

SAQQARA GEOPHYSICAL SURVEY PROJECT

PRELIMINARY REPORT

2002

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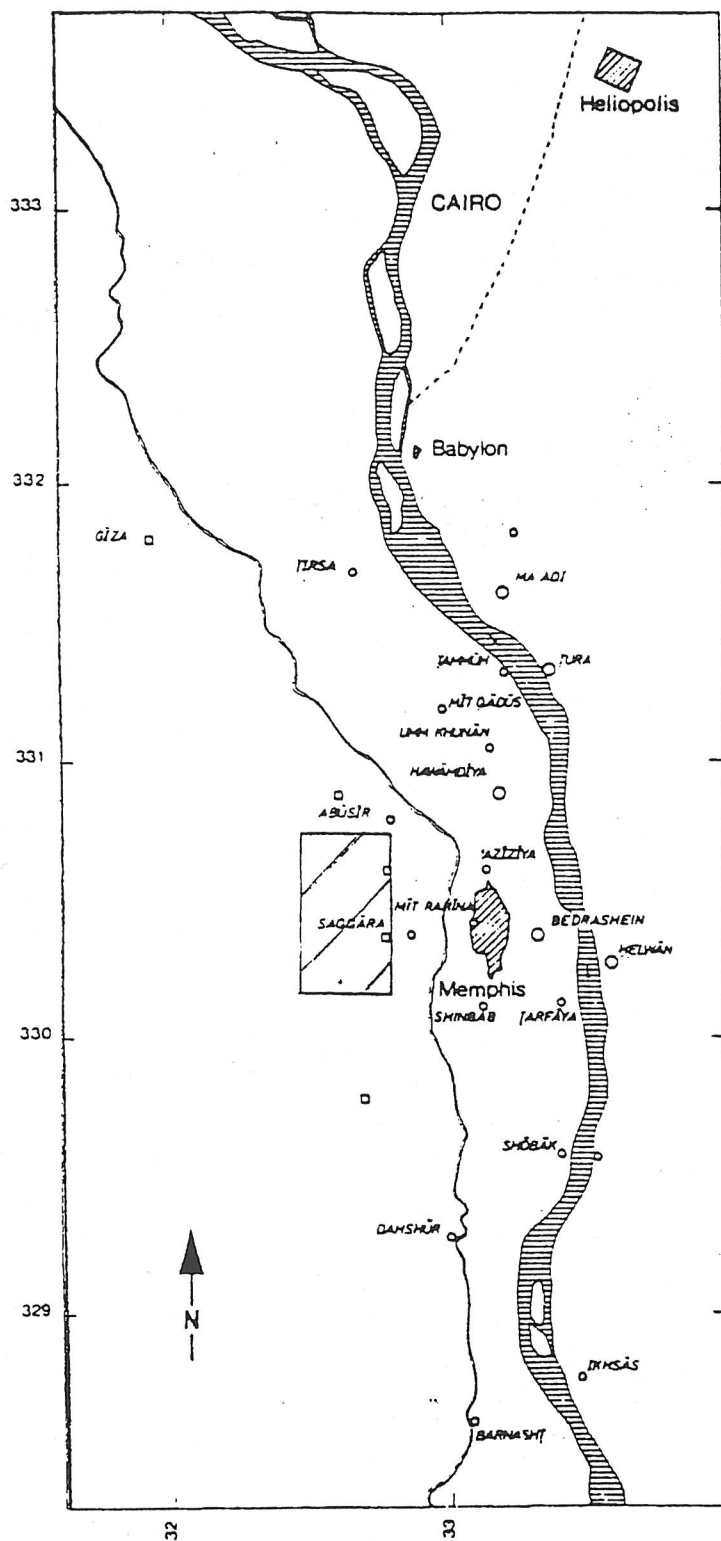
SAQQARA GEOPHYSICAL SURVEY PROJECT 2002

**Jon Dittmer, Carla Gallorini, Salima Ikram, Anthony Leahy,
Dan Lines, Ian Mathieson, Colin Reader**

Abstract: An interim report on the work carried out during the 2002 season covering the use of the model 18 Geoscan Gradiometer equipment to test previous geophysical results and record archaeological features in the valley on the north side of the Serapeum leading to the village of Abu Sir. The results have shown a previously unknown line of temple structures, many tombs, some of which may be those excavated by Mariette and De Morgan in the 1890's and an apparent town or large settlement near the old Lake of Abusir which could have housed workers or priests attached to the many monuments of Saqqara.

**Project Director
Ian J Mathieson**

**Glasgow Museums
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SCOTLAND**



SAQQARA

Location map

- extent of Nile flood plain
- course of Nile
- course of Bahr Libeiny
- course of Red Sea canal

TURA modern place name

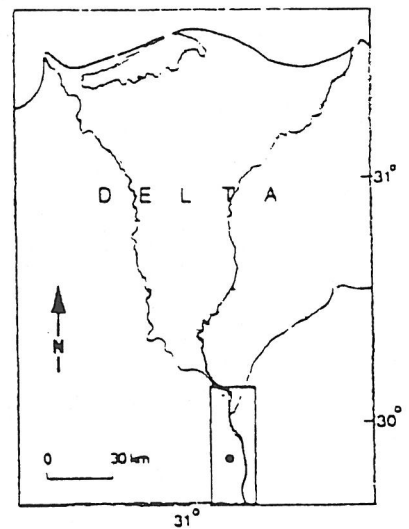
pyramid field

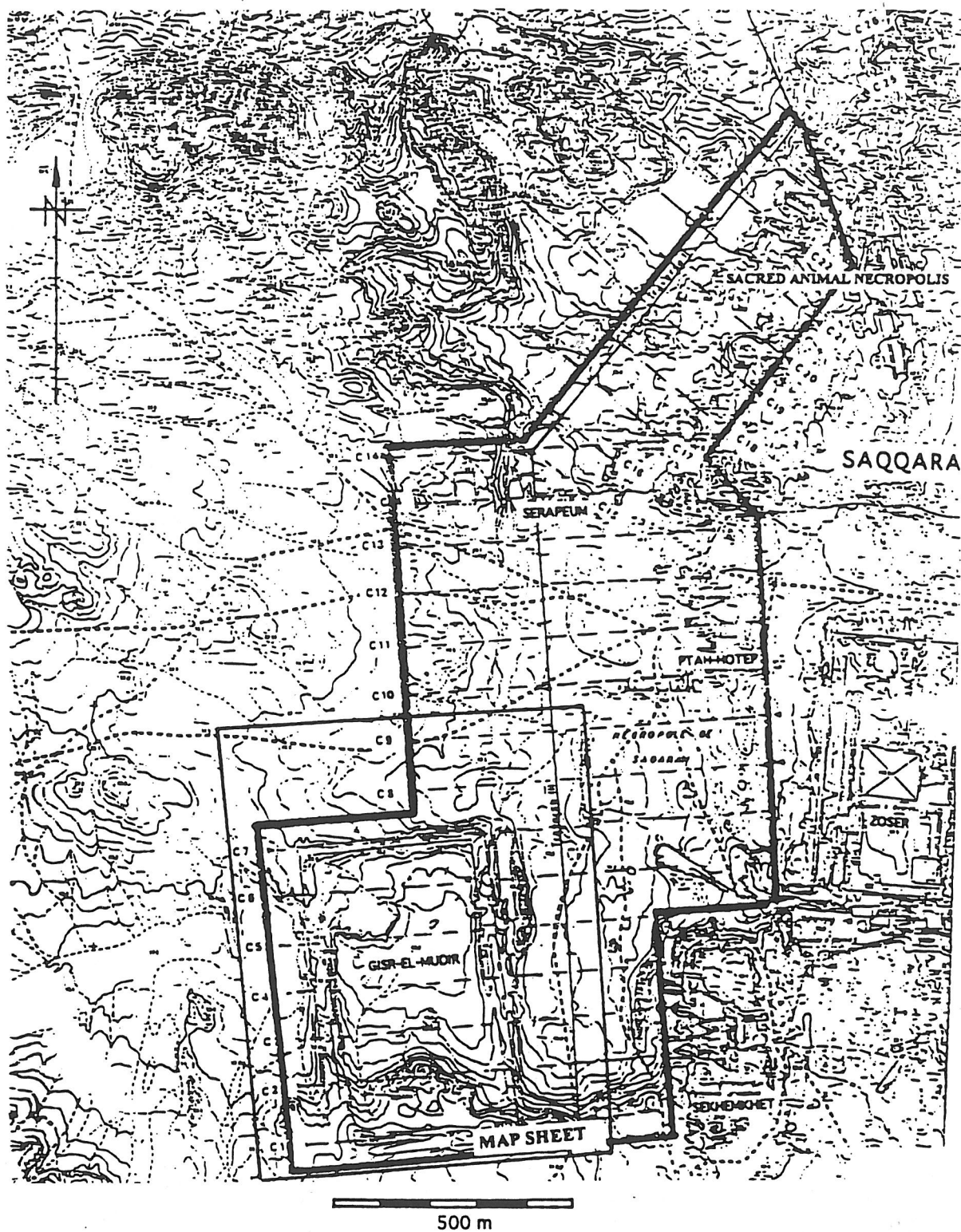
Babylon ancient place name

UTM GRID INTERVALS = 10 000 m

SOURCE SOE 1930

EE'S 1983





Saqqara Geophysical Survey Project Concession Area

Fig. 1

THE SAQQARA GEOPHYSICAL SURVEY PROJECT

PRELIMINARY REPORT OF THE SAQQARA SURVEY PROJECT 2002

By Jon Dittmer, Carla Gallorini, Salima Ikram, Anthony Leahy, Dan Lines, Ian Mathieson, Colin Reader

The aims of the Saqqara Geophysical Survey 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, which was the major city of Egypt from c.3000 BC to Hellenistic times. The area concerned comprises the Gisir el-Mudir 'the Great Enclosure' in the south; the structures lying to the west of the mastabas of Ptah-Hotep known as the L-shaped enclosure; 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 under 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).¹

The Glasgow Museums, 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 Dr Zahi Hawass, Mr Magdy El Ghandour at the Secretariat, Mr Ahmed El Haggag General Director of Saqqara, the Chief Inspector Hasama el Shami, Mr Khairay K. Malek Beshay the inspector attached to the mission. The October - December 2002 season was undertaken with the generous financial support of grants from the Gerald Averay Wainwright Fund (Oxford University) and the Russell Trust.

The Glasgow Museums of Scotland field team comprised Ian Mathieson-field director, Jon Dittmer-geophysicist, Carla Gallorini-ceramicist, Salima Ikram-faunal analyst, Anthony Leahy-Egyptologist, Dan Lines-archaeologist surveyor and Colin Reader-geologist. Professor Harry Smith is archaeological advisor. The 2002 season opened on 1st October and continued until 15th November.

Previous Fieldwork - under the sponsorship of the National Museums of Scotland (NMS)

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 Gisir 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

¹ See I. J. Mathieson et al., *JEA* 85 (1999), 21-43.

original concession area, from the northern access road to the Serapeum to the southern limit of the concession, some 100m south of the southern boundary of the Gisir el-Mudir². In 1993 sondage trenches were opened on anomalies in the southwest corner of the Gisir-el-Mudir to confirm the structures the resistivity data had shown 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)³.

During 1995 further sondage trenches were opened (1995 Report, Map Sheet 1, A9-14), to inspect anomalies over the southwest corner of the monument where the inside corner was located and surveyed⁴. 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 Gisir el-Mudir and a portion of the L-shaped structure (Report 1997). In 1998 the conductivity survey of the Gisir el-Mudir was completed and several auger holes were drilled to determine the elevation of the bedrock. Sondage excavations examined the structure of the East Wall (Report 1998). In 1999 the project was fortunate to obtain the loan of Global Positioning Satellite equipment from The Natural Environment Research Council and surveyed all the main triangulation stations in the Saqqara area. The position of the South Wall of the Gisir el-Mudir and the southeast corner were located (Report 1999). In 2000 the Gradiometer was used for the first time and the results obtained showed this to be an ideal instrument for tracing mud brick structures. On the northern boundary of the L-shaped enclosure a line of rectangular anomalies was found and these formed the area for sondage excavation in 2001. In 2001 small sondages at the north side of three of the anomalies showed that they were probably temple casement foundations with entrance stairways on the north sides.

The Objectives of the 2002 season under the sponsorship of Glasgow Museums were:

1. To continue the electromagnetic survey from the Serapeum down the valley between the Sacred Animal Necropolis and the ridge on the north side, using the Geoscan Gradiometer instrument to measure the apparent influence of the surface material to a depth of approximately 3 metres.
2. To re-observe certain areas previously surveyed by other electronic means to obtain comparative results.

² See I. J. Mathieson and A. Tavares, *JEA* 79 (1993), 17-31.

³ See I.J. Mathieson et al. *A Stela of the Persian period from Saqqara*. *JEA* 81 (1995), 23-41.

⁴ See I.J. Mathieson et al. *The National Museums of Scotland Saqqara Survey Project 1993-1995*. *JEA* 83 (1997)

3. To carry out a geological survey of the concession area to up-date the geological maps of the 1984 survey.
4. To study the pottery from the 2001 L-shaped enclosure sites.

Fieldwork

Geoscan Gradiometer surveys. Geophysics team, Jon Dittmer, Dan Lines

The magnetic gradiometer is an instrument that enables the surveyor to measure the earth's magnetic field very accurately. The device is moved across the surface of the area being surveyed and readings are taken approximately every 25cm. This fine density of readings gives an accurate picture of the variations in the magnetic field. As two sensors are used, the instrument is very sensitive to local variations caused by shallow-buried (up to 4 - 5 metres) archaeological features. Features that contain concentrations of magnetic compounds (in particular iron) such as mud brick, ditches, kilns, hearths etc produce measurable anomalies. Due to the diversity of features on the site, the concession area is eminently suitable for this instrument. (Fig.1)

The Serapeum to AbuSir Area.(Figs.2, 3, 4a, 4b & 5, Plate 1)

This area covers the large predominantly flat sand-covered region to the north of the Serapeum and to the northeast down the valley to the village of AbuSir. The area surveyed also straddled the east-west trending band of mastabas and possibly temples which were excavated by Mariette and De Morgan in the 19th century.

A total of 164 grid squares measuring 30m were observed giving 662,400 data points. Once again the equipment proved very successful in locating mud brick structures and as can be seen on Fig.2, lines of very interesting anomalies appear to stretch in a northwest – southeast direction down the valley between the Sacred Animal Necropolis and the excavations of the Czech concession. (Fig. 3)

Items of particular interest are:

1. The line of structures running east-west on the south side of the valley which have the appearance of the temple bases found on the south side of the Serapeum in 2000.(Fig. 4b)
2. The many rectangular structures visible in the centre of the valley, some of which are 50x30m in size. These could be identified as the mastabas excavated by Mariette and shown on the De Morgan maps of 1895. (Fig. 4a)
3. The large concentration of structures in the northeast near the probable position of the old AbuSir Lake. This could be a small town or workman's village for the Necropolis area. (Fig. 5)



Fig. 3 Gradiometer data plot for 2002

Approximate Scale 1/5000



Fig. 4a Enlargement of Tombs area

Approximate Scale 1/5000

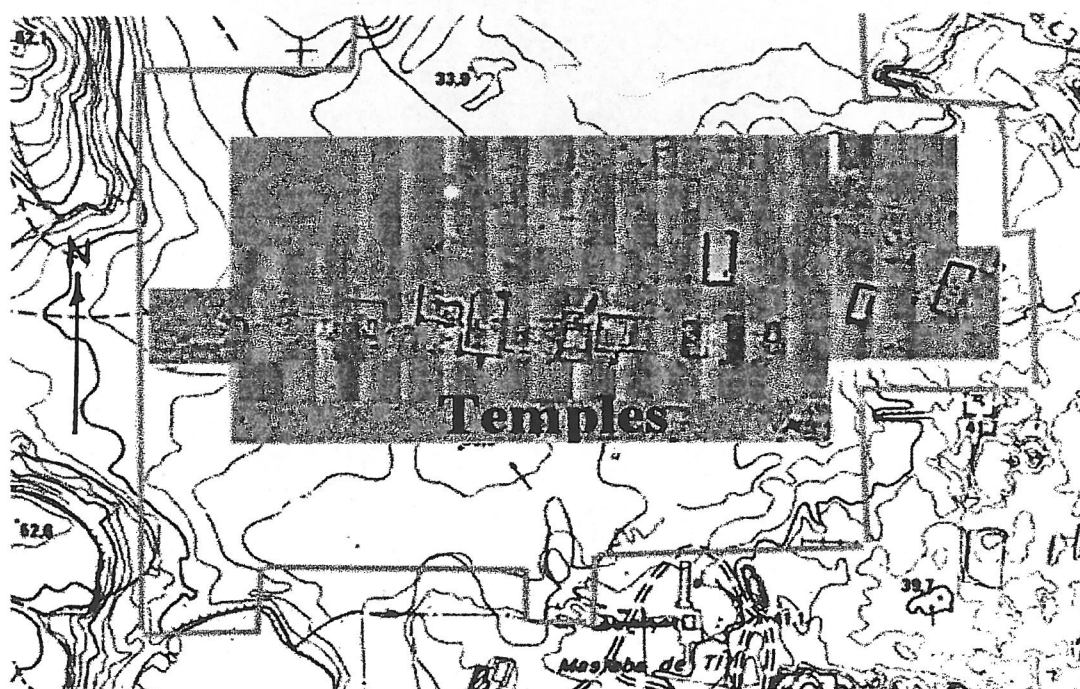


Fig. 4b Enlargement of probable Temple sites

Approximate Scale 1/5000

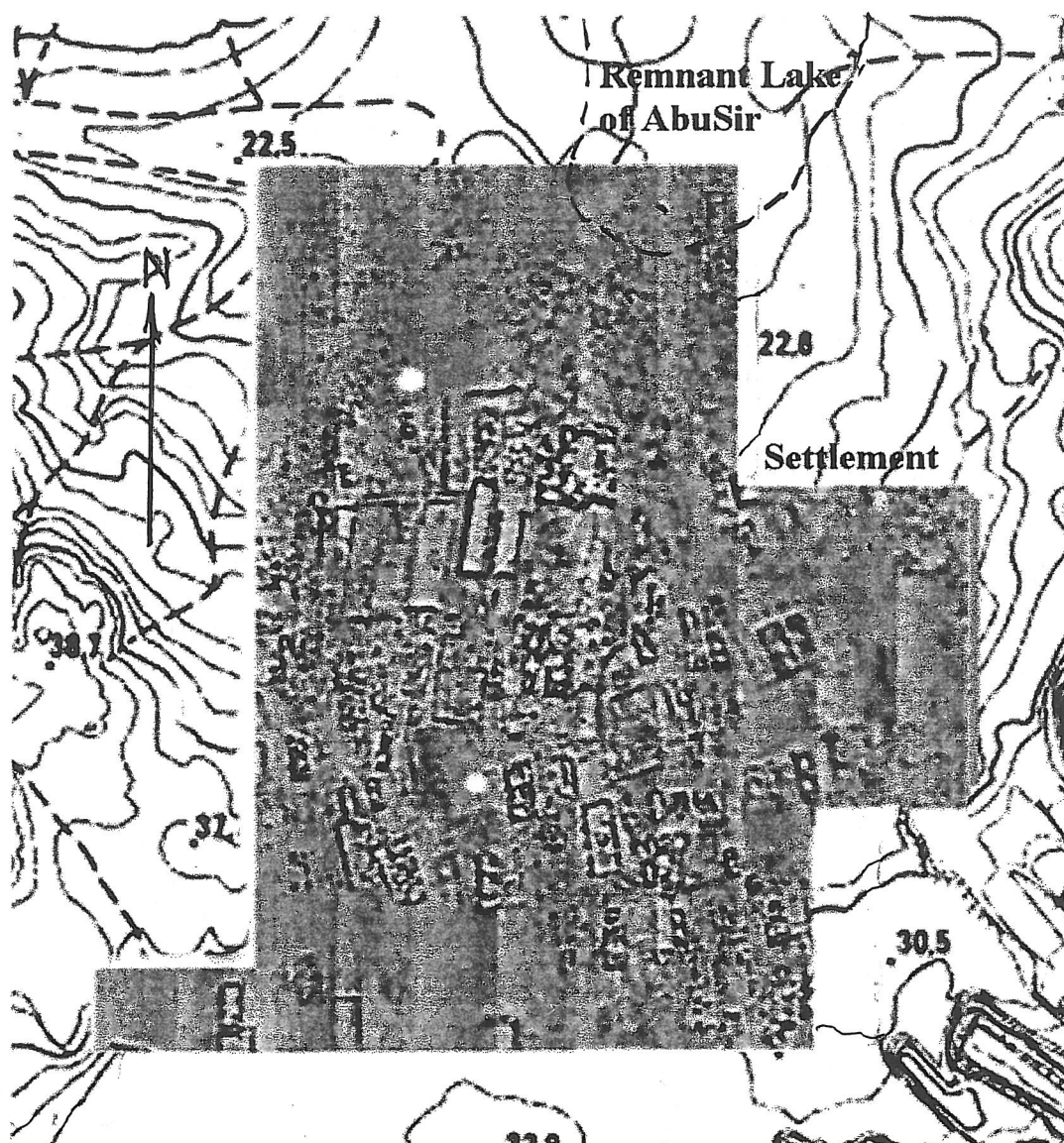


Fig. 5 Enlargement of Settlement area

Approximate Scale 1/5000

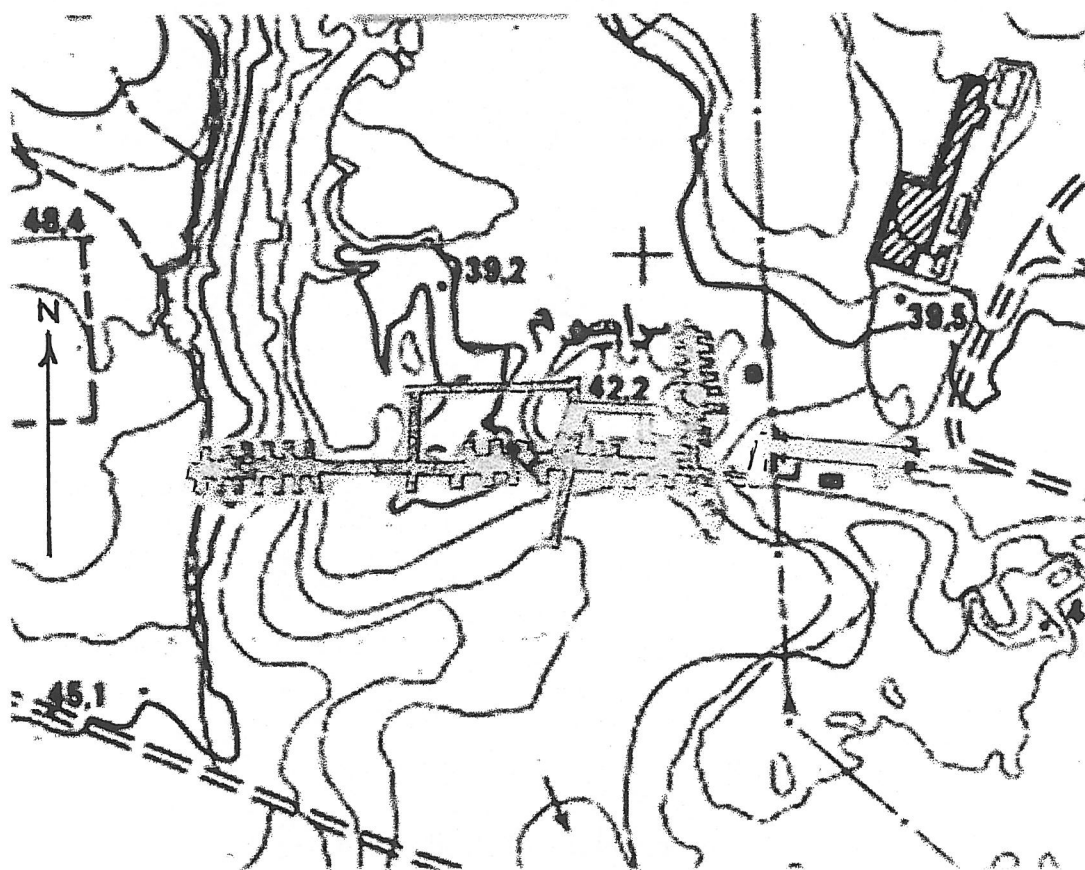
Geological field survey (Colin Reader, Geologist)

The concession area was field walked by the team geologist and several exposures studied to trace changes in the geology due to fault conditions in the post-Eocene era. Fossils were examined to trace

the extent of the late Eocene Maadi formations. The concession of the Saqqara Geophysical Survey Project includes the Serapeum, the site of the burial of the sacred Apis Bulls, in North Saqqara.

Members of the Saqqara Geophysical Survey Project Team were allowed access to the Serapeum to undertake a brief inspection of the underground galleries. The purpose of this inspection was to identify the presence of any geological faults within the limestone strata into which the Serapeum has been cut.

Two parallel east-west aligned galleries were available for inspection, together with connecting passages and a number of the burial chambers that extended from them. These galleries date from the Late Period (745 to 525 BC⁵). Earlier excavations, which date from the New Kingdom, are present in the east of the Serapeum, however, these are understood to be in a poor state of repair, and could not be accessed.



**Fig. 6 Composite showing position of Apis Bull Galleries
below the Serapeum**

Approximate Scale 1/2500

⁵ N. Grimal, *A History of Ancient Egypt*, Blackwell, Oxford, 1995

The predominant rock type exposed in the galleries that were inspected belonged to the Upper Calcareous Beds, however, in the western-most galleries, the upper parts of the galleries appeared to be cut from the Giran el Ful member. No evidence for faulting or the disturbance to the strata that is commonly associated with faulting was encountered.

What was evident during the inspection, however, was that a number of cracks and other small-scale discontinuities are present within the galleries. Many of these appeared to have been identified by the ancient excavators of the Serapeum and had been made good by the provision of masonry within the galleries. Other discontinuities have been identified during restoration works currently being undertaken in the Serapeum. These discontinuities do not appear to have a dominant trend with, at some locations, cracks observed to cross one another at near right angles.

In all significant cases, the contractors currently working within Serapeum have been able to identify these cracks and to fit 'tell tales' to monitor any movement along the cracks. In the smaller number of areas in which the cracks have been considered to be more significant, the ceiling of the galleries has been shored with timber supports, pending the provision of a more permanent roof support – presumably using masonry.

The only issue of any note recorded during the geological inspection was that in a number of instances, thin 'plates' of limestone were spalling from the roof. As with other discontinuities within the Serapeum, these should be monitored to determine whether any movement is taking place and if so, the affected areas trimmed or supported by some appropriate means.

Conclusions

Within the section of the Serapeum available for inspection, there was no evidence for faulting or other movement of geological origin. This supports the geological interpretation of the site, as set out in the forthcoming publication in JEA, in which the geological boundary between the Upper Calcareous Beds and the overlying Giran el Ful Member is controlled by the dip of the strata and the topography of the North Saqqara area.

There was evidence of some minor movement within the Serapeum galleries; however, this is considered to have been induced by the excavation of the galleries followed by arching or other stress-related adjustments of the strata over the intervening period of time.

It is apparent from the work underway, with provision of 'tell-tales' and temporary support where necessary, that the contractors currently involved in the restoration of the Serapeum are maintaining an appropriate programme of inspection and monitoring. All that can be added by the current authors is that this inspection and monitoring programme should be continued throughout the works, with particular attention paid to areas in which spalling of the ceiling is apparent.

Pottery Study (Carla Gallorini, ceramicist) (Figs. 7& 8, Plate 2)

During the 2001 season, test excavations in three of the seven L-shaped structures to the south of the Serapeum (LS1, LS4 and LS5) recovered a considerable amount of pottery. A preliminary sorting of the pottery took place at the time: all diagnostics (rims, bases, handles and any other sherds with significant features – decoration, marks, carination etc) were marked with their context number and kept, while the body sherds were documented, bagged and deposited back on site.

The full recording of the diagnostics was the main aim of the 2002 study season. Over 400 sherds were recorded and 113 were drawn and arranged in a corpus by fabrics and shapes. A visual analysis and description of the fabrics was also carried out, examining fresh breaks in direct sunlight with the help of a 10x hand lens.

Evaluation of the archaeological data and of the pottery is now under way. At this early stage the assemblage seems to be constituted mainly by open forms in Nile clays. Small plates and dishes are very common and many of them show black staining on the interior and on the rim. The staining is similar to the blackening found on torches and suggests the possibility that these vessels were used either as lamps or for incense offerings. Only one example shows traces of mummification material adhering to the exterior, as is often the case for this type of vessel in contemporary Late Dynastic deposits at Saqqara,⁶ but no examples of jars containing such material were found. Cups and bowls of various sizes and shapes are also common (fig. 8 nos. 1-3), together with lamps and torches (fig. 8 n. 4), fragments of which were found in almost every context. Large vessels seem to be uncommon: only two large storage jars in coarse Nile clay were found. Marl clays make up less than 1/3 of the recorded material and were used mainly for small and medium-sized jars and jugs (fig. 8 nos. 5-7). A kiln-waster from a 'double-rim' deep bowl found in LS4 suggests that pottery production may have taken place nearby. Imports include a Phoenician amphora of a very common type (6th-5th cent. BC) and a rim sherd of an Aegean amphora, from the island of Samos⁷ (4th cent. BC).

A preliminary analysis of the material suggests a life-span for the sites ranging from the mid-6th century B.C. to the early Ptolemaic period, although, not surprisingly, a small amount of Old Kingdom pottery was also found.

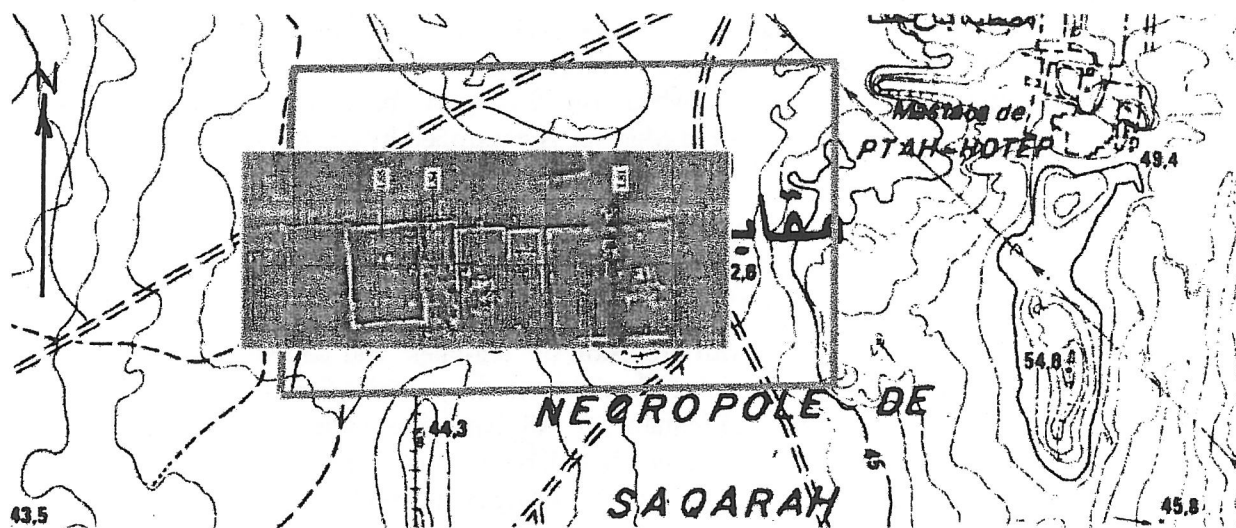


Fig. 7 2001 Pottery sample sites

Approximate Scale 1/2500

⁶ P. French and H. Ghaly, 'Pottery chiefly of the Late Dynastic Period, from Excavations by the Egyptian Antiquities Organisation at Saqqara, 1987', *CCE* 2 (1991), 93-123.

⁷ Cf. A.J. Spencer, *Excavations at Tell el-Balamun 1991-1994* (London, 1996) p. 21 and pl. 82 no. 2

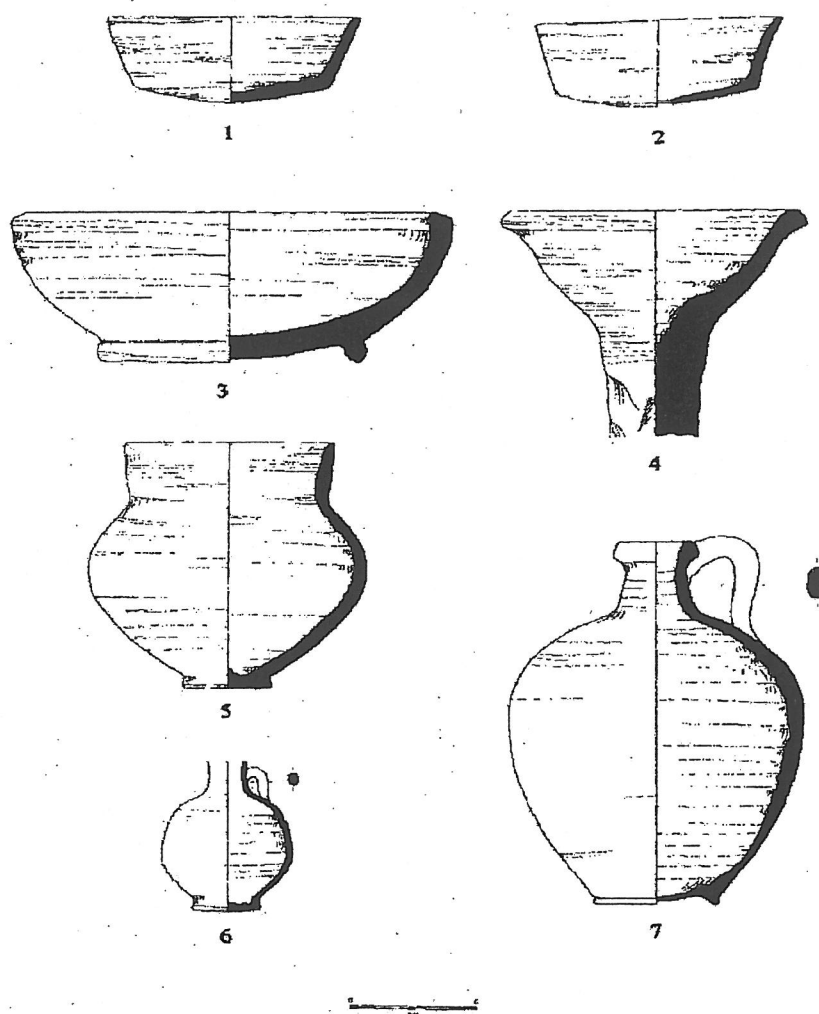


Fig. 8 Types of Late Dynastic Pottery

1 – 2 carinated bowls; 3 incurved bowl; 4 torch; 5 – 7 marl clays jar and jugs

Conclusions – Ian Mathieson

Our work this year has once again proved the value and accuracy of the geophysical and topographic surveys. The use of the gradiometer to delineate sub-surface features has been amply proved by the small-scale *sondage* trenches excavated in 2001 to test the anomalies. In all cases the accuracy of the topographic survey has enabled the *sondage* to be opened exactly over the anomaly shown by the geophysical data. The saving of labour time and the ability to keep the excavation to strict size limits,

means the environmental damage is controlled and at the same time enhancing the archaeological interpretation of the site.

The geophysical survey was extended on the north side of the Serapeum and we can now say that we have found or rediscovered the sub-surface signatures of the tombs and chapels reported by De Morgan and Mariette in 1882-1889.⁸ What is interesting is that there appears to be many more features in this area than those recorded by the two excavators. It is our intention to extend the geophysical survey to the north and east to join our work with the concession of the Czech Archaeological Mission, which should be of mutual benefit to the Saqqara office of the Supreme Council of Antiquities and future excavators.

Also of benefit to all concerned was the geological survey work carried out this year to up-date the geological mapping of the Saqqara plateau.

With the permission of the Supreme Council for Antiquities the Saqqara Geophysical Survey Project plan to continue the work through 2003 to 2005 and complete the geophysical survey of the concession with particular reference to the Gisir el-Mudir, the proving of the L-shaped enclosure structures, the Serapeum and the valley between the Sacred Animal Necropolis and the Ka'Aper tomb group.

Ian J Mathieson

Project Director

March 2003

⁸ A. E. Mariette, *Les Mastabas de l'Ancien Empire*. G. Maspero Paris, 1889. J. de Morgan, *Carte de la Necropole Memphite*. Cairo 1897



Plate 1a Vegetation signs of the remnant Lake of AbuSir



**Plate 1b Surface indications of excavations by A. E. Mariette
and J. de Morgan in the 1890s**

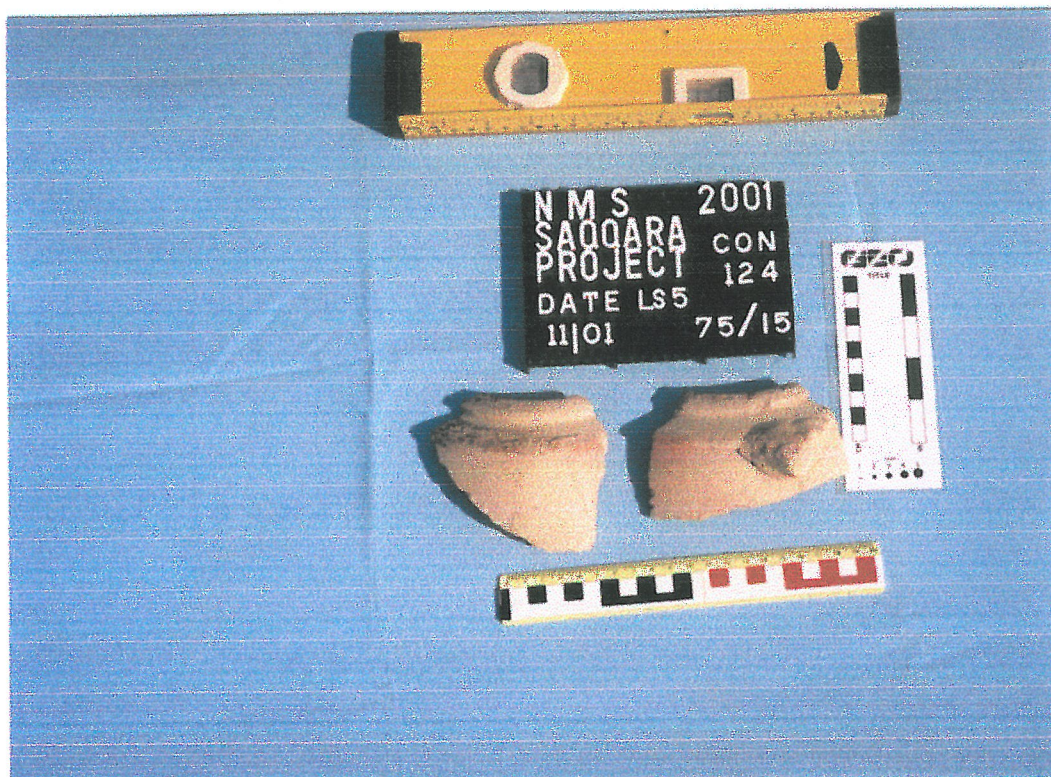


Plate 2a Phoenician amphora (6th – 5th cent. BC)



Plate 2b Small dishes in Nile clays showing traces of black staining