OLD KINGDOM BASALT QUARRYING ACTIVITIES AT WIDAN EL-FARAS, NORTHERN FAIYUM DESERT*

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The quarry of Widan el-Faras in the Northern Faiyum Desert was the source of basalt used mainly for paving mortuary temples floors in some of the Fourth and Fifth Dynasty pyramid complexes. An examination of the layout of the quarry and the attached infrastructure, as well as the extracted volumes and the use of the basalt, indicates a campaign-like, seasonal exploitation of the stone linked to the high level of Lake Moeris during the Fourth and Fifth Dynasties. These conditions enabled medium-sized basalt blocks to be transported largely via water to the pyramid construction sites, thus avoiding lengthy and difficult carriage overland.

THE Widan el-Faras Project carried out in May 2001 was an archaeological survey of the basalt quarries sponsored by the EES as part of their Centenary Award 2000.[1] The survey concession area included the quarries, settlements, an ancient paved road and its terminus at Qasr el-Sagha. The Widan el-Faras quarry is the most likely source of basalt used in Old Kingdom pyramid complexes, most conspicuously during the Fourth and Fifth Dynasties, for paving mortuary temple floors. The 300 m high twin sandstone peaks capped in basalt called Widan el-Faras, literally translated to 'horses' ears',[2] are the distinctive landmarks which demarcate the entrance to the site (pl. V, 1). The presence of ancient basalt quarries in the vicinity of Widan el-Faras has long been known,[3] and research in the environs of the Qasr el-Sagha temple, in particular into the fluctuating levels of Lake Moeris, has been well documented.[4] James Harrell and Tom Bown were the first to make a differentiation be-

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[1] The 2001 investigations were supplemented by a few observations made in June 2002: L. Giddy, 'Digging Diary' *Egyptian Archaeology* 21 (Autumn, 2002), 32.

[2] Rawya Ismail, personal communication May 2001.

[3] G. Caton-Thompson and E. W. Gardner, *The Desert Fayum*, I (London, 1934), 132–8.

[4] J. Ball, *Contributions to the Geography of Egypt* (Cairo, 1939), 204, 225, 228; O. H. Little, 'Recent Geological Work in the Faiyum and in the Adjoining Portion of the Nile Valley', *BIE* 18 (1936), 201–40; A. Shafei, 'Lake Moeris and Lahûn Mi-Wer and Ro-Hûn: The Great Nile Control Project Executed by the Ancient Egyptians', *BSGE* 33 (1960), 187–217; F. Wendorf and R. Schild (eds), *Prehistory of the Nile Valley* (New York, 1976), 155–226; D. Arnold and Do. Arnold,

tween the east and west quarry areas and to assess the archaeological features at Widan el-Faras, and their work on interpreting how stone was transported from the quarry to the pyramid fields has provided the foundation for our current investigations.[5] Therefore, the objectives of the 2001 survey were to supplement Harrell and Bown's work by a closer examination of the east and west quarries and by surveying the archaeological features of the site, in order to enhance our understanding of the logistical apparatus applied in the extraction and transportation of stone from remote sources during the Old Kingdom.

The basalt quarries

The Widan el-Faras basalt consists of several individual lava flows of early Oligocene age, capping extensive deposits of sandstone, mudstone and some limestone that form the Gebel Qatrani Formation. The highly fractured nature of the basalt has given rise to extensive, dark scree slopes (up to 40–50 m high) along the basalt escarpment and is certainly why the Gebel Qatrani escarpment literally translates as 'tar hills'. 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.[6]

The basalt extraction sites, located between 0.7 and 1.6 km north-west of the Widan el-Faras peaks (fig. 1), are contained in two areas of workings along the rim of the escarpment, called the east and west quarries. Harrell and Bown describe the extraction sites as '...a series of shallow swales (depressions) and benches cut into the upper part of the basalt layer' and estimate that the east and west quarries extend for about 800 and 60 m along the rim respectively.[7] The 2001 investigations indicate that it is possible to distinguish four individual quarries in the east quarry and one in the west quarry, labelled 1–5 on figure 1, each typically containing 4–8 individual extraction sites, distinguishable as swales/depressions and/or benches. The layout and dimensions of each extraction site are variable and very difficult to measure due to loose blocks and the weathered state of the basalt.

The middle part of quarry 1 is quite different from the rest (pl. V, 2). It has very distinguishable remains of benches created from the quarrying, as well as waste dumps left within the quarry. 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. These have split the basalt and created plumose marks radiating from the point where the rupture was initiated. Apart from these observations, and although diorite mauls have been found in several parts of the quarry,[8] there are few tool marks from which to

Der Temple Qasr el-Sagha (AV 27; Mainz, 1979); F. A. Hassan, 'Holocene Lakes and Prehistoric Settlements of the Western Faiyum, Egypt', *JAS* 13 (1986), 483–501; J. K. Kozołowski and B. Ginter, 'Holocene Changes in the Fayum: Lake Moeris and the Evolution of Climate in Northeastern Africa', in L. Krzyżäniak, M. Kobusiewicz and J. Alexander (eds), *Environmental Change and Human Culture in the Nile Basin and Northern Africa Until the Second Millennium BC* (Poznań, 1993), 327–36.

[5] 'An Old Kingdom Basalt Quarry at Widan el-Faras and the Quarry Road to Lake Moeris in the Faiyum', *JARCE* 32 (1995), 71–91.

[6] For a geological description of the Widan el-Faras basalt, see Harrell and Bown, *JARCE* 32, 74–7; M. A. Heikal, M. A. Hassan and Y. el-Sheshtawi, 'The Cenozoic Basalt of Gebel Qatrani, Western Desert, Egypt - as an Example of Continental Tholeiitic Basalt', *Annals of the Geological Survey of Egypt* 13 (1983), 193–209; T. M. Bown, T. M. Kraus and M. J. Kraus, 'Geology and Paleoenvironment of the Oligocene Jebel Qatrani Formation and Adjacent Rocks, Fayum Depression, Egypt', *U.S.G.S. Professional Paper* 1452 (Washington DC, 1988), 1–59; R. Klemm and D. Klemm, *Steine und Steinbrüche im alten Ägypten* (Berlin, 1993), 413–20.

[7] Harrell and Bown, *JARCE* 32, 74–5.

[8] Harrell and Bown, *JARCE* 32, 75.

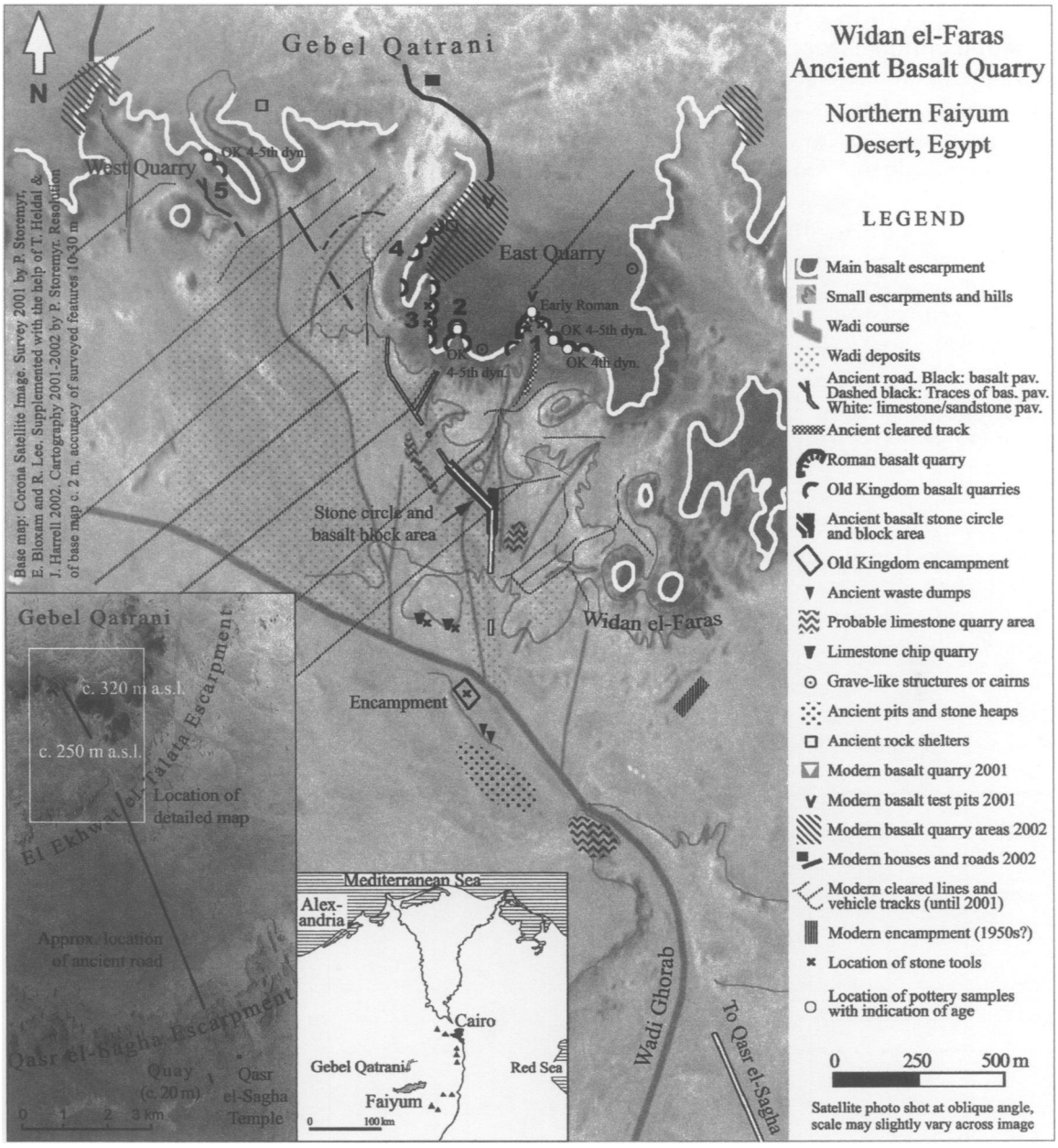


FIG. 1. Map of the Widan el-Faras ancient basalt quarry, Northern Faiyum Desert, Egypt.

interpret how the extraction generally was carried out. However, it seems reasonable to assume that the quarrymen took advantage of the fractures and simply wedged the blocks out with levers and tumbled them down the scree slopes to await transport.[9]

The fractured nature of the basalt made it easy to wedge out blocks, but it also meant that blocks measuring up to and more than 1 m^3 were difficult to obtain. The normal block size

[9] As suggested in Harrell and Bown, *JARCE* 32, 74–5.

may have been in the order of 0.2–0.4 m^3 or less, as evidenced by observations of the pyramid temple floors. In the vicinity of the ancient extraction sites, especially a few hundred metres to the west of the west quarry where a modern basalt quarry has recently been opened, there are thicker basalt layers from which larger blocks could have been obtained. However, there is no evidence that these layers were worked in ancient times. Thus, we must conclude that the ancient quarrymen were looking primarily for medium-sized blocks at Widan el-Faras, perhaps to ease the difficult transport from the site.

Pottery sherds in small surface scatters lie in and around the extraction sites in both the east and west quarries. These all date to the Fourth and Fifth Dynasties, except for those in the middle part of quarry 1, where there is also Early Roman Period pottery.[10] Taken together with the wedge holes found here, as well as the distinctive quarry layout, it is reasonable to suggest that the Old Kingdom quarrying at this site has been obscured by later Roman extraction of basalt. This evidence of an Early Roman Period presence is a recurrent problem in interpreting the archaeological features at Widan el-Faras and is puzzling because the Roman use of basalt in Egypt was limited to small statuettes.[11]

The use of basalt

Widan el-Faras is an extensive archaeological *site*, but a small basalt *quarry*. This statement is based on the fact that there are only five small quarries throughout an area covering almost 1 km^2. A very rough and preliminary estimate of the amount of stone obtained from all extraction sites is given in Table 1. Assuming 50–70% waste, the calculations show a basalt volume between 1,600–3,000 m^3. Given that blocks were also extracted at places not

TABLE 1. *Rough Estimate of Volume Extracted from the Five Quarries in the Old Kingdom*

Quarry no.	Quarry area	Individual extraction Sites				Total Volume** (m^3)	Volume 50% waste (m^3)	Volume 60% waste (m^3)	Volume 70% waste (m^3)
		No.	(m) Depth	(m) Height	Length (m)				
1	East	8	10	5	2	480	240	192	144
	Middle*	8	10	8	2	768	384	307	230
	South	4	10	8	3	576	288	230	173
2		7	10	10	2	840	420	336	252
3		6	10	8	3	864	432	346	259
4	South	2	12	6	5	432	216	173	130
	North	4	12	6	5	864	432	346	259
5		6	10	5	3	540	270	216	162
Total	-	-	-	-	-	5364	2682	2146	1609

* Site obscured by more recent, possibly Roman, quarrying. Dimension estimates are based on comparison with the other Old Kingdom extraction sites.

** 'Total Volume'refers to the total volume removed, supposing a quite uniform downward slope from the top-back of the quarry bench to the front edge. A triangular shape is thus obtained, but the actual removed rock is estimated to a bit more than a triangular shape would imply (60% instead of 50% of the length × width × height - volume).

[10] Examination and dating of the pottery was made by Asraf el-Senussi during the survey in 2001.

[11] Harrell and Bown, *JARCE* 32, 73.

TABLE 2. *Estimated Use of Basalt in Old Kingdom Royal Pyramid Complexes (Fourth–Fifth Dynasties)*

Dynasty	Structure	Length (m)	Width (m)	Height (m)	Volume (m_)	Comment	Reference
Fourth	Khufu Mortuary Temple Floor	50	42	0.4	840	possible small addition of arris line blocks on Queen's pyramid	*JARCE* 30, 118
Fourth	Khufu Valley Temple Floor				100	size of valley temple floor is an estimate - only part remains	*JARCE* 32, 71; Lehner, *Pyramids,* 109
Fourth	Khufu Harbour Wall				100	estimate: wall not complete, found 500m east of the Valley Temple	Lehner, *Pyramids*, 109
Fifth	Userkaf Mortuary Temple Floor	35	21	0.4	294	dado in mortuary temple of basalt and possible the sarcophagus was basalt	*JARCE* 30, 118; Verner, *Pyramids,* 276-7
Fifth	Userkaf Sanctuaries (2) and Chapel Floors	10	5	0.4	60	volume total for three floors	*JARCE* 30, 118
Fifth	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 authors	*JARCE* 30, 118
Fifth	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_. The higher figure of 150 m_ remains as this includes the side rooms	*JARCE* 30, 119
Fifth	Sahura Valley Temple Floor	20	10	0.4	80		Borchardt, *Sahu-re*, (1910), 32, pl. 2
Fifth	Sahura Causeway Walls	235	1.5	0.4	282	volume total is for two walls, unclear if floor was also basalt	Borchardt, *Sahu-re*, (1910), 32, pl. 2
Fifth	Nyuserra Mortuary Temple Floor	15	25	0.4	150		Borchardt, *Ne-User-re*, (1907), 56
Fifth	Nyuserra Valley Temple Floor	18	10	0.4	72		Borchardt, *Ne-User-re*, (1907), 56
Fifth	Nyuserra Walls of Mortuary Temple	80	0.4	1	128	approximate volume for four walls	Borchardt , *Ne-User-re*, (1907), 56
Fifth	Nyuserra Causeway Walls	400	0.4	1.5	480	volume total is for both walls although they now cannot be observed, unclear if floor was also basalt	Borchardt, *Ne-User-re*, (1907), 13

Total (estimated) volume of basalt used **with** Sahura and Nyuserra causeway walls: **2836 m_**
Total (estimated) volume of basalt used **without** Sahura and Nyuserra causeway walls: **2074 m_**

yet discovered, the usable amount could range between 2,000 and 4,000 m^3. More accurate analyses of extracted basalt volume are pending.

The Fourth and Fifth Dynasties clearly represent a period in pharaonic history in which the use of basalt for monumental construction purposes was not equalled. The most famous and largest remaining example of this is the mortuary temple floor of Khufu at Giza. In order to establish some parity between the volumes of basalt used in the pyramid complexes *vis-à-vis* the volumes extracted from Widan el-Faras, we undertook our own investigations of the pyramid fields at Saqqara, Giza and Abusir. Combining these observations with relevant published sources, it has been established that basalt was used in just four royal pyramid complexes—those of Khufu, Userkaf, Sahure and Nyuserra, as shown in Table 2. Due to generally poor preservation and re-use of stone from these pyramid complexes, the estimates of the quantity of basalt used can only be very approximate. Considering 10% waste during trimming of blocks etc. and smaller basalt structures not yet discovered, the basalt used could range between 2,000 and 4,000 m^3.

Basalt was certainly employed for small stone vessels from the Predynastic Period, but the volume would have been very limited, and it is impossible to know if the source was Widan el-Faras.[12] Other uses of basalt in the Old Kingdom were restricted mainly to sarcophagi and it is here that problems have arisen with misclassification. Black granodiorite from Aswan and siltstone or greywacke from Wadi Hammamat have often been wrongly classified as basalt and the late Fifth Dynasty and Sixth Dynasty sarcophagi of Unas, Teti, Pepi I and Merenra are in fact made from greywacke and not basalt.[13] Similarly, it remains uncertain if the material of the sarcophagi of Userkaf and Sahura, both referred to as 'basalt', is correctly identified because only fragments of these were found.[14] However, in general terms there appears to be some parity between basalt quarried from Widan el-Faras and basalt used for monumental structures in the Fourth and Fifth Dynasties. Due to the fractured nature of the basalt, it is hard to imagine that very large blocks, such as one 5 m^3 block at the Nyuserra temple complex, could have been extracted at Widan el-Faras. It may be that the source of such blocks must be sought elsewhere, for instance, at Abu Roash.[15]

The use of basalt in comparison with other hard stones, such as Aswan granite, was fairly short lived and after the Old Kingdom it is rarely seen in monumental construction and is used mostly for statuettes, of which there are several Middle Kingdom examples in the Cairo Museum. Its use was then completely phased out until the Late Period. During the Graeco-Roman Period it was used mainly for statuary, examples of which are in the Graeco-Roman Museum in Alexandria. Many are likely to be made from Widan el-Faras basalt.

Size of the quarry labour force

The small size of the five quarries at Widan el-Faras, combined with the fact that the main use of the basalt must have taken place over a 150–170 year period, suggests that the quar-

[12] A. Lucas,'Egyptian Predynastic Stone Vessels', *JEA* 16 (1930), 205; B. G. Aston, *Ancient Egyptian Stone Vessels: Materials and Forms* (SAGA 5; Heidelberg, 1994), 20; A. H. Bevan, *Value Regimes in the Eastern Mediterranean Bronze Age: a Study through Stone Vessels*, (unpublished PhD thesis, University College London, IOA (2001), 126–8.

[13] B. Aston, J. A. Harrell and I. M. E. Shaw, 'Stone', in P. T. Nicholson and I. M. E. Shaw (eds), *Ancient Egyptian Materials and Technology* (Cambridge, 2000), 24.

[14] M. Lehner, *The Complete Pyramids* (London, 1997), 142; M. Verner, *The Pyramids* (London, 2002), 276.

[15] Harrell and Bown *JARCE* 32, 76; Klemm and Klemm, *Steine und Steinbrüche*, 415; see also S. Clarke and R. Engelbach, *Ancient Egyptian Construction and Architecture* (London, 1930), 23. If other sources were indeed used on a larger scale, it will, of course, have implications for the overall interpretation of the Widan el-Faras site.

rying operations were undertaken as campaigns when stone was needed for a specific project. The campaign-like nature of the quarrying can be elucidated by using 4,000 m^3 (maximum estimated extracted volume) as a total amount of stone quarried from Widan el-Faras to work out how long it would take to extract this volume. Assuming that one team of ten people are able to extract 1–2 m^3 basalt and transport this to the nearest quarry road branch in one week, and that five teams could work simultaneously in one of the quarries (1–5), it would have taken ten to twelve years to extract 4,000 m^3. Although highly speculative, our calculations show that even if only 0.5 m^3 was quarried per team per week, it would have taken 5 teams no more than 30 years to obtain the same amount. Thus, we believe that a range is established: it did not take hundreds of people and several decades to quarry all the basalt obtained at Widan el-Faras; it could have been done with a limited number of people over less than a ten to fifteen year period. It could even have been possible to obtain enough basalt for a small project (e.g. a small temple floor) during a season's work. However, the above estimates do not include transportation time along the quarry road to ancient Lake Moeris (see below).

The ancient paved quarry road

The 11 km long paved road that connects Widan el-Faras with Qasr el-Sagha represents the oldest and most pristine example of a purpose-built quarry road in the world and has been described in detail by Harrell and Bown.[16] The objective of the 2001 survey was to supplement some of Harrell and Bown's findings, concentrating mainly on the road segments within the quarry area and including a short investigation of the road's terminus at Qasr el-Sagha. Harrell and Bown mapped seven road branches leading into the east and west quarries. Our investigations generally concurred with these observations, although there appear to be only five branches terminating beneath the escarpment directly below worked basalt quarries. Moreover, the cleared track below quarry 1 might be connected with the possible Roman quarrying here. The most visible remaining branch leads towards quarry 2, the rest being fragmentary, due in part to recent disturbance of the site from vehicles and natural disturbance from occasional flash-floods.

The road conforms in its entirety to a width of 2.10 m, which is equal to the ancient Egyptian measurement of 4 cubits and 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 (pl. VI, 1). Limestone and basalt fragments are used predominantly for the road's surface within the Widan el-Faras area; the main sources of limestone are indicated on the site map (fig. 1). The limestone deposits occur as thin, flat outcrops, partly with polygonal crack patterns, which would have made it very easy to lever out the stone, appropriate for producing a flat surface requiring little working beyond basic trimming. Possible limestone chip quarries close to the Wadi Ghorab could suggest that activities here were necessary for maintenance of the road in the wadi. Although Harrell and Bown dismissed the idea of the road having any foundation or being mortared,[17] our investigations of some sections of the road, particularly within the quarry area, found relatively thick layers (1 cm) of gypsum (calcium sulphate) below a number of road slabs.[18] However, it is

[16] *JARCE* 32, 78–83.

[17] *JARCE* 32, 78–9.

[18] Gypsum has been used as a stabilising substance on ancient road surfaces, an example being the Twelfth Dynasty haulage track found at the Lisht pyramid field; see Lehner, *The Complete Pyramids*, 203.

difficult to ascertain whether the gypsum found underneath the road slabs at Widan el-Faras is man-made, since the surface at the site contains much natural sulphate and calcium. This requires further investigation.

The 17 km road leading from the Hatnub travertine quarries is the closest comparable example of a purpose-built road associated with an Old Kingdom quarry.[19] In similar fashion to the Widan el-Faras road, it provided a solid base across the sand. However, at Hatnub steep gradients, such as a deep wadi, on its descent to the Nile, were bridged by piling up rocks and boulders to create a causeway. From the two parallel track-ways observed on the Hatnub road, it has been suggested that sledges were drawn along it.[20] There are no signs of similar wear on the Widan el-Faras road; in fact, the surface is so pristine that if it were not for the branches leading directly into the quarries, it could be speculated that it was constructed for a non-utilitarian purpose.[21] Harrell and Bown explained the absence of wear marks on the quarry road by suggesting that flat wooden beams might have been laid, unfixed, across the road surface in advance of the sledge.[22] However, the use of unfixed rollers or crossbeams with sledges to move heavy weights over large distances has been proven impractical.[23] This method of conveyance only seems possible if the beams are part of a fixed track, like those at Lisht and Mirgissa, where the beams are embedded into a prepared surface.[24]

The problem with the Widan el-Faras road is not only its unworn surface, but its narrowness, at only 2.10 m. The Middle Kingdom Dahshur sledge in the Cairo Museum (CG 4928)[25] is 4.21 m in length and 80 cm wide and would fit on the road, but it cannot be firmly established that a sledge of such dimensions could accommodate the size and weight of a 1 m^3 block of stone. Furthermore, the Twelfth Dynasty sledges found at Lisht and Dahshur did not show any signs of wear on their runners.[26] Therefore, further consideration needs to be given to the type of vehicle used in any future research on the ancient desert road.

The environs surrounding the terminus of the Widan el-Faras road are situated within a natural inlet 1 km south-west of the Qasr el-Sagha temple, which was clearly utilised as a harbour when the levels of Lake Moeris were at 22–23 m above sea level.[27] The features that make up the harbour consist of four natural promontories at an elevation of 22 m, which have been artificially reinforced with limestone and sandstone slabs. Behind these is another natural promontory at the same elevation, 311 m long by 19 m wide, which is strewn with basalt blocks. This feature has previously been interpreted as a quay, which in turn acts as the terminus of the quarry road.[28] The weathered basalt blocks strewn along the top of the quay sometimes form circular constructions around shallow depressions in the

[19] I. M. E. Shaw, 'Survey at Hatnub', in B. J. Kemp (ed.), *Amarna Reports,* III (EES Occasional Publication 4; London, 1986), 189–212, and *Amarna Reports,* IV (EES Occasional Publication 10; London, 1987), 160–7.

[20] Shaw, in Kemp (ed.), *Amarna Reports* IV, 160.

[21] An Argentinian team of road engineers and archaeologists led by G. Cornero surveyed and excavated sections of the road in the 1990s and made the same observations, even doubting it could support heavy weights and postulating it was perhaps for ceremonial use.

[22] *JARCE* 32, 82-3.

[23] See in B. Cotterell and J. Kamminga, *Mechanics of Pre-industrial Technology* (Cambridge, 1990), 220.

[24] Lehner, *The Complete Pyramids*, 203; J. Vercoutter, *Mirgissa,* I (Paris, 1970), 204–14.

[25] D. Arnold, *Building in Egypt: Pharaonic Stone Masonry* (Oxford, 1991), 276.

[26] Arnold, *Building in Egypt*, 277.

[27] Wendorf and Schild (eds), *Prehistory of the Nile Valley*, 220.

[28] Harrell and Bown, *JARCE* 32, 86; Wendorf and Schild (eds), *Prehistory of the Nile Valley*, 220; Arnold and Arnold, *Qasr el-Sagha*, 25.

sand. Small heaps of basalt chips and stone tools suggest that some trimming of stone took place here, but determining the precise date of this secondary production is problematic as pottery found here dates to both the Old and Middle Kingdoms.

Stone circles and basalt blocks: the 'quarrymen's camp'

The so-called 'quarrymen's camp' is exposed as single level stone circles surrounding depressions in the sand and covering an area 275 m long by 11 m wide on an east–west axis (pl. VI, 2). The circles range in diameter from 2 m to 7 m and are clustered on each side of the ancient road (fig. 2). Calculating the number of stone circles is problematic due to the weathered nature of the basalt blocks that make up each circle. The majority of once large blocks are now represented by piles of small pebbles due to weathering and, therefore, the walls of each circle have tended to collapse into each other, making it difficult clearly to distinguish one circle from another. At places it is even hard to determine if there were originally circles at all. Due to this natural weathering phenomenon combined with flash-floods and some man-made disturbance, there is some discrepancy between our survey calculations of 24 circles and those made previously. Past surveys of the 'camp' have estimated the number of stone circles to range from a maximum of 160 observed by Bown in 1993 [29] to 47 calculated by Cornero in 1999.[30] It is unclear what survey methods were used

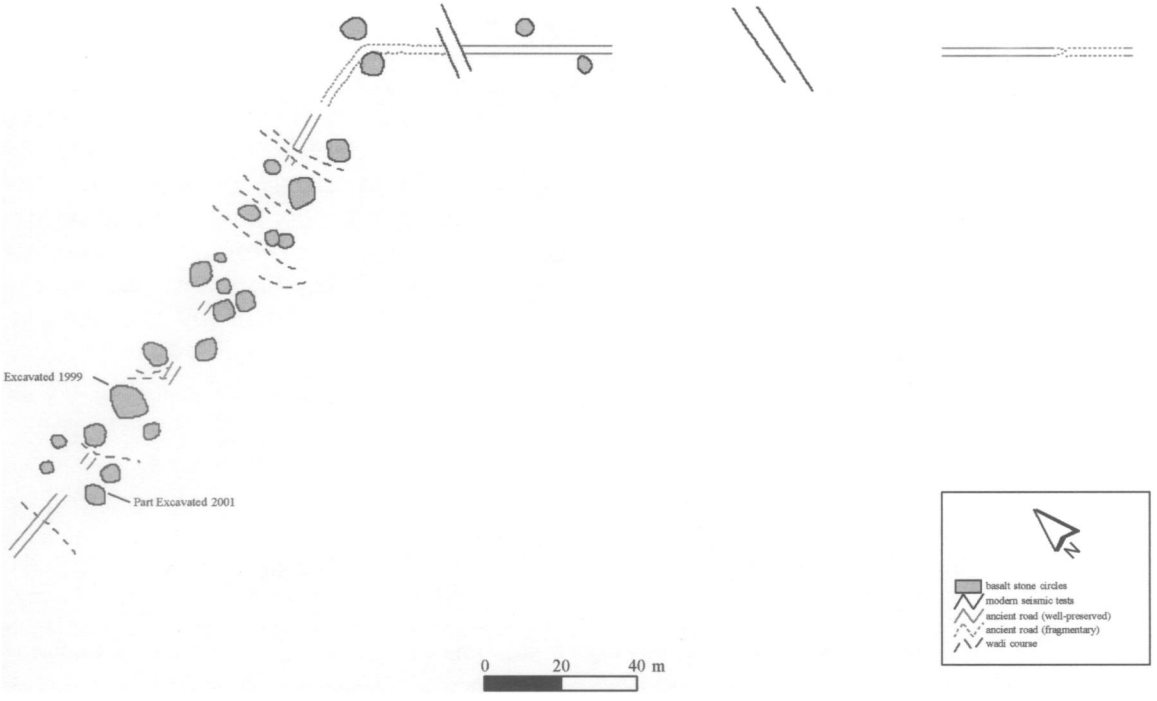


FIG. 2. Preliminary plan of the large area of stone circles and ancient road at Widan el-Faras.

[29] Harrell and Bown, *JARCE* 32, 77–8; and Harrell, personal communication October 2001.
[30] See n. 21.

to produce these figures, but given the nature of the 'camp' as described above, assessing what constitutes a 'circle' in these conditions has to be quite subjective.

Our observations at the 'quarrymen's camp' call into question whether this site was indeed a place of habitation. Firstly, it is positioned across a wadi, which probably already crossed the area in the Old Kingdom. Secondly, there were no visible signs of entrances into the structures and no post-holes to support roofing; the camp would have been extremely exposed to the prevailing northerly wind. Thirdly, the now weathered blocks, as explained above, would originally have been much larger than what is visible today, seemingly too large for tent footings.[31] Artefactual evidence of habitation was minimal, with no hearths and limited amounts of pottery in small surface scatters, dating to the Fourth Dynasty and to the Early Roman Period.[32] Because of the wadi's discharge into the '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 located. Equally, pottery could have been washed out of the 'camp', but no traces were found along the wadi's path, and excavation of a stone circle revealed no 'living floor', charcoal or artefacts. In fact, the site was clean of any material relating to a permanent or even semi-permanent presence here.[33]

The lack of evidence for a discernible settlement at Widan el-Faras might be explained from observations made by Caton-Thompson and Gardner during their excavations at Qasr el-Sagha, which suggested an Old Kingdom presence here associated with a gypsum vase-making industry.[34] With a high lake level providing abundant subsistence such as fish and birds, a seasonal/permanent settlement here in the Old Kingdom is quite probable. Subsequently, it could 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.

An alternative explanation of what these stone circles could represent is a temporary storage yard for quarried blocks, a suggestion also put forward by Harrell and Bown.[35] Our calculations 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 were added. This idea is based on the proximity of the basalt concentrations to the road as representing a central collection area for transportation, given its positioning in the central part of the site. However, storage areas of blocks observed at Chephren's Quarry in Nubia[36] tend to be in rows, so that the

[31] These structures differ significantly from the Old Kingdom huts found at Hatnub; see Shaw, in Kemp (ed.), *Amarna Reports* III, 198, where multi-level dry-stone walls of limestone boulders are built up from ground level to a height of at least 1 m and have defined entrances.

[32] See n. 10.

[33] This observation is consistent with Harrell, Brown and Masoud's geological survey of the Early Dynastic green tuff and tuffaceous limestone quarry at Gebel Manzal el-Seyl in the Eastern Desert (J. A. Harrell, V. M. Brown and M. S. Masoud, 'An Early Dynastic Quarry for Stone Vessels at Gebel Manzal El-Seyl, Eastern Desert', *JEA* 86 (2000), 41). There were no signs of habitation in permanent or temporary structures and no pottery at Gebel Manzal el-Seyl, which is puzzling given that the outcrop was intensively exploited. A similar situation is also seen at the nearby Umm es-Sawan gypsum quarry, where 250 stone circles are found encircling 75 cm deep depressions. The huts are tightly packed together and Caton-Thompson and Gardner's excavations found them to have no clearly discernible 'living floors' or entrances. They further commented that the pottery was very little indeed for a habitation site (*The Desert Fayum* I, 120, 122).

[34] Although there are no workable gypsum deposits in the immediate surroundings, the artefact assemblage located here closely resembles that found at the main gypsum quarry of Umm es-Sawan, 30 km to the north-east (*The Desert Fayum* I, 134).

[35] *JARCE* 32, 78.

[36] Observations from surveys made at Chisel Quarry at Chephren's Quarry in Lower Nubia, see forthcoming P. Storemyr,

predominantly circular arrangement of the stones at Widan el-Faras suggests 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.[37] Some of the stone circles might even represent the superstructures of a system of wells, either tapping an artesian system or reaching ground water discharged down the wadi over which the circles are situated.[38] The feasibility of this option would require more geophysical analysis and greater study of the local geology.

The encampment

The encampment is situated at the entrance to Widan el-Faras, approximately 500 m south-west of the 'quarrymen's camp' and 30 m from the south bank of the Wadi Ghorab. The encampment comprises a cluster of single-level circular and oval structures of small basalt blocks across an area 60 m long by 36 m wide. Although the basalt has been subject to weathering, the larger spaces between the features meant that the limits of each circle were easier to define and thus six circles were surveyed with diameters ranging from 3 m to 8 m (fig. 3). As opposed to the 'quarrymen's camp', the encampment shows minimal distur-

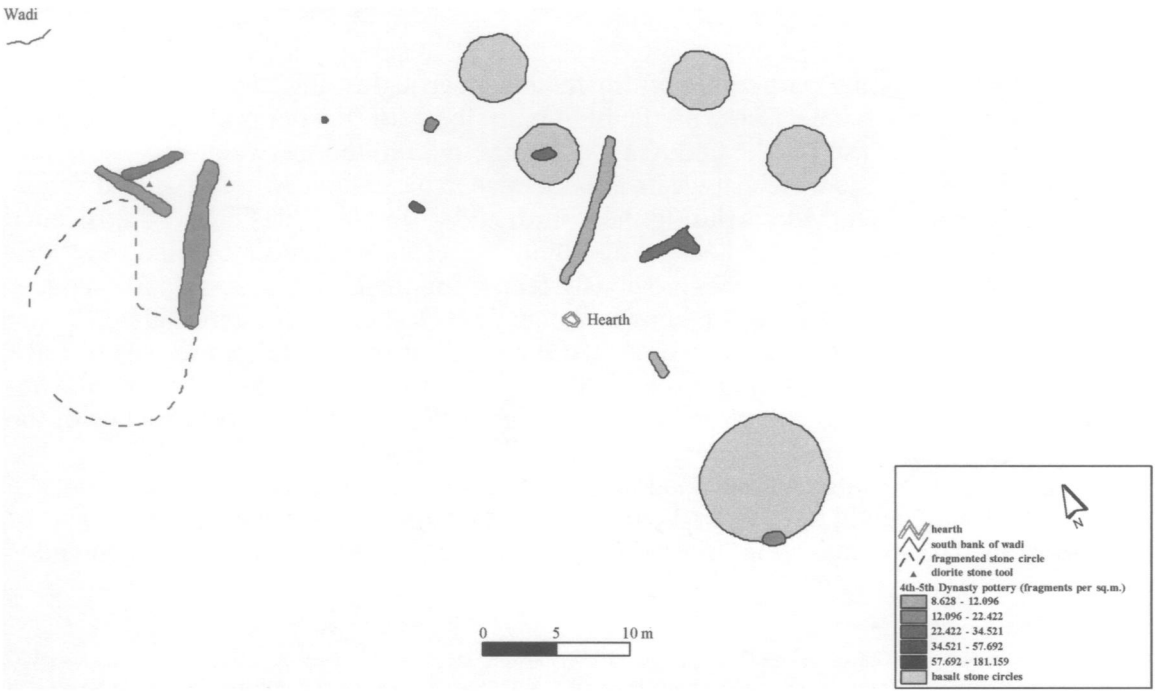


FIG. 3. Preliminary plan of the encampment at Widan el-Faras.

E. Bloxam, T. Heldal and A. Salem, 'Survey at Chephren's Quarry, Gebel el-Asr, Lower Nubia: 2002', *Sudan & Nubia* Bulletin 6 (2002), 25–9.

[37] Harrell, personal communication October 2001.

[38] Tapping an artesian system is an ancient art and in Iran the surface evidence of such a system is represented by a linear arrangement of circular mounds which demarcate shafts that connect beneath the ground to a horizontal tunnel system; see B. J. Skinner and S. C. Porter, *Physical Geology*, (Chichester, 1987), 252. The surface patterning of such a system closely resembles the linear arrangement of circles at Widan el-Faras.

bance and is situated in a more sheltered part of the site, and is not crossed by wadis. Small but dense scatters of pottery sherds are to be found across the site, dating from the Fourth to Fifth Dynasty and comprising only two categories: storage vessels and cooking bowls.[39] Other items found, such as two dioritic pounders made from non-local stone, a hearth and plentiful amounts of charcoal in one of the circles excavated, are all suggestive of this being a small area of temporary habitation. Its location places it strategically at the entrance to Widan el-Faras, with vantage points north into the quarry and south, where the road heads towards Qasr el-Sagha.[40]

The distance of the encampment from the basalt quarry (at least 500 m), and its proximity to a nearby limestone deposit and rows of spoil heaps, possibly from limestone working, as well as limestone chip quarries with numerous stone pounders and mauls, suggest that it could have been associated with the road construction side of the operation. The encampment, similar to the 'quarrymen's camp', requires more investigation by excavation to determine more clearly its function. However, it can be concluded that this site does represent at least a temporary Old Kingdom presence at Widan el-Faras.

Discussion

Logistics

The movement of stone, particularly from remote quarries during the Fourth and Fifth Dynasties, suggests a connection with the high Nile floods of this period.[41] The volume of Widan el-Faras basalt used in the Old Kingdom, although limited, outweighs its use at any other period in antiquity, which suggests a link between these high Nile floods and subsequent high level of Lake Moeris during the Fourth and Fifth Dynasties.[42] The significance of the harbour features at Qasr el-Sagha and the connection between these and the transportation of Widan el-Faras basalt has previously been mentioned.[43] Our investigations concur with the theory that the basalt was taken via the quay at Qasr el-Sagha, across the lake and through the Hawara Channel which connected the Bahr Yusef channel of the Nile to Lake Moeris. The decline of Nile flood levels by the late Fifth Dynasty[44] might explain the absence of basalt in pyramid complexes after the reign of Nyuserra, as a consequence of the severing of the connection between Lake Moeris and the Bahr Yusef.

As the discussion of the ancient road implies, the overland transport of basalt from the quarry to the quay would have been the most time consuming and labour intensive part of the operation. The minimisation of overland transport would be the prime concern and if

[39] See n.10.

[40] Caton-Thompson and Gardner (*The Desert Fayum* I, 137) also found an Old Kingdom encampment with a similar artefact assemblage on the south edge of the middle plateau that would mark a midway point between Qasr el-Sagha and Widan el-Faras.

[41] B. Bell, 'The Dark Ages in Ancient History, I. The First Dark Age in Egypt', *AJA* 75 (1971), 1–26; F. A. Hassan, 'Historical Nile Floods and their Implications for Climatic Change', *Science* 212 (1981), 1142–5; F. A. Hassan, 'Nile Floods and Political Disorder in Early Egypt', in H. Nuzhet Dalfes, G. Kukla and H. Weiss (eds), *Third Millennium BC Climate Change and Old World Collapse* (Berlin, 1997), 1–23.

[42] Hassan, in Nuzhet Dalfes et al. (eds), *Climate Change*, 1–23; R. Said, *The River Nile: Geology, Hydrology and Utilization* (Oxford, 1993), 134.

[43] See in Shafei, *BSGE* 33, 192–3; Harrell and Bown, *JARCE* 32, 83; Arnold and Arnold, *Qasr el-Sagha*, 25.

[44] See n. 42.

barges laden with basalt from Widan el-Faras were to reach the pyramid fields of Giza, Saqqara and Abusir, the stone would need to be transported directly to harbours located close to the valley temples. Recent resistivity work at Saqqara, east of the Fifth Dynasty valley temple of Unas, indicated that a harbour was probably located here.[45] At Abusir, the occurrence of two entrances south and east into Sahure's valley temple might imply that the southern entrance was connected to a canal linking it with the marginal lakes of Abusir and Middle Saqqara for delivery of raw materials.[46] A topographical study of the Giza plateau also suggests that the valley temple of Khufu was part of a large harbour area, extending as far as Khafre's pyramid complex.[47] Moreover, the discovery of basalt fragments 160 m south of Khufu's valley temple suggests they could have fallen from the barges as they were being unloaded.[48]

Organisation

The campaign-type nature of basalt quarrying at Widan el-Faras, perhaps seasonal and linked to the Nile flood and involving small numbers of people, is a probable organisational framework for discussion. Clear evidence of a permanent or semi-permanent settlement cannot be firmly attested at Widan el-Faras and the archaeological record does not support 'hundreds' of workmen being employed here, as has been previously suggested.[49] The small size of the quarries tends to imply that only limited numbers of people were involved, perhaps in highly organised groups working one quarry at a time. Each extraction site cannot practically accommodate more than ten people at a time, which is an interesting observation as groups of ten people is not an uncommon unit to find with work at lower skill levels in ancient Egypt.[50]

The actual quarrying process would not be too difficult because the basalt was easy to extract along its natural fractures. It was simply levered out of place and slid down the escarpment. The short overland transport process would certainly be more labour intensive, but with the use of dray animals, perhaps a labour force of about 50+ is a reasonable estimate. Each campaign could have been linked to a specific royal project ordained by the king, such as paving a temple floor. Stone procurement for specific funerary objects is also implied from the Sixth Dynasty autobiography of Weni, as he gives an account of being sent to both the Hatnub and Aswan quarries on the orders of King Merenra.[51] Only Middle Kingdom and New Kingdom texts give an idea of the numbers of people involved in these expeditions, and in relation to the Twelfth Dynasty exploitation of Chephren's Quarry in

[45] I. Mathieson et al., 'The National Museums of Scotland Saqqara Survey Project, Earth Sciences 1990–1998', *JEA* 85 (1999), 35.

[46] Verner, *The Pyramids*, 290, 319.

[47] M. Lehner, 'The Development of the Giza Necropolis: The Khufu Project', *MDAIK* 41 (1985), 122–3.

[48] Lehner (*MDAIK* 41, 137–9) has suggested that the transfer of Tura limestone to the Giza plateau could only have been achieved via a large transverse canal. The advantages of a canal connecting the Bahr Yusef and running parallel to the Western Desert for servicing the pyramid complexes from Hawara to Abu Roash has also been pointed out in G. Goyon, 'Les portes des pyramides et le grande canal de Memphis', *RdE* 23 (1971), 137–53.

[49] Harrell and Bown, *JARCE* 32, 78–9.

[50] C. J. Eyre, 'Work and the Organisation of Work in the Old Kingdom', in M. A. Powell (ed.), *Labor in the Ancient Near East* (New Haven, 1987), 12.

[51] Clarke and Engelbach, *Ancient Egyptian Construction*, 21; N. Grimal, *A History of Ancient Egypt* (Oxford, 1992), 83–5.

Lower Nubia, these numbered well over a thousand.[52] However, the archaeological record at Chephren's Quarry does not substantiate such a large presence.[53]

Research potential vs destruction of the site

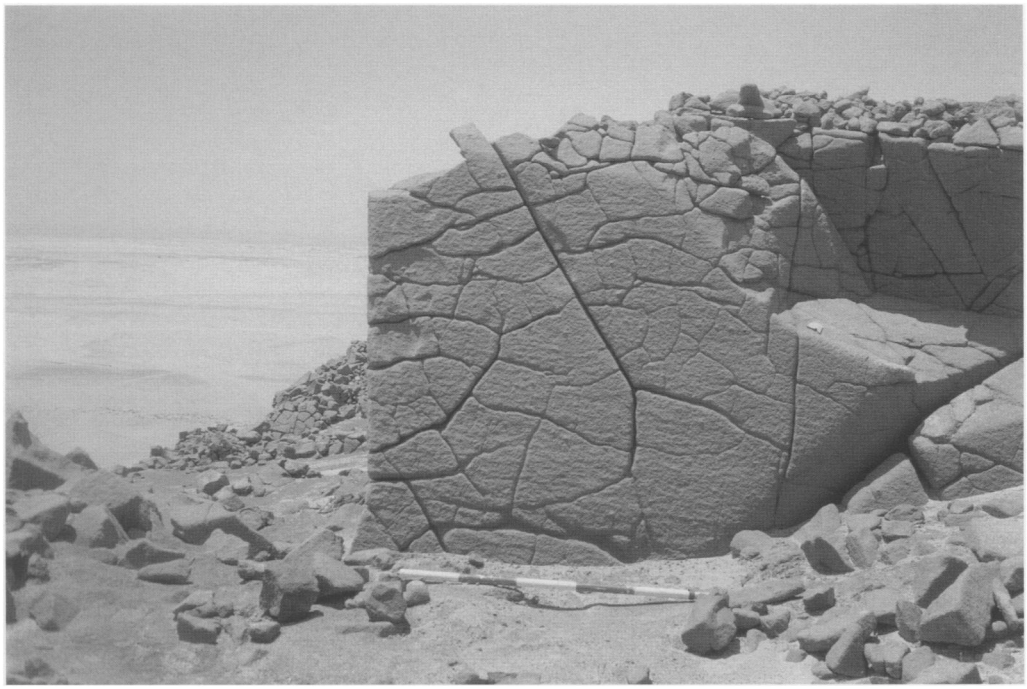
The colossal movement of stone in the Old Kingdom was never equalled in ancient Egyptian history and if we are to understand why this is the case, then quarry sites such as Widan el-Faras are of enormous historical importance. The poor state of preservation witnessed at Widan el-Faras from modern exploration and haulage traffic is thus a cause of great concern. Moreover, the impact of modern quarrying in the area observed in 2002 has already destroyed parts of Old Kingdom quarries 3 and 4.[54] There is clearly great potential for future research at Widan el-Faras, not only to understand more about the pivotal part water transport played, but also for a greater insight into the social organisation of these operations, especially set against the backdrop of Old Kingdom state monopolies over remote sources of raw materials. Therefore, the urgency in protecting this fragile quarry site should be stressed.

[52] A Middle Kingdom inscription relating to exploitation of Chephren's Quarry in Lower Nubia during the reign of Amenemhet II implies that the total number of people involved was approximately 1,300. See in W. K. Simpson, 'Nubia: 1962 Excavations at Toshka and Arminna', *Expedition* 4/4 (1962), 36–46. New Kingdom texts relating to quarrying expeditions in the Wadi Hammamat suggest very large numbers being involved (over 8,000); see Clarke and Engelbach, *Ancient Egyptian Construction*, 33.

[53] The archaeological record at Chephren's Quarry does not support numbers over a thousand being present here due to minimal settlement and artefactual evidence, such as pottery, which would be expected from such a large presence. These observations are from recent archaeological survey and excavation (1997, 1999, 2000) at Chephren's Quarry in Lower Nubia. See I. M. E. Shaw and E. G. Bloxam, 'Survey and Excavation at the Ancient Pharaonic Gneiss Quarrying Site of Gebel el-Asr, Lower Nubia', *Sudan & Nubia* Bulletin 3 (1999), 13–20.

[54] See details in 'News and Notes', *EA* 21 (Autumn, 2002), 11.

1. The twin peaks of Widan el-Faras with the encampment in the foreground (view to the north-east).



2. The middle part of quarry 1 (view to the west).

OLD KINGDOM BASALT QUARRYING ACTIVITIES AT WIDAN EL-FARAS, NORTHERN FAIYUM DESERT (pp. 23–36)

PLATE VI

1. Ancient road segment paved with silicified wood (view to the south-east).

2. Basalt stone circle in the large area of stone circles at Widan el-Faras (view to the south-east).

OLD KINGDOM BASALT QUARRYING ACTIVITIES AT WIDAN EL-FARAS, NORTHERN FAIYUM DESERT (pp. 23–36)