NATIONAL MUSEUMS OF SCOTLAND

SAQQARA PROJECT

REPORT

1998

NATIONAL MUSEUMS OF SCOTLAND
CHAMBERS STREET EDINBURGH EH1 1JF

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Joanne Clarke, Jon Dittmer, Ian Mathieson and Mark Roughly

An interim report on the work carried out during the 1998 season covering the use of ground conductivity equipment by repeating previous resistivity and electro-magnetic impulse scanning results and taking further survey profiles over areas of particular interest with sondage trenches to test the geophysical reseults and record archaeological features in the Gisr el-Mudir area.

Project Directors
Ian J Mathieson
Prof Harry S Smith

National Museums of Scotland
Chambers Street Edinburgh EH1 1JF

THE NATIONAL MUSEUMS OF SCOTLAND

PRELIMINARY REPORT OF THE SAQQARA SURVEY PROJECT 1998

By Joanne Clarke, Jon Dittmer, Ian Mathieson and Mark Roughly

The aims of the National Museums of Scotland Project have been:

a) To produce an up-to-date archaeological and subsurface geophysical map of an interesting and relatively little studied area of Saqqara, the great necropolis of Memphis, the major city of Egypt from c.3000 BC to Hellenistic times. The area concerned comprises the Gisr el-Mudir ('the Great Enclosure') in the south, an area of the Old Kingdom tombs around the mastabas of Ptahhotep, the area of the Serapeum and its dependencies, part of the Archaic necropolis, and the Sacred Animal Necropolis complex near the village of Abusir in the north (see plan of concession area).

b) To adapt and combine a series of well-known geophysical techniques to the special problems of plotting large monuments, cemeteries, catacombs and natural features in desert conditions where unexcavated and previously excavated monuments are buried either under drift-sand or the dumps of former excavations. These techniques incorporate resistivity survey, electro-magnetic impulse profiling, ground conductivity, proton magnetometer survey, sonic profiling, field inspection, archival research and test-excavation (for descriptions see 1992/3 Report pp. 1-4).

The National Museums of Scotland acknowledge with gratitude the help and co-operation of the Supreme Council for Antiquities with whose permission the Museum's work is carried out; the Chairman Prof. Dr G A Gaballa, Mr Magdi at the Secretariat, Dr Zahi Hawass at Giza, Mr Mohammad Hagras, Director of Saqqara, the Chief Inspector Mr Magdi el-Ghandoor and Mr Azzam Salama, the inspector attached to the mission. The October - December 1998 season has been undertaken with the generous financial support of grants from the National Museums of Scotland, the Gerald Averay Wainwright Fund (Oxford University), and technical assistance in map reproduction by Survey and Development Services, Bo'ness, West Lothian. Professor Harry Smith is co-director and archaeological advisor.

The National Museums of Scotland field team comprised Ian J.Mathieson, field director, Dr Joanne Clarke, archaeologist and ceramicist, Dr Jon Dittmer, geophysicist and Mark Roughly, illustrator and archaeologist. The 1998 season opened on 1st October and continued until 8th November.

Previous Fieldwork

During the 1990 season resistivity work was completed along the length of the concession area and four of the proposed cross-sections covering the large enclosure known as the Gisr el-Mudir were surveyed (fig. 1). In 1991 the complete concession area was field-walked and all visible surface indications of structures and old excavations were located for inclusion on the base maps. Work was completed in 1992 on the observation of the resistivity data covering the southern two-thirds of the original concession area, from the northern access road to the Serapeum to the southern limit of the concession, which lies some 100m south of the southern boundary of the Gisr el-Mudir[1]. In 1993 sondage trenches were opened on anomalies in the southwest corner of the Gisr-el-Mudir to check the resistivity data plotted at these points. A mud-brick platform was discovered inside the enclosure at the SW corner and the construction of the enclosure walls was investigated (1993 Report, Map Sheet 1, A7 & A8). In the 1994 season sondage trenches were opened to confirm the geophysical findings on profiles taken over the North Wall (1994 Report, Map Sheet 1, GMNWXS2). The construction of the wall was found to extend to the North with a buttress formation on the North face. Several graves were found on the South side of the wall, one of which had a stela of the Persian period deposited in the sub-structure (Reports 1990 - 1994)[2].

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1 See I.J.Mathieson and A. Tavares, *JEA* 79 (1993), 17-31.

2 See I.J.Mathieson et al. *A Stela of the Persian period from Saqqara. JEA* 81 (1995), 23-41.

During 1995 further sondage trenches were opened (1995 Report, Map Sheet 1, A9-14), to inspect anomalies over the south-west corner of the monument where the inside corner was located and surveyed [3]. In 1996 electro-magnetic impulse equipment, kindly loaned by ERA Technology of Leatherhead, Surrey, was used for the first time in Saqqara. Many scanning profiles were taken over existing resistivity surveys and the results confirmed the previous findings and gave a much-enhanced interpretation of the sub-surface conditions (Report 1996). In 1997 conductivity surveys were carried out using the Geonics EM 31 covering half of the Gisr el-Mudir and a portion of the L-shaped structure. (Report 1997)

The Objectives of the 1998 season were:

- To continue the electromagnetic induction survey of the Gisr el-Mudir using the EM31 instrument to measure the apparent conductivity of the surface material to a depth of approximately 6 metres.
- To re-observe certain areas previously surveyed by other electronic means to obtain comparative results and to auger small diameter test bores over possible anomalies.
- To test by small sondage trenches the results of the electronic surveys, which had indicated anomalies in the sub-surface materials.

Fieldwork Gisr el-Mudir (The Great Enclosure)

Conductivity

The Geonics EM31 ground conductivity meter maps geological variations, man-made material intrusions and sub-surface structures associated with changes in the ground conductivity using an electromagnetic technique that makes measurements without electrodes or ground contact. With this inductive method, surveys are readily carried out in regions of high surface resistivity such as sand and gravel.

The effective depth of exploration is about six metres and important advantages of the EM31 over normal resistivity methods are the speed at which surveys can be conducted, the precision with which small changes in conductivity can be measured and the continuous readout while traversing the survey area. Two digital meters display both the quadrature-phase (conductivity) and the inphase components that are recorded simultaneously on a digital data recorder. The inphase component is useful for detecting ferrous and non-ferrous metallic debris. The 4m boom, digital recorder and method of carrying are shown in (fig. 9).

The Gisr el-Mudir was sub-divided into a grid consisting of 50 metre squares. In total the enclosure was covered by some 85 squares. Readings were taken every 1 metre, which means the area was covered with over 200,000 readings. The results are shown in fig. 2, with an enlargement of the eastern wall, excavated in 1998, shown in fig. 3.

Figure 2 shows that the enclosure exhibits regions of high and low electrical conductivity. The high conductivity occurs mainly within the interior of the enclosure, and particularly in the regions of lower elevation. Boreholes have indicated that in these areas, the bedrock is just below the surface and never more than one metre down. This shows that the region's limestone bedrock tends to have a high conductivity, which explains why the ground radar performance was not so good in regions where the bedrock is near to the surface. The survey has also shown that the bedrock layers exhibit different electrical properties, this can be seen in the data by the northeast to southwest banding in the data.

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[3] See I.J.Mathieson et al. *The National Museums of Scotland Saqqara Survey Project 1993-1995. JEA* 83 (1997)

Areas of lower conductivity represent two features; regions where the windblown sand has collected against some structure, usually a wall, or regions where sand and gravel have been collected and deposited by hand in antiquity. The large 'mound' in the south of the Gisr el-Mudir is such a feature. The walls of the Gisr tend to consist of two single skins of local stone facing, with a rubble and mud-mortar core forming a 'bund' structure. This makes them difficult to discern in the conductivity data. What the method can detect is the dry sand, which collects against the walls. This has a much lower conductivity and demarcates the wall lines quite clearly. The enlargement of the east wall fig. 3, has the line of the east face indicated. Excavation showed that a large thickness of sand had built up against the wall and underlying cliff. The clarity of this abrupt change from stone to sand has been reduced due to a layer of wall destruction overlying the sand. Such layers of overburden act as a blanket, reducing the measurable effect due to any change in the underlying structure.

With the exception of previously identified shafts and surface exposures of the East Wall no additional structures were found in this survey area.

Borehole survey

A total of 12 boreholes were drilled as shown in fig. 4 using a standard 15cm auger. The depth to the bedrock, the soft yellow marl that forms the local desert clay or *tafl*, was determined in each case. Borehole No. 9 was drilled to find the depth, through the wind blown sand, of the quarry face cut in the good quality local limestone found at the sondage square B4 (85+40).

Auger Borehole Logs

Bore No. 1	Surface	50.129m amsl.	E: 326820 N: 305178
		49.429	Yellow aeolian sand
		49.209	Yellow sand and gravel
		48.909	Blue grey mudstone with gravel inclusions.
Bore No. 2	Surface	49.134m amsl.	E: 326819 N: 305199
		48.344	Yellow aeolian sand
		47.874	Yellow sand & gravel
		47.434	Yellowish grey mudstone.
Bore No. 3	Surface	48.405m amsl.	E: 326818 N: 305214
		47.665	Yellow aeolian sand
		47.185	Yellow sandy clay & gravel
		46.955	Brown grey mudstone
Bore No. 4	Surface	54.316m amsl.	E: 326660 N: 305182
		52.586	Yellow aeolian sand
		52.546	Yellow sand & gravel
		52.500	Marl bedrock
Bore No. 5	Surface	49.304m amsl.	E: 326602 N: 305204
		48.664	Yellow aeolian sand
		48.314	Yellow sand & gravel
		47.994	Marl bedrock
Bore No. 6	Surface	46.307m amsl.	E: 326647 N: 305347
		45.767	Soft sandy clay
		45.740	Marl bedrock
Bore No. 7	Surface	43.932m amsl.	E: 326663 N: 305537
		43.362	Soft sandy clay
		43.162	Gravel & sandy mudstone
		43.140	Mark bedrock
Bore No. 8	Surface	45.041m amsl.	E: 326564 N: 305452
		44.541	Yellow aeolian sand
		44.500	Mark bedrock
Bore No. 9	Surface	43.469m amsl.	E: 326881 N: 305265
		40.689	Marl bedrock (base of quarry face)

Bore No.10	Surface 43.876m amsl. E: 326900 N: 305284
	43.176 Yellow aeolian sand
	42.656 Stone in hole
Bore No. 11	Surface 42.982m amsl. E: 326912 N: 305286
	40.071 Yellow aeolian sand
	40.70 Marl bedrock
Bore No. 12	Surface 41.388m amsl. E: 326977 N: 305300
	41.200 Marl bedrock

Sondage excavations

The aim of the 1998 excavation season was twofold, to explore the anomaly located around the area of the East Wall during the 1997 sub-surface sensing investigation, and to locate the outer and inner faces of the East Wall in order to compare building methods with those previously recorded on the North and West Walls. A 100m x 50m grid was pegged out running north-south over the assumed position of the East Wall, encompassing the region of the anomaly. The grid was divided into 5m x 5m squares, numbered according to the survey grid system established in previous seasons (see Mathieson *et al.*, 1997)[3]. B4 (0 + 15) was the most south-westerly square within the 100m x 50m grid and each subsequent square was numbered sequentially, B4 (0 + 20), B4 (5 + 15), B4 (5 + 20) etc, (Fig. 4). The west face of the East Wall was visible on the surface in square B4 (0 + 20) running in an approximately north-south line.

It was therefore decided that excavation should begin in square B4 (0+15) and B4 (0+ 20), exposing the face of the wall and any associated features and construction methods. Fine aeolian sand (context 2006) was found to abut up to the wall on the western face to a depth of 1.5m. The removal of this exposed 5 courses of undressed roughly cut and poorly laid local limestone blocks standing to an extant height of 49.47 amsl., and which comprised the west face of the East Wall (context 2005) (fig. 7). The construction of the wall was of significantly poorer quality than that of the inner face of the south-western corner of the wall exposed during the 1995 season. The limestone blocks were of irregular rectilinear shape, averaging 25cm x 80cm x 80cm in dimension, interspersed with smaller coursing stones and rubble, and between which was a thick, coarse, mud and limestone chip binding matrix. Blocks were laid in a buttress like fashion, sloping inwards in the same construction style as previous exposures of the wall have attested (fig. 6). Beneath the aeolian sand, and also abutting up to the wall was a surface comprised of flint and limestone chips set into a hard mud matrix (context 2008), varying between 48.37 amsl. and 48.28 amsl. When part of this surface was removed, a further wall course was exposed which was laid directly onto the natural bedrock (context 2012), (fig. 6). Pottery associated with the wall and floor consisted primarily of Old Kingdom Nile C Beer Jars, and some fragments of fine red burnished wares of unknown shape but dating to the late Old Kingdom. However, on the whole the area around the wall and floor were almost devoid of any pottery, a phenomenon noted in previous seasons and for which we have no convincing explanation.

A further sounding was opened 75m to the north of the first sounding, in square B4 (75 + 15) and B4 (80 + 15) in the region of the anomaly. Here, the west face of the East Wall was exposed in the east baulk, approximately 1.5m further to the west than its position in B4 (0 + 20), clearly showing that the wall is aligned very slightly to the north/north west. Aeolian sand again abutted the inner face of the wall to a depth of 1m. Only three wall courses were found extant in this region and standing to a height of 47.00 amsl., again laid directly onto the natural bedrock surface with a hard compact surface of flint and limestone chips in a mud matrix abutting up to the first course of limestone blocks (fig. 7). The construction of the wall at this point appeared to be even more haphazard than in the southern portion of the grid. There was no clear evidence that the individual limestone blocks were interspersed with smaller coursing stones, or was there any evidence for a binding matrix of mud and limestone fragments. The stones were actually rather sparsely laid on what appeared to be compacted aeolian sand. Further exploration of the construction of the East Wall at this point would be needed to confirm this observation.

The exposure of the wall face in B4 (80+ 15) gave no indication of what might have contributed to the anomaly apparent in the conductivity readings of the previous season, therefore it was decided that the wall would be further explored eastwards to locate the east face, in order to correlate construction methods with that already known from the North and West Walls.

A further five 5m x 5m squares were pegged out in an east-west line from B4 (80 + 15). These were B4 (80+20), B4 (80+25), B4 (80 + 30), B4 (80 + 35) and B4 (80 + 40). In was presumed on the basis of previous exploration that the east face of the East Wall should lie approximately 15m to 17m to the east of the west face. In order to understand the construction of the east face, excavation was undertaken first in B4 (80 + 40) with the intention of excavating inwards towards its estimated position. However, a surprising discovery was made when excavation uncovered the quarry face of the western edge of the valley running north-south between the Gisr el-Mudir and the Early Dynasty structures of Zjoser's Step Pyramid and Sekhemkhet's structure (figs. 5 & 9). It had been previously assumed that much of the local limestone used in the construction of many of the tomb complexes within the Saqqara necropolis actually came from exposed outcrops and quarrying activity along the valley floor and presumably these faces lay beneath aeolian sand. The discovery of the worked face of the western edge of the valley confirmed this premise and was therefore of particular interest. Upon the discovery of the quarry face a further square B4 (85 + 40) was opened so that the quarry face could be properly explored. The highest point of the quarry face measured 45.94 amsl. Deep aeolian sand abutted up to it in a series of fine layers, interspersed with two hard mud mortar and limestone chipping layers, presumed to be wall collapses. At 43.25 amsl. a worked rock face was uncovered protruding at a 30° angle from the quarry face (fig. 9). The excavation was carried down to 41.76 amsl. without reaching the natural floor of the valley, however deep boring carried out with an auger later tested the depth of the valley floor in relation to the quarry face to a depth of 40.689 amsl.(fig. 5).

The relationship between the east face of the East Wall of the Gisr el-Mudir and the quarry face was now considered to be of prime importance, therefore the squares B4 (80 + 35) and B4 (80 + 30) were opened in the hope of locating the east face of the East Wall. Approximately 2m to the west of the quarry face a small, poorly constructed wall was discovered running east-west, perpendicular to the East Wall of the Gisr el-Mudir (fig. 5). This wall reached an extant height of half a meter at its highest point and was built directly onto a combination of an earlier East Wall collapse and the *tafl* bedrock. It was constructed of small very roughly cut limestone blocks and mud brick and limestone pebble coursing layers. The limestone blocks measured no more than 40cm x 20cm, while the mud brick coursers were similar in type to those used in the construction of the platform discovered in Sondage A8WW in 1993, which is thought to date to the Old Kingdom. The southern face of this wall was not located within the extent of the excavation, but the fill was comprised of very hard man-made mud mortar, limestone and flint chips and some mud brick. This factor, and its similarity to the platform in Sondage A8WW, suggested to the excavators that it might in fact be a ramp or platform roughly constructed for the purpose of removing blocks from the Gisr el-Mudir East Wall. Given that the wall sits partly on East Wall collapse indicates that it was built sometime after the construction of the Gisr el-Mudir, but still in the Old Kingdom, as indicated by the composition of the mud bricks and associated pottery (fig. 5). As if to confirm this theory, approximately 12m from the quarry face, in square B4 (80 + 30), the east-west wall peters out at a man-made cut in the bedrock, which was filled with debris from East Wall collapse. The stratigraphic relationship of the wall and the depression (fig. 5) indicate that the debris filled depression is actually the robbed out trench for the east face of the East Wall, and that the east-west wall (or platform) apparently was used in the removal of the limestone blocks. The presence of an earlier collapse upon which the platform partly rests might be the product of small scale earlier robbing of the East Wall.

Pottery associated with the collapse of the East Wall, and the platform all dates to the Old Kingdom and includes Meydum bowls of early and late type, large shallow Meydum Ware platters with out-turned folded rims and Nile C beer jars (fig. 8). No pottery was clearly associated with the East Wall itself. The presence of Meydum bowls and other Meydum Ware shapes associated with the two wall collapses indicates that the robbing of the East Wall took place around the end of the Old Kingdom.

A number of statements can be made regarding the relative stratigraphic association of the East Wall, the platform and the quarry. The Quarry face was utilised very early in antiquity, perhaps during the time of the construction of the Gisr el-Mudir, although we have no evidence to confirm this. What we do know is that by the first collapse the quarry face was no longer utilised, and in fact, had been out of use for some considerable period of time indicated by the depth of aeolian sand deposited under the first East Wall collapse and abutting up to the quarry face to a height of 45.56 amsl. The East Wall of the Gisr el-Mudir collapsed, or was partly robbed out during the 5th or 6th Dynasty resulting in a layer of hard mud mortar beneath the platform, and associated with Meydum Ware pottery. The platform, which runs perpendicular to the east face of the East Wall, was then constructed on top of this collapse. During this phase the East Wall was completely robbed out in this area, exposing its rock-cut foundation trench. The second layer of hard mud mortar and limestone chips comprises the debris left from the second robbing of the East Wall, associated with the platform. This second robbing of the East Wall also occurred towards the end of the Old Kingdom, probably not long after the first collapse.

The results of the excavation reveal a number of new features previously suspected but unconfirmed. First, the presence of a robber trench and associated platform abutting up to the east face of the East Wall confirm that organised large scale robbing out of the Gisr el-Mudir occurred in antiquity, probably late in the Old Kingdom. Secondly, the extensive quarry face appears to have been utilised very early in the Old Kingdom and was probably covered by sand towards the end of this phase.

Conclusions

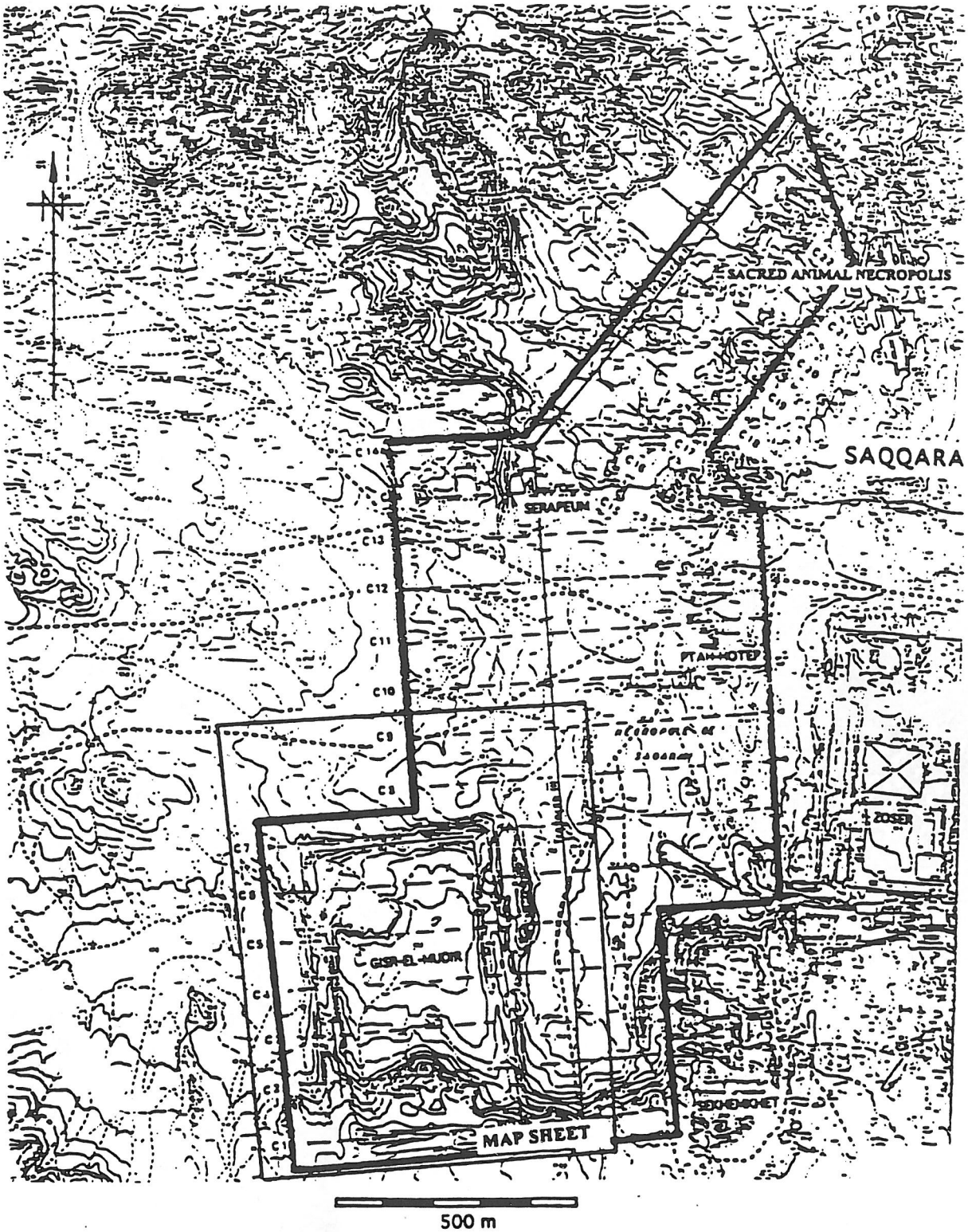
The EM31 conductivity equipment has shown that, when used in desert conditions, the equipment enables sub-surface surveys to be carried out to a depth of approximately six metres with great accuracy and at a very economical speed. Archaeologists can now plan to carry out quite large surveys, for example 500m square, within a seasons work, pinpoint anomalies, scan them with impulse equipment and make firm decisions as to whether to excavate or not.

The small-scale trenches excavated to test the anomalies have provided good evidence of the accuracy of geophysical data and at the same time have enhanced the archaeological interpretation of the site and provided results which give strong indications of an early dynastic date for the Gisr el-Mudir.

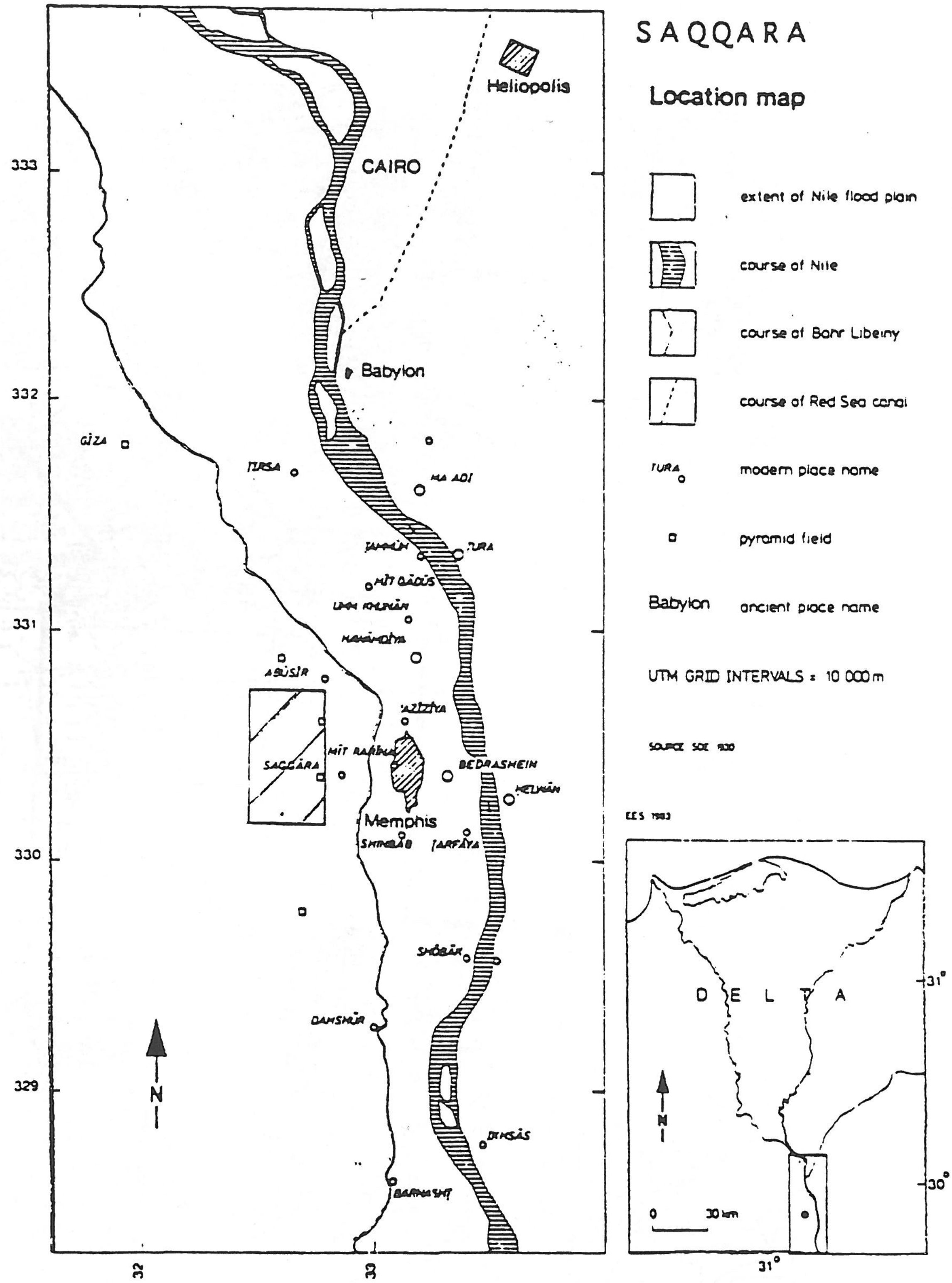
With the permission of the Supreme Council for Antiquities the NMS plan to continue the work through 1999 and 2000 and complete the inspection of the South and East walls.

Ian J Mathieson

Project Director



National Museums of Scotland Concession Area


SAQQARA
Location map
extent of Nile flood plain
course of Nile
course of Bahr Libeiny
course of Red Sea canal
TURA
modern place name
pyramid field
Babylon
ancient place name
UTM GRID INTERVALS = 10 000 m
EES 1983
Heliopolis
CAIRO
Babylon
Memphis
GIZA
TIRSA
MA'ADI
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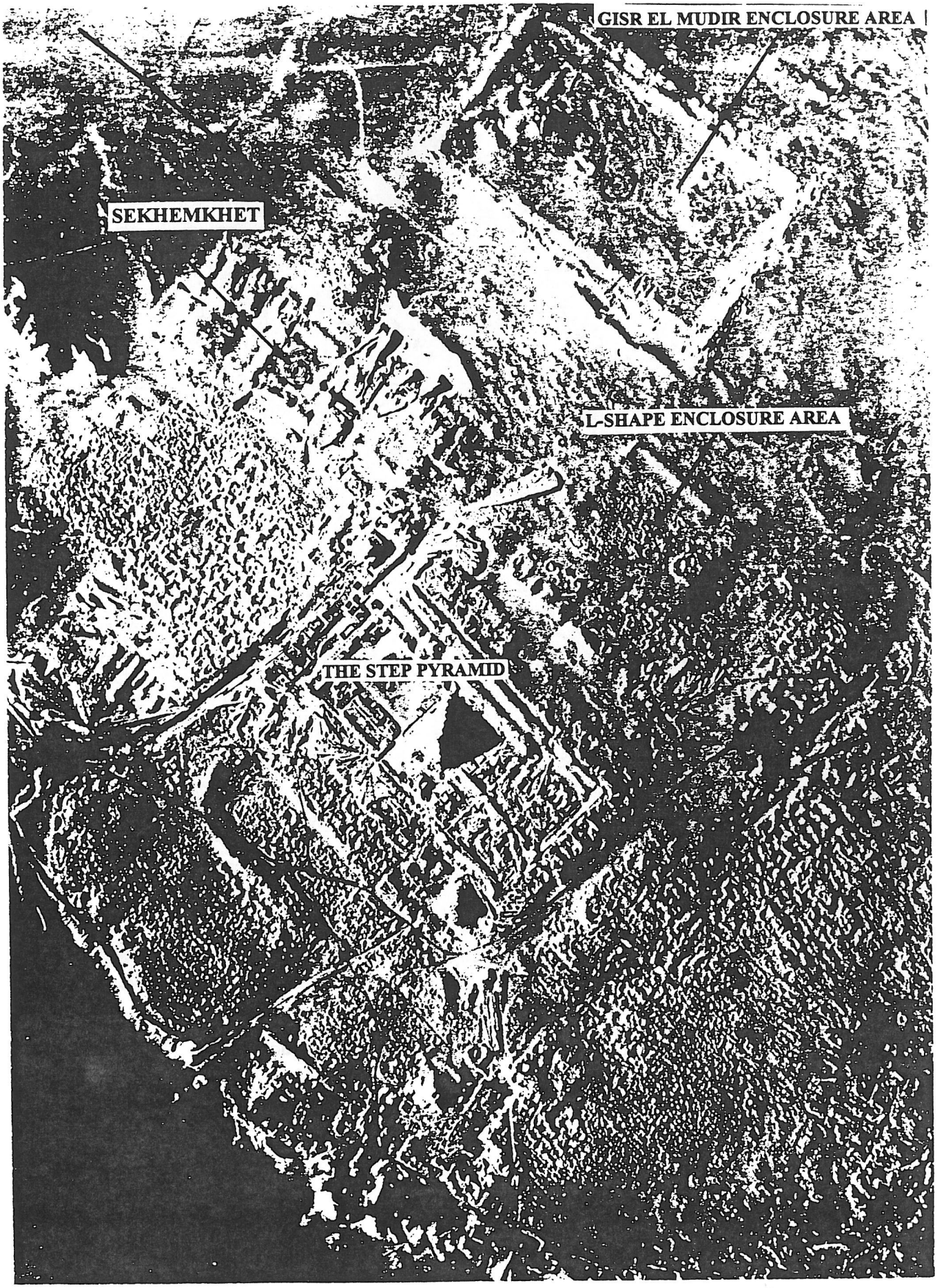
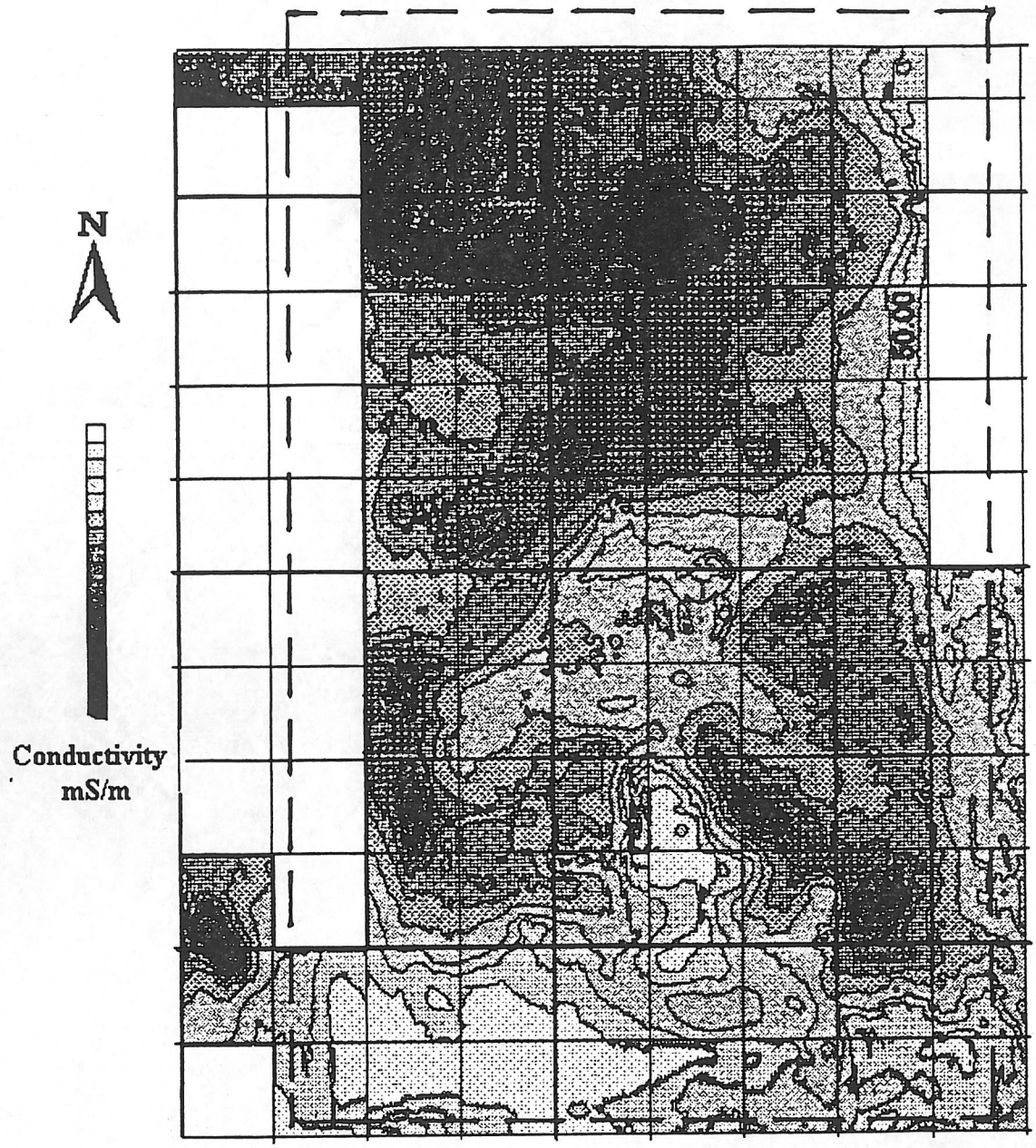
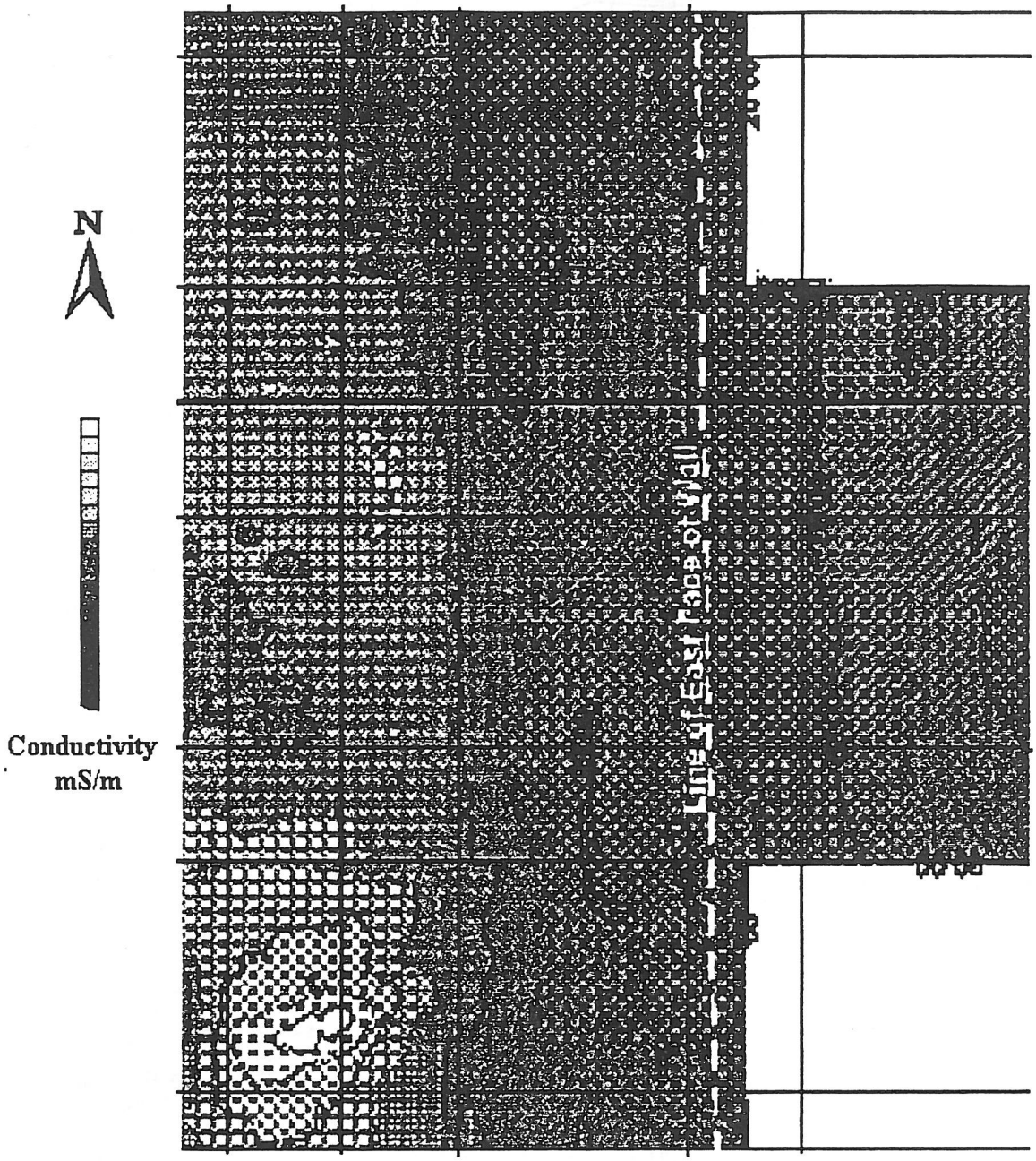


GISR EL-MUDIR & L-SHAPED ENCLOSURES
IN RELATION TO THE STEP PYRAMID

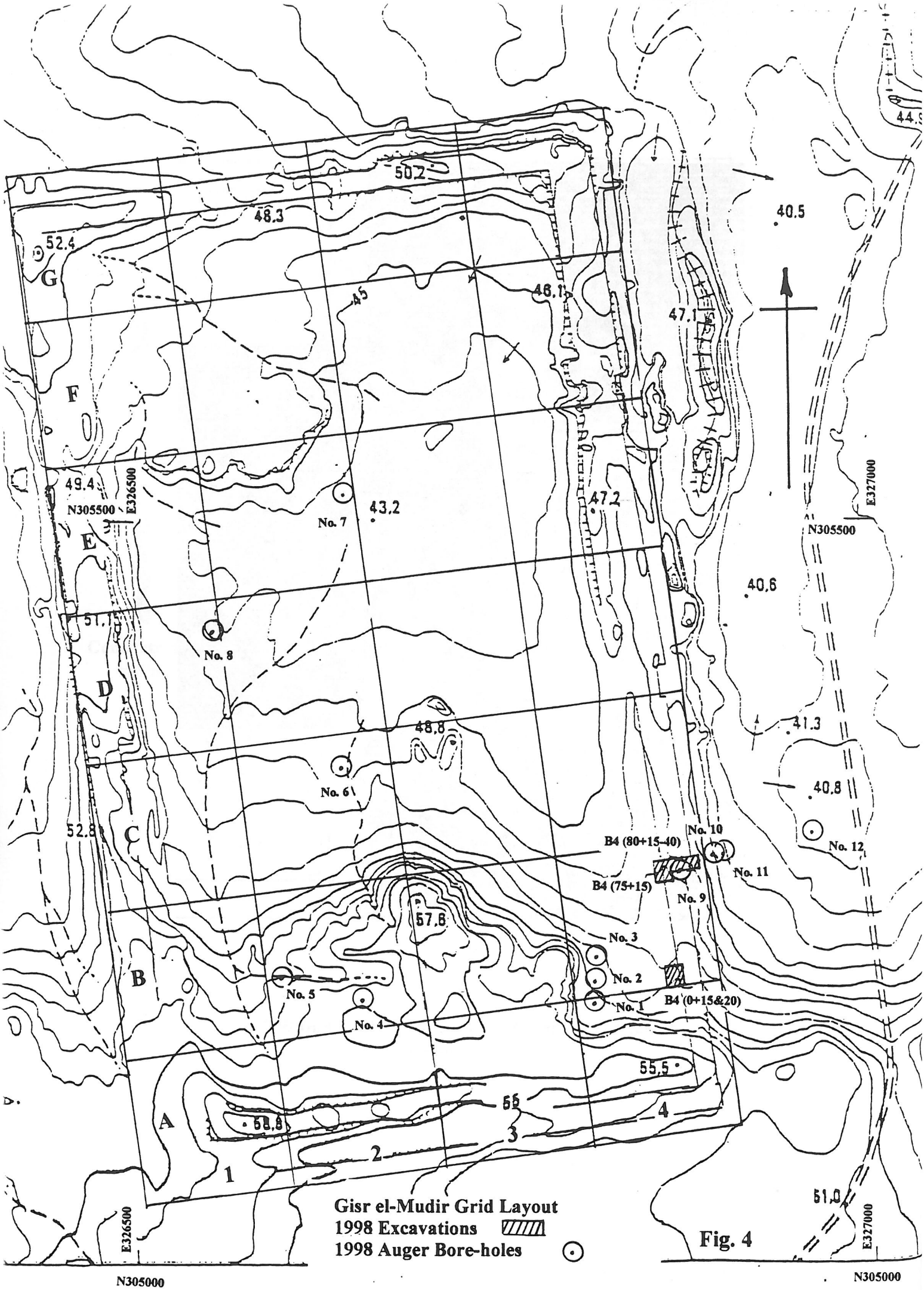
Fig. 1



EM 31 Conductivity Survey of the Gisr el-Mudir Fig. 2

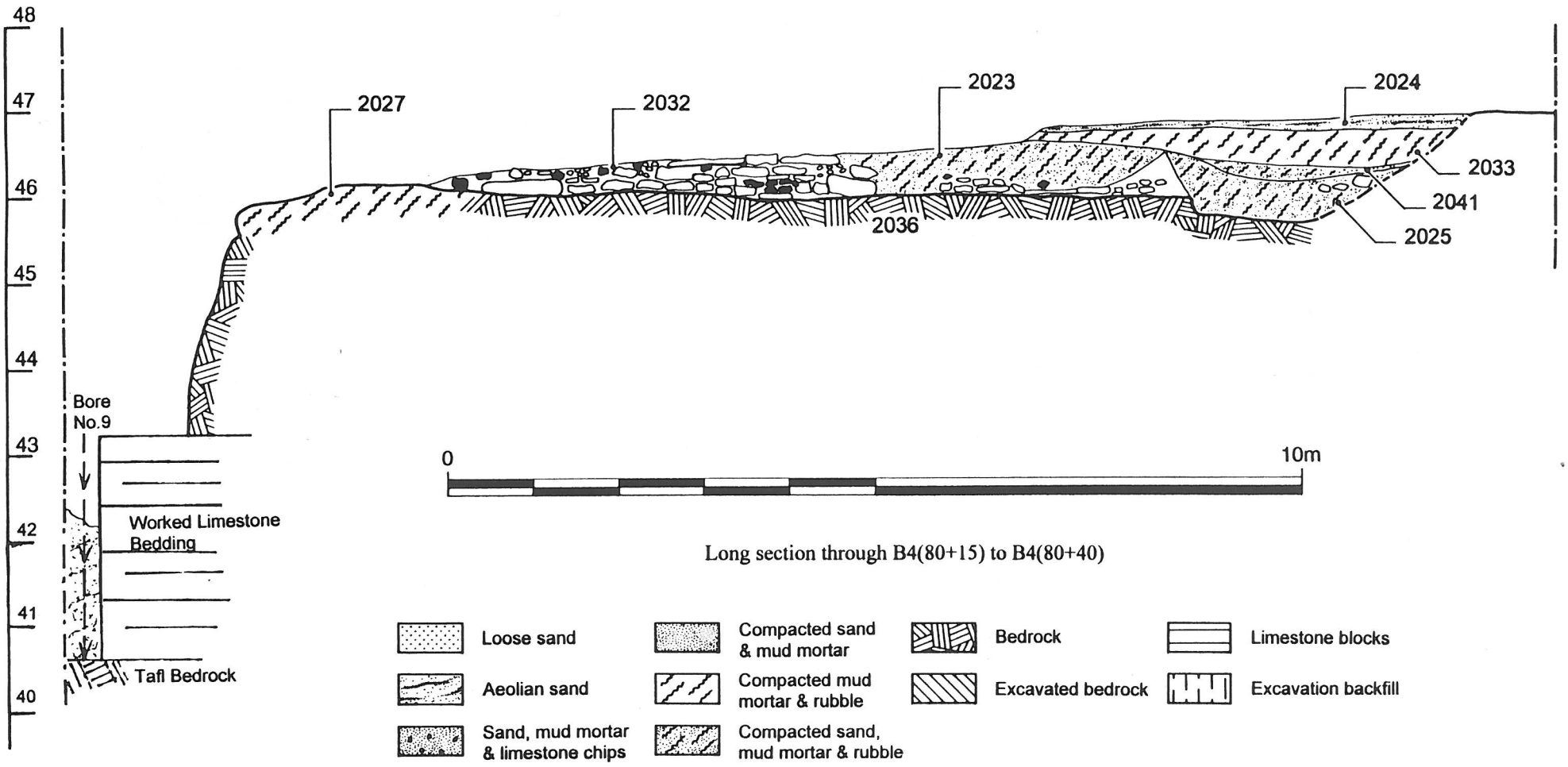


EM 31 Conductivity Survey of Gisr el-Mudir East Wall
1998 working area Fig. 3



Gisr el-Mudir Grid Layout
1998 Excavations
1998 Auger Bore-holes

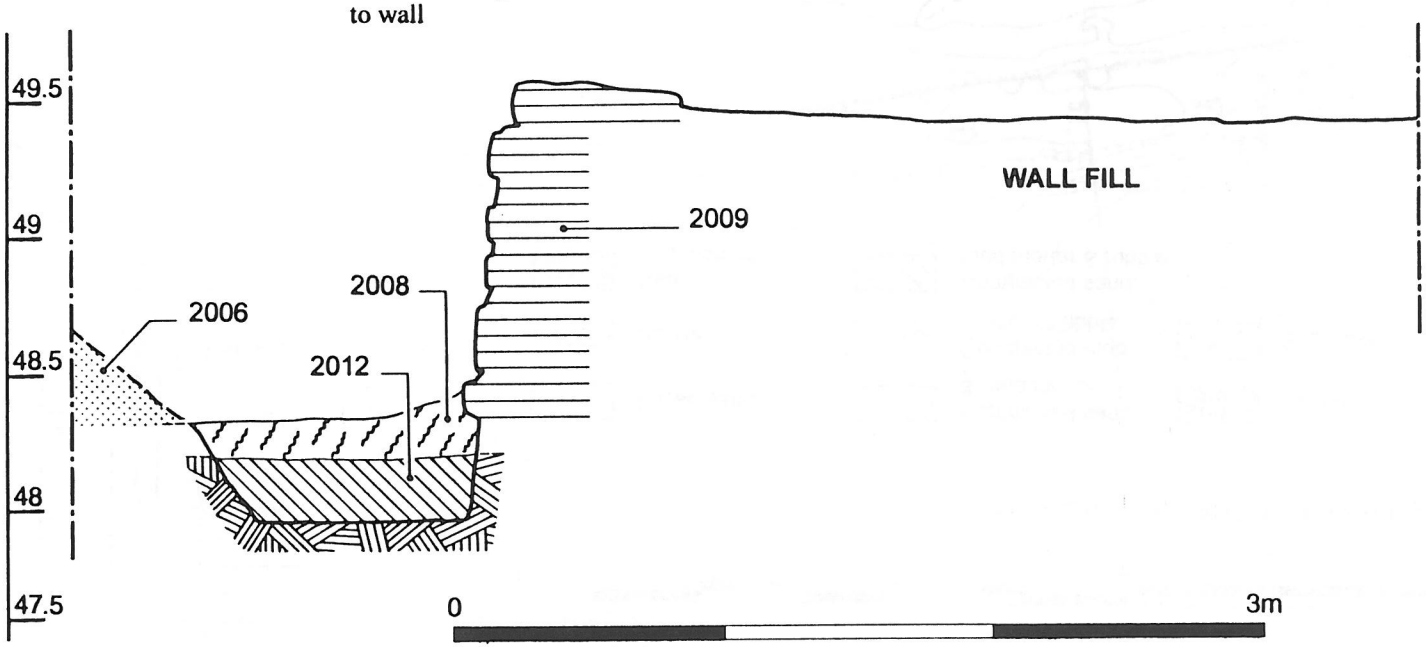
Fig. 4

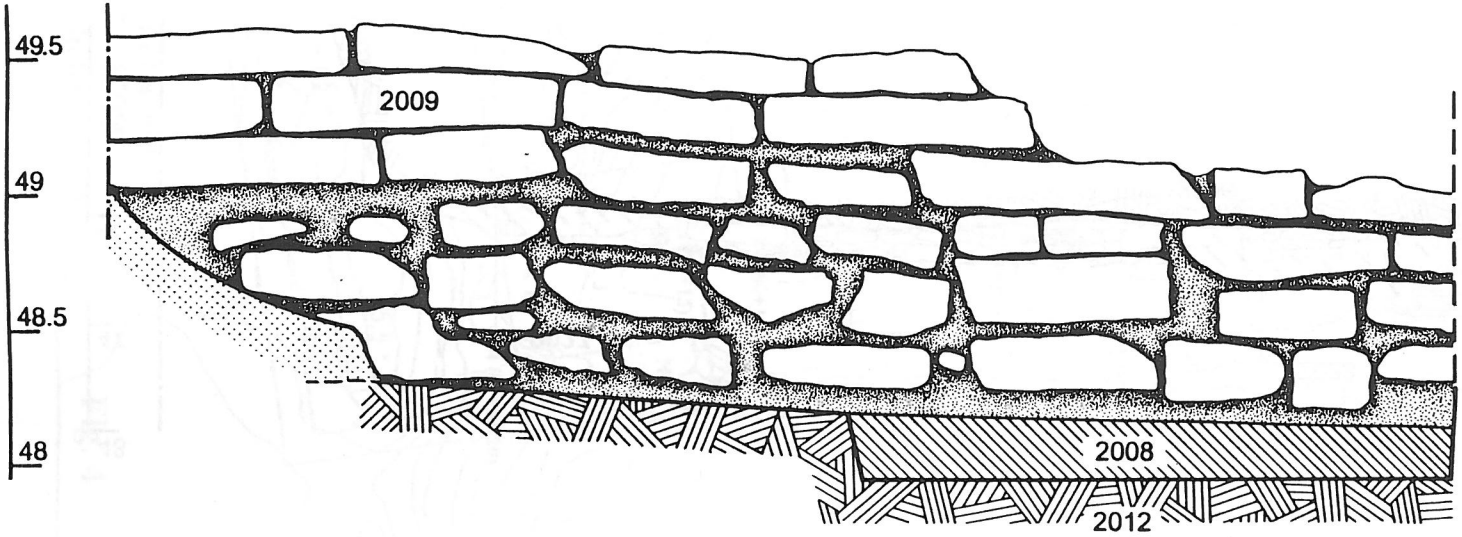


Long section through B4(80+15) to B4(80+40)

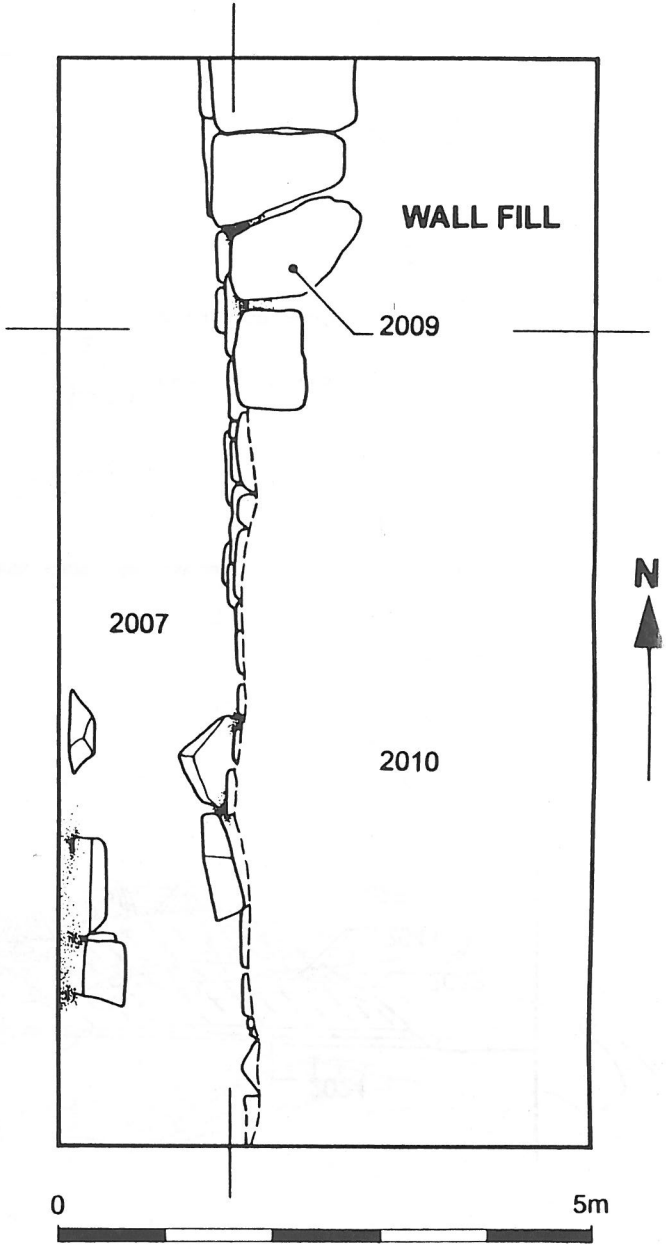
Fig. 5

Section through E-W baulk of B4(5+20) showing relationship at surface to wall



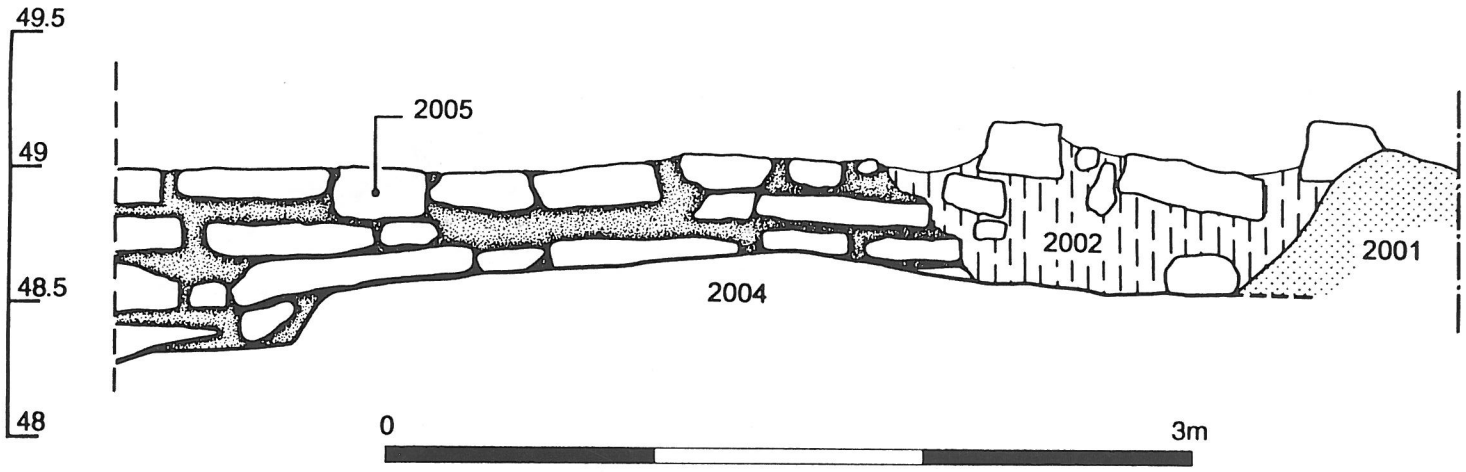


Elevation showing the west face of the east wall B4 (5+20)

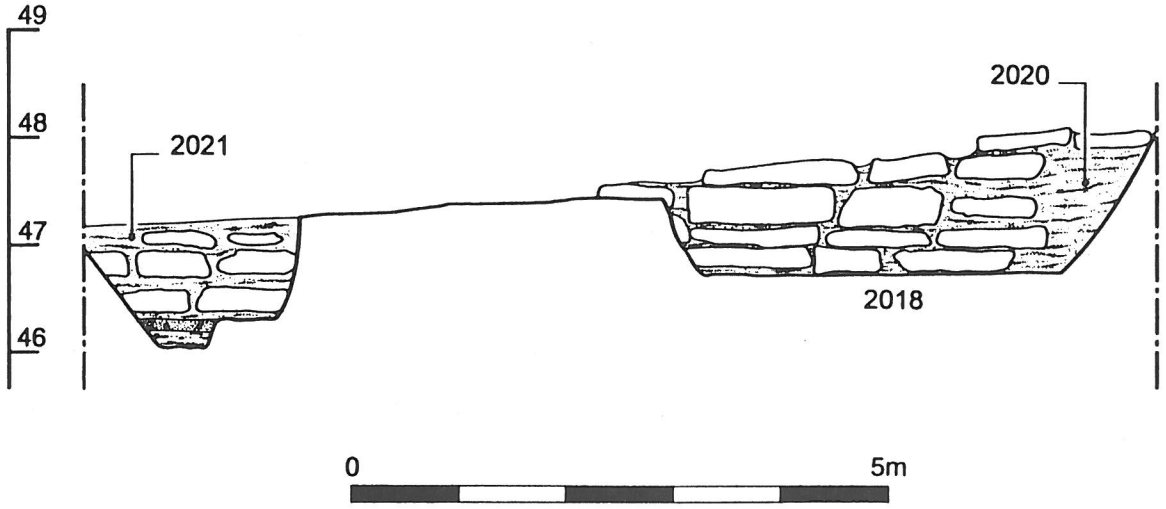


Plan showing the west face of the east wall B4(5+20)

Fig. 6

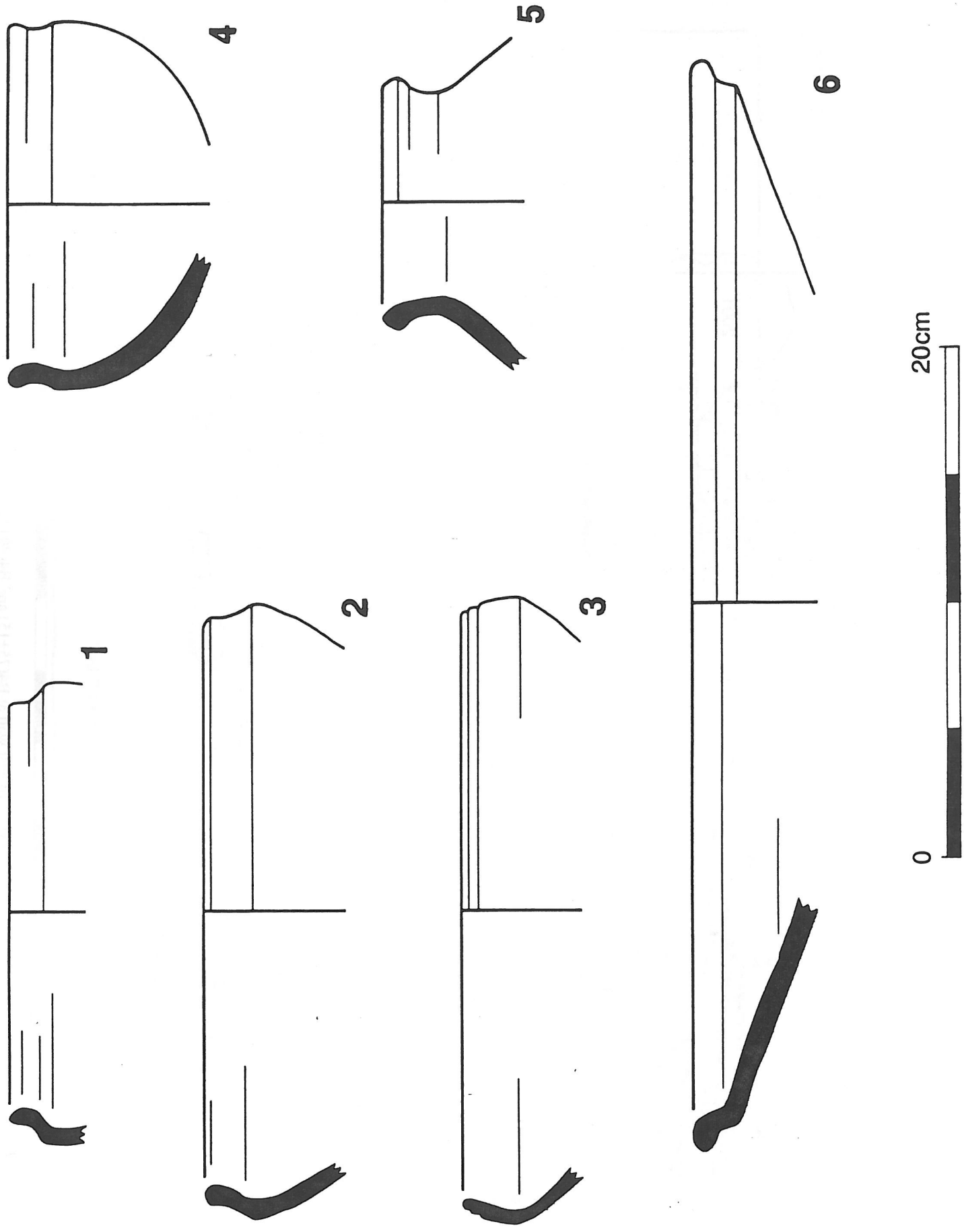


Elevation showing the west face of the east wall B4 (0+20)



Elevation of east wall at B4(75+15) and B4(80+15)

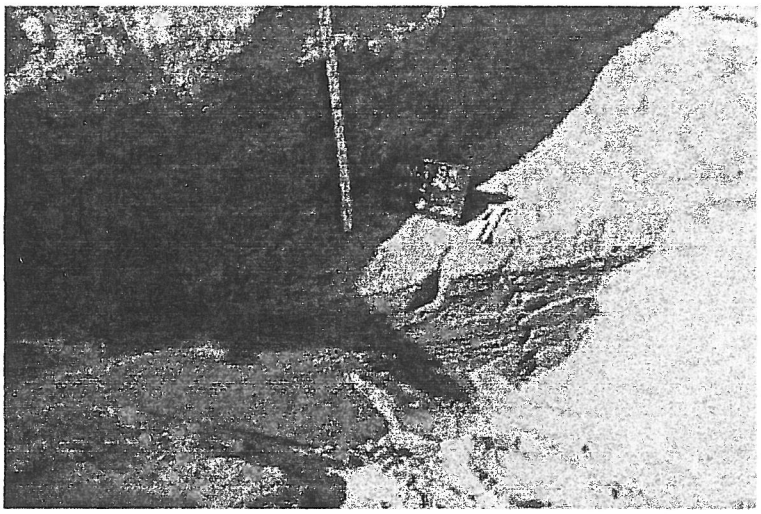
Fig. 7



Pottery associated with the excavations in B4

Fig. 8

Geonics EM 31 Conductivity Meter



Gisr el-Mudir Quarry Face in Tafl Bedrock B4 (85+40)
With worked local limestone bed below

Fig. 9