's Quarry and perhaps demonstrate some form of Egyptian control over sources of exotic raw material such as Chephren Gneiss in Nubian territory.[1] This might further explain the absence of defensive structures at the quarry, unlike the situation at the equally remote mining settlements of Wadi el-Hudi in the south-eastern desert and Wadi Maghara in the Sinai, where this form of evidence does exist. Crucially, the pottery corpus at Chephren's Quarry is totally of Egyptian origin (Darnell 1999; El-Senussi 2003).

Nubia appears to have become free of Egyptian occupation by the 6th Dynasty and it is noteworthy that no pottery dating past this dynasty of the Old Kingdom was found at Buhen or at Chephren's Quarry until the Middle Kingdom. Nubia still remained important in the late 6th Dynasty, but there is no evidence of exploitation of stone from Chephren's Quarry by this time, although the quarries at Hatnub and Aswan were still being exploited. Trigger (1965: 80) suggests that the cessation of exploitation was due to alabaster (travertine) replacing Chephren Gneiss in fashion, an important point that is tackled in the following chapter.

Perhaps these changes in trading relations with Nubia were to do with the gradual decentralisation of power and the growing influence of provincial governors (Trigger 1976: 48; Trigger *et al.* 1983: 124-7; Grimal 1992: 85). Incursions into Nubia by this stage seem to have been in the form of expeditions, rather than being associated with colonial ambitions. The 6th Dynasty funerary biography of Aswan governor Harkhuf gives some insight into the nature of these later trade relations with Nubia and the establishment of caravan routes through the oases of the Western Desert. Was the inception of these desert routes (and control of them) associated with the onset of low Nile floods, as discussed in Chapter 2 (Bell 1971; Butzer 1984; Hassan 1997; Stanley *et al.* 2003), their subsequent effects making it necessary to find alternative overland routes?

[1] The implications and form of Egyptian control over remote stone sources is discussed further in Chapter 7.

Harkhuf made three trading trips into Nubia during the reigns of Mernere I and Pepi II. These expeditions commenced at Memphis and led into the Nubian territory of Yam and the confederate chiefdoms of Wawat and Satju, either via the Nile Valley or Western Desert, on the request of 'his majesty' (Trigger *et al.* 1983: 126; Grimal 1992: 87; Manley 1996: 26). Mention is made of an army being sent with him, although the text implies that his journeys into Upper Nubia were accomplished without interference (Lichtheim 1973: 25-6 in Grimal 1992: 87). Inscriptions at Tumas, 40 km north of Tushka, similarly suggest only an ephemeral presence here, as mentioned in Chapter 2. The abandonment of Egyptian settlement in Nubia by the 5th Dynasty implies the ephemeral nature of these later journeys, Nubia being seen as a foreign land, giving rise to Elephantine governors with the title 'overseer of the foreign lands' (Trigger *et al.* 1983: 126).

Population and Towns

Any demographic study of Egypt in the Old Kingdom is circumspect due to the paucity of settlement data and with the textual sources being limited principally to mortuary contexts. Estimates of population, although extremely uncertain, have come from calculating available arable land, yield and population sustainable on that yield. The most convincing estimate of population size from the archaeological record has come from the Middle Kingdom town of Kahun, due to relatively good site preservation and a supplemental textual record (Butzer 1976: 58; Kemp 1991; Hassan 1993b: 558). Kemp (1991: 155-7) calculated from the size of granaries and number of dwellings at Kahun that if each household averaged six people living on maximum rations, a population of around 3,000 was a feasible estimate. This figure is about half of Petrie's earlier estimate and this follows a trend for earlier evaluations of population being substantially higher than more recent demographic studies.

The breathtaking accomplishments in monumental construction and concomitant procuring of raw materials by *c.* 2500 BC are thought to have been achieved via the effective organisation of extremely large labour forces, into tens of thousands (Rowe 1961: 110; Mendelssohn 1974: 143; Andreu 1997: 42). However, recent calculations of the Old Kingdom population suggest that numbers were simply too small, particularly in the Memphite nome, to sustain this view (Butzer 1976: 87). A population density of around 100 people per square kilometre would have been required to sustain such large labour forces; even taking seasonal labour into account, this would mean that Old Kingdom Egypt would have to have had a population of at least 2 million. The current estimates of the Old Kingdom population are about half this figure (Hassan 1993b: 563).

Butzer (1976: 83) calculated a population distribution for the Old Kingdom in four geographical regions as follows:-

Nile Valley	1,040,000
Faiyum	9,000
Delta	540,000
Desert	25,000

This estimate of approximately 1.6 million compared with Hassan's (1993a: 165-9) calculations of between 1.2 to 1.42 million produces a feasible maximum and minimum population range. Hassan (1993a, 1993b) and Butzer (1976) used similar methods for determining population density and spread based on key variables related to agricultural ecology (cultivable area and crop yield) and economy. Hassan (1993b: 563) then suggests an average of 200 persons per hectare which is analogous with Mesopotamia. Based on these variables, Hassan (1993b: 563) draws up an average population size in cities, provincial towns (nome capitals), rural centres and villages that can be related to these principal Old Kingdom settlements:

City (Memphis)	36,000+
Provincial towns/Nome capital (Hierakonpolis)	1,400-3,000
Cult Centre/Town (Abydos, Elephantine)	900
Villages	452

As Hassan (1993b: 563) points out, producing population estimates for Egyptian towns is problematic due to the lack of archaeological evidence with which to establish their boundaries. Thus a high differential range of between 1,400 - 3,000 people per town is suggested. Within these populations adults would have made up 40-50%, adult male farmers about 20%, with an average population growth rate of approximately 0.1% per year (Hassan 1993a: 170). In summary, a total Old Kingdom population can only be estimated as ranging between a minimum of 1.2 million and a maximum of 1.6 million.

Overview of Provincial Towns

The most densely-populated regions of Egypt were between Aswan and Qift in Upper

Egypt and from the Faiyum entrance to the head of the Delta in Middle-Lower Egypt (Butzer 1976: 100). After the establishment of the capital in Memphis, the spread of nome capitals (provincial towns) suggests a minimum of 16 in Upper Egypt and 10 in Lower Egypt that antedate the 3rd Dynasty. This rises by the 5th Dynasty to 22 in Upper Egypt and eventually rises to 20 in Lower Egypt by the Ptolemaic Period (Butzer 1976: 100; Hassan 1993b: 552). This imbalance in the spatial organisation of settlements and population densities, particularly in the early Old Kingdom, can be related to the Predynastic antecedents of the Old Kingdom originating in Upper Egypt.

Elephantine Island was already an important provincial settlement in the Predynastic and, due to its pivotal location on Egypt's southern border where it could control the flow of goods from Nubia, became even more strategic in the Old Kingdom. The southernmost small step pyramid dating between the reigns of Huni and Snefru (3rd to 4th Dynasty) is one of seven such pyramids that seem to significantly mark out important provincial towns from Elephantine in Upper Egypt to Seila (Faiyum) in Middle Egypt (Verner 2002: 168-73).

Provincial towns or nome capitals such as Naqada and Hierakonpolis that were major centres in the Predynastic and Early Dynastic seem to have survived Old Kingdom centralisation, with mediation between them and Memphis functioning on more traditional lines via a number of indirect agents and agencies (Butzer 1976: 110). Collection of revenue would have been centrally controlled but in essence these nomes were almost autonomous sociopolitical units. Although as capitals they declined during peaks of centralisation, they appear to have gained in stature during periods of weak government (*op. cit.*, 103-5).

When Memphis became the established capital and administrative centre, it is thought that it might have been the hub of a continuous string of settlements within the Lower Egyptian Memphite nome. The location of these settlements corresponded with the Old Kingdom pyramid fields from Abu Roash in the north to Meidum in the south. Because it is difficult to define the Old Kingdom boundaries of Memphis alone, a total population figure upwards of 36,000 to 50,000 is now suggested for the whole Memphite nome (Jeffreys pers. comm. 2002). The Predynastic settlement of Iunu (modern Heliopolis) also rose in prominence during the 4th Dynasty as the city of the sun god Ra, and fragments of an obelisk dating to the reign of Teti (6th Dynasty) suggest that by this time it had become an important cult centre (Quirke 2001: 81-90).

Identifying Old Kingdom provincial towns in the Faiyum is problematic due to overbuilding since antiquity and into the present day, but clearly the Faiyum played an important role as a cult centre during the Old Kingdom. Although this theme is covered in more detail later, it is pertinent to mention some of the main areas of possible settlement due to their proximity to the quarry at Widan el-Faras. An Old Kingdom cult/regional centre associated with the crocodile god Sobek called Shedet, is thought to refer to the modern city of Medinet el-Faiyum, the name of the town appearing specifically in the 5th Dynasty mortuary temple of Nyuserra and in the Pyramid Texts. Some 4th and 5th Dynasty titles on official's tombs at Meidum such as 'Chief of the Lake of the Crocodile' suggest that the Faiyum was also an administrative centre with its own necropolis (Ćwiek 1997: 18-9).

The presence of a small stepped pyramid at Seila which was built during Snefru's reign on the edge of the Faiyum oasis, 10 km west of Meidum, also strongly supports an early 4th Dynasty presence here (Verner 2002: 168-9). This small monument shows no evidence of being a place of burial and, in line with its southernmost counterpart at Elephantine and others in Middle Egypt, could mark these places as provincial centres and royal residences. Perhaps they acted as reminders of the king's presence and authority in places far from the capital (*op. cit.*, 173). The settlement that Caton-Thompson and Gardner (1934: 99) called Kom IV, located on the northern shore of ancient Lake Moeris 20 km south-east of Widan el-Faras, also appears to have been a sizeable occupation site during the 4th and 5th Dynasties. This settlement is discussed in more detail in following chapters.

Concomitant with the establishment of a national capital would be the need to invest in good transportation networks, particularly riverine, to connect the distant regional nomes in Upper Egypt with its northern capital. This would be essential for the provision of food resources to the high proportion of non-producers living in the capital and to maintain control over the provinces. Hassan (1993b: 556, 565) estimates that each nome would have to send 30-65 boats loaded with grain to the capital each year, if the Memphite population had exceeded local arable yield, and that any other method would have been uneconomical. This stresses the necessity for central government to invest in well-organised transport systems in order to maintain control over this linear arrangement of provincial towns.

Monumental Architecture and Kingship

Gradual development of larger tombs in mastaba form had started by the 1st Dynasty at Abydos in Upper Egypt and ended with the late 2nd Dynasty royal enclosure of King Khasekhem(wy), notable for its enormous quantities of stone vessels, a subject returned to in the following chapter. The scene was clearly set by these early tombs for the funerary monument institutionalizing the concept of kingship with its legitimacy to rule through ceremonial display becoming an increasingly powerful ideological tool (Hoffman 1991: 335). From the 3rd to the 6th Dynasties the locational focus of monumental construction shifted to Lower Egypt along the western desert plateau of the Nile Valley, oscillating between Dashur, Saqqara, Abusir and the Giza Plateau (Goedicke 2000: 398) **(see Fig. 20)**. The shifts in location between these major sites and the concomitant changes in architectural style can be paralleled with the sociopolitical and theocratic developments of this period. The following discussion intends to plot these developments as a reflection of the changing theocratic emphasis of kingship during the Old Kingdom, and notes the significance of particular stones used in these monuments which is the subject of detailed analysis in the following chapter.

3rd Dynasty: Djoser's Step Pyramid

It is clear that the changes in monumental architecture to the use of stone for a funerary monument by the 3rd Dynasty, as opposed to mud-brick, have deep significance associated with political and ideological changes. Djoser's Step Pyramid heralded the most conspicuous display of the ability of the king to consume not only large amounts of raw material but also human energy in the construction of his monument (Trigger 1993: 75). The funerary monument became the symbol of the political institution of kingship, its revolutionary architectural design mirroring the conception of the king as being the single divine ruler under a single creator, the sun that replaced the god Horus and anarchic Seth (Goedicke 2000: 400; Quirke 2001: 83, 120-1). As Kemp (1991: 53) suggests, changes in the royal tomb provide the single most important guide to ancient perceptions of monarchy and also the principal public statement of the nature of kingship.

The pyramid complex evolved around an enclosed arena or 'the field' that provided a formal setting for the appearance of the monarch. A ritual of early kingship was the *Sed*-festival that celebrated the 30 year jubilee of the monarch. He was characterized enacting territorial authority over Upper and Lower Egypt, symbolised by striding between two cairns (Kemp 1991: 59-61). Djoser's Step Pyramid established the main architectural elements of a pyramid complex, most crucially its vertical axis replacing superior overall size, the pyramid form being a geometricized version of the sacred *benben*-stone of Heliopolis that symbolises sunrise and renewal (Kemp 1991: 85-8). This recodification, as Kemp (1991: 103-5) argues, produced an ideal prototype that produced an ideological mask to change '...the Egyptian genius for clothing change in traditional costume.'

4th Dynasty

The prototype or ideal form of architecture for the funerary monument went through varying degrees of metamorphosis by the 4th Dynasty, with some elements becoming more dominant than others. No two pyramid complexes were ever exactly the same, each monarch making subtle variations on a theme, either through adjustments in design or through use of different stones (Lehner 1997). However, the most important adjustment of the dominant architectural elements in the 4th Dynasty was the temple (valley temple and mortuary temple) replacing the enclosed arena as the focus of an offering-cult to the king's spirit, embodied through life-size statues (Kemp 1991: 62). The mortuary temple and its cult would continue as an economic force that formed the central core of the state (Hoffman 1991: 335).

During Snefru's reign the true pyramid form becomes a consistent feature with the 'Red Pyramid' at Dahshur being his third and final successful attempt that in scale is only slightly smaller than Khufu's great pyramid (Fakry 1969: 95-7; Quirke 2001: 121; Verner 2002: 183-9). Snefru is attributed with the inception of two mortuary developments; first, the causeway linking the valley temple with the mortuary temple, and second, the royal cemetery as a delineated area where royal followers and high officials were allowed to build their tombs (Hornung 1999: 209; Goedicke 2000: 402).

The reason for Snefru choosing the site of Dahshur for his last two pyramids is curious, given its distance from Iunu (Heliopolis) which by this time was becoming the focus of the sun cult. Jeffreys (1998: 67) explains this as the king's non-affiliation with the sun god, that these sites (as well as others at Saqqara) are either remote from Iunu in distance and/or in sight. This implies that sight-lines (rather than practical considerations) could have been instrumental in the choice of the location of monuments, and that the locations were political statements in themselves (*op. cit.*, 65, 67-8). Thus, the move north to the Giza Plateau by the mid 4th Dynasty (and the distribution thereafter of pyramids across it) has been connected with the religious and political dominance of the sun god at this time, given that there is a clear line of sight from here to Iunu (Jeffreys 1998: 63, 65; Goedicke 2000: 403).

The relationship between the true pyramid form as a symbol of the sun and the first appearance of the title 'Son of Ra' during the reign of Djedefra is concomitant with the emergence of the king as the son of the sun god (Quirke 2001: 122, 127). However, there is no instance where a pyramid name expressly refers only to the sun and perhaps kingship should be viewed as part of a celestial body or a whole that has many parts (Quirke 2001: 117). As O'Connor (1998: 140, 144) points out, the architectural form of the pyramid complex does not simply represent the cosmos, but also the key cosmic processes in their entirety - cosmogony, cosmic renewal and cosmic governance. The theological precedents of kingship as the sun god (the source of cosmic renewal) replace those of territorial ruler, with the architecture of the funerary monument encapsulating this change by the 4th Dynasty (Kemp 1991: 62; O'Connor 1998: 140; Quirke 2001: 126).

The sociopolitical change initiated by Snefru for a royal cemetery reached extensive proportions during the reign of Khufu, then steadily declined under Menkaura and perhaps indicates the changing role of the king *vis-á-vis* society (Goedicke 2000: 403). The perceived conformity of the 4th Dynasty funerary monuments at Giza was briefly interrupted between the reigns of Khufu and Khafra when king Djedefra moved his burial place 8 km north of the Giza Plateau to Abu Roash. There has been much speculation about why this happened, including a conflict over succession which is now widely invalidated (Fakry 1969: 127; Lehner 1997: 120-1). Perhaps the reasons for the move to Abu Roash were astronomical/geographical (its elevation above the Giza plateau gives a commanding view) as well as religious, given that he was the first king to take the title 'Son of Ra' thus bringing the sun-cult centre of Iunu that much closer to his funerary monument (Lehner 1997: 120; Goedicke 2000: 405). There is also a hint of retrospection to Djoser's monument, given that the burial chamber reverts to being subterranean (Lehner 1997: 120).

King Djedefra's pyramid's poor state of preservation is mainly due to it being used as a granite quarry during the Roman period, and vast areas north of the monument are littered with fragments (Fakry 1969: 129; Lehner 1997: 120-1; Valloggia 2001). It is worth mentioning that there is no indication of basalt being used in this monument, as presumably fragments of it would also occur. This is surprising given that a basalt quarry exploited during antiquity is thought to be located at Abu Roash, making it an ideal local source, and given that his father Khufu had used basalt so extensively in his mortuary temple (Aston 1994: 19). It might suggest two things; first, that Abu Roash basalt was never exploited in the Old Kingdom as Aston (*op. cit.*) suggests, or second, that the Widan el-Faras basalt used for the floor of Khufu's mortuary temple was used because it had particular religious or symbolic associations which were not carried on by his son. This subject will be returned to in Chapter 4.

There was a second break in funerary tradition at the end of the 4th Dynasty by Shepseskaf, who not only left the Giza Plateau and returned to south Saqqara, but whose monument essentially changed back to the mastaba form (Fakry 1969: 152; Lehner

1997: 139; Goedicke 2000: 405). It has been remarked that its form, neither pyramid nor true mastaba, might resemble more the tombs of the 1st and 2nd Dynasties (Fakry *op. cit.*). This could imply a nullification of the religious roles of kingship adopted by the kings buried on the Giza Plateau and perhaps a return to the theology of the Early Dynastic period where the funerary monument is not the vehicle to move into another realm after death, but is the continuation after death of the residence occupied during life (Goedicke 2000: 405). It is impossible to know how significant a reflection of societal changes this retrospective funerary monument might attest ; however, it certainly marks the end of an epoch in monumental construction that was never to be repeated.

5th Dynasty

The changes in monumental architecture in the 5th Dynasty are extremely interesting, the pyramid complex still retaining all its main elements, although on a reduced scale at Abusir, but with the addition of a separate sun-temple at nearby Abu Ghurab. The tradition of a sun-temple being in close proximity to the mortuary complex was begun by Userkaf, and has been the subject of speculation as to what message this conveys about the relationship between the king and the sun-god. One suggestion is that this was the physical separation of the religious aspect from the king's expectations for the afterlife, with the sun-temple marking the setting sun rather than the funerary monument itself (Goedicke 2000: 406). Another more practical suggestion is that the sun-temples at Abu Ghurab simply re-establish the sight-line to the centre of the solar cult at Iunu which was obscured from Abusir (Jeffreys 1998: 63, 65; Quirke 2001: 127).

The best-preserved sun-temple is that of Nyuserra, which consists of a valley temple linked by a wide causeway to an upper temple pedestal of quartzite and granite supporting a granite obelisk (Lehner 1997: 150; Malek 2000: 108-109; Quirke 2001: 127). This temple, and that of Userkaf, went through four stages of transformation during the 5th Dynasty, from its first development, ostensibly using mud-brick, to its final stage when stone was used (Lehner 1997: 151). The renewal of the sun-temples during the reign of Nyuserra might be connected with the commemoration of the *Sed* festival, given that some of the earliest scenes of this festival are depicted in fine relief carvings here (Lehner 1997: 151). Alternatively, the use of stone ensured the survival of the monument and its firm re-establishment of the sun cult (*op. cit.*). The sun-temples clearly played an important part in maintaining the king's cult as reflected in the Abusir Papyri accounts of deliveries of bread, beer and meat by canal twice daily, suggesting that the temple was a sacred filter for the goods that sustained the pyramid (*op. cit.*).

The establishment of the pyramid field at Abusir has not been satisfactorily explained and it is probable that there were many practical reasons to do with lack of space at Giza-Saqqara for the establishment of a new dynastic necropolis (Krejčí 2000: 473; Verner 2002: 266). However, the ground was generally unsuitable for monumental construction, given that it consists mainly of *tafl* and gravel layers. There is the possibility that ease of access to building stone could have been an important factor, given that the nearby limestone quarry in the area of 'Lion's Hill' was a readily-available source of masonry (Krejčí 2000: 473).

Outwardly, the architectural components of the pyramid complex remained more or less intact into the later 5th Dynasty, but without the additional sun-temple after the reign of Menkauhor. However, there was an interesting episode in this continuity associated with Neferirkare's pyramid, the largest in the Abusir necropolis. Recent excavations have shown that its first intended form was that of a six-stepped pyramid similar to that of king Djoser (Verner 1991: 418; 2002: 297). Later it was converted into a true pyramid, although it is uncertain if this happened before or after Neferirkare's death. The significance of this attempt to break away from the true pyramid form has been suggested as Neferirkare wanting to detach himself from the traditions of the 4th Dynasty, given that he is deemed the founder of a new dynasty in the Royal Turin Canon. Perhaps he considered the step pyramid a better device to worship the sun, but also wanted to provoke recognition of a new era symbolically via his funerary monument (*op. cit.*).

Another significant change that took place in the later 5th Dynasty was within the burial chamber itself, started by Unas at Saqqara with the 'Pyramid Texts'. These texts represent the earliest longer religious writing involving deities such as Atum, Osiris, Re and Horus (O'Connor 1998: 140). Walls of burial chambers and adjacent chambers from this moment onwards to the end of the Old Kingdom carried hieroglyphic inscriptions of ritual utterances spoken for or by the ruler which enabled him to achieve rebirth that could be visualized through cosmogony (O'Connor 1998: 140; Quirke 2001: 128-9).

Although both 5th and 6th Dynasty pyramid complexes still retained all the elements of pyramid complexes, the king's actual pyramid structure was drastically reduced in size, the megalithic core of the 4th Dynasty pyramids having been replaced with rubble and gravel (Trigger *et al.* 1983: 87). Even though the pyramid form was re-established in the Middle Kingdom (and even into the 1st millennium BC Kushite period at Nuri and Meroe in the Sudan), these later forms did not come close to the megalithic proportions of the 4th Dynasty complexes.

The scaling down of megalithic stone use that had started even in the 4th Dynasty with Menkaura and continued into the 5th Dynasty, could have been a purely rational response, if the same result could be achieved by more economic means (Trigger *et al.* 1983: 89). Moreover, greater demands on resources must have been incurred by the 5th Dynasty given the additional construction of sun-temples and thus some rationalisation would have to occur. However, the range of stones used, particularly in Sahure's pyramid complex, does not attest to a reduction of the 5th Dynasty kings' influence or power over resource acquisition. In fact the opposite seems to be the case, with 5th Dynasty rulers expanding their geographical range of raw material acquisition even outside of Nubia (Stevenson Smith 1958: 75; Malek 2000: 111; Verner 2002: 267).

6th Dynasty

The 6th Dynasty pyramid complexes continue the trend of location set by the last king of the 5th Dynasty and are clustered at south Saqqara (Lehner 1997; Goedicke 2000: 409). The reason for the abandonment of the Abusir pyramid field could simply be the fact that the plateau was fully utilised and unsuitable for further building (Krejčí 2000: 483). Alternatively, their closeness to the pyramid of Djedkare Izezi or the shift in the urban nucleus east and south during the reign of Pepi I might have taken precedence over the need for a sight-line to Iunu itself (Jeffreys 1998: 69).

The decline of the Old Kingdom has often been mirrored in the perceived dramatic scaling down of the pyramid complex by the 6th Dynasty. This scaling down has been used as the gauge to measure government decentralization, reduced elite wealth and equalization amongst officials. This situation is reflected in relatively wealthy rock-cut tombs in Middle and Upper Egypt (Butzer 1997: 261). Yet it has to be carefully considered whether sociopolitical changes and gradual decentralisation should be equated with the size of monuments. Although Teti has the Horus name 'He who reconciled both lands', which has been suggested as linked to the changes referred to above (Verner 2002: 340), the funerary monument does not explicitly reflect this because it roughly follows the same prototype of the late 5th Dynasty kings (Lehner 1997: 156).

The 6th Dynasty pyramid complexes of Teti, Pepi I, Merenre and Pepi II basically have the same architectural elements with slight additions and modifications, most significantly the substantial pyramids for the queens (Verner 2002: 349-51). This trend of pyramid construction for consorts exceeded those of any past kings during the reign of Pepi I, given that six monuments to queens were constructed around his pyramid (Verner 2002: 355). Other significant aspects of Pepi I's funerary monument are the expansion of the 'Pyramid Texts' from the burial chamber into the access corridors and the fact that the inscriptions were altered from large to smaller types of sign (Verner 2002: 354-5).

The final large royal pyramid complex of the Old Kingdom, that of Pepi II, became the inspiration for the architects of the Middle Kingdom (Verner 2002: 341). The complex also had three pyramids for queens and, due to the long reign of this last ruler, (ranging between 64 and 94 years) had architectural elements associated with the *Sed*-festival (Lehner 1997: 161). This was in the form of a 'girdle' 6.5 m wide, added after the pyramid was built, although it has also been suggested that it was constructed for practical reasons to support the lowest level of the outer casing (Verner 2002: 363). The design and relief decoration in the mortuary temple is interestingly retrospective reminiscent of Sahure's 5th Dynasty temple with a copied scene depicting the execution of a Libyan chief, accompanied by his consort and his son (*op.cit.*, 364). The texts of provincial governor Weni and his trips into Nubia during Pepi II's reign indicate that foreign expeditions for material resources ordered by the king still occurred, albeit with more friction, and in spite of the gradual decentralisation that was taking place in response to the growing autonomy of provincial nobility (*op. cit.*).

Decline of the Old Kingdom

The concept of a principal cause bringing about the increasing fragmentation of centralised government during the 6th Dynasty still remains a problematic issue in ancient Egyptian history (Grimal 1992: 137). Economic decline triggered by climatic change to increasing aridity and failure of the Nile flood has, however, produced some strong arguments (Bell 1971; Butzer 1984; Hassan 1997). The evidence for low Nile floods occurring around *c.* 2200 BC (during the reign of Pepi II) and the concomitant decline in the levels of Lake Moeris in the Faiyum have been highlighted in the previous chapter. The famous inscription of the 9th-10th Dynasty nomarch Ankhtifi (*c.* 2135-1986 BC) has often been cited in reference to climatic disaster due to its macabre reference to cannibalism as a result of famine (Seidlmayer 2000: 129-30). This is probably an over-blown statement combined with the Old Kingdom tradition of moral integrity. Although written sources need to be treated with caution, there are similar textual references in less stately contexts such as an employee of a priest who states (*op. cit.*):

> 'I stood in the doorway of his excellency the overseer of priests Djefy handing out grain to (the inhabitants of) this entire town to support it in the painful years of famine.'

The coincidence of low Nile floods and references to famine occurring alongside a period of political decentralisation of authority could suggest a connection, although Kanawati (1977: 70-1) argues for economic decline having already started by the 5th Dynasty. This he suggests was the response to increasing demands being made on the central economy for royal and officials' tomb construction and the maintenance of funerary cults. A weakened government and economy made it vulnerable to outside pressures, such as the need for buffering the effects of climate change (*op. cit.*; Müller-Wollermann 1986).

Discussing all these arguments in detail goes beyond the scope of this work. There is always the danger of taking an environmentally deterministic argument too far; perhaps environmental change simply accelerated, or was a catalyst to, gradual changes already in progress. Butzer (1997: 258) takes the view that low Nile floods compounded sociopolitical turmoil rather than causing it. The processes of decentralization became magnified during the 6th Dynasty reign of Pepi I due to the dynastic alliance he formed with a prominent family in Upper Egypt, where provincial government was already becoming consolidated (Baer 1960: 301-2; Butzer 1997: 258). Then, after the long reign of Pepi II, the Egyptian state seems to have disintegrated into regional seats of power (Trigger *et al.* 1983: 177; Butzer 1997: 258).

Consideration should however be given to whether the concept of a highly-centralised and rigid societal order was ever truly valid in the first place. The theoretical implications of this are dealt with in Chapter 5, but it is important to mention new approaches to Old Kingdom decentralization that vie against some of the more traditional views. Cruz-Uribe (1994: 49) attempts to formulate a more flexible model for societal structure in the Old Kingdom, based on the ebb and flow of spheres of influence, to explain the gradual political and ideological undermining of a centralised power base. Although by the 6th Dynasty the king is still central to the societal structure and has ultimate authority, it is by the intermarrying of nomarchial families and the increasing influence of the vizier that the spheres of this influence overlap, diminishing the power of the king (Müller-Wollermann 1986; Cruz-Uribe 1994: 49).

This idea might be reflected in the inscriptions of Ankhtifi, when in the only reference made to the king there is the implication that he still holds a sacred role in society as intermediary between nature and society: 'May Horus grant a (good) Nile flood to his son Neferkara.' (Seidlmayer 2000: 131). The archaeological and epigraphic data further suggest a thriving culture among the lower levels of society during the First Intermediate Period, this being concomitant with the social development of the provincial towns in Upper Egypt. This tends to suggest the re-focusing of centres of activity in the continuing dynamic of society, rather than a collapse (Seidlmayer 2000: 120).

Although the effects of these sociopolitical changes on royal funerary architecture become noticeable during the 6th Dynasty through more modest structures, the changes are even more obvious when the burials of officials are considered. Significantly, the funerary monument of Pepi II is surrounded by the impoverished burials of his courtiers, contrasting starkly with burials of the provincial aristocracy in rock-cut tombs or mastabas in Middle and Upper Egypt (particularly at Qau). The contrast is indicative of wealth and resources being channelled away from the capital (Trigger *et al.* 1983:112; Müller-Wollermann 1986; Hassan 1997: 13; Butzer 1997: 360-1; Malek 2000: 116-7). However, this idea needs careful consideration because rock-cut tombs and mastabas would have required less investment in human resources and raw materials than pyramids.

Consumption of objects increases in provincial cemeteries and their nature changes from items made specifically for funerary use to those used in everyday life, such as cosmetic stone vessels, gemstones and gold (Seidlmayer 2000: 122). Concurrently, poorer burials started to contain objects specifically created for funerary use and although these were mainly poorly executed copies of Old Kingdom prototypes, this does indicate that non-utilitarian craft production could be supported at a local level (*op. cit.*, 124). This might indicate a shift from large centralized monumental construction projects to more projects on a smaller and more provincial level.

Egypt's relations outside of its borders in the north and south appear to have ceased by the late 6th Dynasty, with no evidence of the links established with Syria-Palestine or Nubia being maintained (Grimal 1992: 139). Exploitation of mines in the Sinai seems to have ended and there is no inscriptional or archaeological evidence to suggest exploitation of Chephren Gneisses after the 5th Dynasty. The rise in Nubian C-group culture in Lower Nubia at this point could also be a significant factor, but whether this was a cause or a result of the apparent abandonment of Egyptian settlement in Nubia after the 5th Dynasty, is difficult to determine (Trigger *et al.* 1983: 126).

Summary

There is a clear connection between the consolidation of a centralised Egyptian state and the construction of the first stone funerary monument by king Djoser in the 3^{rd} Dynasty. The volume and range of stone sources exploited for monumental architecture and funerary objects, inside and outside of Egypt's territorial boundaries, significantly increased as a result of this metamorphosis in the kings' funerary monuments. As the momentum of theocratic and ideological transformation manifest through the royal funerary monument took hold, there is an implication that remote stone sources came under the control of the central authority. The form that this control might have taken is the subject of a more detailed discussion in Chapter 7.

The pursuit of larger pyramid size reached its peak in the 4^{th} Dynasty and, although by the later dynasties pyramids had become more modest structures, they still required considerable investments in labour and resources, particularly during the 5^{th} Dynasty when the range of raw material sources exploited was at least consistent with that of the 4^{th} Dynasty. The urge for perceived continuity and order, as expressed through monumental construction, has been interpreted as an important political and ideological concept. Periods of architectural retrospection and location shifts of the funerary monument have also been interpreted as a reflection of these ideological concepts, along with the king's need to reinforce legitimacy to rule through succession and via the re-enactment of rituals and alliances with particular gods.

The peak of stone acquisition particularly in Lower Nubia generally corresponds with the development of Elephantine Island as a pivotal staging post for trade movements into Egypt from Nubia. The flow of goods through Nubia seems to have been effected without interference at the height of the Old Kingdom, but by the late 6^{th} Dynasty there appears to have been a change to presumably less co-operative conditions, as indicated by their more sporadic nature and the military aspect that has been interpreted from the textual sources. This is coincidently when exploitation at Chephren's Quarry ceases, the late 5th Dynasty marking the end of the Old Kingdom presence here and at Widan el-Faras, although quarries in the Nile Valley continued to be exploited into the late 6th Dynasty.

Producing firm population estimates for Old Kingdom Egypt and the dispersal of these people throughout the Egyptian state is problematic due to the minimal amount of settlement evidence. However, it seems reasonably clear that labour forces of tens of thousands simultaneously constructing pyramids, quarrying and transporting stone over 1,000 km distances is unlikely, given the relatively small population of Egypt at this time of probably around 1.5 million. It would seem more likely that small numbers were highly organised and perhaps loosely structured around kinship ties.

The end of large-scale monument building by the end of the 6th Dynasty and the cessation of exploitation of stone outside the Nile Valley, such as at Widan el-Faras and Chephren's Quarry, is significant. The abandonment of remote stone sources could be due to one or several of the following events:- low Nile floods making stone transportation impossible; the decline in central authority that masterminded these projects; changes in fashion allied to theocracy. The effects of these on stone procurement and the use of particular stones form the subject of the next chapter.

Chapter 4

Consumption of Stone for Monumental Architecture and Stone Vessels: 3rd to 6th Dynasties

Introduction

The quest for hard stones for monumental construction and stone objects increasingly went beyond Egypt's territorial boundaries in the early Old Kingdom, along with dramatic increases in the volumes extracted. However, the reasons why some stones were preferred over others, be this aesthetic value, theological changes, fashion, remote source, ease of removal and working, are still not fully understood. Part of the reason is that past studies of the radical changes in monumental architecture in the Old Kingdom and their subsequent implications have tended to focus on the changes in the monuments' architectural elements, rather than on the raw materials themselves.

This chapter therefore looks at the consumption of hard stone for monumental construction and stone objects in royal contexts and observes the changes in stone use with the aim of determining with what factors these changes might be associated. These observations will focus particularly on the stones sourced to Chephren's Quarry and Widan el-Faras and match the periods of exploitation of these sources against the use of the stone. From this analysis it might be possible to determine not only whether the consumption of the stone, *vis-à-vis* exploitation of the resource, is contemporary, but also the reasons behind the commencement and cessation of exploitation of remote source stones. It might also be possible to determine whether stone preferences were driven by purely theological reasons, or are associated with the display of power by the ruler to mobilise labour to procure remote source stone.

Stone Consumption Analysis

Elite use of stone: an overview

Stone use in the Old Kingdom is known almost exclusively within royal and elite contexts. Given the vast quantities and varieties of stones used, the limited Old Kingdom textual record provides few insights into their symbolic meaning (Baines 2000: 29). Stone vessels were one of the commonest funerary objects and may have originally contained food, oils and other liquids requisite in the afterlife. They can be grouped roughly into three categories: cosmetic and ointment vases with thick walls, imitations of terracotta utilitarian vessels and miniature vases (El-Khouli 1978: viii, 797; Arnold and Pischikov 1999: 124). During the period being studied almost all occur in royal and elite funerary contexts as they had an important function in temple rituals, many being found in burial chambers, mortuary and valley temple storerooms and often left as votives in sanctuaries and in foundation deposits.

Stone use in monumental construction does not dominate pyramid construction until the 3rd Dynasty. Djoser's Step Pyramid is the oldest-known entirely stone-built funerary monument, its architectural elements being in cut limestone rather than mudbrick (Firth and Quibell 1935; Lehner 1997: 84-93; Verner 2002: 109). Limestone was always the principal stone used for monumental construction, probably because its sources were close to the pyramid fields, as discussed later in this chapter. Arguments for the stone, particularly due to its use in statuary, having any special value or symbolism is not specifically alluded to in the textual sources (Grzymski 1999: 53; Baines 2000: 34).

The limited epigraphic sources that relate to specific stones and their use come from the tomb autobiographies of officials Debhen (4th Dynasty), Nenkhsekhmet (5th Dynasty) and Weni (6th Dynasty) (Breasted 1906: 94-149; Lichtheim 1973). The tomb inscriptions of Debhen mention him procuring Turah limestone for the pyramid temple and false door of Menkaura's pyramid complex, while Nenkhsekhmet mentions the king giving him a gift of Turah limestone for two false doors, saying they were painted blue.

The Weni autobiographical texts are the most enlightening in the context of quarry expeditions during the reign of 6th Dynasty Merenra and are referred to later in subsequent chapters.

Not until the New Kingdom does a more reliable textual source emerge that clearly relates to the importance of stone source itself. The first known geological map 'The Turin Papyrus' dating to the reign of Ramesses IV (1151-1145 BC) is the most famous and illustrates the topography and geology of the Wadi Hammamat (Harrell and Brown 1992). The map is believed to be connected with quarrying expeditions to acquire 'bekhen-stone' (*bhn*) which is generally identified as a greyish-green chloritic ('greywacke') sandstone and siltstone that had been highly prized for royal monuments since the Old Kingdom (Lucas 1962: 420; Harrell and Brown 1992: 104).

Utilitarian use of stone

Most hard stones were used in both utilitarian contexts, for tools and in elite contexts, for high status objects. Quartzite (silicified sandstone) was used for borers and for 'rubbers' for the process of sanding-down timber, as depicted in tomb-paintings (Aston *et al.* 2000: 54; Hikade 2000: 15). Basalt was also used for tools, mainly pounding tools, many of which are found at quarry sites such as Aswan and Chephren's Quarry (see Chapters 2 and 6). Chephren Gneiss was even more highly prized as a tool, given the stone's hardness and resistence to fracturing, and has been found in contexts distant from its source, such as Umm es-Sawan. A number of non-local stones were found here as worked and unworked blocks, including Chephren Gneiss, basalt and quartzite, in an area of the quarry that appears to have been a tool-making factory (see Chapter 2; Caton-Thompson and Gardner 1934: 104).

The problem of stone mis-classification and a fragmentary archaeological record

Studies of stone use compiled from excavation reports of royal necropoli can be compromised due to the confusion surrounding stone classification and nomenclature, such as classifying travertine that consists largely of calcite as 'Egyptian alabaster' or 'alabaster' (Spencer 1980: 17; Aston 1994: 169; Aston *et al.* 2000: 59). Determining the ancient use of basalt is also complicated by Egyptologists confusing black greywacke and black Aswan granodiorite for the stone (Aston *et al.* 2000: 24). Equal confusion also revolves around Chephren Gneisses that are frequently mis-classified as 'diorite gneiss', 'Chephren Diorite' or just 'diorite'.

In the 1930s after Engelbach and Murray's expedition to Chephren's Quarry, Little (1933: 78) examined samples of the stone and although he mentions anorthosites and altered gabbros, he suggests that 'diorite gneiss' is the more correct term. Even though Little's analysis put an emphasis on the difference between this metamorphic rock and igneous 'diorite', the latter classification was still ubiquitously used and it is common to find the Chephren Gneiss statue of Khafre (Chephren) referred to by some present writers as 'diorite'.[1] This is despite Harrell and Brown's (1994: 52-3) most recent detailed petrological analysis of the stone that gives the classifications 'anorthosite gneiss' and 'gabbro gneiss' to the speckled and banded varieties respectively, as described in Chapter 2.

Stone mis-classification has been to the detriment of research into both hard and soft stone use and consequently the exploitation of the stones' source. In relation to Chephren Gneiss, the archaeological significance of its highly characteristic nature and its provenance to just one remote source, at Chephren's Quarry, has been overlooked until recently.

Another problem with a study of stone use in the Old Kingdom is that most of the pyramid complexes were plundered for stone, some probably even during the Old Kingdom and certainly from the First Intermediate Period. Djedefre's 4th Dynasty pyramid complex at Abu Roash suffered the most and even in the 19th century AD up to 300 camel-loads a day of stone were taken away (Verner 2002: 221-2). Stone was

[1] See Lehner (1997: 126).

also frequently re-used and blocks from Khufu's mortuary temple appear in Amenemhet I's Middle Kingdom pyramid at Lisht and latterly to build the step medieval gateway *bab el-futuh* in Cairo (Verner 2002: 206). Statuary and stone vessels have suffered a similar fate, as Petrie (1883: 135-7) describes finding fragments of 'diorite' statues (these were fragments of Chephren Gneiss statues) in rubbish pits surrounding Khufu's pyramid complex that appeared to have been used as tools. This might explain why only 6 out of a possible 24 Chephren Gneiss life-size statues of Khafre (Chephren) were ever recovered from the valley temple (Reisner 1931; 1942; Lehner 1997: 126).

Loss of context, particularly with stone vessels, due to pilfering of tombs and stone re-use is clearly problematic. For example, stone vessels inscribed with the names of Pepi I and Pepi II have been found in diverse elite contexts from the Levant to Nubia. An interesting cache of stone vessels inscribed with the names of Pepi I and Pepi II was found amongst an eclectic range of prestige objects in the chapel of the 2nd millennium BC Eastern Deffufa at Kerma. This suggests that these vessels were either plundered from Old Kingdom tombs or were the result of gift exchange during the Second Intermediate Period (Lacovara 1991: 118). Chephren Gneiss vessels with inscriptions relating to the *Sed*-festival of Pepi I and Pepi II were also found in Early and Middle Bronze Age royal necropoli at Ebla and Byblos and in elite contexts of the Late Bronze Age Aegean (Montet 1928: 37, pl. xxxix.45; Warren 1969; Scandone-Matthiaea 1988; Redford 1992).

Another problem that occurs specifically with Chephren Gneiss vessels and continues throughout their occurrence in the Old Kingdom is the use of names, although in some cases not explicit, of earlier kings and even officials on the vessels. For example, several Chephren Gneiss bowls found in Djoser's Step Pyramid had the name of a private person 'Hpn-hpn' engraved (Firth and Quidbell 1935: 132). Two explanations have been given for such an occurrence: first, that officials gave stone vessels as gifts to the king for his *Sed*-festival, or second, that the vessels were simply gifts for the king's burial (Arnold and Pischikova 1999: 125). This trend becomes particularly notable during the 4th and 5th Dynasties and is a curious aspect of the Menkaura stone vessel assemblage, in which none of the vessels are inscribed with his name. The few Chephren Gneiss vessels that are inscribed have the names of 2nd Dynasty Khasekemwy and 4th Dynasty Snefru (Reisner 1931: 103, 179).

Therefore care has to be taken when trying to draw conclusions and make inferences about stone use over time when the archaeological record is both fragmented and in some cases incorrectly recorded. Stone vessels in particular are not reliable chronological indicators in a burial since deposition may not be contemporary with extraction and manufacture. However, use of stone for monumental construction and correlating stone extraction with period of use is more reliable, particularly with basalt because of its use on mainly mortuary temple floors which have, as opposed to other hard stones, survived plundering.

Sources of Data

Stone Vessels

With the above problems in mind, the study of stone use is covered first with an analysis of the stone vessel corpus housed in the Petrie Museum of Egyptian Archaeology (UCL) in order to establish that excavation reports, particularly of the early 20th century excavators such as Petrie, Borchardt, Reisner, Firth and Quibell, used the classification 'diorite' for Chephren Gneiss. Petrie's stone classifications, such as 'diorite' for Chephren Gneiss and 'alabaster' for travertine, were the nomenclatures also adopted by his peers and therefore this information can help identify Chephren Gneiss from other reports. The author has made a proportional analysis of Chephren Gneiss use for stone vessels against the use of other stones for this class of object in order to determine whether fashion trends in hard stone can be identified and what these might be associated with (see Chapter 1).

The methodology for the study combined information from Petrie's volume *Funeral Furniture with Stone and Metal Vases* (1937) with a physical analysis to identify and count the anorthosite gneiss vessels within the collection (see Chapter 1). Due to the fragmentary archaeological record of this type of object, a comparative framework to analyse the collection against seemed the practical solution to increase the sample size. This comparative method also accounted for the 4th and 5th Dynasties that are under-represented in the Petrie collection, partly due to Reisner and Borchardt's domination of elite excavations for these periods (Arnold and Pischikova 1999). Therefore Reisner's (1931) study of stone vessels from his own excavations at Giza (4th Dynasty Menkaura) and those of Borchardt at Abusir (5th Dynasty Sahure) have been used to correct this imbalance.

The other comparative sources come from Lucas (1930) and El-Khouli (1978), who have each made an analysis of stone vessel forms and materials. Lucas (1930: 200) examined stone vessels from a range of descriptions in excavation reports, including Petrie (1883, 1900, 1901a, 1907, 1920), Petrie and Quibell (1896), Firth and Quibell (1935), Brunton and Caton-Thompson (1928) and concentrated his study within the Predynastic to Early Dynastic period. El-Khouli's (1978) work covered the Predynastic to 3rd Dynasty from a dataset of provenanced stone vessels collated from publications and studies of vessel collections, particularly from the Egyptian Museum in Cairo. For the purposes of this study only the 3rd Dynasty data will be used. All these sources are further supplemented with published material relating to other aspects of stone vessel use in the Old Kingdom, particularly from Aston's (1994) study of stone vessels and forms.

The Petrie Stone Vessel Corpus: Petrie Museum of Egyptian Archaeology, University College London

The objectives of this study are as follows:-

1. To identify and count Chephren Gneiss vessels in the collection dated to the period between the Predynastic and the Middle Kingdom.
2. To produce a proportional estimate of the number of Chephren Gneiss vessels in relation to other hard and soft stones used for vessels, with the aim of detecting trends in hard stone use over time.

3. To ascertain from the physical analysis of the collection against Petrie's (1937) volume, errors in stone classification.

The Petrie stone vessel corpus in the 1937 publication comprises a total of 997 vessels from the Predynastic to 1st century AD. These have been derived mostly from Petrie's own excavations and to a lesser extent from those of Garstang, Quibell and Reisner. They were collected from royal and elite burial contexts such as Abydos, Ballas, Dendereh, Disopolis Parva, Fayum, Arabah, Giza, Rifeh, Mahasna, Bet Khallaf, Meidum, Memphis, Tarkhan and Kerma. The corpus also includes vessels bought by Petrie and donations made to it. The analysis of the corpus concentrated on provenanced and dated objects between the Predynastic to Middle Kingdom which results in a total sample of 677 vessels.[2] The reason for extending the study into the Middle Kingdom is to ascertain whether the use of Chephren Gneiss occurs in this period since there is evidence of a 12th Dynasty presence at Chephren's Quarry (see Chapters 2, 6 and 8).

The analysis appears in the chronological graphs (**Figs. 24a, 24b, 24c**) that give the percentages of each material type relative to the others per period. Given the enormous range of stones in the collection and for reasons of clarity, only the stones that are the specific focus of the thesis (basalt and Chephren Gneiss) are individually shown, as is travertine (given its ubiquitous occurrence). The other stones are grouped into 'miscellaneous hard stones' (red) and 'miscellaneous soft stones' (green).[3] The complete listing of the collection (**Appendix B 2**) is colour-coded so that those stones grouped under either hard or soft stones are easily identified. The comparative data from the sources mentioned above has been organised in a similar manner; spot tests have shown that Chephren Gneiss has usually been classified as 'diorite'. Although three types of igneous 'diorite' or 'hornblende diorite' were also used for stone vessels,

[2] The fragments of 42 Chephren Gneiss vessels are part of the corpus in the Petrie Museum, however, these are of unknown date or provenance and were not included in the publication (Petrie 1937). Therefore, these objects have not been included in the analysis.

[3] Refer to Appendix B for definitions of hard and soft stones.

particularly from the Predynastic to Early Dynastic; these can be distinguished from Chephren Gneiss in published sources not only by the visual quality of the stone but by the specific vessel form. These other 'diorite' vessel forms are usually ovoid with tubular handles, a form rarely used for Chephren Gneiss (Aston 1994: 13-5, 121, pl. 1a-c).

Monumental Construction and Other Elite Funerary Objects

The data for monumental stone use and for other stone objects (apart from stone vessels) found in royal pyramid complexes comes from a synthesis of published sources from Petrie's (1883) volume *'The Pyramids and Temples of Gizeh',* to Verner's (2002) volume '*The Pyramids*'. Additional information has also been acquired by the author during observations made at the pyramid fields of Giza, Saqqara and Abusir in 2001 and 2002 (see Chapter 1). The analysis of this data has been tabulated (**Appendix B 3**) with a concise overview table (**Fig. 21**) of hard stone consumption for monumental construction. A concise overview of stone use for vessels, statuary and other funerary objects between the 3rd and 6th Dynasty is also tabulated (**Appendix B 4**) with a concise overview (**Figs. 22, 22a**).

It is outside the scope of this study to estimate absolute volumes of consumption of all the hard stones used in monumental construction, apart from Widan el-Faras basalt. The estimates of volume that are compiled in the table (**Appendix B 5; see Figs. 23a, 23b**) can be correlated against the actual basalt quarries at Widan el-Faras (**see Fig. 23c**) (see Chapter 2 and 6). Unfortunately it is not possible to produce similar estimates for Chephren Gneiss because of the fragmentary data due to re-use and loss of context. Furthermore, the nature of the stone deposits as widely scattered outcrops and extractions concealed beneath aeolian sand presents problems in estimating the volumes extracted, as explained in more detail in Chapters 2 and 6.

Stone Use from the Predynastic to 6th Dynasty

Chephren Gneiss

Symbolic and Elite Association

The study of the Petrie stone vessel corpus confirmed that of the 16 vessels classified as 'diorite', 12 were Chephren Gneiss, 2 were hornblende diorite, Type C (see Aston 1994: Pl. 1c.) and 2 were missing from the corpus. One vessel listed as 'hornblende schist' was Chephren Gneiss, making a total of 13 Chephren Gneiss vessels in the corpus (**see Appendix B 2, Figs. 24a, 24b**). The comparative data analysed and collated from published sources of stone vessels found in Early Dynastic to 6th Dynasty elite contexts produced a similar result. Of the vessels classified as 'diorite' approximately 90% were of Chephren Gneiss. Of the 10% that were not Chephren Gneiss vessels, these were *generally* igneous 'hornblende diorite'. However, where photographs or descriptions were inadequate to determine this, 10% has been deducted from the total 'diorite' figure to allow for this probable margin of error (**Fig. 24c**).

Chephren Gneiss is almost always found in the exclusive realm of royalty for statuary and statuettes, but for vessels it can occur in both royal and elite contexts. Grzymski remarks (1999: 53) that the blue radiance of the stone could signify a celestial connection and association with the cult of Horus. This association could possibly be reinforced by the stone being used in such spectacular fashion in the Khafre statues where the king's head is protected by the god Horus (CG14, **Pl. 18**). However, determining the symbolic and elite associations of this stone remains pure conjecture because of the almost non-existent inscriptional record.

However, Emery's excavations of 1st Dynasty mastaba tombs at Saqqara recorded the unusual occurrence of Chephren Gneiss in the burial of a high-ranking official named Ankh-Ka where Chephren Gneiss vessels made up 58% of the hard stone vessel corpus (Emery 1949: 71). How disturbed the context in which the vessels were found in the subterranean rooms is not clear from Emery's description, although he mentions fire having deterred plunderers from some of the tombs (Emery 1949: 17). Hence care needs to be taken with this data; however, the official had a title that has been translated as 'Governor of the district of (the estate) of promoting the mountain of Horus, (or Horus made foremost of the mountain)'. This was the only burial that contained Chephren Gneiss and invites further speculation on this official's connection with procurement of the stone from Chephren's Quarry, and its connection to the god Horus.

Blue is suggested as being a colour of symbolic importance although there was no basic colour term for it (Grzymski 1999: 53; Baines 2000: 33). Hence, in combination with the semi-luminous properties of Chephren Gneiss, the reason that it was so highly valued becomes understandable from a purely aesthetic/visual point of view. The Chephren Gneiss life-size statues of Khafre (Chephren) project this luminosity and the 'radiant' facial expression is often referred to as being attributed to the properties of the stone (Grzymski 1999: 53). Although as Grzymski (1999: 53) further points out, many statues were painted (in the case of limestone either fully or partially), thus obscuring the material's possible symbolic and religious content. It could be that parts of the Khafre statue might also have been painted, as Petrie (1883: 136-7) records the presence of 'diorite' (Chephren Gneiss) and 'alabaster' (travertine) fragments all baring traces of colour, white on the former, black and green on the latter. These fragments were found in workshops associated with Khufu's pyramid. Therefore, some care should be taken in attributing too much significance to the natural colour of the stone.

Chephren Gneiss has been suggested as being *mntt* stone, based on a Middle Kingdom stele dating to the reign of Amenemhet II found at Stele Ridge (Chephren's Quarry) that states: 'for the purpose of bringing *mntt* stone' (Lucas 1962: 410; Aufrère 1991; Aston 1994: 63). However, as Aston (1994: 33) points out, two Middle Kingdom statuettes dedicated to kings of the 5th Dynasty by Senusret I bearing the inscription 'He made for him a statue of *mntt* stone' are in fact not Chephren Gneiss but made from ordinary igneous diorite (hornblende diorite) and porphyritic quartz monzodiorite quarried at

Aswan.

Neolithic to Early Dynastic Period

It has been suggested that the presence of exotic hard stones in elite burials could be connected with increasing social complexity and the exponential rise of an elite class during the Predynastic (Baines 2000: 23). However, Chephren Gneiss appears amongst assemblages of rich burial goods in Lower Nubia dating to the Late Neolithic and also as a fragment of a palette dating to the Neolithic site of Kom W in the Faiyum (Caton-Thompson and Gardner 1934: 22, pl.xii; UC2529). The Late Neolithic burials excavated by Schild and Wendorf (2001: 16-7) at Gebel Ramlah, 25 km northwest of Gebel Nabta, are particularly interesting. Here, the Chephren Gneiss is worked into the shape of a cup or bowl with a phallic handle and found almost exclusively in female burials. This seems to be a recurring trend into the Old Kingdom, where stone vessels played a part in the *Sed*-festival, perhaps to propagate basic ideas about kingship that were passed through the female burial. It has been argued that the king's rebirth was guaranteed in particularly potent ways through women (Troy 1986; Arnold and Pischikova 1999: 127-8). Carnelian, ivory and other exotic materials made up some of the Late Neolithic assemblages in Lower Nubia and it is significant that Chephren Gneiss and carnelian often occur together in elite burials. This connection is considered in more detail later.

Apart from Chephren Gneiss being found in reliable Neolithic contexts in Lower Nubia and the Faiyum, other vessels dating to the 4th millennium BC are known in the archaeological record. These include a cosmetic pot dated to Naqada III in the Musées Royaux d'Art et d'Histoire, Bruxelles (**6409**) (Waelkens 1990) and a shallow bowl in the Hermitage in St. Petersburg (**No. 5357**, Hermitage Museum Catalogue). Hence there is a strong case for the stone's use at least 1,000 years prior to the formation of the Egyptian state, indicating that the use of this - and by implication that of others as well - exotic stone is not exclusively due to the rise of social stratification during the Predynastic Period. However, it is in the Early Dynastic Period that Chephren Gneiss begins to make a real impact on the corpus of stone vessels in royal and elite contexts.

This change is evident in the increased occurrence of Chephren Gneiss in both the Petrie collection and Lucas's (1930) study (**see Figs. 24a - c**).

Late 2nd to 3rd Dynasty

The vogue for stone vessels within the funerary corpus reaches its peak by the late 2nd to early 3rd Dynasties, exemplified by an explosion in the diversity and range of vessel forms in the tomb of King Khasekhemwy at Abydos (over 400 vessels). This is a significant increase from the tomb of his predecessor Peribsen, in which only 35 vessels were found (Petrie 1901a: 27; Amélineau 1902; Reisner 1931: 153). Although travertine dominates the assemblage, Chephren Gneiss constitutes the majority of *hard* stones used, at approximately 10% of the total collection (Reisner 1931: 159-60). However, care needs to be taken with these estimates given the fragmentary nature of this data (*op. cit.*). Djoser's Step Pyramid (3rd Dynasty) contained the largest assemblage of stone vessels in a single burial at over 30,000 (Firth and Quibell 1935: 132). Of this assemblage, 50% were of travertine and the remainder comprised a variety of hard stones that included 892 Chephren Gneiss bowls (about 3% of the entire corpus), all found within the royal burial rooms under the pyramid (**see Pls. 39a, 39b**). Firth and Quibell (1935: 132) suggested that Chephren Gneiss was reserved exclusively for the king, while the softer less expensive travertine served for his family. A number of the Chephren Gneiss vessels bore the titulary of earlier kings, such as Khasekhemwy, which becomes a recurring trend in the Old Kingdom, as discussed later (Reisner 1931: 103; Firth and Quibell 1935: 18). The relative amount of Chephren Gneiss in comparison with its occurrence in other periods peaks during the 2nd and 3rd Dynasties in both Petrie's collection and in El-Khouli's (1978) analysis (**see Figs. 24a - c**).

Chephren Gneiss makes its only known use in monumental construction in the 3rd Dynasty, when small blocks of the stone (approximately12 cm long and 55 cm thick) were fitted together to make a 'tesselated pavement', in the subterranean passages of Djoser's burial chamber (Firth and Quibell 1935: 20). Firth and Quibell (1935: 127) describe the stone as 'highly valued' and as having had a 'long history since they were quarried' due to the small blocks having been previously laid and later reused. They may have been taken from King Khasekhemwy's tomb as many of the stone vessels found in Djoser's tomb bear his titulary (*op. cit.*, 18). Thus re-use of Chephren Gneiss was already occurring by the 3rd Dynasty. The statuette of a standing deity in Chephren Gneiss is the first of its kind known and is suggested as dating to the 3rd Dynasty, although its provenance to Djoser's Step Pyramid remains uncertain (Grzymski 1999: 53, MMA: 178) **(see Pl. 40a)**.

4th Dynasty

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. Royal statues of this period depicting the king outnumber those of the gods by a wide margin (Grzymski 1999: 51) and form a unique category in manifesting the position of the ruler in society. Six Khafre statues are known (CG10-14, Borchardt 1911: 9-14), although there could have been up to 24 in the valley temple of the pyramid complex because placing for this number has been observed (Lehner 1997: 126). It is probable that similar life-size statues also existed for Djedefre and Khufu; Petrie recording fragments of a 'diorite' (Chephren Gneiss) statue close to the pyramid entrance of Khufu (Petrie 1883: 136-7). The fragments of a Chephren Gneiss statue found in a rubbish pit outside Djedefre's pyramid, although inscribed (with the hieroglyphs) for Menkaure (*op. cit.*), further demonstrate that the surviving remains of these statues are only a fraction of what was originally produced.

The 4th Dynasty is also the period that showed the greatest change in the use of stone vessels, when the placing of stone vessels expanded into non-royal burial contexts (Reisner 1931: 174). This commenced during Snefru's reign, given the number of Chephren Gneiss bowls inscribed with his name which have been found widely distributed throughout Upper Egypt.

5th Dynasty

The 5th Dynasty sees a rise in the use of Chephren Gneiss for vessels, as evident from Borchardt's (1910: 114) excavations in the mortuary temple of Sahura at Abusir. Most of the vessels were broken, but included five bowls of Chephren Gneiss with names of earlier kings, one of Khaba (3rd Dynasty) and two of Snefru (4th Dynasty) (Borchardt 1910: 114; Reisner 1931: 200). Unfortunately Borchardt did not give the number of each vessel type, therefore Reisner's calculations of materials used as shown in the graph (**Fig. 24c**) come from just 60 examples and care has to be taken with these calculations.

Chephren Gneiss use for large statuary seems to have been phased out in the 5th Dynasty, as none are known from this period. However, fine examples of small statuettes in Chephren Gneiss, particularly the speckled variety, were found in the pyramid complexes of Sahura and Neferefre (Metropolitan Museum of Art 1999: 328, 18.2.4) (**Pl. 40b**). The range of vessel forms in Chephren Gneiss, a feature particularly of the 3rd and 4th Dynasty, become limited to shallow bowls and dishes, these generally retrospective to 3rd Dynasty styles, that often show crude workmanship. Reisner (1931: 180) suggests that after the 3rd Dynasty Chephren Gneiss was rarely used for deep vessels; in fact, due to the hardness of the stone, almost never used for forms such as deep cylinders which were almost always manufactured in travertine (Aston 1994: 42-7). The Petrie corpus similarly demonstrates this with none of the Chephren Gneiss vessels being deeper than 10.8 cm (UC41216) (**Pl. 41a**). However, a Chephren Gneiss vase 73 cm deep by 52 cm wide (CM39409) (**Pl. 41b**) inscribed with the name of 5th Dynasty Unas is in the Egyptian Museum (Cairo) and presents a rare departure from this norm. It is probable that there were many such large vessels which were broken down and re-used for smaller vessels at a later date.

6th Dynasty

By the 6th Dynasty Chephren Gneiss use is only attested for shallow dishes and bowls with a dominance of small cosmetic pots, as reflected in the Petrie corpus (UC41381, UC41053, Petrie 1937 pl. xxvii) (**Pl. 41c**). The larger bowl shapes disappear suggesting a decline in stone vessel use as part of the 6th Dynasty royal tomb funerary corpus; indeed hard stone usage generally shows a dramatic fall, with funerary objects such as statuettes mainly being made from travertine. This has been attributed to the increasing importance of metal vessels and wheel-made pottery over stone (Ogden 2000: 157; Bevan 2001: 139); suggesting that the occurrence of Chephren Gneiss bowls and small cosmetic jars might be from re-used stone.

Although no excavation reports of the 6th Dynasty pyramid complexes refer to finding Chephren Gneiss vessels, bowls inscribed with the names of Pepi I and Pepi II found in Middle Bronze Age Byblos and Middle Kingdom Nubia suggest that they were still being manufactured in the 6th Dynasty and either robbed from their original funerary complexes and/or incorporated into elite gift exchange. Travertine and Chephren Gneiss vessels were also found in *contemporary* 6th Dynasty contexts (2250 BC) at the Temple of Babat Gebal at Byblos, and 153 travertine and 69 Chephren Gneiss vessels at Palace G at Ebla, Syria (Scandone-Matthiae 1988; Bevan 2001: 369).[4] The Chephren Gneiss vessels are particularly interesting because some were inscribed with the names of Khasekhemwy, Snefru, Khafre, Menkaura, Userkaf, Pepi I, Pepi II and Queen Neith, suggesting that these could have been the product of contemporary elite gift exchange or trade that could have emanated directly from the royal workshops, rather than being the product of tomb-robbing (Scandone-Matthiae 1988; Bevan pers. comm. 2002).

First Intermediate Period to New Kingdom

From the First Intermediate period into the Middle Kingdom the use of Chephren Gneiss becomes extremely sketchy. There are no examples of it in the Petrie corpus but there is a proportionally high occurrence of anhydrite. Anhydrite was called 'blue marble' by Petrie and subsequent writers until Lucas (1934) provided the correct identification

[4] Many thanks go to Andy Bevan who has provided much additional information and discussion on the subject of Egyptian stone vessels in Aegean and Levantine contexts from his recent PhD research.

(Aston 1994: 51-2, pl. 11a) (**see Pl. 42a**). The use of anhydrite for vessels after Chephren Gneiss has been phased out, particularly during the Middle and New Kingdoms, might suggest that it was used as a skeuomorph of Chephren Gneiss given its blue colour. A facsimile or skeuomorph of a Chephren Gneiss vessel in limestone in the shape of a cylinder was seen by the author in the Egyptian Museum in Cairo (**Pl. 42b**), but unfortunately there is no date or provenance. Indeed the use of skeuomorphs for certain high status-stones is common and is a theme that is returned to later in Chapters 5 and 7.

The use of Chephren Gneiss in the Middle Kingdom is restricted to just the 12th Dynasty and mainly for statues. Examples are the torso of a statue of King Senusret I (Berlin, ÄM 1205) and a sphinx of Senusret III (MMA 17.9.2) (Aston *et al.* 2000: 33). A rare example of a Chephren Gneiss vase bearing the cartouche of Amenemhet II (Montet 1928: 160, pl. xci) was found in the Middle Bronze Age royal necropolis at Byblos in Tomb II. Whether the vessel's occurrence in Byblos was the result of trade or tomb robbing is unknown. The question of whether some or all of these objects were produced from re-used stone has to be considered, particularly as the evidence of Middle Kingdom quarrying for Chephren Gneiss remains uncertain, as discussed in Chapters 2, 6 and 7. Aston (1994: 64) suggests that Chephren Gneiss was no longer used for vessels, which might further explain the occurrence of facsimiles during this period.

In New Kingdom contexts a Chephren Gneiss bowl dedicated by Tuthmosis III to Hathor was found in the royal tomb at Amarna (Martin 1974: 96, pl. 55-6) and a Chephren Gneiss bowl with the name of Khafra incised was also found in a shaft of the royal tomb (Martin 1974: 96, pl. 57). A further New Kingdom (19th Dynasty) example is the block statue of Khai-Hapy, 49.5 cm in height, probably from Heliopolis (Vienna ÄS64) and in the British Museum (BM 4701) a Chephren Gneiss vessel is inscribed for Amenirdis, Divine Votaress of Amen-Re dating to the 25th Dynasty (Aston 1994: 64; Aston *et al.* 2000: 33). As Aston (1994: 64) points out, these later examples, particularly from the New Kingdom and 25th Dynasty, are probably from re-used stone; the 25th Dynasty bowl having a form that dates to the Old Kingdom. As there is no ceramic or inscriptional evidence of exploitation of Chephren's Quarry past the 12th Dynasty, it is highly probable that any objects made from Chephren Gneiss post this date are of re-used stone. However, re-use of stone even during the Old Kingdom can be attested; Reisner found fragments of Khafre statues that had been broken up to model vessels in the 5th and 6th Dynasty (Resiner 1931: 104). Hence, stone re-use is a recurrent phenomenon throughout antiquity that must qualify any absolute quantification of stone consumption.

Outside Egypt, Chephren Gneiss has been found in elite contexts contemporary with the 6th Dynasty at Ebla, as mentioned above (Warren 1969: 46; Bevan 2001: 369), and into the Late Bronze Age Aegean at the mortuary sites of Knossos in Crete, Kythera in Greece, Byblos in Lebanon and Ebla in Syria (Warren 1969: 110-1; Redford 1992: 41, 81; Bevan 2001: 369). Thus Chephren Gneiss from Chephren's Quarry might claim to be one of the few hard stones that has retained its elite status over at least three millennia.

Basalt

Symbolic and Elite Association

Given the paucity of the textual sources and no known inscriptions from basalt quarries, the ancient Egyptian word for basalt remains unknown and therefore the significance of its use, and why this peaked during the 4th and 5th Dynasties, can only be speculated upon. Colour and hardness are probably the most important characteristics of this stone, but the difficulty of access, particularly from Widan el-Faras, could have been equally significant (Borchardt 1907: 142). Hoffmeier (1993: 120) suggests that the distance the stone had to travel to Abusir and Giza implies its use was for purely religious and/or symbolic reasons. Colour is the principal characteristic that Hoffmeier (1993: 121) emphasises as the reason for its use on 4th and 5th Dynasty mortuary temple floors by proposing that basalt represented the 'earth or black-land' associated with the earth gods Aker and Geb and the king's ascension to the sky as related in the Pyramid Texts.

Although there is no written evidence to support this suggestion, the association of black earth with Geb is interesting given that he is represented as the '...divine presence in the earth on which humans walk' (Hoffmeier 1993: 121; Assmann 1995; Quirke 2001: 34-5, 39). This further implies the conception of the cosmos being related to certain stones, particularly during this period of solar symbolism. The importance of a uniform black appearance is well-exemplified by the meticulous way in which basalt was used in the mortuary temple of Nyuserra, where even the white mortar between the blocks was painted black on its visible surface (Borchardt 1907: 56).

Predynastic to 2nd Dynasty

The principal use of basalt from the Predynastic to the 2nd Dynasty was for small vessels, as demonstrated by the proportionally high number of basalt vessels recorded in the Petrie collection (UC41135) **(Pl. 43a)** for this period, and similarly reflected in Lucas's (1930) study. Numerous fragments of basalt vessels (between 115-160) were found in the Predynastic settlement of Maadi and also at Heliopolis (Rizkana and Seeher 1988: 56-70; Debono and Mortensen 1988: 34-5). There is a hiatus in its use for vessels during the 4th and 5th Dynasty when it began to be used for monumental construction, as amply demonstrated by its first use for the mortuary temple floor of Khufu (Mallory-Greenough *et al.* 2000).

4th to 5th Dynasties

As the table (**Appendix B 5**) clearly shows, the greatest use of basalt for floors and walls peaked and then ended in spectacular fashion by the 5th Dynasty reign of Nyuserra (**see Figs. 23a, 23b**). (The reasons for this abrupt cessation will be considered in Chapters 6 and 7). Its other uses in Old Kingdom royal pyramid complexes were restricted mainly to sarcophagi and it is here that problems have arisen with mis-classification. As mentioned earlier, black granodiorite from Aswan and siltstone or greywacke from Wadi Hammamat have often been wrongly classified as basalt and the late 5th Dynasty and 6th Dynasty sarcophagi of Unas, Teti, Pepi I and Merenra are in fact made from greywacke and not basalt (Aston *et al.* 2000: 24). Similarly, it remains uncertain whether the sarcophagi of Userkaf and Sahura both referred to as 'basalt' were correctly classified (Verner 2002: 276; Lehner 1997: 142).

6th Dynasty

The importance of stone colour seems to crop up again when basalt reappears in the 6th Dynasty corpus of the Petrie collection at a time when there is a renaissance in hard stone use for vessels. However, this use is generally for small vessels and models associated with specific festivals and ceremonies, such as the *Sed*-festival and 'opening of the mouth' that have antecedents in the Predynastic (Roth 1993b: 67-9; Aston 1994: 21). There is the strong possibility that these were produced from re-used stone and not from fresh quarrying (Reisner 1931). In these small sets of black and white stone flasks and straight-sided cups in basalt, quartz crystal, and sometimes obsidian, it has been suggested that black symbolised the left eye of Horus and the moon, and white the right eye of Horus and also the sun (Roth 1993b: 62).

After the 6th Dynasty finds of basalt vessels become isolated and rare (Aston 1994: 21). However, basalt, like Chephren Gneiss, appears to have been copied in much softer stones such as black limestone and black serpentine in the later Old Kingdom and into the First Intermediate Period. Exact copies or skeuomorphs of the distinctive form used for Predynastic basalt vessels (small cylindrical jars with two horizontally pierced shoulder lugs) also appear in black limestone, such as a Naqada period vessel in the Petrie Museum of Egyptian Archaeology (UC4320)(**Pl. 44a**) and this substitution endured into the New Kingdom (Aston 1994: 39). This suggests that form and colour together were more important attributes than the actual material. The same criteria might also apply in monumental construction, for example, in the mortuary temple of Pepi I black limestone was used instead of basalt for paving and wall linings (from author's field observations in 2002) (**Pl. 44b**). Furthermore, the 6th Dynasty was a period of retrospection to pyramid prototypes of the 5th Dynasty pyramid complexes (Lehner 1997: 156) and this might explain why black was so important to copy (see Chapter 3). However, why basalt was not used when supplies of the stone were still plentiful at

Widan el-Faras is a crucial point returned to later.

The use of basalt in monumental construction after the Old Kingdom is rarely seen and its use in the Middle Kingdom is known primarily for statuettes, some examples of which are housed in the Egyptian Museum (**Pl. 45**). Evidence for the use of basalt after the Middle Kingdom remains unclear (Aston 1994: 21) until the Late Period, and into the Græco-Roman Period. The use of basalt during these periods seems to have been mainly for sarcophagi and statuary, (an example is in the Græco-Roman Museum in Alexandria, in Empereur 2000:11, fig 13). It is difficult to say whether these objects were made from freshly-quarried basalt or from re-used stones. Widan el-Faras basalt was exploited during the Early Roman Period (see Chapter 6), but evidence for re-use of older stone also exists. Evidence for the removal of some basalt blocks from all the 4th and 5th Dynasty pyramid complexes in later periods is attested: secondary wedge-hole toolmarks can be observed on many remaining blocks at these sites (**Pl. 46**). Furthermore, re-use of basalt even during the Old Kingdom has to be considered, as discussed above in relation to Chephren Gneiss. Nevertheless, it can be argued that the use of basalt, certainly for monumental purposes, was a phenomenon of the Old Kingdom.

Aswan Granite and Granodiorite

Symbolic and Elite Association

Even though Aswan granite and granodiorite have a long history of use in antiquity, the reasons for their preference in royal and elite contexts remains unclear. The 6th Dynasty autobiography of Weni (see Chapters 3 and 6) has provided documentary evidence of expeditions to the Aswan Quarries, specifically to procure stone for King Merenra, including an account of cutting canals through the cataract, presumably to ease the passage of stone from the quarries (Fourtau 1905: 2-5; Breasted 1906: 148; Aston *et al.* 2000: 18; Verner 2002: 364). However, the general theme of the narrative is to focus more on the feats accomplished in the task, rather than any direct reference as to why the stone was specifically selected. Hence, it might be assumed that the stone's visual/aesthetic properties, hardness and distant source on Egypt's southern border would have been sought-after attributes by an elite.

1st to 3rd Dynasties

Coarse pink/red Aswan granite was mainly used in monumental construction throughout the Old Kingdom, first appearing in the 1st Dynasty tomb of King Den at Abydos as paving and as door lintels in 2nd Dynasty King Khasekhemwy's temple at Hierakonpolis (Petrie 1938: 24; Röder 1965: 480). In the 3rd Dynasty the stone was used for wall linings in Djoser's Step Pyramid burial chamber, and it continued to be used in such contexts throughout the Old Kingdom. The stone was rarely used for small vessels, although the literature suggests that some use of it was made between the 1st and 6th Dynasties (Aston 1994: 16). There were no examples of its use in the Petrie collection of stone vessels.

4th Dynasty

The use of Aswan red granite for monumental architecture peaked in the 4th Dynasty where it was used not only for wall linings inside the pyramid but also for columns in the pyramid temples and for the lower courses of the pyramids' outer casing (Aston *et al.* 2000: 36-7). The stone was also used for sarcophagi, statues (although limited) and stelae, with Khufu and Djedefre's sarcophagi both being of this stone (Lehner 1997: 120-21, 125-6). Röder (1965: 550-1) calculated that red granite used in the construction of Khafre's mortuary temple, valley temple, sphinx temple and pyramid facing would have required upwards of 17,000 cubic metres of dressed stone, and for the facing alone of Menkaura's pyramid approximately 15,000 cubic metres. These totals dwarf any other hard stone used in the Old Kingdom, such as basalt, by an enormous margin. Aswan granodiorite (black/grey) did not appear in royal pyramid complexes until the 4th Dynasty and even then it had a limited range of uses for objects such as sarcophagi, including that of Khafre (Lehner 1997: 126; Aston *et al.* 2000: 37).

5th Dynasty

By the 5th Dynasty Aswan red granite was used to a greater extent for statuary than in the 4th Dynasty, the statue of Userkaf being the oldest known colossus of any king (Grzymski 1999: 55;Verner 2002: 277). Red granite continued to be used in the 5th Dynasty for an ever-increasing range of funerary objects and monumental architecture, extending to canopic chests, false doors, offering tables, lion statues and an obelisk from the sun temple of Nyuserra (Borchardt 1907: 56; Verner 2002: 315-9 (**Appendix B 3, B 4; Figs. 21, 22, 22a**). The use of Aswan granodiorite in the 5th Dynasty was again limited and in monumental construction is known for the wall linings of the 5th Dynasty passageways of Userkaf's pyramid (Fakhry 1969: 171) and for a few pyramidia, such as that of Queen Khentkawes II (Verner 2002: 298).

6th Dynasty to First Intermediate Period

By the 6th Dynasty Aswan red granite use within the pyramid's structural elements becomes greatly reduced and there is certainly no evidence for its use in the outing pyramid casing. There was also a reduction in its use for wall linings, particularly in burial chamber corridors and paving, these being replaced with limestone (Lehner 1997; Verner 2002) (**see Appendix B 3, B 4; Figs. 21, 22, 22a**). The use of red granite for columns in the mortuary temple was phased out by the reign of Pepi I. In Pepi II's mortuary temple 'reddish' quartzite (silicified sandstone) was used instead, as discussed below (Verner 2002: 364).

Middle Kingdom to New Kingdom

Although red granite continued to be consumed in quantity, particularly in the New Kingdom, consumption never reached the levels attained in the Old Kingdom. As Röder (1965) calculated, during the Old Kingdom upwards of 100,000 cubic metres of Aswan red granite was removed from the quarries, a figure not equalled until the Roman Period (see Chapters 1 and 2).

Travertine

The ancient Egyptian word for travertine occurs occasionally as *bỉt* in the Old Kingdom but is later dropped and the more widely used word *šs* is attested by monuments and by the Hatnub inscriptions (see Chapter 2). The term *šs* was frequently modified by the adjectives *wʿb* 'pure' or *b3ḫ* 'white' or the phrase *n ḥwt-nbw* of Hatnub (Aston 1994: 44). Thus its white translucent quality seems to have been an important factor in its almost continuous use into the Roman Period, as well as it being easy to work (Reisner 1931: 139; El-Khouli 1978: 765; Aston 1994: 47).

Travertine dominates every collection of stone vessels from the Predynastic onwards and extends into monumental construction by the 4th Dynasty (**see Appendix B 3, B 4; Figs. 21, 22, 22a**). However, its use never exceeds the use of limestone as the principal soft stone for monumental construction (Baines 2000: 34). The ubiquitous use of travertine for stone vessels and its occurrence in even relatively poor tombs suggests that it was not the exclusive domain of an elite, which was generally the case with hard stones (Aston 1994: 47). This further implies that stone *hardness* (granites and gneisses) and their greater resistance to weathering had prestige value, as well as a more remote and exclusive source (*op. cit.*).

Travertine was used in monumental architectural elements by the 4th Dynasty, such as the paving of the valley temple of Khafre (Lehner 1997: 125-6; Verner 2002: 228, 234), which is notably the antithesis of colour association from his predecessor Khufu's use of basalt. This is also curious because there are no indications of a break in funerary traditions at this time, as discussed in Chapter 3 (Aston *et al.* 2000: 60). Travertine again replaces basalt for temple floors by the late 5th Dynasty reign of Djedkara-Isesi (*c.* 2388 BC); however, this is a period when there is generally a more limited use of remote source hard stone (Verner 2002: 328). Travertine was used for larger funerary objects, particularly altars and sarcophagi. The latter were rarely for kings, the only known example from the Old Kingdom being 3rd Dynasty king Sekhemkhet's sarcophagus cut from one single block of the stone (Goneim 1956: 107-8; Goneim 1957: 18-20; Lehner

1997: 94).

Quartzite (silicified sandstone)

The hard stone often known as quartzite, or silicified sandstone in recognition of its sedimentary origins (Klemm and Klemm 1981: 25), is relevant to mention due to its use in architecture and its supremely solar and kingly associations, being the most '...solar of the stones of Egypt...' (Quirke 2001: 76). A statement in the Pyramid Texts attests to the belief that the 'flesh and bones' of Egyptian deities were composed of gold and silver (Shaw 1998: 253). The essential role that gold played in the royal funerary cult is well-known and it is suggested that quartzite was equally important due to its colour ranges covering the spectrum from golden and white to purple-red (Quirke 2001: 76). The solar association between deities and building stone is also apparent from the inscribed relief on two quartzite lintels dating to the Middle Kingdom reign of Senusret III of the gods Atum, Ra and the Powers of Iunu (Quirke 2001: 79).

The first known use of quartzite is in life-size statuary of 4th Dynasty Djedefre, which has been connected with the emergence of the title 'Son of Ra' during his reign, and continues into the 6th Dynasty (Aston *et al.* 2000: 53-4; Quirke 2001: 122, 127) (also see Chapter 3). The stone was rarely used in any context other than for royalty, in items such as statuary and sarcophagi, but it did have a limited use in monumental architecture, particularly during the 5th and 6th Dynasties in the pyramid complex of Userkaf as a false door and as columns in Sahure's mortuary temple (Borchardt 1910: 40-53; Lehner 1997: 141; Aston *et al.* 2000: 53-4;Verner 2002: 220). The 6th Dynasty pyramid complex of Teti sees its greatest use as foundation blocks, basins and pillars, and in the mortuary temple of Pepi II 18 columns are of quartzite (Jéquier 1938; 1940: 22-4; Lauer and Leclant 1972; Lehner 1997: 156; Verner 2002: 370).

The links with Iunu (Heliopolis), the principal sanctuary of the sun god are strong, not least, presumably, because the main source of the stone is the nearby quartzite quarries of 'the Red Mountain', modern Gebel Ahmar (Aston 1994: 34; Aston *et al.* 2000: 53-5;

Quirke 2001: 76, 79-80). The royal use of quartzite continued into the Middle and New Kingdom, the solar association still remaining an important factor in its use, although by the New Kingdom it was quarried from Gebel Gulab near Aswan. Although quartzite outcrops are found at Chephren's Quarry (see Chapter 2) it is unclear whether they were ever exploited on a monumental scale.

Summary

Making firm inferences from the analysis of stone consumption needs care given the fragmentary nature of the archaeological record. However, the hypothesis that Chephren Gneiss was almost always mis-classified as 'diorite' was conclusively achieved from the study of the Petrie stone vessel corpus. Further investigations of published sources from a range of excavation reports, dating between the early and mid 20th century, similarly demonstrated the frequent mis-classification of Chephren Gneiss as 'diorite'. The study also included the consumption of basalt, red granite, granodiorite and travertine from which general trends could be observed in stone use over time.

These stone preferences can be gauged against simultaneous political, ideological and theological changes, but what seems to be the over-riding criteria in stone preference is the aesthetic/visual qualities for outward display. This seems to have antecedents as far back as the Neolithic, and by the Naqada II period was driven with increased intensity, as indicated by the range of exotic hard stones being used for small vessels at this time. Attributes such as colour, texture and hardness are indeed an over-riding factor, although with the absence of textual sources it remains uncertain whether elite stone use was also linked with certain deities. The blue colour of Chephren Gneiss along with its hardness and resistance to weathering makes it easy to understand why it was so sought-after, and might also explain the exceptional chronological and geographical range of contexts in which the stone is found. Chephren Gneiss is likely to be the most enduring of all the hard stones used for vessels in antiquity, given that its royal and elite status remained almost unbroken from the Late Neolithic to New Kingdom Egypt and into the Late Bronze Age Aegean. Other hard stones used for vessels are generally short-lived in their use and, apart from basalt in the Predynastic, Chephren Gneiss always takes precedence among the samples studied during the Old Kingdom.

The association of Chephren Gneiss and basalt with any specific deity is largely unknown due to the absence of textual sources. A connection with Horus and Upper Egypt for

Chephren Gneiss is a possibility, as is suggested for Aker and Geb in relation to basalt. However, there was certainly a special value attached to these stones, in particular Chephren Gneiss, that must have been the motor that drove the kings of the early Egyptian state into extraordinary investment in resources to acquire it. Perhaps the antecedents for these investments lie specifically with colour, hardness, durability, remote source and cultural traditions into the Neolithic and Predynastic, that were later incorporated into a web of cosmological meanings associated with Old Kingdom pyramid building.

The consolidation of stone use to a few select hard stones by the 4th Dynasty is matched against the vast increases in territorial range covered to procure them, along with the dramatic increases in volume. These changes are indeed significant given the political and ideological transformations occurring from the 3rd Dynasty onwards. Despite the 6th Dynasty increase in the use of hard stones like basalt for vessels, hard stone use in monumental architecture was generally in decline by the late Old Kingdom. Although procurement of red granite was still maintained, the consumption record implies that in some architectural elements which previously used this hard stone, its use was replaced with soft stones. Basalt has been completely phased out by the 6th Dynasty and it is notable that black limestone replaces basalt for mortuary temple paving in Pepi I's mortuary temple. Consideration should also be given to the occurrence of (blue) anhydrite vessels by the First Intermediate Period; which could have been produced to copy Chephren Gneiss vessels. Both situations might suggest skeuomorphism or copying of hard stones in soft stones, substitutions implying that visual qualities such as colour and form were the most important attributes to emulate.

Chapter 5

The Social Context of Hard Stone Procurement in the Third Millennium BC: some Theoretical Perspectives

Introduction

Archaeological and anthropological theoretical approaches to the social relations that enabled labour to be organised, mobilised and maintained for non-utilitarian projects have great and largely unexploited potential for addressing the same questions in an Egyptian context. This chapter will therefore consider a range of these theoretical models, taken from cross-level and cross-cultural contexts, that have been applied to labour organisation and to conceptions of monumentality. The objective is to focus specifically on the interplay between the ideologies and power structures through which labour was mobilised. The first part of the chapter discusses a range of theories that have been applied to the archaeological record, from functional, contextual and behavioural approaches to production at quarries, to Marxist-structuralist and evolutionary models of labour organisation associated with monolithic burial sites.

In conclusion, the chapter discusses how a broadly-based reflexive theoretical approach to interpreting the archaeological record at quarry sites can produce cogent models for understanding the social context of Old Kingdom hard stone quarrying. Approaches to the questions surrounding labour organisation and mobilisation on a macro-level will be advanced within the context of recent social theory.

Social Organisation and Raw Material Acquisition: Cross-cultural Perspectives on Stone Procurement, Monumental Construction and Labour Mobilisation

Conceptions of Monumentality

The term 'conspicuous consumption' is often applied to monumentality or these 'material extravaganzas' as the ultimate expression of wasteful spending in human and material resources for the purposes of display (Veblen 1949: 68ff; Trigger 1990: 119-32; Rathje 2000: 1). In the context of the monolithic cultures of Egypt and Mesoamerica, the social relations that gave rise to monumental construction are often explained in Marxist/behavioural terms, because monumental structures are deemed as the ultimate expression of elite power whereby a few individuals can call upon the energy of many in non-utilitarian ways (Shanks and Tilley 1987b: 30; Trigger 1990: 124-5). Structural-Marxist approaches to labour relations are based on the premise of societal inequality or class division, whereby the interests of one class are pursued at the expense of another. In pre-capitalist societies this notion is generally applied to social divisions based on age, gender and lineage (Hodder 1991: 60).

However, contrary to the customary use of structural-Marxist theoretical models in the context of monumentality and labour organisation in early states, this one approach is not necessarily applicable to all pre-capitalist societies (Mays 1995: 216). Approaches to the monolithic cultures of Neolithic western and northern Europe by Renfrew (1973a: 539-58) have tended to tackle the question of megalith construction from a functional/evolutionary viewpoint. This framework envisages monolithic developments as a move towards increased social stratification or 'chiefdoms' via group-oriented levels of organisation working together within regional networks. The transportation of raw materials would have necessitated greater co-operation between these regional groups that, by the Early Bronze Age, could have been unified under a single chiefdom (Renfrew 1973a: 552-5; Feinman 2000: 36). Thus a comparison can be made between Trigger (1990: 119-32) who explains pyramid building in terms of states and Renfrew

(1973a: 542) who uses henge construction in an evolutionary context to explain chiefdoms.

These approaches, particularly when applied in Egyptian contexts, tend to focus on the deployment of, often extremely large labour forces, organised through strict hierarchies and within an increasingly socially-stratified society. A similar explanation for the emergence of monumental constructions called 'nuraghi' in Sardinian Nuragic culture (*c.* 1800-500 BC) has also been proposed (Webster 1991: 840-56). It has been suggested that these displays of consumption arise through a politically-centralised and socially-stratified society (Webster 1991: 854). However, Webster's analysis of the organisation and scale of labour associated with nuraghi constructions challenged these assumptions. Calculations into the number of man-days required to build a nuraghi suggest that an adult male would only devote 2.5% of his time each year to its building, therefore placing only modest demands on the community labour pool. The expedient use of readily-available raw materials and construction techniques would require neither high levels of sophistication nor hierarchical planning, such a loosely-organised endeavour being within the capabilities of '...tribal and emergent (petty) chiefdom-level organisations...'(Webster 1991: 855).

Abrams' (1987: 485-96) study of social stratification in the division of labour in Late Classic Period Maya in Honduras produced similar conclusions to Webster (1991: 840-56). Principally, the number of man-days required to build the stone Temple of Meditation suggested that little stress or demands were placed on the societal infrastructure or labour pool (Abrams 1987: 495). Specialists were few in number and drawn from the ranks of the elite with recruitment of unspecialised labour through lineage organisation, within a well organised, co-operative labour structure at the lowest level of social organisation. Kinship ties were the prime mechanism in organising labour, which accords with both early state formation and the model of Maya society being structured as 'ranked households' (Abrams 1987: 496).

Sherratt (1997: 334-5) takes a fresh view of monumentality by looking at the cultural and historical antecedents of European Neolithic megalithic cultures, which allows for more flexibility in understanding the social relations through which these phenomena emerged. Sherratt (*op. cit.*) turns the argument around by suggesting that monumentality was as much a cause as a consequence of social complexity. Such an approach avoids assumptions about evolutionary trajectories and social organisation to explain the origins of monumentality. As Sherratt (*op. cit.*) points out, the question really to be asked is why was monumentality necessary in the first place and what were its antecedents? From this angle, it might then be easier to understand how labour was amassed for increasingly extravagant and ambitious monuments. This approach allows labour mobilisation to be seen in more reflexive ways, removing it from preconceived and structured categories.

Sherratt (1997: 336) argues that the first monumental structures were the focus for the symbolic construction of the community in the absence of large stable residential units. These structures were built by a dependable and relatively small pool of labour of between 20-50 that would normally be employed in the cultivation process. As suggested by Abrams (1987: 496), this small labour pool worked through widening kinship ties within a well organised co-operative labour structure. The conversion of the demographic pool derives from ever more sophisticated monuments that gave the potential for employment for farming communities moving into optimal ecological zones (Sherratt 1997: 362-4). The consolidation of settlements can perhaps be analogous to the Nile Valley during increasing aridity with movements of people from the desert margins and the rise of the agricultural base by settled communities (see Chapter 3; Trigger 1993: 31).

In Sherratt's (1997: 362-4) model, labour recruited for projects was derived from a blend of population density, highly-organised social networks and existing lineage structures which correspond with the peaks in building. Within this context, hallucinogens were powerful inducements to beliefs in the cosmology as represented by the tombs and from this precedence social ranking would rapidly build up (*op. cit.*, 365). In Egypt and other Near Eastern cultures perhaps a similar situation arose, whereby social organisation centred on a transformed *domus* (Hodder 1991: 77, 103-4) with its Neolithic origins of culture and subsistence. As Hodder (1991: 78) argues, processual, structuralist and Marxist analyses are unable to grapple with the cultural and historical meanings of where ideology or structure come from. Hodder (*op. cit.*) asks if it is possible to explain the function of funerary monuments in society, in the absence of understanding their historical meaning? In an Egyptian context, it has been suggested that the Early Dynastic mastaba tombs at Saqqara were representations of the earthly dwelling, and at Abydos the funeral mound symbolised the primeval mound that represented creation and resurrection (Verner 2002: 24; see Chapter 3). Similarly, the transformation of these structures into stone was the desire for more permanent above-ground monuments, these becoming the focus for the community as the outward demonstration of feats of co-ordinated efforts. Hence, these efforts became imbued into the meaning of the monument as well as its skeuomorphic origins (Sherratt 1997: 338; Bard 1992: 5). It is interesting in this context, to note that the few textual sources that specifically mention stone procurement tend to emphasise the feats involved in obtaining the material for the king (Baines 2000: 36; see Chapters 4 and 7).

It is also probable that the Predynastic stone-using communities in Upper Egypt had equally highly-organised social networks involved in craft production and quarrying, as exemplified by the huge range of stone vessels, particularly of hard stone, for this period (see Chapter 4). In the 4th millennium BC site of Maadi there was already a marked craft specialisation in stone vase production from a range of imported stones, as was the case in Upper Egypt at Naqada and Hierakonpolis (Caneva 1989: 291; Bard 1992: 16; Hoffman 1991: 117, 121, 124, 303). Therefore, a cultural and historical tradition in craft production was already well-developed prior to the Old Kingdom.

The transformations of monumental constructions into structures which could be entered (Sherratt 1997: 369) might also be applied to the emerging architectural elements of

Early Dynastic funerary monuments. By the 3rd Dynasty, the changes in architectural elements attributed to Djoser's Step Pyramid, in particular its large enclosure, have been interpreted as providing a formal setting for the display of the leader where 'the field' became the focus for the public appearance of the king in the '*Sed*-festival' (Kemp 1991: 57-9). The 'field' was where the ritual of the ruler enacting territorial authority was played out at a festival that was replayed throughout the Old Kingdom to legitimise the monarchy (*op. cit.*). It was these 3rd Dynasty architectural elements that were the prototypes for the pyramid complexes of the 4th Dynasty onwards throughout the Old Kingdom (see Chapter 3). By the height of the Old Kingdom, between the 4th and 5th Dynasties, hard and soft stones were being procured in increasing quantities, as discussed in Chapter 4. What impact did these changes in stone consumption have on the social organisation of labour to procure these stones and particularly in the control/ownership of remote stone sources? Were already-established self-sufficient craft groups with well-developed social identities called upon, therefore not requiring any radical changes in hierarchical or structural organisation, similar to the Abrams (1987: 485-96) model ? These questions will be addressed in Chapters 7 and 9.

Power, Ideology and the Mobilisation of Labour

The most obvious outcome of more ambitious monumental constructions in stone from the 3rd Dynasty onwards was the quest for *volumes* of hard stones from sources outside the Nile Valley, and/or geographically-distant sources in Upper Egypt (see Chapter 4). As the previous section of this chapter has briefly mentioned, many assumptions have been made about the social organisation and mobilisation of labour behind these projects. These models have generally adhered to 'monolithic conceptions' (Feinman 2000: 50-1), in many cases structural-Marxist paradigms of labour relations, whereby monumental construction was only achievable via overtly coercive methods, even state force (Tilley 1984: 143; Shanks and Tilley 1987b: 49; Trigger 1989: 341-2). But, paradoxically the continuity of monumental construction with its corresponding achievements in stone procurement, over great distances, could have been possible to maintain because it was *not* forced. As Shanks and Tilley (1987b: 180) point out, sheer force in the long-term would have been unstable and inefficient. Perhaps the mobilisation of labour can be thought of as operating via a network of social relations whereby the procurement of labour was not overtly coercive but perhaps more ingeniously motivated.

Saitta (1997: 9) suggests that what really mattered was the maintenance of guaranteed access to surplus labour via entitlements to subsistence goods (beer) and exotic prestige objects. Hence it is the specific relationship between these phenomena, not degrees of specialisation and hierarchy, that are important. This type of relationship via entitlements is suggested as a principal antecedent to the control of labour whereby individuals with access to rare valuables converted these into labour (Bard 1992: 1-24; Rathje 2000: 3; Arnold 2000: 14-30). This system, Rathje (2000: 3) suggests, is typical of most complex societies and involves community participation in the act of 'withdrawing' significant quantities of social production from further circulation through monumental building projects that become the focus of symbolic wealth and power. The 'aggrandizers' or the elite capitalise on 'innovation and risk', the most successful being those who provide the most physical, social and/or spiritual benefits to the most people on the most reliable basis (Clark and Blake 1994: 19; Arnold 2000: 27). Differential access to unique resources allows economic dominance to develop and changes in the organisation of labour can be revealed in the co-ordinated large-scale production of goods (Arnold 2000: 27).

In the Old Kingdom this was effectively managed by ideological means and by focusing projects on the funerary monuments and thus the institution of the king. Therefore, the reproduction of power relations became embedded in the death of the king via symbolic maintenance of the social structure and the maintenance of funerary cults that were often deeply retrospective (Bard 1992: 5; see Chapter 3). The dynamic underneath this ideological mask of perpetuity was a labour-force which was mobilised perhaps *not* by overtly coercive methods, but by a manipulation of ideological power, whereby the social order is naturalised. As a consequence, constant contradictions and internal dynamics are represented as coherent through strong iconographical images, theology and monumentality (Shanks and Tilley 1987b: 180-1). This concept conforms to Giddens (1979) theory of 'relational power', whereby the ability to secure outcomes depends on the actions of others. This is what successful rulers manage, in particular their renewable right to the labour of a larger segment of the population (Arnold 2000: 20). These approaches to power strategies and ideology within social dynamics allow for more flexible ways to interpret the archaeological record, as an alternative to monolithic concepts of static institutions and passive individuals.

If labour was co-opted for monumental construction projects and maintained by focusing the interests of the few as being those of the many, how can the cessation of exploitation of remote source stone be explained in the 6th Dynasty? It is likely that changes in environment, economic and regional interests played a part, or external constraints that remote source stone acquisition was more vulnerable to (Trigger 1991: 556; Spence 1982: 180-7; Spence *et al.* 1984: 102; see Chapters 2, 4 and 7). However, these conditions were constraining rather than determining and perhaps collided with shifting internal social relations at the same time. This can be well played-out using Cruz-Uribe's (1994: 45-53) model of Egyptian society in the Old Kingdom, based around a family structure with the king having ultimate authority with all aspects of society subsumed within his sphere of influence. However, these spheres of influence are constantly shifting, such social dynamics perhaps being less obvious due to the continuity expressed through ideology, ritual displays and monumental construction projects.

These ideas can also be embraced by Yoffee's (1993: 71) paradigm of new social evolutionary theory, whereby the demise of the state can demonstrate the power relations under which it is formed. The urge for supremacy can undermine the state from within, although in the Old Kingdom this did not lead to collapse, but rather a dispersal of wealth or economic resources away from the royal family to the nomarchs (Müller-

Wollermann 1986: Cruz-Uribe 1994: 49). This dispersal of resources and economic power would logically lead to the dispersal of labour as reflected in the more modest funerary monuments of the 6th Dynasty into the First Intermediate Period. However, to view decreased size in royal pyramid complexes as indicative of societal decline can be misleading, because sometimes the opposite can be true. As Saitta (1997: 21) suggests, building frenzies can occur to mask economic decline in an effort to absorb excess labour, a situation well played-out in collapsing totalitarian states. Therefore, there were multiple factors at play and any one 'monothematic' causal explanation takes us to pre-processual thinking. Hence, refocussing ideas about societal change away from monument size and deconstructing them into their constituent parts (or the raw materials), can allow for a greater understanding of the nuances behind these dynamics (see Chapters 7 and 9).

Production at Quarry Sites

Torrence (1986: 165) suggests, in relation to the study of production at quarries, that the absence of an explicit theoretical perspective has had the effect of divorcing stone procurement from the socioeconomic system in which it occured. As discussed in Chapter 1, studies of ancient (Pharaonic period) quarries in Egypt have also tended to suffer from a bias of description over theory. Theoretical approaches to production at ancient quarries have generally focussed on obsidian procurement, these being from a broad range of cross-level and cross-cultural contexts, such as: California between 4th - 2nd millennium BC (Ericson 1982); Mesoamerica from the Early Formative Period to the Late Classic Period (Spence 1982; Spence *et al.* 1984); Neolithic Calabria in the Mediterranean (Ammerman and Andrefsky 1982); the Bronze Age Aegean (Torrence 1982, 1986, 1989). Apart from obsidian quarries, Bradley and Edmonds' (1993) study of the stone axe trade in Neolithic Europe is an important contribution to understanding the social context of stone procurement. All these studies have approached the interpretation of quarry data from a range of theoretical positions, such as: functional, behavioural, contextual and cultural/historical perspectives. These approaches have consequently produced fresh insights into the social context of raw material procurement. In addition, the conceptual models produced from these studies have also highlighted the interdependency between production and transport of material as being an economic variable (Ericson 1982: 129-48; Ammerman and Andrefsky 1982: 149-72).

In an Egyptian context prior to the Pharaonic period, the Vermeersch (*et al.* 1990: 77-102) analysis of Middle to Upper Palaeolithic chert exploitation in Middle Egypt at Nazlet Safaha and Nazlet Khater (the world's oldest extraction sites) does go beyond description by explaining production methods, presence/absence of settlements with levels of social organisation. The implications of this study are that, even in the Middle Palaeolithic, well organised but irregular exploitation was taking place by individuals living on the Nile floodplain. Such a hypothesis might be applicable to Neolithic and Predynastic hard stone procurement of fallen blocks, carried out by small local groups that did not require high levels of organisation (Lucas 1930: 201, 211; see Chapter 4). However, in the absence of any empirical data relating to procurement at this time at the source, this is impossible to test.

It is also interesting to look at Burton's (1984: 234-47) investigation into the organisation of quarrying in the Papua New Guinea highlands during the early 20th century AD by the egalitarian Tungei for axes. Burton (1984: 244) argues that because no individual was vying for control of the resource, mass efforts could be undertaken without the need for an over-riding central organisation to exploit resources on an equally large scale. These expeditions were co-operative enterprises whereby large volumes of stone were quarried for axes by relatively small numbers of quarrymen, around 25 men per working party. This study revealed that workforces could be mobilised as co-operative exercises in acephalous societies *(op. cit.)* and counters Renfrew's (1973a: 554) argument that such works can only occur in centrally-organised societies.

Torrence's (1982: 193-221; 1986) survey of production at the Neolithic obsidian quarries on Melos in the Aegean goes some way further in hypothesising the degrees of organisation that can be extrapolated from obsidian production processes. With negative evidence of settlement, pottery or territorial boundaries, Torrence (1982: 196-7) suggests that the quarries were not owned or operated for profit but were probably exploited at irregular intervals via 'direct access'. Only primary production areas were located, these showing no signs of spatial segregation or organisation, suggesting an unskilled labour force working on a non-industrial scale. Production was just focussed on extraction (primary production) of the material, rather than crafting (secondary production) at the source (Torrence 1986: 169-71). The correlation between *ad hoc* procurement and 'direct access theory' (Renfrew 1973b: 180) is important in determining whether more standardised methods of production are indicative of monopolies over resources, this situation being concomitant with changes in elite consumption demands. Such changes in demand characterised by state involvement in stone procurement could imply trade and/or consumption outside of purely funerary requirements. In Spence's (1982: 173-97; *et al.* 1984: 97-105) model of *regional* exploitation of green obsidian during the Classic Period in Mesoamerica, he hypothesises that resource *absorption* is a key factor in state intervention, rather than monopolies over sources. This is deduced from increased production at the obsidian source to just 'blanks' that were channelled directly to workshops close to administrative centres (Spence *et al.* 1984: 102).

The study of obsidian production at Teotihuacán during the Classic Period in Mesoamerica produced an interesting comparative model to use in an Egyptian context, whereby the social context of these activities is understood within a centralised state. In the Mesoamerican quarries, the centralised state was not concerned in controlling or directly organizing this industry, but rather facilitating the partial organisation of independent craftsmen (Spence 1981: 784; Spence *et al.* 1984: 103). This situation is suggested as a saving in costs to the state in subsidising the craftsmen, but it also suggests antecedents to a long history prior to state formation when craft specialisation and procurement were conducted within well-defined social groups that were still powerful in the Teotihuacán social system (Spence 1981: 784; Spence *et al.* 1984: 103).

Thus the state protected and encouraged the obsidian industry but did not dominate all aspects of it. Such fluidity allowed for entrepreneurial elements to co-exist with the state. At regional levels there was more control, due to the returns being higher, but in both regional and local sectors some exchange was conducted in workshop areas outside of state supervision (Spence 1981: 779).

Stone tools at quarry sites can also give insights into production strategies, in particular if there is a presence of non-local stone used for tools. The significance of non-local hammerstones in just a few of the quarries on Melos might indicate their value, as they would have been retained by the quarrymen and not discarded at all the quarry sites (Torrence 1986: 186). A similar situation is seen at the Widan el-Faras basalt quarries and at nearby Umm es-Sawan (see Chapter 2). Chephren Gneiss and dolerite sourced to the environs of Chephren's Quarry appear as pounders, stone axes and small unworked blocks, the latter in a tool-making context at Umm es-Sawan (see Chapters 2, 4 and 6). Tools and toolkits, perhaps removed for refurbishing and repair elsewhere, have been conceptualised as 'curation' (Nelson 1991: 63). Curation of tools and toolkits suggests expedient strategies of technological organisation, particularly when tools are manufactured elsewhere and then transported to quarry sites. The process of manufacturing and repairing tools at a central place or domicile implies either the close proximity of the raw material or the accumulation of material at a place that is occupied extensively or often (*op. cit.*, 79).

The standardisation of stone tools may not necessarily suggest linear technological progression. Using a behavioural model to interpret irregular, non-standardised stone tool assemblages at quarries, Torrence (1989: 57-8) suggests that declines in standardisation might be indicative of least effort to minimize the expenditure of time, energy, or raw material. For example, the quantity of technological investment could be conditioned by the consequences of failing to procure the resource in question (*op. cit.*, 60).

Bradley and Edmonds' (1993) contextual approach to their study of stone axe production in Neolithic Britain raises similar questions to those posed in this thesis. For example, they discuss questions concerning the ownership and control over resources and the significance of non-local stone tools at quarry sites. Their interpretive methodology is not to study production data at quarry sites in isolation from each other, but to draw a composite picture within particular social and historical contexts (*op. cit.*, 200). This avoids generalised reconstructions and, as pointed out in Chapter 1, is indeed integral to the research methodology adopted in this thesis. The presence of non-local or imported stone tools is particularly relevant to this thesis as they are observable in the archaeological record at two of the quarry sites being researched (see Chapters 2 and 6). Bradley and Edmonds' (1993: 96) similar findings are interpreted in several ways, such as: a higher investment in technology at certain locations; connections between certain quarry sites and settlements over a wide area; or individual extraction sites being associated with imports from only one source area. All these questions have implications for the social context in which these quarries operated.

Transportation Technologies

Water

Transportation systems and technologies can contribute much to an understanding of socioeconomic change and constructs of social power: as Arnold (1995: 744) points out, the role of sophisticated transport systems has generally been underestimated. Water transportation and the management of a community's water system by an elite are concepts particularly relevant to this study. However, there is the danger of channelling this concept into a deterministic model of sociopolitical organisation with state development being linked to the control of water and irrigation systems (see Butzer 1976: 100, 111 on Wittfogel's 1938, 1957: 344 'Oriental despotism'). As Trigger (1991: 556) points out, ecological and economic factors also have to be considered, however, these should be viewed more as constraining than determining. Within this framework, water-management systems or use of these within a transport network should not be ignored, particularly in Egypt with its linear spread of settlements down the Nile Valley.

A discussion by Arnold (1995: 738-44), linking sociopolitical evolution to water transport systems in maritime hunter-gatherer societies produces some concepts relevant to this study. The context of Arnold's study is the bead industry and the control and distribution of these goods via a water distribution network, controlled by an elite who owned the means of transport. The ownership of boats and command over transport networks had economic and political uses, which were employed by elites to organise labour and complex social interactions (Arnold 1995: 738-44). Bard (1992: 18) also suggests that a major factor in the rise of social complexity in Egypt was due to the management of river transport by an elite who sponsored boat-building and other exchange-related activities that centred on river transport.

Another important consideration is the production/transport interdependency paradigm proposed earlier (Ericson 1984: 7; Ammerman and Andrefsky 1982: 167-71) that posits a close relationship between these practices. The model hypothesises the connection between materials being transported greater distances with greater waste at the source. These reduction processes can be observed in secondary production at the source and/or at the junction where one mode of transport replaces another. Such evidence can be indicative of more efficient methods of stone transport related to increased demand by the expansion of regional networks or elite consumption (Ericson 1984: 7; Ammerman and Andrefsky 1982: 167-71). In such a hypothesis, more efficient transport methods can be related to efforts to maximise water transport and/or use of domestic animals to haul stone overland (Ericson 1984: 7). As Bradley and Edmonds (1993: 52) point out, the largest henges in Britain are actually situated relatively close to waterways.

Overland

Other theoretical enquiries into the transportation of materials, in particular megaliths as a measure of social organisation and specialisation, have focused on overland transport (Thorpe and Williams-Thorpe 1991: 71-2). With the lack of empirical data associated with transportation technology, environmental and geologically-deterministic models have been applied, for example, the assertion that megalith transport for henge construction in Neolithic Britain never exceeded 5 km from the source of the raw material (*op. cit.*). The notion that spatial distribution of monuments is dictated by the local geology is a common assumption (Thorpe and Williams-Thorpe 1991:71-2). In terms of social organisation, this seems to imply a gradient whereby low levels of social organisation coupled with technological limitations are the determining factors in how far stone was transported overland.

Webster (1991: 849) uses a similar model in his discussion of the technological and human resources required for transporting stone for the nuraghi monuments on Sardinia. To support his argument for modest demands on the labour force associated with low-level organisation, he cites the relatively short distance between stone source and construction sites. In contrast to this, Abrams (1987: 492) suggests that transportation of raw materials from quarries in the Classic Mayan Period (the distances are not mentioned) would require the highest investment in labour and energy, particularly as this would be overland. However, this is still cited within the context of low-level social organisation undertaken by non-specialists.

The limitations of the models posed above are raised by Childe (1958: 74) who remarked '...the environment that affected a prehistoric society was not that reconstructed by geologists and palaeobotanists, but that known or knowable by the society with its then existing material and conceptual equipment. A society's scientific knowledge is in turn limited by its economic and social organisation'. Bradley and Edmonds (1993: 206) likewise turn the argument away from deterministic models by suggesting that '...the archaeological visibility of these [stone] sources cannot be explained by saying that they were the only places at which raw material could be found.'

In an Egyptian context, the majority of building stone (limestone) was local (see Chapter 4) to the construction site. However, some hard stones were transported in excess of 1,000 km during the Old Kingdom (see Chapter 2), so in relation to the discussion above this would presuppose high demands in labour within high levels of social organisation. Iconography, such as the 12th Dynasty Djehutihotpe statue, being transported from the Hatnub quarries would seem to further enhance this view (see Chapters 6 and 7; **see Fig. 25**). Hence, the concept of mass labour involved in hauling raw materials overland has tended to dominate perceptions of stone transport and has also arisen from the lack of evidence in the archaeological record. As Shennan (1993: 55) points out: '...[written records] are weak as a record of practice, but strong as a record of roles and institutions...'.

Value, Exchange and Consumption

'Conspicuous consumption' is the most commonly used term to describe wasteful spending not only in human, but also material, resources as public displays of power by an elite (Rathje 2000: 2). In Rathje's (*op. cit.*) model of the 'nouveau elite potlach', consumption is viewed within the spectrum of dispersal and withdrawal of human and material resources from social systems as a key component of how power became centralised. Some of the greatest centres for displays of conspicuous consumption are Egypt and Mesoamerica (such as Teotihuacán and Tikal) whereby the hordes of symbolic wealth in materials (monumental architecture, objects) were generated through the deployment of other people's labour, all to legitimize the prestige of the elite (Rathje 2000: 3). As Bevan (2001: 38) points out, the elites become 'super-consumers' who are often the driving force behind stylistic and technical innovations and setters of vogues in the use of certain materials. Therefore, expeditions for exotic stones were likely to have been driven from the 'top down' by the ruler who specifically chose their own forms of funerary equipment (Breasted 1906: i.764, ii.545; Bevan 2001: 129).

Rathje (2000: 5) suggests that the burial of exotic commodities in early civilisations represents the first ceremonial disposal and withdrawal of labour and materials as symbolic wealth in huge quantities. Bard (1992: 9) makes a similar deduction in the context of Egyptian Predynastic burials whereby the increased wealth of burial goods, such as exotic stone vessels, meant the withdrawal of these goods from circulation as they accompanied the burial rather than being in the economy. Thus consumption of material goods has both cultural and symbolic aspects in social relations that can be used in social strategies of recruitment and exclusion, thus forming an important component of social change (Sherratt 1991: 354).

Wealthy elites, in particular an individual ruler, might also at certain times disburse prestige objects rather than withdraw them in order to give rewards to supporters. High status goods, such as stone vessels, were also redistributed at public ceremonies (the *Sed-* festival) as gifts to family, officials and favoured individuals, particularly women, and so stone vessels were particularly valued in this context (see Chapter 4; Müller-Wollermann 1985: 121-68; Arnold and Pischikova 1999: 125). As Miller (1995: 73, 267) argues, '...those who give gifts and compete to acquire collectable objects are using consumption to mediate human relationships'. Using Sherratt's model of Bronze Age Mediterranean trade, consumption of stone vessels would have been limited to a minority of elites locally, and on an intra-regional basis with other elites, in the form of gift exchange, with the producers not participating in this consumption (Sherratt 1991: 360, 376). There would have been a royal monopoly on the distribution of 'luxuries' (high-value, low-bulk items) from market centres, which in Egypt might be, in practice, extended royal households constituting the royal residence and workshops. Production of alcohol such as wine and beer were also part of this concentration in areas of palace production, as the archaeological record at the Giza plateau and at Hierakonpolis implies (Lehner 1992; Geller 1992: 24). Additional labour inputs for these commodities added value, rather than just the distribution of specialised agricultural products (Sherratt 1991: 359). The production of beer within these royal palace installations and its use in relation to labour mobilisation is a subject that is expanded upon in Chapters 8 and 9.

In the model of Bronze Age Mediterranean trade, concentrations of production controlled by an elite were all part of the self-definition of emerging elites through conspicuous consumption and display. Any independent merchants worked within the framework of diplomatic links that were subject to the taxes on which the palaces depended (Sherratt 1991: 359). Thus the economy was 'redistributive' to other elites, but also market-driven by the demands of specific types of export to obtain specific goods (Sherratt 1991: 376; Warren 1991: 297). In an Egyptian context for example, cedar from Lebanon was a commodity in demand by elites and a relief in the 5th Dynasty mortuary temple of Sahure shows a fleet of ships (possibly going to Byblos) that could have been carrying stone vessels in exchange for wood (Borchardt 1913: 25-8, 86-8, 162-6, pls. 11-13; Redford 1992: 37-43; Arnold and Pischikova 1999: 128). Bietak (1988: 35-40) argues further that the Asiatics depicted onboard these ships were Egyptian-employed sailors who could have taken stone vessels as votives back to Byblos. Egyptian stone vessels are known in 6th Dynasty contexts at both Byblos and Ebla (see Chapter 4) that could suggest then such exchanges and/or gift giving was being practised in the Old Kingdom. As Appadurai (1986: 56) would argue, the source of value for such objects was from exchange and not vice versa (Appadurai 1986: 56).

A number of Chephren Gneiss stone vessels of the Old Kingdom in Egyptian and Levantine contexts have the inscriptions of 4th Dynasty kings, specifically those that relate to the *Sed*-festival of Pepi I and Pepi II (see Chapter 4; Scandone-Matthiae 1988; Arnold and Pischikova 1999: 125-6). These are suggested as emanating from the royal workshops, possibly for reasons of propaganda in the sphere of diplomatic relations. This implies changes in the value attached to these objects outside of just the funerary realm (Bevan 2001: 139; Bevan pers. comm. 2002). The dynamic between consumption and production at quarry sites, apart from appropriation for a ruler, may have intensified by the mid-Old Kingdom for reasons of exchange, with royal workshops producing items to satisfy a demand outside of royal requirements for funerary equipment. A modern analogy would be the production of objects to commemorate royal jubilees in Britain: these perpetuate the status and continuity of the monarchy, but also become collectable and valued items in themselves over time.

Competition might also enter the consumption equation, whereby subsequent builders wish to surpass the achievements of their predecessors, a situation that can provide further motors for even more ambitious monuments, for the benefit ultimately of the elite (Clarke *et al.* 1985: 71-8). Such internal competitiveness ultimately presents a win-win situation for the elite. Choices that are made (such as fashion, aesthetics, taste and competition) can all be ideologically manipulated for social ends; the exotic character of the foreign object and distance over which it has travelled can give it to social as well as religious cachet (Bourdieu 1977; Giddens 1979; Melas 1991: 394). As Miller (1995: 24) argues, those who were best able to express their relationships through the material worlds formed the closest social networks. This brings the argument back towards the concept of the interests of the few becoming naturalised to those of the many.

Consumption, as Bourdieu (1984) argues, was the key to the reproduction of class relations and a mechanism for studying social relations in some objectified form. Therefore it is extremely hard to find evidence for merely functional or utilitarian applications for material culture (Miller 1995: 26). Why did some materials such as Chephren Gneiss have value over others? This subject is usually tackled in Egyptology from approaches which place emphasis on religious and symbolic associations with certain stones (Baines 2000: 29-41) as discussed in Chapter 4, but what were the properties of the stone that gave it this value in the first place? Aesthetic/visual qualities such as colour and texture, and practical attributes such as hardness, would have been desirable properties (Gryzmski 1999: 53; Baines 2000: 33), but Chephren Gneiss has another even more important attribute: only one remote source. Therefore 'prime value' and consequently 'symbolic value' could have been further attributed due to source, over and above anything else, explaining why its first inclusion among burial equipment was only in elite contexts.

However, value is not a property inherent within an object or material, but rather something assigned by an individual or group that cannot be measured outside of its social context (Renfrew 1986: 158, 160). Perhaps the use of Chephren Gneiss and basalt for tools as well as prestige items is analogous to the use and distribution of obsidian (also with few sources) in the central and western Mediterranean during the Late Neolithic. Close to one source of obsidian at Monte Arci in Sardinia the material was used in utilitarian ways for tools, but remote from its source it had enhanced prestige value due to its diminished availability (Tykot 1996: 67). Perhaps the dichotomy between elite use of hard stones for statuary, vessels and monuments (this applies to basalt as well as Chephren Gneiss) *vis-á-vis* its utilitarian use for tools, can be explained by the value attached to these stones being in the finished product. In this instance, value is being measured by the labour to procure, transport, and craft it, rather than in the material itself: in other words the Marxist labour theory of value (Renfrew 1986: 157).

In the theory of social exchange (Hodder 1982: 207) however, exchange is viewed outside of Marxist labour theory whereby exchanged items may have different values and meanings within each local context and distance from source. The importance of context and cultural/historical associations can also explain why material used for prestige items can also be used in utilitarian ones, within the same historical context (Bradley and Edmonds 1993: 13, 96). In addition, as Bradley and Edmonds (1993: 206) point out, the Neolithic axe trade cannot be seen in modern economic terms, and should instead be linked to broader questions of communication and control whereby status items would seem to be intimately connected to the contexts in which they circulated, or their 'regimes of value'. These models might provide more balanced approaches to the problems of non-local stone tools and unworked blocks of Chephren Gneiss in the Faiyum quarries (see Chapters 2 and 6). Furthermore, these might imply connections between the labour forces or indeed labour being mobilised from the Faiyum. In the discussion of labour mobilisation, the acquisition of such a durable stone for tools might have been a motivator to work at remote source quarries.

Skeuomorphism

Imitations of some hard stones in soft stones, or skeuomorphs, are known as early as the Neolithic in Europe where stone axes from one source were often imitated in a different material (Bradley and Edmonds 1993: 204). As Bevan (2001: 306-8) explains, the degree to which imitations are convincing substitutes for the real thing remains unclear, so imitations or fakes can occupy a range of phenomena from the desire to mislead to isolating stylistic and technical illusions. In Bourdieu's (1984: 176, 251-2) conception of the 'habitus' (practical activities that are materially situated) any type of skeuomorph or fake reinforces the value hierarchy of the objects they seek to imitate and thus reveals the dominant materials and styles.

Skeumorphism as a deliberate attempt to copy silver vessels in ceramics is forwarded as a possible reason for the appearance of the distinctive Grey Burnished ceramics in Palestine in the Early Bronze Age (Philip and Rehren 1996: 144-5). These ceramics, designed as grave goods, copy specific silver vessel forms, similar to the Egyptian example of typical basalt stone vessel forms being copied in black limestone (see Chapter 4). However, in the Palestine example it is interesting that the black glossy ceramics appear to have been produced to copy not new silver vessels, but tarnished ones. Perhaps this was the normal condition of many such vessels circulating in the southern Levant in the 4th millennium BC (*op. cit.*). It could be argued that fakes of hard stones in soft stones, such as copying Chephren Gneiss with (possibly) anhydrite and basalt with black limestone (see Chapter 4), represent an attempt to undermine these higher-value items by being accepted as the real thing. However, evidence for such deliberate attempts to mislead is difficult to ascertain (see further in Chapter 7).

Contextualising Social Organisation and Labour Mobilisation during the Old Kingdom

Several theoretical models of the social context of stone consumption, production and transportation have been selected to show the broad range of conceptual approaches to these issues. The archaeological data is however polarised between elite funerary sites and exotic stone objects on the one hand, and non-elite production sites (quarries) on the other. This polarity in the classes of data suggests that a more broadly-based approach using an eclectic range of theories is more appropriate. As discussed above, Sherratt's (1997) model to understanding the emergence of monumental architecture in the European Neolithic provides some fresh insights by avoiding the standard evolutionary paradigms (in regard to social complexity) and focusing on the importance of the cultural and historical contexts through which monumental construction arose. Torrence (1982, 1986, 1989), Spence (1982), Spence *et al.* (1984) and Bradley and Edmonds' (1993) work in quarries in diverse contexts such as the Bronze Age Aegean, Mesoamerica and Neolithic Britain, respectively, have shown how archaeological evidence (also negative evidence) at production sites can provide significant insights into their social context. These models have used a range of theoretical positions, such as behavioural, functional, contextual, historical and cultural paradigms.

These models tackle some, but obviously not all, of the issues surrounding raw material acquisition in Old Kingdom Egypt. Social organisation and labour mobilisation in this context need to be viewed within the framework of a dominant ideology that surrounds the institution of the king, but avoids monolithic conceptions (such as Marxist-structuralist approaches). The latter of these approaches can produce statements such as this: 'As societies become more hierarchical and their control mechanisms more despotic, power is expressed by commanding the labour of others...' (Trigger 1990: 125). Macfie (2002: 93-5) argues that such a viewpoint is the failure of the traditional Marxist model in its characterisation of the Middle East, even into classical times, as timelessly stagnant, despotic or in decline. In addition, 19th century perceptions of monuments in Teotihuacán also claimed that rulers were 'despotic' and the masses of people were 'slaves' who were sacrificed without scruple (Keen 1971: 442).

In an Egyptian context such distortions, apart from issues related to political and ideological positions of the day, were also common due to the bias of funerary data over settlement evidence, coupled with a strong reliance on written sources and the iconographic record. As a consequence, deterministic and behavioural correlations between people, resources and mortuary practices (Shanks and Tilley 1987b: 34, 44) were made, with sweeping generalisations about the social and political system in Egypt and whether support for it was coerced or voluntary (O'Connor 1974: 16).

Wenke (1989: 132, 149) makes an important point with regard to theoretical approaches to the archaeological record in an Egyptian context, when he suggests that more powerful forms of archaeological theory are required, including the application of powerful social theories: '...if archaeological explanation can ever usefully incorporate social theory, Egypt would seem to be the ideal case to demonstrate this.' The limitations of evolutionary models that suggest preconceived categories of what constitutes a state, chiefdom and social hierarchy can render them blind alleys. In an Egyptian context, iconographic depictions and monumental structures tend to create an impression of continuity and static institutions on a macro-level, particularly when considering the often retrospective nature of certain images and structures, which whether intentional or not, tends to obscure the social dynamics operating on a micro-level.

What seems to be required is a more reflexive theoretical approach, or as Miller (1982: 88) suggests, a realistic view of observable phenomena via empirical data and of structures that are non-observable. It is possible to achieve this on two levels by looking at the empirical data at quarry sites on a micro-level and, at a macro-level, the royal or elite institutions through which labour was mobilised. As Sherratt (1993: 128) and Schiffer (2000: 1-6) point out, there can be a danger in being locked in to one theoretical approach, because any understanding of human phenomena needs to be broadly-based from both cross-level and cross-cultural contexts, from which unexpected connections can be made. This approach, coupled with a broadly-based use of post-structural social theory, can provide useful formulations that allow for greater flexibility in understanding the dynamics of labour mobilisation and move it away from passive actors. Arnold (2000: 14-30) skilfully uses an eclectic approach to power and labour rights in kin-based societies in Melanesia without recourse to passive actors. This is done by incorporating Giddens' (1979: 145-50) 'dialectic of labour control' that is non-passive, because actors create political systems and the power of rulers is the execution of their ideas through the ability to engage others in those actions (Arnold 2000: 15; Schiffer 2000: 8).

To extrapolate this from the archaeological record, Arnold (2000: 19) suggests that changes of great magnitude in power all have material consequences that should be quite visible in the archaeological record. Thus, in an Old Kingdom context, this can be seen on two levels: on a macro-level from the explosion in the consumption of raw materials for monumental construction (driven from the top down); and on a micro-level at quarry sites through standardised production into object blanks, prestige tools (perhaps from non-local stone), alcoholic beverages (presence of beer jars) and transportation innovation to exploit remote source stone.

The 'dialectic of labour control' and 'relational power' encapsulated in Giddens' (1979) structuration theory can produce extremely powerful theoretical models. Such models can be used to explain not only labour mobilisation, but also production and consumption behind the mask of ideology. Although structuration theory is highly abstract, these approaches can be suitably reflexive when applied to the archaeological record at quarry sites. A specific example on a micro-level is explaining the large quantities of beer jars found and what this might imply about the role that alcohol could have played in the mobilisation of labour. This theme is expanded upon in Chapter 9 by developing a hypothesis for labour mobilisation using Giddens' (1979: 88-94) theory of 'relational power' and Sherratt's (1995: 14-5) cultural and historical approach to the manipulation of culturally-embedded commodities to secure outcomes, such as mobilising labour.

At a macro-level ideology is the significant stabilising force or social glue that in an Egyptian context was brilliantly achieved via a mix of theology with implicit iconographic representations and through the cosmology of the monumental structures themselves. These all focus attention on the kings' divine right to rule as constituted within strong cultural and historical antecedents. The institution of the king as the dominant structure thus serves the interests of the few who are closely associated with the ruler. In Weber's (Miller *et al.* 1995: 6, 17; Rowlands 1995: 30) conception of dominance as legitimacy, the institution is maintained by voluntary submission without the threat of force or requirement of persuasion via 'false consciousness', and hence individuals can act in ways apparently contrary to their objective self-interests. Thus the dominant institution of kingship would express itself by the king being given the credit for the existence of the social order. In an Egyptian context this could come via the concept of *ma ʿat* (see Chapter 3) and through the leaders' ability to mobilise collective thought and belief. This legitimization of kingship is a binding force that becomes embodied or becomes the norm. In Giddens' view (1979: 103), these material aspects lock contradictions from view by naturalising these relationships (through rituals) and via control of knowledge. These forms of knowledge in an Egyptian context would be via writing and iconography as a mode of co-ordinating the administrative order of the state and thus a medium of domination (Giddens 1979: 162; Giddens 1982: 229). But this is not static: meanings are concealed and released via those with knowledge and individuals will manipulate these to bolster their own power.

Naturalising the sectional interests of the dominant few to make them appear as universal to maintain the *status quo* is the most compelling aspect of Giddens' theoretical model and in the context of the Old Kingdom this is materialised and played out in many ways. Conspicuous consumption in monumental architecture or, in other words, those who were able to express relationships via material worlds, could manipulate these for social ends. In relation to exchange in the Bronze Age Aegean, Melas (1991: 393-4) uses Giddens social theory with Bourdieu's 'theory of practice' to understand exchange outside of economic and adaptionist frameworks of positivism but in constructions. Thus archaeologically commodities reveal more than materialistic trade but political and religious activities and cultural choices set in historical contexts (*op. cit*: 395).

If the structure (ideology) in Giddens terminology was constantly under pressure, how were labour forces mobilised and organised in such a consistent manner during the Old Kingdom (at its peak) for almost 200 years? This might not have been so difficult, not only due to the naturalisation of the structure but to the cultural and historical antecedents through which it operates. A general assumption made concerning labour organisation and mobilisation for construction projects and thus stone procurement, is that this could only have been achieved within high levels of organisation and with large numbers of people (Trigger 1990; Lehner 1997: 224; Verner 2002: 76, 78). However, interpretation from the cultural and historical perspective of Sherratt (1997), Adams (1987), Spence (1981, 1982) and Spence *et al.* (1984), suggests that highly organised social networks might have already existed through lineage structures. In the context of stone procurement, the Old Kingdom state probably controlled the resource, but production at quarry sites could have been the domain of specialist groups and transportation of stone from remote sources could have been the domain of other specialist groups that were already well established. These themes are further developed in Chapters 7 and 9.

Thus monumental construction did not necessarily put such huge demands on the labour pool, nor did it necessarily arise as a consequence of increasing social complexity (Sherratt 1997: 334-5). As the discussion on population size and demography suggests (see Chapter 3), the idea of tens of thousands of workers involved in pyramid construction may be mistaken, as it is likely that the population was not large enough to sustain such huge drains on human resources for such an extended period. Furthermore, the idea of mass labour being conscripted to work on construction projects during the annual innundation is sparse and only indirect (Eyre 1987: 18). Iconographic depictions and inscriptions at quarry sites, particularly those of the large Middle Kingdom expeditions into the Wadi Hammamat (see Chapter 8), tend to suggest large numbers, into the many thousands, being involved in quarry expeditions. The idea that these sources are simply exaggerations needs to be cautiously approached, particularly in regard to the Western perception of exaggeration as being implicit in some, generally non-Western written sources (Bloom 2001: 116). Hence interpretation needs to consider either possibility; on the one hand whether these inscriptions have a direct relationship to accountancy records of the expedition at the time, or are ideological devices used to express individual aggrandisement which are a limited reflection on actual practices. In the latter case, the act of recording the quarry expedition on stone for perpetuity bears a closer relationship to questions relating to ideology. Further discussion of these aspects are contained in Chapter 8.

Summary

The focus of the first part of the chapter has been to provide a broadly-based overview of the conceptions of power, ideology and labour mobilisation associated with monumental construction projects and how these might be applied in an Egyptian context. From this synthesis it has been proposed that the phenomena of monumental construction and elite stone consumption with their concomitant acquisition of the raw materials cannot be satisfactorily understood under one over-arching theoretical model. An eclectic use of conceptual models from cross-level and cross-cultural contexts, in particular obsidian production, applied to aspects of Old Kingdom quarry data can produce fresh insights into the social context of hard stone quarrying. Furthermore, such an analytical framework allows for social relations to be viewed as dynamic and nuanced, rather than passive and highly-structured, a position that structural-Marxist approaches tend to adopt.

Generalisations about labour force size and transportation of materials from quarries have tended to rely on written sources and iconographic representations to explain these processes. Although these can explain institutions and ideologies as conceived by an elite, they do not explain actual practices because supplicants are represented as passive actors. From these depictions along with the monuments themselves, the implication is of the deployment of large labour forces to procure raw materials who were coerced into this work on a non-voluntary basis. This would only conceivably work on a short-term basis and is not a satisfactory explanation for how stone procurement for large-scale monument building was consistently maintained for over 200 years during the height (4^{th} - 5^{th} Dynasty) of the Old Kingdom. Therefore, this chapter proposes a different approach to problems related to the social organisation and mobilisation of labour by applying reflexive theoretical methods. Models taken from an eclectic range of theories can provide useful formulations to deal with aspects of the empirical data on a micro-level. At a macro-level, ideology *vis-á-vis* the ability to mobilise labour and maintain it for such a long period is understood through post-structuralist social theory.

This approach to aspects of the macro-level, although in part highly abstract, can produce new insights into the observable in the archaeological record with the unobservable structures through which it was maintained.

The cultural and historical antecedents of monumentality and stone procurement within the construct of already well-developed social identities are important concepts that can be used to interpret the empirical data at quarry sites. Such a construct can also be used to approach the complex issues surrounding monumental architecture and why it arose in the first place, outside of evolutionary paradigms. In addition, there is the suggestion that monolithic structures were not necessarily the result of social complexity or strict hierarchies. Explanations of the empirical data at quarry sites can thus be constructed within the context of these operations possibly being carried out by highly-organised but small groups of skilled stoneworkers who were mobilised for these operations. This avoids conceptions of the mass deployment of large labour forces for such projects, that are not borne out by the archaeological record at the quarry sites.

PART 2

THE ARCHAEOLOGICAL RECORD AT QUARRY SITES: STONE PROCUREMENT AND TRANSPORTATION

Chapter 6

Stone Procurement and Transportation from Old Kingdom Quarries: the Archaeological Evidence

Introduction

This chapter concerns stone procurement and transportation from Old Kingdom quarries outside of the Nile Valley using analysis of data collected from recent surveys and excavations at Widan el-Faras and Chephren's Quarry (see Chapter 1). The Nile Valley quarries of Hatnub and Aswan are then compared with this data to establish whether extraction technologies and transport infrastructure might differ between quarries close to and distant from the Nile. The discussion includes relevant textual and iconographic sources to compare against the fresh data, in particular where there are gaps in the archaeological record pertaining to the types of vehicles used to transport stone.

Production processes at quarries and how volumes of stone extracted can be related to stone consumption is also presented here. The objective is to ascertain whether the archaeological record of production processes at quarries can assist in determining whether such activities were exercised on an *ad hoc* basis or were predetermined for specific projects.

Production at Old Kingdom Quarry Sites

REMOTE SOURCES

Chephren's Quarry, Lower Nubia (Upper Egypt)

The geology, geomorphology and layout of the gneiss quarries at Chephren's Quarry have already been described in Chapter 2; the following discussion presents more detail on the quarries, or areas of production, themselves. Production processes at quarries can be divided into two broad categories: 'primary production' covers the method of extracting the stone from the deposit; and 'secondary production' comprises the working or shaping of the stone into either manageable blocks or vessel/statue blanks for transportation, up to the final working of the stone (Ericson 1982: 129-147; Rehren pers. comm. 2001).

Primary Production

From the regional map of Chephren's Quarry (**Fig. 14**) five geographical zones of quarries are identified, each quarry consisting of predominantly *in situ* weathered Chephren Gneiss boulders occurring as groups and varying in size and layout. The majority of these boulders have been removed, and as a result the extraction sites can only be seen as sand-filled depressions. These depressions are surrounded by waste or spoil heaps in varying sizes which reflect the depth of the extractions. All the quarry zones, except Chisel Quarry, have scattered and less-organised satellite quarries on their peripheries that represent workings of single boulders or small groups of boulders.

As described in Chapter 2, the quarries represent two types of workings, either large blocks for statues or small blocks for vessels (**see Fig. 15**); the methods of primary production differ accordingly. For production of large blocks the 'boulder quarrying method' or 'harvesting' of the rock from the bedrock was used, in similar fashion to the extraction of Aswan red granite 'woolsacks' in the Old Kingdom, as described by Röder (1965). This method of primary production involves the digging of a deep trench around the large blocks in order to make space around it to set fires. Evidence from charcoal deposits in the base of one excavated boulder extraction site (EA1) and also under a partially-worked statue block in the 'Unfinished Statue Quarries' (Central Chephren's Quarry), strongly suggests that fire-setting was being practised here **(Pls. 47a, 47b)**. This technique would precipitate the opening of potential cracks and exfoliation of the outer weathered crust to the sound core of the boulder (Storemyr *et al.* 2002: 27; Heldal and Storemyr 2003: 21). The use of fire-setting is also evident at the Aswan quarries. It is suggested by Clarke and Engelbach (1930: 27) that fires were banked up around the boulders with crude brick to concentrate them and, once the outer surface was hot, water was applied. This rendered the stone soft and crumbly and easy to remove by hand. These earlier observations and interpretations made by Clarke and Engelbach are supported by current excavations in the 'Obelisk Quarry' (part of the Aswan quarries). These excavations have revealed abundant evidence of burnt mudbricks associated with thick ash layers and charcoal under stone blocks, supporting the view of fire-setting being extensively employed **(Pl. 47c)**.

The depth of the boulder extraction site (EA1), excavated in the 2003 season in the 'Loading Ramp Quarries' (Central Chephren's Quarry), revealed that the quarrymen had to dig into the bedrock to a depth of almost two metres before reaching the base of the boulder **(Pl. 48a)**. The tools used in this process are difficult to determine, because tool marks in the sides of the extraction site are not clearly visible. However, a magnificent hand-held finely crafted stone axe of Chephren Gneiss was found within a spoil heap associated with this extraction site, suggesting that such sharp cutting tools were probably used at some time in this process **(Pl. 48b)**. A sloping pathway leading up to the ground surface implies that once the boulder was separated from the bedrock it was hauled up onto the surface for further splitting **(Pl. 49)**. This would seem most practical, given the restricted size of the work area inside the extraction site.

Quarrying of small blocks for vessels involved the use of heavy, rounded stone pounders to crack the blocks, many of which litter the Northern vessel quarries **(Pl. 50a)**. These large pounders would require two hands to lift and were only used for a short time before they cracked. Hence, the majority of these large pounders lie broken in half in the vessel quarries. Smaller, more rounded pounders that can be cupped in one hand also occur, mostly unbroken, and were used for rough trimming of the blocks **(Pl. 50b)**.

The stone tools (discussed in detail later in this chapter) are provenanced to local dioritic dykes and sound granite outcrops which occur close to the quarries. Chephren Gneiss was also used for tools, but to a lesser extent and generally where dioritic dykes were not close by.

The spoil heaps from primary production of large blocks in Central Chephren's Quarry consist of a matrix of black (hornblende) and white (feldspar) minerals that represent the highly-weathered fragments of Chephren Gneiss; the extent of the weathering suggests high degrees of humidity (Storemyr pers. comm. 2002). Fire-setting would also have accelerated the weathering process quite considerably. Therefore, the spoil heaps that surround the extraction areas were probably originally just piles of Chephren Gneiss fragments which now have the appearance of powdery dunes **(Pl. 51)**. As seen from the plans of 'Khufu Stele Quarries' and 'Chisel Quarry' workings **(Figs. 26a, 26b)**, the distribution of the spoil heaps forms an organised, almost circular, arrangement around a central area of boulder extraction, approximately 100 m in diameter.

Vessel and Block Quarries

The characterisation of the numerous quarries that make up Chephren's Quarry into either predominantly 'vessel' or 'block' quarries is assessed from variations that can be observed in primary and secondary production evidence. The criteria being used to designate 'block' and 'vessel' quarries is set out in the table **(see Fig. 27)** which details the production evidence observed at the main quarries. Following is an overview of these criteria:

Block Quarries: these are characterised from primary production evidence consisting generally of single large depressions from where a single boulder has been extracted, for example, at 'Loading Ramp Quarries'. Evidence for fire-setting is evident in the block quarries, this can be inside an extraction area (see above at EA1) or under partially-worked blocks. Secondary production evidence is characterised by the presence of partially-trimmed large blocks, which have been shaped, either by fire-setting or pounding, into standard sizes (usually over one metre in length) or statue blanks (a stone block that is shaped into the rough outline of a statue). Stone tools are limited and are either widely scattered or absent.

Vessel Quarries: primary production is characterised by numerous scattered small depressions surrounded by spoil heaps of varying sizes, with numerous satellite quarries. Secondary production is characterised by clusters of work areas where small blocks were trimmed into either vessel blanks (stone that is shaped into a vessel form but not hollowed and mostly found at Quartz Ridge) or homogenous small blocks (Chisel Quarry). Stone tools are numerous in the vessel quarries consisting of large two-handed stone pounders in primary production areas, and small hand-held pounders and axes in areas of secondary production.

There are some 'grey' areas in these criteria, particularly in the block quarries. For example, at Khufu Stele Quarries, although this quarry is predominantly a large block quarry, scattered areas of vessel blanks can be also be observed. However, at the vessel quarries, particularly Chisel Quarry and Quartz Ridge, there is no evidence for large block quarrying. Variations in the size of spoil heaps is not a criteria that can be used to distinguish vessel from block quarries, because the size of these is dependent upon how deep the extractions are and the quantities of bedrock that have to be removed. For example, Chisel Quarry (a vessel quarry) has the largest spoil heaps due to the extraction having to penetrate into the solid bedrock. This has formed a deep, almost circular depression, now filled with aeolian sand (**see Fig. 26b, Pl. 52**). It was at Chisel Quarry that the only evidence of copper tools was found, in the form of a rounded chisel which is described later in this chapter (**see Pl. 38**).

Secondary Production

At the block quarries basic trimming to produce standard rectangular sizes was by pounding with predominantly small pounders and/or by fire-setting. At the Unfinished Statue Quarries both these production methods were used to produce the rough outline of a seated statue (**Pl. 53**). A more detailed discussion of these object blanks follows later in this chapter. The vessel quarries reveal more numerous but smaller areas of secondary production: these are clearly exposed at Quartz Ridge and Pounder Quarries. At Pounder Quarries these areas are visible on the surface as clusters of concentric rings of production, which grade inwards, from larger chips on the outer edge to small chips in the centre. Associated with these work areas are small stone pounders and pottery dating to the Old Kingdom (El-Senussi 2003: 2). Four such work areas can be observed at Pounder Quarries, suggesting that four people probably worked here (**Pl. 54**).

Quartz Ridge and some areas of the Khufu Stele Quarries are the only quarries where working of the stone into vessel blanks is observed. These objects lie as surface scatters close to stone-walled structures that represent the only visible remains of a possible settlement (see Chapter 8). The vessel blanks are mainly of shallow bowls and are forms which have direct correspondence with finished objects (see Chapter 4 and later in this chapter). Final hollowing and polishing was carried out somewhere else, probably in specialist workshops closer to the Nile Valley, as no boring or drilling tools were found.[1] Quartz Ridge is also different from the other quarries because secondary production evidence outweighs that of primary production, suggesting that this area might have been the hub of vessel blank production. At Chisel Quarry secondary production concentrated on trimming small blocks into homogenous rectangular sizes, these being placed in regular rows close to a cleared path leading away from the quarry in a northerly direction. Perhaps Quartz Ridge was the destination?

[1] An Old Kingdom stone vessel workshop is known at Hierakonpolis (described in Chapter 8). Alternatively, vessel and statue blanks could have been transported up to Lower Egypt; this is discussed in more detail in Chapters 7, 8 and 9.

Widan el-Faras

Primary Production

The basalt quarries at Widan el-Faras present a completely different impression because there *are* visible quarry faces and so evidence of primary production can be clearly seen. The quarries have been described in more detail in Chapter 2, to summarise, they are represented by five individual extraction sites labelled 1-5, four of these are in the East Quarry and one in the West Quarry (**see Fig. 2**). Each quarry consists of typically 4-8 individual swales (depressions) that are a series of shallow benches cut into the upper part of the basalt layer. These depressions extend along the escarpment rim for approximately 800 m in the East Quarry and 60 m in the West Quarry (Harrell and Bown 1995: 74-5; Bloxam and Storemyr 2002: 24-6).

Production waste in the form of basalt fragments was thrown behind the quarrymen as they worked and this cascades down the escarpment as scree. Therefore, estimating the volume of production waste is problematic. However, the middle part of Quarry 1 is quite different from the rest (**Pl. 55a**). It has very distinguishable remains of benches created from quarrying, as well as waste dumps left within the quarry. As the waste is stacked in relatively organised heaps, it is possible to calculate that, on average, 60% of the total volume extracted was waste (Heldal pers. comm. 2002). This is also the only quarry in which tool marks were found, in the form of two or three weathered wedge-like holes and the marks of a blunt tool on fragments in the waste dumps (**55b**). These have split the basalt and created plumrose marks radiating from the point where the rupture was initiated (Bloxam and Storemyr 2002: 24). From the presence of Early Roman Period pottery associated with the middle part of Quarry 1, and the absence of similar tool marks in the Old Kingdom quarries, it seems that these tool marks are representative of the Roman extractions (Röder 1965: 517; Klemm and Klemm 1993: 305-53). Although it is difficult to assess exactly how extraction took place, the depth of middle Quarry 1 indicates that the use of metal tools allowed quarrying to progress deeper into the flow. This might explain why the Roman extractions are concentrated in just one quarry.

The Old Kingdom quarries show no signs of tool-marks and the method of extraction can only be surmised as via wedging of the blocks from the deposit with levers, the highly fractured nature of the basalt availing itself to this method (Harrell and Bown 1995: 74-5; Bloxam and Storemyr 2002: 25). Although the fractured nature of the stone made it relatively easy to wedge out, it also made it difficult to extract blocks of more than 1 m^3. Observations of modern quarrying at Widan el-Faras confirms that the deeper into the flow the quarrymen went the more massive (thick and less jointed/fractured) it becomes and hence more difficult to extract (Bloxam and Storemyr 2002: 25-6). This geological circumstance might explain the presence of so many individual extraction sites which are relatively shallow and laterally spread, the quarrymen needing to move to a new site once the massive rock was reached. Despite the difficulty presented to the Old Kingdom quarrymen when reaching the massive basalt, there were still areas of the flow, particularly west of the West Quarry, where better-quality basalt was left completely untouched in antiquity. Much larger blocks could have been obtained from here which suggests that the quarrymen were only interested in medium-sized blocks of roughly 1 m^3 (the average size used for paving). This size block would also be more feasible to transport, given the 11 km overland journey to Lake Moeris, (this distance being even greater when starting west of the West Quarry).

Secondary Production

Secondary production seems to have concentrated only on the basic trimming of blocks into more manageable sizes for transport. At the terminus of the quarry road on the quay at Qasr el-Sagha there is more evidence of secondary production, in the form of circular depressions surrounded by small heaps of basalt chips and remains of blocks associated with a few small stone pounders (**Pl. 56**). Old Kingdom pottery sherds were also found associated with these areas (El-Senussi 2001: 3-4).

NILE VALLEY AND ADJACENT EASTERN DESERT PLATEAU

The Aswan (granite) Quarries

Primary Production

Evidence of Old Kingdom primary production of Aswan granite and granodiorite is almost impossible to determine due to consistent quarrying into the present day destroying most of the older quarries. Therefore, discussion of production processes here is sourced mainly to Röder's (1965) geological description and assessment of quarrying methods. Clarke and Engelbach (1930), Klemm and Klemm (1993), Arnold (1991), Peacock and Maxfield (1997); Maxfield and Peacock (2001) have also produced discussions about granite-quarrying methods, these, however, have mainly centred on New Kingdom and Roman Period production processes.

It is likely that the Old Kingdom quarries concentrated on the 'woolsacks' or large loose boulders with volumes of between 4-6 m^3 that had become separated from the massive rock (Röder 1965: 472-4; Klemm and Klemm 1993: 306-7; Aston *et al.* 2000: 35-7). These 'boulder quarries' would be very close to the river and are known on the islands of the First Cataract and on the banks of the Nile. Due to present day lower Nile levels, an indication of what these boulder quarries may have looked like can be seen from similar outcrops that are now exposed on the banks of the river (see Chapter 2) (**Pl. 57**). Although no evidence of Old Kingdom primary production remains, removal of these boulders would be via a similar method as practised at Chephren's Quarry or 'boulder quarrying'. A combination of fire-setting and 'tapping' with pounders of tougher dolerite was probably used to remove the outer weathered surface, followed by utilisation of the natural rock fractures to lever the boulders away (Röder 1965: 479-82; Waelkens *et al.* 1992: 6). Röder (1965: 472-4) suggests that only basic primary production (removal of the outer weathered surface) occurred at the quarries during the Old Kingdom, with secondary production occurring at the construction sites.

The Hatnub Travertine Quarries

Primary Production

Primary production during the Old Kingdom at Hatnub was concentrated at Zone P (see Chapter 2) where the Old Kingdom inscriptions are located. Primary production here would have been much easier given the relative softness of the stone, using a method similar to that of limestone quarrying via deeper 'gallery-style' extraction (Clarke and Engelbach 1930: 20; Aston *et al.* 2000: 6). At Hatnub the quarry would have at one time been subterranean, consisting of an open circular pit with vertical sides more than 20 m deep, which have now collapsed (Clarke and Engelbach 1930: 20). The entire area surrounding the quarry is ringed by spoil heaps consisting of travertine chips, suggesting that initial trimming of the blocks occurred immediately at the quarry (Petrie 1894: 3; Clarke and Engelbach 1930: 20; Shaw 1986: 191; Shaw 1994: 112). Tools used for this process would have probably been copper picks and chisels, although no tools associated with Zone P have been found.

Secondary Production

Large quantities of travertine chips were present in the workmens' huts approximately 100 m from the primary production area, this being where rough dressing occurred prior to transportation (Shaw 1986: 198). A hammer-stone and scatters of flint tools were found in one of these production areas, but in undatable surface contexts (Shaw 1987: 162, 166). The famous 12th Dynasty depiction of Djehutihotpe's statue (Newberry 1895: 16-26, pls. XII-XIX; Clarke and Engelbach 1930: 85; Arnold 1991: 61) being transported from the Hatnub quarries suggests, if taken at face value, that secondary production would have been to final form at the quarries. However, with few iconographic parallels to evaluate the Djehutihotpe depiction, it could be suggested that this was simply a way to combine a view of transport with a view of an ideal finished statue (**Fig. 25**).

There is no evidence of final finishing occurring in the quarries and the road connecting the quarry with the Nile is strewn with blocks of unworked travertine (Petrie 1894: 4), suggesting that only rough trimming occurred prior to transportation. Given the softness of this stone it would seem rather impractical to produce final forms at the quarry, to then transport them overland for 17 km. Furthermore, with the Nile, and thus settlements, being not too distant from the quarry, it would seem feasible that final crafting and polishing would be carried out either at these settlements, or at the palace workshops close to the construction sites.

Tools and Extraction Technologies

Stone and Metal Tools

Methods of primary production are determined by the nature of the stone itself (hard or soft) and how it was deposited. In the context of Old Kingdom quarrying, stone tools dominate the quarrying process (Clarke and Engelbach 1930: 32; Arnold 1991: 258). The stone tools at Chephren's Quarry were always locally-sourced to dioritic dykes, basalt dykes and plugs, sound granite, or Chephren Gneiss if these stones were not immediately available. The tools occur as three specific types: large heavy pounders resembling the huge dolerite rammers found in the Middle to New Kingdom tomb of Mentuhotep at Lisht (Arnold 1991: 263, fig. 6.17) **(Pl. 50a)**; small rounded pounders that would be cupped in one hand **(Pl. 50b)** and small hand-held axes **(Pl. 58)**. All the tools found at Chephren's Quarry were hand-held as none had a contracted neck to attach a handle (Arnold 1991: 262).

The distribution of these three types of tools at Chephren's Quarry are listed in the table **(Fig. 28)** under three category headings: (1)'Two-Handed Stone Pounders' for the large heavy pounders that require two hands to lift; (2) 'One-Handed Stone Pounders' for pounders that can be cupped in one hand; (3) Hand-held axes. From this distribution of stone tool types to either the vessel quarries or block quarries, an indication of the tools used for both production processes can be evaluated. The vessel quarries show a greater number and wider distribution of the two-handed stone pounders and hand-axes, particularly in Northern Chephren's Quarry. At Central Chephren's Quarry (predominantly block quarries) the quarries have small scatters of tools which generally comprise one-handed stone pounders. The stone tool assemblages thus appear to depend on which extraction processes were being practised. In the vessel quarries this comprises cracking of small boulders with the two-handed pounders, followed by rough working with the one-handed pounders and finally working of the blocks into vessel blanks with the hand-held axes. In the block quarries, because fire-setting was the principal method of exfoliating the weathered surface and trimming the blocks (see above), one-handed pounders predominate the small assemblages. These pounders were used for squaring and hewing the blocks and evidence for the use of pounders to work statue blocks can be seen on the surfaces of some of these discarded blocks (Storemyr *et al.* 2002: 27; Heldal and Storemyr 2003: 23) **(Pl. 59)**.

At Widan el-Faras the few stone tools found in the quarries were generally large (25 cm x 14 cm) and small (12 cm x 6 cm) stone axes.[2] In the table **(see Fig. 28)** these tools are listed under two category headings: (1) 'Large Stone Axe' (>21 cm) for those that are greater than 21 cm in length; (2) 'Small Stone Axe (<12 cm) for those that are 12 cm or less in length **(Pl. 60a)**. Both sizes of axes have contracted necks to facilitate the attachment of two wooden sticks with leather straps, as depicted in the tomb of Ti (Arnold 1991: 262, fig. 6.13). Such tools were ubiquitous at 4th Dynasty pyramid sites and used for dressing-down surfaces, many being found at Giza around the pyramid of Menkaura (Reisner 1931: 236-7) and at the Meidum pyramid site of Snefru. An example of a large stone axe found at Meidum (23.4 cm x 9.85 cm) is displayed in the Petrie Museum (UC 30858; Petrie 1917: 46, pl. LIII, 74) **(Pl. 60b)**. Smaller axes in basalt and synenite are also known in contexts such as the Sinai copper mines (Petrie 1917: pl.LIII, 75-7). Harrell's recent geological analysis of the Widan el-Faras tools classifies the stone as dolerite, with a provenance to either the Aswan region and/or Chephren's Quarry (Harrell pers. comm. 2003). It is probable that these tools were produced at the nearby Umm es-Sawan gypsum quarries where unworked blocks of several non-local stones were found in a tool-making context. These assemblages also included unworked blocks and pounders of Chephren Gneiss **(see Pls. 14, 15a, 15b)**. The implications of these findings are discussed in Chapters 8 and 9.

[2] These tools have been given a number of different names: axes, mauls and picks (Arnold 1991: 260). In this thesis the term 'stone axe' will be used.

The predominance of stone axes at Widan el-Faras is rather puzzling because the method of extraction is thought to have been by levering of the blocks from the deposit, probably with copper gads/chisels (Harrell and Bown 1995: 74; Harrell 2002: 237). This method would provide the precision required to utilise the natural rock fractures and although no metal tools have been found in the basalt quarries, this does not rule them out, given that metal tools were highly prized and so rarely discarded. If the levering method was used this would render the stone axe rather redundant for such a task, as they were mainly used for rough work, such as excavating chambers and also breaking the separation trenches for building blocks in quarries (Arnold 1991: 262). This might explain why plenty of them were observed in the limestone chip quarries, 500 m south of Widan el-Faras (**see Fig. 2**). Stone axes, rather like picks, tend to leave a curved line on surfaces (*op. cit.*). However, no such traces are evident in the basalt quarries and although these traces could have weathered away or indeed have been obliterated by later quarrying, later extraction only occurred in the middle of Quarry 1, as described above. Consequently, for what were the stone axes used? It is possible that they were used to trim the blocks *after* extraction for transportation, given that they have been specifically associated with the trimming of basalt to produce a flat surface (Arnold 1991: 262).

The use of metal (copper) tools in the Old Kingdom for stone-working tends to be a controversial subject, mainly due to the lack of data in the archaeological record (Aston *et al.* 2000: 7). However, metal chisels are known to have been used in stone-working since the 3rd Dynasty with examples found at Djoser and Pepi II's pyramid complexes (Arnold 1991: 257-8). The copper chisel found at Chisel Quarry is 24 cm in length and has a rounded cutting end. The chisel was found in a surface context by Engelbach (1938, pl. LIX) and is now in the Egyptian Museum (**Pl. 38**). Petrie classified this type of chisel as a regular stout form of stonemason's chisel, with examples also found in late Middle Kingdom contexts at Kahun (1917: 20, pl. XXII: 76, 77). Interpretation of the inscriptions (discussed in Chapter 8) on the chisel by Rowe (1938: 391-3, pl. 59) dated the chisel to the 4th Dynasty and to a 'company' of workmen who used it. Analogous inscriptions are also known on the adze of Snefru (Petrie 1910: 43, pl. XXXVII) and the axe-head of Khufu or Sahure (Rowe 1938: 391). The use of this chisel in either primary or secondary production at Chisel Quarry has yet to be determined. Traces of chisel marks have not been detected on the partially-trimmed blocks at the quarry and excavation into the extraction area at Chisel Quarry is yet to be undertaken.

Estimating Volumes of Stone Extracted

Estimating the total volume of stone extracted from Chephren's Quarry, given the enormous geographical range of the quarries, is no easy task. It was not until the 2003 season that there was an indication of the depth of boulder extraction sites into the bedrock, or indeed an idea of the total number of extraction sites. Now that these have all been surveyed and mapped, (see Chapters 1 and 2), it might be possible to produce a very rough estimate. Given the fragmentary nature of the consumption record, such a study could produce a rough approximation of the proportion of Chephren Gneiss surviving in the archaeological record.

Rõder (1965: 550-1) faced a similar situation at the Aswan red granite boulder quarries, although here the problem was mainly one of determining where the Old Kingdom extraction sites might have been. Hence, Rõder tackled the problem by estimating the volume of stone *used* at the Old Kingdom pyramid complexes. From this study Rõder (*op. cit.*) calculated that the Aswan red granite used for monumental construction would have amounted to approximately 40,000-45,000 m^3 of dressed stone. This calculation of dressed volume Röder (*op. cit.*) based on waste averaging 60% of the total volume extracted, therefore the undressed volume extracted would have been approximately 100,000 m^3.

Estimating the volume of travertine extracted from Hatnub has not been attempted in any previous study due to two probable factors: firstly, the difficulty of using consumption as a guide, given that sourcing of the stone to one quarry is problematic (see Chapter 2); and secondly, the collapse of the quarry faces. However, Widan el-Faras presented the best opportunity to attempt this, given the visibility of the extraction sites and because basalt consumption in the Old Kingdom was generally restricted to monumental use in just four royal pyramid complexes that are still partly visible. An estimate of the total volume of basalt extracted from each of the five quarries at Widan el-Faras in the Old Kingdom is given in the table (**see Fig. 23c**), and from these figures a net volume is calculated by deduction of waste volumes of between 50%-70%. This gives a net basalt volume extracted in the Old Kingdom that ranges between 1,600 m^3 and 3,000 m^3.

Using Röder's (1965) waste calculations as a guide, and calculating the size of waste heaps in the Roman extraction area (middle of Quarry 1), a waste estimate of 60% is suggested (Bloxam and Storemyr 2002: 26-8). If 60% waste is applied, the total net volume of basalt extracted in the Old Kingdom is approximately 2150 m^3, making it close to that of the total volume used in the four Old Kingdom pyramid complexes at 2074 m^3 (**Appendix B 5**). However, this *only* applies if the walls and floor of both Sahure and Nyuserra's causeways were *not* of basalt which still remains unclear. Borchardt (1907: 13; 1910: 32) mentions that at least the lower courses of the causeway walls were basalt, this however was only deduced from spot excavations, rather than complete excavation (**see Figs. 23a, 23b**). Furthermore, the other unknown variable is the possibility of basalt re-use during the Old Kingdom.

What clearly emerges from these calculations is that the procurement of Widan el-Faras basalt during the Old Kingdom was more than in any other period, although the volume of red granite extracted from the Aswan quarries during the Old Kingdom outweighs basalt by a ratio of almost 20:1. However, some caution needs to be applied to the estimates of basalt consumption in the Old Kingdom, due to re-use and the poor preservation of some structures. Although estimates have been given for unseen structures from other published sources, there is no way of knowing exactly what the total basalt use was. Taking these points into consideration, along with the *very* large blocks (up to 5 m^3) lining the wall of Nyuserra's mortuary temple (this size being difficult to extract from the Widan el-Faras quarries), another source of basalt cannot be ruled out. This additional source could be in the region of Abu Roash (Clarke and Engelbach 1930: 23; Klemm and Klemm 1993: 415; Harrell and Bown 1995: 76; see Chapter 2) or even at El Bahnasa, where there are a few potential sources. However, modern quarrying has obliterated all traces of ancient workings in these quarries (from field observations by the author, 2002).

Vessel and Statue Blanks: Evidence of Secondary Production into Standardised Forms

The comparison of extracted volumes and consumption estimates at Widan el-Faras suggests that even in primary production some predetermination and standardisation of block size was being practised. As explained above, it seems likely that the quarrymen were primarily after medium sized blocks of approximately 1 m^3, the most common block size used for paving mortuary temple floors. Secondary production, as a consequence, was likely to have been minimal, consisting of rough trimming of blocks for transportation purposes, with final finishing occurring at the pyramid construction site.

At Chephren's Quarry, one criterion for characterising block quarries and vessel quarries was derived from the nature of the discarded material, such as statue and vessel blanks. Two statue blanks located in the Unfinished Statue Quarries were probably intended for seated life-size statues **(see Pl. 53)**. The excavated dimensions of one statue blank are: 1.7 m (L) x 0.7 m (width at base) x 0.7 m (depth), the width at the head of the block is reduced to 0.28 m. This compares to a completed (headless) Khafre seated statue **(Pl. 61)**, in the Egyptian Museum (Cairo) (CG 10, Borchardt 1911: 9-14) as follows: 1.06 m (L) x 0.44 m (width at base) x 0.6 m depth. Superimposing the outline of the finished statue over the blank **(see Fig. 29a)** shows a possible predetermination of the blank for a specific object.

In Khufu Stele Quarries standardised blocks for either statues or large vessels can be observed. Lined up and destined for one loading ramp are five roughly-squared blocks, with almost identical widths between 0.7 m to 0.8 m and lengths that range between 1.3 m and 1. 2 m **(Pl. 62)**. It is possible that these could have been used in the manufacture of large vessels, such as the 5th Dynasty example displayed in the Egyptian Museum (CM39409) and described in Chapter 4 **(Pl. 41b)**. The finished dimensions of this large vessel are 0.73 m (H) by 0.52 cm (W) suggesting that it could have been produced from blocks of the size mentioned above. Vessel blanks, found mainly at Quartz Ridge, also tend to be of standardised sizes, mainly for shallow bowls and cylindrical cups (**Pl. 63a**). Sizes of blanks for shallow bowls range typically between 10 cm and18 cm in diameter and up to 15 cm deep (**Pl. 63b**). Compared against finished Chephren Gneiss bowls in the Petrie Museum, measuring between 17.9 cm in diameter by 10.8 cm in height (UC41216) (**Pl. 41a**), to 8.6 cm diameter by 3.7 cm in height (UC41245) (**Pl. 63c**), this further demonstrates the parity between secondary production to vessel blanks and the final product.

Standardisation can also be observed at other Old Kingdom quarries, particularly those also exploited for vessels, such as the Umm es-Sawan gypsum quarries in the Northern Faiyum (see Chapter 2) and the Gebel Manzal el-Sayl tuff and tuffaceous limestone quarries in the north-central part of the Eastern Desert (Harrell *et al.* 2000; Harrell 2002). Vessel blanks in these quarries are more plentiful than at Chephren's Quarry, indicating the significance of reducing the amount of discards of highly-valued Chephren Gneiss (**Pl. 64a**) (see Chapter 4). At both Umm es-Sawan and Gebel Manzal el-Sayl, the production of vessel blanks tends to occur in designated areas away from the extraction sites, as in Chephren's Quarry. At Gebel Manzal el-Sayl 15 such areas are designated as quarry workshops, where the blanks were simply shaped to standard forms with stone pounders and small stone axes. These tools litter the site (Harrell *et al.* 2000: 38-9, pl. IV.4). There was no evidence to suggest that hollowing or polishing of the vessels was practised at the quarry; this was more likely to have occurred in specialist workshops closer to the Nile Valley (Harrell 2002: 232-3).

At Umm es-Sawan among more than 3,000 vessel blanks, three types of tools were discarded in the stone workshops: axes of dolerite and Chephren Gneiss, 'pebble' hand picks, and huge quantities of crescent shaped flint drills for hollowing, suggesting that production to final forms took place there (Caton-Thompson and Gardner 1934:104-12; Harrell 2002: 234) (**Pl. 64b**). Based on these finds Umm es-Sawan has been designated as a stone vase factory (Caton-Thompson and Gardner 1934: 106), which could have been linked to a palace workshop connected to the cult centre/town of Shedet (Ćwiek 1997: 18-9; see Chapter 3).

A factor specific to the Gebel Manzal el-Seyl vessel blanks is that some are inscribed with the hieroglyph that can be read as 10 (*mḏ*) which Harrell (2002: 232) interprets as representing an accounting device to mark every tenth blank produced. Whether this is a correct assumption or not, the significant parallel that *can* be drawn between Gebel Manzel el-Sayl, Umm es-Sawan and Chephrens' Quarry is that secondary production was in all probability for standard vessel forms. However, it cannot be firmly established that objects were more likely to have been finished at remote source quarries as opposed to less remote quarries. For instance, at Widan el-Faras only very basic trimming of the blocks occurred *in situ* before transportation and at Chephren's Quarry there is no evidence to suggest that final forms were produced here. Much confusion surrounds this matter, mainly due to the overemphasis placed on the Djehutihotpe statue scene **(Fig. 25)** being a literal representation. This implies that, at Hatnub, statues were completely finished in the quarries, a situation that could have been replicated at other quarries. Although in the New Kingdom workings at the Aswan quarries almost finished statues are clearly seen, this is so far unknown in Old Kingdom contexts (Röder 1965: 479-82, see above). As Aston *et al.* (2000: 15) point out, Pharaonic period artists portrayed objects in finished form even when they were clearly incomplete. Moreover, evidence to suggest that completion of objects occurred close to the pyramid construction site, possibly in royal workshops, comes from Reisner's (1931: 112, pl. 62; MMA 281) discovery of 14 unfinished seated Chephren Gneiss statuettes of King Menkaure **(Pl. 65)**. Four statuettes and four larger statues had all been crafted to the stage where signs of bruising/dressing of the stone had been removed to a dull polish.

To summarise **(also see Fig. 29b)**, the production patterns observed at Widan el-Faras comprise primary production at the source in areas of the basalt flow that yields blocks of up to 1 m^3, the standard block size used on mortuary temple floors. Secondary production evidence is limited, although basic block trimming would have occurred at the quarries (and is evident at the quay) to reduce the transportation weight. Final trimming would have occurred at the pyramid construction site during the process of floor laying. At Chephren's Quarry primary and secondary production tends to be designated as exploitation either of large blocks intended mainly for statues, or small blocks for vessels. The secondary production evidence ranges from working to standardised blocks for vessels or statues, or further working to object blanks. Finishing (polishing and final crafting) would have occurred elsewhere, probably in specialist workshops closer to the Nile Valley, as there is no evidence of discarded finished forms or tools such as grinders and borers which are necessary for this final production phase. The amount of stone reduction occurring during secondary production at Chephren's Quarry, especially to object blanks, is probably connected with the practicalities of reducing the transport weight as much as possible.

Pottery in Production Areas: Evidence for Dating

In general, quantities of pottery found in the production areas of remote source quarries, such as Chephren's Quarry and Widan el-Faras, are extremely small; at the isolated Old Kingdom stone vessel quarry of Gebel Manzal el-Seyl, *no* pottery was found at all (Harrell *et al.* 2000: 41). The pottery collected in the quarries at Chephren's Quarry is scant and consists mainly of body sherds of small bowls, storage jars and beer jars, dating between the Early Dynastic to Old Kingdom (El-Senussi 2003: 2) **(Figs. 30a, 30b; Pl. 66a)**. At Quartz Ridge, however, small pottery assemblages have only been found in contexts associated with the settlement area (discussed further in Chapter 8) which date not only to the Early Dynastic and Old Kingdom but also to the late 12th Dynasty (Darnell 1999; El-Senussi 2003: 1-2). These comprise sherds of storage vessels and small bowls **(Figs. 30c, 30d)**. At Stele Ridge Middle Kingdom pottery dominates and is clearly associated with the Middle Kingdom amethyst/carnelian mining here. Small amounts of Old Kingdom pottery were also found at Stele Ridge, such as sherds of Meidum bowls and one sherd deriving from a 4th Dynasty footed bowl or stand (Darnell 1999; Shaw 2002: 248).

At Widan el-Faras pottery dating to the 4th and 5th Dynasties was found in all the quarries except Quarry 4, and small amounts of Early Roman Period amphora sherds were found in the middle of Quarry 1 (El-Senussi 2001: 1-2) **(Figs. 31a, 31b, 31c)**. The context of the Widan el-Faras pottery is reasonably secure, despite these assemblages being surface scatters, due to generally good preservation and little later activity in the quarries. The Old Kingdom amounts are small and generally fall into two categories: wine/beer storage jars and bowls, consistent with temporary rather than settled domestic use. A more specific date of the early 4th Dynasty has been suggested for the pottery in the eastern area of Quarry 1, based on comparative examples known at Giza (Reisner 1942). A sherd found between the 'Main Quarrymen's Camp' and the quarries is similar to sherds found at early 4th Dynasty Meidum and Abydos and also in the workmen's community at Giza dating to the reign of Khafre (El-Senussi 2001: 1-2). However, this could have been washed down from Quarry 1, and is therefore not a secure context.

Assessing a chronology from these limited ceramic assemblages, to determine which quarries were first at Widan el-Faras, is difficult. However, the possibility of Quarry 1 being opened first is suggested, given that the ceramic sequence starts here in the early 4th Dynasty. This opens up the possibility that quarrying along the basalt flow was in an east-west direction.

Summary

Old Kingdom primary and secondary stone production evidence at Chephren's Quarry and Widan el-Faras suggest that procurement of stone from these remote sources was for specific objects and likely to have been project-driven. At Widan el-Faras this is implied by the quarrymen exclusively seeking 1 m^3 or medium-sized blocks, the dimensions which correspond with the size of blocks used for paving temple floors. Furthermore, when the estimated volume of basalt extracted from Widan el-Faras is compared with the estimated volume used on temple floors, the figure strongly suggests that the quarry was the principle basalt source for these temples. However, another basalt source might have to be considered for 5th Dynasty temple wall lining blocks and causeways, given that the total estimated volume of basalt extracted from Widan el-Faras does not allow for its use in these features.

At Chephren's Quarry the methods of production observed enable each of the boulder quarries to be classified as either vessel or block quarries and imply that the exploitation of certain quarries was predetermined with specific projects in mind. This view is further enhanced via the evidence of standardised secondary production, such as vessel and statue blanks, commensurate with the theory that procurement was for particular objects.

Comparing the production evidence at Widan el-Faras and Chephren's Quarry with that at the less remote sources of Hatnub and Aswan is problematic due to the poor preservation and modern quarrying at these sites. However, it can be implied from the sources researched that Old Kingdom secondary production was minimal at these Nile Valley quarries, a situation that could be related to their closeness to places of permanent settlement. Secondary production probably took place in local workshops with exploitation being on a more continuous basis and perhaps not linked *specifically* to certain projects. Furthermore, contrary to the iconographic depictions, there is no evidence to suggest that objects were finished in Old Kingdom quarries, even if the stone source was remote. In summary, stone procurement at Widan el-Faras and Chephren's Quarry in the Old Kingdom is considered to be campaign or project-based, setting a framework from which the social organisation of these enterprises might be determined.

The use of specific stone tools and their presence or absence within the quarries at Widan el-Faras and Chephren's Quarry, indicates that the methods used to extract the stones showed a clear understanding of how to exploit geological phenomena such as fracturing. All the stone tools found at Chephren's Quarry were hand-held and locally sourced to dioritic, granitic and basalt dykes, whereas those at Widan el-Faras were mainly of non-local stone with the axes having contracted necks for the attachment of a haft. The dolerite used for the stone axes at Widan el-Faras is suggested as having a source either at Chephren's Quarry and/or the Aswan region. Chephren Gneiss tools at Umm es-Sawan further imply a connection between the Faiyum quarries and Chephren's Quarry. The form that this connection took raises some interesting questions: was this connection through the same quarrymen who took Chephren Gneiss tools with them from Chephren's Quarry as precious toolkits? Or, was procurement at Chephren's Quarry also for utilitarian purposes such as tool-making, given the presence of unworked Chephren Gneiss blocks at the tool making factory at Umm es-Sawan? These questions are discussed in subsequent chapters.

Overland Transportation Infrastructure: Ramps and Roads

Chephren's Quarry

Loading Ramps

The loading ramps are structures unique (in an Old Kingdom context) to Chephren's Quarry. They are situated in the Old Kingdom block quarries within the Central Quarries: two in the environs of Loading Ramp Quarries and two at Khufu Stele Quarries. The two largest ramps, loading ramp 1 (LR1) at Loading Ramp Quarries (**Pl. 67a**) and loading ramp 2 (LR2) at Khufu Stele Quarries (**Pl. 67b**), were subject to systematic excavation over two seasons in 1999 and 2000 (Bloxam 1999). Both ramps are orientated on a north-south axis and are constructed from spoil heap material (fragments of Chephren Gneiss) encased within larger blocks of gneiss to form a solid exterior; the durability of this construction is exemplified by their remarkable preservation. The excavated dimensions of the features are shown in the table (**see Fig. 32**) from which similarity in size can be seen, the only notable difference being the size of blocks used for the exterior and the amount of wear they have received. From this evidence it is clear that LR1 had been considerably less used than LR2. This is directly in proportion to the intensity of production estimated for the respective quarries in which they are situated.

Front and Rear of the Ramps: tracks and paved surfaces

The differences to the rear of each ramp are indicators of the varying volumes of traffic that each ramp has received. LR2 has a compact paved surface or road emanating from the rear into the quarry workings, this route is clearly demarcated on each side by large boulders of gneiss (**Pl. 68a**). In contrast, LR1 only has a short and less compact, paved path emanating from the left-hand side, not demarcated by boulders or leading specifically into any quarry workings (**Pl. 68b**). This indicates that the boulder traffic ontoLR1 was less and probably originated in closer proximity. This matches the observation that the depressions where large boulders have been extracted are much closer than at LR2.

The parallel tracks that emanate from the face of each ramp (**see Figs. 33a, 33b**) are however almost identical in depth and width (**see Fig. 32**). In both cases the tracks make a gradual ascent onto the original ground surface, which they reach about five metres from the ramps' face. After another five metres they have completely disappeared (**Pl. 69a**). The tracks have two interesting aspects: first, the bases are cut into the hard calcrete surface; and second, the sides of the tracks show no signs of abrasion, a situation that would be expected if the tracks were simply worn away by constant traffic (**Pl. 69b**). This implies that the tracks were artificially dug to accommodate the runners of the transportation vehicle and to bring it level with the top of the ramp. The calcrete surface at the base of the tracks would provide good load-bearing potential for the vehicle which, in conjunction with the wide runners, would distribute the weight over a large surface area, reducing the tendency to dig into the ground. There was no evidence to suggest that rollers or levers were used; as these would have left clear imprints. The quarrymen obviously recognised the potential of natural ground surfaces to alleviate the need for road-building or the production of rolling devices.

Dating of the Ramps

From the similarities in construction and size of the loading ramps it can be deduced that both are contemporary Old Kingdom features, purpose-built to accommodate the same type of vehicle. Small scatters of pottery sherds dating to the Old Kingdom or earlier were found at both ramps, inside the tracks and also between the stones of the exterior construction (Darnell 1999). However, with only a few diagnostic sherds, a more precise date for the ramps cannot be established. Given that the loading ramps are only known from the block quarries, it seems reasonable to suggest that they were constructed predominantly for the purpose of transporting large blocks of gneiss. This would link them to the 4th Dynasty use of the stone for life-size statuary (see Chapter 4 and above). Hence a construction date can be subsequently narrowed down to, at least, the reign of Khufu, as he seems to have been the first king to use the stone for life-size statuary, and also by the presence of his stele at Khufu Stele Quarries (see Chapter 4).

Evidence of Roads

There is no evidence for the former existence of a purpose-built quarry road to transport the stone away Chephren's Quarry, such as those known at Widan el-Faras and Hatnub. This suggests that the Old Kingdom ground surface had sufficient load-bearing potential to alleviate the need for a prepared surface. Engelbach (1938) and Murray (1939a) reported that the sections of an 80 km 'track' connecting the quarry with the Nile only comprised '...hundreds of animal hoof-marks, almost certainly of donkeys...' with no evidence to suggest that any type of vehicle had been moved across the track, or any 'sleepers' over which sledges might have been drawn (Engelbach 1938: 388). The track was marked by quarter and halfway cairns and by dropped pieces of 'diorite' which they concluded had fallen from the backs of donkeys. Stelae found along its path dated it to the 12th Dynasty exploitation and they found no evidence to suggest an Old Kingdom use of this route. Engelbach and Murray proposed that the track was probably a supply route servicing the Middle Kingdom exploitation of Chephren's Quarry and connected it with the Nile settlement at Tushka (Engelbach 1938: 388).

Several attempts were made to relocate this track during the 1999 and 2000 seasons. During the 2003 season, a 10 km section was rediscovered, emanating from Quartz Ridge (Northern Chephren's Quarry) (**Fig. 17**). It has no artificially-laid surface and, in confirmation of Engelbach (1938) and Murray's (1939) report, there was no evidence to suggest that any type of vehicle with runners had been moved across it. The route was identifiable, in the first instance, from the location of strategically-placed cairns aligned with the prominent cairn at Quartz Ridge. The cairns form a direct sight-line heading in a south-easterly direction across the lowest elevations of the desert plateau (see Chapter 2). The cairns are placed at regular intervals along the route either on the desert floor or on low ridges (**Pl. 70a**). In two instances, natural rock features have been used as route markers, one having a small cairn on its peak (**Pl. 70b**).

Although our investigations found no evidence of the hoof-marks described by Engelbach (1938: 388), further indirect evidence of this was that at least one route from the quarry to the Nile comes from the position of two groundwater wells (Well 3 and Well 4) (see Chapter 2) associated with two ephemeral camps (see Chapter 8). Pottery associated with them dates to the Old Kingdom. Small blocks of Chephren Gneiss also occur along the route and, in places, there is evidence to suggest that working of the stone also took place as clusters of Chephren Gneiss chips were observed close to one cairn. After 10 km the sight-line cairns disappear and, despite lengthy investigations in the area, no more cairns were found. There could be a number of reasons for this, in particular recent dismantlement due to increased human activity in this area from the Tushka Hydrological Project. However, even when navigating with GPS from the last cairn on a south-easterly bearing towards the Nile, no cairns were located. The route eventually becomes obstructed by a massive dune, on the other side of which are numerous obstructions from the construction of Canal 3 associated with the Tushka Hydrological Project. Therefore, determining the direction that the route took from this point remains unclear.

If this was the track that Engelbach (1938) and Murray (1939) described, then our findings differ from theirs in relation to dating, as this short section was clearly an Old Kingdom development. Pottery collected at the camps was all Old Kingdom in date, the only evidence of a Middle Kingdom presence coming from two sherds found at the Well 4 storage area, dating to the 12th Dynasty (El-Senussi 2003, see Chapter 2). Hence, the pottery sequence was overwhelmingly Old Kingdom. However, it seems feasible to suggest that, if this route was already established in the Old Kingdom with its groundwater wells, a Middle Kingdom re-use of the track is probable. However, there is no ceramic evidence to suggest that the camps were re-used in the Middle Kingdom.

Whether this was the route that the large statue blocks took to the Nile or Wadi Tushka is difficult to ascertain. However, it should be borne in mind that this route is clearly more associated with the Northern (vessel) quarries than with the Central (block) quarries. There are also no traces of sledge runners, (although these would probably have weathered away) or the abandonment of any large blocks of Chephren Gneiss. The blocks were all small and partially-worked, not to vessel blanks, but consistent with vessel quarrying. Attempts were made in previous seasons to find a southerly route to the Nile that emanated directly from the Central Quarries and loading ramps. However, this was impossible due to mesas, dunes and obstruction from numerous Nubian sandstone basement outcrops (Klitzsch and Schandelmeier 1990: 251). Although the sand dunes are recent geomorphological developments, the other geomorphological features, such as mesas and sandstone outcrops, would have been present in the Old Kingdom landscape. Hence this approach to the Nile, particularly in relation to transporting large statue blocks, would be extremely difficut. Furthermore, there were no cairns visible in this region that demarcated a route from the Central Quarries in this direction. These points are further raised in Chapter 7.

Widan el-Faras

The Quarry Road

The only remaining transportation infrastructure at Widan el-Faras is the 11 km Old Kingdom paved road that connects the quarries with a quay at Lake Moeris (see Chapter 2). Although some sections of the road have disappeared due to natural and man-made disturbance, the road still represents the oldest and best preserved archaeological example of an ancient purpose-built quarry road in the world (Harrell and Bown 1995) (**Pl. 71a**). The quay now stands as an island, but it would have originally been a continuation of the road that has been subsequently washed away due to flash floods. This event occurred in recent times, as Harrell (pers. comm. 2001) observed a segment of the road just north of the quay in 1993 that has since disappeared.

The road is constructed from sandstone, limestone, basalt and silicified wood. Their intermittent use for certain sections is clearly related to the proximity of these raw materials. Limestone and basalt fragments are used predominantly for the road's surface within the Widan el-Faras area. The main sources of limestone (indicated on the site map **Fig. 2**), occur as thin and flat outcrops, the stone being easy to extract as slabs, rendering it ideal for producing a flat surface requiring little working beyond basic trimming (see Chapter 2; Storemyr 2001: 28; Bloxam and Storemyr 2002: 29). Limestone chip quarries close to the Wadi Ghorab could suggest that these were necessary for maintenance of an embankment constructed nearby to even-out the relatively steep descent into the wadi, in similar fashion to the Hatnub road described later (also see Chapter 2).

Although Harrell and Bown (1995:78-9) dismissed the idea of the road having any foundation or being mortared, investigations of some sections of the road, particularly within the quarry area, found relatively thick layers of gypsum (up to 1 cm) beneath a number of road slabs (**see Pl. 12**). Gypsum has been used as a stabilising substance on ancient road surfaces, such as the 12^{th} Dynasty haulage track found at the Lisht pyramid field (Lehner 1997: 203). However, it is difficult to state whether the gypsum found underneath the road slabs at Widan el-Faras was artificially-laid or naturally-occurring (Bloxam and Storemyr 2002: 30). This clearly requires further investigation.

The road is 2.10 m wide over its entire length, equal to the ancient Egyptian measurement of 4 cubits. This standard is maintained even by the branches that lead into the quarries at Widan el-Faras (**Pl. 71b**). Harrell and Bown (1995: 73 fig. 3; 80) observed and mapped seven road branches leading into the East and West quarries, and terminating beneath the escarpment directly below the quarries. Investigations in 2001 and 2002 generally concurred with these observations. The most visible remaining branch leads towards Quarry 2, the rest are very fragmentary, partly due to recent disturbance of the site by haulage vehicles and natural formation processes due to wadi action (see Chapter 2). It is clear that the road branches were constructed to provide a paved surface as close to the quarries as possible because, unlike the situation at Chephren's Quarry, the ground surface at Widan el-Faras did not have load-bearing potential (see Chapter 2). The logistics of transporting the stone away from the quarry is discussed in Chapter 7.

Dating

There are two indicators for an Old Kingdom date for the road, from two deductions: first, the road's terminus at a quay which stands at 22 m asl gives it parity with the level of Lake Moeris at 22-23 m asl during the Old Kingdom (see Chapter 2; Hassan 1986a: 491); second, the use of basalt for monumental construction in the Old Kingdom outweighs that of any other period (see Chapter 4). Given that the road branches are clearly associated with individual extraction sites dating to the Old Kingdom, then an Old Kingdom date for the road seems the strongest possibility.

Overland Transportation Infrastructure: Comparative Archaeological Evidence

Other Old Kingdom Quarries and Construction Sites

In the context of other Old Kingdom quarries, loading-ramps such as those found at Chephren's Quarry are so far unknown. However, at pyramid sites, ramps formed a crucial function during pyramid construction, either to facilitate the movement of stone from local quarries and/or in actual pyramid construction (Arnold 1991: 81-98; Lehner 1997: 215-7). One of the few remaining examples of these ramps connected the Giza plateau quarries to the Khufu pyramid. The ramp is constructed from locally available gypsum, tafla and limestone chips so that, after pyramid completion, these could be easily broken down into their constituent parts and removed (Lehner 1997: 215-7). Unfortunately, there are no tracks visible on the surface of the ramp to indicate the means by which stone was hauled over them.

The 17 km road leading from the Hatnub travertine quarries to the Nile is the closest comparative example of a purpose-built road associated with an Old Kingdom quarry (Shaw 1986, 1987). The road is raised only a few centimetres above the desert floor and was constructed to smooth out irregularities in the geomorphology and to minimise steep gradients, in similar fashion to the Widan el-Faras road. The longest stretches of the road are loosely-constructed from local limestone pebbles and boulders, but the causeways that cross two wadis are more tightly packed to a height of 2.5 m and are obviously more solid constructions. There are several other minor roads leading to smaller travertine quarries, but these secondary roads are essentially cleared tracks rather than stone constructions (Shaw 1987: 160-2). From the two parallel track-ways observed on the Hatnub road it has been suggested that sledges were drawn across it, although there are no firm details about these, such as possible dimensions (Shaw 1987: 162, Arnold 1991: 94).

Roads associated with the pyramid construction sites usually function to connect the site with the quarries. Two transport roads, almost 1,000 m long, connect Shepseskaf's mastaba tomb at south Saqqara to the quarries. In similar fashion two supply roads connect the 'Red' pyramid of Snefru at Dahshur with its quarry (Arnold 1991: 85; Verner 2002: 184), but unfortunately there are no visible vehicle tracks on any of these roads.

Middle Kingdom and New Kingdom Quarries and Construction Sites

The Middle Kingdom pyramid site of Senusret I at Lisht has numerous 5 m wide transport roads surrounding it. These roads have a counterpart at Mirgissa in Lower Nubia which facilitated the conveyance of boats and sledges around the Second Cataract (Vercoutter 1970: 204-14; Arnold 1991: 86-92). The fact that these roads are so well preserved is testament to their careful and durable construction, consisting of a limestone chip foundation covered in a layer of mortar and mud which acted as a lubricant. This foundation was embedded with re-used boat timber to form a solid track (Vercoutter 1970: 204-14; Arnold 1991: 86-92; Kemp 2000: 93).

In Middle Kingdom and New Kingdom quarries the roads tend to be networks of short stone ramps that converge on a single road artery. These can be clearly observed at the New Kingdom and Roman Period Gebel Gulab silicified sandstone quarries on the west bank of the Nile at Aswan **(Pl. 72)**. The main road is 3.5 m wide by 2 km long, paved with stone fragments and raised above the desert surface. The objective was to even out topographical irregularities on the road's descent to the Nile, as with the Hatnub and

Widan el-Faras roads (from field observations in 2002; Klemm and Klemm 1993: 289-96). Roads and ramps in the Aswan quarries were probably similar to those at Gebel Gulab due to proximity to the Nile, thus requiring the same logistical arrangements. Engelbach (1922: 32; pl. vii) recorded an impressive embankment close to the quarries south of the 'unfinished obelisk' and concluded that this was the main road to the Nile over which New Kingdom obelisks would have been hauled. However, due to poor preservation from recent quarrying and over-building by more modern ramps and tracks, this embankment is no longer visible (see Chapter 2).

Overland Vehicles

Sledges

The use of sledges to move raw materials in quarries and construction sites has always been assumed (Clarke and Engelbach 1930: 88; Arnold 1991: 276), although the archaeological evidence for such vehicles is extremely scant. Only three sledges are known in the archaeological record in Egypt, associated with the 12th Dynasty pyramid sites of Dahshur and Lisht. The Dahshur sledge, associated with the pyramid of Senusret III, is displayed in the Egyptian Museum (CG 4928) (**Pl. 73**). It is 4.21 m in length and 80 cm wide, with runners 12 cm deep by 20 cm wide connected by four crossbeams (Arnold 1991: 276). What is puzzling about this sledge and the one found at Lisht, is that the runners do not show any signs of wear. Hence, there has been speculation that these probably played more of a role in ceremonial contexts, such as moving statues and/or shrines, than in utilitarian ones (Arnold 1991: 277; Eaton-Krauss 1984; Partridge 1996: 134).

Due to the lack of archaeological evidence in relation to vehicles associated with the movement of stone, there has been a tendency to rely on the iconographic record to explain these practices. The Middle Kingdom Djehutihotep transport scene is probably the most referred to depiction to explain stone transport from a quarry (Newberry 1895: 16-26, pls. XII-XIX; Clarke and Engelbach 1930: 85; Arnold 1991: 61). There are Old Kingdom depictions of statues on sledges, but not specifically related to transport from quarries. The statues are always shown as finished objects; the 5th Dynasty depiction of Ptahshpses at Abusir (Eaton-Krauss 1984: 62; Verner 1986: 104-5, pl. 58) is fairly representative of these images. A low-relief in Ptahshpses' mastaba tomb shows his standing statue being pulled on a sledge by eight pairs of men with another man pouring liquid in front of it (Verner 1986: 104-5, pl. 58). As Eaton-Krauss (1984: 62, pl. xix) explains, for artistic purposes the sledge might also function as the statue base. In addition, the 5th Dynasty Unas causeway transport scene shows columns tied to sledges on a barge (Clarke and Engelbach 1930: 85; Arnold 1991: 277).

The funerary context of these depictions implies that symbolic and ceremonial meanings were more important to convey than the practicalities of moving the statues. Furthermore, a scene depicting a half-finished statue would not be aesthetically pleasing. Depictions of sledges outside ceremonial/funerary contexts and *specific* to quarry sites are rare, with only a New Kingdom (18th Dynasty) rock relief associated with the Tura limestone quarries of a sledge carrying a block of stone drawn by oxen (Daressy 1911: 262-5; Clarke and Engelbach 1930: 88; Arnold 1991: 278).

Sledges with Ramps

Taking into consideration the limitations of the archaeological record, these examples of sledges do not have parity with the ramps at Chephren's Quarry nor the road at Widan el-Faras. Traces such as tracks left by such vehicles used in antiquity are very rare and so the tracks leading from the loading ramps at Chephren's Quarry are exceptional. The width of the tracks combined with the height of the ramps argues against the use of low-lying sledges like those described above, and an estimate of the size of the vehicle that the ramps were purpose-built to accommodate can be calculated. These calculations are based on the following criteria: height being equal to the ramp's face (including the depth of the tracks), length being where the tracks are deepest, width being variable to either the total distance between the outer edges of each track, or the total width of the ramp. For LR1, this indicates a minimum vehicle size of 1.6 m (H) x 5 m (L) x 2.2 m (W) and a maximum size of 1.6 m (H) x 5 m (L) x 4.7 m (W). Even if the minimum measurements given above are compared with the dimensions of the Dahshur sledge, it becomes clear how much bigger the Chephren's Quarry vehicle would have been. Although the length is quite similar, both the height and width of the Chephren's Quarry vehicle exceeds that of the Dahshur sledge by 1.4 to 1.5 metres.

Hence, the vehicle used in conjunction with the loading ramps at Chephren's Quarry would have been much bigger than any sledges known in the archaeological record. Indeed, considering that the weight of one statue block is likely to have been in the region of 4 tons (Harrell pers. comm. 1998), then a sledge the size of the Dahshur example would be totally inadequate. The absence of any form of artificial paving at the face of each ramp, combined with the width of the tracks, suggests that the vehicle that took the blocks away from the quarry was different to any used within the quarry itself. There are no similar tracks at the rear of the ramps, as they would have probably left an imprint on the paved surfaces. Therefore, it can be suggested that the trimmed blocks were either rolled or pulled across the paved surface onto the back of the ramps. There is also the possibility that blocks were placed on low-lying sledges and pulled onto the back of the ramp for transference onto the larger vehicle. However, the line of large blocks behind a third loading ramp located in Khufu Stele Quarries, suggests that they were dragged across the (hard) surface. A detailed discussion of these logistics follows in the next chapter.

Sledges with Roads

The most puzzling aspect of the Widan el-Faras road is the total *absence* of any wear marks across it, in fact the surface is so pristine that, if it were not for the branches leading directly into the quarries, one could assume that it was constructed for a non-utilitarian purpose. An Argentinian team of road engineers and archaeologists surveyed and excavated sections of the road (this work is still unpublished) in the 1990s and made the same observations. This team even doubted it ever did support heavy weights and suggested that it was perhaps for ceremonial use (Cornero 1996-7). Harrell and Bown (1995: 82-3) explained the absence of wear marks on the road by suggesting that flat wooden beams might have been laid, unfixed, across the surface in advance of the transportation vehicle or sledge. However, the use of unfixed rollers or crossbeams with sledges to move heavy weights over large distances has been proven impractical (Cotterell and Kamminga 1990: 220). This method of conveyance only seems possible if the beams are part of a fixed track, like those at Lisht and Mirgissa described above.

The problem with the Widan el-Faras road is not only its unworn surface, but its narrowness, at only 2.10 m. A sledge similar to those found at Lisht and Dahshur would fit on the road, but there would be little room for the sledge to be manoeuvred. For example, the tracks across which the Lisht sledges are thought to have been drawn are almost 5 m wide and thus almost five times the width of the sledge (Arnold 1991: 91, 92 fig. 3.44, 277). Furthermore, it cannot be firmly established that a sledge with the dimensions of the 12th Dynasty examples could accommodate the size and weight of a 1 m^3 block of basalt, the standard size quarried for mortuary temple paving. Moreover, it has to be borne in mind that much larger blocks were used for wall linings, particularly in Nyuserra's mortuary temples where one block is actually 5 m^3. Other modes of transport (flexible enough to accommodate blocks of varying sizes and suited to such a narrow gauge) should be considered in any future research on the ancient road. As Clarke and Engelbach (1930: 84) point out, it should *not* be assumed that identical methods of stone transport would be applied to the moving of colossi and the moving of building blocks.

Wheeled Vehicles

Engelbach (1938: 372) could only explain the excessive height of the loading ramps at Chephren's Quarry and the deep tracks associated with them, if a wheeled vehicle, such as a wagon, was used to transport the stone. The Roman Period loading ramps at the Mons Claudianus granodiorite quarries in the Eastern Desert have average heights of between 0.7 m and 0.9 m (Peacock and Maxfield 1997: 261-3), and are therefore lower than the height of the Chephren's Quarry loading ramps. (These Roman ramps are also presumed as being constructed for a specific height of vehicle) (*op. cit.*). It was suggested that the ramps were built for wide-wheeled carts that had sufficient strength to carry a stone column weighing about 207 tonnes. Although determining exactly what these carts looked like is not possible, particularly in relation to the number of wheels, it has been suggested that they consisted of an 18 m long platform, 2.6 m wide supported on wheels 2 m in diameter, with a gauge of at least 2.8 m. The carts would have been pulled either by animals or humans (*op. cit.*).

These dimensions are certainly closer to the size of the Chephren's Quarry loading ramps in width, and, even though the height of the carts would be beneath the level of the top of the loading ramp, they would still be much closer than the low-lying sledge. However, there are two fundamental problems when considering the use of wheeled vehicles in the Old Kingdom: first, producing an axle that would take the weight of the stone, and second, the use of the wheel in this context and period is unknown. The only depiction of wheels in an Old Kingdom context is in the 6th Dynasty tomb of Kaemheset at Saqqara, but these are thought to be 'siege towers' and not associated with moving raw materials (Clarke and Engelbach 1930: 87; Arnold 1991: 282). Furthermore, Arnold (1991: 84) could not explain the height of the loading ramps at Chephren's Quarry and also asserts that wagons were not used in the Old Kingdom. Therefore, consideration has to be given to a type of vehicle, previously unknown, which was exceptionally high with a platform and supported by wide runners.

Water Transportation Infrastructure: Quays, Harbours, Canals and Dams

Old Kingdom Quarry and Construction Sites

The quay at Widan el-Faras and a dam at the Wadi Gerrawi travertine quarries, 11 km south-east of Helwan, are the only known features in Old Kingdom quarry contexts associated with water transport. Only the east and west flanks remain of the dam at Wadi Gerrawi, the once-solid structure constructed of limestone masonry would have spanned the wadi trapping rainwater run-off. The dam is clearly associated with the Old Kingdom travertine quarries located 4 km away, suggesting that it either formed a waterway connecting the quarries via the wadi to the Nile and/or provided drinking water for the quarrymen (Petrie and Mackay 1915: 39-40; Murray 1947: 38).

The dam at Wadi Gerrawi suggests that artificial means to control water were well in place by the Old Kingdom, even to the extent of weir construction where the Bahr Yusef enters the Hawara Channel at Lahun (Shafei 1960: 206-7). Shafei (*op. cit.*) proposes that the masonry weir observed by Nabulsi c. 1245 AD regulated the exceptionally high Nile floods of the 4th Dynasty into Lake Moeris, creating a 15 m wide navigation channel for barges going into and out of the Faiyum (see Chapter 2). Canal networks associated with pyramid construction sites to maximise water transport of heavy materials are still a controversial subject, particularly for valley temples possibly doubling as harbours at the Abusir, Saqqara and Giza pyramid fields (Lehner 1985, 1997; Verner 2002). However recent research, such as Mathieson *et al.* (1999: 35) resistivity work at Saqqara, to the east of the 5th Dynasty valley temple of Unas, indicated that a harbour was probably located here. At Abusir, Verner (2002: 290, 319) suggests that the occurrence of two entrances south and east into Sahure's valley temple implies that the south entrance was connected with a canal. The canal would have provided access to the marginal lakes of Abusir and Saqqara for delivery of raw materials. As already discussed in Chapter 2, these marginal lakes are thought to have been fed either on a seasonal or perennial basis by the Bahr Libini, the northerly canal extension from the Bahr Yusef that ran 2 km east of the desert edge at North Saqqara (Jeffreys and Tavares 1994: 155, 159; see also Koziński 1969: 52-5; Goyon 1971; 1977: 131-38; Smith *et al.* 1983: 41). This might explain why the Abusir pyramids and solar temples were located much closer to the edge of the plateau, the logistics of delivering raw materials via water thus being optimised. The original foundations of both Sahure and Nyuserra's valley temples would have lain more than 5 m below the present ground level, suggesting that this put them close to the then level of the lake which served as a natural harbour (Lehner 1997: 142; Verner 2002: 290, 319).

Lehner's (1985: 122-3) topographical study of the Giza plateau reached similar conclusions in regard to the valley temples of Khufu and Khafra being an integral part of a large harbour area. More recent excavations in front of Khafre's valley temple seems to confirm this hypothesis by the discovery of boat-shaped paved and convex tunnels under the causeway that led to two entrances in the valley temple. Although the archaeological investigations are not complete, the preliminary interpretation is that they could be the remains of quays (Verner 2002: 232), i.e. the entry points for raw materials. In addition, Lehner (*op. cit.*) mentions the discovery of several basalt fragments lying 160 m south of Khufu's valley temple. Perhaps these could have fallen from barges as they were being unloaded?

There is further speculation that the transfer of Tura limestone from the east bank of the Nile to the west bank at Giza could only have been achieved via a large transverse canal (Lehner 1985: 137-9). Kersial's (1993: 49-50) recent research of the Khufu pyramid also points to the existence of a 'great canal' used to transport stone that ran in the plain along the Giza plateau, the water coming from Lake Moeris via the Hawara Channel. These investigations go on to suggest the existence of a man-made canal, constructed at right-angles to this main canal, that continued under Khufu's pyramid to a subterranean chamber near the axis of the pyramid, as inspired by Herodotus testimony (*Histories*, Book II, 2003: 147). The textual record might also subscribe to the existence of a transverse canal on the west bank of the Nile via a 6th Dynasty communication between a vizier at Saqqara and the 'Military-commander of the Necropolis-masons' based at the Tura limestone quarries. The letter from the commander suggests that a stone-carrying barge should bring clothing for his battalion (Gunn 1925: 244; Gardiner 1927: 75-8; Wente 1990: 42).

Middle Kingdom and New Kingdom Quarries

The Middle and New Kingdom sandstone quarries at Gebel Silsila extend immediately east and west of the Nile, 50 km north of Aswan. Their positioning right on the Nile provides good examples of how the logistics of stone transportation revolved around short ramps or cleared tracks (Klemm and Klemm 1993: 243-7) leading to natural harbours. Two such harbours can be identified in both the east and west quarries, the latter has what could be described as 'mooring sockets' cut into the rock face that forms a small natural inlet **(Pls. 74a, 74b)**. Clarke and Engelbach (1930: 20) could not explain the function of these sockets in relation to hauling blocks of stone overland because they showed no wear marks, and were equally puzzled by their placement at different levels high above the ground. It is possible that the sockets could have marked mooring places for boats and that their arrangement at different levels was related to the fluctuating levels of the Nile flood. Water transport of stone from here was obviously the principal method of conveyance. Accounts from ostraca found in the New Kingdom Ramesseum specifically mention deliveries of stone from Gebel Silsila by boat to a construction site. From these accounts it can be established that 10 boats delivered 64 stone blocks daily (Arnold 1991: 65-6, Kitchen 1991: 85-93).

Canal construction in relation to the Aswan quarries has been alluded to via textual accounts and inscriptions, such as Weni's 6th Dynasty autobiography that mentions the cutting of canals at the First Cataract to ease the passage of stone from the quarries (Fourtau 1905: 2- 3; Grimal 1992: 83; see Chapters 2 and 3). Pliny also reports how an obelisk for Ptolemy II Philadelphos was transported from Aswan to Alexandria by the digging of a canal from the Nile that passed underneath the obelisk, this presumably still being in the quarries. The transport boat was subsequently unballasted underneath the obelisk to take its weight (Clarke and Engelbach 1930: 35; Arnold 1991: 63).

These accounts further stress that the appearance of the cataract region now bears no resemblance to how it appeared in antiquity. Nile sediments 8 m above the current highest Nile level can be clearly seen in the New Kingdom and Roman quarries on the east bank at Aswan, as already mentioned in Chapter 2. Furthermore, current Supreme Council of Antiquities excavations in the Aswan quarries, close to the 'unfinished obelisk', have exposed more obelisk extraction areas. These extractions are approximately 300 m south of the 'unfinished obelisk' and have associated with them drawings of a boat, ostrichs and two obelisks which date from the Middle Kingdom onwards (Adel Kelany pers. comm. 2003; also from field observations January 2003). In addition, these excavations have revealed a possible natural harbour area leading away from the quarry in a south-westerly direction towards the Nile. Drill cores were taken in this area to a depth of 10 metres that did not reach the bedrock. A 4-metre-deep test pit into the area only revealed sand and domestic rubbish, suggesting that this was an open area (Kelany pers. comm. 2003) **(Pls. 75a, 75b)**. These are important new findings in relation to questions surrounding the transport of obelisks from the quarry and the role that water might have played, such as channelling Nile flood water via canals into the quarries.

Barges and Rafts

Barges

Sources relating specifically to the water transportation of stone objects and the types of craft used are mainly derived from texts and iconography (Aston *et al.* 2000: 18). Tomb paintings and reliefs of stone being transported by barge usually show the stone as a finished object, such as the Unas causeway depiction of a barge carrying obelisks and its New Kingdom counterpart, the great barge scene in the cult temple of Hatshepsut at Deir el-Bahari (Naville 1908; Clarke and Engelbach 1930: 39; Landstrom 1970; Jones 1995: 65). An inscription in the New Kingdom tomb of Ineni stated that he had built such a cargo vessel specifically for the transport of Thutmose I's obelisks. This account gave the dimensions of the vessel: length of 120 cubits (63 m) and breadth 40 cubits (20 m) (Wehausen *et al.* 1988: 296). A similar size could be assumed for the Unas and Hatshepsut barges, constructed from Lebanon cedar and local acacia in brick-wall fashion fastened with dowels and ropes (*op. cit.*).

Textual references to boats in an Old Kingdom context *specific* to quarrying expeditions come from the private tombs of 5th Dynasty Senedjemib Inty at Giza (Porter and Moss 1974-81: 85-7) and 6th Dynasty Ipy at Saqqara (Porter and Moss 1974-81: 671-2; Aston *et al.* 2000: 18). The text of Sendjemib Inty refers to the eight-ribbed '*satj*-boat' that carried his limestone sarcophagus from the Tura quarries, a journey lasting five days. Similar boats are also mentioned in the funerary autobiographies of Weni (Abydos) and Sabni (Aswan) associated with the transport of stone in the 6th Dynasty. Weni's autobiography goes into some detail by giving an account of two types of cargo vessels '*satj*-boats' and '*weskhet*'-boats, both constructed from acacia wood of Wawat (Lower Nubia) by Nubians, that were laden with very large granite blocks for the pyramid of King Merenra (Breasted 1906: 148; Aston *et al.* 2000: 18).

Rafts

The use of ephemeral watercraft such as rafts is even more difficult to determine given the greater limitations and gaps in the archaeological record (Gould 2000: 93). Artistic representation of such vessels in an Old Kingdom context is limited to the papyrus raft or 'marsh boat' that is almost exclusively associated with marsh hunting scenes (Reisner 1913: xvii). Although the raft was solidly constructed by binding together papyrus reeds, it seems unlikely that such a craft could convey several ton blocks of stone on a long river journey. However, Reisner (1913: xviii) suggests that in the Predynastic these rafts were constructed from wooden planks, mortised and tied together with cords.

The only other type of raft that would be suitable for transporting heavy loads is the kelek, also known as the buoyed raft or inflated skin float described by Herodotus and in other classical sources such as the '*Periplus* of the Erythraean Sea' (Johnstone 1980: 32, 184; Bradbury 1996: 40-1). Keleks are ideally suited for navigating rivers that have rapids and shallows and are hence ideal for coping with the fluctuating levels of the Nile and negotiating the cataracts (Hornell 1946: 14; Bass 1995: 1422; Bradbury 1996: 40-1). In Egyptian iconography the kelek is possibly the type of craft depicted carrying goods from Punt to Egypt in the 18th Dynasty Theban tomb 143 of Min, Chief Treasurer for Thutmose III and Amenhotep II (Säve-Söderbergh 1946: 23-5, fig. 6; Johnstone 1980: 183; Bradbury *op. cit.*). The accompanying text to the relief calls these craft *Kpn*-boats (*'h'.w n Kpn*) (Bradbury *op. cit.*)

The kelek is simply constructed using minimal amounts of wood, the buoyancy being achieved from inflating either sheep or goat skins with light grass. These were then compressed and stitched so that the water could not penetrate them. A wooden framework provides a rigid structure which is topped with a wooden platform. Such craft were widely distributed in the Near East in antiquity (Hornell 1946: 21; Johnstone 1980: 31; Fitchen 1986: 178). As recently as the 20th century AD keleks were still being used on the Tigris and Euphrates to carry heavy loads of timber and grain. Some of these were up to 15 m^2 in area and 12 m long and are known to have taken loads of up to 150 tons (Hornell 1946 pl. IV; Bass 1995: 1422). Such a vessel, constructed from 600 skins, was used by Sir Austen Layard (1849) to transport the winged bulls from Nineveh to Bagdad (Johnstone 1980: 31). Keleks can be easily dismantled into their constituent parts and re-used for other purposes, such as using the skins as tent-coverings (Hornell 1946: 21).

The kelek is therefore a versatile craft and its simplicity of construction and method of buoyancy (Gould 2000: 96), would be well-adapted to local conditions on the Nile. As Greenhill and Morrison (1995: 20) point out, boats have developed in different ways in response to local waters, climate, availability of raw materials and specific needs. The minimal representation of keleks in Egyptian iconography may be due to aesthetic concerns: tomb and temple reliefs tend to condense stone transport scenes into a single episode (for example, the Unas and Hatshepsut barge scenes). The mundane aspects of stone removal from quarries are depicted in one dramatic scene in which large barges have a greater visual impact than simple rafts. However, these craft *are* depicted in Mesopotamian contexts and the most interesting representation comes from a relief in the Palace of Sennacherib at Nineveh (1st millennium BC) which shows a kelek *specifically* transporting a block of quarried stone (Hornell 1946: 27, fig. 4; Casson 1994: 9) **(see Fig. 34a)**.

Summary

The roads and ramps constructed at the remote source quarries imply that expedient use was made of locally-available resources, and that there was an understanding of the potential, or otherwise, of local geomorphological conditions. At Chephren's Quarry the hard ground surface was effectively utilised, while at Widan el-Faras geomorphological and topographical problems were overcome by constructing a paved surface. These features were also constructed with a specific transport vehicle in mind. However, determining precisely *what type* of vehicle is problematic, given the lack of direct evidence in the archaeological record and the limitations of indirect iconographic sources. The evidence of tracks at Chephren's Quarry combined with the height of the ramps suggests that a vehicle other than a low-lying sledge was used to transport the stone away. The possibility of a vehicle similar to the kelek being used is discussed further in the next chapter.

At Widan el-Faras it can only be concluded that the paved road provided the shortest overland route to water at Lake Moeris, but by what means the basalt was transported across the road is extremely difficult to determine due to the lack of traces. It is therefore proposed that a flexible approach to the logistics of stone transportation has to be considered, with paramount consideration being given to minimising the overland journey. The points raised here will provide the basis of discussion in following chapters.

Chapter 7

Reconstructing Production and Transportation Systems from Remote Source Quarries

Introduction

The phenomena of monumental construction and the acquisition of raw material from remote sources and how this was achieved *par excellence* during the 4^{th} and 5^{th} Dynasties, cannot be understood from just one theoretical perspective. The following discussion aims to reconstruct these activities by developing some working hypotheses of stone acquisition from Widan el-Faras and Chephren's Quarry using a range of conceptual models. These models come from diverse cross-cultural and cross-level interpretations mainly of obsidian procurement and transport, in contexts such as Californian hunter-gatherers, the Bronze Age Aegean, and Mesoamerica from the Early Formative Period to the Classic Period.

The chapter aims to create a discursive framework that allows interpretation of production and transport evidence at Widan el-Faras and Chephren's Quarry to be understood within a broader conceptual framework. From this basis, it might be possible to interpret the ebb and flow of hard stone consumption and production within the context of the social, political and ideological transformations that occurred during the Old Kingdom.

Hard Stone Production at Remote Source Quarries in the Old Kingdom: a Reconstruction

As discussed in Chapter 1, the research questions being considered in relation to the procurement and transportation of stone from remote sources in the Old Kingdom are as follows:-

i. Can the explosion in elite consumption of remote source hard stones be characterised from production evidence at the quarry sites?

ii. Is it possible to observe, from production evidence and the transportation infrastructure, the influence of a well-organised and proficient central administration on procurement strategies?

iii. How sensitive to Egypt's regional influences/control was stone procurement from *remote* sources, and does this suggest monopolies/ownership over these sources?

iv. To what degree were stone procurement strategies linked to the annual Nile flood and access to a source of water for transportation?

v. How accurate is the textual and iconographic record in explaining how raw materials were transported over large distances from quarries?

vi. Was the cessation of remote source hard stone procurement associated with a change in climate and environment or changes in the demands of the state connected with political decentralisation?

The Historical Context of Hard Stone Production: an overview of the rise in elite consumption

It is important to return to some of the main points raised in previous chapters concerning the historical background to hard stone procurement from Chephren's Quarry and Widan el-Faras and its relationship with elite consumption. The history of stone consumption suggests that the procurement of exotic *hard* stones, driven by an elite for funerary equipment, was practised prior to the inception of a centralised state or authority (see Chapter 4). Chephren Gneisses were part of elite consumption from the Late Neolithic, as evident from its presence in elite burials in Nubia and from a palette in a Neolithic context in the Faiyum (see Chapter 4). However, it is more difficult to confirm when exploitation of specifically Widan el-Faras basalt first occurred, even though basalt was used for stone vessels in the Predynastic (see Chapter 2; Mallory-Greenough *et al.* 1999).

Soft stones such as travertine always dominated the corpus of stone vessels, but the greatest *range* of *hard* stones used for small vessels in elite burials occurred between the Predynastic (from Naqada II) to the 3rd Dynasty (see Chapter 4). However, the empirical data at quarry sites in relation to this early procurement of hard stones is difficult to attest, principally because the methods of extraction were probably foraging for loose or fallen boulders and have left no traces (Lucas 1930: 201, 211, 1948: 487; El-Khouli 1978: 798). Large quantities of Chephren Gneiss were being consumed by the late 2nd Dynasty reign of King Khasekemwy for vessels and it is unfortunate that what must have been a gradual intensity of production cannot be assigned to specific quarries within Chephren's Quarry (see Chapters 2 and 6).

The consolidation in consumption of basalt, Aswan red granite, granodiorite and Chephren Gneisses by the 4th Dynasty, as expressed by their incorporation into monumental architecture and life-size statuary, has to be one of the most pivotal transformations in hard stone procurement ever known. Another important transformation in elite stone consumption is that this moved outside of simply funerary requirements to include gift-giving (Arnold and Pischikova 1999: 125). Whether this was incorporated into a 'redistributive system' economy in the Old Kingdom, as proposed by Müller-Wollermann (1985: 121-68), is not yet fully understood. However, gift giving between elites and/or trade involving stone vessels as luxury items, expanded outside of the local to include Egypt's regional neighbours, particularly in the Levant, by the Old Kingdom (Scandone-Matthiae 1988; Bevan 2001: 369; see Chapter 4). Travertine and Chephren Gneiss vessels inscribed with the names of Snefru, Khafre, Pepi II and Queen Neith have been found in Old Kingdom (6th Dynasty) elite contexts at Byblos and Ebla (Scandone-Matthiae 1988; Bevan 2001: 369; see Chapter 4). There is the suggestion that these could have emanated directly from Egyptian royal/palace workshops, rather than being the product of tomb-robbing (Scandone-Matthiaea 1988; Bevan 2001: 369).

Some Expectations of the Archaeological Record at Quarries

This transformation in hard stone consumption is observable from the production evidence at Widan el-Faras and Chephren's Quarry. Hence there is a rare opportunity to observe the impact of this increased demand within its social context, and in particular, how involvement by a centralised administration in quarry expeditions might be hypothesised from production evidence. Discussions in relation to such questions have come mainly from research conducted at obsidian quarries in a range of contexts, such as: California between the 4th - 2nd millenniums BC (Ericson 1982); Mesoamerica from the Early Formative Period to the Late Classic Period (Spence 1982; Spence *et al.* 1984); Neolithic Calabria in the Mediterranean (Ammerman and Andrefsky 1982) and the Bronze Age Aegean (Torrence 1982, 1986, 1989). These sources have been *principally* used to help evaluate observations of production and transport evidence and what their relevance is to the social context of these activities.

The expectations of the archaeological record in relation to increased consumption should be constituted by intense exploitation of the resource, with consistency or homogeneity in waste material (Ericson 1982: 131). Disposal of waste should exhibit some form of organisation and regularity, and secondary production evidence should also show degrees of standardisation in forms, possibly to object 'blanks' (*op. cit.*: 132). The amounts of waste could be an indication not only of exploitation for specific forms, but as a means to reduce transportation weight. In addition, maximising water transportation, particularly from remote source quarries, would be important to reduce 'costs' in terms of human resources (*op. cit.*; Ammerman and Andrefsky 1982: 167-71). The construction of purpose-built transportation infrastructure would also be expected during periods of intense exploitation, particularly in relation to overland journeys that might need to overcome topographical irregularities. The immediate relationship of this infrastructure to the extraction sites is to expedite removal of the stone. Hence, would also be expected to observe an interdependency of transportation efficiency with production, that could include further stone reduction where two different modes of transport meet (Ericson 1982: 132; Ammerman and Andrefsky 1982: 167-71).

It would be expected that production tools would show some standardisation of form and be consistent with the most expedient means to extract the stone from its deposit (Torrence 1986: 186). The amount of tool preparation or curation would also suggest strategies of technological organisation with significance being placed on whether these were produced locally at the quarry or imported from another source (Torrence 1986: 186; Nelson 1991: 63; Bradley and Edmonds 1993: 96).

The above are just some expectations of the archaeological record in relation to stone production and transportation that could indicate degrees of planning and forethought consistent with a more 'industry'-based procurement.

Production Evidence at Widan el-Faras and Chephren's Quarry

One of the difficulties in reconstructing stone production at both Chephren's Quarry and Widan el-Faras is the fragmentary nature of any data which could determine a precise chronology for each of the extraction sites (see Chapters 2 and 6). Dating can only come indirectly from pottery sherds found within these sites, analysis of which can only produce a date *range* between the 4th and 5th Dynasties. Therefore, some assumptions have to be made about the production evidence being contingent with its consumption. However, in relation to the broad parameters of discussion outlined above and as a means of approaching the questions being asked of the data, it is possible to formulate a composite picture of production and some working hypotheses.

Primary and secondary production at both quarries indicate that predetermination for specific objects was being practised, as opposed to *ad hoc* improvisation (see Chapter 6). At Widan el-Faras areas of concentrated extraction are restricted not to the parts of the basalt flow that would necessarily provide the best quality basalt, but to those that would yield blocks of approximately one cubic metre, the size required for paving mortuary temple floors (see Chapter 6). At Chephren's Quarry where more production stages are evident, it is also possible to observe that correct block size *as well as* quality were being sought from the outcrops, as is evident from the large amount of discarded material, mainly consisting of blocks penetrated by unsightly syenite/granitic veins. Blocks penetrated by these veins, of which the unfinished statue blocks are good examples, were discarded even after laborious partial working (see **Pl. 53**). If these veins could be clearly observed prior to extraction then the outcrop has not been worked at all, and a few of these therefore remain (see Chapters 2 and 6; **Pl. 19**). There are two further insights that can be drawn from this discard evidence: first being the importance placed on aesthetic value over quantity, and second, a degree of geological knowledge, since syenite/granitic veins are also zones of weakness that would make the stone more susceptible to fracturing during the stages of final crafting (Heldal pers. comm. 2003, see Chapters 2 and 6).

Ericson (1982: 140) points out that consistency in relation to obsidian production processes at the source can be indicative of early *intense* production for luxury items and later *reduced* production for utilitarian use. This can be measured by the amount of debitage and percentage ratio of primary to secondary production, which can also indicate the number of people present at the site. At Widan el-Faras the waste amounts have been roughly estimated at 60% of the total volume extracted (see Chapter 6), but at Chephren's Quarry this is more difficult to calculate, as explained in Chapter 6. Although there is nothing to quantify the production waste against at Chephren's Quarry, it can be speculated, due to the geological and aesthetic considerations explained above, that waste would have probably have been at an even higher ratio, probably above 60% of the total volume extracted. The disposal of waste at Chephren's Quarry is generally systematic, particularly at the block quarries where the spoil heaps almost form a circle around the extraction sites (see Chapter 6; **Figs. 26a, 26b**). At Widan el-Faras waste disposal is harder to determine, however it appears that it was probably pushed back down the escarpment so as not to obstruct the entrances to the extraction sites. The storage of vessel blanks and blocks trimmed to standard sizes in specific groups and locations for possible collection, are an observable phenomenon at Chephren's Quarry (see Chapter 6), a situation that indicates organised work practices in secondary production.

Estimates of manpower levels just from the extraction sites have to be extremely speculative. However, at Widan el-Faras each extraction site could only accommodate a maximum of 10 people at a time. When calculated against the volume of basalt extracted for one pyramid complex, this implies that this *could* have been achieved by 50 people in under a year (see Chapters 6 and 8). Ericson (1982: 140) suggests that greater efficiency, particularly when manpower is limited, can be equated with raw materials being transported away from quarry workshops to regional production centres for finishing. This alleviates the need to move 'producers' to the quarries. Perhaps this should be considered in relation to the long-distance transport of basalt and Chephren Gneiss to palace workshops and/or construction sites for final crafting.

Using the survey data of production systems at both quarries, the criteria indicative of intense exploitation to satisfy increasing elite demands during the 4th and 5th Dynasty can be met. The characterisation of stone production practices as being prescribed to satisfy elite demands for specific objects can be proposed (see Chapters 6 and 8). Unfortunately, there are no published sources that relate to Old Kingdom production processes of travertine at Hatnub or red granite at Aswan to compare against the findings made above. However, at Gebel Manzal el-Seyl (see Chapter 6, Harrell 2000, 2002) and at Umm es-Sawan in the Faiyum (Aston 1994: 47-53; Harrell 2002: 234, see Chapter 6) *soft* stone quarrying for vessels between the 1st and 3rd Dynasties has produced comparable production evidence of standardised forms to vessel blanks and distinct work patterns. This suggests that planned extraction was already being practised in the

Early Dynastic Period with exploitation being carried out *not* on an *ad hoc* basis but as a sizeable 'industry', although this term has to be used in a wide sense when discussing the period from the 1st to 3rd Dynasty. The absence of pottery and stone structures associated with this period of exploitation suggests that procurement was a more locally-based and organised affair. Therefore, prior to the 4th Dynasty and the consolidation of centralised authority, systematic resource exploitation seems to have already been practised. Whether this was also the case for *hard* stone quarrying in the Early Dynastic Period is unknown, given the dating problems mentioned above.

Extraction Technologies: stone tools

Standardisation of stone tools can be recognised at both quarries with size tending to be uniform in respect of the two major stone tool forms used: stone axes at Widan el-Faras and pounders at Chephren's Quarry (see Chapter 6; **Fig. 28**). However, the significant *difference* between the stone tool assemblages is that all the tools at Chephren's Quarry are locally sourced within the quarry, whereas at Widan el-Faras they are predominantly of non-local origin. There are several implications to this data: at the obsidian quarries on Melos, Torrence (1986: 186) interprets the presence of non-local hammer-stones as indicating a measure of forethought in production. Applying Nelson's (1991: 63) curation model to this evidence would further suggest advanced planning in relation to the technologies being used to extract the stone. This particularly applies when tools are manufactured elsewhere, for example at Umm es-Sawan, and transported to Widan el-Faras. In Nelson's (1991: 59) model, this would also imply that tool workshops operated where the material was centrally accumulated, at a place that was occupied more often. As far as Widan el-Faras and Umm es-Sawan are concerned, this might suggest the Faiyum district as a possible hub of a stone-working industry which connected the workers with a central residence or palace workshop. As Bradley and Edmonds (1993: 96) point out, the presence of imported tools can shed light on connections between those sites and settlement in the wider landscape. This point is discussed in more detail in Chapter 9.

Conversely, at Chephren's Quarry all the stone tools are locally-sourced within the quarry. Although these are generally of standard sizes and not so 'finely' worked to attach to a haft, this does not necessarily imply lack of skill or technological progression (Torrence 1986: 186; see Chapter 6). Bias in the archaeological record also has to be considered; expensive copper tools, probably administered by a central authority, would not be discarded (see Chapter 6). However, the fact that such copper tools were used at Chephrens' Quarry, is demonstrated by the presence of a chisel. Torrence (1989: 57-8) points out that a range of tools, from locally-sourced stone tools to imported, more highly- refined, copper tools, can be an indicator of an effort to minimise time and energy at the resource. Considering the probable seasonal nature of quarry campaigns to remote sources (discussed in detail in Chapter 8), time could have been a primary determining factor, particularly if the transport of material relied on the (seasonal) maximum levels of the Nile floods.

Direct Access or Monopolies?

The production evidence in relation to 'super consumption' of remote source hard stones between the 4th and 5th Dynasties is characterised by intensified resource exploitation. How might this have affected access to the source material? Direct access to a resource is usually characterised by *ad hoc* procurement strategies associated with non-commercial or non-elite consumption, whereby consumers travelled to the source to obtain their own supplies (Renfrew 1973b: 180; Torrence 1982: 197; Ericson 1982: 131; Spence *et al.* 1984: 102). Framing the production and consumption evidence at Widan el-Faras and Chephren's Quarry within 'Direct Access Theory' (Renfrew 1973b: 180) therefore appears an inappropriate model to use in relation to this evidence. Hence, can it then be assumed that the resources were operated as 'monopolies'? [1]

Trying to determine the existence (or not) of such a concept from the archaeological and

[1] The term 'monopoly' is often used in relation to the state/king's control over exotic material sources in antiquity; and it is also often used by modern commentators to describe exclusive possession over the resource.

textual record is difficult (Shaw 1998: 251) and needs to be approached from within broader terms of reference. Production evidence and the presence/absence of structures at the quarries need to be explained in their historical context, particularly in relation to their regional setting. The concept of a 'monopoly' over stone resources was a position reached in relation to the Roman granodiorite quarries at Mons Claudianus in the Eastern Desert (Peacock *et al.* 1994: 229). An 'imperial monopoly' was deduced from three sources of evidence: first, limited distribution; second, restricted consumption and third, *ostraca* that suggest finished objects were reported to the *procurator caesaris* (*op. cit.*). From these criteria restricted consumption can be applied only to the use of basalt and Chephren Gneiss and this does not seem a sufficient basis to assume that the resources were royal monopolies. Furthermore, as Kemp (1991: 246) points out, it would be expected that a monopoly would require enforcement by decrees and even punishments. In the absence of any textual data associated with Chephren's Quarry and Widan el-Faras, this is of course impossible to determine. However, some expectations of the archaeological record have to be considered, such as defensive structures or the presence of a 'military' at the quarries.

Because of these uncertainties it is necessary to assess other criteria for resource exploitation outside the extremes of 'direct access' or 'monopolies'. Studies made by Torrence (1982), Spence (1982) and Spence *et al.* (1984) have examined a range of data from production evidence and infrastructure at the quarry sites, to the distribution of the material. In the Mesoamerican model, Spence *et al.* (1984: 102) deduced that the remote source region from where superior green obsidian was procured (50 km from the city of Teotihuacán) had become *absorbed* into the Teotihuacán state. This was based on evidence of increased production at the source and the stone being worked only to 'blanks', with finishing occurring in workshops close to administrative centres within Teotihuacán (*op. cit.*). The concentration of material at these centres, and nowhere else, combined with evidence of storage facilities demonstrated some centralised control over the material. Furthermore, there seems to have been an efficient funnelling of the raw material via a single system to the centre that indicated a level of state involvement in the transport of obsidian (Spence 1982: 180). Such a system would probably allow for the maintenance of a stable flow of the material to satisfy the huge increases in demand. Some elements of such a model can be applied to exploitation of Chephren's Quarry and Widan el-Faras; the most obvious being the intensification of production and secondary production ceasing at object 'blanks', implying that finishing took place elsewhere. Royal workshops where stone was crafted into high-status objects associated with the Giza plateau pyramids have been excavated (Lehner 1997: 238-9) and there is the possibility that Umm es-Sawan in the Faiyum was a vessel workshop connected with elite consumption (see Chapters 6, 8 and 9). This can also be implied from the discussion above relating to the stone tools. An administrative centre with its own necropolis connected with the Old Kingdom regional centre of Shedet (modern Medinet el-Faiyum) has been proposed (Ćwiek 1997: 18-9; see Chapter 3). Therefore, the proximity of Umm es-Sawan could suggest some royal control over production also here. Chephren Gneiss was certainly being worked there, given the presence of the stone as worked and unworked blocks (see Chapter 2, 3, and 6). However, a more intensive and systematic survey would be required to develop such a hypothesis, particularly to determine context, as some of the unworked blocks were observed (by the author) in contexts relating to utilitarian production.

The concept of resource *absorption* rather than monopoly can be further explored in relation to Chephren's Quarry, due to the Old Kingdom presence in Nubia corresponding with the peaks in acquisition. As discussed in Chapter 3, Egypt's interests in Lower Nubia were of a commercial nature that took on some form of permanency or even dominance by the 3rd Dynasty (Trigger 1965: 79; Manley 1996: 26; Seidlmayer 1996: 112). Securing the flow of exotic items from Upper Nubia was an important factor in these relations (Adams 1977; O'Connor 1993) and such regional ambitions probably also applied to stabilising the flow of Chephren Gneiss. As in Spence's (1982: 180) model, maintaining a stable flow of the material would have been crucial to satisfy demand. However, this situation would be extremely sensitive to oscillations in economic relations with Nubia and to the internal political stability necessary to keep these channels open.

The Old Kingdom stelae at Chephren's Quarry might suggest some kind of *claim* over the resource, or some kind of territorial marker, consistent with the idea put forward by Spence and his colleagues (1984: 102) of *absorption*. However, this is far from clear-cut and could merely imply a 'projection' in Egyptian view of *presence* rather than anything else (see Chapter 4). Resource absorption, as opposed to individual ownership or royal monopoly, might further explain the absence of defensive structures at Chephren's Quarry and Widan el-Faras (see Chapters 6 and 8). As Torrence (1982: 196-7) points out, access to a monopolised resource would have been restricted in some way by boundaries or defences to control access. The only evidence that could suggest guards or military being present at Chephren's Quarry is the stone structures on Quartz Ridge and at the encampment at Widan el-Faras, given their strategic locations. However, this accommodation is extremely ephemeral and could only provide for a very small number of people; it is therefore unrealistic to suggest, given the size of both quarries and the numerous means of access, that the resource could be comprehensively protected or defended (see Chapter 6). Although poor preservation has to be considered at both quarries, in effect, anyone could directly access the resource, so perhaps the material itself was not deemed necessary to protect in its raw form. This might explain why the only evidence of Old Kingdom raw material sources (possibly) being defended is in the Sinai turquoise *mining* site of Wadi Maghara. This is in all likelihood related to the semi-precious nature of the material being procured that would have value even in its raw form. Hence, although Chephren's Quarry and Widan el-Faras could in fact be directly accessed, it cannot be assumed that this implies *ad hoc* procurement.

Understanding the social context of remote source stone procurement in the Old Kingdom is perhaps better approached outside of monolithic concepts such as state monopolies on the one hand and direct access on the other. Rather, resource exploitation constructed in terms of their context within a broader framework of political, regional and economic interests is more appropriate. As a consequence, it might then be possible to develop a greater understanding of the ebb and flow in stone procurement as a response to internal and external influences, which by their very nature are fluid. These themes will be developed further in relation to the cessation of exploitation.

Transportation of Stone: a Reconstruction of the Logistics

Transport Infrastructure at Quarry Sites

With more intense exploitation of remote stone sources would come the need to develop efficient means of transportation, particularly in the interests of maintaining the flow of material and the desirability of a single channelling system (or transport artery) to a centre for final finishing (Spence 1982: 179). Reducing the material into manageable pieces for transportation is implied from the secondary production evidence, which Ericson (1982: 132; 1984: 7) terms the 'waste reduction process' (see Chapter 6). In the context of obsidian exchange, evidence of waste reduction can suggest changes in procurement strategies linked to the expansion of regional exchange networks or elite consumption. These changes can be reflected in more cost effective procurement strategies that would necessitate an interdependency of transport efficiency and production (Ericson 1982: 132). The evidence for materials being transported greater distances from the source can be the outcome of more efficient methods of stone transport, a situation particularly related to water transport and/or using domestic animals to haul stone overland (Ericson 1984: 7).

The dramatic increase in the distance that large volumes of stone travelled by the 4th Dynasty was perhaps one of the most phenomenal achievements of the Egyptian Old Kingdom. The connection between this phenomenon and increased production concomitant with consumption is clear. Therefore, investments in a transport infrastructure to cope with these demands for stone should be observable in the archaeological record. The concept of a greater interdependency between production and transport should also be observable, with transportation structures being located within production areas and connecting these with preferably the closest water supply for transport (Ammerman and Andrefsky 1982: 167-71; Ericson 1984: 7). At both Widan el-Faras and Chephren's Quarry purpose-built structures to expedite the removal of the stone from the quarries are attested, although the form that these structures take is quite different.

At Widan el-Faras this is a paved road and at Chephren's Quarry loading ramps, but what *connects* them is that they are located within the areas of production and purpose-built to accommodate a specific vehicle (see Chapter 6). It is evident that not only was maximum use made of locally available materials to construct the quarry road and loading ramps, but there was clearly an intimate knowledge of ground surfaces in respect of their load bearing potential. As a consequence, the necessity (or not) for constructing paved surfaces explains its presence at Widan el-Faras but not at Chephren's Quarry (see Chapters 2 and 6). Such knowledge is certainly attested in relation to the best locations to access groundwater that would involve the least amount of digging (see Chapter 2). Furthermore, in relation to Romano-Libyan Period pre-desert floodwater farming in the Libyan desert, the construction of walls and channels indicated that this was also a knowledge-based activity which took into account the particularities of local topography, geology and hydrology (Gilbertson and Hunt 1996: 225).

In relation to the criteria set out above, the quarry road at Widan el-Faras attests to an interdependency between production and transport. The road branches are specifically related to each quarry and terminate at the corresponding base of the escarpment (**see Fig. 2; Pl. 71b**). The main branch of the road delineates the *shortest* route to water at Lake Moeris and its construction attests to the need to overcome topographical irregularities along the way, as in the Hatnub quarry road (see Chapter 6). The road channels the stone into one single transport artery, the Nile, via its connections to the Bahr Yusef branch of the Nile via the Hawara Channel. If the Bahr Libini extension of the Bahr Yusef was active then there would be an effective water transport artery direct to the pyramid fields at both Giza and Abusir; the principal sites that used basalt in the Old Kingdom. The burden of transporting stone 80 kilometres overland to the pyramid fields is significantly reduced to just 11 kilometres, as the satellite image demonstrates **(Fig. 34b)**.

It could be suggested that both primary and secondary production sequences at Widan el-Faras were specifically geared towards water transportation. This might explain why better quality basalt in the western environs of the Gebel Qatrani flow was not exploited because it would have a greater distance to travel overland, an idea which has also been postulated by Harrell and Bown (1995: 83). As a consequence, this might imply that the chronology of the basalt quarries would be from east to west along the outcrop, a situation that could be attested from the earliest ceramic evidence being at Quarry 1 (see above and Chapter 6). Furthermore, as Ammerman and Andrefsky (1982: 164) observed in relation to obsidian transportation in Calabria, the stone is further reduced at the juncture between land and water transportation systems. Evidence of block trimming is attested at the quay that is the terminus of the quarry road at Qasr el-Sagha (see Chapters 2 and 6), in other words the junction between two different methods of transport.

The benefits of maximising water transport from remote sources, particularly in relation to the intense production and consumption during the 4th and 5th Dynasties, would seem quite obvious. Bradley and Edmonds (1993: 52) point out that the largest henges in Britain are nearly always situated close to major waterways. Discussions of these issues have surrounded the transport of Stonehenge bluestones from the Preseli Hills in south-west Wales to Salisbury Plain and the enormous benefits in human resources if this was via water (Castleden 1993: 114). Castleden (*op. cit.*) constructs an hypothesis for water transport in preference to overland through utilisation of inland rivers and streams near to the stone source that had increased flow during the summer. The increase in water supply would be enough to float 4 ton bluestones (similar weight to a Chephren Gneiss statue block) placed on dug-out canoes lashed together to make a platform. Such a process could reduce the overland portion of the journey to just 15 kilometres (Castleden 1993: 114, Fig 45).

In an Egyptian context *overland* transport of stone from quarries was an essential procedure at some point. The 12th Dynasty depiction of Djehutihotpe's (**see Fig. 25**) statue being transported from the Hatnub quarries is perhaps too often seized upon as a practical explanation of these practices, because representations of stone being transported from quarries are so limited in an Old Kingdom context. This depiction has had the effect of influencing ideas about *overland* transport of stone from quarries as *finished* objects placed on sledges, in preference to other possible modes of transport. In the absence of explicit archaeological data, it has also tended to place emphasis on large numbers of people involved in the dragging process (animals are rarely shown), which given the funerary context of this depiction might have more to do with individual aggrandisement than real life practice. As Baines (2000: 36) points out, the tendency is to focus on the feats involved. Suffice it to say, some caution has to be applied to this data and certainly the archaeological record does not suggest that objects were finished at quarries.

The seasonal nature of the bluestone transport model is an important factor that would equally apply to remote source stone transport from both Widan el-Faras and Chephren's Quarry. The annual innundation (although at the hottest time of the year) would have been the optimum time to secure the highest levels of seasonal waterways connected to the Nile (see Chapters 2 and 6). Capitalising on annual climatic and flood cycles, particularly in relation to water transport of megaliths, has influenced discussions of how the Olmec (1500 BC) transported 40 ton blocks of basalt from the Tuxtla Mountains (60 km) to San Lorenzo in Mexico. There is the high probability that this occurred at the end of the rainy season when the rivers would be at their highest levels. The massive blocks were probably placed on balsa rafts and then floated down the coast to where the Río Coatzacoalcos meets the Gulf of Mexico (Coe and Diehl 1980: 296-7; Coe 1994: 68). This longer journey by water seems to have been in preference to undertaking the shorter overland route of 60 kilometres (Coe 1994: 68). The only empirical data that can attest to the use of the Río Coatzacoalcos in the transportation process is the remains of a causeway, 1.2 metres wide by 200 metres long, that was the disembarkation point at San Lorenzo (Coe and Diehl 1980: 296-7). The river now flows some distance from San Lorenzo, the causeway is now high and dry, but the parallels with the quay at Qasr el-Sagha are striking.

The benefits of accessing a close waterway to Chephren's Quarry are quite obvious, although there is no explicit empirical data with which to determine what efforts were made to reduce the 80 kilometre overland journey to the Nile. However, the elements of production/transport interdependency are attested, given that secondary production was to object blanks and that the loading ramps are strategically placed within the block quarries.

It has yet to be determined whether the 10 kilometre section of an Old Kingdom route from Quartz Ridge heading south-east in the direction of the Nile (see Chapters 2 and 6) could be just one of several overland routes, and/or was opened for just one period of exploitation. A point that needs to be stressed is that the direction of the sight-lines along the track via cairns to Quartz Ridge, are in fact to the vessel rather than block quarries (see Chapters 2 and 6). Thus it cannot be assumed that large statue blocks were also taken this way, given that the block quarries are located 4 km south of Quartz Ridge. The loading ramps were clearly purpose-built to expedite the removal of the large statue blocks involving a transportation device of considerable height and width, given the dimensions of the tracks emanating from the front of the ramps (see Chapter 6). The absence of a purpose-built track leading away from the ramps suggests that the original ground surface had load bearing potential, given that a statue block would weigh in excess of 4 tons (see Chapters 2 and 6). If the large blocks were transported entirely overland to the Nile, then considerably more effort in human resources would be required. Mobilising extra labour just for the transportation process has been suggested in relation to Hatnub (Shaw 1987: 166; also by Eyre 1987: 17; see Chapter 8). Although this is quite feasible from quarries within the Nile Valley closer to permanent settlements, accounting for large numbers of extra people at remote source quarries is difficult to attest in the archaeological record. Even at Camp 1 that seems to be connected at least with the transport of small blocks, the amounts of pottery are still relatively small (for these camps see Chapter 8). The use of dray animals has to be a possibility (see Daressy 1911: 262-5; Chapter 6) and could be attested if the exterior wall of each well found along the track functioned as a corral (see Chapter 2). In

Ericson's (1984: 7) model this would be a reflection of greater efficiency.

However, minimising the overland journey would still be desirable, although the archaeological evidence to support this hypothesis is harder to find. In consideration of these problems and as previously hypothesised (Bloxam 2000: 19-27; Shaw and Bloxam 1999: 13-20), the closeness of the Wadi Tushka, 15 kilometres north of the quarries, could have provided close access to a waterway in wetter climatic conditions. The possibility that Wadi Tushka could have been active during the final pluvial phase of the mid Holocene around 4090 ± 500BP (Wendorf and Schild 1980: 236; Haynes 1980b; Pachur and Hoelzmann 2000: 936) requires further investigation. However, due to the current Tushka Hydrological Project, any investigations of the Wadi Tushka and the northern environs of Chephren's Quarry are now impossible. Therefore, the use of this route to maximise the water transport of the large blocks can only remain very hypothetical. However, groundwater was very close to the surface, less than one metre (see Chapter 2). Furthermore, it could also be considered that the exterior walls surrounding the wells along the track were defences against wadi water run off across the plateau and the resulting clogging up of the wells with debris (see Chapter 2).

Castleden (1993: 119), in his hypothesis concerning water transport of Stonehenge bluestones, discusses the benefits that would also be derived from reducing the amount of stone transference from one type of vehicle to another. Such operations would require the greatest use of *extra* manpower, particularly lifting megaliths from a sledge onto a boat in the absence of lifting gear. Taking into consideration the above points and given that there is no purpose-built road or quay associated with Chephren's Quarry (see Chapter 6), then designing a vehicle that negotiated both the land and water journey would alleviate the need to transfer blocks from one vehicle to another after the initial loading. A hypothesis related to this issue has already been proposed (Bloxam 2000: 19-27; Shaw and Bloxam 1999: 13-20) which in essence postulates that a kelek or buoyed raft on runners would indeed solve some of these logistical problems (**see Fig. 35**). Such a vehicle could explain some of the anomalies that the archaeological record presents, in particular the excessive *height* of the loading ramps and the fact that these structures are only known at this particular quarry. There would be three important advantages to such a vehicle within Ericson's (1982: 132; 1984: 7) model of greater transport/production efficiency: first, alleviating the need to transfer blocks; second, it could be assembled using locally available materials and third, as a consequence of the first point, would require less manpower in the transport and lifting process than using conventional sledges which require the lifting of blocks onto a boat for transport on the Nile.

The Decline of Remote Source Hard Stone Procurement: Economic, Political or Environmental?

Cessation in the procurement of remote source hard stone from Widan el-Faras and Chephren's Quarry occurring in the late 5th Dynasty is implied from the archaeological record at the quarry sites and consumption record in the royal funerary complexes (see Chapter 4). Whether cessation was *abrupt* or a *gradual* decline is difficult to determine, although basalt procurement seems to have suddenly ceased after the reign of Nyuserra, given that his funerary monument is the last to use the stone. However, some care needs to be taken in making any broad assumptions about this, due to the fragmentary record of consumption and stone re-use. Nevertheless, there was a general scaling down of hard stone procurement into the 6th Dynasty and this has often been seized upon as the measure of gradual state decentralisation. However, there are many other considerations in the grey areas of the decline of central power in the Old Kingdom (see Chapter 3) that might have influenced changes in hard stone acquisition. These issues could relate to internal political problems, socio-economic changes and environmental conditions, each being reflected in what is perceived as the scaling down of pyramid complexes.

Changes in elite stone consumption: the implications on hard stone procurement

It should not necessarily be assumed that the overall decrease in the size of pyramid complexes reflects social and economic decline, as building frenzies can sometimes be specifically ordained to create employment and mask economic decline (Saitta 1997: 21). A similar point has been made by Shaw (2002: 250-1) in relation to the peaks of emerald and amethyst procurement from the Pharaonic period into the early Byzantine period. The suggestion is that peaks in acquisition may not necessarily be indicators of prosperity and stability, but conversely, could be responses to economic and social stress, particularly in the realm of semi-precious stones being used to 'buy off' officials.

With these ideas in mind, it is perhaps more important to focus on changes in the use of raw materials as a possible indicator of social, economic and political changes, rather than just monument size. After all, royal funerary monuments were in a sense facades in which power and legitimacy to rule were embedded naturalizing the social order, the maintenance of which would be crucial (Shanks and Tilley 1987b: 180-1; Bard 1992: 5; see Chapter 5). It might therefore have been important to absorb the effects of internal pressures in less obvious ways, by replacing internal architectural elements which in the past were in hard stones with soft stones, *locally* sourced within the Nile Valley (see Chapters 3 and 4). Something was clearly happening in the late Old Kingdom that affected hard stone procurement *outside* of the Nile Valley, because it seems to have been completely phased out, with the exception of greywacke from Wadi Hammamat, which was generally used for single objects such as sarcophagi. It could be argued that attempts were made to conceal this fact, with the use of skeuomorphs or soft stone facsimiles of exotic hard stones. This might be implied by the use of black limestone (soft) instead of basalt for paving and wall linings in the mortuary temple of Pepi I (see Chapters 2 and 4). Could this have been a deliberate attempt to conceal the decreased ability of royalty to procure remote source hard stones?

On the other hand, it could also be argued that there was simply a change in preference by royalty or indeed *symbolic* reasons for these changes in stone consumption. For example, the increased use of quartzite (silicified sandstone) during the 5^{th} and 6^{th} Dynasties has been suggested as due to its strong solar and kingly associations (Shaw 1998: 253; Baines 2000: 36; Quirke 2001: 76). Perhaps this was also to do with emulation, whereby new status goods such as hard stones need to be found to replace devalued artefacts (Hodder 1982: 207). In other words, elite stones were becoming more widely consumed at lower levels. It also has to be considered that these changes could have been used as a manipulation of symbolism for self interest, where the manipulation of prestige goods and ideology was also the manipulation of social and ideological value systems (Kristiansen 1995: 214). These points are raised because there is no evidence of significant theocratic shifts between the 5^{th} and 6^{th} Dynasties; if anything the 6^{th} Dynasty was a period of retrospection to prototypes of the 5^{th} Dynasty pyramid complexes (Lehner 1997: 156; Verner 2002: 364, see Chapter 3). This could explain why black was so important to copy, given its largest use in the 5th Dynasty. It would also be interesting to speculate whether the limestone and travertine used for paving and wall linings in other 6th Dynasty pyramid complexes were painted the colour of exotic hard stones, as some statues and walls were at least partially painted (Grzymski 1999: 53; Baines 2000: 34; Verner 2002: 364). A fine example in respect of colour effect is the use of black paint in the mortuary temple of Nyuserra to conceal the white mortar between the basalt blocks (Borchardt 1907: 56, see Chapter 4).

Apart from architectural elements reverting back to soft stones, this was also happening with high-status hard stone vessels being copied in soft stones or skeuomorphs, such as anhydrite ('blue marble') to perhaps copy Chephren Gneiss (see Chapter 4). A cylindrical vessel in limestone in the Egyptian Museum (unfortunately with no date, number or provenance, **see Pl. 42b**) has been painted with blue speckles, in all likelihood as a skeuomorph of a classic Chephren Gneiss vessel. The creation of skeuomorphs of hard stone objects in soft stones certainly seems to have been practised by the First Intermediate Period, in particular black limestone replacing basalt for small vessels (see Chapter 4). From the discussion of skeuomorphism in Chapter 5, an important point to stress is the suggestion that the 'fake' reinforces the value of the objects and/or the materials that they seek to imitate (Bourdieu 1984: 176, 251-2). This further implies the value attributed to hard stones such as Chephren Gneiss and basalt, and also to their specific attributes such as *colour*, along with the form in which they were mostly commonly associated. Whether there were deliberate attempts made to mislead or 'pass off' soft stone objects as the 'real thing' is unclear. However, skeuomorphism as a deliberate attempt to copy silver vessels in ceramics is forwarded as a possible reason for the appearance of the distinctive Grey Burnished ceramics in Palestine in the Early Bronze Age (Philip and Rehren 1996: 144-5).

What could have been happening in the 6th Dynasty might be the outcome of a gradual channelling of consumption away from the royal household based in Lower Egypt, concomitant with a shift in the spheres of political influence (Cruz-Uribe 1994: 49, see

Chapter 3). It seems as if the reach of consumption away from the 'super-consumers' in Lower Egypt to the provinces was in fact a return to consumption practices of the Predynastic (see above and Chapters 3 and 4). This would imply, as suggested by Butzer (1976: 103-5; see Chapter 3), that important provincial towns might have seen a renaissance during periods of central decline, with the effect of diverting labour away from centralised projects. The textual record certainly attests to officials of the 5th and 6th Dynasties having the ability to mobilise labour to construct their private tombs with all the inducements necessary, such as access to fermented beverages, as discussed in Chapter 9.

This dispersal of raw materials and exotic hard stones presents a similar situation as suggested by Shaw (2002: 250-1, see above) where the maintenance of the *status quo* was by 'paying off' officials through increased access to raw materials. The archaeological record does attest to consumption becoming less focused on a few individuals, as indicated in provincial cemeteries of officials where cosmetic stone vessels, gemstones and gold occur as everyday items, rather than being specifically for funerary use (Seidlmayer 2000: 122; see Chapter 3). Likewise, poorer burials started to contain objects specifically created for funerary use, such as stone vessels or models of them, these usually in soft stones and poorly crafted (Seidlmayer 2000: 124). Also, individuals outside of the royal household had access to a possible medium of labour mobilisation, such as fermented beverages. The unintended consequence of all this was the potential to undermine the state from within, because the power to secure outcomes via the agency of others became increasingly diminished (Giddens 1979: 88-94; Roscoe 1993: 113). As Yoffee (1993: 71) points out, the demise of the state can be as enlightening as to the power relations under which it formed and thus the recursive nature of political centralisation and decentralisation (Roscoe 1993: 117).

Environmental, regional and economic considerations

Maintaining a stable flow of material from regional or remote sources was crucial in the model of resource *absorption* and the channelling of material via a single transport artery to central workshops. Taking into account the political dimension, regional or remote stone sources would be particularly sensitive to changes in regional economic interests and/or environmental changes. Spence *et al.* (1984: 104) make the point that state-organised quarrying expeditions in Teotihuacán to regional sources would be susceptible to oscillations in the stability of the central authority. Such a situation could lead to the total collapse of regional source exploitation by the central authority's withdrawal from the region, a situation that could have aggravated the difficulties that the state was already experiencing.

Perhaps such a parallel can be drawn against the apparent diminishing influence of Egypt in Nubia by the 6th Dynasty and the apparent abandonment of permanent settlement at Buhen. Changes in economic and political relationships with Nubia could have affected the ability to maintain control over the flow of exotic items from outside Egypt's territorial boundaries to Lower Egypt. This situation could have had consequences on procuring stone from Chephren's Quarry. Although expeditions into Nubia were still happening in the 6th Dynasty, as attested in Harkhuf's funerary biography, these campaigns were of an ephemeral nature organised from Elephantine and concomitant with the growing influence of provincial governors (see Chapter 3; Trigger 1976: 48; Trigger *et al.* 1983: 126). Although this might have affected procurement of stone from Chephren's Quarry it would certainly not have affected stone procurement from Widan el-Faras and therefore different explanations need to be considered.

In relation to procurement of Widan el-Faras basalt, it is evident from the empirical data that the interdependency between production and transport relied more on water transport of the stone than overland routes. As a consequence, the transport network required the flooding of seasonal waterways to connect the source with the Nile, a fragile system that would be vulnerable to any major decreases in flood levels. The evidence for climate change and lower Nile flood levels occurring during the 6th Dynasty has been discussed in Chapter 2. In summary, a catastrophic decline in the Nile flood is suggested between *c.* 2220-2000 BC, commencing during the reign of Pepi II of the late 6th Dynasty (Butzer 1984: 107; Hassan 1997: 5-6; Stanley *et al.* 2003: 395-402), and in Upper Egypt the last pluvial phase of the mid Holocene Wet Phase occurred around 4090 ± 500 BP, from which time hyperarid conditions set in (Wendorf and Schild 1980: 236; Haynes 1980b; Pachur and Hoelzmann 2000: 936; see Chapter 2). It has to be considered that a probable contributing factor towards the *explosion* in basalt procurement from Widan el-Faras during the 4th Dynasty was due to favourable flood levels as attested on the Palermo Stone (Butzer 1984: 107; Hassan 1997: 5-6) and from studies of the levels of Lake Moeris (Shafei 1960; Butzer 1976; Wendorf and Schild 1976; Hassan 1986a). Therefore, a reversal in these conditions could be equally as enlightening to its decline.

However, to avoid the dangers of creating a too environmentally deterministic hypothesis for cessation, the concept of interdependency between production and transportation of material is important to consider in this regard (Ericson 1982: 132). Any breakdown between these two interdependent processes could have an effect on the efficiency and cost effectiveness of procuring stone from remote sources. Therefore cessation might not have been determined explicitly by changes in flood levels, but because procurement became non-viable as a consequence of having to establish overland routes requiring greater investments in human as well as material resources. In relation to this point, it has to be remembered that stone sources inside the Nile Valley do not seem to have been affected because Aswan red granite and Hatnub travertine were still being transported in quantity during the 6th Dynasty (see Chapters 2 and 6). This might be due to water transport from these sources not being reliant on seasonal waterways and were therefore less susceptible to changing flood levels. An economic or more viable *status quo* between production and transport would probably be easier to maintain.

It could be argued that basalt and Chephren Gneiss simply went out of fashion or favour. As Ericson (1982: 144-6) remarks, the near collapse of obsidian production around AD

650 in California might be related to significant consumption changes from luxury to utilitarian consumption and the impact of new bow and arrow technology. However, such changes cannot be detected in the elite consumption record in the 6^{th} Dynasty and there does not seem to have been any significant theological changes that would imply this. If anything the opposite is implied, particularly given the attempts that seem to have been made to copy remote source stones in soft stones and the retrospection to 5^{th} Dynasty funerary concepts (see above and Chapters 3 and 4).

Cessation of Chephren Gneiss exploitation could have been a consequence of regional economic changes, but were these environmental changes also a contributory factor? The practicalities of maximising transport by water have been expressed above and, as a consequence, lower Nile levels might have had a knock-on effect at Chephren's Quarry, particularly if there was the dependency on seasonally flooded waterways. This is of course highly speculative due to the limitations of the archaeological record. However, a situation that is *less* speculative would be the environmental impact that the Old Kingdom exploitation of local non-renewable floral resources would have had on the *local* environment. This particularly relates to the felling of trees that would be necessary for fuel associated with domestic and production needs, which could have contributed to the acceleration of ground surface deflation. Combining this with the return to hyperarid climatic conditions, then perhaps the transportation of large volumes of stone, particularly if this was overland to the Nile, would have become too impaired by increasing sand accumulation.

If the events as speculated above are measured against Ericson's (1984: 7) argument of the 'waste reduction process' and the connection between production and transportation costs, it could be considered that the costs in labour and time, if transportation had to be predominantly overland, would have made this a non-viable operation. Consideration also needs to be given to perhaps an increasing reliance on subsistence being brought to the quarry from outside, a situation that would also have had economic consequences (see Chapter 2). Add to this decentralisation and the dispersal of wealth, resources and labour away from the capital to the regions, then such a confluence of events might explain the consolidation of raw material procurement to sources that were in easier reach, hence inside the Nile Valley.

The end of the 6th Dynasty was also the end of an era in hard stone procurement that was never again to be repeated in such volume until the Roman Period. Notwithstanding the Middle Kingdom re-opening of Old Kingdom quarries such as Widan el-Faras and Chephren's Quarry, the scale of procurement, in particular in its regularity and organisation, was nowhere near the levels attained in the Old Kingdom (see Chapter 4). Although there could be many reasons for this, such as re-use of stone, it is rather perplexing, particularly in the case of Widan el-Faras basalt, as the resource was far from exhausted and yet there is no evidence of fresh quarries being opened. This is also despite quite an elaborate infrastructure being built at Qasr el-Sagha, including a temple, so the reasons for this remain quite obscure and clearly require further investigation. At Chephren's Quarry, the Middle Kingdom exploitation appears to have had other aims that were more focused on the exploitation of semi-precious stones rather than Chephren Gneiss (see Chapters 2, 4 and 6).

The reasons for the Middle Kingdom presence at both Chephren's Quarry and Widan el-Faras was to perhaps fulfill other raw material ambitions which were more cost effective to procure, particularly if water transportation was no longer viable. This could explain why in the Middle Kingdom only small statuettes of basalt are known and Chephren Gneiss also had a very limited use. These limited requirements for basalt and Chephren Gneiss could have been satisfied via re-use of the stones from Old Kingdom royal pyramid complexes, or even from scavenging waste left after the Old Kingdom exploitation.

Summary

The approaches made to the production and transport evidence at Chephren's Quarry and Widan el-Faras from cross-cultural, cross-level and functional interpretations of the data provide ways to reconstruct stone procurement strategies within a broader framework of understanding. The interdependency between production and transport systems as observable in the archaeological record attest to procurement being undertaken on perhaps a more 'economic' basis, concomitant with consumption moving outside of just funerary requirements by the 4th Dynasty. To expedite transport and channel the flow of the material, water transport would be the preferred method of transport. This seems to have been acted upon at Widan el-Faras where efforts were made to reduce the overland journey, a situation that cannot be attested at Chephren's Quarry. However, the interdependency between production and transport is attested by the efforts made to reduce the transport weight of Chephren Gneiss to object blanks and by the construction of loading ramps in the block quarries. The loading ramps were purpose-built for a specific type of vehicle, perhaps similar to a kelek or raft-like structure, designed for both overland and water transport of large (statue) blocks. The vehicle was probably adapted for this specific venture, given its unusually large size, that within current research has no known counterpart in the archaeological record.

Production evidence and technology show standardisation concomitant with procurement as an organised activity with knowledge and predetermination being practised, as opposed to *ad hoc* improvisation. Visual qualities were particularly important in selecting Chephren Gneiss, which explains the large amount of waste material; although this is difficult to quantify due to the nature of the outcrops. Despite procurement strategies exhibiting levels of organisation and predetermination, there is no evidence to suggest that the sources were owned or monopolised by the state. Direct access could have occurred, but procurement was not *ad hoc*; even so, determining the levels of state involvement in actual procurement is problematic. It was driven by elite demand, but not necessarily controlled at all levels, as discussed in Chapter 9.

The concept of resource *absorption* is the preferable construct to understand regional procurement strategies and hence their vulnerability to changes in regional economic interests. The fragility or possible long-term instability of such relationships, along with a transport system probably dependent on high Nile floods, made them more vulnerable to unfavourable economic and/or environmental conditions. Although regional interests would not have affected basalt procurement from Widan el-Faras, the logistics of procurement relied on an environmental system dependent on the seasonal flooding of waterways. As a consequence, relatively high Nile floods were required to keep the crucial Hawara Channel open. In avoidance of a too environmentally deterministic hypothesis, if cost in transport is also considered, then undertaking a lengthy overland journey, with all that this implies, perhaps made basalt procurement from Widan el-Faras non-viable. Certainly it was never procured again in such quantities after the 5th Dynasty.

Cessation of procurement can thus be understood within a confluence of events, coming together during the 6th Dynasty. There was no collapse of the state, but rather a spread of influence away from the centre. Such changes affected the consumption of hard stone, with procurement seeming to contract to just inside the Nile Valley, and soft stones replacing hard stones in some architectural elements. This need not have been obvious, but changes were happening and it seems that focusing attention on the raw materials rather than the monuments can produce some interesting insights. It can be argued that political, economic and ideological transformations that were nuanced are more observable through the consumption of the *actual* raw materials, than by changes in the size of buildings. Therefore, a reflexive approach to the archaeological record that considers a range of theoretical approaches and cross-cultural comparisons questions the validity of some monolithic concepts that can obscure these nuances in production and consumption. Outwardly, the monuments were ideological devices that probably intended to obscure rather than reveal any elements of discontinuity in social relations, when in fact these were fluid and contingent upon a range of political and economic interests.

PART 3

THE ARCHAEOLOGICAL RECORD AT QUARRY SITES: ORGANISATION AND MOBILISATION OF QUARRY LABOUR FORCES

Chapter 8

The Organisation of Quarry Labour Forces: the Archaeological and Textual Record

Introduction

The first part of this chapter describes the settlement and artefactual evidence found at the remote source quarries of Chephren's Quarry and Widan el-Faras from recent survey and excavation. A discussion of this data and comparison with published data from a selection of other Old Kingdom quarry and mining sites aims to establish whether occupation of remote source quarries was on a permanent or temporary basis.

Labour organisation in the 3rd millennium BC and its representation in the textual record are presented in the second part of the chapter. The objective is to draw together the textual sources with the archaeological record at quarry sites to develop a hypothesis of how labour was organised for quarry expeditions, such as the size of labour forces and hierarchical structures. This study also attempts to establish the domicile from where labour forces might have been deployed. The concept of seasonal, campaign based expeditions for specific purposes is further explored, with the aim of formulating an organisational framework upon which remote source stone acquisition can be modelled.

Settlement Evidence

Chephren's Quarry

Settlement evidence within Chephren's Quarry is only found at Khufu Stele Quarries and at Quartz Ridge, located approximately 4 km apart (**see Fig. 16**). The following is a synthesis of the archaeological evidence pertaining to these areas of settlement obtained from two seasons of survey and excavation (see Chapter 1).

Khufu Stele Quarries

Approximately 500 m west of loading ramp 1 (LR1) an area of settlement is exposed as single level dry-stone walled features. These have been subject to recent disturbance due to the construction of the Tushka - Uweinat tarmac road in the mid 1990s which dissected the settlement causing extensive damage to the site (**see Fig. 16**). It is therefore difficult to estimate the original size of the settlement, but the scattered remains of stone walled features and quantities of pottery sherds in the modern spoil heaps suggests that it could have covered an area of approximately 500 m^2.

The settlement features were excavated during the 2000 season and details of their excavated elements and associated artefacts are given in the table (**Fig. 36**). Analysis of this data suggests that at least part of the settlement was designated as an area of food production for the labour force, in particular bread baking. Although Building A was only part excavated, it was apparent that the entire feature constituted a bakery as evident from the thick ash layer continuing outside of the excavation area (**Fig. 37a; Pl. 76a**). The presence of intact bread moulds found within the building, some inside their baking pits, and in the modern road construction spoil heaps, suggests a sizeable production of bread (**Pl. 76b**). The close proximity of Building B to Building A suggests an association with food production processes at the site, although there is no evidence remaining to suggest what this might have been, other than an annexe? The poor preservation of Building C makes this feature even more difficult to interpret. It has subterranean walls with no 'living floor' and bears similarities with the two groundwater wells (Well 1 and Well 2) described in Chapter 2. Fragments of a spouted vessel for pouring of liquids (discussed below) was found within the feature and since the process of bread making would require water, the close proximity of a suitable source would be expected (**Pl. 76c**). It is therefore interpreted as a well, probably serving the bakery.

Dating

An analysis of the bread moulds found *in situ* within Building A, and out of context in the road construction spoil heaps, can only establish an Old Kingdom date range between the 1st and 5th Dynasties (El-Senussi 2003: 1, 3-4). The classic 'bell-shaped' bread mould of the Old Kingdom is known between these periods of the Early Dynastic into the Old Kingdom (Jacquet-Gordon 1981:12-3, El-Senussi 2003: 1, 3-4) (**see Figs. 30a, 30b**). The clay used to produce the bread mould was locally acquired and shaped into the mould; called the 'negative' mould technique (Arnold and Bourriau 1993: 23). The clay was subsequently fired at approximately 500°C (*op. cit.*, 173-4) during the process of baking the bread. Each bread mould may only be used once, or at most twice, during this process (El-Senussi 2003: 1). A similar bread mould in the Petrie Museum (UC 15096) from Hierakonpolis is dated between the 1st and 3rd Dynasty and other examples have been found at the Giza necropolis and Naga ed-Dêr, thus extending the date range to the end of the 5th Dynasty (Reisner 1908: 98, Fig. 186; Reisner and Smith 1955: 88, Fig. 132, G7144M). Therefore, only ^{14}C dating of the charcoal from the ash layers in the bakery could provide a more specific date. A study season in Egypt to undertake this analysis is planned for 2004.

Pottery in the spoil heaps comprises, apart from bread moulds, storage vessels and small platters in burnished red Meidum ware. Although these are out of context, they date exclusively to the Old Kingdom, in particular the early 4th Dynasty (El-Senussi 2003: 1, 3-4). The rare spouted vessels found *in situ* in the well at Quartz Ridge and in the well close to the bakery (Building C), were difficult to compare exactly with those from other datable contexts. However, these vessels have two distinctive diagnostic features: a vertical spout emanating from the body and a tapered base, giving a total length of approximately 25 cm (**see Pl. 28b**). A similar vessel with a slightly longer neck and body, and a flat rather than rounded base, has been described as a 'practical jug' and found in the 5th Dynasty mastaba tomb in the Western Cemetery of the Giza necropolis (dating to the reign of Userkaf)[1] of an official named Khufuw-ankh (Reisner 1942: 503-7, Fig. 310, 14-4-13, Pl. 66 *f*, Pl. 69 *a*, Cem. 400 No. G4520; Reisner and Smith 1955: 79, Fig. 104.G4520). Reisner (1942: 503-7) suggests that although this type of vessel is rare and could even be attributed to one potter, it had a practical function and has a date range back to 4th Dynasty Khafre. This evidence suggests that pottery for utilitarian use (particularly the Meidum ware vessels) could have been brought down to Chephren's Quarry from Lower Egypt with the quarrymen, raising the possibility that they could also have resided in Lower Egypt. The implications of this are discussed later. In summary, the pottery corpus at Khufu Stele Quarries all dates to the Old Kingdom, ranging between the 3rd to 5th Dynasties.

Quartz Ridge

Quartz Ridge is an exposed quartzite escarpment orientated on an east-west axis approximately one kilometre long and rising about 10 metres above the desert plateau (**see Fig. 16**). Along the escarpment scatters of dry-stone walled features are exposed as circular or oval constructions, these usually comprising between one and three courses of *ad hoc* dry-stone walls, and also as a cluster of rectangular interconnecting rooms with dry-stone walls preserved up to seven courses high. These features suggest a main area of settlement or central depot of subsistence supplies for the labour force. The possibility of the area functioning as a supply depot has been further attested by the prominent quartz cairn, at the eastern extremity of the settlement, which forms a direct sight-line east to a series of cairns that demarcate at least one track to and from the quarry (see Chapters 2 and 6). The cairn is also clearly visible from the north, in the

[1] Userkaf used Chephren Gneiss for vessels and statuettes.

direction of Wadi Tushka.

Huts SP 85 and SP 90

Two of the circular features Hut SP 85 and SP 90 were excavated in the 2000 season and details of their excavated elements and associated artefacts are given in the table (**Fig. 36**). Hut SP 85 is located approximately 200 m from the main area of settlement on the north-east side of the ridge, and Hut SP 90 is located 400 m to the west on the west bank of a narrow wadi. Both features are constructed using the same method of *ad hoc* dry-stone wall construction with no foundations or evidence of roofing. The floor level of both features, reached at a depth of 65 cm, is rocky and uneven, suggesting these were not conducive as dwellings. Alternatively, they could have been extremely ephemeral accommodation and/or work places (**Figs. 37b, 37c; Pls. 77a, 77b**).

Both features revealed only a small number of artefacts, at SP 85 these were limited to a few pottery sherds under the lowest level of the wall. At SP 90 a small quantity of pottery sherds, fragments of Chephren Gneiss, ostrich eggshell, charcoal and seeds were discovered on the floor level, as well as an animal carcass of either sheep or goat. However, given SP 90's close proximity to the wadi, implies that (the directional flow of) any flood water from the wadi could easily collect inside the feature. Therefore, the faunal and floral remains might be the result of natural transformation processes, thus giving unreliable contexts.

Area of interconnecting rooms

In the 1999 survey and excavation season the area of interconnecting rooms was partially excavated and has been described in detail (Bloxam 1999; Shaw and Bloxam 1999). A synopsis is given in the table (**Fig. 36**). In summary, three of the interconnecting rooms excavated comprised up to seven courses of dry-stone walls constructed in a less *ad hoc* fashion than the oval and circular structures mentioned above. A living floor level appears to have been laid, giving a smooth appearance in comparison with other settlement features here. Within Rooms 1 and 2 wheel-made ceramic vessels were found intact, including a large fragment of a classic Meidum bowl (Darnell 1999). Part excavation of the largest room, Room 3, revealed 21 intact storage vessels dating between the late 12th Dynasty to early 13th Dynasty (Arnold 1988: 114, Fig. 74. No. 51; El-Senussi 2003: 1) **(Fig. 37d; Pl. 78a)**. The vessels are of Marl C fabric, each having a capacity of 76 litres, with pre-firing marks incised on their rims and post-firing numbers incised on their shoulders (Bloxam 1999: 36-8; El-Senussi 2003: 1, 3) **(Pl. 78b)**.

One of the objectives of the 2000 season was to re-excavate Room 3 to determine if it contained more storage vessels and to complete the excavation of the interconnecting rooms. However, all but 6 of the 21 storage vessels in Room 3 had been recently uncovered and smashed, the vandalism of the site extending into the previously unexcavated portion of Room 3 (the implications of this site destruction are addressed in the final chapter). Despite the loss of contextual evidence from Room 3, the room was cleared of aeolian sand to assess if any other storage vessels had survived the vandalism. However, the only remaining intact objects were two pieces of local sandstone 34 cm x 3 cm and 21 cm x 18 cm, that had numerous narrow grooves across their surface containing a green staining, suggestive of them being used as sharpening devices for copper picks.

Dating

In contrast to the settlement/food production area at Khufu Stele Quarries, the pottery found at Quartz Ridge suggests multi-period occupation during the Old Kingdom and Middle Kingdom. Analysis of pottery located at Hut SP 90, and as surface scatters along the escarpment, suggest the *earliest* presence to date from the Early Dynastic period through to the 5th Dynasty (Darnell 1999). Dating of SP 85 is problematic due to the lack of artefactual data. The spouted vessel found in the walk-in groundwater well (Well 2) at Quartz Ridge with its counterpart at Khufu Stele Quarries, suggests a 4th - 5th Dynasty date (El-Senussi pers. comm. 2003). Other evidence for an Old Kingdom presence at Quartz Ridge comes from a fragment of a trachyte stele, (found outside the area of interconnecting rooms), inscribed with the cartouche of 5th Dynasty king Nyuserra (**see Pl. 23**) (Darnell 1999; Bloxam 1999: 37).

There is then a hiatus until the Middle Kingdom (late 12th Dynasty to early 13th Dynasty), given that the *in situ* storage vessels found in Room 3 of the interconnecting rooms date to this period. These vessels are known to be associated with the storage of liquids, in particular beer, as state administered rations (Arnold 1988: 114; El-Senussi 2003: 1, 3) (**Fig. 30c**). Similar vessels in Marl C fabric are known at the Middle Kingdom sites of Lisht and Qasr el-Sagha and were probably produced in the Memphis-Faiyum region (Arnold 1988: 114, Fig 74 No. 51; Arnold and Arnold 1979; Arnold and Bourriau 1993: 180; Shaw *et al* 2001: 34). In addition, Marl C storage vessels seem to have been traded into Upper Egypt and Nubia during these periods, some being found in Middle Kingdom contexts at Karnak (Arnold and Bourriau 1993: 180). A Lower Egyptian connection specific to these vessels therefore seems probable. Pottery post-dating the Middle Kingdom is only known at Stele Ridge where a few fragments of Roman Period amphorae were found (Engelbach 1933: 68; Shaw and Bloxam 1999: 13-20; Darnell 1999).

Ancient Track: the environs of Chephren's Quarry

Camp 1 and Camp 2

Two ephemeral camps were located approximately 4 kilometres apart along the 10 kilometre section of ancient track emanating from Quartz Ridge, as described in Chapters 2 and 6 (**see Fig. 17**). Each camp is associated with a groundwater well: Well 3 with Camp 1 and Well 4 with Camp 2. Due to time constraints Camp 1 was only partially excavated and at Camp 2 just surface pottery was analysed. Each camp nestles into the slope of a low hill-side and is enclosed by a semi-circular dry-stone wall. The excavated dimensions of the wall enclosing Camp 1 are 1.5 m high by 70 cm thick (**see Fig. 36**) for further details of the excavated dimensions) (**Pl. 79a**). The placement of the camps into the hill provided good protection from the wind and on the hill-top above Camp 1, a cairn, now partially dismantled, clearly marked it to traffic along the track.

The overall size of Camp 1 is approximately 5 m north to south and 10 m east to west, and the ceramic assemblage (discussed below) revealed a single period of occupation during the Old Kingdom (El-Senussi 2003: 1). Partial excavation of Camp 1 exposed a 2 m^2 area of thick ash with *in situ* (intact) bread moulds lying on the ashy surface (**Pl. 79b**). Good preservation could be observed and an incised flat tray 'pesen-loaf' mould had clearly remained undisturbed on the hearth since the Old Kingdom (**Pl. 79c**). This area of what constituted mainly bread-baking, occurred at the back of the camp, or where it was most protected by the hill-side (**Pl. 79d**). Similarly at Camp 2, a section of the camp closest to the hill-side was designated for food preparation and from the bread moulds found here, also functioned as a bakery (**Pl. 80a**). Although Camp 2 was not excavated, an exposed low stone wall separated the bakery from the main camp, as an ash layer could be observed under a thin deposit of aeolian sand (**Pl. 80b**). Animal bones (either sheep or goat), sherds of plates, beer jars and cooking ware made up the ceramic assemblage in Camp 1, with similar ceramics as surface finds at Camp 2. This assemblage is consistent with basic subsistence needs.

Although Camp 1 was only partially excavated, this structure presents the first substantial evidence of a feature that could have been a temporary dwelling place. Certainly, the camp provides a rare example of food production occurring within the environs of Chephren's Quarry, in addition to the bakery at Khufu Stele Quarries. However, with almost one-third of the camp being taken up with bread-baking, the number of people who might have been housed here, although difficult to estimate, would probably have been more than 20. The ceramic assemblage is the largest yet found associated with one structure at Chephren's Quarry, and although small, is consistent with ephemeral use. The association between the groundwater wells, camps, and the track acting as a stone transport route (probably for small blocks, see Chapter 6) from the quarries, is further attested by the presence of a small piece of Chephren Gneiss on the living floor of Camp 1. These interpretations are only at a preliminary stage due to the camps being found in the most recent survey season (2003). Completion of excavation of Camp 1 and excavation of Camp 2, proposed for the forthcoming season at Chephren's Quarry in 2004 (see Chapter 11), should provide additional data to determine the function of the camps within the logistics of stone transport from the quarry.

Dating

As mentioned above, the ceramic assemblage all dates to the Old Kingdom, between the 3rd - 5th Dynasty, although the 'pesen-loaf' mould is more characteristic of the late 4th to early 5th Dynasties (El-Senussi 2003: 1-3) (**see Figs. 30a, 30b**). A connection/contemporaneity between the camps can be proposed from the ceramic assemblages, given they represent the same pottery types.

Widan el-Faras

'Main Quarrymen's Camp'?

A synopsis of the main elements of the single-level basalt stone circles that comprise the 'Main Quarrymen's Camp' are contained in the table (**Fig. 38**). An overall plan of the 'Main Quarrymen's Camp' (**Fig. 39a**) comes from fresh survey and planning of the site in May 2001. The problem encountered when surveying and planning these features was calculating the exact number of stone circles due to weathering of the basalt blocks into tumbles of rounded pebbles (**Pl. 81a**). This natural weathering phenomenon causes the walls to collapse into each other and therefore makes it difficult to determine if these were ever originally circles. Added to this are periodic flash-floods and man-made disturbance which have all contributed to the discrepancy between our survey calculations with those made previously. The 2001 survey identified 24 circles; however, previous surveys made in the 1990s have estimated the number to range from a maximum of 160 observed by Bown in 1993 (Harrell and Bown 1995: 77-8) to 47 calculated by Cornero in the mid-late 1990s (Cornero 1996/7). It is unclear what survey methods were used to produce these figures, but given the nature of the 'Main Quarrymen's Camp' as described above, 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 explained above, the now weathered basalt blocks would originally have been much larger than what is visible today and seemingly far too large for tent footings. Trial excavation of a section of one circle (marked on plan) (**Fig. 39a**) to a depth of 40 cm produced no evidence of a living floor level or discernible entrance (**Pl. 81b**). 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. With no evidence seen throughout the 'Main Quarrymen's 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: 77-8) that this was the quarrymen's main settlement. The implications of this are discussed below.

Dating

The minimal amounts of pottery, found in small surface scatters, comprise sherds of wine storing amphora dating to the Early Roman Period and storage jars dating to the early 4th Dynasty (**see Figs. 31a, 31b**). These 4th Dynasty jars are also known in contexts at Abydos, Meidum and Giza (El-Senussi 2001: 1-5). However, because of the wadi's discharge into the 'Main Quarrymen's Camp' it is possible that these sherds were washed down from Quarry 1 directly above, where Old Kingdom and Early Roman sherds were also located (see Chapter 6). Equally, pottery could have been washed out of the camp, but no traces were found along the wadi's path. Therefore, it is extremely problematic to date the 'Main Quarrymen's Camp' to either the Old Kingdom or Early Roman Period.

The Encampment

The encampment is situated at the entrance to Widan el-Faras, approximately 500 m south-west of the 'Main Quarrymen's Camp' and 30 m from the south bank of the Wadi

Ghorab. The features that make up the encampment are detailed in the table **(Fig. 38)** and can be referred to from the plan **(Fig. 39b; Pl. 82a)**. Although the basalt blocks that make up the circles have also been subject to weathering, these blocks would originally 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 **(Pl. 82b)**.

The purpose of the encampment, given its distance from the basalt quarries, is puzzling; however, it is in close proximity to nearby limestone deposits and rows of spoil heaps. Quarrying of these limestone deposits for road slabs and chips with stone pounders and small stone axes was attested, as described in Chapters 2 and 6. This suggests that the encampment could have been associated with the road construction side of the operation. The encampments' location strategically at the entrance to Widan el-Faras provides a clear sight-line north into the basalt quarry and south following the road towards Qasr el-Sagha, suggesting that it could also have been dwellings for a contingent of guards.

Dating

As opposed to the 'Main Quarrymen's Camp', the encampment is not crossed by wadis and has therefore seen minimal disturbance. Dense surface scatters of pottery sherds found across the site suggest only a single period of occupation during the Old Kingdom. A rim sherd found *in situ* under an ash layer in the hearth dates to the early 5th Dynasty and analysis of other diagnostic sherds provides a date between the early 4th and 5th Dynasties (El-Senussi 2001: 2) **(see Figs. 31a, 31b)**. Due to the fragmentary ceramic data here, only densities of pottery sherds can be shown on the plan **(Fig. 39b)**. However, even from this fragmentary data, the pottery corpus comprised only two categories of ceramics; storage vessels for liquids and cooking bowls, these being indicative of minimal subsistence needs for a small number of occupants on a temporary basis (El-Senussi 200: 3). A single body sherd with a pot-mark inscribed found in a rubbish heap close to the encampment has an equivalent at nearby Umm es-Sawan, the significance of which is discussed later in this chapter (**see Fig. 31b: No. 10**).

The Stone Features at Chephren's Quarry and Widan el-Faras: were these places of Old Kingdom habitation?

The 'settlement evidence' described at both Chephren's Quarry and Widan el-Faras is extremely limited for the purposes of establishing the size and hierarchical organisation of quarry labour forces. At Widan el-Faras, apart from the encampment which comprises all the elements of being a place of temporary habitation, the function of the 'Main Quarrymen's Camp' is far less clear. The many anomalies, such as its exposed location across a wadi, linear patterning and absence of artefactual evidence, means that consideration needs to be given to an alternative function. However, it has to be borne in mind that any explanations have to consider the disturbed nature of the features and the later Early Roman Period presence at the site.

The most compelling alternative suggestion, put forward initially by Harrell and Bown (1995: 78), is that the circles could represent a temporary storage yard for quarried blocks. Calculations made during the 2001 survey of the number of blocks making up the circles (430 ± 30 blocks, considering that each block often consists of weathered fragments) would in fact be enough for one temple floor, if the 160 blocks found on the quay (the road's terminus, see Chapter 6) were added. This idea is based on the proximity of the basalt concentrations to the road as representing a central collection area for transportation, as indicated by its position in the central part of the site. However, storage areas of blocks observed at Chisel Quarry in Chephren's Quarry tend to be in rows (see Chapter 6). The predominantly circular arrangement of the stones may suggest that the blocks could have been re-arranged into circles at a later date, perhaps for storage of food and water supplies, as fragments of a large storage vessel were found in the area by Cornero (1996/7). However, this work is still unpublished and provides no dating of the vessel.

Another suggestion is that the stone circles might even represent the superstructures of a system of wells reaching ground water discharged down the wadi over which the circles are situated, or tapping an artesian system similar to those observed in Iran (Skinner and Porter 1987: 252). Tapping an artesian system is an ancient art and the surface evidence of such a system is similarly represented by a linear arrangement of circular mounds; these demarcate shafts that connect beneath the ground to a horizontal tunnel system (*op. cit.*). The surface patterning of such a system closely resembles the linear arrangement of circles at Widan el-Faras. However, the feasibility of this option clearly requires more geophysical analysis and a greater study of the local geology.

At Chephren's Quarry similar problems arise when considering the function of the stone features described above as representing Old Kingdom dwellings at the quarry. Apart from the bakery located at Khufu Stele Quarries and the wells, the function of Huts SP 85 and SP 90 along with the other circular and oval features across Quartz Ridge, is extremely problematic to determine. In general terms, the rocky living floors with no evidence of a laid surface and minimal evidence of food production suggests that these were more likely to have been used to store food supplies and/or were sheltered places for finer stone-working. This situation is more clearly represented by the Middle Kingdom area of interconnecting rooms containing storage vessels and from the evidence of secondary stone production *outside* of the rooms. Although it is problematic dating the outside areas to specifically the Old or Middle Kingdoms, the evidence from the vessel blanks found here (see Chapter 6) suggests that this was also an area of finer stone-working.

Perhaps Quartz Ridge's central and elevated position within Chephren's Quarry does avail itself to such suggestions as a central production area for vessel blanks, as well as a focal point for food storage and distribution. The area demarcated by the clearly visible quartz cairn is particularly prominent when approached from Wadi Tushka to the north and from the direction of the Nile to the east. The recently discovered wells and camps marked by cairns along an Old Kingdom track heading east (see above and Chapters 2 and 6), with a clear sightline to Quartz Ridge, strongly suggests its importance within the organisational logistics.

The minimal amounts of pottery found in association with these areas of stone walled features at both Widan el-Faras and Chephren's Quarry, implies that small numbers of people were present on a temporary basis. It would seem feasible to suggest, in relation to Chephren's Quarry, that dwellings for the quarrymen were likely to have been ephemeral shelters which have left no trace in the archaeological record. At Widan el-Faras, apart from the encampment that could only have accommodated approximately 20 people, the lack of evidence for a discernible large settlement might be explained from observations made at Qasr el-Sagha by Caton-Thompson and Gardner (1934: 134). During their excavations at Qasr el-Sagha where the quarry road terminates, the abundance of Old Kingdom pottery suggested a sizeable presence here associated with a gypsum vase-making industry. Although the issue of a large Old Kingdom settlement here is still controversial (see Chapter 2), it has to be considered that with the high level Lake Moeris during the 4th and 5th Dynasties providing ample subsistence, such as fish and birds, a seasonal/permanent settlement here is entirely feasible (see Chapter 2). Subsequently, it would be expected that the quarrymen would also reside here, close to these resources at the terminus of the quarry road, rather than at Widan el-Faras. These points are expanded upon later in this chapter.

Comparative Settlement Evidence at Old Kingdom Quarry and Mining Sites

The table (**Fig. 40**) sets out a comparative framework of settlement evidence surveyed and excavated at other Old Kingdom quarry and mining sites such as: Hatnub, Wadi Gerrawi, Umm es-Sawan, Wadi Maghara and Gebel Manzal el-Seyl. From this data it might be possible to build a picture of what constituted Old Kingdom habitation at these sites. The general pattern that seems to emerge, as already pointed out by Shaw (1994:

111), is that Old Kingdom settlement structures comprise either small clusters or scatters of huts/windbreaks (**Pl. 83a**). The height of the walls (preserved) are generally below one metre and they are constructed in an *ad hoc* fashion. In some instances, both at Hatnub and at Chephren's Quarry (SP 85), the huts have been expediently constructed around an existing natural rock feature (Shaw pers. comm. 2003). These structures suggest either temporary accommodation or were simply sheltered areas to work stone.

The amount of pottery at all the above sites tends to be relatively small when compared with sites of permanent occupation, such as the Ptolemaic period emerald mining sites at Sikait-Zubara in the Eastern Desert, where there are multi-storey stone structures and extensive amounts of pottery (Shaw 2002: 250). At Umm es-Sawan 250 stone circles, clustered on an exposed plateau near the tool-making workshops, have been suggested (Caton-Thompson and Gardner 1934: 120) as representing a sizeable settlement, although no pottery was found here. The settlement at Wadi Gerrawi also had small amounts of pottery recorded relative to the size of the settlement (Petrie and Mackay 1915: 39), although this could be due to poor documentation. Hatnub seems to provide the largest pottery corpus but this is restricted to bowls, storage jars, bread moulds and beer jars. This limited range of vessels is further attested at the encampment at Widan el-Faras and at Chephren's Quarry and is suggestive of fairly temporary and basic subsistence.

The settlement evidence at Umm es-Sawan is the most contradictory and determining where the quarrymen resided is quite problematic. Similar to the main camp at Widan el-Faras, it gives a superficial impression of a substantial camp with its 250 circular stone shelters (**Pl. 83b**) (Caton-Thompson and Gardner 1934: 121). However, there is minimal artefactual evidence to suggest that these were dwellings for the labour force. Pottery is minimal (in comparison to the large amounts at the workshop areas) and there were no visible areas designated for food production, as would be expected if such a large number of people resided here. However, evidence of habitation at Umm es-Sawan can be seen in the natural rock shelters situated above the stone vessel workshops. These places are well protected from the wind and inside were hearths and broken shells of *Helix desertorum* used as food. Plentiful amounts of pottery inside and outside the shelters suggests their use as dwellings (Caton-Thompson and Gardner 1934: 120-2).

There are a series of 'workshop' mounds comprising gypsum debris, flints and pottery that are associated with an area of vessel production at Umm es-Sawan (Caton-Thompson and Gardner 1934: 103-4). Pottery in the workshop mounds is almost exclusively beer jars (**Pl. 83c**) and a pot mark on one of these resembles a pot mark found on a sherd at the encampment at Widan el-Faras, as mentioned above (Caton-Thompson and Gardner 1934: 110-6, pl. LXVI.30). It is important to note the high proportions of beer jars in the pottery corpus at Hatnub which compliments the pottery data from Umm es-Sawan. Likewise, there were storage vessels for liquids, possibly wine, at the encampment at Widan el-Faras and beer at Chephren's Quarry. The implications that this data might have on the mobilisation of labour are discussed in the following chapter. A further thread that does emerge from this comparative data is that within the majority of these stone features, secondary stone production seems to have also taken place (see Chapter 6).

The problem of the oval and crescent shaped huts

Despite the limitations of the data due to poor documentation and in some cases poor preservation, it cannot always be assumed that stone structures at quarry sites were necessarily dwelling places for the quarrymen. At both Widan el-Faras and Chephren's Quarry and indeed the other contemporary sites mentioned above, this type of stone feature presents a problem. As the seasons of survey and excavation at Chephren's Quarry have shown, circular and crescent shaped stone features surrounding depressions, often interpreted as dwellings, have been wells (see Chapter 2). Therefore, the location of these features is crucial and indeed from the 2003 season, camps where habitation took place tend to be extremely sheltered and almost never on the top of ridges or hills (**see Pl. 79d**). The groundwater wells associated with the camps are close by, but on the desert plateau, and prior to excavation can resemble shelters (**Pl. 84**).

Recent excavations of four dry-stone walled crescent shaped huts on the hilltop site of Nephthys Hill in the Dakhleh Oasis have provided useful comparative data about the function of such elevated structures. The features date to the 4th and early 5th Dynasties and the largest Hut A (4 m x 4.5 m) is approximately the same size as huts SP 85 and SP 90 at Quartz Ridge. Although this structure was paved, it has been interpreted as a storage area due to its prominent position on the hill (Kaper and Willems 2002: 83-4, pl.65), but from the large number of petroglyphs, tools and potsherds found here was also interpreted as the main dwelling (*op. cit.*). Hut B was of similar construction using slabs of local sandstone to construct the walls around a shallow pit dug into the hill. It had a layer of compacted earth on top in one corner and was interpreted as the sleeping area (*op. cit.*). Hut D resembled this construction and had a hole in the middle that might have contained a storage vessel (*op. cit.*). Evidence for fires was associated with the huts such as quantities of ash and a few faunal remains. Ceramic finds were few but from a range of different vessels including Meidum bowls (*op. cit*: 85).

The Nephthys Hill huts have been interpreted, due to their strategic positioning, as dwellings or shelters for a small watch post/campsite during the development of trading posts through the Western Desert oases (Kaper and Willems 2002: 82-90). The notches found on the walls of the huts and at the other hilltop sites are suggested as being 'mute accounts' as known from the clay tablets at Ayn Asil, the emphasis on the Nephthys Hill accounts being the numeral 'ten' where the notches are also accompanied by the hieratic sign for ten (Eyre 1987: 12; Kaper and Willems 2002: 89, 87: Fig 10). This sign was also present on a 'pesen' flat bread mould dating to the late 4th Dynasty and early 5th Dynasty (El-Senussi pers. comm. 2003) found *in situ* on a hearth at Camp 1 (**see Pl. 79c**). Could this imply some connection between these places? Exactly what was being counted in groups of ten is still open to conjecture; possibilities include people, days in a shift, or product deliveries. There is also the interesting assertion that these hill top sites did not function independently, as indicated by the lack of food remains, and therefore all foodstuffs were brought to the hill from kitchens elsewhere. Perhaps a similar situation can be deduced at Chephren's Quarry, whereby the bakery at Khufu Stele Quarries and perhaps those at Camp 1 and Camp 2 were the focus of food production and Quartz Ridge the central place for keeping watch over the site and for receiving supplies.

The final synopsis of what the Dakhleh hill top camps represent on a broader scale of Egyptian interests in this area has implications in elucidating the nature of quarrying expeditions into the Western Desert. The main points that emerge are through the Meidum bowls of Nile silt, also found at Chephren's Quarry, with origins in the Nile Valley suggesting that these items have come from a central Nile Valley location. This might also apply to the pottery corpus at Chephren's Quarry, excluding the bread moulds which are locally produced. Kaper and Willems (2002: 90) suggest that this constitutes Egyptian Old Kingdom strategies in controlling the oasis trading routes south into Nubia. These routes have been documented in the 6th Dynasty funerary biography of Harkhuf (see Chapter 3). These expeditions commenced at Memphis and seem to have been accomplished without interference (Lichtheim 1973: 25-6; Trigger *et al.* 1983: 126; Grimal 1992: 87; Manley 1996: 26). This might explain the absence of defensive structures at Chephren's Quarry.

The Concept of Specialist Towns and the Middle Kingdom Presence at Chephren's Quarry

Specialist towns associated with quarries and mines are usually indicative of Middle Kingdom resource exploitation at remote sources, as exemplified by the mining settlement at Wadi el-Hudi and the settlement at Qasr el-Sagha associated with the basalt quarries at Widan el-Faras (Arnold and Arnold 1979; Kemp 1991: 166; Shaw 1994: 116-

7).[2] The evidence for this statement comes from the rigid planning of these settlements where the dwellings are orthogonally built and either enclosed within a rectangular wall, such as at Qasr el-Sagha (Arnold and Arnold 1979: 26; Kozołowski 1983: 81, 89; Kemp 1991: 166; Shaw 1994: 117), or within fortified enclosures as evident at Wadi el-Hudi (Shaw 1994: 111). The Middle Kingdom planned town comes sharply into focus when compared with the informal and *ad hoc* nature of the Old Kingdom quarry settlements described above. Kemp (1991: 149, 167, 247) equates this phenomenon with the Middle Kingdom drive for planning at its height, the archetypal Kahun settlement associated with the pyramid of Senusret II representing an integration of temple, storage and administration facilities with an urban community in its own right. Although Old Kingdom pyramid towns constructed around the maintenance of the king's funerary cult are known in the major necropoli of Dahshur, Abusir and the Giza Plateau (Kemp 1991: 144-7), as discussed in Chapter 3, the dwellings were placed inside existing enclosure walls of the funerary complex, rather than as separate constructions.

This type of planning that emerged in the Middle Kingdom is not represented from the settlement area at Quartz Ridge where the Middle Kingdom storage vessels were found. However, the concentration of Middle Kingdom activity seems to have centred around the carnelian (and possibly amethyst) mines at Stele Ridge (see Chapter 2). Although this area is now greatly disturbed by construction of the Abu Simbel-Uweinat road, no settlement remains have been found here. The evidence of a Middle Kingdom presence is only represented by numerous pottery sherds, votive objects and sandstone stelae, one such example being found during the 2000 season dating to the reign of Amenemhet II (Pl. 85).

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[2] Some caution needs to be applied when connecting the Middle Kingdom enclosed settlements at Qasr el-Sagha *specifically* with exploitation of Widan el-Faras basalt. As already remarked in Chapters 2, 4 and 6, there is no evidence from within the basalt quarries themselves or from consumption of basalt in the Middle Kingdom to suggest a specific relationship between them. Excavations by Kozołowski (1983: 81, 89, 113, Fig. 48) suggest that the settlements were principally related to functions concerning the temple and nearby necropolis. A partly worked small basalt statuette located in the Eastern Settlement and many crescent shaped drills suggests that this was a workshop settlement housing craftsmen rather than quarrymen.

Even Engelbach (1933, 1938) and Murray's (1939) expeditions to the quarries found no settlement evidence at Stele Ridge, which at this earlier time should have exhibited relatively good preservation. However, in association with the eight cairns that mark the ridge, they found a number of courtyards containing stelae dating to the reigns of Senusret I, Amenemhet II and votive hawks with the cartouches of Senusret II and Amenemhet III (Engelbach 1933: 68-73). Engelbach (*op. cit.*) concluded that these places marked burials, as on excavating one courtyard they came across human remains. However, some caution needs to be applied to this interpretation, given that some of the excavation methods practised at the site, as recorded by Murray (1939: 107, 109), embraced the words 'ransacked' and 'removal of a retaining wall'. It is possible this evidence at Stele Ridge is more representative of shrines, such as those found at Hatnub, which seem to be seeking protection of the goddess Hathor, the deity associated with desert expeditions (Shaw 1986, 1987, 1998). Even in the later Old Kingdom at the time of Harkhuf, Nubia was regarded as being under the patronage of the Egyptian goddess Hathor, who, like Horus, was to assume in the Middle Kingdom this role in several places in Nubia (including Chephren's Quarry) and in the Sinai mines (Trigger *et al.* 1983: 129-30).

This situation implies that even during the Middle Kingdom exploitation, ephemeral accommodation in temporary shelters constituted dwellings for the labour force. Hence the stone structures functioned as storage facilities and/or landmarks/shrines associated with dieties and kings under which these operations were carried out. Perhaps the Middle Kingdom storage area at Quartz Ridge was simply an over-building of an existing Old Kingdom structure here, given the number of Old Kingdom storage vessels that appear to have been discarded outside the walls. This situation could be representative of periodic clearing out, as observed at Hatnub (Shaw forthcoming). In contrast to the contemporary Middle Kingdom amethyst mining settlement at Wadi el-Hudi, there was no need for fortifications at Chephren's Quarry. This could be due to the value attached to the material being procured, assuming that amethyst mines would be more necessary to defend than Chephren Gneiss quarries. However, there is no evidence of defensive structures at Stele Ridge, the presumed location of amethyst as well as carnelian procurement in the Middle Kingdom (Engelbach 1933: 68-73). Therefore there is the suggestion that raw material procurement in the Lower Nubian Western Desert was carried out unhindered perhaps due to Egypt's domination of Nubia at this time (see Chapter 6; Trigger *et al.* 1983: 124-36). Shaw (2002: 249) draws similar conclusions from this contrasting settlement evidence and suggests that Egyptian 'policy' in Lower Nubia was not necessarily uniform or inflexible, but might well have been adapted to changing circumstances, both geographically and chronologically.

Summary

The archaeological record of settlement features at Old Kingdom quarry and mining sites comprising scatters of stone walled features can be difficult to interpret. A situation which seems to be common to these features is that they can be regarded as multi-functional structures, for example, as places of food storage and production, such as the bakeries at Khufu Stele Quarries, Camp 1 and Camp 2, and/or stone workshops. If such features are located on the desert plateau it has to be considered that these might be wells. Therefore, survey *and* excavation of these features is necessary to determine function. Excavation of a variety of stone features within Chephren's Quarry (excluding Camps 1 and 2), indicates that their function as dwellings for the quarry labour force is the least likely option, due to the absence of hearths, associated pottery, or laid living floors. A similar situation is apparent at the 'Main Quarrymen's Camp' at Widan el-Faras (excluding the encampment) and at Umm es-Sawan.

Therefore, care needs to be taken when interpreting stone features at quarry sites and any immediate assumption that these are dwellings, from which estimates as to the size of the labour force could be calculated, could be misleading. The location of stone features needs to be carefully considered, a view that has been enhanced during the 2003 season at Chephren's Quarry, whereby dwelling places or camps tend to be located in sheltered positions. These camps contain hearths with thick ash layers and higher densities of pottery. Ephemeral accommodation for the labour force leaving no traces in the archaeological record is also an important factor that has to be considered when trying to assess the size of the labour force. This applies equally to determining organisational hierarchies involved in these operations. In general terms and taking the above into account, the ephemeral nature of all the stone structures in Old Kingdom quarries and mines is apparent and the generally small amounts of artefactual data opposes large labour forces (into the hundreds) residing at these places.

At remote source quarries, particularly at Chephren's Quarry, some defensive structures might have been expected given that it is located outside of Egypt's known territorial boundaries; however none have been found. Even at Wadi Maghara in the Sinai, the hill top location of huts associated with the mines would provide minimal protection against a hostile enemy. Although the question of preservation of defensive structures has to be taken in account, it can be proposed that Old Kingdom raw material acquisition, even outside Egypt's territorial boundaries, was carried out with minimal hindrance. This situation is not applicable to mining operations in Egypt's marginal territories in the south-eastern desert and Sinai during the Middle Kingdom. However, this could be because semi-precious metals/gemstones were predominantly being procured.

The organisational model for the deployment of quarry labour forces in remote sources during the Old Kingdom needs to be carefully considered, but what seems to emerge from the archaeological evidence at these sites implies the involvement of small numbers of quarrymen. These labour forces could be either locally conscripted or centrally mobilised, but in an expedient manner that was predominantly a campaign based operation. These hypotheses are expanded upon in the concluding chapters.

Labour Organisation in the Old Kingdom

Size and Division of Quarry Labour Forces

The first part of this chapter has highlighted the difficulty in determining whether the stone features at Chephren's Quarry and Widan el-Faras represent dwellings for the quarrymen. As a consequence, estimating the size of labour forces working here at any one time has to be approached with caution. Equally problematic is determining degrees of hierarchical complexity in these operations, as structures that could constitute places of accommodation for an 'elite' class are not possible to identify. Although the room clusters recorded at Hatnub, Wadi Maghara and Wadi Gerrawi might suggest accommodation for possible overseers or even some kind of military detachment, this is open to conjecture. Despite some inscriptions using titles such as 'army' and 'generals', the leading personnel had naval designations, but in essence these expeditions cannot be distinguished from other missions abroad, such as trading or military (Eyre 1987: 10). The presence of a scribe is the only suggestion of a practising minor 'elite' role at the quarries, given the presence of inscribed stelae at Chephren's Quarry and quarry inscriptions at Hatnub.

The Old Kingdom textual record at quarries provides only very limited insights into the working personnel and administration of quarrying expeditions (Eyre 1987: 12). The few Old Kingdom inscriptions tend to simply record a presence, such as those at Chephren's Quarry and Hatnub, but rarely an indication of numbers (see Chapter 4; Helck 1975: 128). One reference to numbers involved in an expedition comes from the 6th Dynasty, such as an inscription at Hatnub during the reign of Teti that records an expedition of 300 quarrymen (?) apparently sent from the 'residence', with 60 occupied in boat building (Anthes 1928 in Eyre 1987: 14). Another Hatnub expedition at the time of Pepi II mentions even greater numbers being involved, up to 1,600 and bringing down 300 stones at a time to load into 2 boats (*op. cit.*).

The siltstone-greywacke quarries in the Wadi Hammamat are celebrated for their quarry inscriptions that go into some detail about the personnel involved in the expeditions; these date mostly to the Middle and New Kingdoms. There are six inscriptions dating to the Old Kingdom, commencing from the late 5th Dynasty reign of Unas into the 6th Dynasty (Couyat and Montet 1912: 2-3). One inscription dating to the reign of Pepi II records an expedition led by the chief architect and two treasurers of the god giving a list of 1,200 quarrymen (?). Transport of the stone was presumably facilitated by the 50 oxen and 200 donkeys (Breasted 1906: 137; Couyat and Montet 1912: 2-3, nos. 169, 206). Such texts taken literally have generated assumptions of extremely large numbers of people being involved in these expeditions, a situation that is not borne out at present by the archaeological record at the quarry sites.

A Middle Kingdom quarry inscription in the Wadi Hammamat, dating to the reign of Senusret I, attests to an extraordinary number of people involved in an expedition to procure greywacke (Couyat and Montet 1912: 64-6, pl. 20, no. 87; Goyon 1957: 81-5, no. 61) **(Fig. 41)**. Interpretation of the inscription attests to the expedition being a 'royal commission' to procure blocks for sphinxes and statues, which involved a total of 18,628 people. [3] Within this total number, the largest body of people in the detachment, 17,000, are designated with the title 'recruits of the force'. Whether the 'recruits' were involved in the transport of the stone from the quarry cannot be determined. However, there is a list of numbers where '2000 men' to a minium of '500 men' appear to be associated with a tally of the 210 blocks brought down from the quarry in 30 days. Whether these numbers represent actual people involved in the transport of the blocks, or man hours is unclear.

Other titles mentioned in the inscriptions attest to the many levels of hierarchies involved in the operation, these comprise scribes, guards, rowers, carpenters, bakers, brewers, overseers, palace officials and 20 mayors. However, the number of people

[3] Stephen Quirke very kindly provided fresh interpretation and discussion of this text with the author.

designated with the title 'stoneworkers' is only 100, with another 100 designated as 'quarrymen'. Hence, actual quarrymen is a mere 200 or less than 10% of this enormous 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 *Old Kingdom* quarries, the gap between the numbers attested by such an inscription become closer, when more closely read, to the empirical data.

A list of subsistence requirements or rations appears further on in the inscription, presumably prepared by the 20 cooks, 20 bakers and 20 brewers mentioned in the text. Each member of the expedition, according to hierarchical rank, received rations of bread and beer in quantities according to the pecking order. For example, the 'herald' or leader of the expedition, Ameny, received '200 bread' and '5 beer', whereas the 'recruits' only received '10 bread' and '1 beer'. Clearly it is impossible to know if these were rations given during the expedition or after as payment, but certainly if these were subsistence rations, these amounts to do not have parity with the numbers supposedly involved in the expedition (see Mueller 1975).

In a mining context, some of the Sinai inscriptions which date to the Old Kingdom again only record a presence and in just a few instances furnish a few more details. The inscriptions begin with 3rd Dynasty Djoser at Wadi Maghara and indicate the presence of Old Kingdom expeditions into the 6th Dynasty (Gardiner *et al.* 1955: 14-5, 53). The only idea of numbers involved in these expeditions comes from a broken inscription, again indicating an extremely large contingent of over 1,400 people (Gardiner *et al.* 1955, no. 19). These later inscriptions do however start to list the more important members of the expedition and what emerges is a string of titles with nautical connotations such as 'under the command of the admiral of the fleet' with subordinate officials having titles such as 'pilot', 'pilot of the fleet', the 'ship's lieutenant' (Gardiner *et al.* 1955: 14-5). Recently discovered 6th Dynasty inscriptions associated with wells in the Eastern Desert at Bir Mueilha also express a nautical theme, such as 'Captain of the ship's [crew]' (Rothe *et al.* 1996: 77, 80). This term is suggested as literally implying 'ship's' and suggests these expeditions were on the way to the Red Sea, given that no other purpose for them is given in any of the inscriptions.

Although care needs to be taken with this type of evidence, it is interesting to note that such naval titles are generally phased out by the Middle Kingdom (Gardiner *et al.* 1955: 11-12; Shaw 1998: 247). None are attested in the Wadi Hammamat inscription of Senusret I. This could indicate the importance that water transport might have played in the Old Kingdom Sinai expeditions and its decreasing role by the Middle Kingdom due to climatic change (see Chapter 2).

The organisation of labour into naval patterns is also well attested in the domain of quarrymen and construction personnel from the marks left by such individuals on building blocks in Old Kingdom royal pyramid complexes (Reisner 1931: 273-7; Eyre 1987: 12; Verner 2002: 79, 167). Perhaps these marks are of greater significance in arguments surrounding the organisation and division of labour, as they were presumably not produced for reasons associated with ideology for outward display and/or personal aggrandisement. For example, graffiti in red paint concealed beneath a mudbrick outer casing found by Reisner (1931: 276) in the mortuary temple of Menkaure has been illuminating in respect of the numbers involved in pyramid building and how labour was divided (Reisner 1931: 276, pls. XI, XII; Lehner 1997: 136, 224-5). Such graffiti on blocks is attested at most of the pyramid complexes and has also provided insights into the time-scale of these constructions. At Snefru's Bent Pyramid such dates show that approximately one-fifth of the pyramid was built over a two year period (Verner 2002: 185). These masons' marks indicate an organised division of labour based on a boat crew suggested as representing 200 people and composed of 5 gangs or phylai bearing names such as 'starboard-front', 'port-front', these then divided into a further 2 or 4 sub-groups (Eyre 1987: 12; Verner 2002: 79). Each sub-group then had a name related to the individuals' geographical origin, skills or virtues, that all seems highly suggestive of teamwork.

The inscribed copper chisel, dating to the 4th Dynasty, found on the surface at Chisel Quarry (within Chephren's Quarry) close to a spoil heap conforms to this principle. Rowe (1938: 391-93, pl. 57, Fig 1.) **(Pl. 38)** interpreted three parts of the inscription thus:-

Face i.	The Crew: (*'prw*) called by the proper name Kamu (*K3mw*).
Face ii.	The Watch (*s3*): called *w3ḏt* namely 'Bow' or 'Fore'.
Face iii.	The Sub-gang of the Watch: called 'South Libyan'.

Although care needs to taken with this interpretation, Rowe (*op. cit.*) surmises that the Old Kingdom chisel belonged to the 'South Libyan Gang of the Bow Watch of the 'Kamu' Crew'. However, 'Kamu' is unlikely to be the name of a workforce as there are few parallels among personal names before the Middle Kingdom (Quirke pers. comm. 2003). The implications of these inscriptions are discussed later in this chapter.

Fantastic claims have been made about the number of people involved in pyramid construction that run into figures of 100,000+ to construct Khufu's pyramid, a figure that even Petrie accepted (Lehner 1997: 224; Verner 2002: 76). As discussed in Chapter 3, the population of Egypt at this time was relatively small and at most 1.6 million, while numbers such as these into the hundreds of thousands working on just one project would require a population at least five times this size (Verner 2002: 78). Lehner's experimental archaeology in constructing a miniature pyramid (the NOVA pyramid) also concluded that the Khufu pyramid could have been built by significantly fewer workmen. These estimates suggest that 2 crews of 2,000 could have constructed the pyramid over a 23 year period (the minimum length of Khufu's reign), with quarrying of local stone for its construction necessitating only 1,212 men (Lehner 1997: 206-7, 224-5). Hence, a relative scaling down in numbers applied to the size of quarry expeditions has to be considered.

Eyre (1987: 12) suggests that the numbers of people involved in projects was far more likely to have varied, and constructing a framework around a crew that had a specific base value is unrealistic. However, the connection with '10' making up a work group at lower work levels has come from sources such as the Sinai inscriptions, where there is the title 'overseer of 10' (Gardiner *et al.* 1955: 15; Eyre 1987: 12). Other sources such as tablets found in Userkaf's sun temple record 20 units assumed as meaning 20 people (Ricke 1969: 7-8 in Eyre 1987: 12). However, Petrie (1883: 210) worked out that there was only room for 8 people to work a single block at any one moment in the Giza plateau quarries.

Extrapolating from this mass of contradictory data any feasible estimate of the number of quarrymen who worked at any one time at Chephren's Quarry or Widan el-Faras is difficult. Petrie and Mackay (1915: 38-40) suggested that around 200 quarrymen resided at Wadi Gerrawi, and Shaw (1994: 112) proposed that a similar number might also have resided at Hatnub, given the comparable number of stone features. 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 (see Chapter 6). 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. In addition, as discussed above, when a detailed Middle Kingdom inscription is read with precision, the actual number of people designated as quarrymen is only 200.

Quarry Expeditions as Seasonal Campaigns

Given the ephemeral nature of the stone features at Chephren's Quarry and Widan el-Faras, permanent habitation at these quarries seems unlikely. Seasonal work patterns have previously been assumed, given the predictable annual cycle of the Nile flood, and the period of inundation is suggested as the time when permanently employed quarrymen undertook stone moving (Eyre 1987: 15). However, the few textual sources that relate to quarry expeditions during specific seasons again tend to be contradictory. For example, Weni's 6th Dynasty autobiography records returning from Aswan with granite for Merenre's pyramid during the inundation, which is the hottest time of the year. However, his expedition to Hatnub for an altar records the object being ferried in month III of *Shemu* (December/January), the time of lowest Nile levels (cf. P: Westcar, 9, 15-8; Eyre 1987: 16). Two Middle Kingdom inscriptions on stelae found at Stele Ridge (Chephren's Quarry) dating to the reigns of Senusret I and Amenemhet III mention expeditions to the quarry covering a time span of just one month, between February and April (Engelbach 1933: 74), the coolest time of year.

Therefore care needs to be taken with these inscriptions, their limitations apparent not only because they are few, but because they require calibrating the Egyptian civil year with a specific season. Eyre (1987: 16) maintains that after readjusting the calendar in relation to the few Old Kingdom Wadi Hammamat inscriptions, stone was moved from here during the winter months to the banks of the Nile where it was stored until the inundation. Similar recorded dates at Hatnub and in the Sinai suggest that a seasonal work pattern was also effected here (Eyre 1987: 16; Gardiner *et al.* 1955, no. 15: IV). However, it is hard to see how this might have applied in practice at Hatnub and Aswan, given the constant demand for these stones and certainly the large quantities of red granite transported in the Old Kingdom (see Chapters 2, 6 and 7). It is therefore questionable that stone deliveries only took place seasonally from Nile Valley quarries, given that their close proximity to the Nile made them less dependent on the inundation. Water access to the actual pyramid sites could have been, as discussed in Chapters 2 and 6, artificially regulated through a network of canals. Artificial waterways would have decreased the dependency on the Nile flood, enabling regular and consistent stone deliveries to be made from Aswan, Hatnub and other quarries located in the Nile Valley.

A similar situation applying to Widan el-Faras and Chephren's Quarry is however less likely, as clearly their remoteness from the Nile meant a heavier dependency on the flooding of seasonal waterways (see Chapter 2). The sparse settlement evidence at Widan el-Faras and Chephren's Quarry cannot attest to a particular season of occupancy, but there is reason to suggest that at both quarries the stone was quarried during the cooler months and stock-piled for transport at the time of optimum flood levels. This situation could be attested at the quay at Qasr el-Sagha (terminus of the quarry road, see Chapter 6) where there is a basalt dump, together with the large area of stone circles at Widan el-Faras (see above), which may also represent some kind of basalt storage area. At Chephren's Quarry storage areas of vessel and statue blocks, presumably gathered together for transport, have been identified **(Pl. 86)** (see Chapter 6).

Subsistence at Widan el-Faras and Chephren's Quarry might be a contributory factor in deducing seasonal work patterns, but as already discussed in Chapter 2, there is very little faunal and floral evidence from which to draw many conclusions. At Widan el-Faras there is no evidence of food production at the site, but as already suggested, food supplies would have come from the environs of Lake Moeris at Qasr el-Sagha or from the settlement of Kom IV. Subsistence on the shores of Lake Moeris was clearly dependent on high lake levels that would be linked to the seasonal flood, but from the settlement evidence at Kom IV it seems as if occupation occurred year round during the 4th and 5th Dynasties (Caton-Thompson and Gardner 1934: 97-8, see Chapter 2). Therefore, work at Widan el-Faras would not be subject to seasonal food resources and only stone transport would require the optimum summer flood levels. A similar situation might be envisaged for the Old Kingdom exploitation at Chephren's Quarry where the presence of the bakery tends to suggest that cereals might have been locally available, as discussed in Chapter 2, as well as wild game, given the wetter more savanna type environment at this time. Therefore, subsistence would not necessarily be affected by the seasons, in contrast to transportation of stone, which must have occurred during the inundation.

There is obviously a great deal of speculation surrounding this subject, although it has to be reiterated that remote quarry sites were not occupied on a permanent basis. Even though the more reliable dates on building blocks further suggest that stone transport occurred during the inundation and procurement during the winter (Grinsell 1947: 57-8), there is still no explanation of how stone procurement from remote sources was actually organised. As Eyre (1987: 17) suggests, the people employed on construction sites might not necessarily be the same people who actually quarried and transported stone. This is a crucial point that forms the basis of a hypothesis surrounding labour mobilisation in the following chapter.

Project Driven Campaigns

Quarry expeditions to *remote* sources organised as short duration campaigns for specific projects is a probable framework for an organisational hypothesis. This is proposed from the archaeological evidence discussed above and in Chapter 6, and forwarded as an alternative to *ad hoc* or improvised procurement. Textual sources making specific reference to campaigns to procure stone for particular objects are attested throughout Pharaonic period. The Middle Kingdom Wadi Hammamat inscription described above mentions the 'royal commission' to procure blocks for 60 sphinxes and 150 statues. In an Old Kingdom context, Weni's 6th Dynasty autobiography is the most cited example. Although the account is overblown and focused on the objective of gaining eternal life for the individual, the narrative mentions three quarry campaigns for specific objects. These campaigns were ordained by King Merenre to Hatnub for an offering table, Elephantine for a false door, and 'Ibhat' for the sarcophagus (Breasted 1906: 148-9; Clarke and Engelbach 1930: 21; Grimal 1992: 83-5). Cross referencing this against the objects mentioned in the archaeological record reveals that 'Ibhat' must be the greywacke quarries in the Wadi Hammamat (Wissa 1994: 379-387) and Elephantine part of the Aswan quarries. The travertine offering table is not attested in the archaeological record.

Another 6th Dynasty inscription of an unknown builder during the reign of Teti refers to quarrying thus:

> 'His majesty sent me to conduct the works in the ka-temple made—and in (the quarry) of Troja (Tura?)___ I made a false door there, conducting [the work]____ His majesty caused that I come down-stream'. (Breasted 1906: 133-4).

These texts imply that the quarrying campaign was for specific objects ordained by the king and thus a project driven organisational scheme seems quite probable. Eyre (1987: 21) suggests that 'fine' stone from distant quarries was only available through the state; luxury items for officials in such contexts being begged from the king who sent boats specifically to procure the raw materials. However, there is a difference between the king having the resources or means to mobilise labour and transport stone from distant sources and the concept of a royal 'monopoly' over them. As Kemp (1991: 246) points out, care needs to be taken with the term 'monopoly' as the existence or validity of such would require enforcement by decrees and punishments. No such administrative documents exist and the archaeological record at these remote source quarries as well as those close to the Nile, strongly intimates that there was no type of military style organisational paraphernalia (see Chapter 7). Kemp (1991: 246) applies this type of non-military style operation to the Umm es-Sawan gypsum quarries, as suggested by the loosely organised settlement and therefore such a scheme of work to exploit Widan el-Faras basalt and Chephren Gneisses might be equally applied. The general lack of material culture and no evidence of fortifications in the archaeological record enhances this view. The textual sources are simply not a full enough guide to these campaigns and *soft* stone sources in *close* proximity to the Nile such as Hatnub could be easily exploited by small local groups in a few days.

In relation to Widan el-Faras, such an organisational framework based on a request driven from the top down may be attested from the archaeological record in the quarries, each extraction site (see Chapters 2 and 6) being opened for a specific 'project'. The 'project' would be to procure paving stone of a specific size (1 m^3 size blocks) for a mortuary temple floor. Such a scheme could also be applied to Chephren's Quarry (see Chapter 6) where only blocks of standard sizes for statues and vessels were required. Evidence for state involvement in administering tools is limited and only suggested in relation to use of metal (copper) tools. The direct supervision by a scribe over distribution of such material is suggested from depictions in private tombs, together with the existence of the title 'metals scribe' (Gardiner *et al.* 1955: 13, no. 13; Eyre 1987: 13). The control over metal tools is perhaps evident from the copper chisel found at Chephren's Quarry inscribed with the name of a specific work crew. Such control of stone tools would be unnecessary, particularly at Chephren's Quarry, because all the stone tool sources are within the quarry itself. This situation can help explain the bias of stone tools over metal tools present in the archaeological record. The probability that stone tools fell outside of state jurisdiction and perhaps assumed a role of possible exchange (particularly the Chephren Gneiss tools) amongst the labour force is considered in the following chapter.

Time also seems to have been a significant and primary factor in these campaigns as Weni boasts of completing the task at Hatnub in just 17 days (Breasted 1906: 149). Other fragmentary inscriptions mention stone being procured and transported from Aswan in 7 days, 4 days being 'in transit' which seems rather unlikely given the distance (Eyre 1987: 11). Extrapolating from these few texts any realistic time scale to procure and transport stone is difficult because of determining the relation between the primary function of the inscription (projection of self into eternity) and any numerical or quantified content. The archaeological record at Old Kingdom quarry sites does not provide any evidence of time scales to procure stone, unlike the more reliable masons marks on pyramid blocks as mentioned above.

However, it is possible to make an *attempt* at estimating the length of a quarrying campaign at Widan el-Faras, if it is assumed that each project was linked to a specific mortuary temple floor. The main assumption would be that small teams of 10 people to a maximum of 5 teams (50 people) worked at the quarry at any one time, a situation that has been proposed above. Taking Sahure's mortuary and valley temple floors as an example, together these comprise an approximate total basalt volume of 230 m^3 (**see Figs. 23a, 23b; Appendix B 5**). If all the basalt came from Quarry 2 (see Chapter 6; **see Fig. 23c**) where the net volume extracted is estimated at 336 m^3 (excluding 60% waste), and if each team of 10 could extract 2 m^3 per week, then it would take 5 teams approximately 34 weeks (approximately 8 months) to extract the stone and move it to the road. Therefore, it is quite feasible to procure stone for two temple floors in under a year if the work was one continuous campaign and could in theory be achieved outside of the hottest 4 months of the year. These calculations exclude the transport time down the quarry road to the lake, although the use of dray animals (oxen/donkeys) for such purposes, rather than gangs of men, has to be considered and is an aspect of stone transportation that is frequently overlooked (see in Eyre 1987: 14) although indicated in the epigraphic record (Daressy 1911: 262-5; Clarke and Engelbach 1930: 88; Arnold 1991: 278). Also, it has to be considered that the transport of the stone across Lake Moeris might have been carried out by a separate group of individuals dedicated to this process, as already mentioned above (see Eyre 1987: 11).

Comparing the calculations made above to extract and transport of 336 m^3 of basalt (time 8 months and numbers of quarrymen 50), with an Old Kingdom Wadi Hammamat inscription that mentions how a 12 'cubit' stone (approximately 6 m^3) was extracted using 200 men (perhaps including boatmen?), with 2 oxen and 50 donkeys to do the transporting, seems to be a gross over-estimate (Couyat and Montet 1912, no. 152; Eyre 1987: 14). The large number of quarrymen involved when 50 people could complete the task in less than a week, renders this account extremely dubious. Perhaps exaggerated or fictitious claims of the numbers of people involved in the task could have been for reasons of personnel aggrandisement of the official and/or were projections of an overall view that could be based on the symbolism and ideology attached to quarry expeditions (see Chapters 5 and 11 for discussion about Western perceptions of exaggeration). However, it has to be remembered that some reigns were particularly short, such as Userkaf, who gathered stone for his pyramid or other complexes from remote sources in Egypt, yet his reign was only 7 years (Manley 1996: 132; Verner 2002: 274-80). Therefore, some expediency in the deployment of labour and time would surely have been practised.

The 'Residence': where did the labour forces come from?

The discussion above suggests that occupation of quarry sites was on a temporary basis, so if this was the case from where were labour forces deployed? The word 'residence' (Eyre 1987: 9) often occurs in textual sources implying that there was some central hub from where labour was deployed. In the context of quarrying expeditions, the few Old Kingdom texts intimate that the labour forces were connected to the 'residence' from where they were sent. The 'residence' also seems to represent the source of payment, supplies and instructions (Eyre 1987: 15). Harkhuf was apparently issued with provisions, possibly from the temples, on his return to the 'residence' from his expeditions in Nubia (*op. cit.*). The 6th Dynasty letter of protest from a quarry expedition commander of the 'necropolis masons' at Tura, found in the pyramid complex of Djoser, also mentions the 'royal residence'. In this context, the 'residence' is implied as being the place that supplied clothing for the quarrymen, presumably located in the Memphite region of the Nile Valley (Gunn 1925: 242-6; Gardiner 1927: 75; also see Chapter 6). However, it remains uncertain if the deployment of labour to Tura constituted a *permanent* work force of quarrymen and construction workers, as this is not evident from the texts. As Eyre (1987: 13) suggests, there could well have been a standing 'navy' to provide transport and the Weni texts might suggest this by referring to the transport boat as being '... of the residence...' despatched by command to bring stone for a sarcophagus from Tura (Anthes 1928, Gr. 1 and 7 in Eyre 1987: 13).

Networks of Labour Forces: Upper Egyptian or Lower Egyptian 'residences'?

The concept of labour networks linking the southern and northern quarries with a central place of manpower deployment is an organisational framework that should be considered. Evidence for such connections, although fragmentary in the archaeological record, might be suggested from stone tool assemblages and from pottery. At Chephren's Quarry the Old Kingdom pottery corpus is entirely Egyptian in origin, probably from Lower Egypt, and covering a similar sphere of vessels as those found on Elephantine Island. This might imply the distribution of rations to regional trading interests in Upper Egypt from a central place in Lower Egypt (see Chapter 3, Seidlmayer 1996: 111-3). A similar situation applies to the Dakhleh pottery, particularly the Meidum bowls. Determining a specific origin of the bread moulds is difficult because the clay used in their manufacture is locally sourced (see above, Arnold and Bourriau 1993: 23, 173-4; El-Senussi 2003: 4). However, the spouted vessel or 'practical jug' seems to suggest a firmer connection with Lower Egypt and the Giza area.

Tracking the movement of Chephren Gneiss tools, given the unique provenance of the stone, provokes interesting questions into how these might have arrived in the Faiyum quarries. At both Widan el-Faras and Umm es-Sawan the stone is found as unworked blocks and as tools, but the predominant tool is dolerite from the dykes at Chephren's Quarry (see Chapters 2 and 6). The idea of quarrymen carrying 'toolkits' of stone tools from Chephren's Quarry to the Faiyum quarries has to be considered. Caton-Thompson and Gardner (1934: 105) identified 'toolkits' close to the Umm es-Sawan workshops which comprised distinct clusters of stone grinders and pebble hand-picks, perhaps belonging to individual quarrymen and associated with rough-model gypsum vases. It is certainly conceivable that tools from Chephren's Quarry, and certainly those of Chephren Gneisses, would be highly prized given their durability (Harrell 2002: 235). Added to their practical value would be their remote origin and it is therefore quite possible that they might accompany the quarrymen over distances as toolkits. This movement of stone tools could suggest at least an element of the Chephren's Quarry expedition force being based in Lower/Middle Egypt, with the further possibility of the

Faiyum district being a 'residence'. Furthermore, Chephren Gneiss tools, together with other non-local stone tools, are at present only known (outside of Chephren's quarry itself) within the Faiyum quarries (*op. cit.*).

The Faiyum district as an important cult and regional centre in the Old Kingdom has already been mentioned in Chapter 3, and possibly was a centre for stone production associated with a royal residence. The area was certainly of some importance by the early 4th Dynasty, given the presence of one of Snefru's small step pyramids here at Seila (see Chapter 3; Verner 2002: 168-173). Umm es-Sawan was the site of a stone vessel making factory (see Chapter 6, Caton-Thompson and Gardner 1934: 134) and this is also implied by similar finds associated with vase production made at Qasr el-Sagha (*op. cit.*). Kom IV was also a sizeable area of permanent settlement during the 4th and 5th Dynasties (see above and Chapter 3) indicated by the large amounts of pottery, hearths, middens and faunal remains present here (Caton-Thompson and Gardner 1934: 98). Elements of the Kom IV pottery corpus are also known at Umm es-Sawan and Widan el-Faras, in particular the beer jars and storage vessels (Caton-Thompson and Gardner 1934: 98-100, pl. LV:13). The intact beer jar (**see Pl. 66a**) found within a boulder extraction area at Chephren's Quarry in the 2003 season closely resembles those found at Umm es-Sawan (see Chapter 6; Caton-Thompson and Gardner 1934: 104, 110, pl. LXV: 7; UC 17867) (**see Pl. 66b**). Fragments of stone vases including fragments of Chephren Gneiss bowls puzzled Caton-Thompson and Gardner (*op. cit*: 98) by their presence '...in such a lowly stratum...'. In addition, large quantities of tools such as flints, quartz hammer-stones and stone pounders were also found at Kom IV, suggesting that this was also an area of workshops where finishing of vessels took place.

The possibility that all these centres in the Northern Faiyum were locally connected has to be considered, as no distance is greater than 25 km. As the map (**see Fig. 18**) from Caton-Thompson and Gardner (1934, pl. CXI) implies, the lakeside centres of Qasr el-Sagha and Kom IV lie directly south of the two quarries. The paved road connecting Widan el-Faras to Qasr el-Sagha is already described (see Chapter 6) and according to observations made by Caton-Thompson and Gardner (1934: 103) a 20 km 'caravan' route heads north-east of Kom IV, clearly connecting it with Umm es-Sawan. The route traverses featureless desert gravel punctuated by an isolated pyramidial hill which marks the halfway point along the route where flint hand-picks and pottery sherds were found belonging to a pottery corpus similar to that found at Umm es-Sawan (*op. cit.*). It is quite conceivable that all four centres were easily accessible from each other: the peaks of Widan el-Faras are visible from Umm es-Sawan and the desert plateau between these sites is relatively easy to traverse overland while Kom IV and Qasr el-Sagha could easily access each other via Lake Moeris. The relationships between these places through the quarrymen working at both sites has to be considered. Such a network centred around the quarries could have been a hub of hard (and soft) stone quarry masons during the 4th and 5th Dynasties, residing at Qasr el-Sagha and Kom IV (see Chapters 2 and 3). From these already established networks a quarry labour force could be relatively easily deployed to distant quarries for specific short duration campaigns.

The historical antecedents connecting Chephren's Quarry with the Faiyum are also important to mention as they appear to go back to the 4th millennium BC, given the presence of a Chephren Gneiss palette at the Neolithic site of Kom W in the Faiyum (Caton-Thompson and Gardner 1934: 22, pl.xii, in Petrie Museum UC2529, see Chapter 4). Hoffman (1991: 203) has suggested that connections between Upper and Lower Egypt could have been established by early nomads via a Western Desert trade route through the oases, the Faiyum being the most northerly oasis in this chain. Furthermore, a storage cellar at the Predynastic Lower Egyptian site of Maadi contained well-made stone vessels of 'gneiss' and 'diorite' along with carnelian beads (Hoffman 1991: 203). In general this 4th millennium BC site revealed marked craft specialisation in stone vase production from a range of imported stones (Hoffman 1991: 203; Caneva *et al.* 1989: 291). These antecedents might have had enduring historical significance.

In an Upper Egyptian and Nubian context consideration also needs to be given to two strategic centres of permanent settlement, Elephantine Island and Buhen, as places from where labour could be deployed. Both places were important centres associated with the control of southern trade routes during the Old Kingdom (see Chapter 3). The material culture at both settlements suggests central authority intervention to serve state projects on an episodic basis, which at Buhen coincides with exploitation of Chephren's Quarry. Perhaps some members of a quarry expedition were gleaned from a more 'local' labour pool, given the gang's name 'South Libyan' inscribed, according to Rowe, on the copper chisel found at Chephren's Quarry (see above). Buhen could also be considered as the source of copper tools, in view of the possibility that copper smelting was undertaken here (see Chapter 3, Emery 1963; Adams 1977; Seidlmayer 1996: 111).

The Old Kingdom town at Hierakonpolis could have been an Upper Egyptian parallel to the Faiyum district as a centre of labour deployment during the 2nd and 3rd Dynasties. The town had some importance in the production of stone vessels, given the ubiquitous fragments of 'diorite' (Chephren Gneiss) and quartz crystal vessels found. These fragments are associated with numerous clay sealings bearing the *ka* names of 2nd and 3rd Dynasty kings (Quibell and Green 1902: 16-8, pl. LXXIII). This period coincides with the peak of stone vessel manufacturing and given the numerous hard stone borers found here suggests that only *finishing* of objects took place. Tool kits were also found in later excavations made in this area by Hoffman in 1984, these consisted of crescent shaped drills and quartzite borers in a stratigraphic sequence from the Predynastic to Early Dynastic period (Hikade 2000: 15). Furthermore, nodules of carnelian were also found here and the preform of a carnelian bead that could be sourced to Chephren's Quarry. As mentioned in Chapter 4, carnelian and Chephren Gneiss often occur together in elite burials from as early as the Late Neolithic.

A stone vessel 'workshop' was clearly defined within a group of houses at Hierakonpolis (Quibell and Green 1902: 17, pl. LXVIII). These houses consisted of a perimeter work bench with sporadic cup-like hollows, inside which were vase borers, some being of 'diorite' (Quibell and Green 1902: 17, pl. LXII, 3, 4). It is therefore quite conceivable that vessel blanks from Chephren's Quarry were transported to Hierakonpolis for finishing during the 3rd Dynasty. Perhaps the town remained an important vessel making hub after this date, since in the Main Deposit at Hierakonpolis a fragment of a Chephren Gneiss vessel with the cartouche of Khufu was found (Quibell 1900: 7, pl. XVIII).

Consideration has to be given to Hierakonpolis being the hub of a stone vessel making tradition that reached its peak in craftsmanship by the 3rd Dynasty, having antecedents into the Predynastic. If vessel blanks were brought to Hierakonpolis from Chephren's Quarry, then it is equally conceivable that this was where the labour force might have permanently resided. Did this hub remain into the 4th and 5th Dynasties or was it gradually (or suddenly) transferred to Lower Egypt? In the context of highly skilled flint knappers located at Hierakonpolis, Hikade (2000: 19) suggests movement of these skilled craftsmen to the capital or royal residence (Memphis) during the Early Dynastic. Was this also the case for skilled stone workers?

Summary

The themes that have been raised in this chapter centre around the dichotomy between the size of Old Kingdom quarry labour forces mentioned in the textual record and the archaeological record at the quarries themselves. The textual sources, although limited in an Old Kingdom context, mention labour forces into many hundreds, a number that is not evident from the material culture found at either Widan el-Faras or Chephren's Quarry. As the first half of this chapter points out, it is difficult to ascertain from the stone features at quarry sites the size and hierarchical organisation of the labour forces. However, the minimal associated artefactual evidence, such as pottery, suggests small numbers being involved. The stone extraction areas in the quarries themselves, particularly at Widan el-Faras, could only accommodate a small number of quarrymen, a maximum of 10 at any one time. Therefore, a reassessment of the size of these labour forces is proposed, ranging from between 50 to 100 people per campaign and certainly not into the many hundreds. In addition, closer examination of a Middle Kingdom Wadi Hammamat inscription, designates only 200 people as 'stoneworkers' and 'quarrymen', from a total of 18,000 contributing to the entire expeditionary force. Therefore the higher numerals can be taken to refer to total project workforce, with as few as 10% being quarrymen.

The organisation of labour into crews and gangs with the predominance of naval titles is well attested in the Old Kingdom textual record. Apart from the copper chisel found at Chephren's Quarry that mentions a similar division of labour, it is impossible to know how labour was organised in practice and the concomitant hierarchical structures. Similarly, determining if the quarrymen were also responsible for stone transport, which could be implied from the naval connotations, is also open to conjecture. However, for remote source quarries this possibility has to be considered.

The strongest argument for a campaign-type deployment of labour to acquire specific objects is perhaps where the textual sources and archaeological record have some coherence. The temporary nature of quarry expeditions to Widan el-Faras and Chephren's Quarry is well attested by the archaeological record, given the absence of permanent settlement structures or material culture that would be expected in such a situation. The duration or seasonal nature of such campaigns is, however, more difficult to determine. Exploitation of remote sources using the innundation as the optimum time for stone transportation has to be considered. Although this falls at the hottest time of the year, a quarrying campaign could involve actual stone production in the winter with stock-piling of the stone for later transportation, presenting an annual cycle of procurement and transportation. Such a seasonal operation would be less likely in the quarries inside the Nile Valley, given their proximity to the Nile offering permanent transport. Furthermore, the greater use of Hatnub travertine and Aswan red granite would have necessitated more consistent year round quarrying and transport.

Due to the temporary nature of these campaigns to remote source quarries, assessing where the permanent residence of the labour force was is uncertain. At Widan el-Faras this is less of a problem, given that the Faiyum was an important cult centre in the Old Kingdom and places of permanent settlement nearby are known, such as Kom IV. However, deployment of labour to Chephren's Quarry needs greater consideration given the changes in use of Chephren Gneisses during the Old Kingdom and the political transformations that occurred during the late 3rd Dynasty. These aspects are particularly associated with the centre of administration shifting to Memphis and royal burials to Lower Egyptian sites. Unfortunately the pottery corpus, although all of Egyptian origin, tends to be ubiquitous throughout Egypt and so it is difficult to know its place of original manufacture. However, the Meidum bowls, beer jars and practical jugs could have been transported to the quarry from a central Lower Egyptian source, or at least from within the Nile Valley given the fabric used. Similar examples of these vessels are also known at Lower Egyptian quarries.

Perhaps during the 3rd Dynasty exploitation labour could have been centred at Hierakonpolis, the centre for stone vessel manufacture, before the shift of craft specialisation to the north. Deployment of labour from a central Lower Egyptian 'residence' by the 4th Dynasty is an organisational hypothesis that could explain the presence of Chephren Gneiss tools and other stone tools from Chephren's Quarry in Lower Egyptian quarries, these travelling back with the labour force. The use of some more locally conscripted labour also has to be considered from the inscription on the copper chisel found at Chephren's Quarry. If short-duration campaign-type deployment of labour is presumed for a specific purpose, as attested by the production and settlement evidence, this implies the campaigns were driven from the top down. This could suggest royal or state control/monopoly over these stone sources, but, in the strict legal sense of the term, this cannot necessarily be assumed (in the Old Kingdom) and is not suggested by the archaeological or textual record. As discussed in Chapter 7, the concept of resource absorption is the preferable construct.

The organisational model thus proposed for remote source stone acquisition, particularly during the 4th and 5th Dynasties, is for small numbers of highly-organised skilled stone-workers deployed on a campaign-type basis from a central location for a specific project. The conditions under which these individuals were mobilised to remote source quarries by state coercion or other means are considered in the next chapter.

Chapter 9

The Social Organisation of Quarry Labour Forces in the Old Kingdom: a Cross-cultural Analysis

Introduction

The objective of this chapter is to create discursive methods of approach to the social organisation and mobilisation of labour to remote source quarries in the Old Kingdom. These approaches to interpretation of the empirical data at Old Kingdom quarry sites come from a range of social theoretical, cross-cultural and cross-level perspectives that have been used to evaluate the social context of raw material acquisition.

These discussions are broadly-based and attempt to understand the micro-level activities at the raw material source, within the macro-level of political, ideological and regional interests that came to bear upon them. This relates in particular to how labour was maintained and how changes in elite demand and political decentralisation impacted upon remote source stone acquisition. The chapter will therefore approach each research question within these discussions, in the awareness of the limitations of both the archaeological record and the textual sources in an Old Kingdom context.

Overview and Research Questions

The procurement of raw material for monumental construction projects and elite consumption has often been used as the measure for determining levels of social complexity or stratification in societies (Renfrew 1973a: 539-58). Principally, monolithic developments have been understood within an evolutionary framework as the move towards centralised bureaucratic management and increased social stratification; for example, as an evolutionary trajectory from Chiefdoms to States (Renfrew 1973a: 542; Trigger 1990; Trigger 1993: 75). Monumentality in 'state' societies has therefore been understood as the product of complex social relations that have become increasingly hierachical and through the centralisation of power lay the ability of an elite class to call on the labour of others (Trigger 1993: 75, 81; Feinman 2000: 31).

In Egypt and Mesoamerica this was practised *par excellence*, which correspondingly raised the important question of whether the ability to mobilise labour for non-utilitarian projects was voluntary as well as coerced within a political system (O'Connor 1974: 16). In an Egyptian context the approach to this question has inclined towards corvée labour being amassed via methods such as compulsory conscription or national service, in essence exploitative labour relations (Eyre 1987: 18; Trigger 1990: 119-31; Trigger 1993: 75; Feinman 2000: 35).

However, do these monolithic conceptions provide an adequate theoretical framework to approach the procurement of the raw materials on a micro-level? Analysis of the archaeological record at the quarry sites being researched suggests small numbers of highly organised workers, but within low levels of hierarchical organisation (see Chapters 7 and 8). In order to rethink some of the ideas surrounding the social organisation and mobilisation of quarry labour forces, the following intends to explore a range of approaches to these issues outside of one theoretical model. For example, by using social theory and making connections with appropriate cross-cultural and cross-level examples, it might be possible to find some fresh approaches to the questions being asked of the empirical data. As Schiffer (2000: 1, 5-6) points out, to explain diverse human phenomena, numerous theories are required in varying levels of generality, degree of abstraction and empirical content.

The research questions being asked, as discussed in Chapter 1, are as follows:-

i. Does the archaeological record at quarry sites support the textual evidence associated with the size of quarry expedition labour forces?
ii. Can settlement evidence and data relating to food production attest to seasonal or permanent exploitation?
iii. Does the organisation of quarry labour forces in a complex society directly compare with those in a range of differing archaeological contexts, and what might these comparisons contribute to the overall understanding of the processes of raw material acquisition in state and non-state societies?
iv. Were there regional bases for exploitation, or were the quarrymen who worked in Upper Egyptian quarries mobilised from quarries in Lower Egypt during the 4th and 5th Dynasties?
v. Were systems of exchange in stone tools operating between quarrymen?
vi. Were quarry labour forces only mobilised by state coercion?

Large Scale Procurement, Small Scale Operations: the Implications on the Social Organisation of Quarry Labour Forces

The idea of large scale procurement of remote source hard stone being practised as small scale operations that were campaign-based and possibly seasonal, has been proposed in Chapter 8. This was deduced from the ephemeral nature of the settlement evidence at Chephren's Quarry and Widan el-Faras, and the relatively small amount of material culture present at the sites, such as pottery. There are no hierarchical structures visible and it is even unclear whether what have been loosely termed 'settlements' were ever intended as dwellings for the labour force (see Chapter 8). Interpreting the 'settlement' evidence at Umm es-Sawan, Kemp (1991: 246-7, Fig. 83; also see Chapter 8) argued that Old Kingdom quarrying was achieved here through low levels of social organisation by small groups of labourers working in a 'primitive' manner. This view seems to have been taken in part due to the 'informal' nature of the settlement features in comparison with Middle Kingdom planned settlements at Qasr el-Sagha, associated with more highly bureaucratised resource exploitation. This view has also been expressed by Shaw (1994: 116). Although the settlement evidence at Widan el-Faras and Chephren's Quarry (see Chapter 8) *might* also suggest this, the production and transport evidence, as discussed in Chapters 6 and 7, suggests something quite different from 'primitive' procurement strategies. So, how can these apparent contradictions in the empirical data be explained and what does this imply about the social organisation of these projects?

Although remote source stone procurement required some level of intervention by a central administration (see Chapters 6, 7 and 8), or from an elite who were driving the demand, it is interesting to speculate on how deep the levels of organisation might have gone in practice. As Ericson (1982: 132-3) suggests, even within political domains of centralised administration, production systems might not all be effected in the same way. Hence, more discussion about the effects of administration on production systems can approach the question of whether there exist cross-cultural developmental sequences in relation to levels of societal organisation in procurement strategies (*op. cit.*). Cross-cultural approaches to the question of labour organisation in societies where monumental architecture was a phenomenon, has come from contexts such as the European Neolithic and Mesoamerica (Renfrew 1973a: 539-58; Spence 1982: 173-97; Trigger 1990, 1993:119-31; Webster 1991: 840-51; Cyphers 1996: 61-81).

In relation to the transport of stone for monuments, it is generally considered that the greater the distance stone travelled (from source to a construction site) can be indicative of higher levels of socio-political organisation and societal complexity (Thorpe and Williams-Thorpe 1991: 71-2; Webster 1991: 849; Cyphers 1996: 64). For example, the source of basalt used for construction of the Nuraghi monuments on Sardinia was within 5 km of the monuments. Therefore, Webster (1991: 855) deduced that movement of stone would have placed minimal demands on the labour force and consequently did not require high levels of organisation, great numbers of people or even specialists. If Webster's (1991: 840-51) model is applied to the phenomenon of long-distance stone transport in Egypt, although local stone sources were principally used for pyramid construction, the implication would be that long distance stone transportation was the product of a highly centralised organisation in complex hierarchies involving large numbers of people.

The problem with this assumption is the high expectations that are then placed on the archaeological record at quarry sites, particularly in view of such large-scale stone procurement in a state society, that should perhaps be reflected by large amounts of material culture at the source. Feinman (2000: 36-8) tries to explain such anomalies in the archaeological record that cannot be understood within monolithic conceptions of what should constitute a state or an egalitarian society, through the concept of corporate/network models of societal organisation. For example, the corporate/network model has provided a means to move away from acrimonious debate in relation to Puebloan sociopolitical organisation, as it accounts for empirical data that cannot be fully explained from an egalitarian viewpoint (Feinman 2000: 50-1). In essence, network strategies focus on personal prestige, wealth, specialised craft goods, and lineal patterns of inheritance. Corporate hierarchies focus on communal ritual and co-operative labour tasks that are woven together through integrative ritual and ideological means. The corporate model has been suggested for Early-Middle Formative Mesoamerican populations, but as Feinman (2000: 37) explains, some elements of both models can also apply.

Relating these models to Old Kingdom Egypt, elements of each model can also be applied to some of the problems that the archaeological record at the quarry sites present. However, the intention is not to go into lengthy debates about whether the Old Kingdom was a 'state' or not, as this question is not the research objective of this thesis. Nor is it the intention to debunk ideas about *large* expeditions being sent to quarries in the Wadi Hammamat during the Middle and New Kingdoms and to 'prove' that these were small. The objective is to rethink some of the ideas that have led to such perceptions and the potential of making fresh approaches to research questions in relation to raw material acquisition. A more dynamic approach to the social relations through which monumentality arose implies that self-interest and pathways to power may not always be enacted in the same way or via one strategy (Feinman 2000: 34-5).

In an Old Kingdom context, as discussed in Chapter 8, the textual record provides only very limited insights into the working personnel and administration of quarrying expeditions (Eyre 1987: 12). In fact there is quite a bit of confusion surrounding this subject and perhaps some great leaps in faith in interpreting some of the inscriptional evidence relating to the organisation of labour, particularly during the Old Kingdom (see Chapter 8). However, the impression given from graffiti on building blocks in 4th and 5th Dynasty pyramid complexes is of an organised division of labour even at low levels, but with no real idea of the numbers comprising each work 'gang' or 'crew' (see Chapter 8; Eyre 1987: 12; Verner 2002: 79).

Things tend to get more obscure with texts and inscriptions that relate specifically to quarry expeditions. Although these are extremely few in an Old Kingdom context, the tendency is generally towards large expedition forces, generally into several hundred per campaign (see Chapter 8). The context of the epigraphic record is important, as mentioned earlier, but it seems apparent that the focus tends to be on the feats or problems overcome in the task, rather than actual practice (Baines 2000: 36). Equally, there is the problem of determining the relationship between self projection of the individual into eternity with any quantified numerical content. Western conceptions of 'oriental exaggeration' (Bloom 2001: 116; see Chapters 5 and 11) also need to be taken into account, and care needs to be taken in this area of discussion in relation to the numbers recorded in these expeditions.

Estimating the demands that super-consumers made on the labour pool to construct monuments and hence procure raw materials is a question that Abrams' (1987: 485-96) study was seeking to explore in the Mesoamerican Late Classic Period. This study came to some unexpected conclusions because elite construction demands to build the Mayan Temple of Meditation at Copan, Honduras, could in fact have been achieved by well-organised but relatively small numbers of people, expediently using raw materials and construction techniques. Hence, kinship ties were proposed as the primary mechanism of labour organisation, an integrative mechanism suggested in early state formation with society structured as 'ranked households' (Abrams 1987: 496). The implications of these findings suggests that the impressiveness of buildings might not necessarily imply huge energetic investment in human resources or necessitated radical social changes. In fact Abrams (1987: 493) proposes that such construction projects did not place major stresses on the socio-economic system either. What is interesting is that Webster and Abrams' hypotheses incline towards parity, despite the extremes of societal level between the European Neolithic and Classic Period Mesoamerica, respectively. In other words they cover both non-state and state societies. Therefore, some care needs to be taken in assuming that monumental architecture is the expression of complex, centralised and hierarchical societies, because it seems that this can arise inside or outside of states, hence simple or complex societies.

The work of Spence (1982: 173-97) in Mesoamerica tends to take an evolutionary approach to changes in obsidian procurement from the Early Formative Period to the Classic Period. Spence (1982) points out that state involvement in obsidian procurement does not necessarily mean these operations were 'state appendages', but were probably conducted by well-developed social groups. The suggestion is that craft specialisation expanded along established social lines that were not necessarily organised and supported by the state (Spence 1982: 181). Although state administration played a part in *regional* procurement, as mentioned in Chapter 7, the history of self-sufficiency protected them from being absorbed or replaced by the state (*op. cit.*). Therefore, state involvement in procuring remote source green obsidian in the environs of Teotihuacán did not necessarily require radical structural changes, because the increases in quarry production were handled through an already existing industry with networks that were regionally based (Spence *et al.* 1984: 103). In Feinman's (2000: 39) corporate/network approach to societal organisation, he suggests in relation to Teotihuacán that hierarchical formations may exist without high degrees of centralisation, economic stratification or personalised leadership.

As a consequence of these approaches, the social organisation of obsidian procurement in Mesoamerica has been hypothesised around a more loosely structured framework that had a reliance on kinship ties between specialists, along with communal efforts. Perhaps as a working hypothesis, such an organisational model could be used to explain some of the problems with the empirical data at Old Kingdom quarries. Another important point that Spence *et al.* (1984: 104) make is that if there were a number of overlapping networks involved in stone procurement, a deterioration in the power of the state would not necessarily halt the flow of the material. This certainly seems to have been the case with procurement of stones *inside* the Nile Valley, such as Aswan granite and granodiorite, travertine from Hatnub and silicified sandstone (quartzite) from Gebel Ahmar.

The antecedents for the Old Kingdom organisational structure were probably already well-developed, given the long history of hard stone procurement in Egypt. Sherratt (1997: 362-4) places a similar emphasis on ideas about labour recruitment for construction projects in the European megalithic cultures, these being derived from a blend of population density, highly organised social networks and existing lineage structures. This implies that monumentality was just as much a cause as a consequence of social complexity. Applying this theory to pyramid building suggests that the Old Kingdom centralised 'state' did not necessarily create pyramid building, but was a consequence of the quest for ever more elaborate above-ground monuments. The antecedents and historical origins for monumental structures derived from community focused small-scale projects centred on a transformed 'domus' (Hodder 1991) as a demonstration of the feats of co-ordinated efforts (Sherratt 1997: 338; Bard 1992: 5).

It is clear that by the 4th and 5th Dynasties some refinement and co-ordinated effort in the way that labour was organised to remote sources would have to have occurred, to meet the increasing demands. Short duration project based campaigns for specific objects can be attested in the archaeological record at the quarry sites (see Chapters 6, 7 and 8), with the probability that some, but maybe not all, labour was mobilised from a central place in Lower Egypt, given that the pottery at Chephren's Quarry has its source certainly in the Lower

Egyptian Nile Valley (see Chapters 6 and 8). One possible residence or residence focus could be the Faiyum district, because the region seems to have already had a well-developed stone vessel industry operating, possibly into the Early Dynastic Period (see above and Chapters 2, 3, 6 and 7). Also, a point addressed in the final part of this chapter, is the probability of a *specific* connection between the Faiyum and Chephren's Quarry that might have historical antecedents. As a consequence, it could be proposed that highly organised small social networks of skilled stoneworkers were called upon to undertake the task of remote source procurement, as opposed to the mass deployment of workers using 'primitive' methods to procure the stone. As the production evidence suggests, ideas about unrefined or crude resource exploitation cannot really be substantiated.

Mobilisation of Labour

The question of how labour might have been mobilised to remote source hard stone quarries is extremely difficult to address from the archaeological and textual sources, due to the limitations of both. As mentioned previously, the question of whether this was voluntary, via force, or by tactical coercion, is an important element to discuss. Discussions surrounding the issue of monumental architecture and the costs in human energy have produced many arguments from a range of theoretical perspectives. For example, Rathje (2000: 9) suggests that one of the motives behind Old Kingdom pyramid construction was to use up labour that would otherwise be available to competitors, a view that is framed in the concept of the 'withdrawal' of social production as part of elite power strategies.

Trigger's (1990: 119-31; 1993:53-4) thermodynamic explanation of symbolic behaviour and ideas about the rise and reason of monumentality rests on the premiss of conspicuous consumption of human energy, via deployment of massive amounts of labour as the materialisation of power. This was availed primarily through labour relations that were part of a system of inequality in the *early* Egyptian state, an accepted norm that went unchallenged, although exploitation had its limits (Trigger 1993: 53-4). However, as Trigger (1990: 125) goes on to suggest, as societies became hierarchical and control mechanisms more despotic, power is expressed by commanding the labour of others for non-utilitarian purposes (Clarke *et al.* 1985, Clark 1986). How this control was activated in practice is not specifically approached, although the underlying suggestion is that these mechanisms were primarily exploitative and outside the ability of any individual to question.

These conceptions tend to suggest a world of passive actors mystified by dominant ideologies, a situation that led to the control of one group over the production and reproduction of others (Miller *et al.* 1995: 10; Hodder 1991: 28, 68, 73). What gets passed over is who were the people being mobilised and were labour relations just exploitative? What subtleties might underlie such mechanisms, particularly if labour was to be maintained. On a general level, power can be used to mobilise labour from divine appeal to physical force, but there are multiple ways in which followers might express their allegiance (Arnold 2000: 14-5). As Arnold (2000: 14-5) further points out, relationships that involve followers in ritual events might appear benign but are in effect obligatory. However, in the 'dialectic of labour control' (Giddens 1979: 145-50), humans can contribute (or not) to certain requests and demands, a situation that can be carried out within societies of many different levels of complexity (Arnold 2000: 16).

The approach to this subject, as similarly made to the organisation of labour at quarry sites, does not intend to prove or disprove such approaches and clearly, as Arnold (2000: 15) points out, complex individual contexts of power are beyond view in the archaeological record. The objective is to produce a working hypothesis to approach the question of labour mobilisation from specific observations made of the empirical data at quarry sites, constructed within a more reflexive theoretical framework. The approach intends to focus ideas about labour mobilisation down to the micro-level at the raw material source and therefore away from constructs that concentrate on just the monuments. The question of how coercive mechanisms or even force used to mobilise labour can be sustained is important, given that hard stone procurement in the Old Kingdom was maintained over several hundred years. When comparing stone procurement in cross-cultural contexts, such as the Olmec of San Lorenzo (Preclassic Mesoamerica 2nd millennium BC) who also consumed large amounts of basalt from remote sources for monuments (Coe 1994: 69-70), a clear difference emerges. This is primarily because such activities were relatively short-lived in comparison with Old Kingdom Egypt. Although there were obviously differing religious and political influences that might have contributed, mass coercive labour deployment has been suggested as a significant element leading to the total societal collapse of the Olmec. As Coe (*op. cit.*) argues, the Olmec of San Lorenzo went out with a 'bang' not a 'whimper' due to the controls and compulsion to build and transport stone for monuments, given their ruthless defacing and ritual burying.

A comparable situation even during the decentralisation of Old Kingdom Egypt did not occur, as discussed in Chapter 7 (also see Chapter 3). Although stone was consistently re-used throughout Egyptian history due to the inability to procure it at later periods, actual destruction of monuments at the end of the Old Kingdom is not attested. For example, in the Middle Kingdom, the pyramid complex of Amenemhet I contained many re-used stone blocks which still bore the names of Old Kingdom kings such as Khufu, Khafre and Unas (Goedicke 1971; Verner 2002: 398-9). This suggests that although these complexes were already in ruins (perhaps from Old Kingdom stone re-use), the rulers names had not been removed. Defacing of Old Kingdom monuments as a response to disputes between leaders, whether these were for reasons associated access to power and/or small scale individual challenges, is not fully attested. Perhaps the Olmec collapse, as exemplified by the destruction of its monuments, indicates the dramatic response to *failure* of compulsory or forced labour mobilisation in the long term, a point that has been raised by Shanks and Tilley (1987b: 180).

In order to rethink aspects of the mechanisms used to mobilise and maintain labour at lower levels, the following section intends to develop a working hypothesis around two classes of objects found in the archaeological record at Widan el-Faras and Chephren's Quarry which might provide a basis for such enquiries: first, is the high proportion of beer and wine jars found at these and other quarry sites; and second, Chephren Gneiss tools and unworked blocks found at Widan el-Faras and Umm es-Sawan.

Alcohol: a strategic means of labour coercion?

The role that beer might have played as a method of payment to tomb workers has been previously speculated upon (Eyre 1987: 25; Roth 1994: 236). Inscriptions on the tombs of officials such as Remenu-ka, Mehu-akhti and Hetepher-akhti in the Giza necropolis list bread and beer, the standard order in the ubiquitous offering lists, over and above other commodities given as payment to construction workers (Roth 1994: 237). The archaeological record also attests to this, given the quantity of bread moulds and beer jars found in the fill of several Giza necropolis mastabas, a situation repeated at Abusir where beer jars form a large element of the pottery corpus associated with 5th and 6th Dynasty royal and officials' tombs (Bárta 1996: 128). Monthly supplies from the king's residence to the funerary temple of Neferirkare mention that beer and bread were commodities more frequently delivered than even grain (*op. cit.*, 129). As Roth (1994: 238) points out, it would be interesting to know whether such payment was given specifically to construction workers on *royal* monuments, which might be suggested from the large bread and beer production houses associated with the 4th Dynasty workmen's settlement on the Giza plateau (Lehner 1992).

At Hatnub (Shaw, forthcoming) and Umm es-Sawan, beer jars make up a high percentage of the pottery corpus (Caton-Thompson and Gardner 1934: 110-6; also see Chapters 6 and 8). Although at Widan el-Faras and Chephren's Quarry such vessels occur only in limited amounts, their proportional occurrence in relation to other vessels is still significant (see Chapters 6 and 8). Furthermore, the recent discovery of an intact beer/wine jar found at Chephren's Quarry with a close counterpart at Umm es-Sawan could suggest its origin being linked to a beer production house in Lower Egypt (see Chapters 6 and 8). In fact, it has been suggested that beer jars actually played an important role in the Egyptian redistributive economy as a means of exchange (Bárta 1996: 129, 131). However, the use of alcohol in pre-monetary societies in the sphere of labour mobilisation has only recently received attention. As Dietler (1990: 352) remarks, the role of alcohol in societies can provide valuable insights into social systems, such as Edwards' (1996: 69) proposal of a 'labour-for-beer-market' in the context of 1st millennium BC Kushite society in Upper Nubia.

It is important, however, to place alcohol accurately in pre-industrialised economies where it is consumed in well-defined and controlled social occasions, and disassociate it from alcoholism and private use in Western industrialised nations (Sherratt 1997: 389). Alcohol therefore has to be viewed as a social form that can have '...profound influence in producing changes in social relations and can be informative about society and culture in general.' (Dietler 1990: 352). In agriculturally-based pre-monetary societies such as Old Kingdom Egypt and Mesopotamia, feast-driven mechanisms of labour mobilisation are common in both the historical and ethnographic record (Dietler 1990: 366). In Mesopotamia, ration-based forms of payment are well documented and clearly connected with central government. Beer belonged to the '...extraordinary rations...' that were issued to officials, employees and conscripts of the crown (Neumann 1994: 330). The Ur 'messenger texts' record the beer rations being distributed to those people '...coming from or going to a certain place, or going for a specific purpose' (Neumann 1994: 330). This implies that employment on these occasions was only temporary, so in relation to Chephren's Quarry, one could hypothesise that the mobilisation of a labour force for a specific project could have a similar mechanism of payment and inducement attached to it. Although in an Old Kingdom quarrying context, textual sources relating to specific payments of this kind are not known.

Evidence for the production of beer has a long history in Egypt back to the Predynastic period (Samuel 2000: 541) and large production areas for beer have been found at the Predynastic settlements (early Naqada II) of Hierakonpolis and Abydos (Geller 1989: 51). It is also interesting to note that the hieroglyphs for bread and beer are combined to form the generic determinative of 'food' (Darby *et al.* 1977: 532). But, despite its apparent ubiquitous nature, the power over production of this commodity has to be carefully considered and the role that elite production houses might have later played in controlling it. A tomb inscription dating to the reign of Sahure (5th Dynasty) mentions large offerings of bread and beer: '...to Nekbet, 800 daily offerings of bread and beer; to Buto, 4800 daily offerings of bread and beer; to Re, 138 daily offerings of bread and beer...' (Darby *et al.* 1977: 503). However, who was producing these commodities? As Sherratt (1997: 391) points out, the preparation of alcoholic drinks required investment and ability to concentrate surplus for conspicuous consumption; a privilege only available to a few. The control of alcohol production is thus crucial in the argument for beer (and/or wine) being used as a mechanism to mobilise labour.

As mentioned earlier, one of the important points associated with hard stone procurement in the Old Kingdom was how it was maintained for hundreds of years on a scale not matched until the Roman Period. Therefore, something quite extraordinary was happening in the Old Kingdom and if sustaining stone procurement was not by force, then perhaps it was the maintenance of specific relationships via reciprocal exchange of commodities such as beer, entitlements and prestige objects (stone vessels) that was paramount. The giving of stone vessels as gifts/rewards may be attested in private burials, as mentioned above, and perhaps also bread and beer (Müller-Wollermann 1985: 121-68; Roth 1994: 236; Bárta 1996: 131). The key to maintaining access to labour in the quest for remote source raw materials was possibly the manipulation of these forces that gave increasing differential access to the material resources (Saitta 1997: 9). As Saitta (*op. cit.*) further points out, it is the maintaining of these specific relationships and not necessarily degrees of specialisation and hierarchy that are important. Access to surpluses and the control of beer production would therefore be crucial and it can be seen that this became diffused in the later stages of the Old Kingdom, given that officials were also using beer in exchange for labour by the 5th and 6th Dynasties (Kanawati 1977: 1; Roth 1994: 236). Similar to the Mesopotamian system, the state or an elite class could mobilise labour for its own purposes and at the same time maintain inequality via access to this commodity.

Even in societies where recourse to coercive power does exist, the mobilisation of labour through work-party feasts and alcohol was employed (Dietler 1990: 365, 368-9). If the social organisation of quarry expeditions was small-scale kinship-based and within well-developed social identities, then perhaps a socially embedded commodity such as beer later became subsumed into a complex network of economic relations, a situation that could be inferred by Bárta's (1996: 131) study of the Abusir beer jars. Therefore, beer could be used as a dynamic element to mobilise labour, and, most importantly, maintain access to it by tactical employment, which possibly had antecedents in the earlier formation of the state (Sherratt 1995: 14-5). This might seem an extraordinary claim for such a product, so it had to have economic value through the social context in which it was consumed. Perhaps a tenuous modern analogy would be to that of champagne which has more elite and social value (in Western society) than any other form of alcoholic beverage, regardless of its monetary value, and is thus an essential commodity consumed at important social events. Appadurai (1986: 4) calls this 'commodity by destination' being an object produced for exchange in the form of consumption within specific social contexts.

It is clear that the elite were able to secure outcomes from the actions of others or what Giddens' (1979) defines as 'relational power', and this could be achieved by those who commanded access to specific prestige commodities, including fermented beverages (Arnold 2000: 20). The mobilisation and maintenance of labour forces in stone procurement projects by strategic means that involved the manipulation of culturally embedded commodities, such as beer, to secure outcomes could be well founded in the control of beer production. The emergence of differential access to a resource is one factor which enables labour to be recruited and mobilised eventually *outside* of kinship ties and can thus be one of the manifestations of a centralised power base (Arnold 2000: 27).

Stone Tools: the evidence for labour being mobilised from Lower/Middle Egyptian residences?

The presence of non-local stone tools in the Faiyum quarries, such as Chephren Gneiss tools and unworked blocks in a tool making context at Umm es-Sawan and dolerite tools sourced to the environs of Chephren's Quarry at Widan el-Faras (see Chapters 2 and 6), is an interesting anomaly in the archaeological record that requires some attention. The significance of non-local stone tools present at these sites has also been mentioned by Harrell (2002: 235). However, the significance of this data in producing a hypothesis relating to the mobilisation of labour, possibly from a Lower Egyptian residence, is yet to be demonstrated. Approaches to this subject have been made in a few cross-cultural and cross-level contexts that have been enlightening as to the social context of quarry operations, the permanent residence of quarrymen and stone transportation routes. For example, dolerite axes sourced to the Presili Hills in Wales were found in high concentrations in ports along the south coast of England, implying that these items were being exchanged (Castleden 1993: 121). This not only suggests that the remote stone was probably highly prized, but also implies that the transport route of the Stonehenge bluestones could have been via the south coast of England. The exchange network could have been driven by those procuring and transporting the megaliths (*op. cit.*).

Studies of the distribution of obsidian tools in the central and western Mediterranean during the Neolithic has further implications on interpreting the value of a material the more remote it is from its source (Tykot 1996: 39-82). For example, obsidian tools in their supply zone were ubiquitously used for utilitarian purposes, but at greater distances became intertwined in local networks of basic exchange due to their added prestige value. These networks worked via direct long-distance contacts with kin connections being the preferred exchange partners (Tykot 1996: 67, 70). Furthermore, as Ammerman and Andrefsky (1982: 152-3) point out in relation to Neolithic obsidian exchange over long distances in Calabria, the material was often exchanged only in semi-processed form. The final preparation of a tool could be carried out at various points within the network. Hence, in comparison with Chephren Gneiss for tools, this might explain the occurrence of the stone as small *unworked* blocks at Umm es-Sawan in a tool making context.

Applying such concepts to the presence of Chephren Gneiss tools and material in utilitarian contexts in the Faiyum quarries presents some interesting approaches to this evidence. The possible exchange of Chephren Gneisses in some form of utilitarian tool exchange operating between social groups involved in stone procurement needs to be considered. Chephren Gneiss tools or even unworked blocks would have two valuable attributes: first would be durability as a tool and second, the prestige attached to a unique and distant source. These attributes alone must have made Chephren Gneiss extremely desirable (also non-local dolerite) as a material of exchange for utilitarian purposes, yet how can this be reconciled against its use for elite objects? This interesting overlap is a point that Hayden (1998: 44-5) raises in connection with the difficulty of identifying the reason why prestige material was also being used for practical purposes: was it simply because the material made better tools? This might indeed be the case with Chephren Gneisses (see Chapters 2 and 6). Or, did it only become 'prestige' as a *finished* product (such as a vessel or statue), as measured by the labour to procure, transport and craft it, in other words the Marxist theory of value (Renfrew 1986: 157).

The social context of exchange is also important and as Hodder (1982: 207) explains using social-exchange theory, exchange systems must be considered by the way in which the symbolism of the artefact legitimates the power basis of certain interest groups. Therefore, the difficulties in explaining the exchange of items, whether these are prestige or utilitarian, are due to a relative cultural value. Exchanged artefacts may have different values and meanings within each local context and distance from its source (*op. cit.*, 208). As Bradley and Edmonds (1993: 13) similarly point out, commodities play an active role in social life and they acquire a past through the history of the contexts in which they pass. It is therefore important to consider that different forms of production *and* consumption can co-exist in the same historical context. What is also important is the social context in which these quarries operated, and the motivators to work in such places can have historical antecedents (Bradley and Edmonds 1993: 96). In the Bradley and Edmonds hypothesis these ideas are further enhanced by interpreting the presence of non-local stone tools, in varying distributions, as controlled by particular communities or groups of an individual source. 'In short, the sources of the axes were not generally accessible.' (Bradley and Edmonds 1993: 143). Hence, it might also be possible to explore the idea of historical antecedents through social groups and/or trade/exchange networks that could connect Chephren's Quarry specifically with the Faiyum quarries, a suggestion that has already been made (see above and Chapters 7 and 8).

Trying to identify these historical links of Chephren's Quarry with the Faiyum and Lower Egypt is of course difficult, although there are two pieces of evidence which might be significant: first is a fragment of a Chephren Gneiss palette found in a Neolithic context at Kom W in the Faiyum (Caton-Thompson and Gardner 1934: 22; see Chapter 4), and second, is the presence of 'gneiss' and 'diorite' in storage contexts in the Predynastic site of Maadi in Lower Egypt, along with a range of other imported stones (see Chapter 8; Hoffman 1991: 203). These small pieces of evidence could suggest that exchange networks or connections between Lower Egypt and Lower Nubia, that included Chephren Gneiss, were already well established. These trade/exchange networks could have been developed by early nomads plying a Western Desert trade route through the oases (Hoffman 1991: 203). The possibility has to be considered that these antecedents had enduring historical significance in the social context of Chephren Gneiss exchange value through a variety of societal levels and contexts. Therefore, acquiring Chephren Gneiss for reasons of exchange between kin at local levels might have been a motivator to procure the stone outside of any form of state coercion. Or indeed, these interactions were later manipulated to maintain the procurement of stone from Chephren's Quarry with all the difficulties that this implies. As Arnold (2000: 29) suggests, the rise in the exchange of exotic stone tools could be indicative of new webs of social interaction that were also part of a mechanism to gather and manipulate labour.

Summary

Rethinking some of the issues surrounding the social organisation of labour to quarries can help evaluate some of the inconsistencies encountered in the archaeological record at quarry sites. Discursive methods of approach to aspects of the empirical data at quarries taken from a range of social theoretical and cross-cultural perspectives, although in some cases quite abstract, can be useful constructs to approach elements of the empirical data whose significance might otherwise be lost. A social organisational hypothesis based on small groups, loosely structured around kinship ties, well-developed social identities and with long cultural and historical antecedents in stone-working is proposed. Although this is a working hypothesis that requires more quantitative data, such a framework can perhaps account for the lack of hierarchical structures at the quarry sites and yet explain organised and expedient production techniques. Also, the problems with interpreting stone structures at these sites that are loosely organised, if they were settlements at all, are not in themselves indicators of 'primitive' procurement strategies. This organisational framework could be applied within a range of societal levels that have procured stone for monumental structures from the Neolithic to Classic Period Mesoamerica. From this stem the problems that can be encountered if monumentality is used solely as a measure for increasing centralisation, social and hierarchical complexity.

Moving arguments outside monolithic perceptions of the state by using a range of social theoretical approaches to problems encountered with the empirical data, can provide some fresh perspectives about how labour was mobilised. This is particularly relevant to periods of exploitation that do not have reliable textual sources of data and where the archaeological record has a bias towards funerary, as opposed to settlement, data. Within such a method it is possible to make connections between beer jars and the role that alcohol might have played as a tactical inducement to mobilise labour to remote source quarries. The

significance of non-local stone tools at quarry sites, particularly Chephren Gneiss in Lower Egyptian Faiyum quarries, can also be explored within the context of social-exchange mechanisms between quarrymen. These networks can have historical and cultural antecedents that might have long connections between certain stone sources, such as Chephren's Quarry and Widan el-Faras. This might further suggest labour deployment from Lower Egypt to Chephren's Quarry.

The impact of political decentralisation on stone procurement can have a variety of consequences, from total collapse to shifts in procurement to more easily accessible sources. It seems that a social organisational model based on kinship ties could perhaps more readily absorb and adjust to such changes, and explain why hard stone procurement was still practised within the Nile Valley even during the 6th Dynasty, when it appears to have ceased outside of it. Tactical deployment of labour via inducements such as beer or prestige objects could maintain labour in the longer term. Force or overtly coercive methods of labour mobilisation can lead to collapse, as proposed with the Olmec of San Lorenzo. In essence, maintaining specific social relationships at the micro-level was the symmetry through which stone procurement from remote sources was continued and could have been more important than specific degrees of specialisation or hierarchy.

Chapter 10

Conclusions

Methodology

The application of a comparative methodology to the study of logistics and social organisation required of hard stone procurement in the Old Kingdom provides fresh insights into the social context of these activities, particularly in the absence of reliable epigraphic sources. It also reveals unexpected connections between the empirical data at quarry sites widely-separated geographically which might otherwise be overlooked when studying individual quarries; for example, stone tools found in quarries far removed from their source, and pottery emanating from a single Nile Valley source. Such evidence strongly suggests centrally-organised stone procurement strategies, and methods of transport and the concept of mobile labour forces.

Interpretation of the data through a theoretical methodology incorporating cross-cultural and cross-level studies of obsidian quarries, in contexts such as the Bronze Age Aegean and Classic Period Mesoamerica, can produce significant insights into the social context of these operations. The relevance of such an approach lies in overcoming some of the inherent difficulties in dealing with a fragmentary archaeological record and limited textual sources. Therefore, the approaches to the central questions being asked of the empirical data at Widan el-Faras and Chephren's Quarry have aimed at producing discursive conceptual frameworks in which some of the limitations of the archaeological record can be addressed and working hypotheses produced, as a basis for future research.

Stone Transportation: Infrastructure, Environment and Logistics

Chephren's Quarry

The probability of there being more than one possible stone transport route from Chephren's Quarry to the Nile (particularly in relation the transport of large blocks) has to be considered. The track that commences at Quartz Ridge leads from vessel rather than block quarries and additionally, small blocks found along the route suggest it was opened for transport of small rather than large blocks. Investigations in the environs close to the southern block quarries have produced no evidence of a track heading south-east in the direction of the Nile. However, a northerly route direct to the Wadi Tushka would reduce the overland transport of large blocks from 80 kilometres to just 15 kilometres, provided the Wadi Tushka carried enough water for (seasonal) boat/raft traffic. The nature of the pre-desertification ground surface in this region has been investigated and was almost certainly load-bearing hard laterite or calcrete. This could explain the absence of artificially-laid surfaces or tracks.

The loading ramps, and the vehicle that they were purpose-built to accommodate, have presented the opportunity to produce an hypothesis about how stone was transported using amphibious vehicles. However, such an hypothesis, encompassing the role that the Wadi Tushka played, cannot be further tested archaeologically, due to canal construction associated with the Tushka Hydrological Project (see Chapter 11). The construction of Canal 4 has cut an 800-metre-wide swathe across the northern environs of the quarry towards the Wadi Tushka, effectively making any meaningful survey to identify a transport route north from Quartz Ridge to the wadi impossible. Construction of the Sheik Zayad Canal that connects Lake Nasser to the canal branches has also affected investigations at the south-eastern terminus of any transport routes to the Nile. Hence, possible evidence of what is one of the most baffling aspects of the logistics of stone transport from this remote source is now lost.

The shallow groundwater wells found at Chephren's Quarry are important features that had either gone undetected, or were mistaken for shelters until the 2000 season.

Evidence for groundwater being less than 1 metre below the surface is an extremely important finding, acting as an indicator of climate and subsistence at the quarries, and demonstrating how dependent these operations were on easily-accessible groundwater. Moreover, in relation to climate, each of the wells found along the track seems to have a shallow but substantial outer perimeter wall constructed. At present the function of these remains unknown. However, two theories have been put forward: first, that they acted as animal corrals; second, that they were defences against wadi water runoff. Other indicators of a wetter open-savanna-type environment comes from the presence of a bakery and the fire-setting of stone, since both processes require substantial amounts of wood (fuel). These processes would also require considerable amounts of water, particularly if the fire-setting technique practised involved the application of water after firing.

Widan el-Faras

It is concluded that efforts were made to minimise the overland transport of stone and this is well attested at Widan el-Faras, given that the paved quarry road delineates the shortest route to water at Lake Moeris. The necessity of a paved surface implies that, in contrast to Chephren's Quarry, the ground surface did not have load-bearing potential and, coupled with topographical irregularities such as steep gradients, required an artificially-laid surface. The volume of Widan el-Faras basalt used in the Old Kingdom, although limited, outweighs its use at any other period in antiquity; this suggests a link to recorded high Nile floods and the subsequently high level of Lake Moeris during the 4th and 5th Dynasties. The significance of the harbour features at Qasr el-Sagha, the terminus of the quarry road, further connect the procurement of basalt to high lake levels and, as a consequence, the importance of keeping Lake Moeris connected with the Bahr Yusef branch of the Nile. The decline of Nile flood levels by the late 5th Dynasty might explain the absence of basalt in pyramid complexes after the reign of Nyuserra; a consequence of the severing of the connection between Lake Moeris and the Bahr Yusef. Indeed, Widan el-Faras basalt was not exploited again in such quantities, even during the Roman Period, its use from the 6th Dynasty onwards is only attested for statuettes not for monumental architecture.

Finally, production and transport of stone from both quarries were interdependent activities to expedite transport and channel stone through one transport artery, the Nile. Efforts were made to reduce transport weight by varying degrees of on-site production which, at Chephren's Quarry, given the greater distance, was the production of object 'blanks'. The transport vehicles at Widan el-Faras and Chephren's Quarry were quite different, as indicated by the dimensions of the quarry road and loading ramps respectively. The transport infrastructure and vehicles were consequently purpose-built to meet local geomorphological and environmental conditions, rather than being prescribed by a central authority to a uniform standard specification.

Stone Production

Chephren's Quarry

In general, the numerous quarries can be classified as either vessel or block quarries, as determined from the geological nature of the deposits. Visual quality and forethought to the final crafting process were high priorities, as indicated by the large volumes of waste material, discarded object 'blanks' and unworked outcrops, left behind due to the presence of unsightly syenitic/granitic veins. The discarded vessel and statue blanks of standard sizes implies that exploitation was predetermined with specific objects in mind. Stone tools were locally-sourced to the quarries, being of Chephren Gneiss, or from dolerite dykes in close proximity to the quarries. The tools are generally of standard sizes, either small hand-held pounders or larger pounders that would require two hands to lift; none were attached to a haft. Hence, the production process appears to have been a highly-organised activity that would have involved a number of stone specialists.

Widan el-Faras

Similar observations that are indicative of highly organised procurement for specific projects were made at Widan el-Faras. Exploitation just of certain parts of the basalt flow suggests that block size was more important than stone quality, hence the minimal incidence of secondary production at the quarry. Final block-trimming would have taken place at the construction sites during the process of pavement-laying or wall-lining. Stone tools of non-local origin were also standardised generally to small and large axes that would have been attached to a haft. These dolerite tools were curated, probably at a central tool-making workshop at nearby Umm es-Sawan, and have been sourced to the environs of either Chephren's Quarry or Aswan.

Production at both Chephren's Quarry and Widan el-Faras, despite the differing nature of stone being extracted, exhibits the same fundamental elements of procurement that is project-driven and executed by skilled practitioners. In the absence of boundaries or defensive structures, the sources could be directly accessed, countering the concept that these resources were necessarily monopolised by the state. It is more likely that the quarry regions were absorbed by the central authority, making controlled access regulations unnecessary.

Stone Consumption

Records of stone consumption are generally very fragmentary, and analysis of the Petrie corpus of stone vessels highlighted how stone mis-classification, such as Chephren Gneiss as 'diorite', can have quite far-reaching implications. Quantification of stone consumption is inherently difficult and fraught with ambiguity at best. However, the observation of general trends in stone consumption was important in this study, not only in how this relates to production at the source, but to the fashion and symbolism of certain stones. The ebb and flow of consumption can provide insights into political, ideological and economic changes that are not easy to establish from the monuments alone. Although difficult to determine due to the lack of textual references, royal preferences for some stones over others seem to be primarily linked to visual qualities for the purposes of outward display. This is further demonstrated by the use of skeuomorphs and facsimiles in soft stones to imitate hard stones, a practice that becomes more evident by the later 6^{th} Dynasty stages of gradual political decentralisation. Hard stone consumption from sources outside the Nile Valley was perhaps only achievable via centralised involvement together with conducive economic and climatic conditions. The concept of resource absorption might explain the vulnerability of regional hard stone procurement strategies to a range of adverse conditions, be those of a political, economic and/or environmental nature. In which case the cessation of Chephren Gneiss and basalt consumption towards the latter stages of the Old Kingdom might be reasoned as pragmatic, as opposed to being due to changes in theological or symbolic associations.

Social Organisation and the Mobilisation of Labour

Epigraphic sources associated with quarry expeditions, although found mainly in Middle and New Kingdom contexts, imply labour forces of several thousands organised along strict hierarchical lines. This study concludes that from the archaeological record at Old Kingdom quarry sites such large numbers were extremely unlikely in this period and that the organisational framework was more loosely structured. It has been difficult to conclude from the stone features at both Widan el-Faras and Chephren's Quarry whether these represented dwellings for the labour force, apart from the small encampment at Widan el-Faras. To produce *quantitative* estimates of numbers present at the quarries is problematic. Nevertheless, these features are ephemeral in nature and with the small amounts of domestic artefactual data associated with them, it is proposed that expeditions to quarries outside the Nile Valley were temporary small-scale operations involving numbers even below one hundred. The high numbers in the epigraphic sources are most plausibly total project workforce, not tallies of quarrymen.

A social organisational hypothesis based on small groups, loosely-structured around kinship ties, well-developed social identities and with long cultural and historical antecedents has been proposed. Although this is a working hypothesis, such a framework might account for the absence of hierarchical structures at the quarries and yet explain the organised and expedient production techniques. [1] Project-driven, possibly seasonal campaigns ordained by the king are implied from the epigraphic sources and it is this aspect of quarry expeditions that has more coherence with the archaeological record at the quarry sites. Deployment of labour to Chephren's Quarry was probably from a central place in Lower Egypt, with the Faiyum being one possible 'residence'. This region as a hub of specialist stone workers, is advanced because of the presence of Chephren Gneiss and other non-local stone tools and blocks which appear *specifically* in the Faiyum quarries. Approaches to the mobilisation and maintenance of labour for such campaigns, given the obvious difficulties that remote source procurement implies, are proposed as being not overtly coercive but via tactical means, such as fermented beverages or prestige objects. Further impetus could have been associated with social-exchange mechanisms operating between labour forces involving stone tools from Chephren's Quarry. This is forwarded as perhaps another explanation for their presence in the Faiyum quarries.

The original contribution of this thesis has been to further the understanding of the social context of stone procurement during the 3rd millennium BC in Egypt, at a time when raw material acquisition was at its height. The interpretation of fresh data collected from recent and ongoing fieldwork within a comparative methodology, and broadly-based cross-cultural theoretical framework, is a new approach to such data. The approach included a reappraisal of Old Kingdom quarry data such as stone features and production evidence, and the implications of this evidence on reconstructing the logistical and organisational processes of quarry expeditions in comparison with the textual sources. The role that water transport and environmental conditions played in the logistics of stone acquisition from remote sources has also been explored, and the ratio of consumption to production volumes from one major hard stone source investigated. This study has demonstrated how focusing on the procurement and

[1] In modern Luxor a family-based group of specialist stone-workers, with a long tradition in ornamental stone working, are well known. These specialists regularly travel all over Egypt to work on specific projects (Madbouly pers. comm. 2003).

consumption of raw materials for monuments, rather than on the buildings themselves, can produce fresh insights into political, economic and ideological transformations over time. Finally, the thesis has aimed to validate the enormous potential of these and other quarry sites for future research. The approaches made to interpreting the archaeological record in this study are only a prelude to future investigations.

Chapter 11

Discussion and Future Research

Reflexive Theoretical Approaches to the Archaeological Record: the potential

A reflexive theoretical methodology to interpret the empirical data at quarry sites, that includes cross-cultural and cross-level approaches to quarry data, can allow for the development of some cogent hypotheses. This is particularly relevant in relation to problematic or extremely fragmentary data that might otherwise be ignored. However, even with taking a reflexive approach, one is still working from the basis of some assumptions, such as, what constitutes a 'state' and what is 'social complexity', both of which are strongly based in modern Western thought (Rowlands 1995: 32-3; also see Claessen 1978 discussion on concepts of the early state). Although it was not an objective of this thesis to go into detailed discussion about these specific aspects, it is pertinent to draw attention to just some of the issues that need to be deliberated upon in the future. This relates particularly to the inclination to make the data 'fit' into such categories as explanations of them - there are clear dangers in this approach. These issues were touched upon in Chapters 5, 7 and 9, particularly in the discussion surrounding monumentality as an explanation of centralised hierarchical societies. As Rowlands (1995: 32-3) explains, searching for elements in past societies associated with an evolutionary continuum, such as cities, writing, social stratification, bureaucratic administration, are European reflections on the important innovations that marked the beginnings of modernity. This is an important point and has to be considered, particularly in Egyptology that has been so dominated by Western archaeologists and, as a consequence, Western concepts of 'civilisation'.

On the other hand, there are also dangers in taking theoretical issues to an extreme where interpretation becomes highly abstract and introspective; away from the empirical data itself, or as Bradley (1993: 132) suggests, studying the past to criticise the present. This is perhaps one of the burning issues in archaeology at present, the perceived polarisation between practice and theory, when in fact the two are complementary (Thomas 1995:

359). This point has also been well argued by Bradley (1993: 131-3), in respect of how counterproductive the polarisation between the two schools of archaeological practice and theory has been to the discipline, particularly when theory is still viewed as a 'specialism'. In fact, empirical assumptions inherent in observation and description in the field might not be objective but illusory (Thomas 1995: 358-9).

The concept of 'divine kingship' in Egyptology has been extremely strong as an interpretative framework through which society was explained, as Wenke (1989: 149) remarks: 'Most scholars consider the Egyptian archaeological record uninterpretable without recourse to the idea of "divine kingship" '. Furthermore, he asks the question of whether it is possible to separate causal relationships among cultural phenomena and compare them cross-culturally '...perhaps even formulate powerful social theories.' Hence, one of the aims of creating an reflexive approach to the empirical data in this thesis has been to explore an eclectic range of theories that accounts for the concept of 'kingship', and yet finds a balance between this and theories for examining the empirical data within an analytical framework using social theory. This departs from extremes of approaches which, as Bradley (1993: 132) stresses, have led to a loss of creativity where there is nothing new to say about the archaeological record due to fear of what '...political vices others may find in them.' As Thomas (1995: 346) aptly points out, theory has to be built and constantly renewed due to the dangers of taking theory 'off the peg', or indeed the notion of a 'theory of everything'. What is also required is a synthesis between the micro-level empirical data locally or regionally, without missing out on the bigger picture or the macro-level constituted by power and ideology.

As Schiffer (2000: 3) argues, the best strategy is to select potentially useful formulations offered by different theoretical camps, in other words an eclectic strategy. As a consequence, one is able to put together diverse ideas that can help in the solution to specific research problems. Therefore, adopting such an eclectic approach in this thesis was important to consider, for example, explanations of monumentality in prehistoric contexts do have relevance when there is no reliable textual data. Deeper insights can also be made from comparing Mesoamerican approaches to the same research questions, particularly those concerning the social organisation of obsidian procurement in a 'state' that produced monumental architecture. These can highlight the importance of kinship and regional social networks of labour, as a means of understanding how such operations were maintained, even during periods of political change. Although it is impossible to get at individuals in the archaeological record at quarry sites, beyond specific areas of stone working, this thesis has attempted to refocus ideas about monumentality and social relations through the raw materials. This deconstruction can provide a framework for understanding the dynamics of the social relations through which the construction of such monuments arose; something that the buildings themselves obscure.

Stone Consumption

The archaeological record only provides a fragmentary picture of stone consumption, due to re-use, destruction, poor documentation and errors in classification. Despite these limitations, the study of the Petrie stone vessel corpus and field observations of Old Kingdom royal pyramid complexes, have provided a template through which trends in stone consumption can be extrapolated. Future research into stone consumption would benefit enormously from a *specific* research project designed to tackle not only the issue of mis-classification, but from a larger data base, help fill some of the data gaps highlighted by this pilot project. If access could be gained to some of the larger stone vessel collections housed in the Egyptian Museum in Cairo, British Museum, Metropolitan Museum of Art and Brooklyn Museum in New York, such a study might clarify some of the grey areas of Predynastic and Middle Kingdom consumption of Chephren Gneiss. The foundations for such a project have been laid by El-Khouli (1978) and Aston (1994).

There is also an enormous potential in studying Chephren Gneiss consumption outside Egypt by tracking its distribution into neighbouring countries, such as the Levant and Aegean. Studies of obsidian distribution in Aegean contexts have provided useful insights into trade and exchange networks by tracking its movement throughout the

Mediterranean and beyond. The usefulness of such models is demonstrated for Chephren Gneiss vessels found in datable contexts in Byblos and Ebla and the implications this has on trade and/or elite gift exchange between Egypt and its neighbours. Moreover, in relation to transport routes of the stone within Egypt and hypotheses relating to stone tool exchange between quarrymen, Chephren Gneiss stones appearing along desert oasis routes in the Western Desert could be signifiers of the stone being exchanged along a transport route.

Due to the problems of provenancing basalt securely to a particular source, this stone cannot provide the insights that Chephren Gneiss can give from source to depositional context (see Chapter 2). However, a surprising development from this study is how black limestone mistaken for basalt can have quite far reaching implications. This particularly relates to how an error in stone classification passed on through literature presented quite a problem in respect of basalt consumption in 6th Dynasty royal pyramid complexes. The archaeological record at Widan el-Faras provides no evidence of 6th Dynasty procurement and yet basalt was mentioned as constituting the paving and wall linings of the mortuary temple of Pepi I (Hoffmeier 1993: 117-23). To check this, field observations of the pyramid complex of Pepi I, assisted by Dr Per Storemyr and Tom Heldal, confirmed that the paving and wall linings in the mortuary temple were in fact black limestone and *not* basalt (see Chapter 4).

The implications of this finding are quite compelling: first, is that the cessation of basalt consumption probably occurred in the 5th Dynasty, almost 150 years earlier than previously suggested; second, there is a consistency between production and consumption of Widan el-Faras basalt ceasing during the 5th Dynasty; third, the probable connection between basalt consumption from Widan el-Faras and transport of the stone by water is a hypothesis that can be furthered. For example, the connection between lower Nile flood levels by the 6th Dynasty and their impact on basalt procurement from Widan el-Faras. Although, as stated in the previous chapter, this could be just one of many factors, future research at Widan el-Faras, particularly in relation to the quay at

Qasr el-Sagha, remains worthwhile to further test this hypothesis. Another unexpected outcome is that black limestone procurement has so far only been attested in vessels and not in monumental architecture. Lucas (1930: 207) proposed that the source of black limestone for Predynastic stone vessels is in the Eastern Desert near Suez. However, Harrell (pers. comm. 2003) suggests there is another source closer to the Nile Valley and near Saqqara. Locating this source will be a future research objective. If the quarry is close to the pyramid fields or within the Nile Valley, then this might further imply that stone acquisition by the later Old Kingdom was, as proposed in Chapter 7, consolidated within the Nile Valley.

Textual Sources

Trying to extrapolate from Middle Kingdom and New Kingdom inscriptions at quarries in the Eastern Desert how labour was organised in Old Kingdom contexts is clearly problematic. The Old Kingdom Sinai Inscriptions again pose problems, particularly in relation to titles. As Shennan (1993: 55) suggests, written records can be explanations of institutions but not necessarily of practices. However, one of the more general desirables of looking at some of these textual sources, and a foundation for future research, is exploring the extent to which these were or were not exaggerations. This becomes an important issue in regard to the Western perception of exaggeration as being implicit in some, generally non-Western written sources (see Chapter 5; Bloom 2001: 116). In the realm of the number of workmen involved in quarry expeditions *vis-à-vis* the archaeological evidence, it might be possible to explore such issues further.

Furthermore, it has to be considered that quarry inscriptions were projections, apart from personal aggrandizement, of an overall view based on the symbolism and ideology attached to quarry expeditions. Perhaps these were never intended to be literal descriptions of actual practice or of the personnel involved. In addition, as discussed in Chapter 8, the large number of people involved in a Middle Kingdom expedition to the Wadi Hammamat relates explicitly to the *total* number of persons involved in the project, but equally explicit are the much smaller numbers of actual 'quarrymen' and 'stoneworkers'. Clearly, there is scope to research further the relationship between quarry inscriptions from both Middle and New Kingdom contexts, and the few historically contiguous archaeological records at those quarries. Such investigations might produce significant new insights into discussions about the function of quarry inscriptions either as ideological narratives, or as records of practice.

The Archaeological Record at Quarry Sites

It is clear from this thesis that investigations of quarry sites can provide opportunities to study workplaces and sites of temporary habitation that are rare in an Old Kingdom context. One of the exceptional things about remote source quarry sites, by their very location, is that the archaeological record is relatively pristine compared to Nile Valley sites. Even an initial archaeological survey (including the transect survey method, see Chapter 1) can provide an overview with contextual data, such as spoil heaps, stone working areas and exposed stone features, which can be mapped without the need of excavation. The value of satellite imagery for a base map and differential GPS are enormously useful tools for surveying such large archaeological sites. The accuracy of these maps and plans are considered entirely adequate for documenting a quarry site that not only comprises numerous quarries, but has archaeological features spread over a wide area. This method is also useful when manpower and time are both limited. Surface survey as the principal method of documentation followed by spot excavations is the most practical archaeological approach to these enormous sites.

At Widan el-Faras future investigation has to include some excavation of both the main 'settlement' and quarries to determine contemporaneity between them. Furthermore, the function of the stone circles still remains obscure, hence spot excavation and drill cores into and around the stone circles could provide useful geophysical data, particularly in determining if these were once wells. The environs around the quarry road and at its terminus at Qasr el-Sagha need to be systematically surveyed, with spot excavations on the quay, as mentioned above, to solve some of the dating problems here.

The discovery of more quarries at Chephren's Quarry in January 2003 presents avenues for future research. However, one of the problems identified here, similar to Widan el-Faras, is that the minimal amounts of material culture found as surface scatters in the quarries cannot give a reliable chronology for the quarries. Given that the quarries within Chephren's Quarry cover such an enormous area, it would be extremely interesting to ascertain whether quarries in the north were exploited at the same time as those in the south, or as speculated for Widan el-Faras, each campaign specifically opened fresh excavations and work patterns were concentrated in one place. Deductions concerning chronology at Chephren's Quarry have come from looking at the 4th Dynasty consumption record that attests to use of the stone for royal statuary. This implies that the Central Quarries, where the Unfinished Statue Quarries are located, were exploited in the 4th Dynasty at least. However, what this does not reveal is whether block quarrying, statue 'blank' production and finishing of the objects at royal workshops were part of one continuous operation over one season, or separate undertakings over space and time.

To approach such questions, a more accurate assessment of the chronology of the quarries is required which might be possible from ^{14}C dating of extraction sites. This is only possible at Chephren's Quarry because fire-setting was practised and excavations around blocks in both the northern and southern quarries had charcoal impacted beneath the blocks and therefore in reliable contexts for dating.[1] This data alongside the consumption record should allow for marked insights into the dynamics between production and consumption demands as simultaneous activities and to ascertain work patterns and whether production was concentrated within one particular quarry at a time, or scattered throughout.

[1] ^{14}C dating has not been possible in the past due to problems in releasing samples from the SCA storage magazine in Aswan for analysis. We have been advised from the SCA that due to the current threat to the site we can propose taking charcoal samples for analysis in our next submission to the Permanent Committee for permission to work at the site.

Chisel Quarry is perhaps the most enigmatic of all the quarries, given its location away from the main quarries and its clearly systematic exploitation. Pottery is extremely minimal, a few body sherds dating to the Old Kingdom, and yet this quarry must have been one of the most intensively exploited quarries for vessels. The enormous spoil heaps and deep excavations imply that quarrying extended to some depth into the bedrock. Due to the essentially 'contained' nature of this quarry, as opposed to the scattered nature of the other quarries, there is an opportunity to conduct a more detailed study of just one extraction area. The objective would be to produce a study in microcosm of Chephren Gneiss exploitation in the Old Kingdom, something that is more difficult to assess from the other quarries. Surface survey has already provided an overview of this extraction site, but more detailed spatial analysis of the spoil heaps, distribution of homogenous small worked blocks, and excavation into the centre of the extraction, could provide fresh data to reconstruct these activities.

Groundwater wells at Chephren's Quarry

The shallow groundwater wells at Chephren's Quarry are extremely significant finds that can open up new areas of investigation, specifically studies of climate and the depth of the Nubian aquifer in the Old Kingdom. The function of the shallow but substantial outer perimeter walls constructed around the large wells (Well 3 and Well 4) along the track remains speculative until they are excavated. The two theories suggested above, namely a protective wall against wadi run-off, and corral for animals, can only be tested via full excavation, which is a primary research objective for the 2004 season.

Acute Threats to Ancient Quarry Sites: The Tushka Hydrological Project and Urban Development

It is clear from the research objectives proposed above at both Widan el-Faras and Chephren's Quarry, that there is great potential for longer term meaningful research at these quarries. However, it will be a race against time at both sites. Only a year after the initial survey of Widan el-Faras in 2001, modern quarrying has already devastated parts of Old Kingdom Quarry 4. Haulage traffic associated with this quarrying and unsupervised visits to the site have caused damage to the quarry road and parts of the main 'settlement'. As a consequence, the author and Dr Per Storemyr have made efforts to include Widan el-Faras and nearby Umm es-Sawn within a proposal already underway to UNESCO proposing the Northern Faiyum Desert a World Heritage Site. However, in the short term, there is an urgent need to continue documenting Widan el-Faras and indeed to elicit at least an archaeological survey of Umm es-Sawan. In the case of the latter, this has not been systematically surveyed or documented since Caton-Thompson and Gardner's work here 70 years ago.

At Chephren's Quarry survey and excavation has been ongoing since 1997 and each successive season has faced the depressing reality of site vandalism concomitant with encroaching modern development. The vandalism associated with the smashing of the Middle Kingdom storage vessels and churning over areas of settlement after the 1999 season was a severe blow to any further meaningful investigations at Quartz Ridge. However, this has now been eclipsed by the Tushka Hydrological Project that will potentially devastate the whole area; hence the urgency in fully documenting this enormous site is now undeniable.[2]

In an effort to protect the remaining archaeological elements of Chephren's Quarry, a deposition was made (by the author, Dr Per Storemyr and Tom Heldal) to the Supreme Council of Antiquities (SCA) to stress the urgency in protecting the quarry as a heritage site of unique historical importance that still holds enormous research potential. The SCA subsequently acted on this report and has allowed for a short window of time to

[2] The Tushka Hydrological Project is an ambitious plan to irrigate and cultivate upwards of 350 km² of the Western Desert north-west of Abu Simbel to grow organic produce for export. The project consists of 4 canal branches connected to Lake Nasser via the Sheik Zayad Canal and construction of the largest pumping station in the world. Each canal branch is up to 30 km long and cuts a 800 metre wide swathe of excavation. As a consequence, infrastructure associated with the canal construction and road building has rendered areas of the environs surrounding Gebel el-Asr either inaccessible or negligible as far as archaeological investigation is concerned. The project is due for completion in 2004 with cultivation commencing soon after.

fully document the site. At present the main elements of the site are within an SCA protected zone, as shown on the map (**see Fig. 14**). However, we learnt in January 2003 that the threat to the site is not so much from the canals, but from the cultivation that is planned throughout the region once the canals are flooded. How the protection zone can be practically enforced by this time still remains unclear. Therefore, the January 2003 mission to the quarry was deemed as being the last; however, due to construction delays, it is probable that one more season will be possible in 2004.

What these unwelcome events have highlighted at both Widan el-Faras and Chephren's Quarry is how such sites of major historical significance are ignored when it comes to land development planning. How conservation/protection of archaeological sites can accommodate the imperatives of modern development is an ongoing problem uppermost in archaeological debate globally. However, quarry sites seem to be even more vulnerable to modern development, partly due to previous poor documentation and the fact that they exhibit no monumental structures. This problem also extends to the Aswan quarries (most of the boulder quarries have now disappeared) and the silicified sandstone quarries on the west bank of the Nile at Aswan, such as Gebel Gulab, that are also imminently threatened by planned urban development. The importance of continuing research at Widan el-Faras and Chephren's Quarry, along with initiating fresh research at other threatened quarry sites, is currently being pursued by the author in regard to future research funding. As this thesis has attempted to demonstrate, the study of ancient quarry sites can contribute fresh ideas not only about the social context of quarrying in the 3rd millennium BC, but also a rare opportunity to gain some insight into a microcosm of ordinary life in Old Kingdom Egypt.

The Organisation, Transportation and Logistics of Hard Stone Quarrying in the Egyptian Old Kingdom: A Comparative Study

Volume II: Illustrations, Plates, Appendices, Bibliography

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A thesis submitted for the
degree of Doctor of Philosophy
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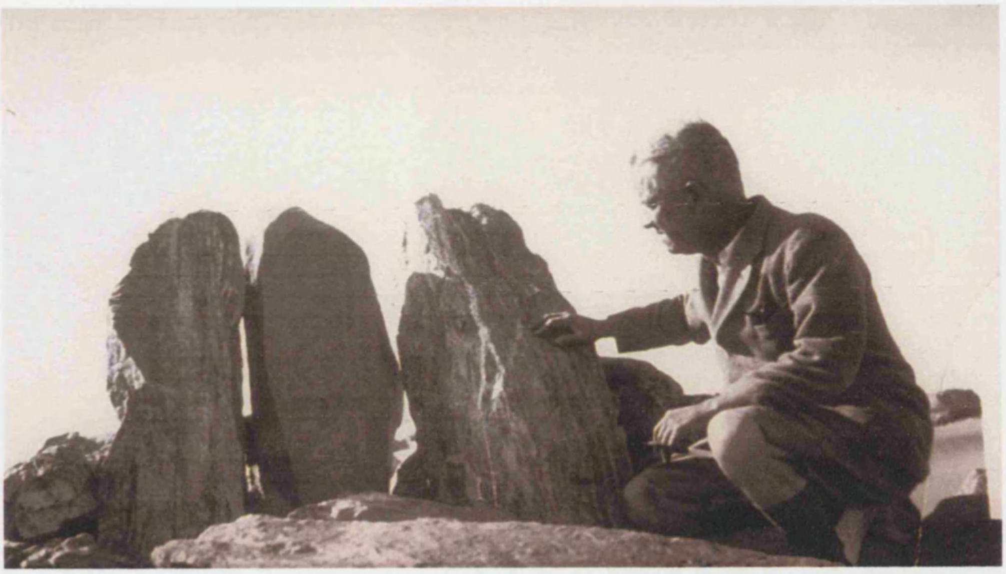
August 2003



Pl. 1. Engelbach at Khufu Stele Quarries platform, 1938 (courtesy Joan Wand-Tetley née Engelbach)

Pl. 2. Engelbach's excavation of loading ramp (LR1) at Loading Ramp Quarries, 1938 (courtesy Joan Wand-Tetley)

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

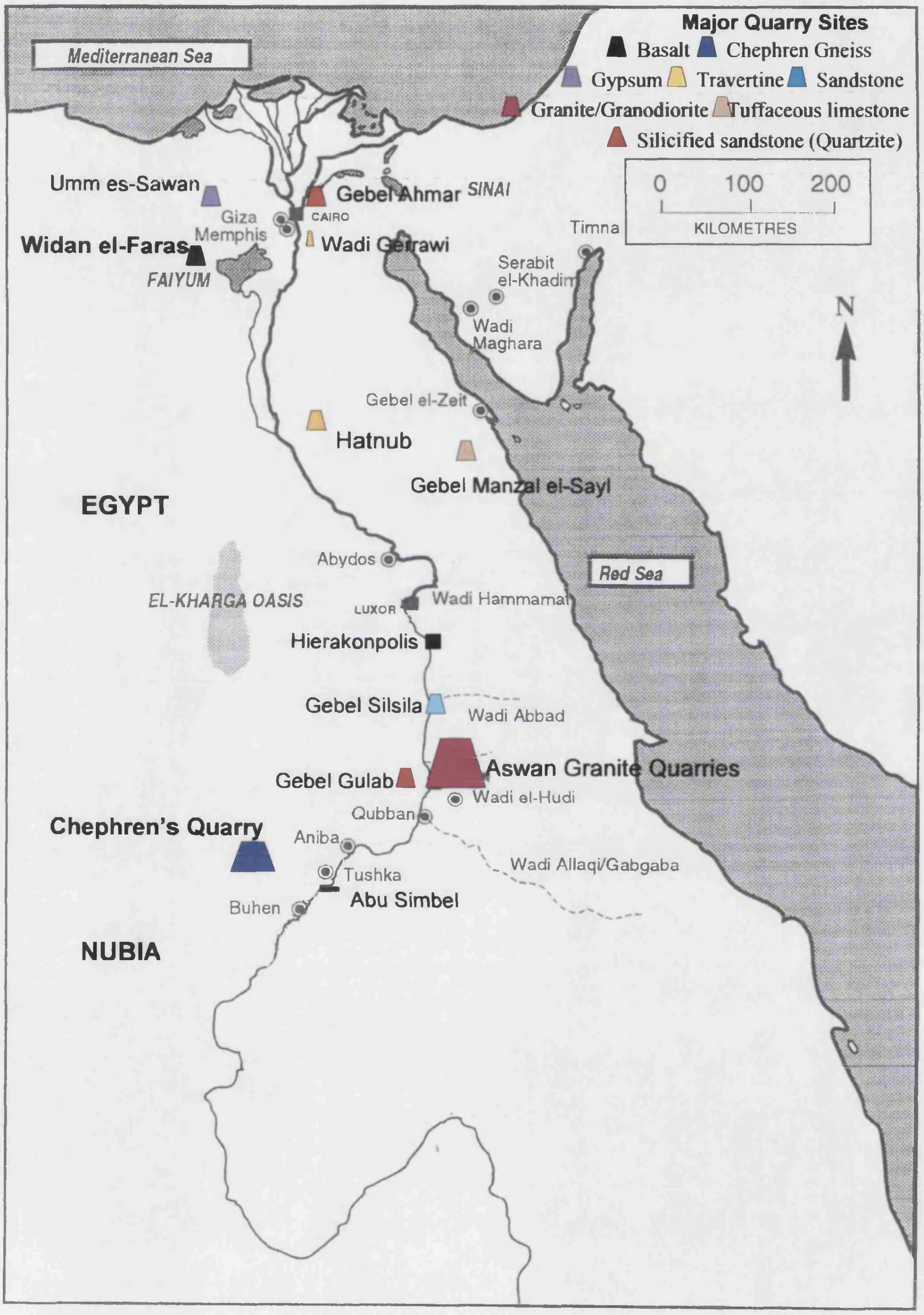
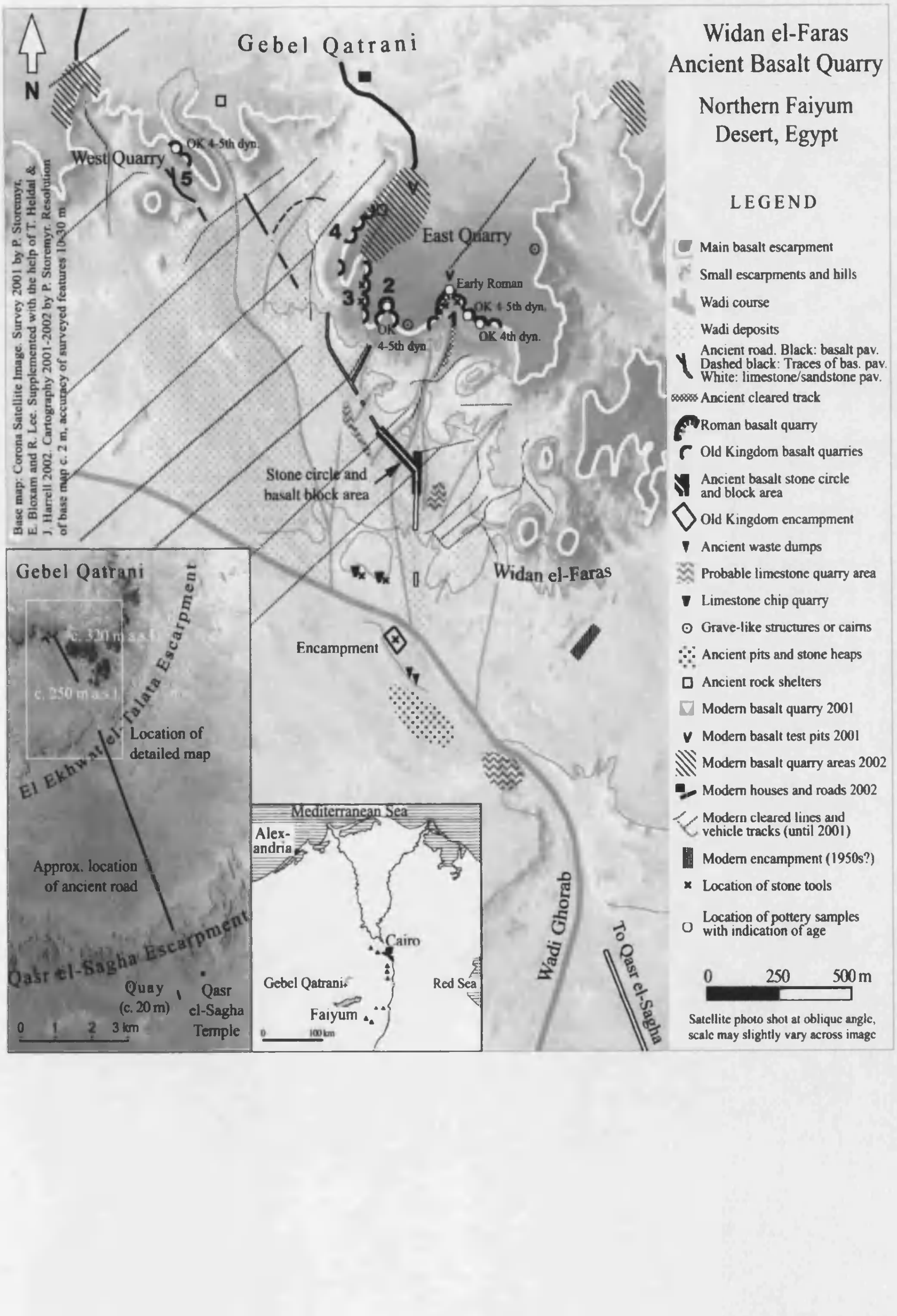
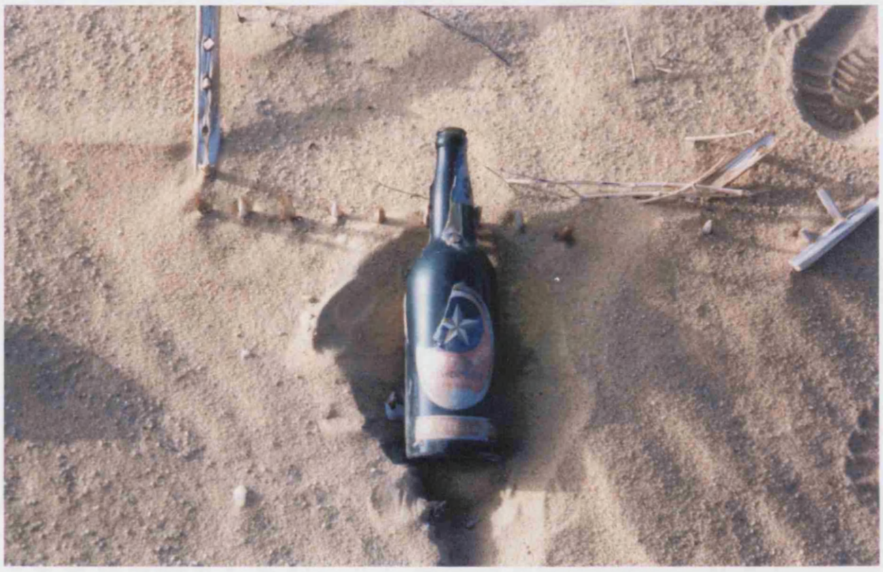


Fig. 2. Archaeological map of Widan el-Faras (2001)



Pl. 3.



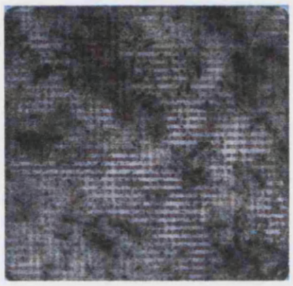
Pl. 3. Stella beer bottle (circa 1938) found (in 1999) at Englebach's camp at Quartz Ridge

Fig. 3. Geographical location of main Old Kingdom quarries being studied

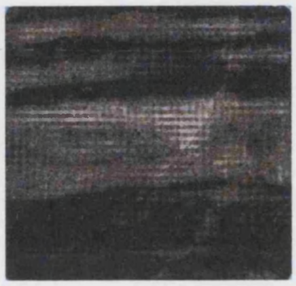
REGION	LOCATION	ROCK TYPE	PERIODS OF EXPLOITATION	COMMENTS
NILE VALLEY (and Adjacent Eastern Desert Plateau)	Hatnub 27°33N 31°1E (adjacent Eastern Desert)	Travertine	OK, MK and NK	
	Aswan 24°3N 32°53'E	Aswan Granite Aswan Granodiorite	Early Dynastic to Roman Period	
FAIYUM	Widan el-Faras (Gebel Qatrani Formation) 29°39N 30°37E	Basalt	OK, Early Roman Period	A MK presence is known at nearby Qasr el-Sagha- however, no evidence of MK presence at the quarry itself.
	Umm es-Sawan 29°42N 30°53E	Gypsum	Early Dynastic to OK	Presence of non-local stone: basalt, Chephren Gneiss, diorite & quartzite.
WESTERN DESERT	Chephren's Quarry 22°48N 31°13E (Gebel el-Asr) Arba'in Desert	Chephren Gneiss (basalt, quartz, granite, syenite and trachyte)	Late Neolithic, Early Dynastic, OK, MK	The MK presence was also to predominantly extract carnelian, and perhaps amethyst - exploitation of gneisses was limited.

Fig. 5. Geological samples of rocks commonly used in the Old Kingdom for monumental architecture, statuary and stone vessels

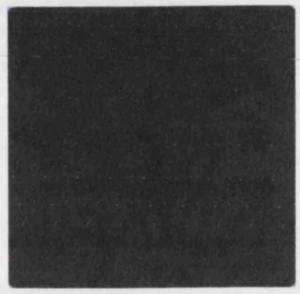
(from http://www.geology.utoledo.edu/faculty/Harrell/Egypt/Quarries)



Chephren Gneiss
(speckled 'anorthosite gneiss')



Chephren Gneiss
(banded 'gabbro gneiss')



Basalt
(Widan el-Faras)

Aswan 'Red/Pink' Granite

Aswan 'Black/Grey' Granodiorite

Greywacke
(Wadi Hammamat)

Gypsum
(Umm es-Sawan)

Travertine
(Hatnub)

Tuffaceous Limestone
(Gebel Manzal el-Seyl)

Fig. 6. Old Kingdom Quarry (P), Hatnub: quarry and settlement (after Shaw 1986: 193)

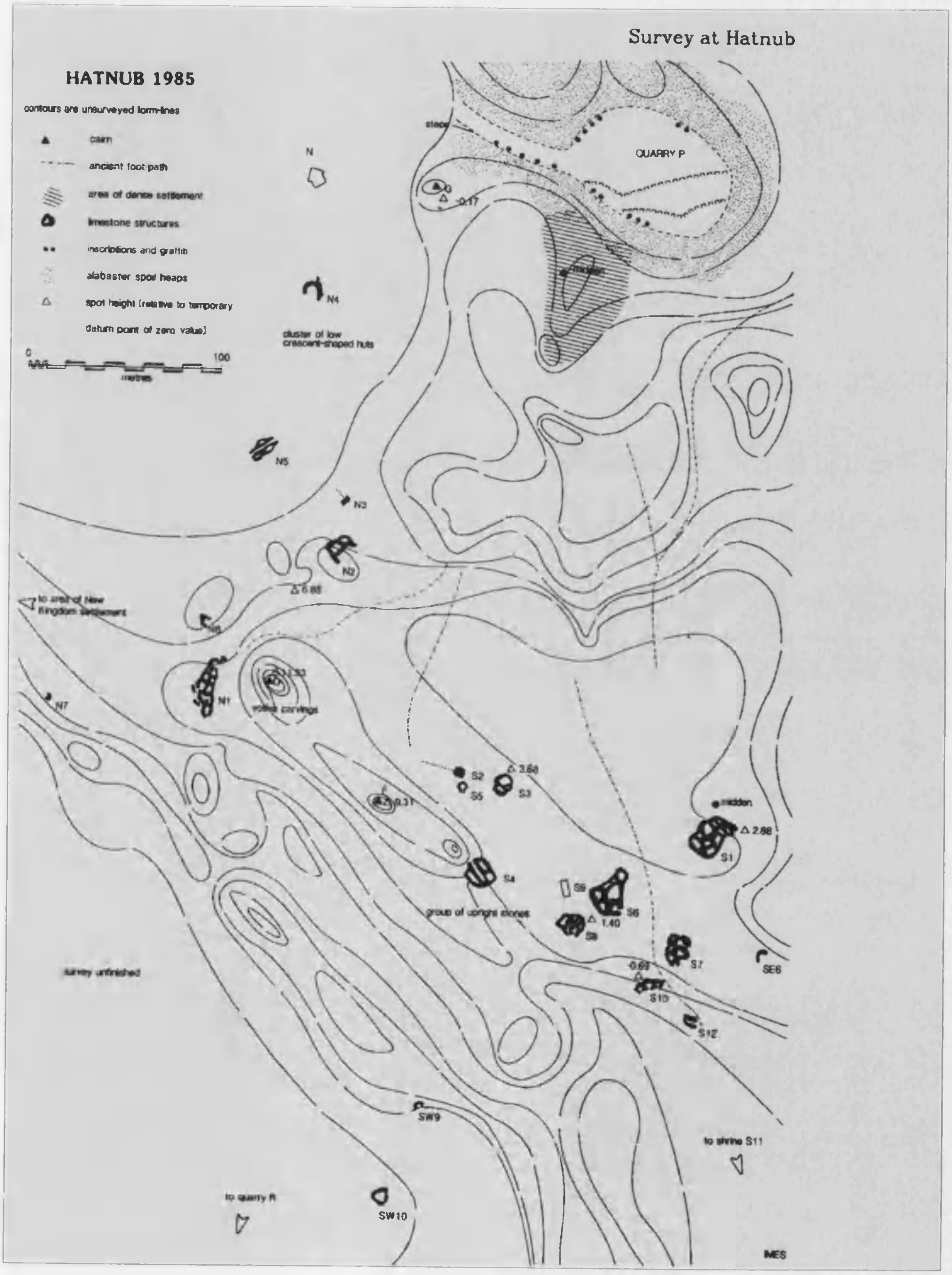


Fig. 8. Generalised geological map of the Aswan area showing locations of granite/granodiorite, quartzite and sandstone quarries (after Aston *et al.* 2000:16)

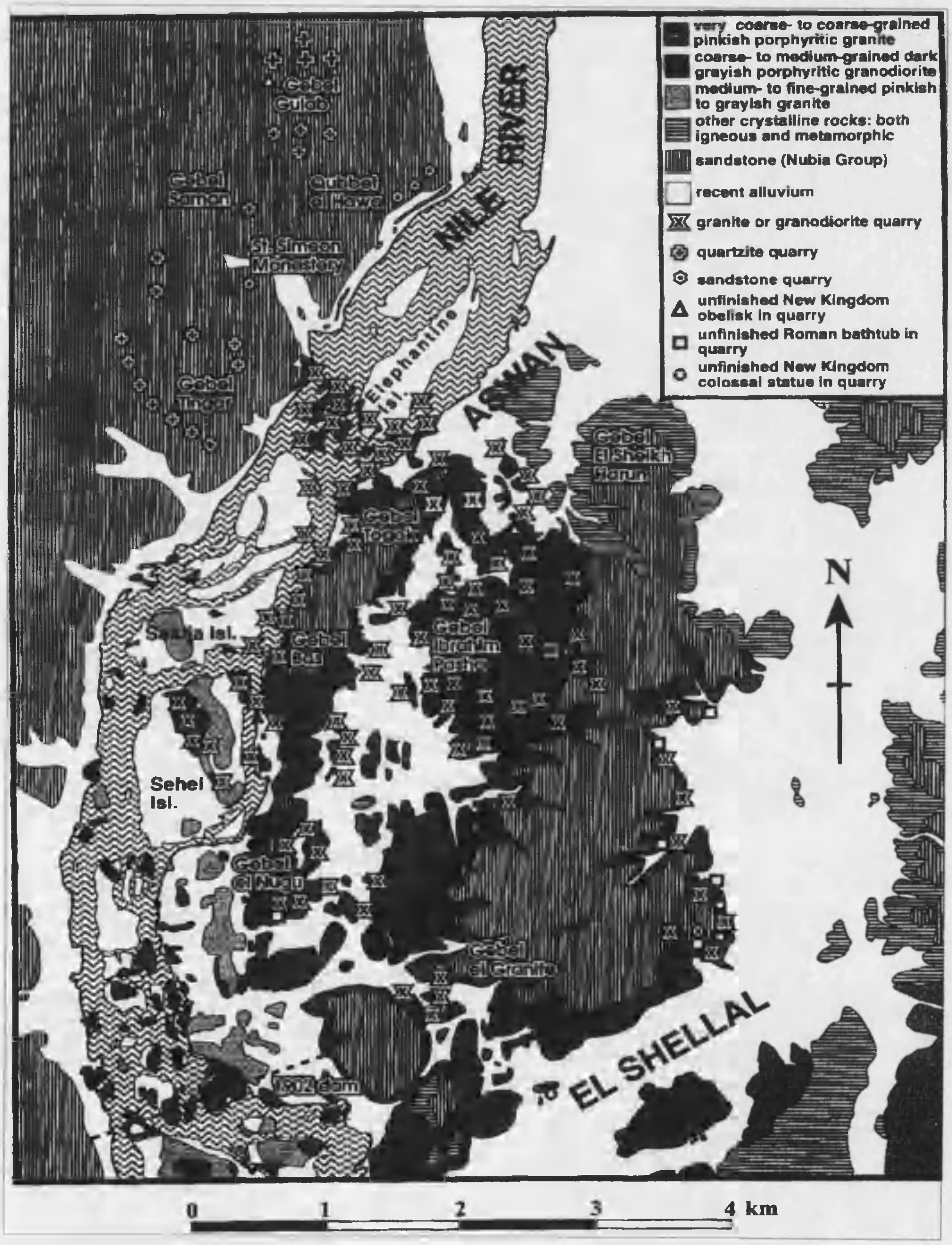
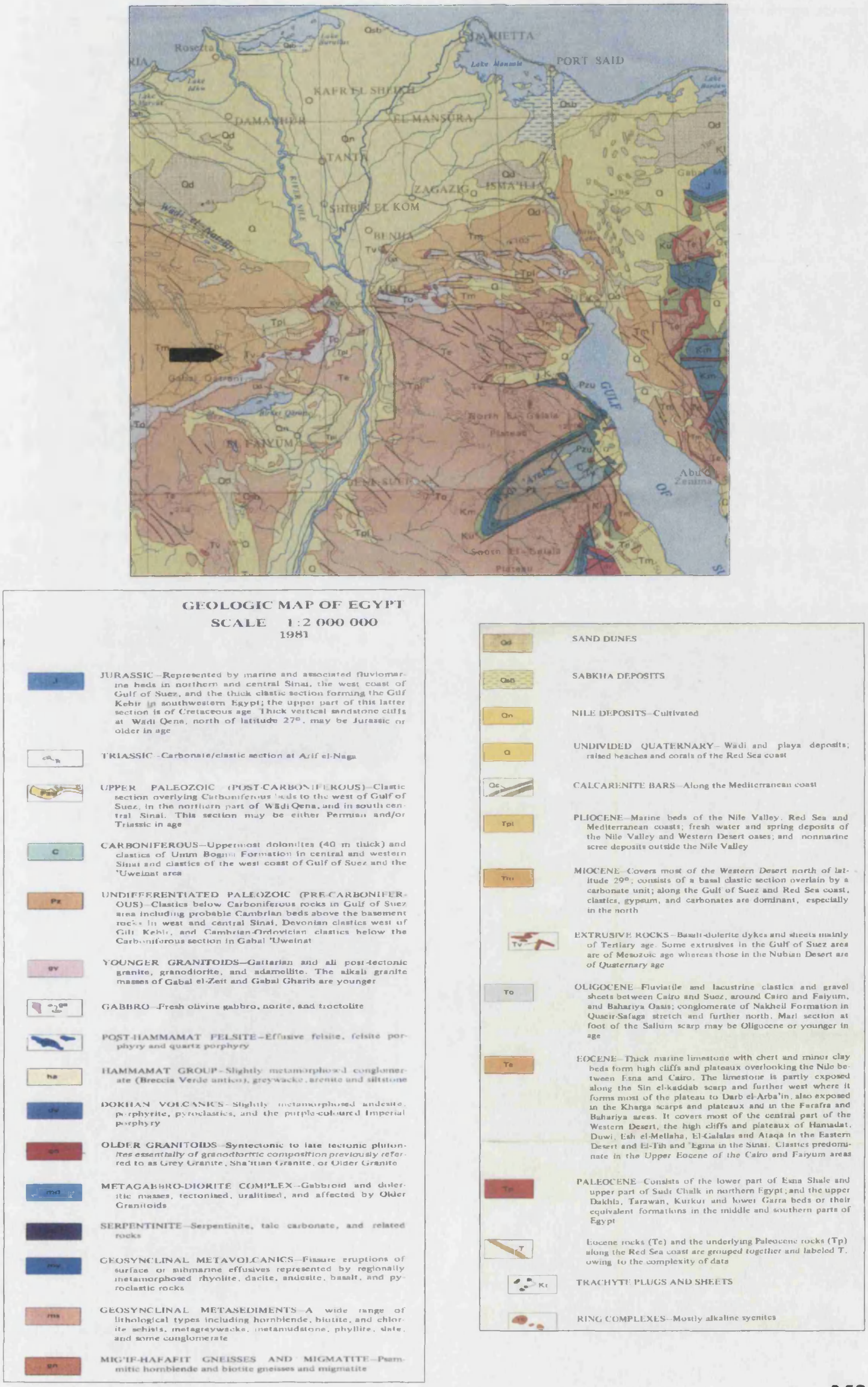
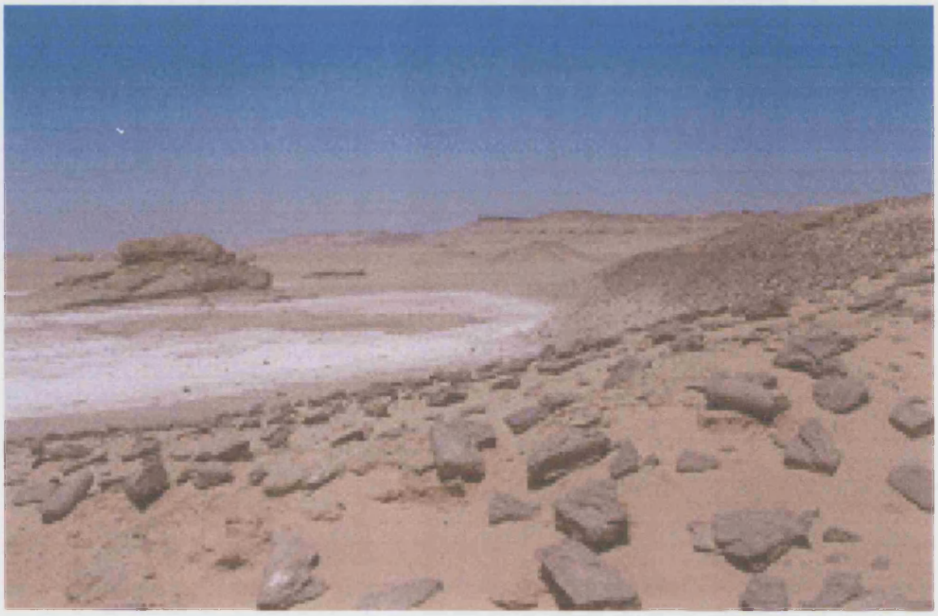


Fig. 9. Geological Map, Faiyum Environs (Gebel Qatrani)



Pl. 4. Ancient shorelines of Lake Moeris at Qasr el-Sagha, Northern Faiyum

Pl. 5. Qasr el-Sagha Temple, Northern Faiyum



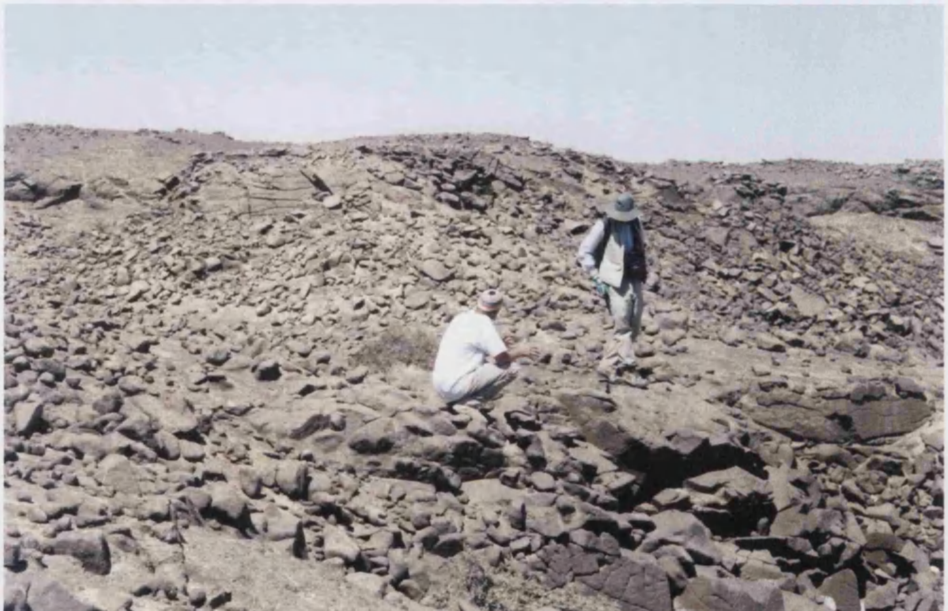
Pl. 6. Reinforced natural promontories surrounding (natural) harbour, Qasr el-Sagha

Pl. 7. Quay or quarry road terminus, Qasr el-Sagha, Northern Faiyum

Pl. 8. Twin peaks at Widan el-Faras basalt quarry, Northern Faiyum

Pl. 9. Widan el-Faras: 'Main Quarrymen's Camp' - view to the south-east

Pl. 10. Widan el-Faras: East Quarry (view to the west)



Pl. 11. Widan el-Faras: inside the West Quarry

Pl. 12. Widan el-Faras: road slab with gypsum underneath

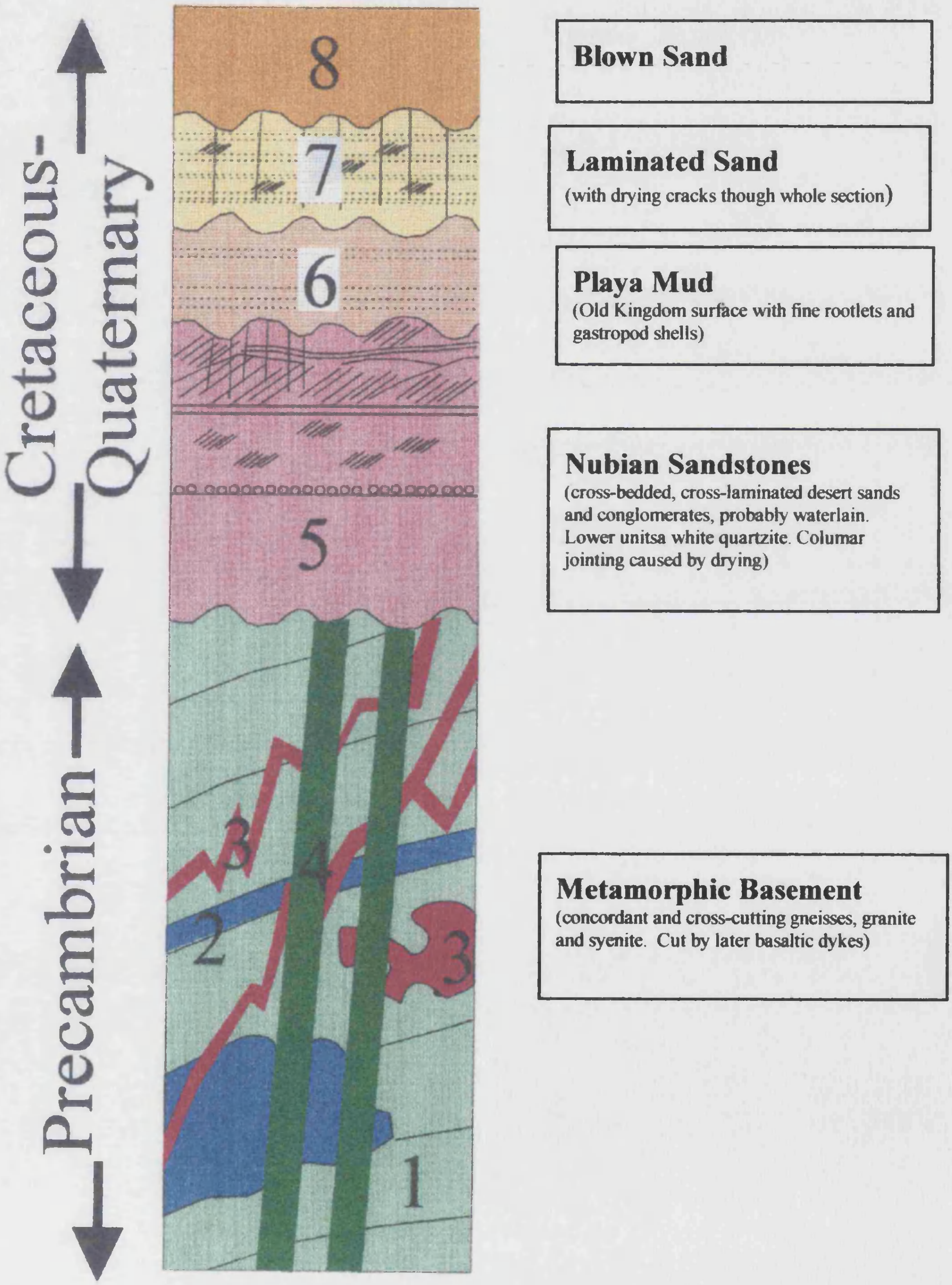
Pl. 13. The Umm es-Sawan gypsum quarries, Northern Faiyum Desert

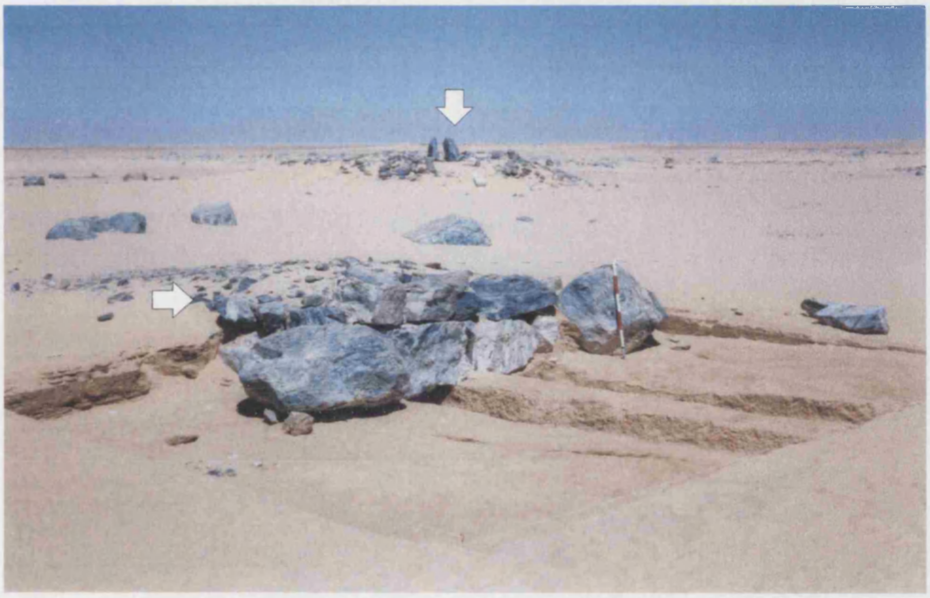
Pl. 14. Chephren Gneiss pounder, tool workshop area, Umm es-Sawan

Pl. 15a. Unworked block of Chephren Gneiss, tool workshop area, Umm es-Sawan

Pl. 15b. Unworked block of Chephren Gneiss in settlement, Umm es-Sawan (courtesy of Harrell)

Fig. 10. Geological section, Chephren's Quarry (modified from Bunbury 1999)





Pl. 16. Central Khufu Stele Quarries, loading ramp 2 foreground, Khufu Stele platform background

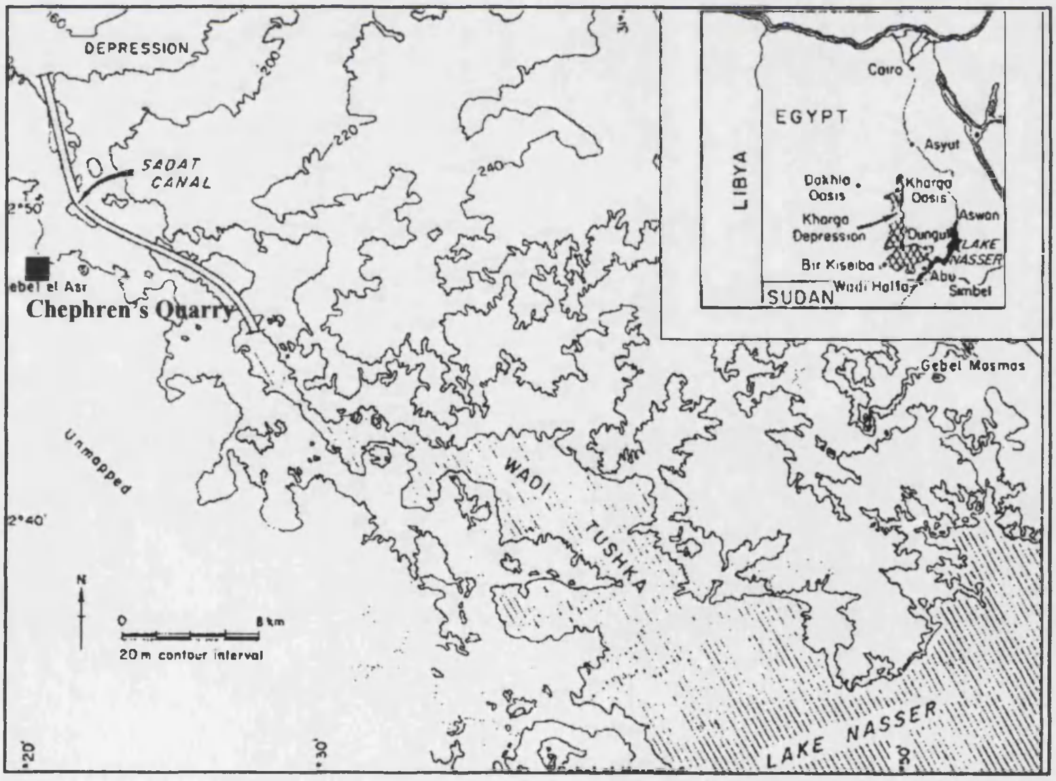


Fig. 11. Map of Western Desert showing the Wadi Tushka area and Gebel el-Asr (after Haynes 1980: 69)

Fig. 12. Map of main quarries, Chephren's Quarry
(after Storemyr and Heldal, Joint British-Norwegian-Egyptian Archaeological Mission, 2003)

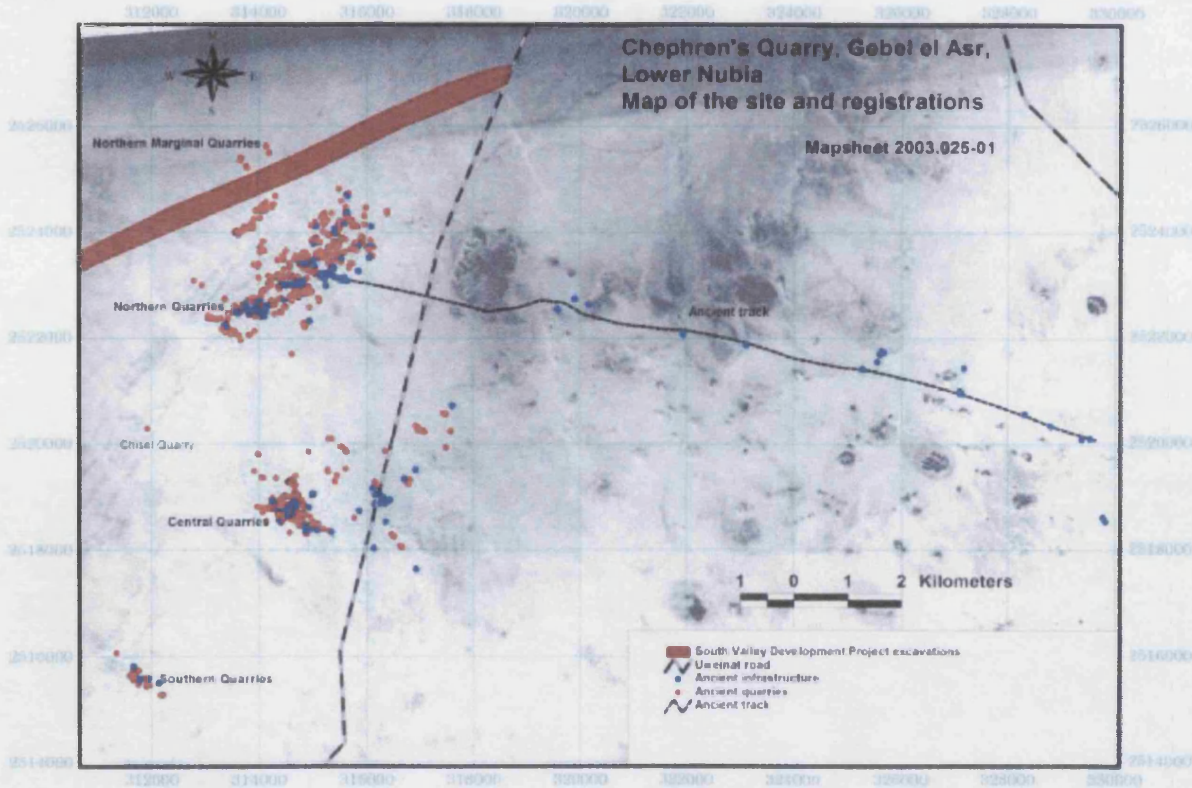


Fig. 12

Fig. 13. Geological map, Chephren's Quarry (Storemyr and Heldal) **2003**

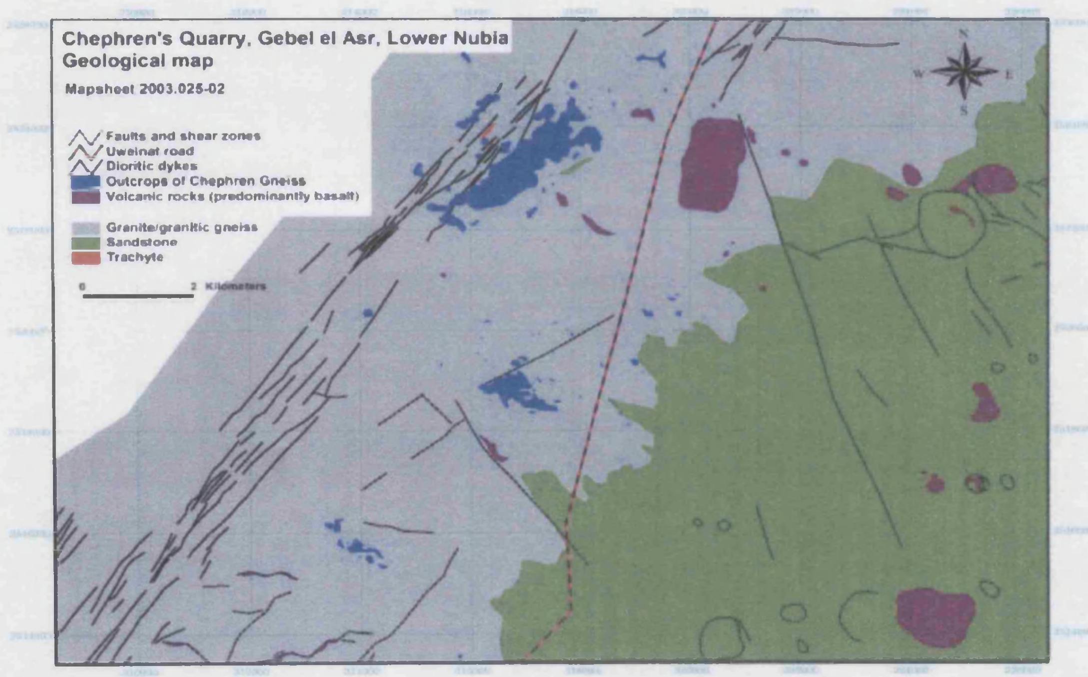
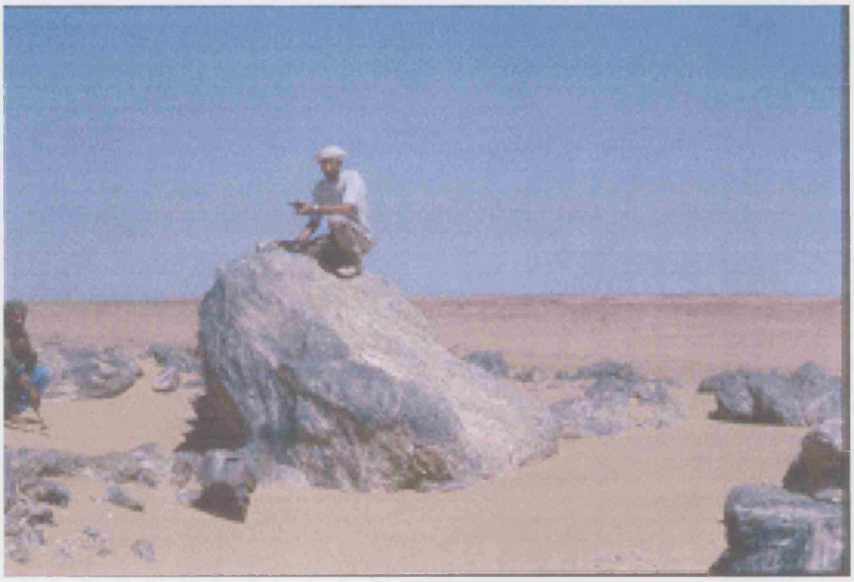


Fig. 13

Pl. 19. Chephren Gneiss boulder *in situ*, penetrated by pink syenitic and granitic veins: Quartz RidgeQuarries

Pl. 20. Large spoil heap behind loading ramp (LR2) at Khufu Stele Quarries



Pl. 21. Largest remaining *in situ* Chephren Gneiss boulder: Unfinished Statue Quarries

Fig. 14. Map of Chephren's Quarry showing quarry zones and area designated for protection by the SCA

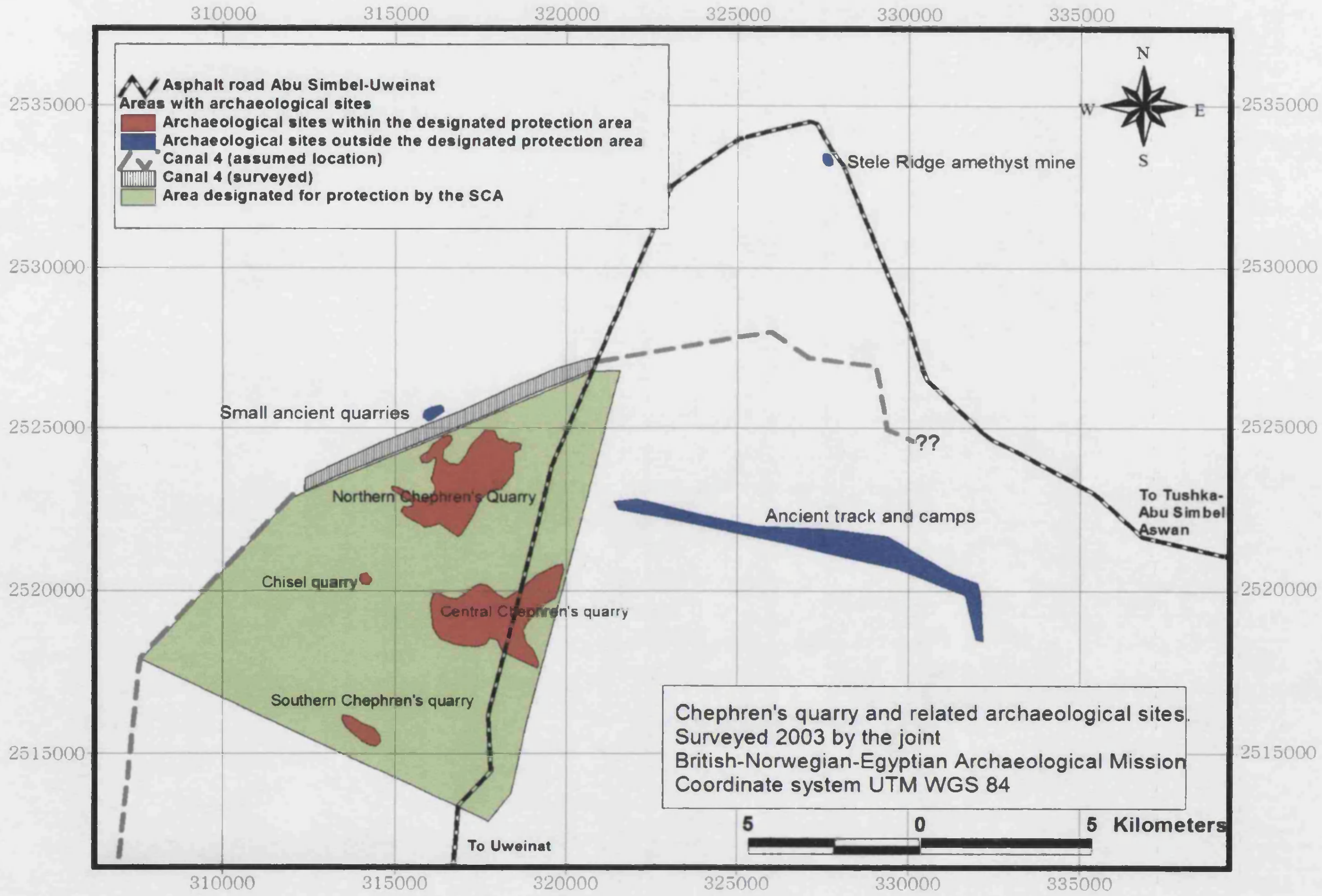
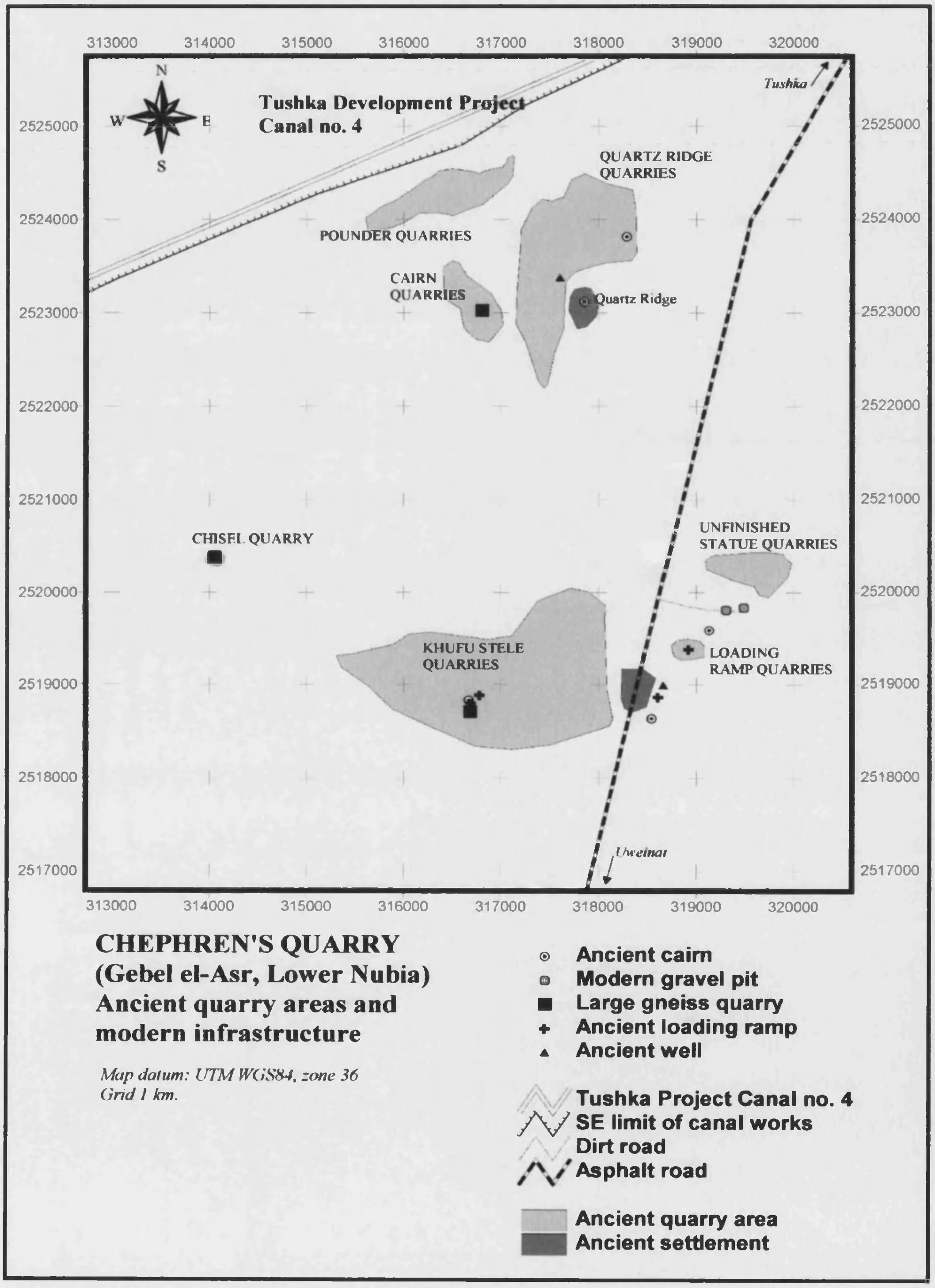


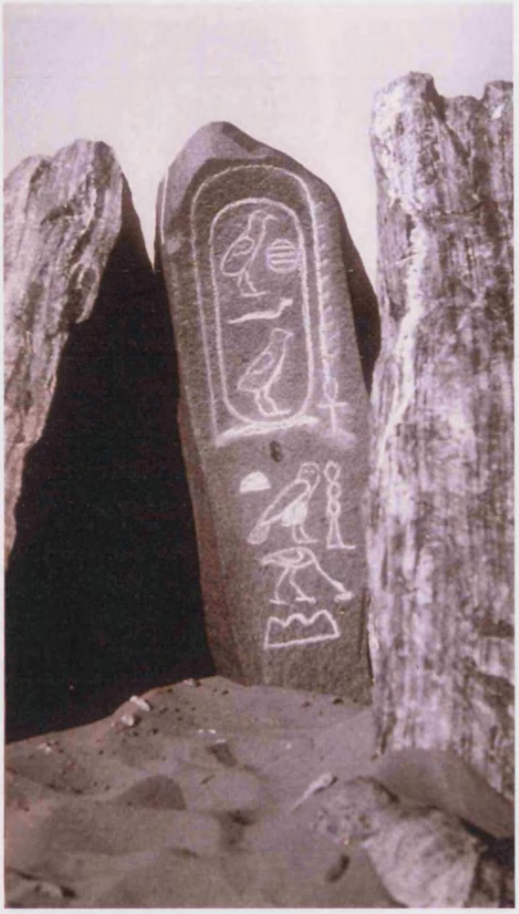
Fig. 14

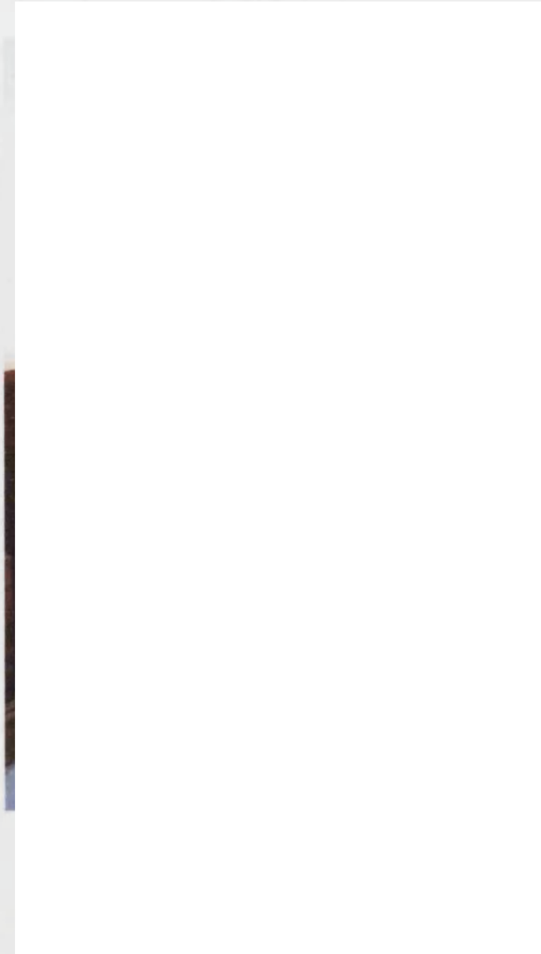
Fig.15. Geographical Quarry Zones at Chephren's Quarry: distribution of vessel and block quarries,

Geographical Zone	Vessel Quarry	Block Quarry
Central Chephren's Quarry		Khufu Stele Quarries
		Loading Ramp Quarries
		Unfinished Statue Quarries
Northern Chephren's Quarry	Quartz Ridge	
	Cairn Quarries	
	Pounder Quarries	
Chisel Quarry	✓	
Northern Marginal Quarries	✓	
Southern Quarries	✓	

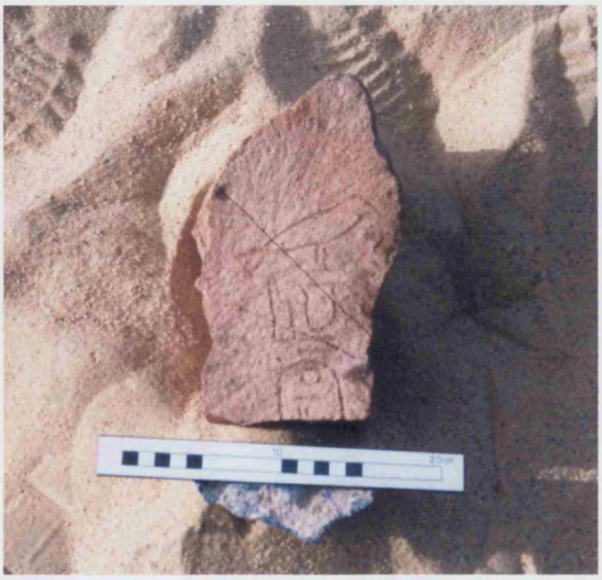
Fig. 16. Main vessel and block quarries showing ancient infrastructure
(surveyed in 2002 by Bloxam, Storemyr and Heldal, cartography Heldal)





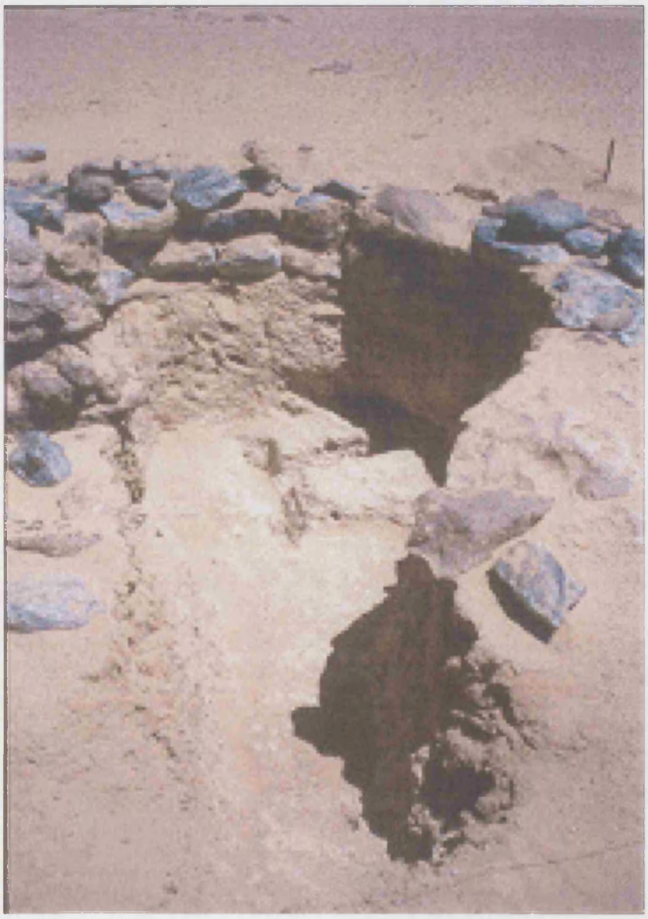


Pl. 22a. **Khufu Stele *in situ* at Khufu Stele Quarries by Engelbach 1938** (courtesy Joan Wand-Tetley)

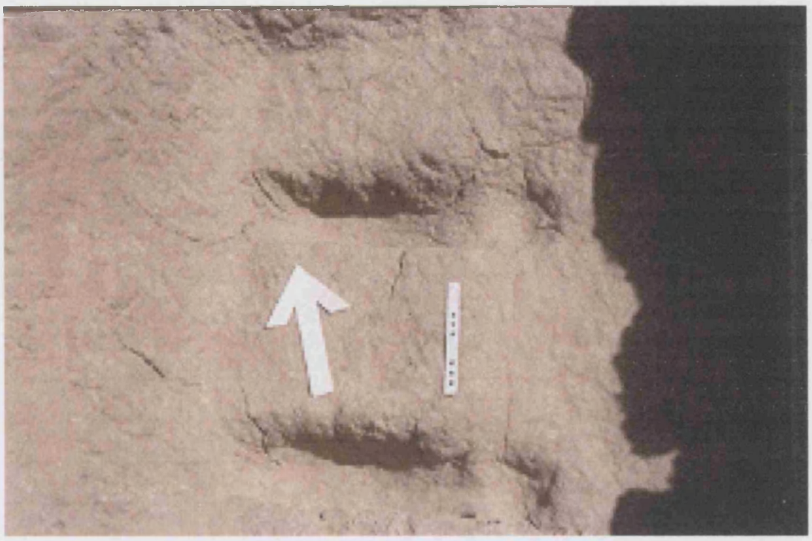


Pl. 23. Trachyte stele with Nyuserra cartouche, Quartz Ridge

Pl. 24. Well 1 (excavated) at Khufu Stele Quarries settlement

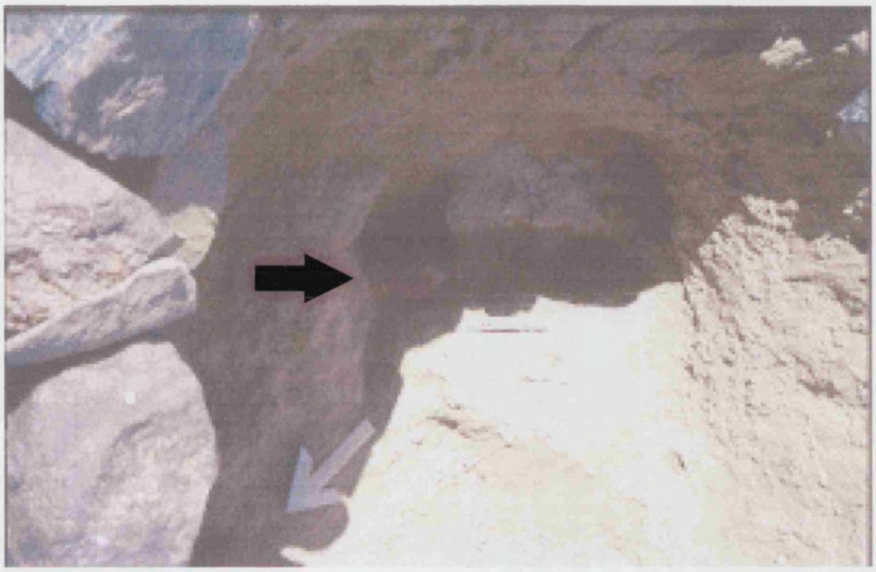


Pl. 25. Well 2 (excavated) at Quartz Ridge



Pl. 26. Channels cut into the bottom of Well 1

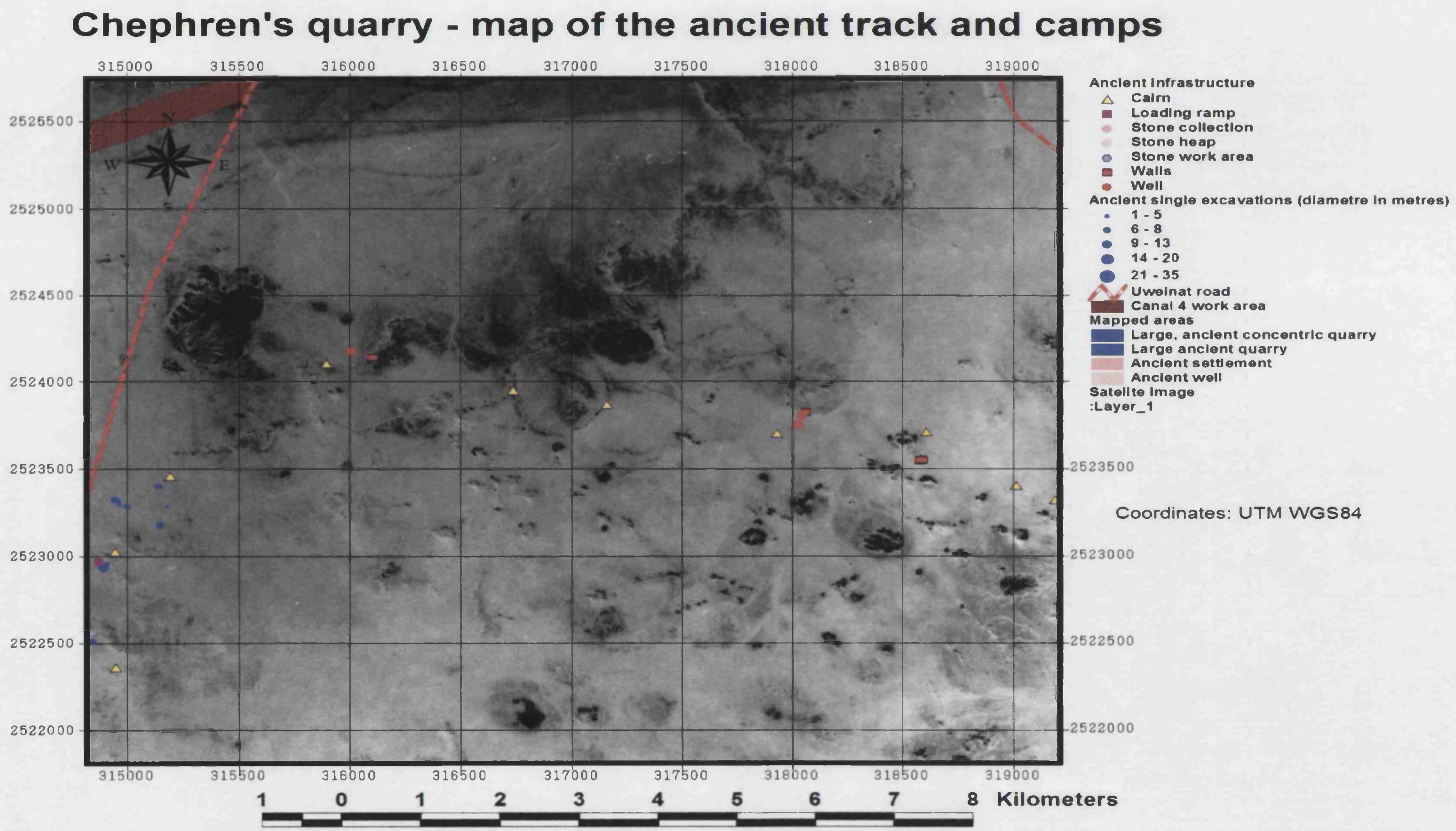
Pl. 27. Channels cut into the bottom of Well 2

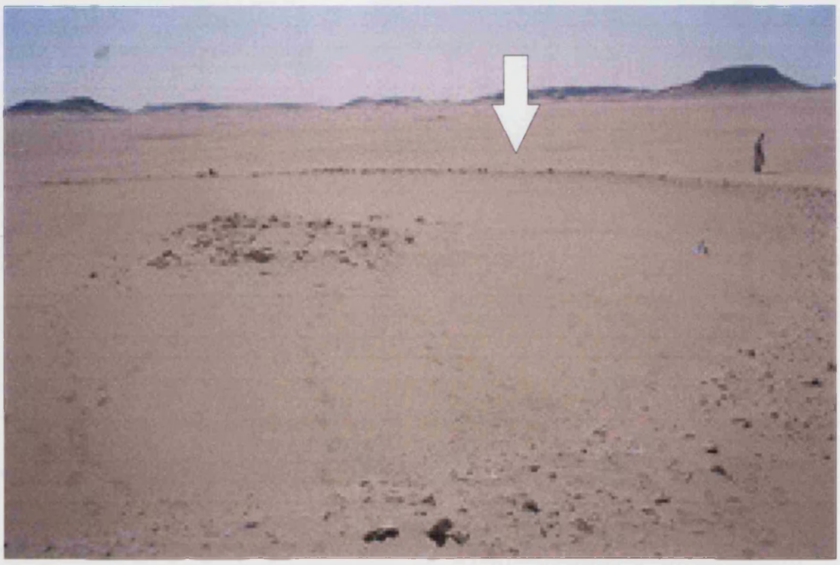


Pl. 28a. Spouted pouring vessel (4th-5th Dynasty) *in situ* in channel at bottom of Well 2

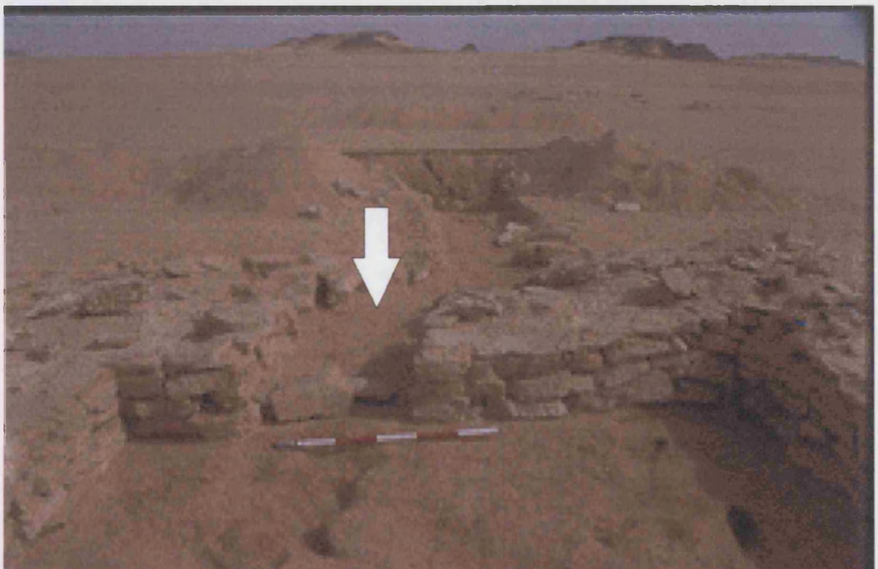
Pl. 28b. Spouted pouring vessel (H. 20 cm; 4th-5th Dynasty): Well 2, Quartz Ridge

Fig. 17. Chephren's Quarry: map of ancient track showing Wells 3 and 4 with associated camps

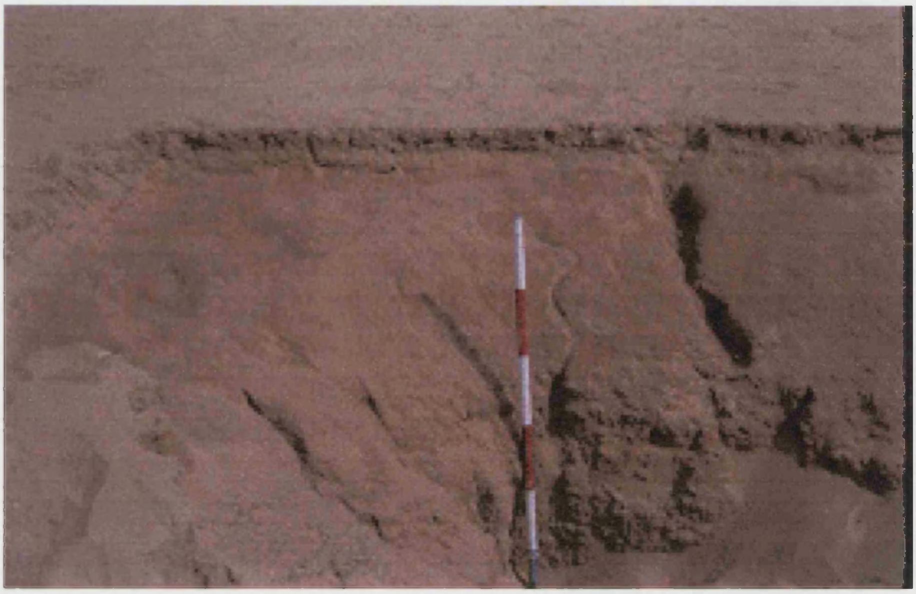




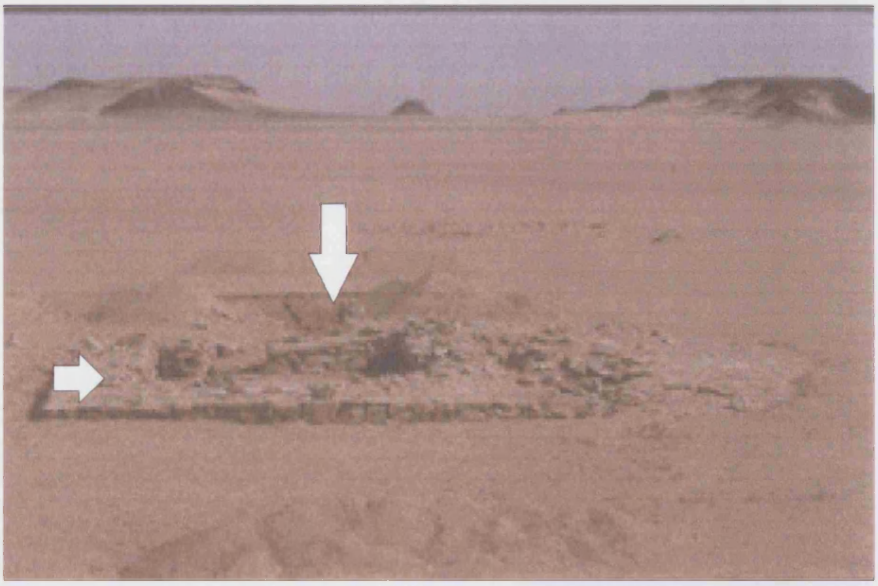
Pl. 29. Well 4: outer perimeter defence or animal corral



Pl. 30. Well 4: pathway from walled storage area (foreground) down to well (background)



Pl. 31. Well 4: partially excavated, metre rod standing on well bottom



Pl. 32. Well 4: position on track (looking south-east), storage area (foreground), well (background)

Pl. 33. Well 3: entire structure excavated

Pl. 34. Well 3: excavated to well base

Pl. 35. Rock art: previously undocumented at Gebel Gulab (west bank Awan) silicified sandstone (quartzite) quarry

Pl. 36. Petrified tree stump in natural harbour area (Lake Moeris) at Qasr el-Sagha, Northern Faiyum

Fig. 18. Lake Moeris: map of settlements, quarries and ancient lake levels (modified from Caton-Thompson and Gardner 1934: CXI)

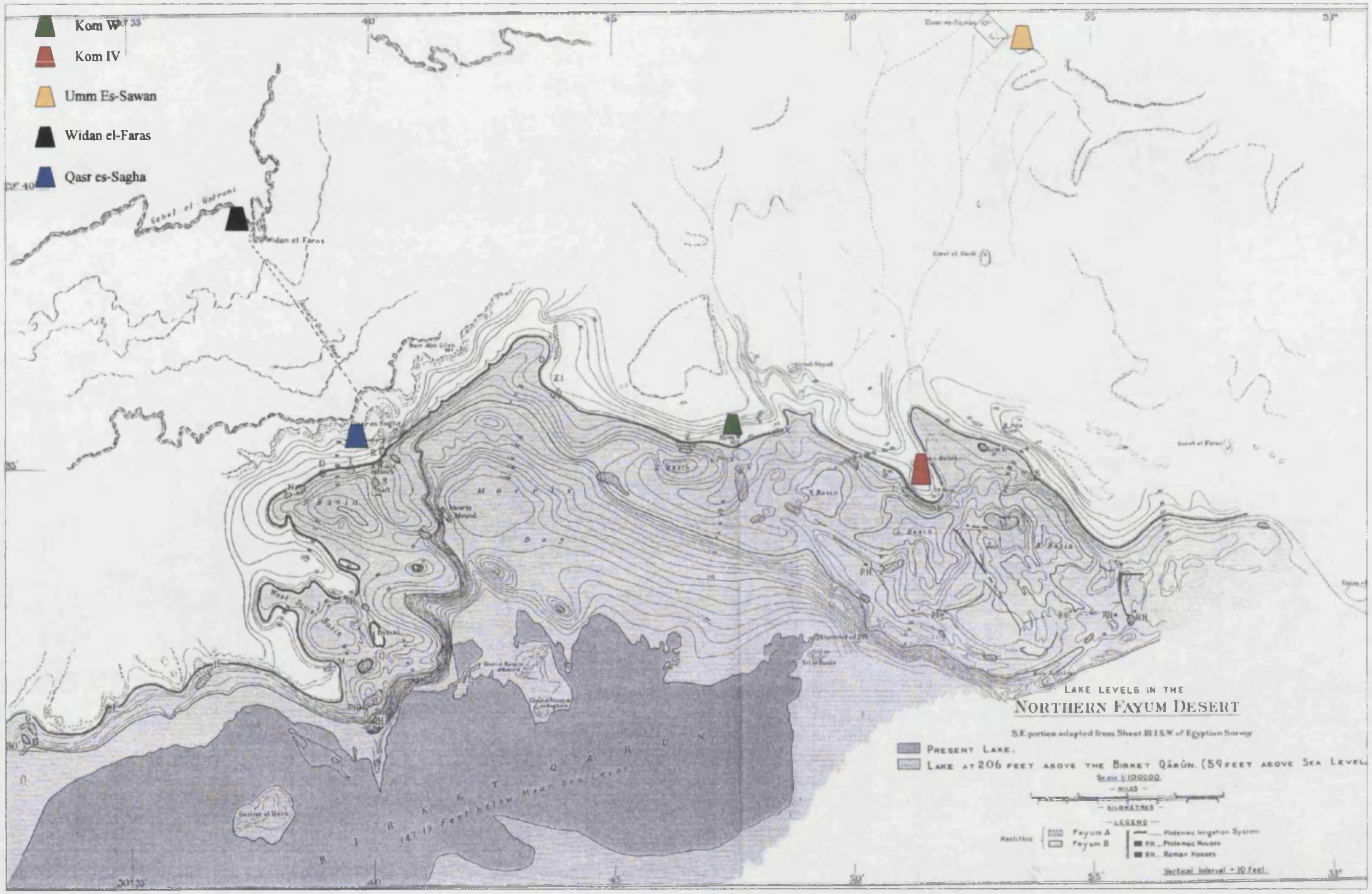
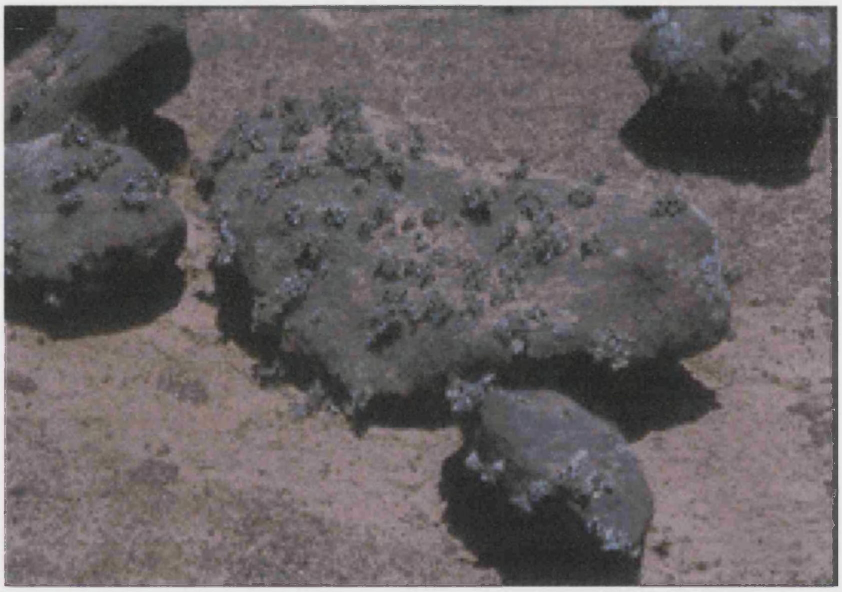
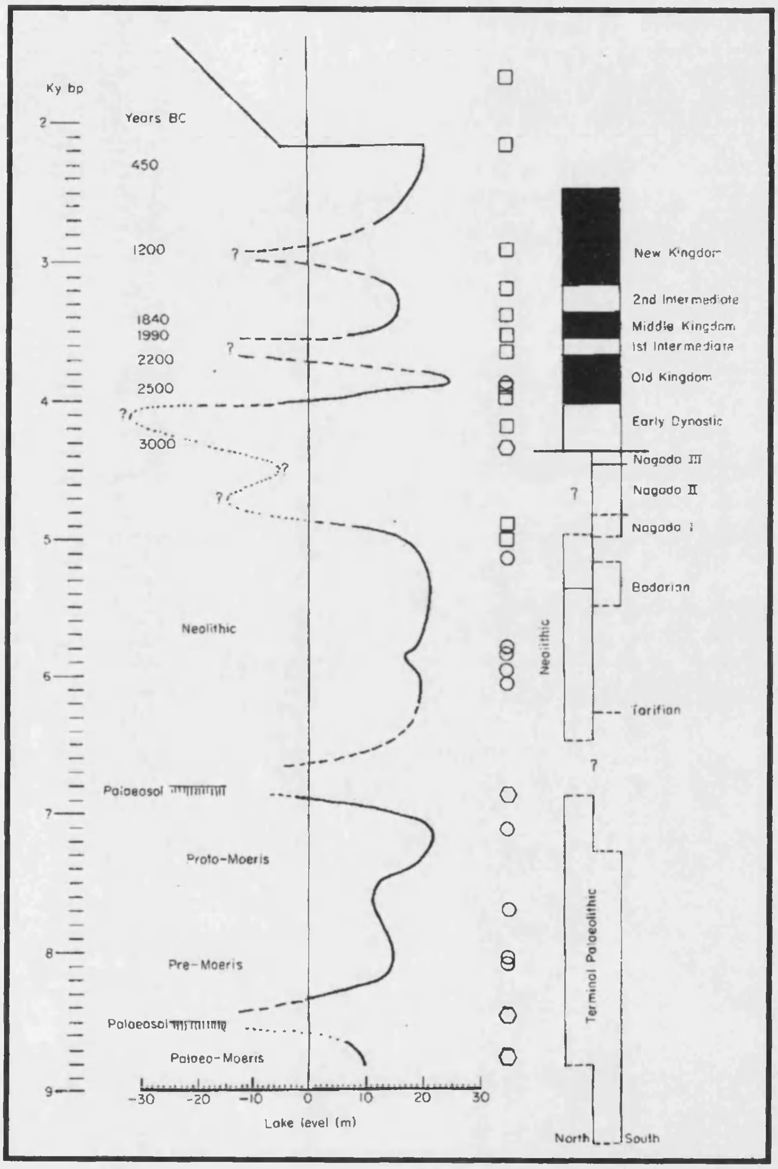


Fig. 18



Pl. 37. Lichens in East Quarry (facing north-west) at Widan el-Faras

Fig. 19. Variation in levels of ancient Lake Moeris
(after Hassan 1986a: 492)



Pl. 38. Copper chisel (Egyptian Museum 6271) found at Chisel Quarry (Chephren's Quarry) by Engelbach in 1938

Fig. 20. Map of the main pyramid fields

(after Manley 1996: 29)

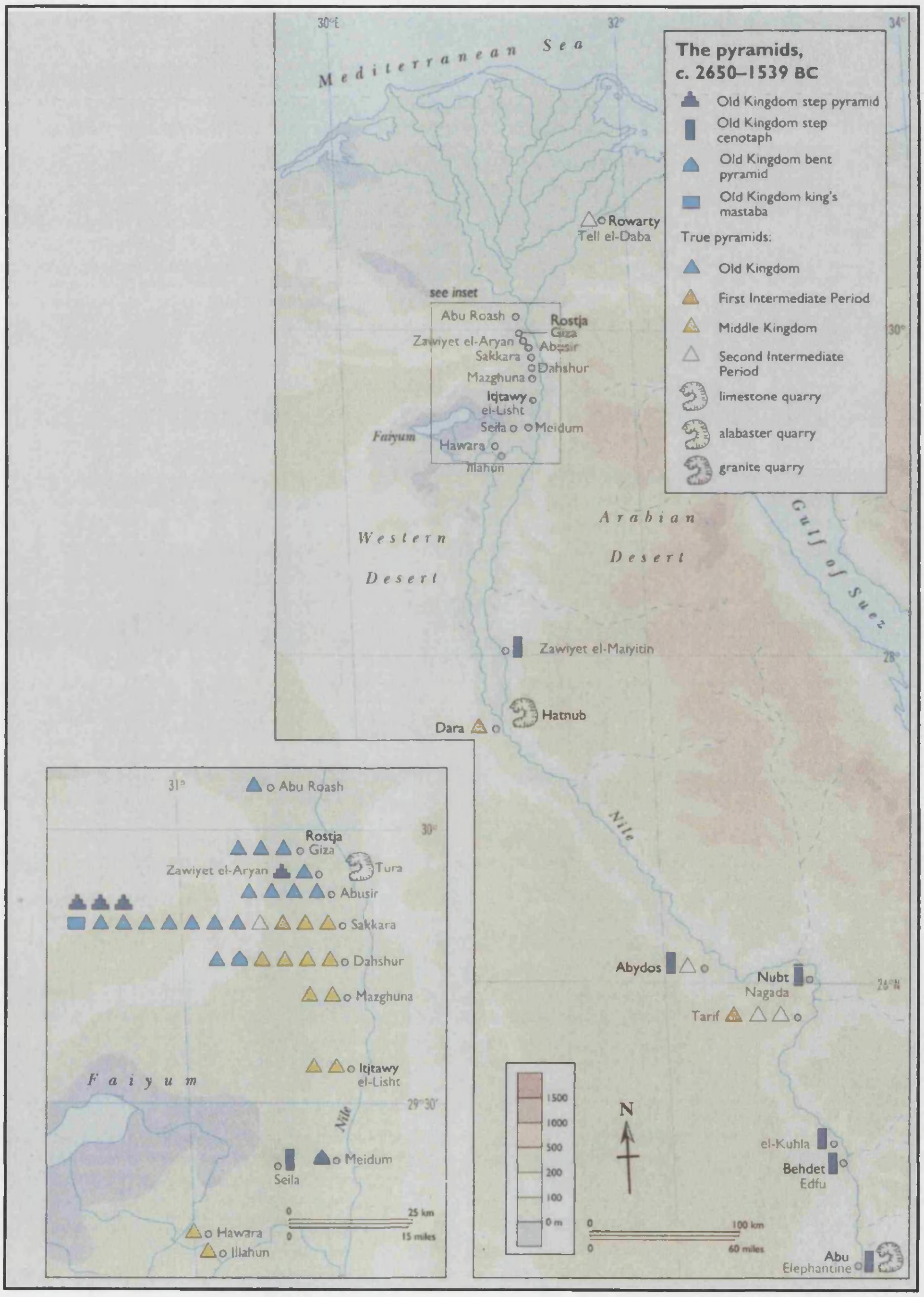


Fig. 21. Overview of stone use for monumental construction 3rd - 6th Dynasty royal pyramid complexes: compiled from Appendix B 3

Dynasty	Pyramid Complex	Chephren Gneiss	Aswan Granite (red/pink)	Aswan Granodiorite	Basalt	Travertine
3rd	Djoser	✓	✓			
3rd	Sekhemkhet					
3rd	Khaba		✓			
4th	Snefru (Meidum)					
4th	Snefru (Bent)					✓
4th	Snefru (Red)		✓			
4th	Khufu		✓		✓	
4th	Djedefre		✓			
4th	Khafre		✓			✓
4th	Menkaure		✓			
4th	Khentkawes		✓			
4th	Shepseskaf		✓	✓		
5th	Userkaf		✓	✓	✓	
5th	Sahura		✓	?	✓	✓
5th	Neferirkara		✓			
5th	Khentkawes II		✓	✓		
5th	Neferefre		✓			
5th	Shepseskara					
5th	Nyuserra		✓		✓	✓
5th	Nyuserra (sun temple)		✓			✓
5th	Menkauhor		✓			
5th	Djedkara-Isesi		✓			✓
5th	Unas		✓			✓
6th	Teti		✓			✓
6th	Pepi I		✓			✓
6th	Merenra		✓			
6th	Pepi II		✓			✓

Fig. 22. Overview of stone use for stone vessels, statuary and other funerary equipment in 3rd - 6th Dynasty royal pyramid complexes: compiled from Appendix B 4

Dynasty	Pyramid Complex	Anorthosite/ Gabbro Gneiss	Aswan Granite (red/pink)	Aswan Granodiorite	Basalt	Travertine
3rd	Djoser	✓	✓			✓
3rd	Sekhemkhet	✓				✓
3rd	Khaba	✓	✓			✓
4th	Snefru (Meidum)					
4th	Snefru (Bent)	✓			✓	✓
4th	Snefru (Red)					
4th	Khufu	✓	✓			✓
4th	Djedefre	✓	✓			
4th	Khafre	✓	✓	✓		✓
4th	Menkaure	✓	✓	?		✓
4th	Khentkawes					✓
4th	Shepseskaf			?		
5th	Userkaf	✓	✓		?	
5th	Sahura	✓	?	✓	?	✓
5th	Neferirkara					
5th	Khentkawes II		✓			
5th	Neferefre	✓	✓			✓
5th	Shepseskara					
5th	Nyuserra	✓	✓		✓	✓
5th	Nyuserra (sun temple)					✓
5th	Menkauhor					
5th	Djedkara-Isesi					✓
5th	Unas	✓	✓			
6th	Teti		✓			
6th	Pepi I	✓	✓			✓
6th	Merenra		✓			✓
6th	Pepi II	✓	✓	✓		✓

Fig. 22a. Overview of stone use 3^{rd} - 6^{th} Dynasty in royal pyramid complexes: compiled from Figs. 21 and 22

Dynasty	Pyramid Complex	Chephren Gneiss	Aswan Granite (red/pink)	Aswan Granodiorite	Basalt	Travertine
3^{rd}	Djoser	✓	✓			✓
3^{rd}	Sekhemkhet	✓				✓
3^{rd}	Khaba		✓			✓
4^{th}	Snefru (Meidum)					
4^{th}	Snefru (Bent)	✓			✓*	✓
4^{th}	Snefru (Red)		✓			
4^{th}	Khufu	✓	✓		✓	✓
4^{th}	Djedefre	✓	✓			
4^{th}	Khafre	✓	✓	✓	✓*	✓
4^{th}	Menkaure	✓	✓	?		✓
4^{th}	Khentkawes		✓			✓
4^{th}	Shepseskaf		✓	✓		
5^{th}	Userkaf	✓	✓	✓	✓	
5^{th}	Sahura	✓	✓	✓	✓	✓
5^{th}	Neferirkara		✓			
5^{th}	Khentkawes II		✓	?		
5^{th}	Neferefre	✓	✓			✓
5^{th}	Shepseskara	✓				
5^{th}	Nyuserra	?	✓		✓	✓
5^{th}	Nyuserra (sun temple)		✓			✓
5^{th}	Menkauhor		✓			
5^{th}	Djedkara-Isesi		✓			✓
5^{th}	Unas	✓	✓			✓
6^{th}	Teti		✓			✓
6^{th}	Pepi I	✓	✓			✓
6^{th}	Merenra		✓			✓
6^{th}	Pepi II	✓	✓	✓		✓

* only stone vessels in Snefru Bent Pyramid and door lintel in Khafre

Fig. 23a. Estimated basalt volumes in the four pyramid complexes that used basalt for monumental construction: Total volumes for Sahura and Nyuserra **including** causeway walls

(After Borchardt 1907, 1910; Hoffmeier 1993; Lehner 1997; Verner and authors observations)

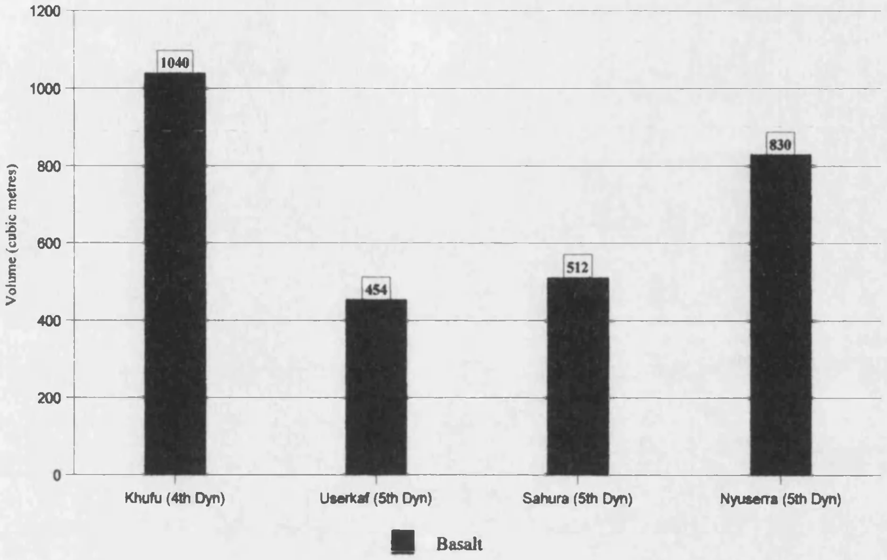


Fig. 23b. Estimated basalt volumes in the four pyramid complexes that used basalt for monumental construction: Total volumes for Sahura and Nyuserra **excluding** causeway walls

(After Borchardt 1907, 1910; Hoffmeier 1993; Lehner 1997; Verner and authors observations)

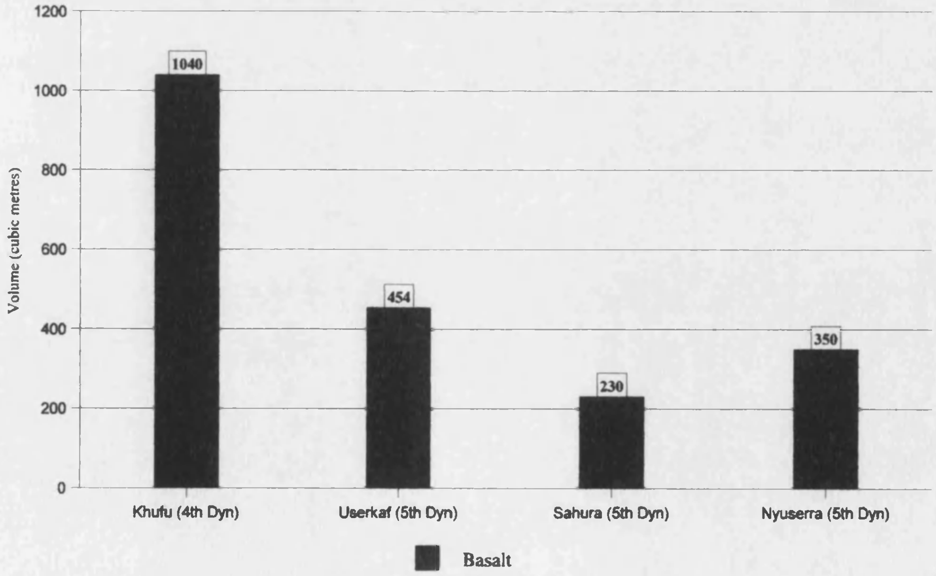


Fig. 23c. Estimates of Basalt Volumes Extracted from Five Old Kingdom Quarries at Widan el-Faras

Quarry No.	Individual Extraction Sites (swales)	Length (m)	Depth (m)	Height (m)	Total Volume (m^3)	Volume with 50% waste (m^3)	Volume with 60% waste (m^3)	Volume with 70% waste (m^3)
1- East	8	2	10	5	480	240	192	144
1 -Middle*	8	2	10	8	768	384	307	230
1- South	4	3	10	8	576	288	230	173
2	7	2	10	10	840	420	336	252
3	6	3	10	8	864	432	346	259
4 - South	2	5	12	6	432	216	173	130
4 - North	4	5	12	6	864	432	346	259
5	6	3	10	5	540	270	216	162
Total	**45**				**5364**	**2682**	**2146**	**1609**

* due to the Early Roman Period extraction from this part of Quarry 1, the dimensions here are estimated from comparison with the other Old Kingdom quarries.

Fig. 24a. Petrie Stone Vessel Corpus*: Numerical Proportions of Materials Used Per Dynasty

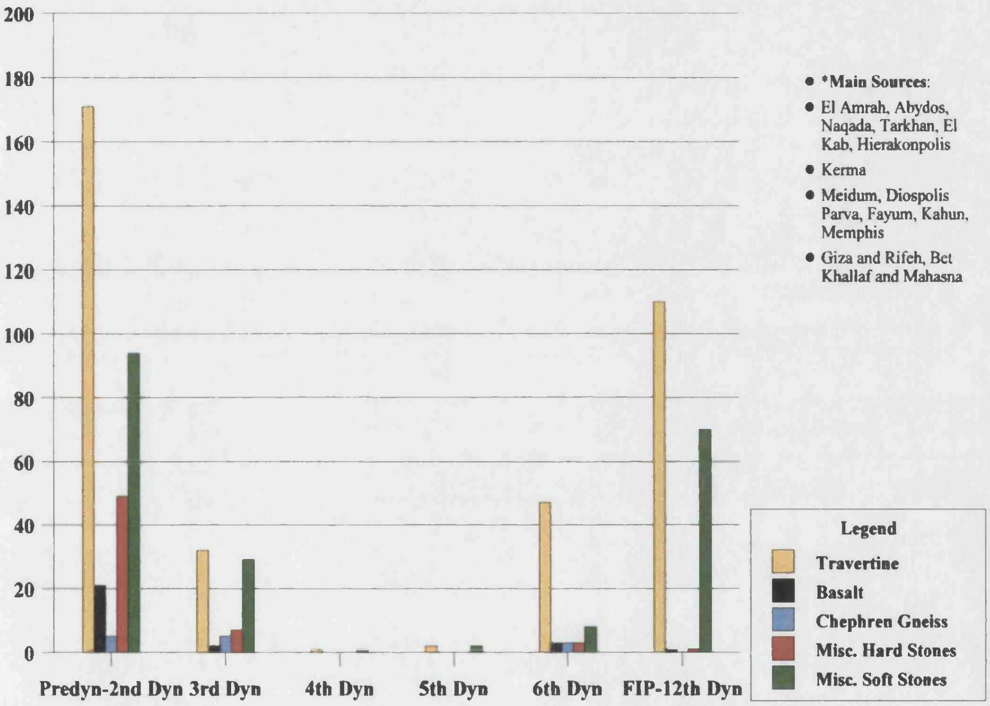


Fig. 24b. Petrie Stone Vessel Corpus*: Percentage Proportion of Materials Used Per Dynasty

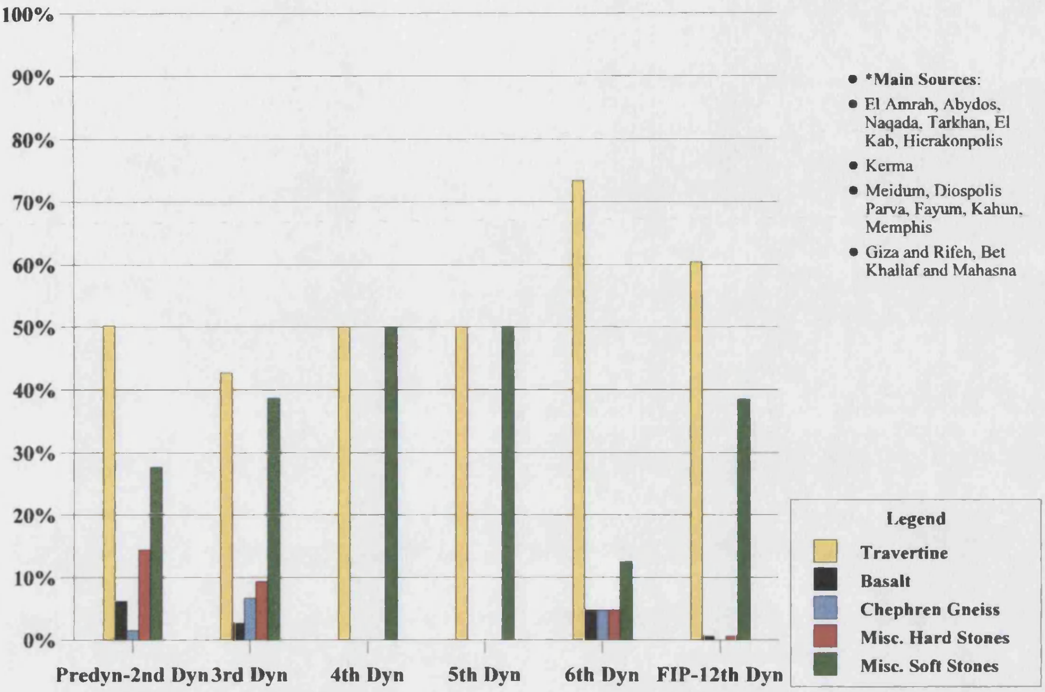
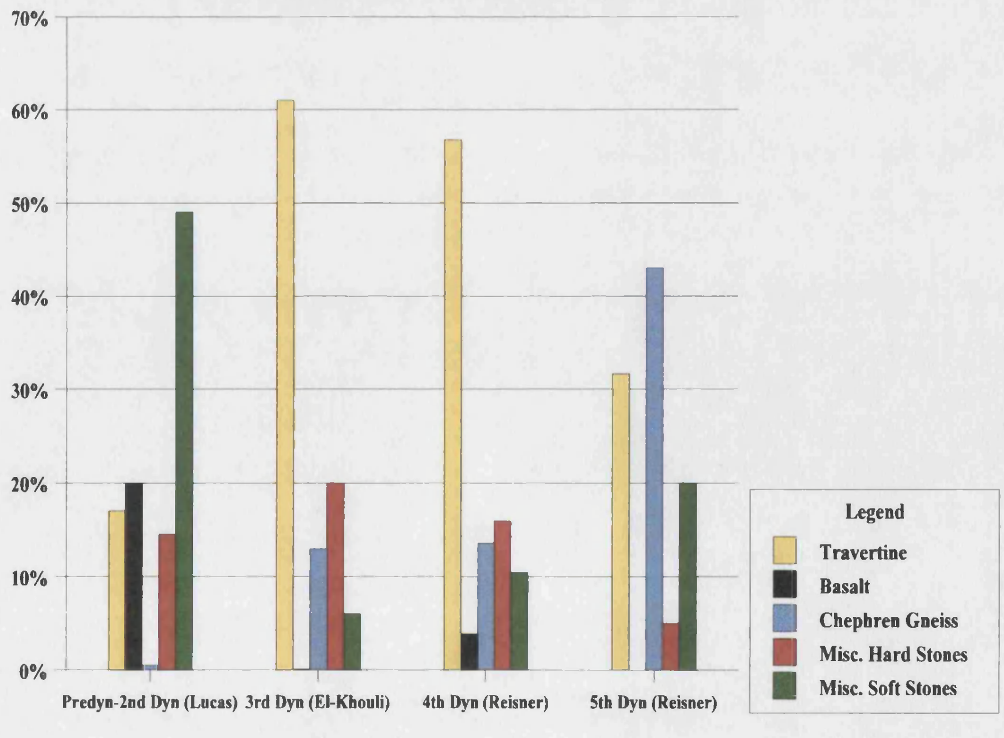


Fig. 24c. Comparative Table of Material Use for Stone Vessels from the Main Sources of Study (After Lucas 1930, Reisner 1931, El-Khouli 1978)



Pl. 40b. Statuette in Chephren Gneiss: Sahura and Nome God,
(H. 64 cm; MMA 18.2.4 (MMA: 328)

Pl. 41a. Deep Chephren Gneiss bowl (H. 10.8 cm),
Petrie Stone Vessel Corpus (UC41216)

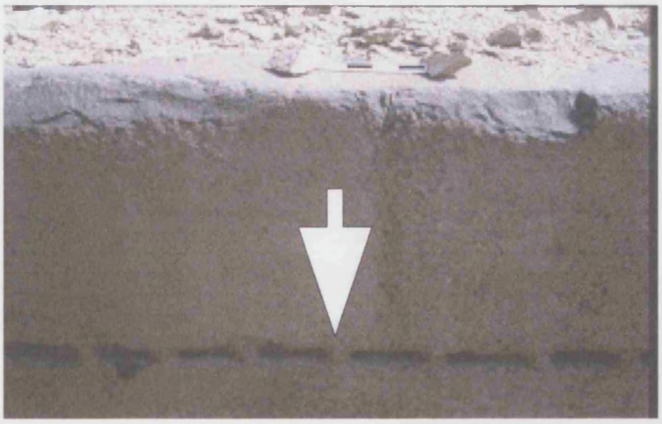
Pl. 43a. Basalt bowl (H. 5.3 cm) Predynastic, Petrie Stone Vessel Corpus (UC41135)

Pl. 43b. Basalt floor, Sahure mortuary temple (5th Dynasty)

Pl. 44a. Black limestone vase (H. 9 cm), Predynastic, Petrie Stone Vessel Corpus (UC4320)

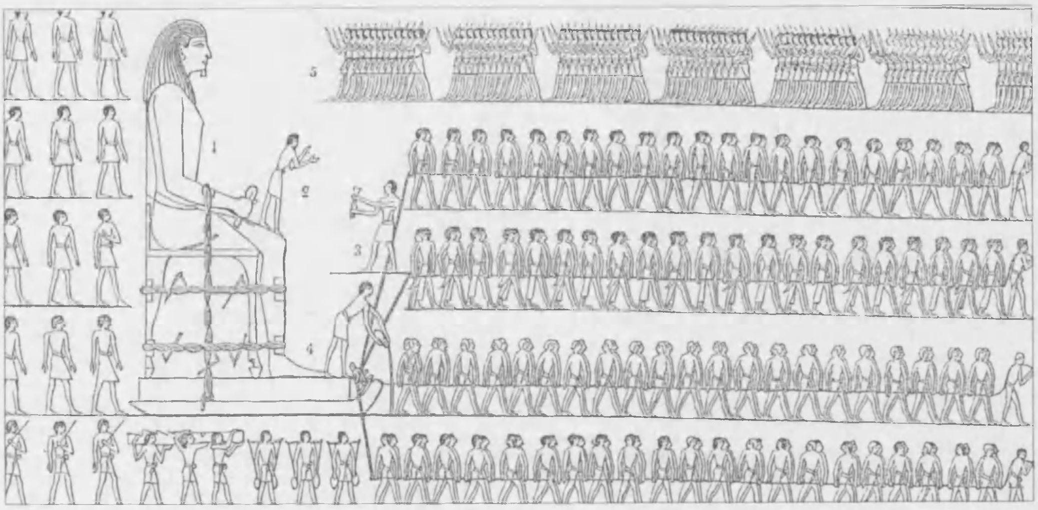
Pl. 44b. Black limestone wall blocks, Pepi I mortuary temple, (6[th] Dynasty), Saqqara

Pl. 4



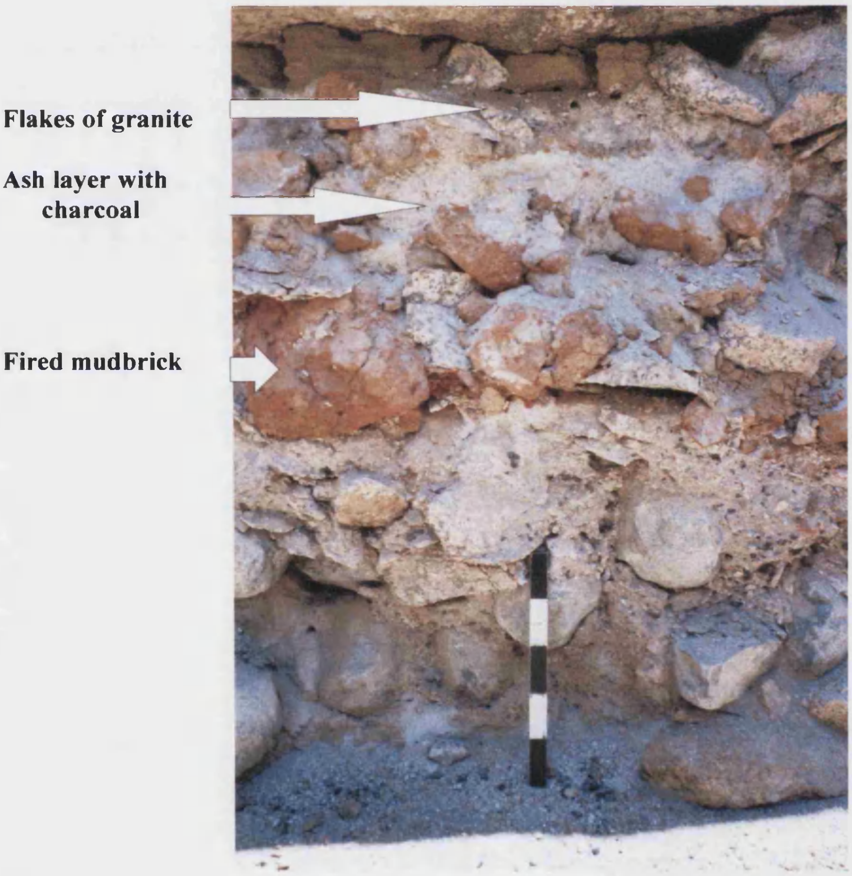
Pl. 46. Wedge-marks (possibly Roman) in basalt wall lining block, Nyuserra mortuary temple, (5th Dynasty), Abusir

Fig. 25. Transportation scene of Djehutihotpe statue from Hatnub: from tomb at El-Bersheh, 12th Dynasty (after Wilkinson 1878: 305)



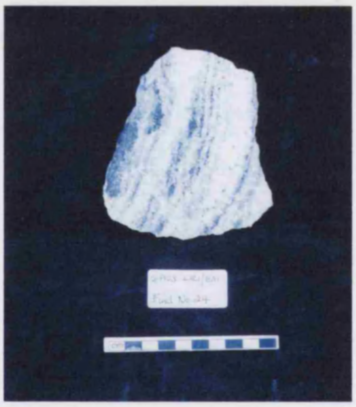
Pl. 47a. Flake of Chephren Gneiss found under boulder with evidence of fire-setting, Khufu Stele Quarries

Pl. 47b. Charcoal deposits at base of excavated boulder extraction site (EA1), Loading Ramp Quarries



Pl. 47c. Fire-setting stratigraphy at 'Obelisk Quarry', Aswan quarries

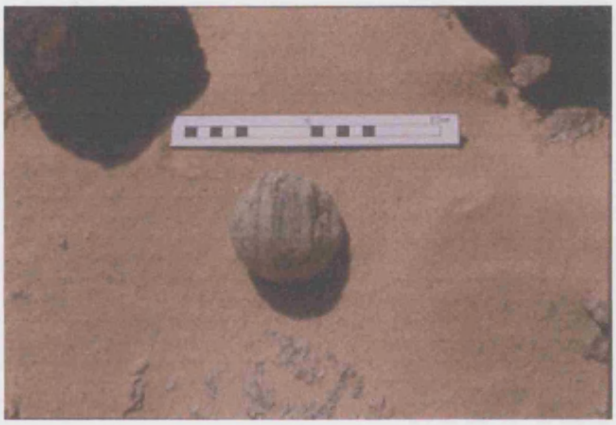
Pl. 48a. Excavated extraction site (EA1) of one large boulder (depth 2 m): Loading Ramp Quarries



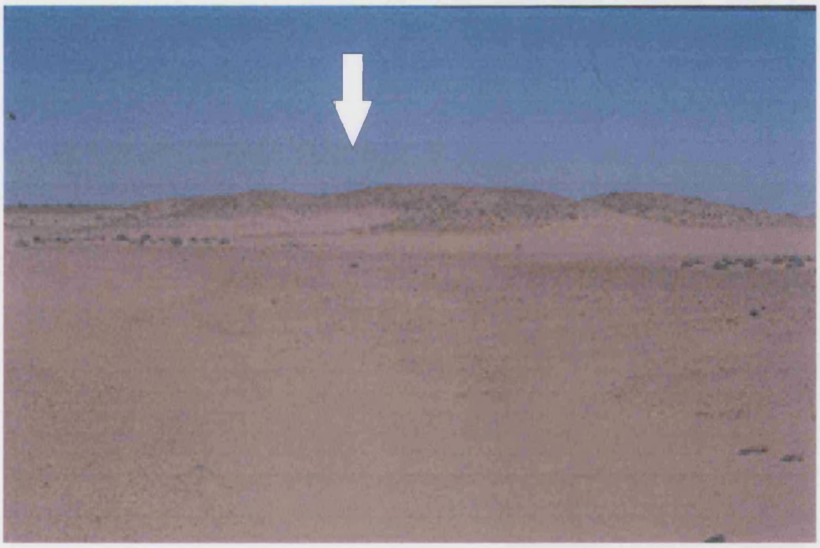
Pl. 48b. Finely crafted Chephren Gneiss hand axe, provenance EA1 spoil heap: Loading Ramp Quarries

Pl. 49. EA1: sloping pathway leading up to ground level

Pl. 50a. Two-handed (basalt) pounder broken in half: Quartz Ridge



Pl. 50b. Chephren Gneiss (rare) one-handed pounder: Khufu Stele Quarries



Pl. 51. Large spoil heaps: view towards Chisel Quarry

Fig. 26a. Plan of large (block) extraction areas and spoilheaps:KhufuSteleQuarries

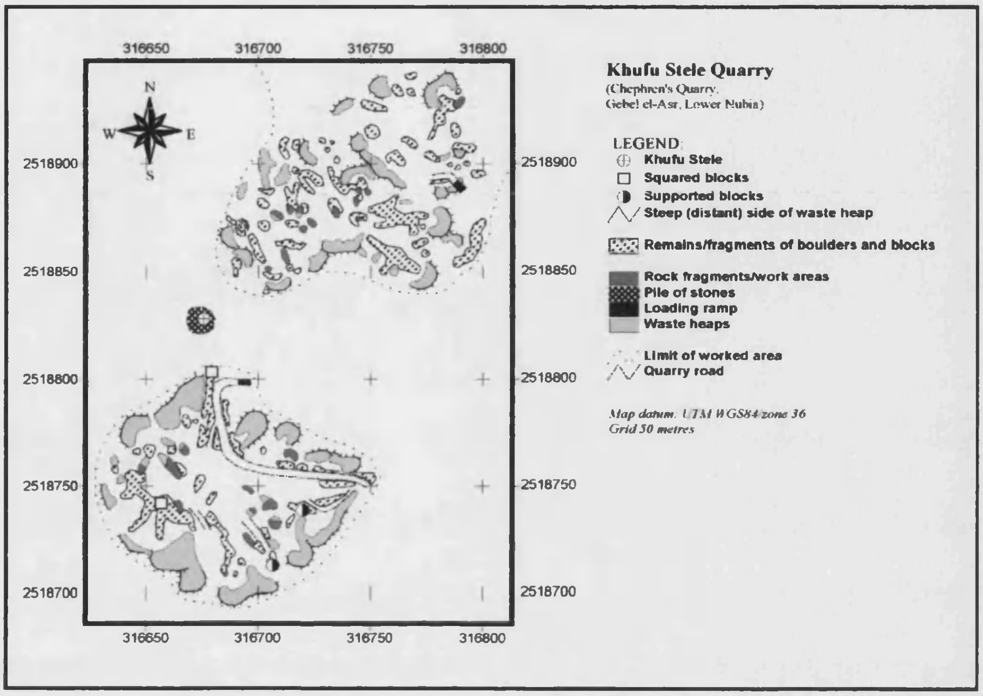


Fig. 26b. Plan of (vessel) extraction area and spoil heaps: Chisel Quarry

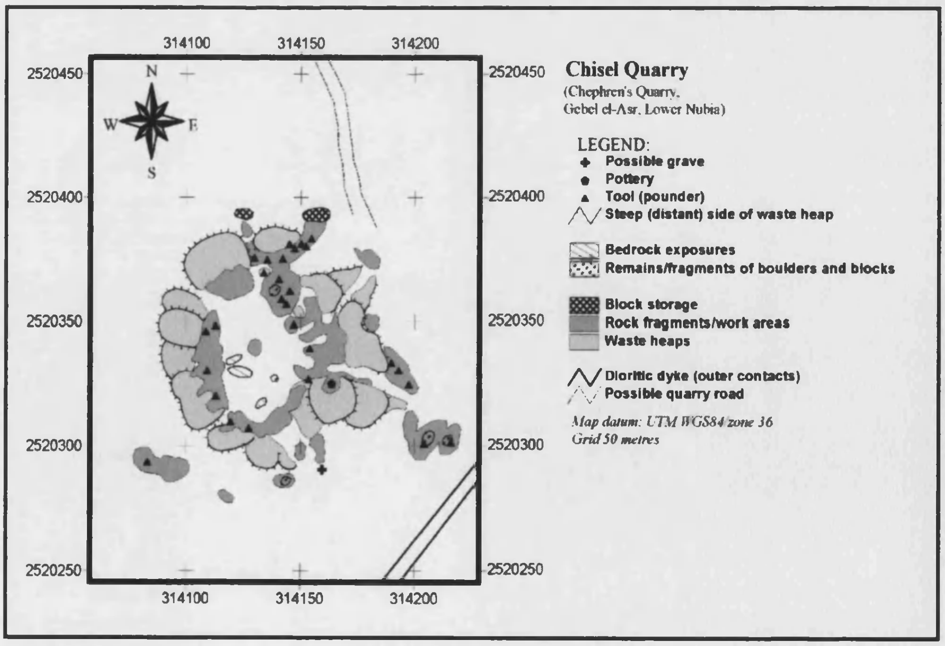
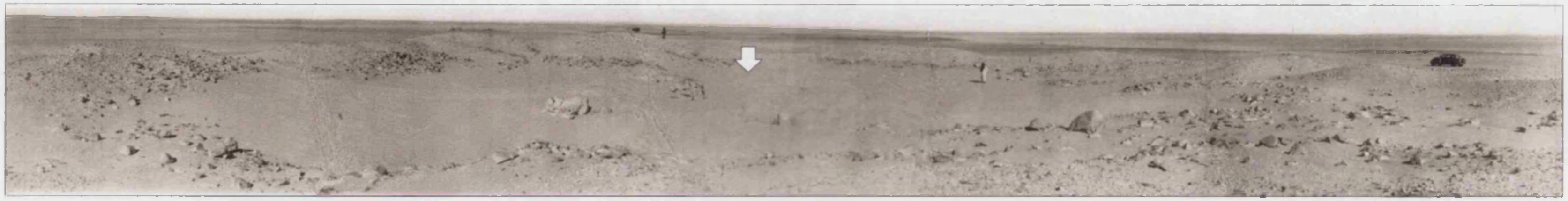


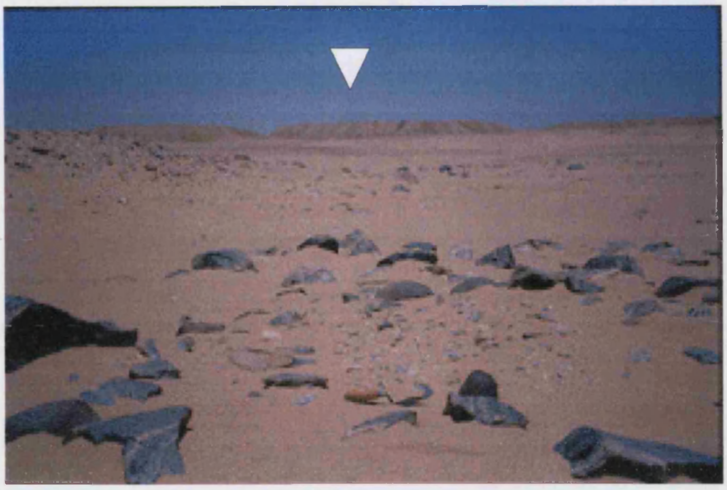
Fig. 27. Evidence of Primary and Secondary Production at Chephren's Quarry

Quarries		Primary Production		Secondary Production		
		Extraction Areas	Tools	Work Areas	Tools	Vessel and Statue Blanks/Standard Size Blocks
BLOCK QUARRIES	Khufu Stele Quarries	Two main extraction sites either side of Khufu Stele platform. These are surrounded by an organised, circular arrangement of spoil heaps of generally the same size. Some satellite quarries comprising single depressions in the sand.	A few one-handed stone pounders	Secondary trimming of blocks in front of spoil heaps, thus forming an inner circle.	A few one-handed stone pounders	Numerous squared blocks with average size of 1.1 m length by 0.7 m width. Small cluster of vessel blanks close to settlement area.
	Loading Ramp Quarries	Generally single large depressions in the sand surrounded by spoil heaps. Evidence of fire-setting at base of EA 1.	One hand-held stone axe of Chephren Gneiss found in spoil heap	Not clearly discernible		
	Unfinished Statue Quarries	Generally single large depressions in the sand surrounded by spoil heaps	A few one-handed stone pounders	Secondary trimming and pounding of standard large blocks into statue blanks occurring close to boulder extraction sites. Evidence of fire-setting under one statue blank.	A few one-handed stone pounders	Two blocks shaped into the blanks of seated statues
VESSEL QUARRIES	Chisel Quarry	One deep extraction surrounded by large, well organised spoil heaps in circular arrangement. No satellite quarries	Many two-handed and one-handed stone pounders	Secondary trimming evident in an inner circle in front of spoil heaps. Copper chisel found here by Engelbach (1938)	Many two-handed and one-handed stone pounders in work areas.	Two areas of small block storage outside of spoil heaps to the north, ready to be transported away. These blocks are trimmed and homogenous in size and probably for vessels
	Cairn Quarries	Numerous small extraction sites and satellite quarries surrounded by spoil heaps of varying sizes	Numerous two-handed stone pounders	Clusters of secondary production where trimming occurred	Mainly one-handed pounders, but some two-handed. Some hand-axes	
	Quartz Ridge Quarries	Numerous small extraction sites and satellite quarries surrounded by spoil heaps of varying sizes	Numerous two-handed stone pounders	Clusters of secondary production	Mainly one-handed pounders, but some two-handed. Some hand-axes	Vessel blanks in the environs and specifically clustered near the Quartz Ridge settlement. Also a few homogenous trimmed blocks for vessels
	Pounder Quarries	Numerous small extraction sites and satellite quarries surrounded by spoil heaps of varying sizes	Numerous two-handed stone pounders	Clusters of secondary production for trimming of small blocks	Mainly one-handed pounders, but some two-handed. Some hand-axes	



Pl. 52. Panorama of central deep depression from extraction into bedrock: Chisel Quarry
(by Engelbach 1938, courtesy Joan Wand-Tetly)

Pl. 53. Statue blank for a seated statue (excavated): Unfinished Statue Quarries

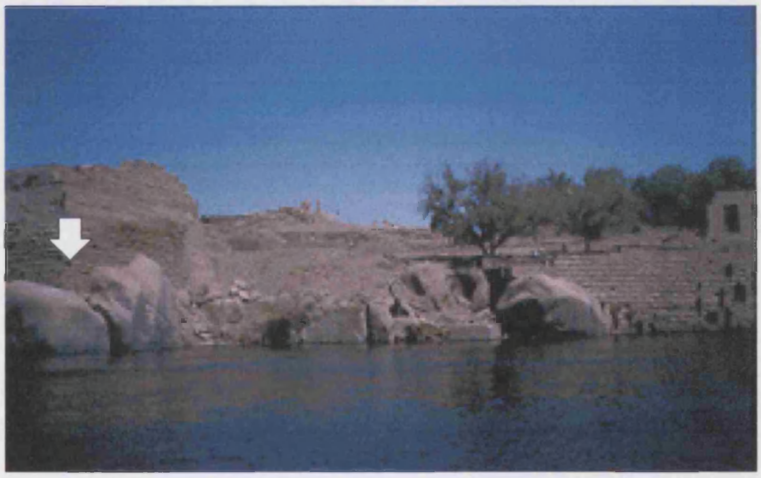


Pl. 54. Cluster of secondary production areas at Pounder Quarries; Canal 4 construction in background

Pl. 55a. Widan el-Faras: middle of Quarry 1 (view to the west), possible Early Roman quarry

Pl. 55b. Widan el-Faras: middle of Quarry 1, possible Roman wedge-mark

Pl. 56. Large basalt blocks on quay (quarry road terminus) Qasr el-Sagha, Northern Faiyum



Pl. 57. 'Woolsack' red granite boulders: east bank, Elephantine Island, Aswan

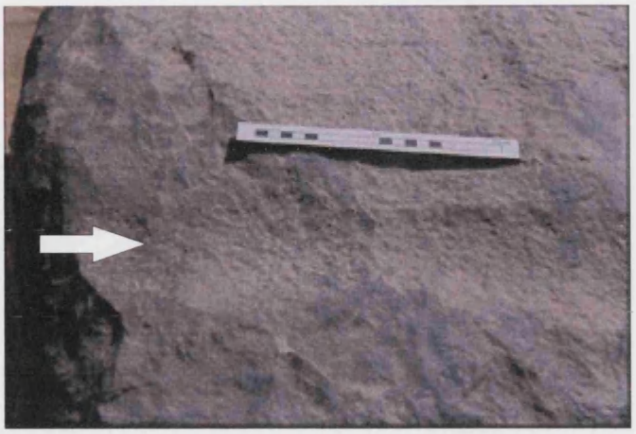
Pl. 58. Hand-held stone axes: Northern Quarries, Chephren's Quarry

Fig. 28. Overview of stone and metal tools found at Chephren's Quarry and Widan el-Faras

Quarries		Two-handed Stone Pounder	One-handed Stone Pounder	Hand-held Stone axe	Large Stone Axe (>21 cm) ①	Small Stone Axe (<12 cm) ①	Copper Chisel
CHEPHREN'S QUARRY							
BLOCK QUARRIES	Khufu Stele Quarries		✓				
	Loading Ramp Quarries			✓②			
	Unfinished Statue Quarries		✓				
VESSEL QUARRIES	Chisel Quarry	✓	✓				✓
	Cairn Quarries	✓	✓	✓			
	Quartz Ridge Quarries	✓	✓	✓			
	Pounder Quarries	✓	✓	✓			
WIDAN EL-FARAS							
Quarry 1 -East						✓	
Quarry 1 -Middle			✓		✓	✓	
Quarry 1 - South					✓	✓	
Quarry 2							
Quarry 3					✓		
Quarry 4 - South							
Quarry 4 - North							
Quarry 5							
Limestone Chip Quarries			✓			✓	

① all produced from non-local dolerite with provenance either to the Aswan region and/or Chephren's Quarry

② a single find in spoil heaps associated with large boulder extraction area (EA1) produced from Chephren Gneiss **(see Pl. 48b)**



Pl. 59. Pounding marks across statue blank to demarcate head of statue: Unfinished Statue Quarries

Pl. 60a. Large and small (dolerite) stone axes with contracted necks: Quarry 1 and 3, Widan el-Faras

Pl. 60b. Large (dolerite/granite) 'maul' (with contracted neck) 4th Dynasty Meidum: Petrie Museum (UC30858)

Fig. 29a. Seated statue of Khafre superimposed into a statue blank: Unfinished Statue Quarries (modified from Heldal 2003)

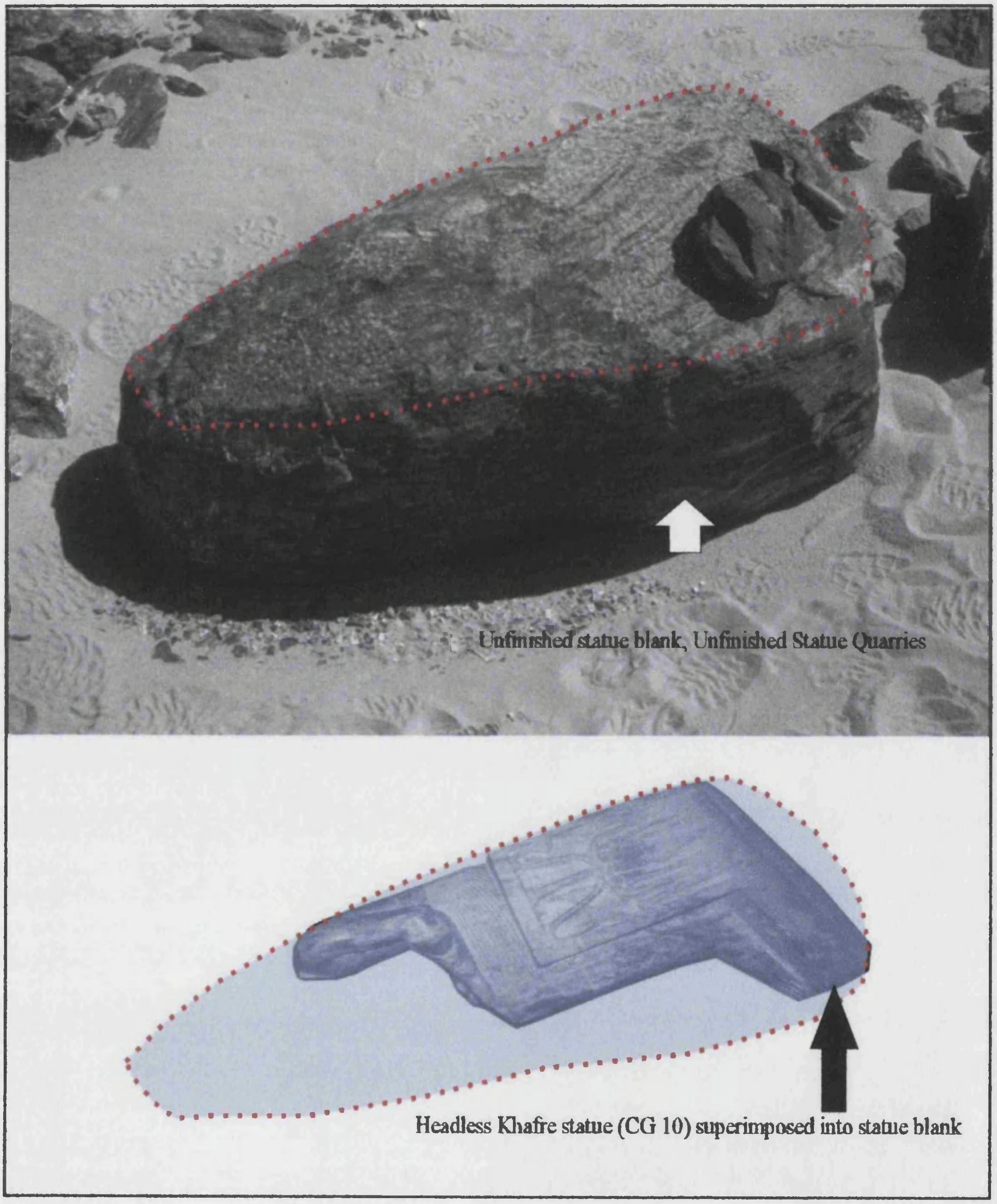
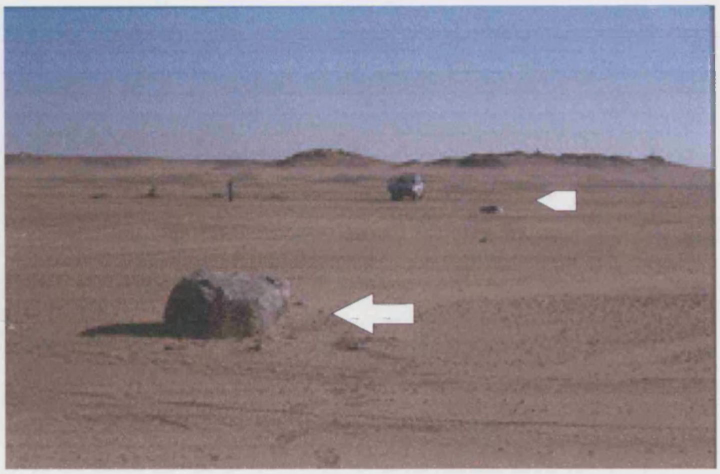


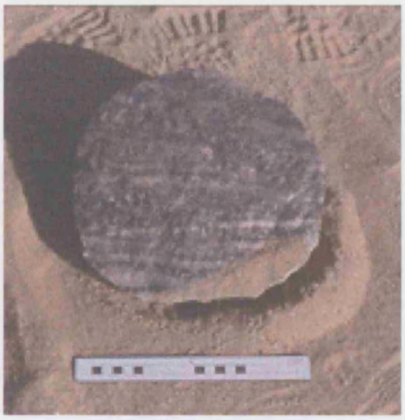
Fig. 29b. Comparative overview of production evidence at Chephren's Quarry and Widan el-Faras

Quarries		Primary Production		Secondary Production		
		Spoil Heaps	Tools	Work Areas	Tools	Object Blanks/Standard Size Blocks
CHEPHREN'S QUARRY						
BLOCK QUARRIES	Khufu Stele Quarries	✓	✓	✓	✓	✓
BLOCK QUARRIES	Loading Ramp Quarries	✓	✓			
BLOCK QUARRIES	Unfinished Statue Quarries	✓	✓	✓	✓	✓
VESSEL QUARRIES	Chisel Quarry	✓	✓	✓	✓	✓
VESSEL QUARRIES	Cairn Quarries	✓	✓	✓	✓	
VESSEL QUARRIES	Quartz Ridge Quarries	✓	✓	✓	✓	✓
VESSEL QUARRIES	Pounder Quarries	✓	✓	✓	✓	
WIDAN EL-FARAS						
Quarry 1 -East		✓	✓			
Quarry 1 -Middle		✓	✓			
Quarry 1 - South		✓	✓			
Quarry 2		✓				
Quarry 3		✓				
Quarry 4 - South		✓				
Quarry 4 - North		✓				
Quarry 5		✓				
Quay at Qasr el-Sagha				✓	✓	✓

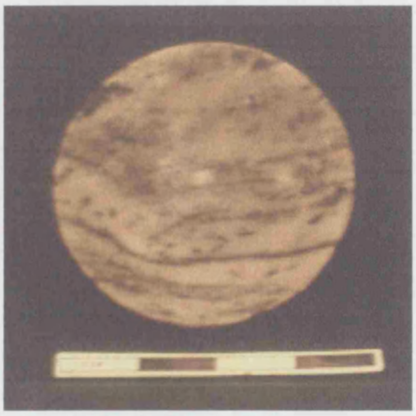


Pl. 62. Two of five roughly squared blocks that form a line towards a loading ramp: Khufu Stele Quarries

Pl. 63a. Vessel blank of a shallow cylindrical cup: Quartz Ridge



Pl. 63b. Vessel blank for a shallow bowl: Khufu Stele Quarries



Pl. 63c. Shallow Chephren Gneiss bowl (3rd Dyn; UC41245) which is close to size of vessel blank (Pl. 63b): Petrie Stone Vessel Corpus

Pl. 64a. Gypsum vessel blanks at (vessel) Workshop Area B, Umm es-Sawan, Northern Faiyum

Pl. 64b. Finished (typical) gypsum shallow bowl of the early 3rd Dynasty (UC41220): Petrie Stone Vessel Corpus

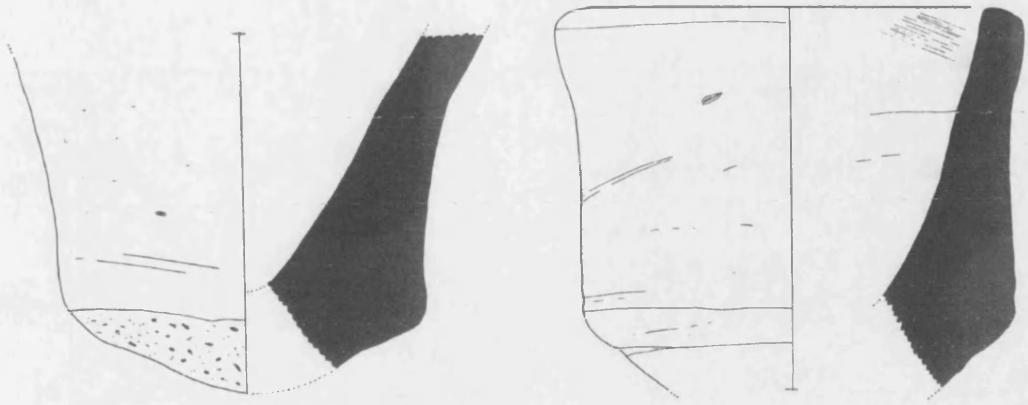
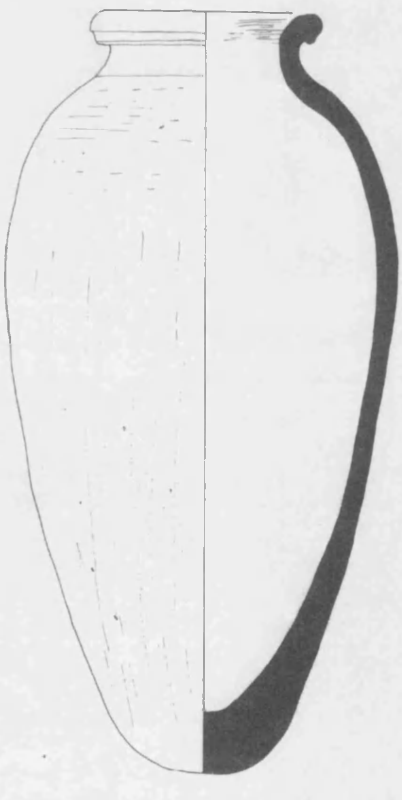


Fig. 30a. Typical bell-shaped bread moulds of 3rd - 4th Dynasties:
Camp 2 (left, H.13.5 cm) and Khufu Stele Quarries (right, H. 16 cm)
(after El-Senussi 2003)



Fi. 30b. Beer jar, typically of the Early Dynastic Period (H. 35 cm):
EA1, Loading Ramp Quarries
(after El-Senussi 2003)

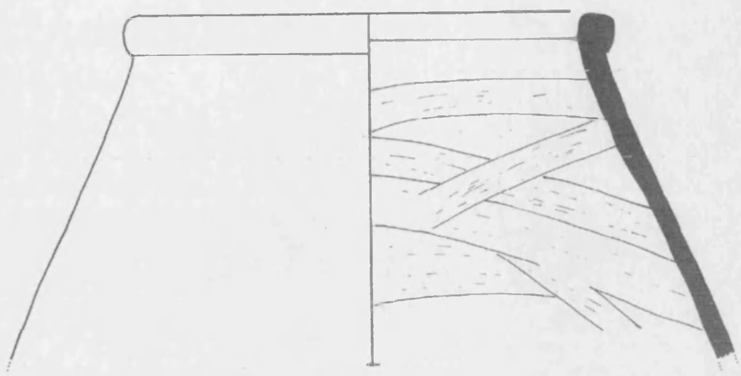


Fig. 30c. Large (water/beer) storage jar (capacity 75 litres), late 12th Dynasty: Quartz Ridge(after El-Senussi 2003)

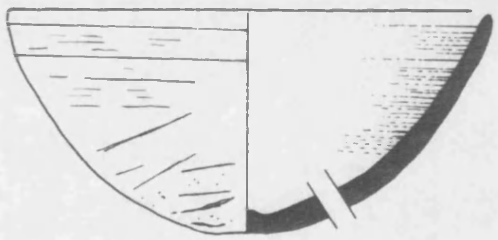


Fig. 30d. Shallow cup (H. 6 cm), late 12th Dynasty: Quartz Ridge (after El-Senussi 2003)

Fig. 31a. Old Kingdom pottery from Widan el-Faras: East Quarry, West Quarry and encampment (after El-Senussi 2001)

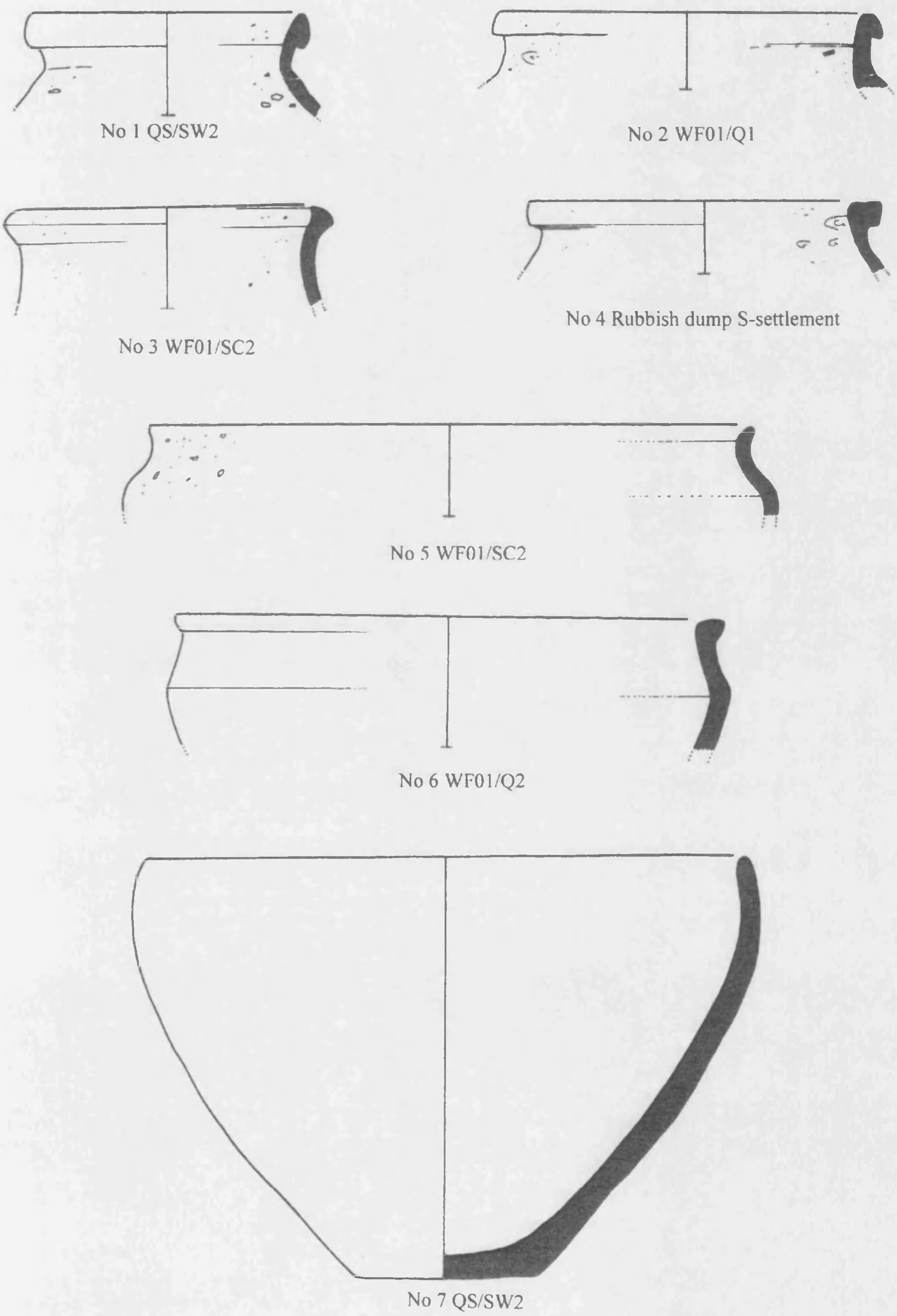


Fig. 31b. Old Kingdom pottery from Widan el-Faras: East Quarry, West Quarry and encampment
(after El-Senussi 2001)

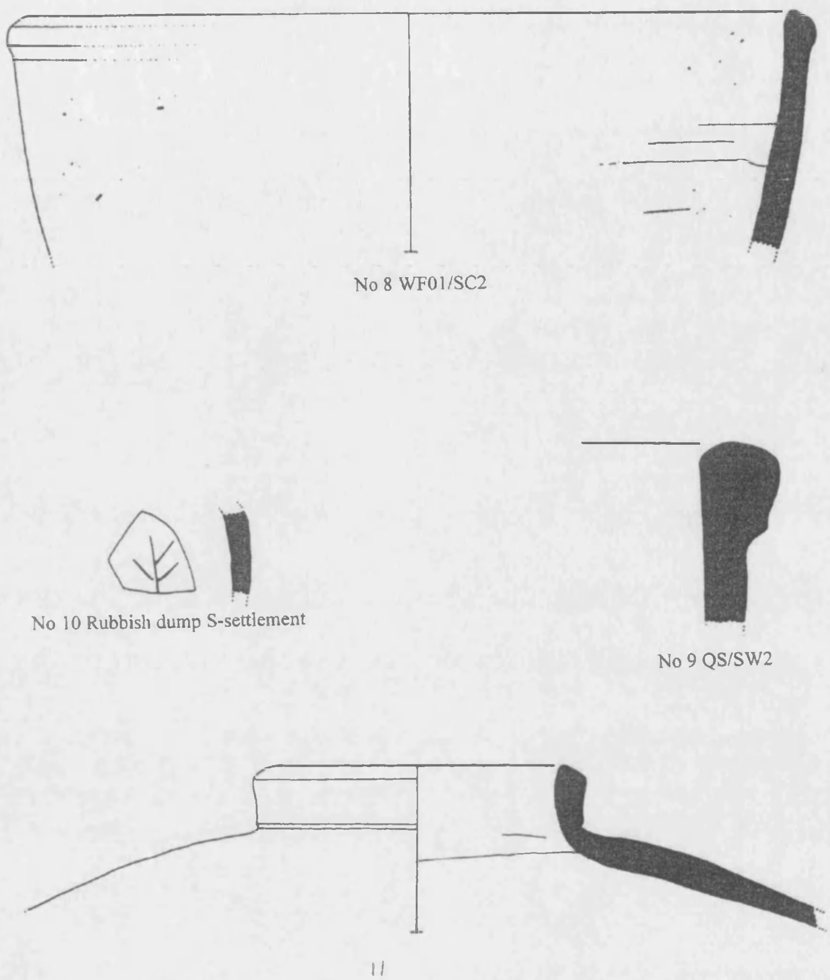
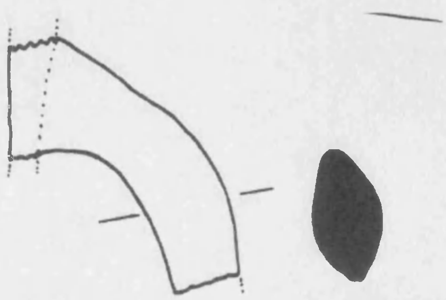
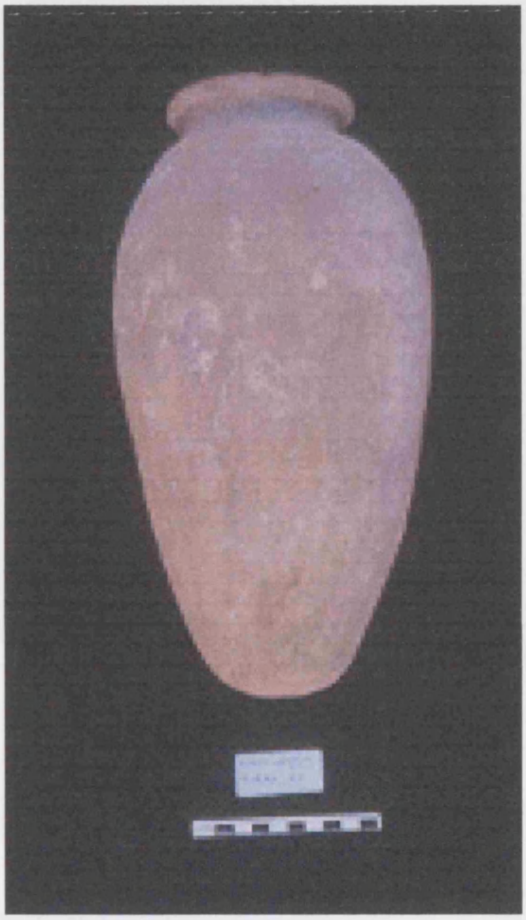
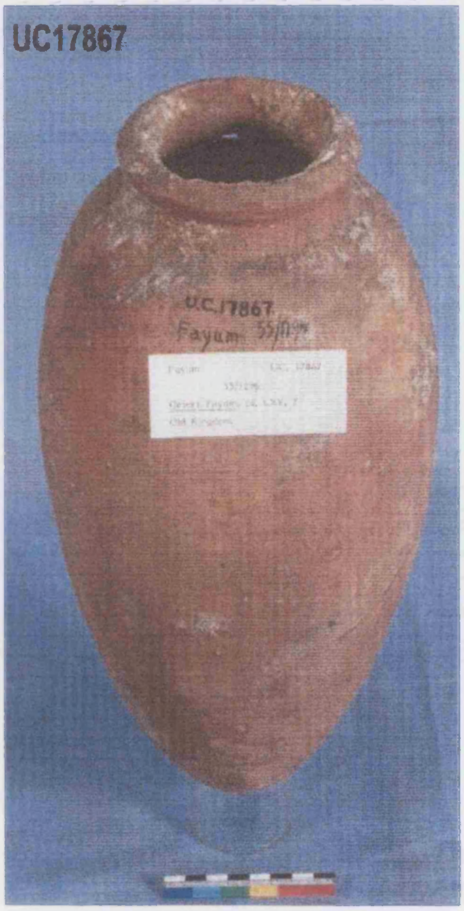


Fig. 31c. Early Roman Period amphorae handle: Widan el-Faras, middle Quarry 1
(after El-Senussi 2001)







Pl. 66a. Beer jar found in base of boulder extraction area (EA1): Loading Ramp Quarries (H. 34 cm)

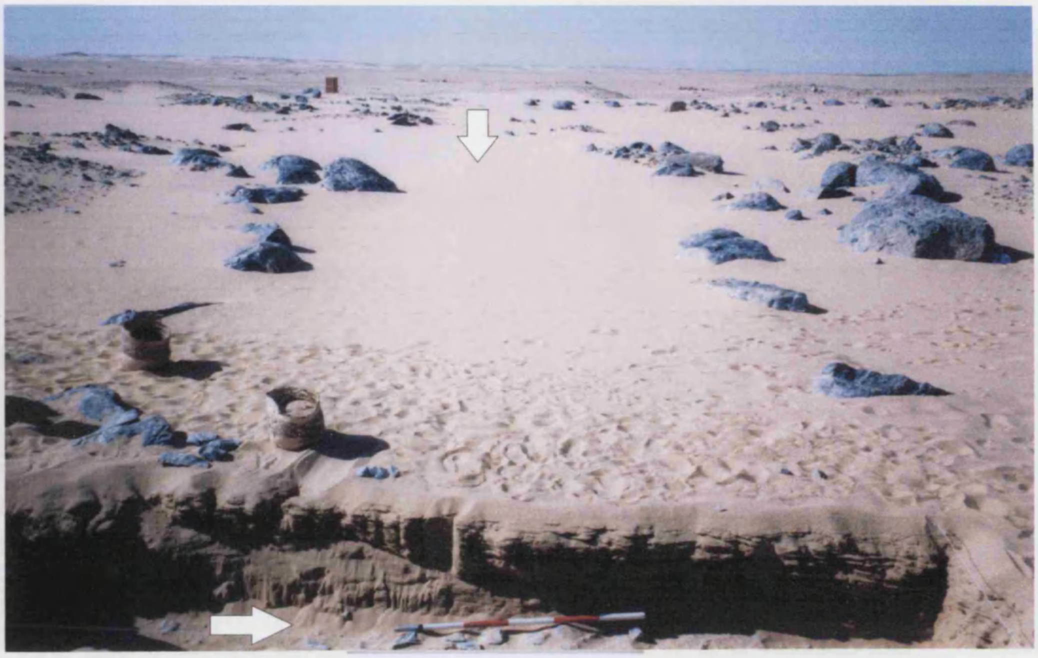
Pl. 66b. Beer jar from Umm es-Sawan Petrie Museum (UC17867; H. 31.5 cm;)

Pl. 67a. Loading ramp 1 (LR1), excavated, showing tracks: Loading Ramp Quarries

Pl. 67b. Loading ramp 2 (LR2), excavated, showing tracks: Khufu Stele Quarries

Fig. 32. Excavated dimensions of Loading Ramp 1 (LR1) and Loading Ramp 2 (LR2)

Feature	LR1	LR2
Width at face of ramp	4.70 m	5.50 m
Height of actual stone exterior at face of ramp	1.22 m	1.00 m
Height of face of ramp from base of tracks	1.63 m	1.32 m
Width of tracks at face of ramp	0.80 m	0.75 m
Depth of tracks at face of ramp	0.33 m	0.33 m
Width of central mound dividing tracks	0.60 m	0.60 m
Total width of both tracks and mound	2.20 m	2.10 m
Distance from face of ramp that the tracks disappear	5.00 m	5.00 m
Approximate overall length of ramp	11.00 m	12.00 m
Approximate angle of slope of ramp	less than 10°	less than 10°



Pl. 68a. Back of LR2 showing excavation area across road, gneiss boulders demarcate road: Khufu Stele Quarries

Pl. 68b. Back of LR1 showing excavation of short less compact paved area: Loading Ramp Quarries

Fig. 33a. Plan of Loading Ramp 1 (LR1) showing face with parallel tracks

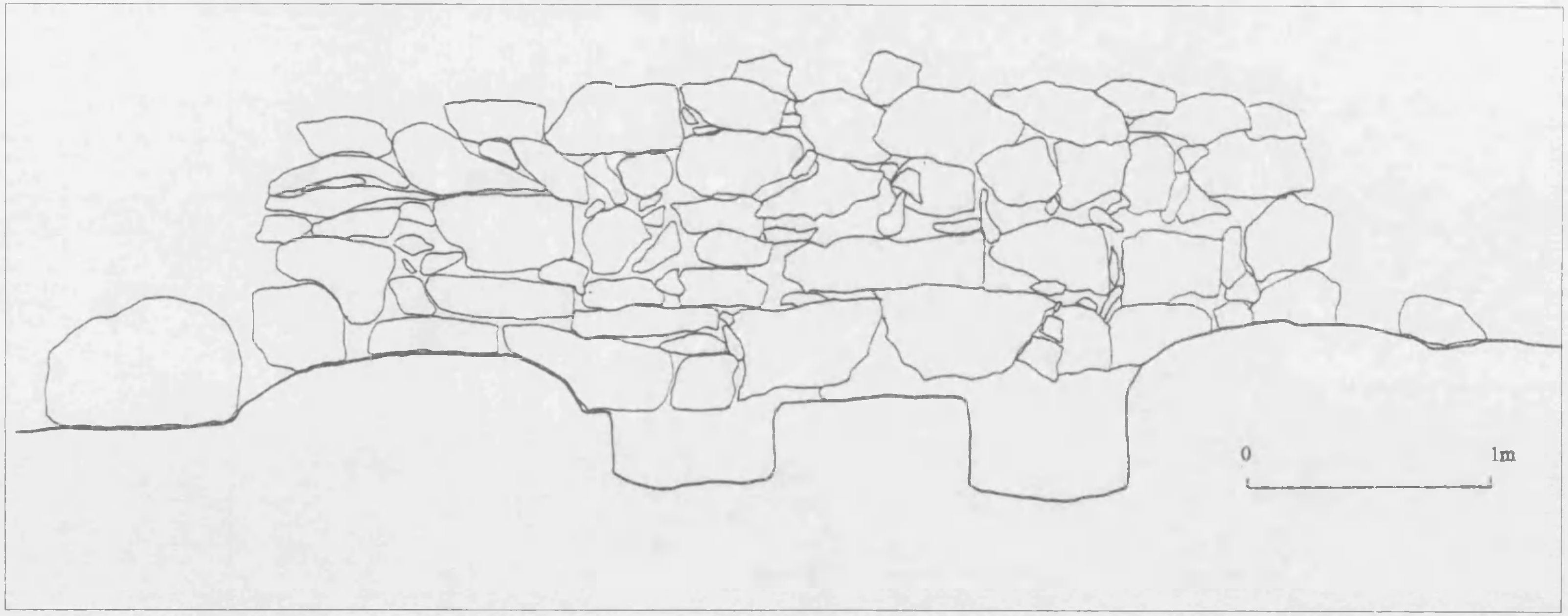


Fig. 33b. Plan of Loading Ramp 2 (LR2) looking down onto parallel tracks

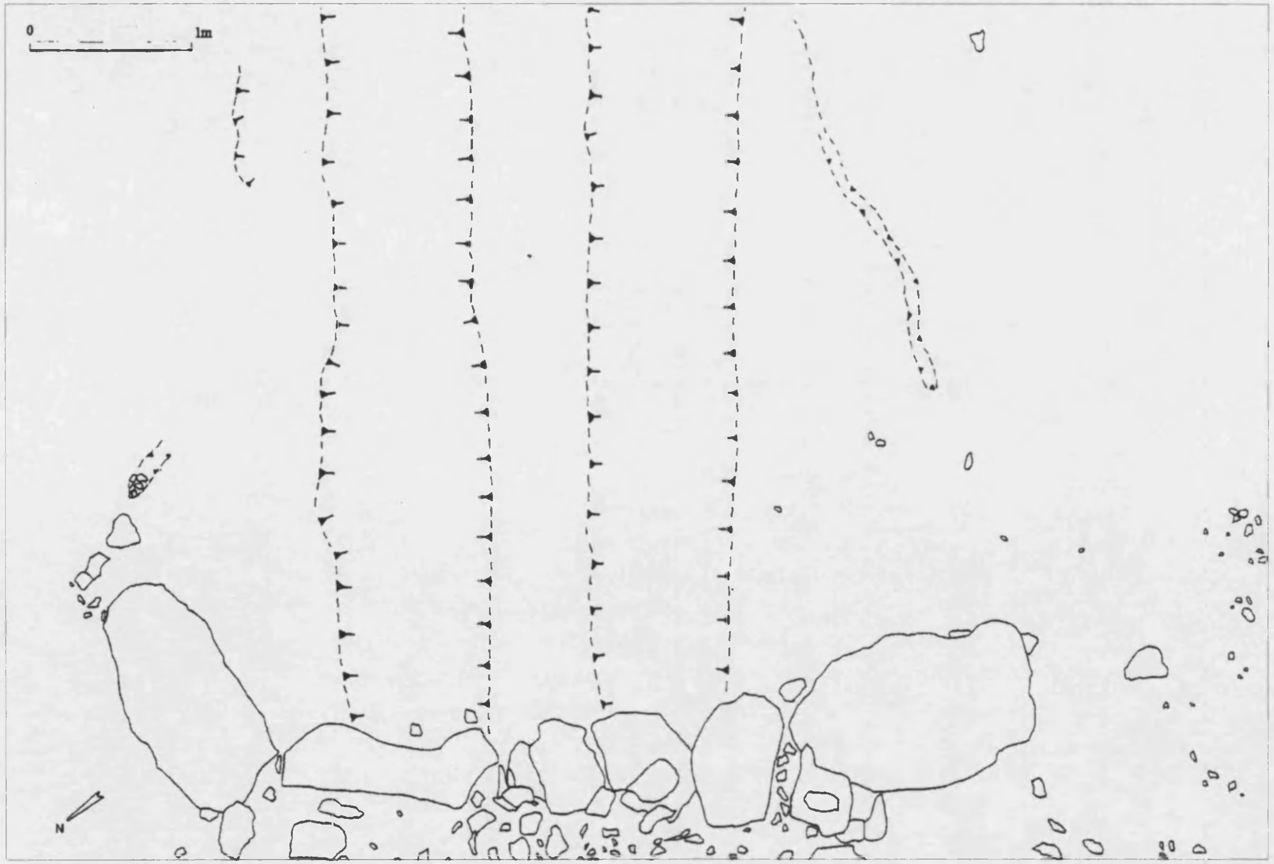
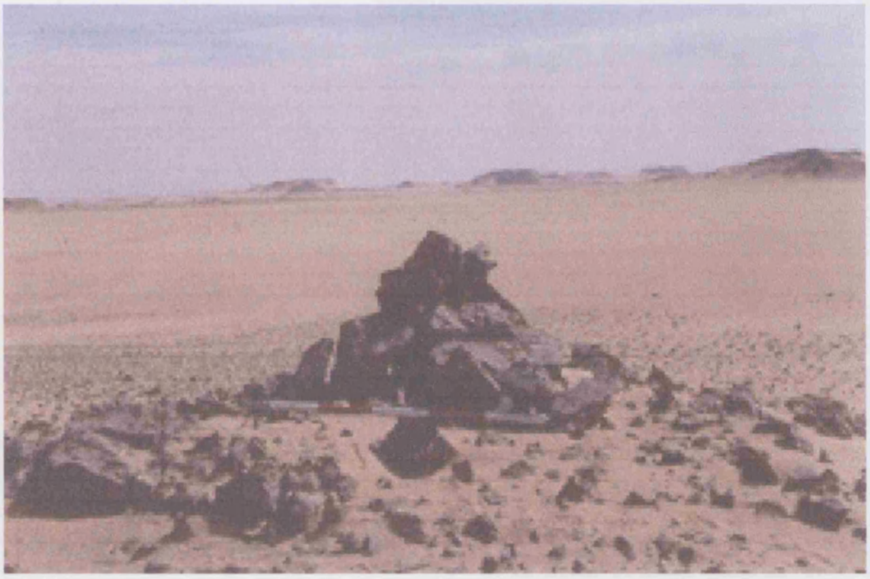


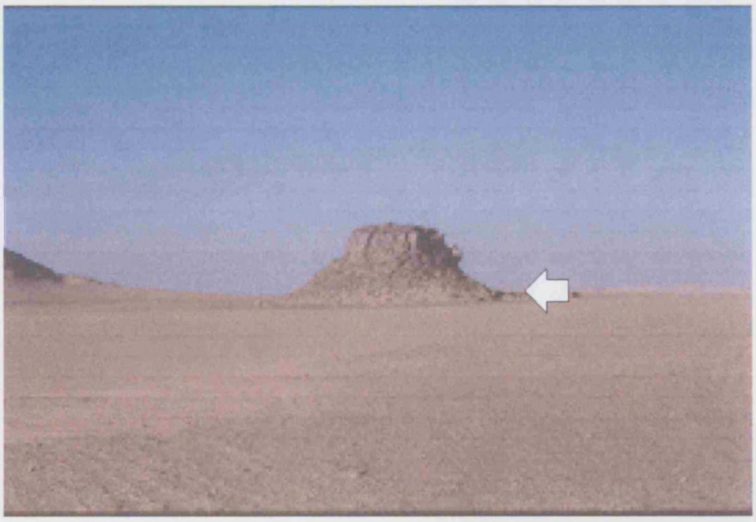
Fig. 33b

Pl. 69a. Looking down on tracks standing on top of LR1

Pl. 69b. Looking down on tracks standing on top of LR2



Pl. 70a. Typical cairn on desert floor of ancient track giving sight-line south-east

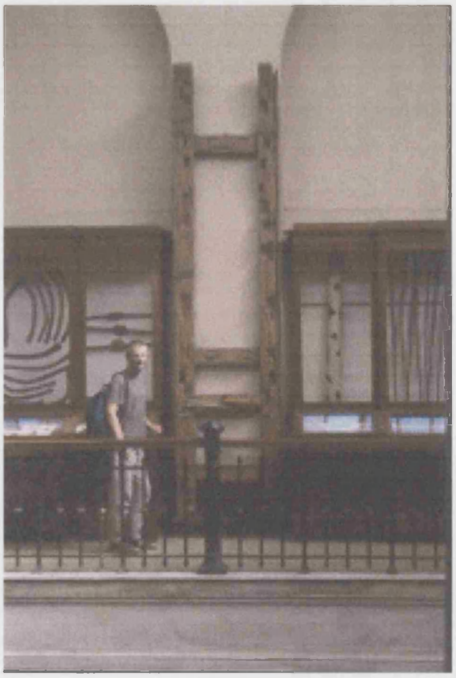


Pl. 70b. Natural rock feature used as a route marker/sight-line, cairn found on top and some evidence of gneiss working at base (see arrow): view to south-east

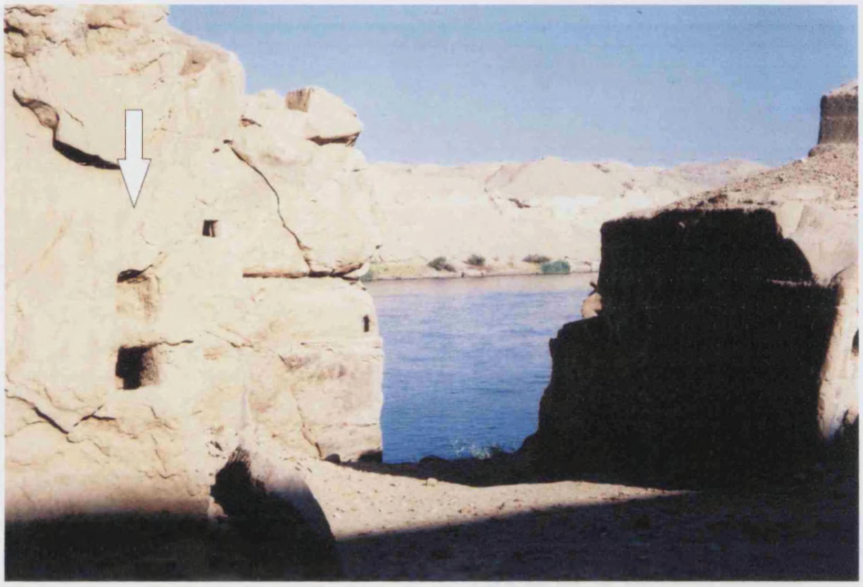
Pl. 71a. Section of ancient paved quarry road along desert plateau connecting Widan el-Faras with Lake Moeris (Qasr el-Sagha)

Pl. 71b. Section of quarry road leading into the West Quarry, Widan el-Faras

Pl. 72. Paved roads (New Kingdom/Roman Period) converging into a single artery at Gebel Gulab silicified sandstone quarry, Aswan



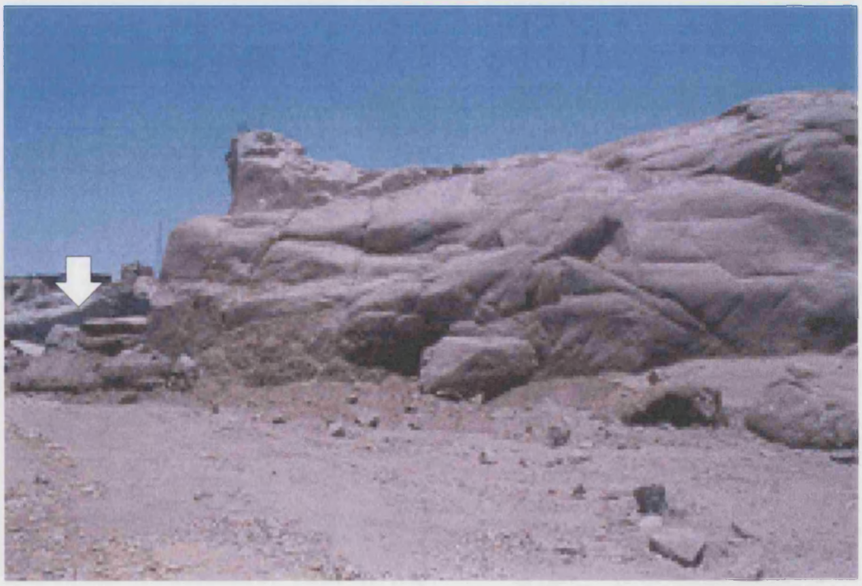
Pl. 73. Middle Kingdom (Dahshur) sledge (H. 4.21m, W. 80 cm): Egyptian Museum, Cairo (CG 4928)



Pl. 74a. Probable 'mooring sockets' for boats, set at different levels: west bank, Gebel Silsila sandstone quarry

Pl. 74b. Close-up of a 'mooring socket' (?): Gebel Silsila sandstone quarry

Pl. 75a. Open channel on ground level, obelisk extractions to the right: 'Obelisk Quarry' Aswan quarries



Pl. 75b. Natural harbour (?) area connecting to channel nr obelisk extractions (see arrow): 'Obelisk Quarry' Aswan quarries

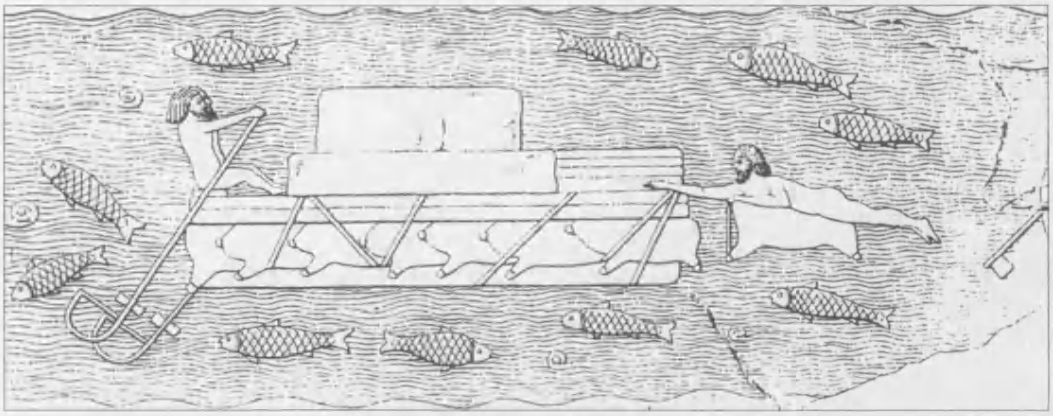


Fig. 34a. Assyrians transporting stone on a buoyed raft (kelek): relief from the Palace of Sennacherib (after Casson 1994: 9)

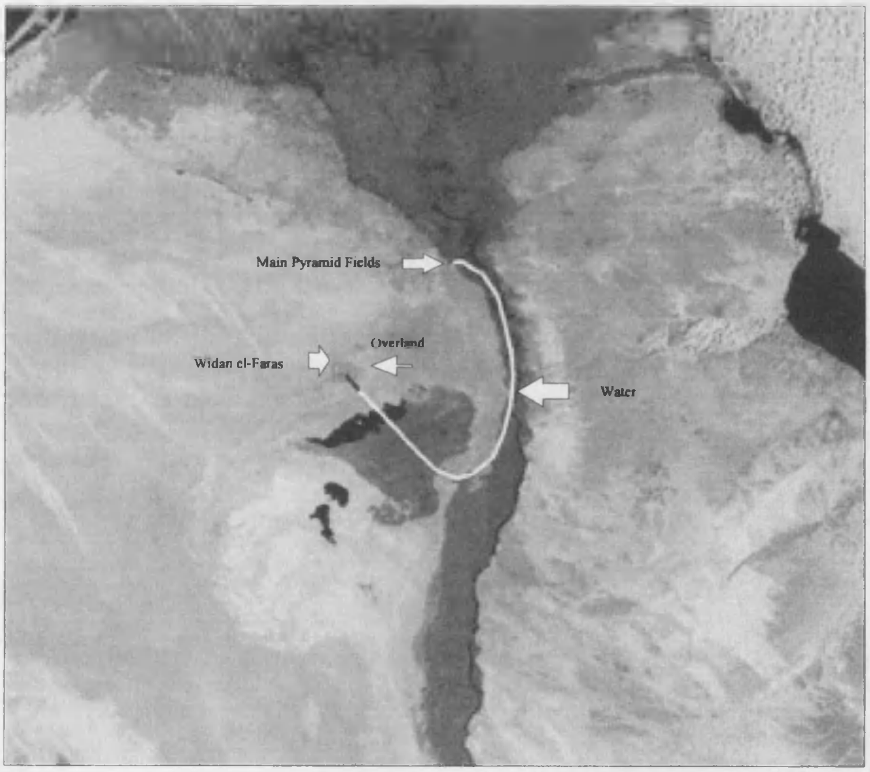


Fig. 34b. Satellite image showing (proposed) basalt transport route from Widan el-Faras, across Lake Moeris, to the main pyramid fields (modified after Storemyr 2001)

Fig. 35

Fig. 35. Illustration of a raft on runners with block being manoeuvred across a loading ramp onto it (drawing by N. Spencer)

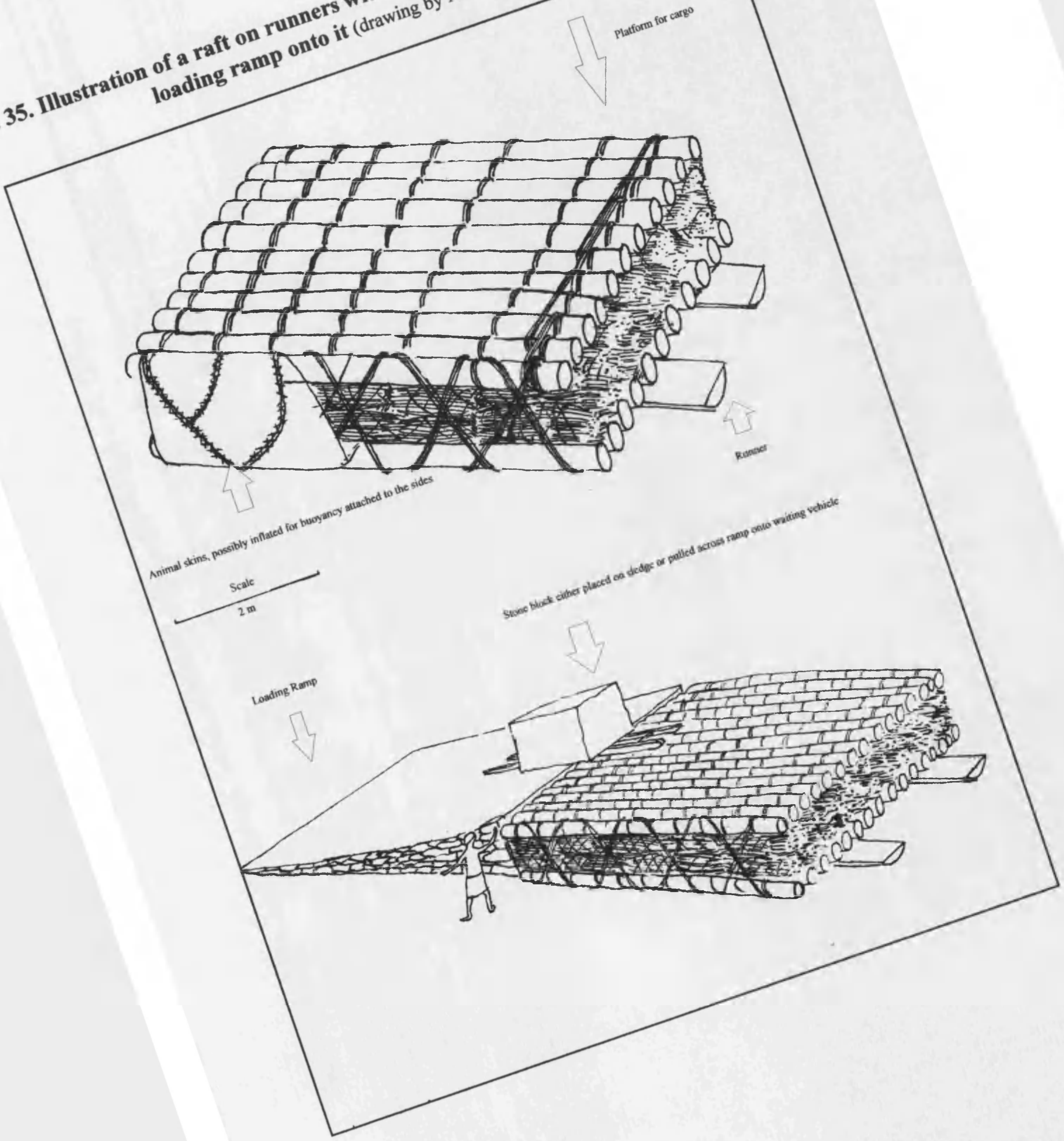


Fig. 36. Structures and Artefacts Associated with Settlement at Chephren's Quarry

Quarries/ Period	Stone-built Features (settlements?)	Food Production/Storage Areas	Faunal/Floral Remains	Pottery	Tools	Defensive or Other Structures
Khufu Stele Quarries (**Early Dynastic - Old Kingdom**)	Possible area of settlement? over an area of approximately 500 m² constituted by scatter of single-level stone walled features, - area greatly disturbed by modern road building.	**Bakery (Building A)** single-level oval stone walled feature (no foundations or roofing) 6 m x 8 m part excavated. South facing entrance.	**Building A**: charcoal	**Bakery (Building A):** intact bread-moulds *in situ* in 10 cm thick ash layer, surface scatters of bowl sherds- dating between 3rd - 5th Dynasty (El-Senussi 2003: 1, 3-4).		Whole of Khufu Stele Quarries demarcated between north and south cairns.
	Building B: 3 m x 4 m oval feature constructed in similar manner to Building A. Living floor is hard ground surface, no evidence of ash or that is was a place of either food production or habitation. No roofing.				**Building B:** 2 dioritic hand-held pounders.	
		Well (Building C) circular, subterranean feature 2 m diameter comprising 3 levels of dry-stone walls, lower courses subterranean- feature is likely to be a well associated with the bakery. No roofing, north entrance		**Well (Building C):** damaged spouted vessel **Note:** spoil heaps from modern road construction contain numerous sherds of bread-moulds, basins, beer jars and storage vessels.		
Ancient Track (Old Kingdom)	Two ephemeral camps (Camp 1 and Camp 2) associated with Well 3 and Well 4 respectively. Both camps contained within a semi-circular dry-stone wall. Excavated dimensions of wall of Camp 1 are: 1.5 m high by 70 cm thick, overall size of camp approximately 5 m N/S and 10 m E/W.	Both contain an area of bread baking and hearths.	Thick ash layers and plentiful charcoal. Sheep/goat bones in Camp 1.	Both camps have quite plentiful amounts of pottery relative to other settlement areas at the quarry. Bread-moulds make up main corpus followed by beer jars and plates (El-Senussi 2003).		Cairns demarcate both camps - also associated with marking the ancient tract.
Quartz Ridge (**Early Dynastic - Old Kingdom**)	**Hut SP 90:** circular feature 4 m in diameter located across the wadi 400 m west of Quartz Ridge consists of 3 courses of loosely assembled dry-stone walls. Has a south entrance, no evidence of roofing. Living level is rocky and uneven, no laid floor. Possible grinding stone of Nubian sandstone. **Hut SP 85:** circular feature 4 m in diameter located 200 m north-west of Quartz Ridge consists of 3 courses of loosely assembled dry-stone walls partly constructed around a natural rock outcrop. Has a south entrance, no evidence of roofing. Living level is rocky and uneven, no laid floor.		**Hut SP 90:** sheep/goat bones; seeds; ostrich eggshell; gastropod shells, charcoal - all are not in datable contexts.	**Hut SP 90:** small scatter of sherds found on floor level, some inscribed , possibly seals? Early Dynastic - Old Kingdom? **Hut SP 85:** few sherds in foundation level of wall, not dated.		Quartz cairn demarcates the eastern extremity of the settlement

Fig. 37a. Plan of remaining settlement area (incl. bakery square SQA1): Khufu Stele Quarries (modified from R. Lee 2000)
Scale 1:75

Contexts:
020 - modern surface
021 - pink mineral deposits
022 - Old Kingdom surface
023 - Ash
024 - (n/a sq C1)
025 - hole in ash pit
026 - vessel in 025
027 - cut of ash pit

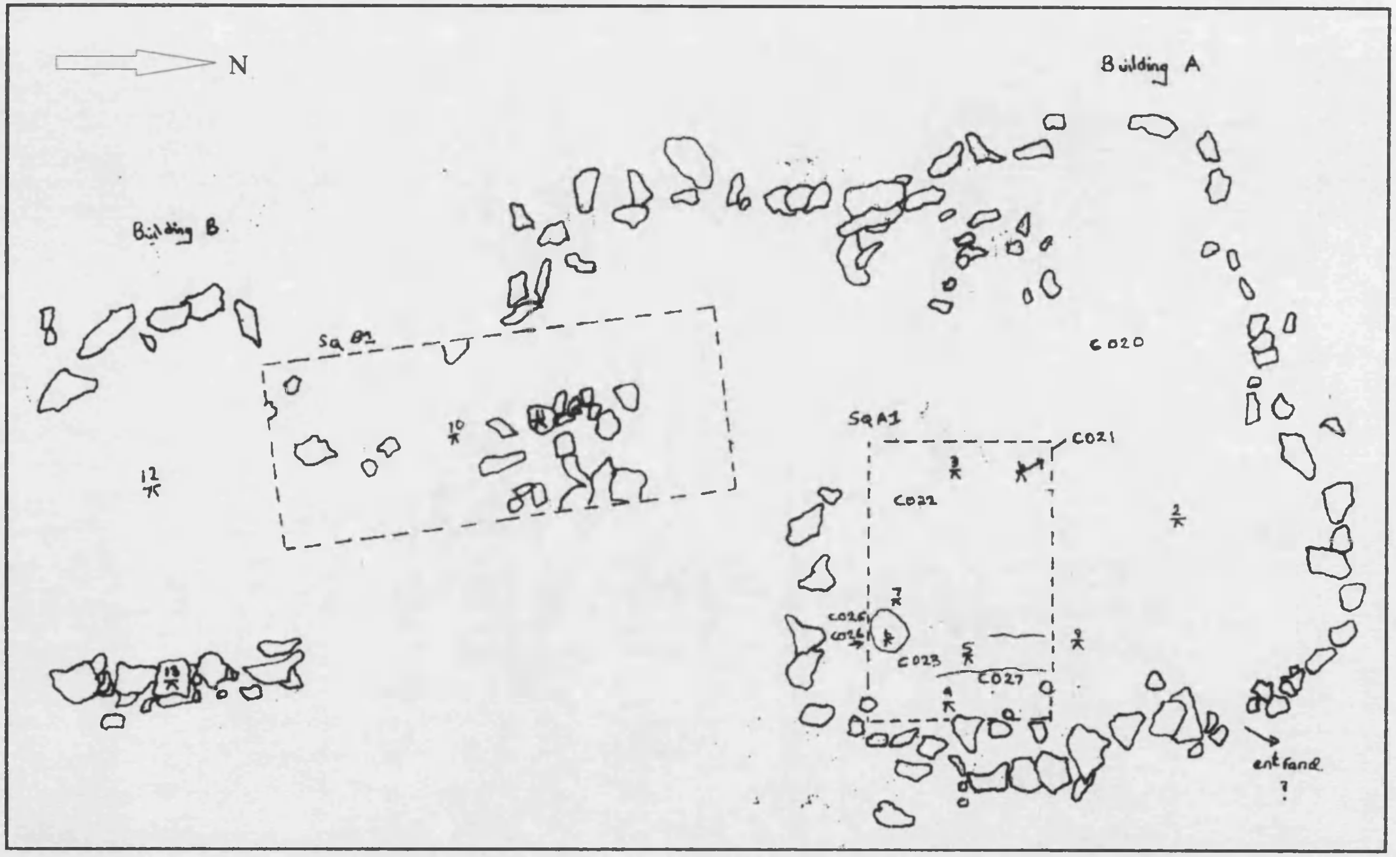
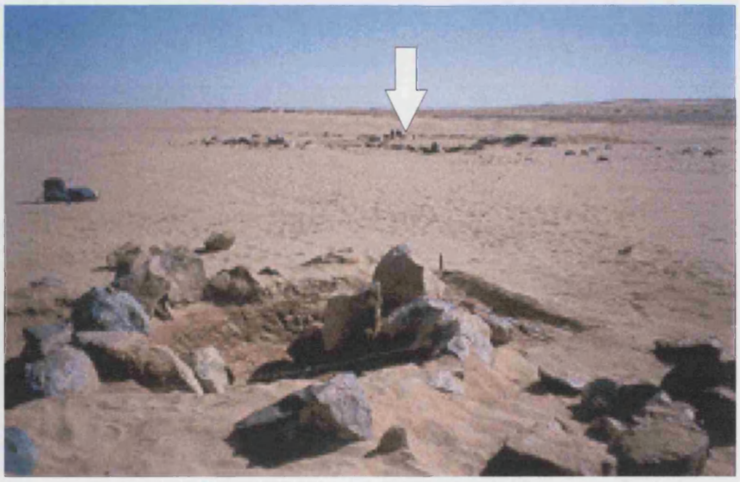


Fig. 37a

Pl. 76a. Bakery, circular pits where bread moulds were placed: Building A (square SQA1), Khufu Stele Quarries, settlement

Pl. 76b. Bread mould found *in situ* in bakery: Building A (square SQA1), Khufu Stele Quarries, settlement



Pl. 76c. Building C or shallow well (?) close to bakery (in background): Khufu Stele Quarries, settlement

Fig. 37b. Plan of SP 85: Quartz Ridge (modified after R. Lee 2000)

<u>Scale 1:50</u>

Contexts:
C 209 - windblown sand
C 213 - natural surface
C 214 - wall

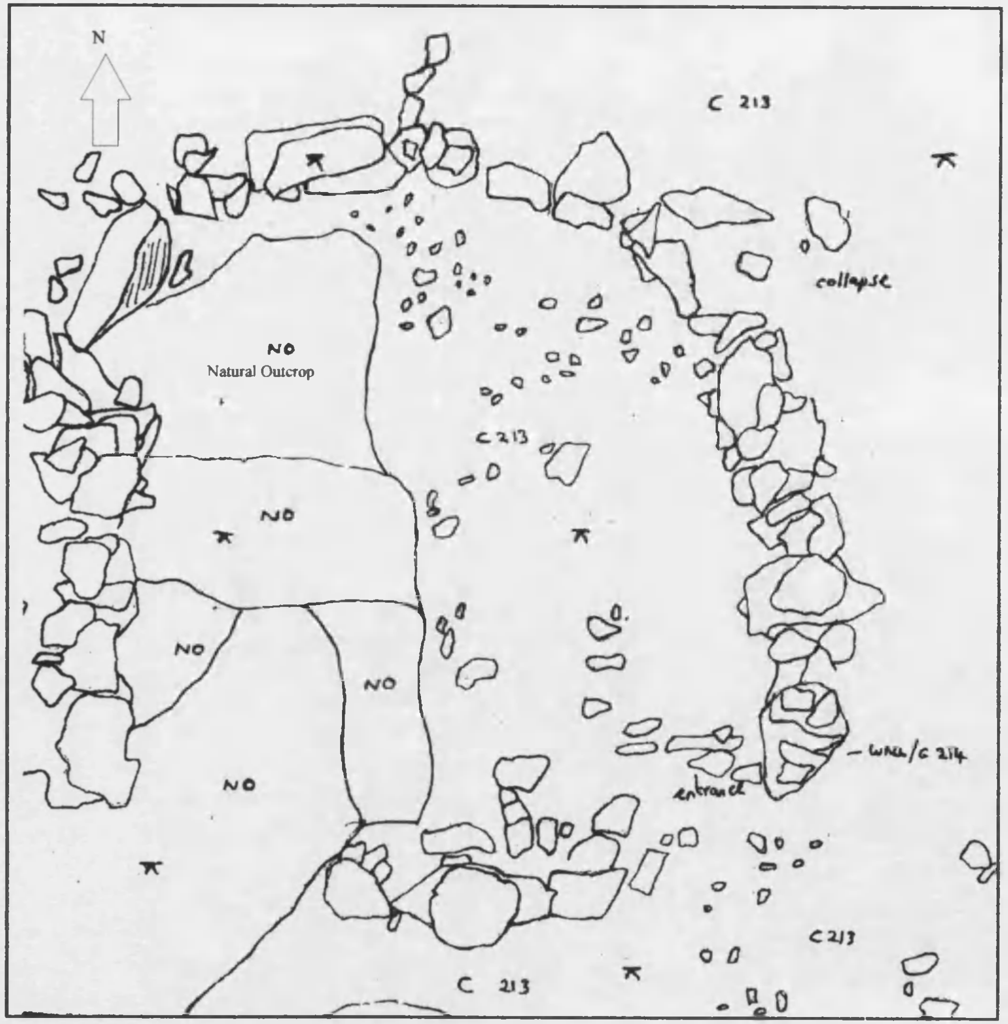
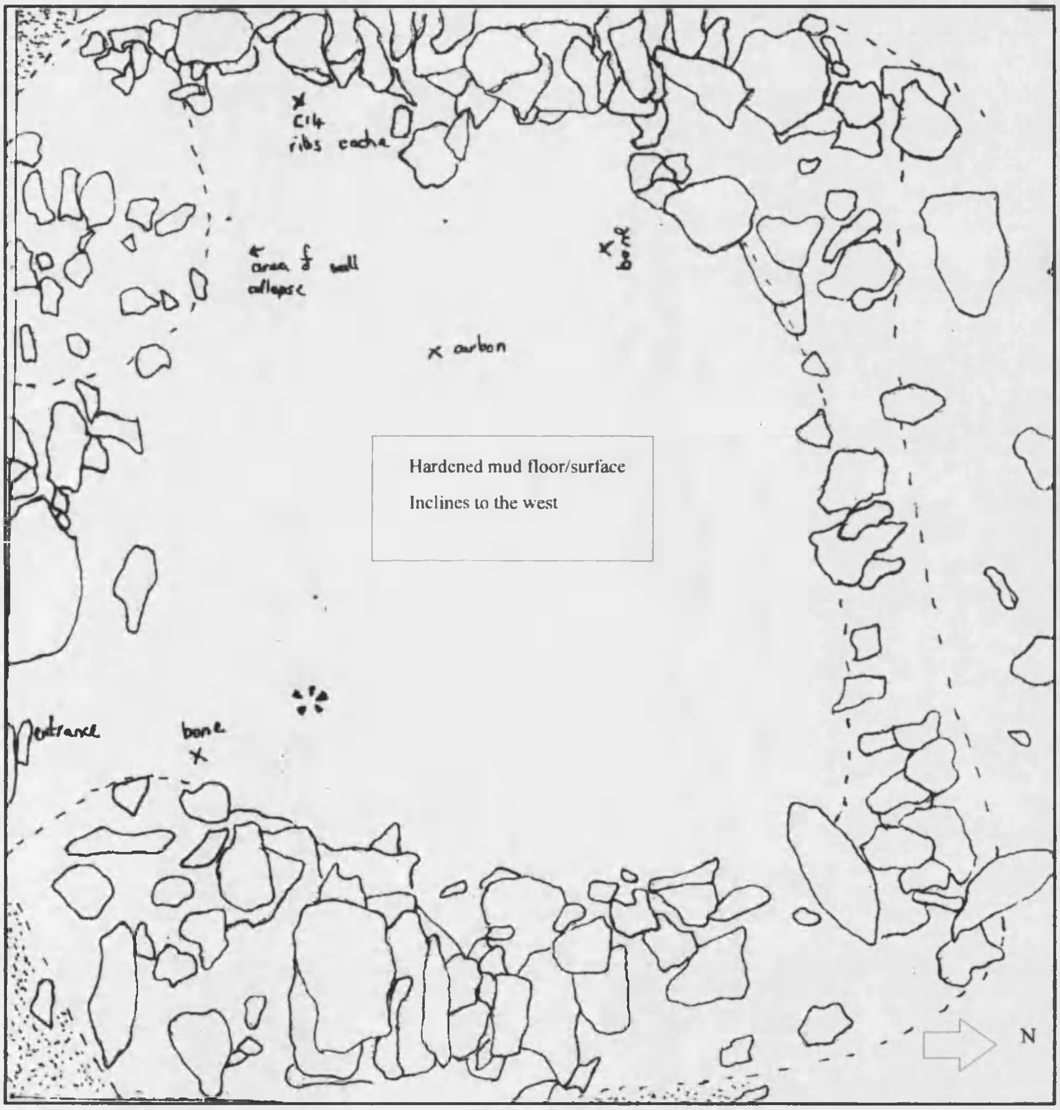


Fig. 37b

Fig. 37c. Plan of SP 90: Quartz Ridge (modified after R. Lee 2000)

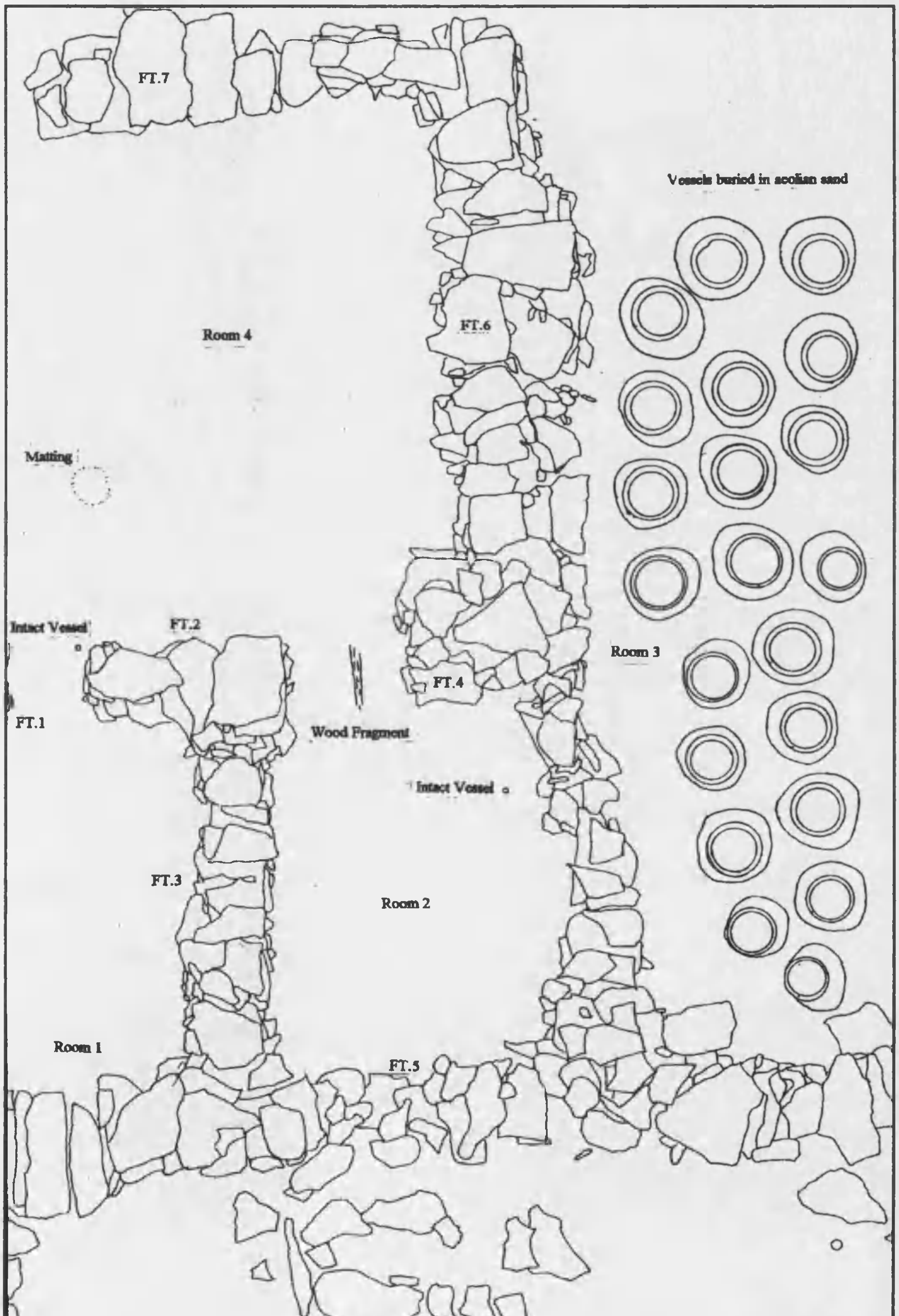
Scale 1:50



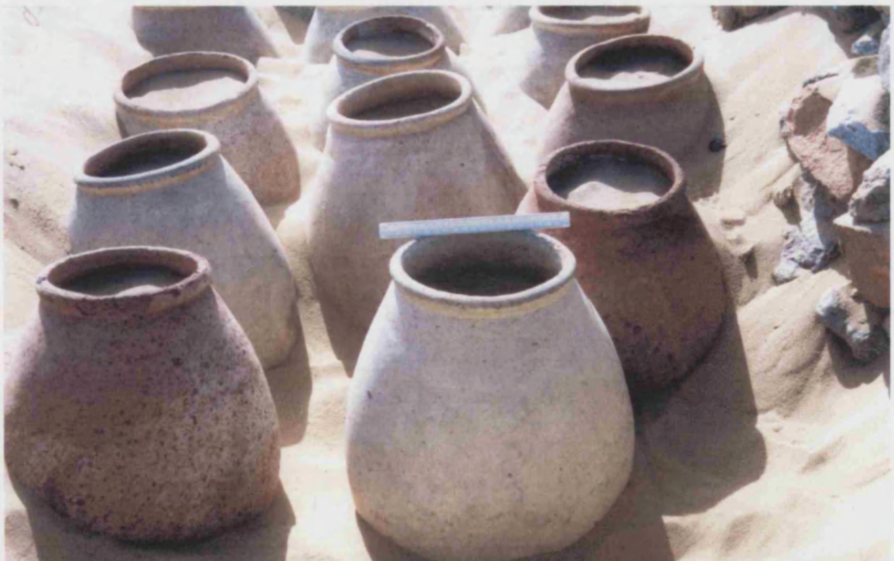
Pl. 77a. View looking down into SP 85 (Old Kingdom?): Quartz Ridge

Pl. 77b. View looking down into SP 90 (Old Kingdom): Quartz Ridge

Fig. 37d. Plan of Middle Kingdom ('settlement'?) or area of interconnecting rooms: Quartz Ridge (R. Lee 1999)

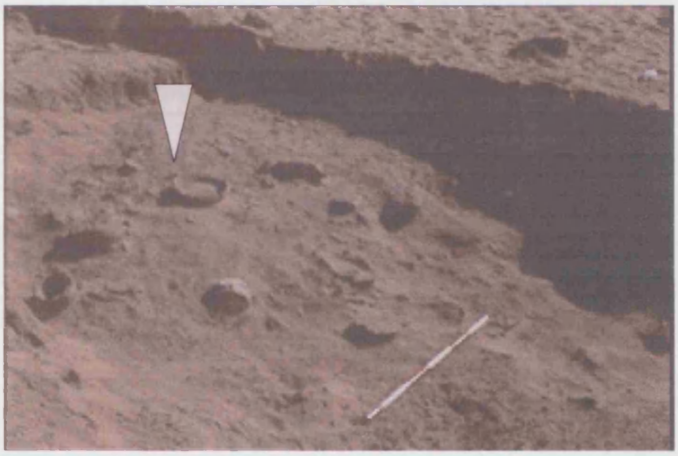


Pl. 78a. Cache of 21 *in situ* late 12th Dynasty beer/water storage vessels: Quartz Ridge



Pl. 78b. Late 12th Dynasty beer/water storage vessels: Quartz Ridge

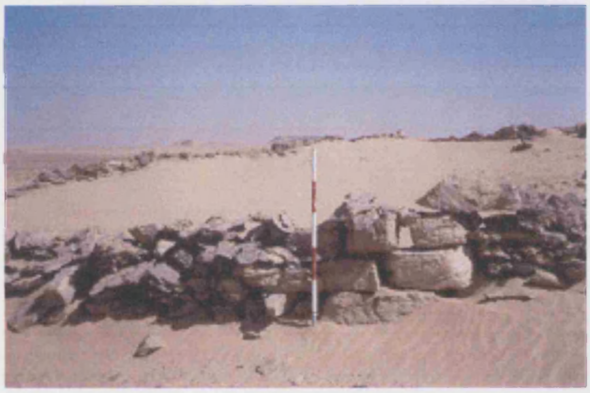
Pl. 79a. Camp 1 (view towards the north and ancient track) partially excavated: ancient track



Pl. 79b. Camp 1 hearth area with bread moulds, partially excavated: ancient track

Pl. 79c. Camp 1 hearth area with 'pesen-loaf' bread mould *in situ* on hearth: ancient track

Pl. 79d. Camp 1: view from outside wall looking towards hillside, hearth area in background: ancient track



Pl. 80a. Camp 2: view from outside wall (unexcavated) looking east: ancient track

Pl. 80b. Camp 2: bread moulds (Old Kingdom) found on surface: ancient track

Fig. 38. Structures and Artefacts Associated with Settlement at Widan el-Faras

Name/ Period	Stone-built Features (settlements?)	Food Production/Storage Areas	Faunal/ Floral Remains	Pottery	Tools	Defensive or Other Structures
Main Quarrymen's Camp? **(Old Kingdom/ Early Roman Period?)**	24 basalt stone circles with range of diameters from 2m to 7 m, linear arrangement each side of quarry road, 275 m long by 11 m wide. Single level structures, basalt weathered and thus walls have collapsed, no roofing or entrances. Circles surround deep depressions, no living floors. No hearths or any evidence of food preparation or storage. Possible area of settlement? Alternatively could be block storage or wells?			Extremely limited, some Early Roman Period and Old Kingdom (4th Dynasty) sherds in either individual or very small surface scatters. No datable context.		
Encampment **(Old Kingdom)**	Small camp represented by cluster of 6 single-level basalt stone circles 3 m to 8 m in diameter. One small hearth. Circles surround shallow depressions, could be tent footings?		Charcoal evident inside one circle. Ash and charcoal in hearth	Relatively plentiful and *in-situ* sherd in hearth dating between 4th-5th Dynasty. Other pottery in dense scatters and dating to same period, corpus only represents storage vessels for liquids (sherd inscribed) and cooking bowls.	2 one-handed pounders of non-local dolerite (origin either Chephren's Quarry or Aswan region)	

Fig. 39a. Plan of 'Main Quarrymen's Camp': Widan el-Faras

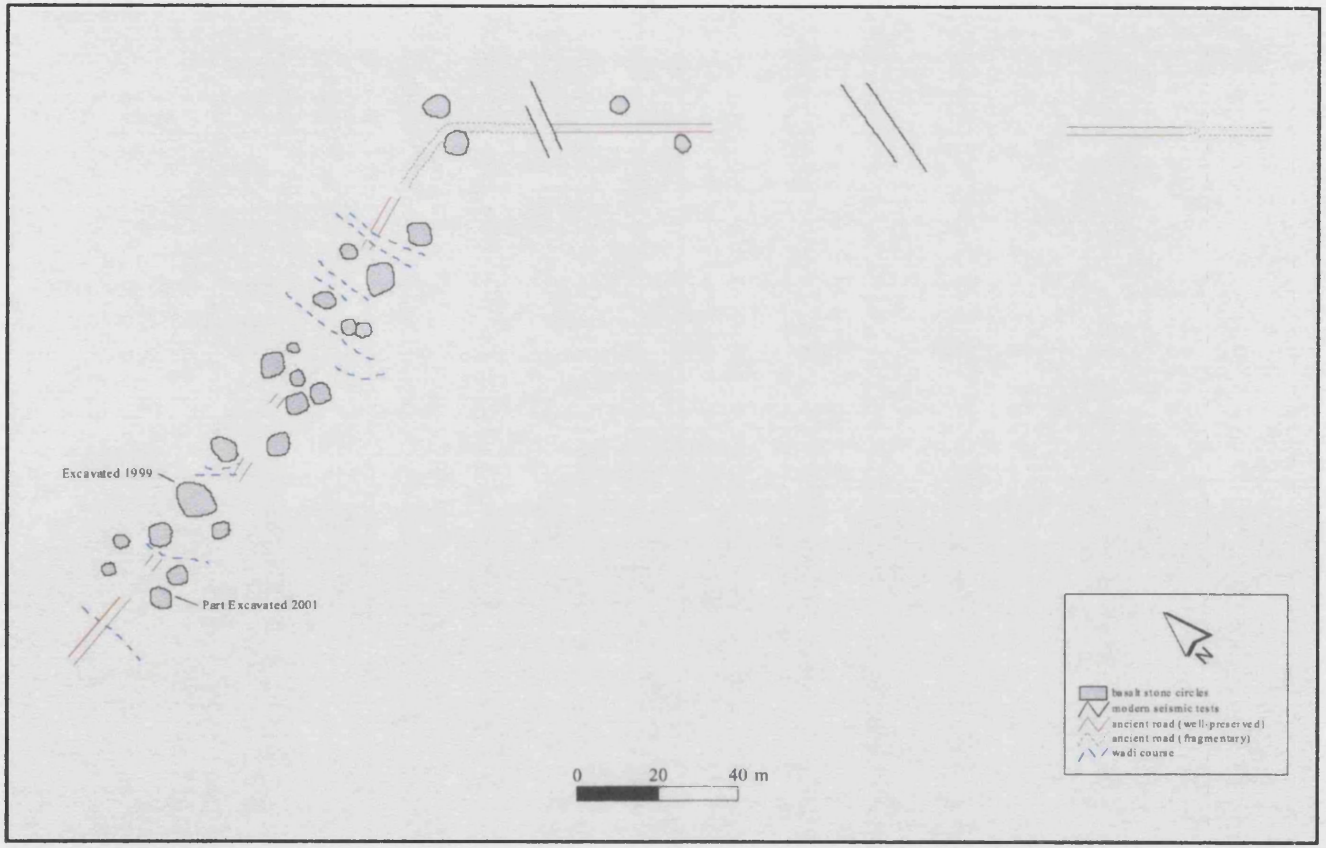


Fig. 39a

Pl. 81a. Basalt stone circles making up 'Main Quarrymen's Camp': Widan el-Faras

Pl. 81b. Trial excavation of a stone circle showing stratigraphy: 'Main Quarrymen's Camp' Widan el-Faras

Fig. 39b. Plan of encampment showing pottery concentrations: Widan el-Faras

Fig. 39b

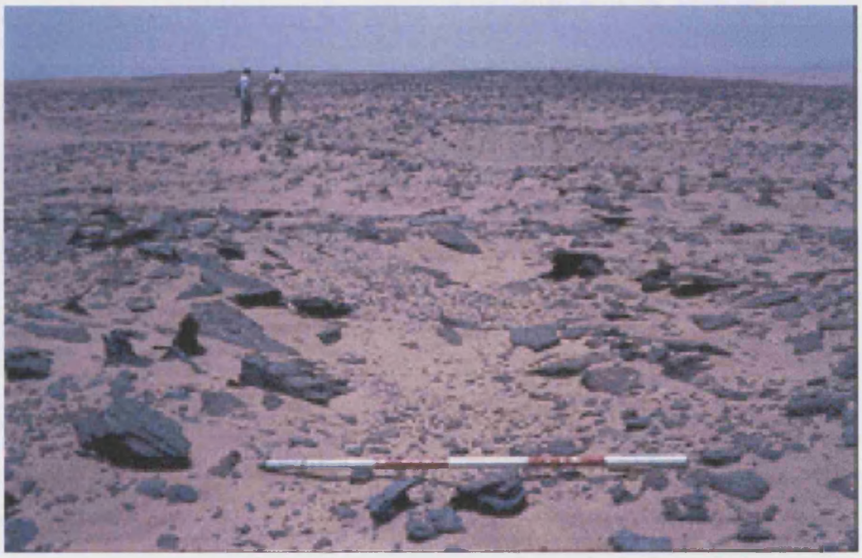
Pl. 82a. Stone circle in encampment: Widan el-Faras

Pl. 82b. Excavated hearth in encampment: Widan el-Faras

Fig. 40. Structures and Artefacts Associated with Settlement at Other Old Kingdom Quarry and Mining Sites

Quarries/ Mines	Stone-built Features (settlements?)	Food Production/Storage Areas	Faunal/Floral Remains	Pottery	Tools	Defensive or Other Structures
Hatnub (travertine quarry, Zone P - Nile Valley)	Sprawling scatter of dry-stone walled huts, some in 8 multi-room clusters and also individual crescent shaped windbreaks close to Zone P Old Kingdom quarry. Some walls over 1.2 m high. Evidence of roofing via post-holes, defined entrances (Shaw 1986: 198-200, 1987: 165).	Many bread moulds were found but no evidence of a bakery, although a heavily charcoaled feature was located but not excavated (Shaw pers. comm. 2001). Generally no evidence of food production taking place (Shaw *op. cit.*, Shaw forthcoming).	Minimal, only some charcoal close to multi-roomed structure NW23 (*op. cit.*).	At NW23 and S26 (hut clusters) found many sherds: Meidum bowls, bread moulds and beer jars. Most sherds typed to 5th Dynasty reign of Userkaf. Only small amounts of pottery or artefacts associated with individual shelters. Later small Coptic and Roman presence (*op. cit.*).	Stone hammer. Some flint tools but uncertain context, possibly New Kingdom? (Shaw 1987: 162, 166).	Some shrines (Shaw 1986: 204-8).
Wadi Gerrawi (travertine quarry - Nile Valley)	Numerous dry-stone walled huts west of the dam and similar to those at Hatnub but little detail given (Petrie & Mackay 1915: 39).	Located above the huts is a square enclosure with walls up to 1 m and 75 m thick - suggested as a storehouse for food and tools (*op. cit.*).		Only mention of pottery found in the enclosure dating between 3rd - 4th Dynasty. There was a later small Roman presence (*op. cit.*).		
Umm es-Sawan (gypsum quarry, Northern Faiyum Desert)	Large area of up to 250 shallow dry-stone walled stone circles (range of diameters 1.5 m - 6 m and 51 cm high) surrounding artificial depressions (approx 75 m deep) into the gebel. No discernible entrances, roofing structures or living floors. Suggested as being seasonal windbreaks (Caton-Thompson & Gardner 1934: 121). A few of the stone circles show evidence via hearths and ash of possibly some food preparation, although extremely minimal for size of the settlement (*op. cit*: 120).		Some charcoal and fish bones near central hearths *inside* the stone circles (*op. cit*: 122).	No pottery found (*op. cit*: 120) and during author's field observations of the area in 2001, no pottery was found.	Pebble-pick and one-handed pounders of Chephren Gneiss found inside the circles, gypsum vessel blanks (*op. cit.*).	
Gebel Manzal el-Seyl Quarry (tuff limestone - Eastern Desert)	Only 4 stone circles, roughly ovoid to circular with diameters between 2-2.5 m. No artefacts to date these features, could be modern? (Harrell *et al*: 2000: 41)				Numerous quantities of pounders and stone axes, but only associated with stone vessel work places where there are no stone features (*op. cit*: 38-9).	
Wadi Maghara (turquoise mines - Sinai)	Cluster of 125 hut shelters or windbreaks with dry-stone walls of less than a metre high near top of 'Fort' hill. Suggested that these were built here as protection from wild animals (Petrie & Currelly 1906: 36-40). At the mines groups of huts on one level, had levelled living floors, well made dry-stone walls. Above this was another groups of huts then above at 60 m above the valley another group of 125 huts with very low walls , probably windbreaks (*op. cit*: 50-2).		Charcoal found in highest level huts at the turquoise mines (*op. cit*: 52).	Pottery mostly dating to the Old Kingdom (*op. cit.*).	Stone axes and pounders found associated with the huts (*op. cit*: 51, Fig. 58).	Although the positioning of the settlements suggests some type of robust enclosure, debatable if these were fortifications or defensive structures (*op. cit*: 40, 51).

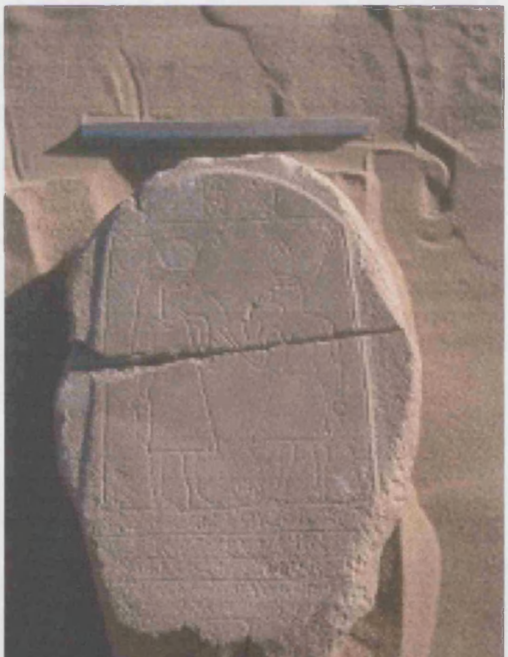
Pl. 83a. Small cluster of huts/windbreaks at Hatnub
(after Shaw 1986: 202)



Pl. 83b. View of 'settlement': Umm es Sawan gypsum quarries

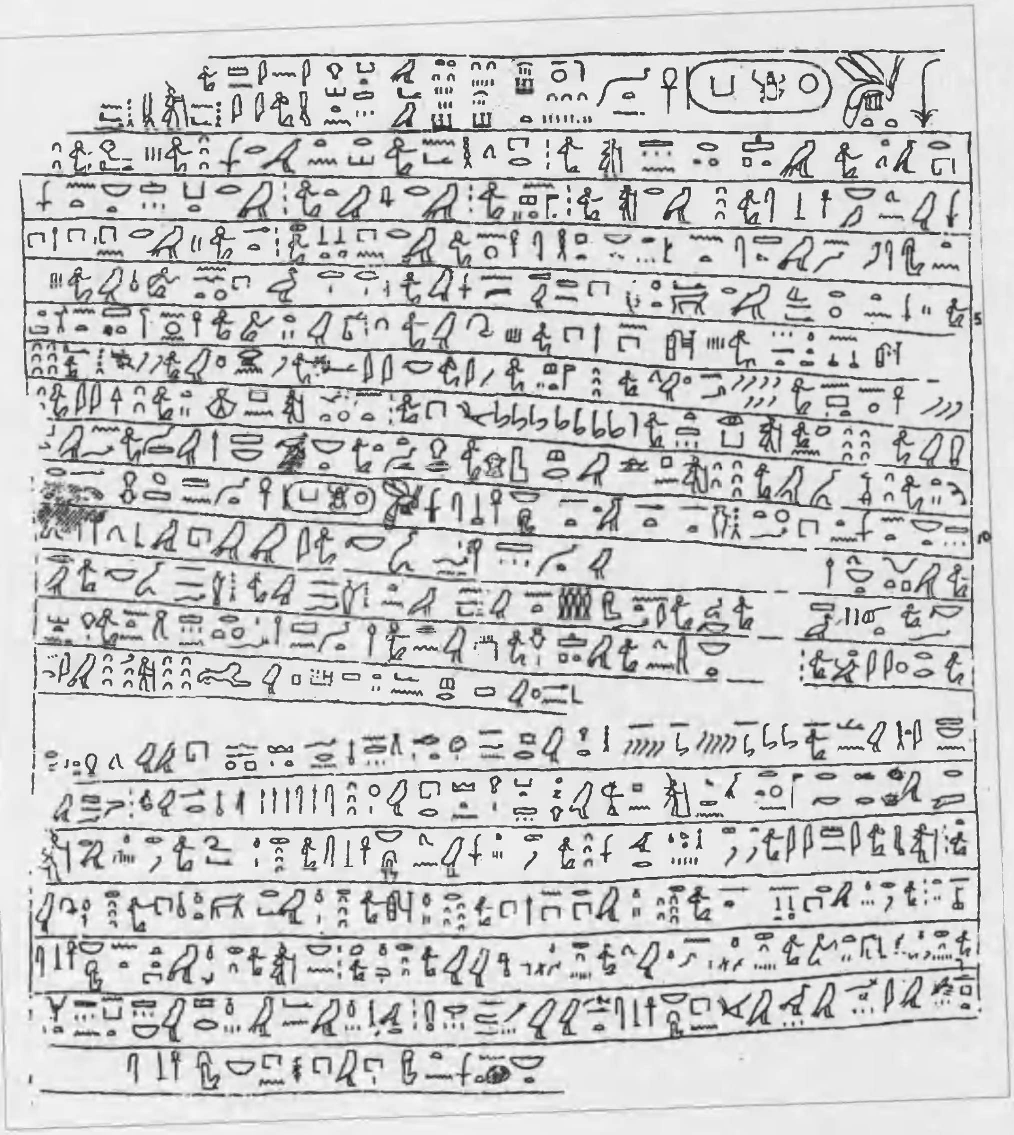
Pl. 83c. Pottery (mainly beer jars) at (vessel) workshops: Umm es Sawan gypsum quarries

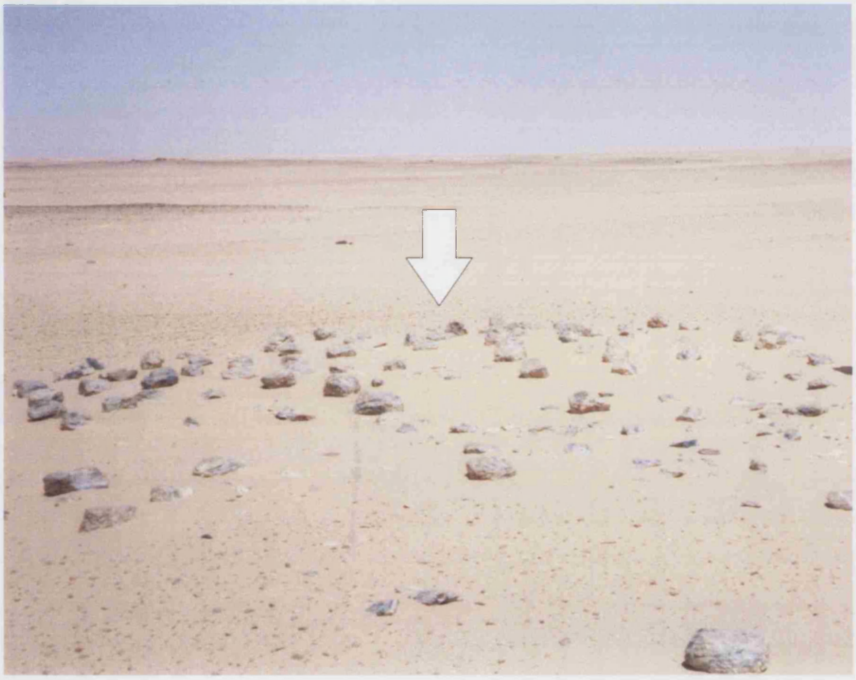
Pl. 84. Well 1 at Khufu Stele Quarries, unexcavated



Pl. 85. Middle Kingdom sandstone stele, Amenemhet II: Stele Ridge

Fig. 41. Wadi Hammamat inscription dating to reign of Senusret I (Middle Kingdom) (after Goyon 1957: Inscription No. 6)





Pl. 86. Small block storage area outside of spoil heaps near cleared track: Chisel Quarry

APPENDIX A

APPENDIX A

GLOSSARY OF GEOLOGICAL TERMS

Aquifer	a formation, stratum or zone below the surface of the earth that, because of good porosity and permeability , is able to transmit water in sufficient quantity to supply springs and wells
Amygdaloidal	a general name for volcanic rocks, such as basalts that contain numerous gas cavities (amygdales) often filled with later minerals
Artesian	ground water under sufficient hydrostatic head to rise above the aquifer containing it
Amphibole	a group of silicate minerals, common in igneous and metamorphic rocks
Basalt	a dark finely crystalline igneous rock common as lava flows and dykes
Basement complex	a series of predominantly igneous and metamorphic rocks considerably older than sedimentary and other rocks overlying them
Biotite	a mineral of the mica group
Calcite	one of the commonest minerals (calcium carbonate); principle constituent of limestone
Calc-sinter	stalactitic or stalagmitic carbonate of lime deposited from thermal springs
Calcrete	case-hardened crust of soil formed in semiarid climates by the cementation of gravel and other residual deposits by calcium carbonate
Cretaceous	third and last period (c. 66 - 144 m. y.)of the Mesozoic Era
Diatom	silica rich single-celled microscopic plant growing in marine or fresh water

Dolerite	(or diabase) are rock names applied to coarse-grained basalt, this is not appropriate for Widan el-Faras basalt due to it being fine-grained (see Harrell and Bown 1995: 76)
Dyke	an injected wall-like igneous intrusion cutting upwards through other formations - often the feeders for lava flows
Eocene	the geologic epoch extending from 60 to 45 million years ago
Feldspar	a rock-forming silicate mineral, usually white or pinkish in colour - very abundant in granite, diorite and syenite
Flood basalt	basaltic lavas of considerable lateral extent and commonly distinguished as tholeiitic or olivine basalts
Gneiss	a metamorphic crystalline rock with light bands of granitic composition (quartz and feldspar) interbanded with dark amphibole rich schistose segments
Granitic	pertaining to, or composed of, granite or granite-like rock
Granitoids	texture of igneous rocks such as granites in which the mineral constituents are mostly crystalline and more than 2 mm
Gypsum	alabaster; selenite. A common mineral in evaporities, used in the manufacture of plaster of Paris
Haematite	an iron oxide mineral; red-brown to black in colour
Hornblende	see 'Amphibole'
Igneous rocks	'hard' rocks derived from the cooling and crystallization of hot fluid magma, such as granite, granodiorite, diorite, gabbro, dolerite, basalt; subdivided into plutonic (intrusive) and volcanic (extrusive) rocks
Ilmenite	a mineral, principle ore of titanium
Lacustrine	produced by or belonging to lakes
Magnetite	an iron oxide mineral; a frequent minor accessory mineral of igneous rocks, black in colour
Massive	occurring in thick beds, free from minor joints and lamination

Mesa a flat topped mountain or other elevation bounded on at least one side by a steep cliff

Metamorphism process by which rocks are altered in composition by pressure, heat and the introduction new chemical substances

Metamorphic rocks 'hard' rocks formed form the heating, recrystallization and partial melting of older igneous, sedimentary and metamorphic rocks buried within the earth's crust, such as gneiss, schist, marble

Mica a mineral group of consisting of sheet silicates

Oligocene the third of th epochs into which the Tertiary period is at present ordinarily divided

Orthoclase a silicate mineral of the feldspar group; common in granitic rocks

Porphyritic igneous rocks containing conspicuously larger crystals in a finer-grained groundmass

Phenocryst large and conspicuous crystals in porphyritic igneous rocks

Plagioclase a silicate mineral group which ranges in composition from albite to anorthite, usually white in colour

Plutonic rocks igneous rocks solidified slowly underground; coarse-grained, crystals visible with naked eye

Quartzite (1) a granulose metamorphic rock consisting of essentially of quartz; (2) sedimentary quartzite that is silica-cemented was used by ancient Egyptians

Quaternary younger (from c. 2 m. y.) of the two periods in the Cenozoic Era; further divided into earlier Pleistocene and Recent or Holocene

Schist a metamorphic crystalline rock in which minerals such as amphibole and mica are parallel aligned to give a fine banded or lamellar texture

Sedimentary rocks	usually 'soft' rocks derived from the consolidation and lithification of sediments like sand, mud, volcanic ash, etc. Also includes calcareous sediments such as limestone, travertine, etc. Some sedimentary rocks can be very hard such as quartzite, greywacke, (siltstone), breccia
Silicified	cemented or replaced by silica
Syenite	a plutonic igneous rock consisting principally of alkalic feldspar with other minerals such as hornblende or biotite
Tertiary	the earlier (c. 2-58 m. y.)of two geologic periods comprised in the Cenozoic era
Tholeiitic basalt	basalt poor in the mineral olivine; commonly glassy
Trachyte	extrusive rock composed of alkalic feldspar, minor biotite and hornblende: the extrusive equivalent of syenite
Tuff	rock both igneous and sedimentary in origin formed from lithification of sediment consisting of volcanic ash; often misidentified in archaeological literature as 'volcanic ash'. Tuffaceous limestone consists of predominantly crystalline calcite, chlorite replaces plagioclase to give it bluish/green colour - used for vessels in Early Dynastic Period, source at Gebel Manzal el-Seyl, Eastern Desert
Vesicular	containing many small gas cavities or vesicles
Volcanic rocks	igneous rocks solidified quickly above ground; fine-grained - individual crystals too small to be distinguished by the naked eye

APPENDIX B 1 - B 5

CATEGORISATION OF 'HARD' AND 'SOFT' ROCKS*

* MOHS hardness scale of 1 = talc (softest) to 10 = diamond (hardest). Soft rocks/minerals genrally have hardness of about 5 and can be scratched with a knife.

Stone Type	Hard	Soft
Anhydrite		✓
Aragonite		✓
Basalt	✓	
Breccia	✓	
Chephren Gneiss	✓	
Diorite	✓	
Dolomite		✓
Dolerite	✓	
Gabbro	✓	
Granite	✓	
Granodiorite	✓	
Greywacke	✓	
Gypsum		✓
Hornblende Diorite	✓	
Limestone		✓
Marble	✓	✓
Obsidian	✓	
Porphyry	✓	
Quartz	✓	
Quartzite (silicified sandstone)	✓	
Sandstone		✓
Schist	✓	
Serpentine		✓
Siltstone	✓	
Slate		✓
Steatite		✓
Syenite	✓	
Trachyte	✓	
Travertine		✓
Tuff	✓	✓
Tuffaceous Limestone		✓

APPENDIX B 2

Petrie Stone Vessel Corpus: table of all stone types and quantities per dynasty (colour coding green = soft stones; red = hard stones)

Stone Type	Predyn to 2nd Dynasty	3rd Dynasty	4th Dynasty	5th Dynasty	6th Dynasty	FIP - 12th Dynasty
Anhydrite (Blue Marble)	0	0	0	0	0	24
Aragonite	2	0	0	0	0	0
Basalt	21	2	0	0	3	1
Breccia	2	0	0	0	0	0
Chephren Gneiss	5	5	0	0	3	0
Dolomite	1	0	0	0	0	0
Granite (White)	1	0	0	0	0	0
Gypsum	18	6	0	0	0	1
Limestone (Red/Pink)	12	0	0	0	0	0
Limestone (Blue/Whit/Gy)	9	2	0	0	1	2
Limestone (Black)	5	8	1	2	1	1
Limestone	21	10	0	0	4	13
Marble (Black/Grey)	0	1	0	0	0	5
Marble (Pink)	1	0	0	0	1	2
Obsidian	0	0	0	0	1	0
Porphyry (Red)	1	0	0	0	0	0
Porphyry	0	1	0	0	0	0
Porphyry (Black/White)	16	1	0	0	0	0
Quartz Crystal	2	0	0	0	1	0
Quartz (White)	0	1	0	0	0	0
Sandstone	0	0	0	0	0	1
Schist	0	0	0	0	0	1
Serpentine (Black)	0	0	0	0	0	11
Serpentine	6	0	0	0	0	6
Slate	15	1	0	0	0	2
Steatite	5	1	0	0	0	3
Syenite	6	0	0	0	1	0
Travertine	171	32	1	2	47	110
Tuffaceous Limestone	19	4	0	0	0	0

Use of Stone for Monumental Construction in Royal Pyramid Complexes: 3rd - 6th Dynasty

(Compiled from:- Petrie 1883; Borchardt 1907, 1910, 1913; Firth & Quibell 1935; Jéquier 1938; Fakhry 1969, Lauer and Leclant 1972; Leclant 1979; Edwards 1991, Lehner 1997 and Verner 2002)

Dynasty	Structure	Chephren Gneiss	Aswan Granite (pink/red)	Aswan Granodiorite (grey/black)	Basalt	Travertine	Comments
3rd	Djoser Step Pyramid (Saqqara)	paving in burial chamber and south tomb	wall linings of king's burial chamber and burial chamber in South Tomb; portcullis				limestone mostly used, floors of temples were mudbirck (Firth & Quibell 1935)
3rd	Sekhemkhet Step Pyramid (Saqqara)						
3rd	Khaba's Layer Pyramid (Zawiyet el-Aryan, Saqqara)		wall linings of burial chamber				unfinished but shows first example of fine polishing of granite, some blocks weighted up to 43 tons (Fakhry 1969: 54-7)
4th	Snefru (stepped tower at Meidum)						mainly all limestone, many masons inscriptions (Verner 2002: 167)
4th	Snefru 'Bent' Pyramid (Dahshur)					offering table in mortuary temple, altar in cult pyramid	much larger core & casing stones (Lehner 1997: 102)
4th	Snefru 'Red' or 'North' Pyramid (Dahshur)		false door in mortuary temple				ramps connect quarry to pyramid (Verner 2002: 184)

Dynasty	Structure	Chephren Gneiss	Aswan Granite (pink/red)	Aswan Granodiorite (grey/black)	Basalt	Travertine	Comments
4th	Khufu Pyramid Complex (Giza)	possible use for protective edges of the Queen's Pyramid (Petrie 1883:136)	wall linings in king's chamber, 3 portcullis, beams in chambers above burial chamber, columns in MT		floors of MT & VT,*[1] harbour wall east of VT; arris lines on corners of Queen's pyramids		first instance of granite and basalt to construct a temple (Lehner 1997: 109)
4th	Djedefre Pyramid Complex (Abu Roash)		20 courses of outer casing, wall linings		few chips in rubbish tip (Petrie 1883:142)		used extensively as a quarry from NK to 19th cent. AD (Verner 2002: 222)
4th	Khafre Pyramid Complex (Giza)		2 courses of pyrmaid outer casing, wall linings of entrance passage, 2 portcullis, walls of MT, VT & causeway, 18 columns in MT & VT		door lintel in VT	wall linings of 2 chambers in MT, floor of MT, VT & Sphinx Temple, channels in VT	VT best preserved of the OK, plundered from FIP (Verner 2002: 228, 234)
4th	Menkaure Pyramid Complex (Giza)		16 lower courses of pyramid outer casing, wall linings of burial chamber & MT, 3 portcullis				pyramid not completed, in relation to previous pyramid complexes used a high proportion of granite (Lehner 1997: 135)

[1]MT = Mortuary Temple, VT = Valley Temple, OK = Old Kingdom, NK = New Kingdom

Dynasty	Structure	Chephren Gneiss	Aswan Granite (pink/red)	Aswan Granodiorite (grey/black)	Basalt	Travertine	Comments
4th	Queen Khentkawes (Two Step Tomb - Giza)		linings of gateway, passageways and burial chamber, 2 false doors				similar to Shepseskaf tomb, altered in early 5th Dyn and linked with her elevation of status (Verner 2002: 262-4)
4th	Unfinished Pyramid at Zawiyet-el-Aryan		paving				possible burial for a pharaoh who ruled between Khafre and Menkaura (Lehner 1997: 139)
4th	Shepseskaf Mastabat el-Farun (south Saqqara)		bottom course of outer casing, wall linings of passageways and burial chamber, 3 plugging blocks				
5th	Userkaf Pyramid Complex (Saqqara)		plugging block in pyramid, in MT: columns & chapel walls; in Sun Temple at Abusir: obelisk and cladding of pedestal	wall linings in pyramid passageways	floor of MT, chapel and causeway, dado in MT		quartzite false door (Lehner 1997: 141)
5th	Sahura Pyramid Complex (Abusir)		portcullis, antechamber & passageway wall linings; columns: 12 in VT, 18 in MT, dado in VT, lintels in MT & false door		floors of MT, VT and causeway (?)	floor of offering chapel, altar, MT stairways	floor of VT was originally 5m above present ground level (Verner 2002: 290)

Dynasty	Structure	Chephren Gneiss	Aswan Granite (pink/red)	Aswan Granodiorite (grey/black)	Basalt	Travertine	Comments
5^{th}	Neferirkara Pyramid Complex (Abusir)		outer casing of pyramid east wall (possibly whole outer casing was in granite), corridor to burial chamber, portcullis				pyramid is unfinished and heavy damage from stone thieves, MT was mudbrick, VT & causeway never built (Verner 2002: 293-7)
5^{th}	Khentkawes II Pyamid (Abusir)		plug before burial chamber, false door in MT	pyramidion (?)			Queen or wife of Neferirkare, construction interrupted (Verner 2002: 298)
5^{th}	Neferefre (Raneferef) 'Unfinished Pyramid' (Abusir)		false door in MT, wall linings of pyramid corridor				
5^{th}	Shepseskara (Abusir)						unfinished-only traces of earthwork (Verner 2002: 310)
5^{th}	Nyuserra Pyramid Complex (Abusir)		3 portcullis, dado, in MT: false door, offering slab, 16 columns, obelisk; in VT: 6 columns, dado		floors of MT, VT, walls of causeway and MT	altar	greatest use of basalt (Lehner 1997: 149) MT basalt wall blocks massive- up to 15 tons, quartzite basins in MT, floor of VT 5m below present level (Verner 2002: 319)
5^{th}	Nyuserra Sun Temple (Abu Ghurob)		5 doorways in Upper Temple, base of obelisk pedestal			altar, 5 offering slabs, 9 basins	obelisk of limestone blocks, first constructed in mudbrick (Lehner 1997: 151)

Dynasty	Structure	Chephren Gneiss	Aswan Granite (pink/red)	Aswan Granodiorite (grey/black)	Basalt	Travertine	Comments
5th	Menkauhor 'Headless Pyramid' (north Saqqara)		pieces in rubble				pyramid completely destroyed- doubts as to whether this is Menkauhor's burial (Verner 2002: 324)
5th	Djedkara-Isesi Pyramid Complex (south Saqqara)		3 plugging blocks, wall linings in passageway, 16 columns in MT			MT floor	limited use of remote source stone (Verner 2002: 328)
5th	Unas Pyramid Complex (Saqqara)		3 portcullis, in MT: doorway, false door, 18 columns			walls of burial chamber, paving of entrance hall to MT	smallest of all OK pyramids; quartzite palm column in MT, has the most impressive causeway (Lehner 1997: 155, Verner 2002: 333)
6th	Teti Pyramid Complex (north Saqqara)		3 portcullis, linings of passageway; in MT: 5 niches, 18 columns. In Queen's pyramids: false door, offering table		false door in offering chapel	altar, tablet in burial chamber; in MT: floor and stairway. In Queen's pyramids: offering slabs	a lot of quartzite: monolithic foundation block, basins and pillar. Pyramid is a late 5th Dyn prototype (Lauer. and Leclant 1972; Lehner 1997: 156)

Dynasty	Structure	Chephren Gneiss	Aswan Granite (pink/red)	Aswan Granodiorite (grey/black)	Basalt	Travertine	Comments
6^{th}	Pepi I Pyramid Complex (south Saqqara)		wall linings of passageway. In Queen's pyramids (6): portcullis			part of floor of mortuary temple	sarcophagus is of greywacke. Previously mistaken floor and wall linings as basalt are in fact black limestone (from field obervations made by author in 2002)
6^{th}	Merenra Pyramid Complex (south Saqqara)		portcullis, false door in MT				texts of official Uni suggest that greywacke was used for the sarcophagus & pyramidion and offering tables of travertine from Hatnub (Verner 2002: 361) - none of these remain in the complex. MT paved in limestone.
6^{th}	Pepi II Pyramid Complex (south Saqqara)		wall linings of passageway, 3 portcullis, door frame in MT, statue niches. In Queen's pyramids: portcullis, false door & gateway			offering table in Queen Udjebten pyamid	note: basalt tablet found in Queen Iput's pyramid has part of royal annals inscribed. 18 quartzite pillars in MT, floor is limestone (Lehner 1997: 162, Verner 2002: 370).

Use of Stone for Statuary, Stone Vessels and other Funerary Equipment in Royal Pyramid Complexes: 3rd - 6th Dynasty

(Compiled from:- Petrie 1883, Borchardt 1907, 1910, 1913; Reisner 1931, Firth and Quibell 1935, Jéquier 1938, 1940;Goneim 1957; Fakhry 1969, Lauer and Leclant 1972; Leclant 1979; Edwards 1991, Lehner 1997, Grzymski 1999, MMA 1999 and Verner 2002)

Dynasty	Structure	Chephren Gneiss	Aswan Granite (pink/red)	Aswan Granodiorite (grey/black)	Basalt	Travertine	Comments
3rd	Djoser Step Pyramid (Saqqara)	stone vessels in burial & antechambers, statuette*	sarcophagus			2 sarcophagi, some statuary, stone vessels, statue bases	* the oldest standing deity in Chephren Gneiss comes from the 3rd Dyn and probably from Djoser's tomb (Grzymski 1999: 53, MMA 1999: 178)
3rd	Sekhemkhet Step Pyramid (Saqqara)	stone vessels				sarcophagus	location of stone vessels (mainly fragments) in pyramid substructure (Goneim 1957: 16-7)
3rd	Khaba's Layer Pyramid (Zawiyet el-Aryan, Saqqara)		sarcophagus			stone vessels	location of stone vessels unknown
4th	Snefru (stepped tower at Meidum)						
4th	Snefru 'Bent' Pyramid (Dahshur)	stone vessels and statuettes in VT			stone vessels	stone vessels in VT	mention of granite vessels but usually not Aswan Granite (Fakhry 1959: 29)
4th	Snefru 'Red' or 'North' Pyramid (Dahshur)						no sarcophagus found (Verner 2002: 167)

Dynasty	Structure	Chephren Gneiss	Aswan Granite (pink/red)	Aswan Granodiorite (grey/black)	Basalt	Travertine	Comments
4th	Khufu Pyramid Complex (Giza)	stone vessels (?) fragments of life-size statue close to pyramid entrance (?)	sarcophagus			stone vessels, statues (east of pyramid)	Petrie (1883: 136-7) mentions finding polished fragments of Chephren Gneiss that could be pieces of a 'huge' statue
4th	Djedefre Pyramid Complex (Abu Roash)	fragments of a throne and life-size statue in rubbish pit	sarcophagus				several pieces of a life-size statue similar to the Khafre Chephren Gneiss statues with hieroglyphs for Menkaura on back (Petrie 1883: 142) first occurrence of large quartzite statues (Verner 2002: 220)
4th	Khafre Pyramid Complex (Giza)	stone vessels in MT, 6 life-size statues in Chephren Gneiss in VT, statuettes near MT	24 statue bases in VT	sarcophagus		stone vessels and statues in MT	although only 6 of the life-size statues are known, there were placements for up to 24, there could have been in total up to 200 statues of the king (in various stones); carnelian beads found in chamber under destroyed cult pyramid (Lehner 1997: 126, Verner 2002: 228, 234, MMA 1999: 259)

Dynasty	Structure	Chephren Gneiss	Aswan Granite (pink/red)	Aswan Granodiorite (grey/black)	Basalt	Travertine	Comments
4th	Menkaure Pyramid Complex (Giza)	stone vessels and seated statuettes in MT*	seated statue of Menkaura in MT, 2 sarcophagi in Queen's Pyramids	sarcophagus (?)		stone vessels in MT, colossal statue of king in MT, 4 statues in VT	*good examples of unfinished statuettes (MMA 1999: 281)
4th	Queen Khentkawes (Two Step Tomb - Giza)					sarcophagus	
4th	Unfinished Pyramid at Zawiyet-el-Aryan		sarcophagus				possible burial for a pharaoh who ruled between Khafre and Menkaura (Lehner 1997: 139)
4th	Shepseskaf Mastabat el-Farun (sth Saqqara)			sarcophagus (?)			basalt is mentioned for the sarcophagus but probable that it is either granodiorite or greywacke (Aston et al. 2000: 36)
5th	Userkaf Pyramid Complex (Saqqara)	statues/statuettes, stone vessels*	colossus of king in MT		sarcophagus (?)		* stone vessels of Chephren Gneiss found in Late Bronze Age Aegean contexts (Warren 1969), note that sarcophagus was undecorated so could have been basalt?
5th	Sahura Pyramid Complex (Abusir)	stone vessels and statuettes		statue of king, offering basin	sarcophagus (?)	stone vessels	

Dynasty	Structure	Chephren Gneiss	Aswan Granite (pink/red)	Aswan Granodiorite (grey/black)	Basalt	Travertine	Comments
5th	Neferirkara Pyramid Complex (Abusir)						
5th	Khentkawes II Pyamid (Abusir)		sarcophagus				
5th	Neferefre (Raneferef) 'Unfinished Pyramid' (Abusir)	stone vessels in MT, heads of small statues	sarcophagus			stone vessels, statuettes, canopic jars	statues show high degree of craftsmanship and contains 3rd largest OK statue in wood; statues in quartzite; carnelian beads found in MT - relatively untouched by tomb robbers (Lehner 1997: 146, Verner 2002: 307)
5th	Shepseskara (Abusir)						unfinished - only traces of earthwork (Verner 2002: 310)
5th	Nyuserra Pyramid Complex (Abusir)	stone vessels in king's & Queen's burial chambers	royal statues and lion statues in MT and VT		lion statue	stone vessels, head of Queen Reputnebu in VT	very few stone vessels of Chephren Gneiss found (Borchardt 1907: 116)
5th	Nyuserra Sun Temple (Abu Ghurob)						
5th	Menkauhor 'Headless Pyramid' (north Saqqara)						lid of sarcophagus probably greywacke (Aston et al. 2000)

Dynasty	Structure	Chephren Gneiss	Aswan Granite (pink/red)	Aswan Granodiorite (grey/black)	Basalt	Travertine	Comments
5th	Djedkara-Isesi Pyramid Complex (south Saqqara)					canopic jars	sarcophagus possibly greywacke, limited use of remote source stone (Verner 2002: 328)
5th	Unas Pyramid Complex (Saqqara)	large vessel*					* this vessel seen at Cairo Museum by author (39409) inscribed with name of Unas (pl.?)
6th	Teti Pyramid Complex (north Saqqara)		in Queen's pyramids: sarcophagus				
6th	Pepi I Pyramid Complex (south Saqqara)	stone vessels*	canopic chest, in Queen's pyramids (6): 2 sarcophagi, sarcophagus lid			canopic vessels, stone vessels	*although not mentioned in any excavation reports vessels inscribed with Pepi I's *Sed*-festival have been found in burial contexts in Middle Bronze Age Byblos, Classic Kerma Period at Deir el-Ballas & Mirgissa (Lacovara 1991: 118, Montet 1928: 37); sarcophagus is of greywacke (from field observations made by author)

Dynasty	Structure	Chephren Gneiss	Aswan Granite (pink/red)	Aswan Granodiorite (grey/black)	Basalt	Travertine	Comments
6^{th}	Merenra Pyramid Complex (south Saqqara)		canopic chest			shells	texts of official Uni suggest that gerywacke was used for the sarcophagus (Wissa 1994: 387; Verner 2002: 361).
6^{th}	Pepi II Pyramid Complex (south Saqqara)	stone vessels* many fragments of vessels found in Queen's Pyramids	canopic chest, in Queen's pyramids: 2 sarcophagi,	sarcophagus		statuettes, stone vessels, in Queen's Pyramids: 3 embalming vessels	* see note under Pepi I, same applies to Pepi II

Estimated Use of Basalt in Old Kingdom Royal Pyramid Complexes (4th-5th Dynasty)

Dynasty	Structure	Length (m)	Width (m)	Height (m)	Volume (m^3)	Comment	Reference
4th	Khufu Mortuary Temple Floor	50	42	0.4	840	possible small addition of arris line blocks on Queen's pyramid (Petrie 1883: 136)	Hoffmeier 1993: 118 (after Lauer 1947)
4th	Khufu Valley Temple Floor				100	size of valley temple floor is an estimate - only part remains (Lehner 1997: 109)	Harrell & Bown 1995: 71, Lehner 1997: 109
4th	Khufu Harbour Wall				100	estimate: wall not complete, found 500m east of the alley temple (Lehner 1997: 109)	Lehner 1997: 109
5th	Userkaf Mortuary Temple Floor	35	21	0.4	294	dado in mortuary temple of basalt and possible the sarcophagus was basalt (Verner 2002: 276-7)	Hoffmeier 1993: 118 (after Firth 1929)
5th	Userkaf Sanctuaries (2) and Chapel Floors	10	5	0.4	60	volume total for three floors	Hoffmeier 1993: 118
5th	Userkaf Causeway Floor				100	estimate: causeway never found, however, basalt blocks making up the top end of the causeway were observed in 2002 by the author	Hoffmeier 1993: 118 (after Firth 1929)
5th	Sahura Mortuary Temple Floor (inclu. side rooms)	15	25	0.4	150	total volume for floor was calculated (Heldal pers. comm. 2002) at 140 m^3. The higher figure of 150 m^3 remains as this includes the side rooms	Hoffmeier 1993: 119 (after Borchardt 1910: 32)
5th	Sahura Valley Temple Floor	20	10	0.4	80		Borchardt 1910: 32, pl.2
5th	Sahura Causeway Walls	235	1.5	0.4	282	volume is total for two walls, unclear if floor was also basalt	Borchardt 1910: 32, pl.2
5th	Nyuserra Mortuary Temple Floor	15	25	0.4	150		Hoffmeier 1993 (after Borchardt 1907: 56)
5th	Nyuserra Valley Temple Floor	18	10	0.4	72		Borchardt 1907: 56
5th	Nyuserra Walls of Mortuary Temple	80	0.4	1	128	approximate volume for four walls	Hoffmeier 1993: 119 (after Borchardt 1907: 56)
5th	Nyuserra Causeway Walls	400	0.4	1.5	480	Lehner (1997: 149) suggests Nyuserra's pyramid complex showed greatest use of basalt, this would be the case if <u>both walls and floor</u> of causeway were of basalt and Khufu used basalt *only* for MT	Borchardt 1907: 13, Lehner 1997: 149

Total (estimated) volume of basalt used per pyramid complex is as follows: 1. Khufu 1040 m^3; 2. Nyuserra 830 m^3; 3. Sahura 512 m^3; 4. Userkaf 454 m^3

Total (estimated) volume of basalt used **<u>with</u>** Sahura and Nyuserra causeway walls: **2836 m^3**

Total (estimated) volume of basalt used **<u>without</u>** Sahura and Nyuserra causeway walls: **2074 m^3**

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