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**NATIONAL MUSEUMS OF
SCOTLAND**

**SAQQARA PROJECT
REPORT
1999**

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CHAMBERS STREET EDINBURGH EH1 1JF**

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Jon Dittmer, Ian Mathieson and Iain Ralston

An interim report on the work carried out during the 1999 season covering the use of Global Positioning Satellite equipment to fix the geographic position of survey work on the Saqqara Necropolis with sondage trenches to test the geophysical results and record archaeological features in the Gisir el-Mudir area.

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THE NATIONAL MUSEUMS OF SCOTLAND

PRELIMINARY REPORT OF THE SAQQARA SURVEY PROJECT 1999

By Jon Dittmer, Ian Mathieson and Iain Ralston

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 Gisir 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).¹

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 abu el-Aala at the Secretariat, Dr Zahi Hawass at Giza, Mr Mohammad Hagra, Director of Saqqara, the Chief Inspectors Mr Magdi el-Ghandoor, Mr Sami Hoseini and Mr Sabri Mohd. El-dein Farag and Mr Moh. Abdel Moneim Abdel Fattah, the inspector attached to the mission. The October - December 1999 season has been undertaken with the generous financial support of grants from the National Museums of Scotland, the Gerald Averay Wainwright Fund (Oxford University), the loan of Global Positioning Satellite equipment from the NERC (Natural Environment Research Council) and technical assistance in map reproduction by Survey and Development Services, Bo'ness, West Lothian. Professor Harry Smith is archaeological advisor.

The National Museums of Scotland field team comprised Ian J. Mathieson, field director, Jon Dittmer, geophysicist and Iain Ralston, archaeologist. The 1999 season opened on 3rd October and continued until 1st 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 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 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 Gisir el-Mudir². In 1993 sondage trenches were opened on anomalies in the southwest corner of the Gisir-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

¹ See I. J. Mathieson et al. *JEA* 85 (1999)

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

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 south-west 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) The various excavation trenches from 1993 - 1999 are indicated on Fig. 2.

The Objectives of the 1999 season were:

- To use the Global Positioning Satellite equipment to fix the geographic position of all major triangulation points in the Saqqara district.
- To observe with the GPS as many Survey of Egypt rails as could be found and to include survey points as indicated by the Saqqara Inspectorate and other missions working in the area.
- To test by small sondage trenches the results of the electronic surveys, which had indicated anomalies in the sub-surface materials over the area of the South Wall of the Gisir el-Mudir.
- To carry out a resistivity survey of the area leading from the SAN Temple to the Abu Sir valley.

Fieldwork

The GPS Survey

The satellite survey was carried out using two Ashtech Z-12 GPS Receivers which are designed to make full use of the Navstar Global Positioning System which automatically tracks all available satellites. During our observation period from 0700 hrs. to 1400 hrs. we were fortunate to have excellent satellite availability with at least 9-12 satellites observed at each station. As the minimum required for accurate work is 4-5 this means that nearly all our observations checked to 100% accuracy. [Plate 1(a)]

With regard to future survey work and to give a base station for the Saqqara - Memphis - Abusir - Dashur areas we picked the Cairo University Triangulation station T3, which is situated close to the Philosopher's busts at the Serapeum. This station is a strong metal pipe well concreted into the natural rock and should last for a considerable time. With the kind co-operation of Dr Jean Eves Empereur, director of the C.E.A. Alexandria, we were able to join station T3 with their GPS base point Station-cea which had been co-ordinated by satellite from Italy and Greece thereby giving global co-ordinates to our base T3. [Plate 1(b)]

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)

Comparison of distances measured by EDM compared to calculated distances from GPS observations as taken from Geographic co-ordinates.

As a guide to the probable MSL value of each station the elevation of a fixed point at the entrance to the Unas temple area which was fixed by spirit levelling by the British Desert Survey in 1934 was observed by GPS to give an ellipsoid height

Line.	EDM Measurement and elevation from MHR 1/5000 mapsheet.		GPS Observations(All 100% fixed) and adjusted GPS elevation.	
T3 to T1	639.29	56.12m	639.228	56.16m
T3 to T2(Teti)	850.92	76.53m	851.128	76.42m
T3 to T4	439.98	63.51m	440.007	63.50m
T3 to T5	not visible	57.03m	1208.902	57.13m
T3 to T6	668.10	44.94m	668.166	44.95m
T3 to T7(Unas)	859.02	73.22m	859.166	73.37m
T3 to T8	not visible	61.65m	1187.945	61.76m
T3 to T9	886.54	62.19m	886.538	62.35m
T3 to New T10	Not observed		Not observed	
T3 to T11(Ka'Aper)	820.99	46.20m	821.014	46.20m
Unas Temple Bench Mark	55.360 (spirit level)		71.329(ellipsoid) Diff: 15.969m	

T3 is the master base for all Saqqara and the surrounding districts and is in the process of being connected to the European Geodetic System. When the results have been processed co-ordinates referred to the MHR 1/5000 scale maps will be published.

In addition to the main control points listed above ten Survey of Egypt cadastral boundary rails and five Cairo University bench marks were observed by GPS, eleven other survey marks found during the survey were included.(fig. 3)

Resistivity Survey

A resistivity survey was carried out from the position of the entrance pylons to the SAN temple towards the Abusir valley and then towards the assumed position of the Lake of Abusir. The results of this survey will be compared with previous resistivity and ground penetrating radar profiles. It is hoped that the interpretation may show traces of roads or haulage ways leading from the Lake to the SAN and to the Serapeum.

Gisir el-Mudir (The Great Enclosure)

Sondage excavations

The aim of the 1999 excavation season was twofold, to explore an anomaly which indicated the position of the South Wall of the Gisr el-Mudir and to find out if the South East corner of the monument existed.

The South Wall

Ground penetrating radar scans and resistivity profiles as shown in Fig. 4 and the conductivity plan Fig. 5 indicated that a probable structure existed at a depth of 2-3 metres which could be the remains of the South Wall. A five metre square was opened at grid point A345+20 and signs of a excavated trench were obvious within 20cms. of the surface. To trace the outline of the trench a further 5m square A345+15 was opened and the fill of the trench excavated. (fig. 5) & [Plate 2(b)]

Several layers of limestone fragments mixed with tafl and gravel gave evidence of robbing and destruction and at a depth of 2.2m from the surface the remains of the lower two courses and the foundation cut of the north face of the South Wall were found. Several large blocks of masonry had collapsed or had been too heavy to be robbed and lay behind the foundation cut. [Plate 3 (a) & (b)]

The South East Corner

Once again working from the GPR scans and the conductivity contours the plots indicated anomaly lines converging at a point. A five metre square was opened at grid point A470+25 and within one metre of the surface the eastern corner block of the first course of the South east Corner was found resting on a cut foundation plinth set in the tafl bedrock. The south face of the block was chamfered to receive a similar face on the south corner block which had been robbed out leaving the impression of the block in mud mortar laid in the bottom of a foundation cut in the bedrock. (fig. 6) & [Plate 2(a)]

We have now located the inside four corners of the Gisir el-Mudir and they were duly surveyed into the GPS system.

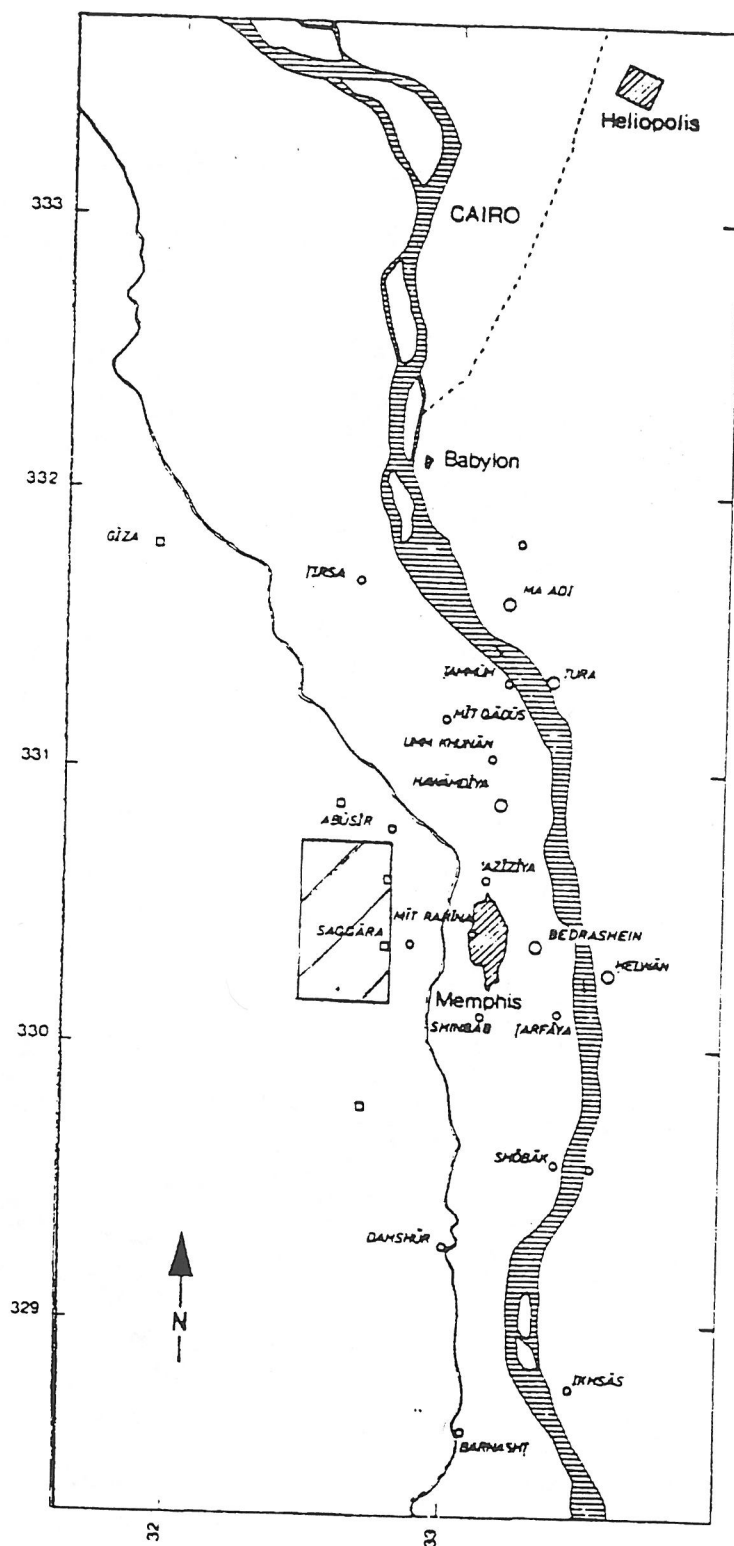
Conclusions

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 Gisir el-Mudir.

With the permission of the Supreme Council for Antiquities the NMS plan to continue the work through 2000 to 2005 and complete the geophysical survey of the concession with particular reference to the Gisir el-Mudir, the L-shaped enclosure, the Serapeum and the valley between the Sacred Animal Necropolis and the Ka'Aper tomb group.

Ian J Mathieson

Project Director



SAQQARA

Location map

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

TURA modern place name

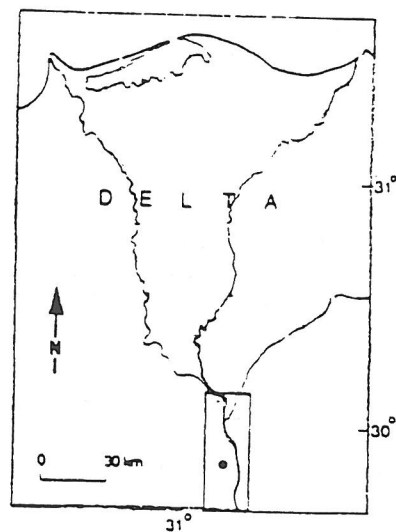
□ pyramid field

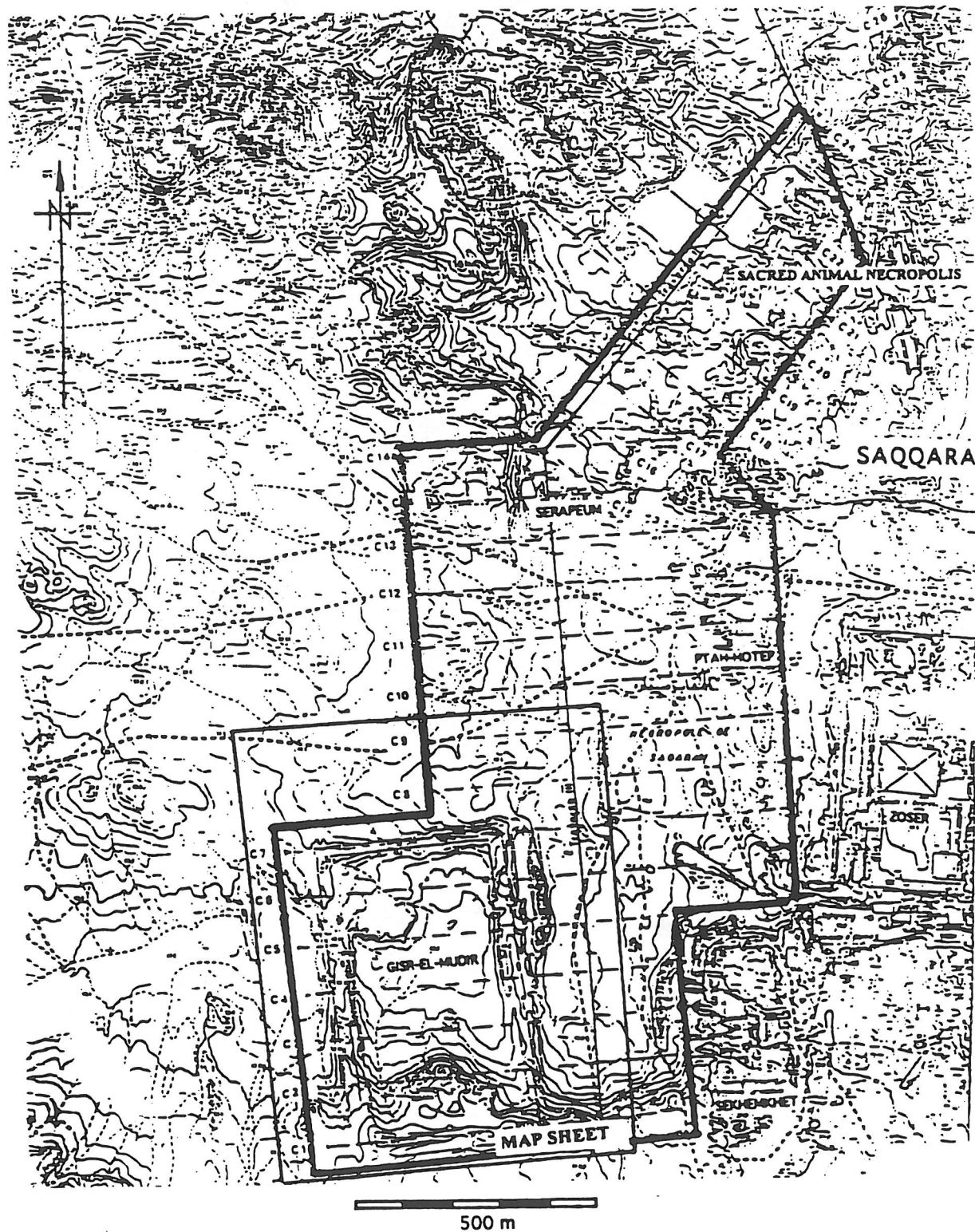
Babylon ancient place name

UTM GRID INTERVALS = 10 000 m

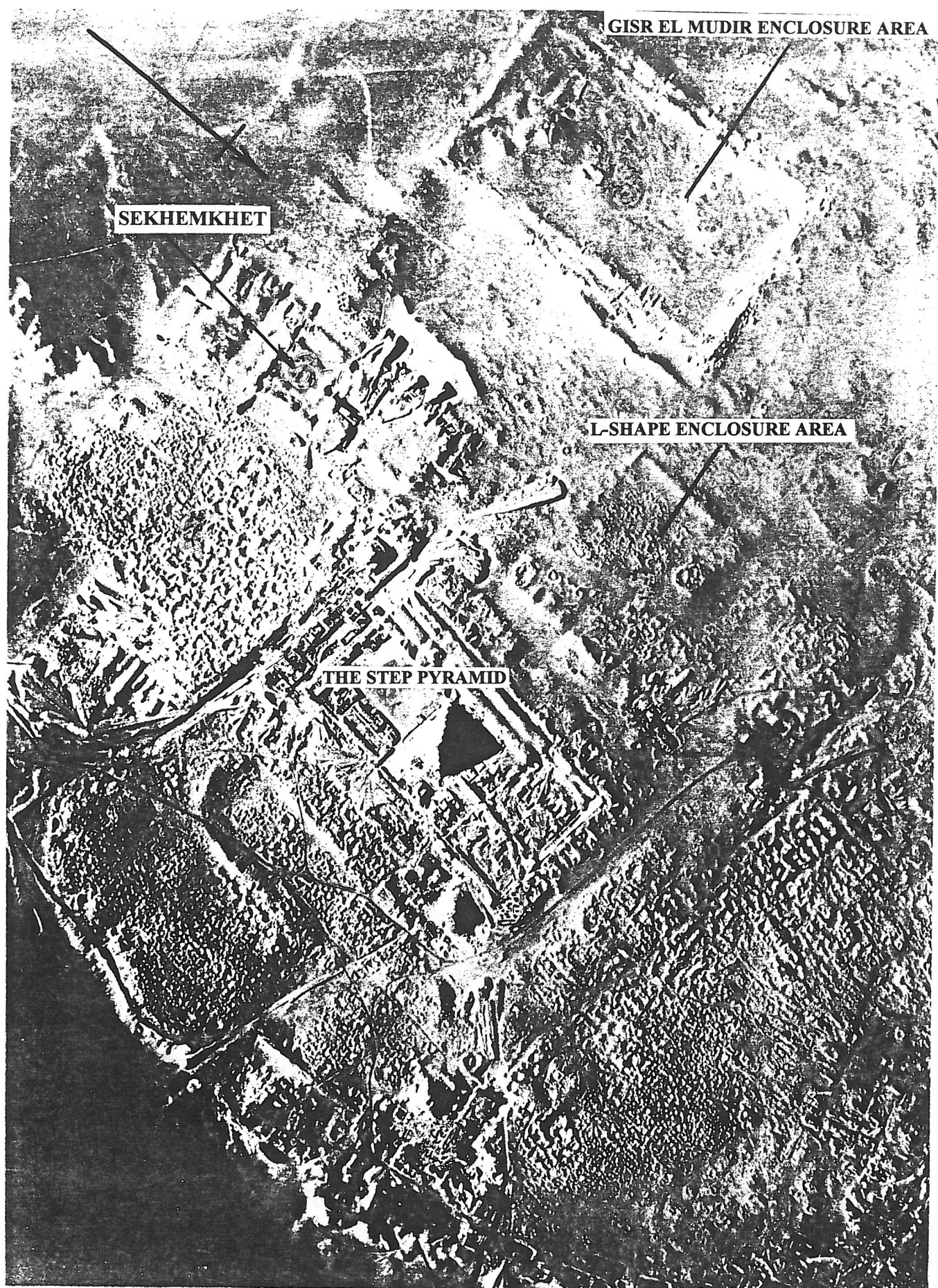
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EE S 1983

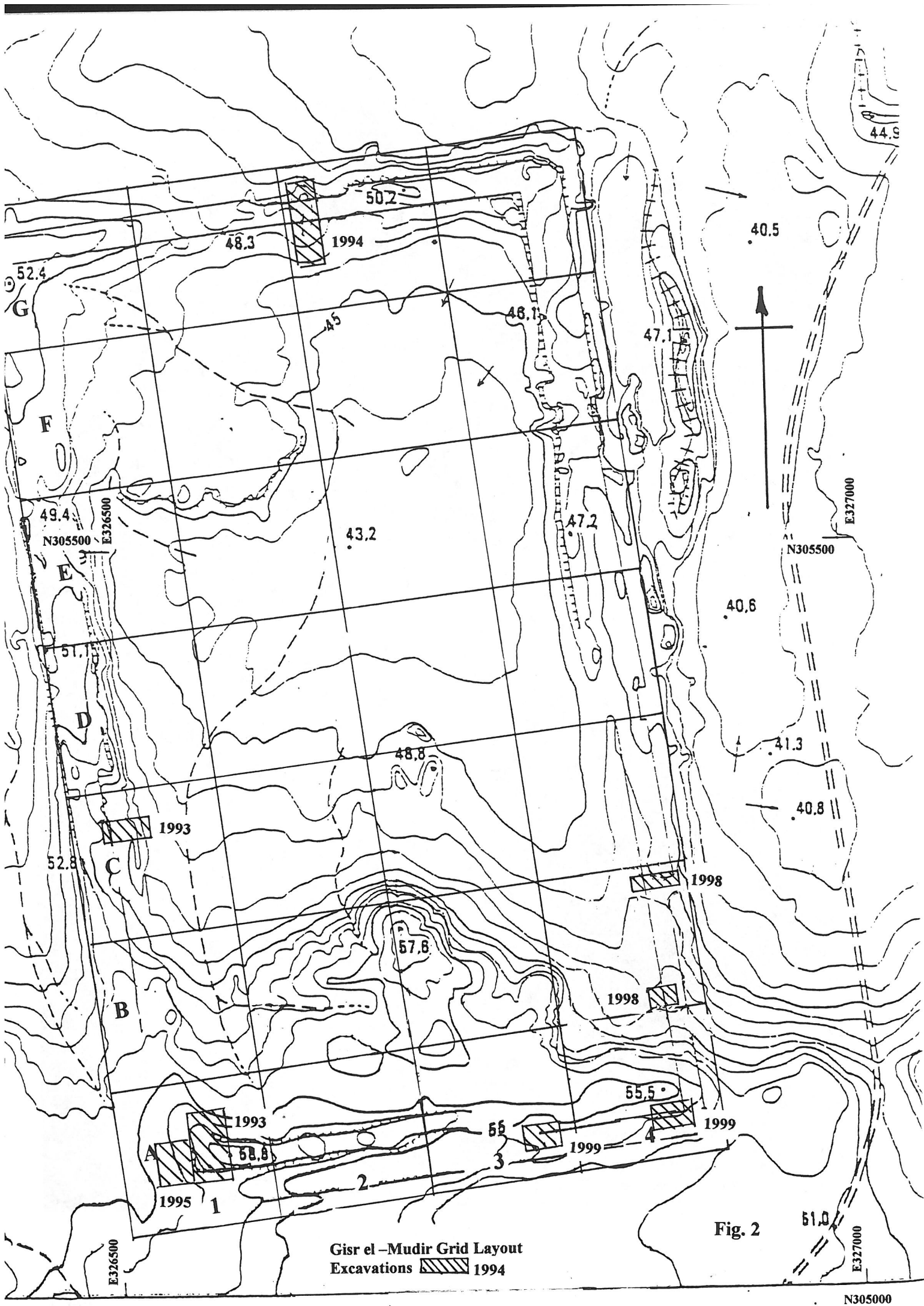


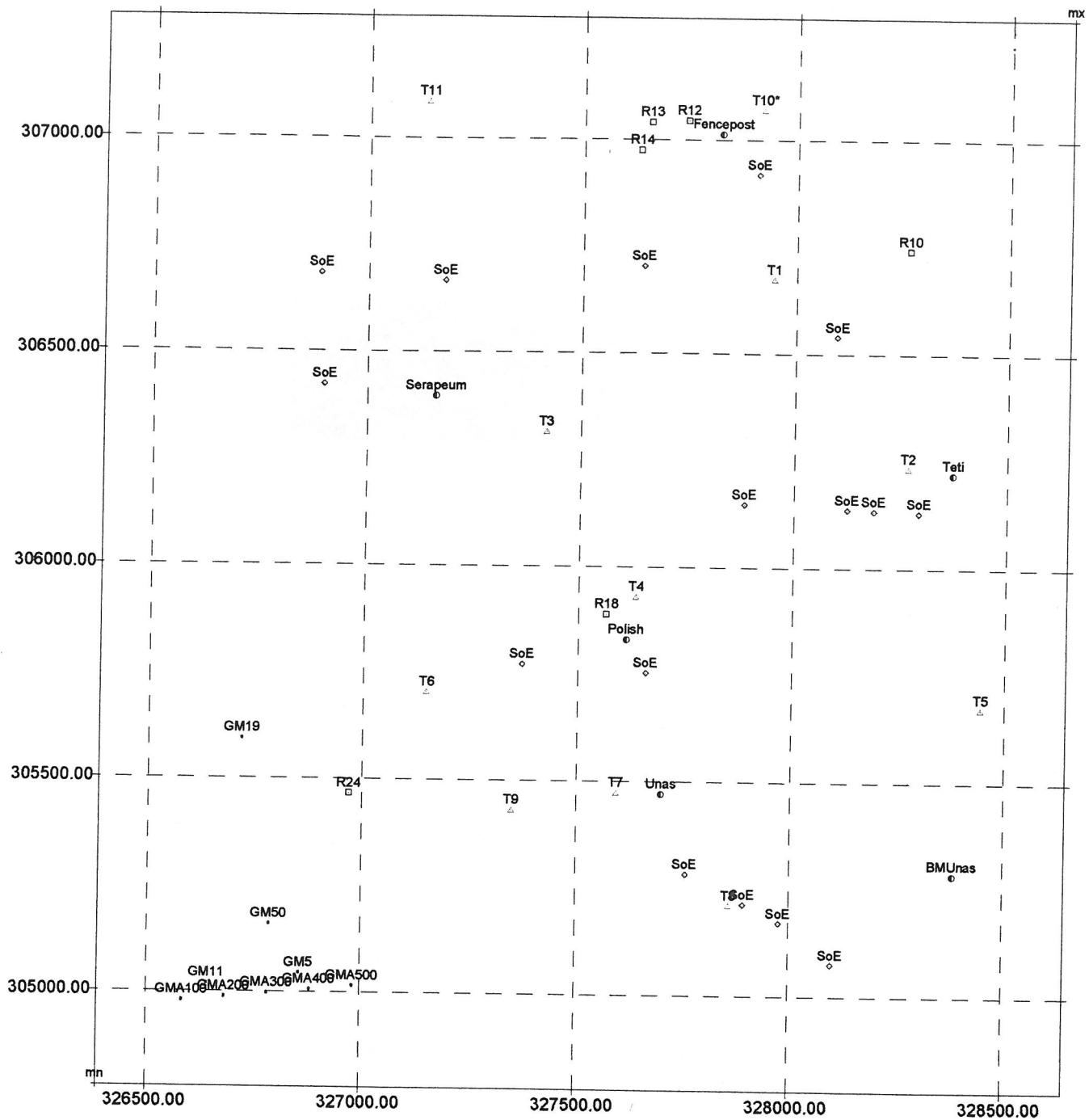


National Museums of Scotland Concession Area

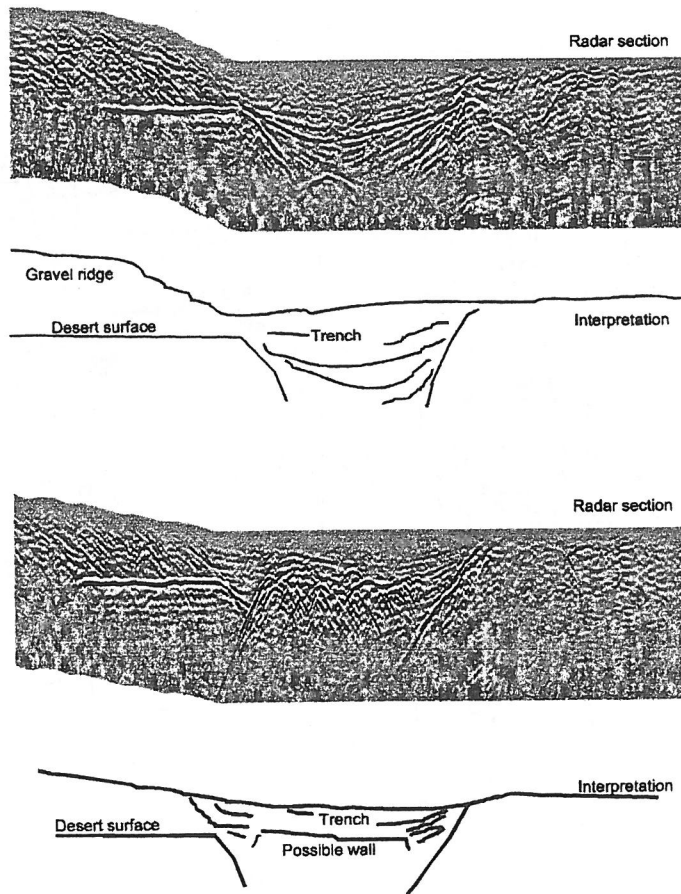


GISR EL-MUDIR & L-SHAPED ENCLOSURES
IN RELATION TO THE STEP PYRAMID

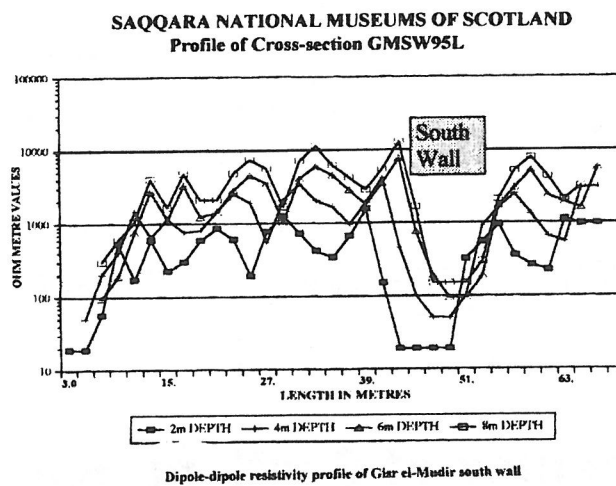




**National Museums of Scotland Saqqara 1999
GPS Results**



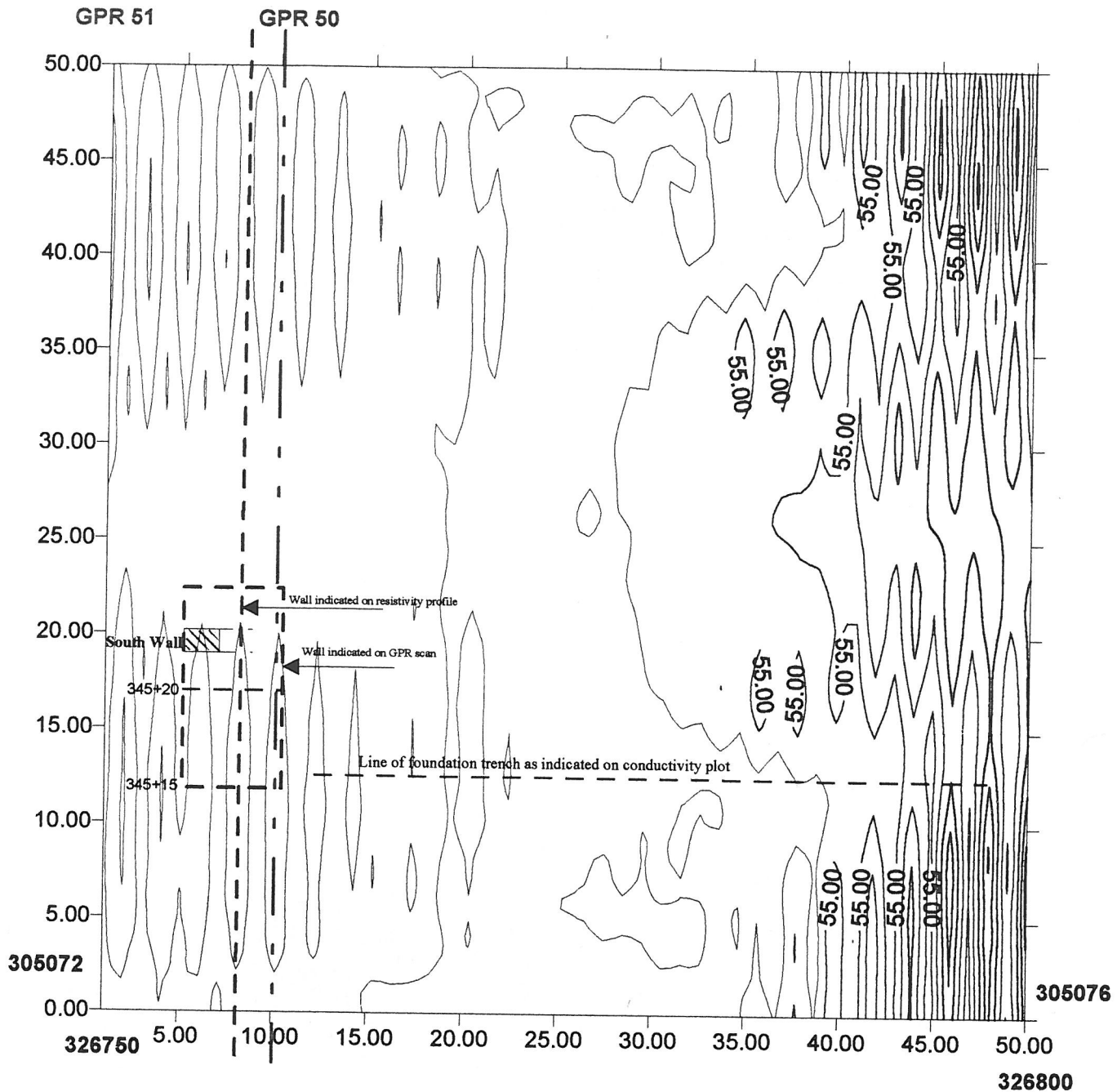
Ground penetrating radar profiles



Resistivity dipole-dipole profile of Girs el-Mudir South Wall

EM 31 Conductivity Contours

Dipole-Dipole
Line 8

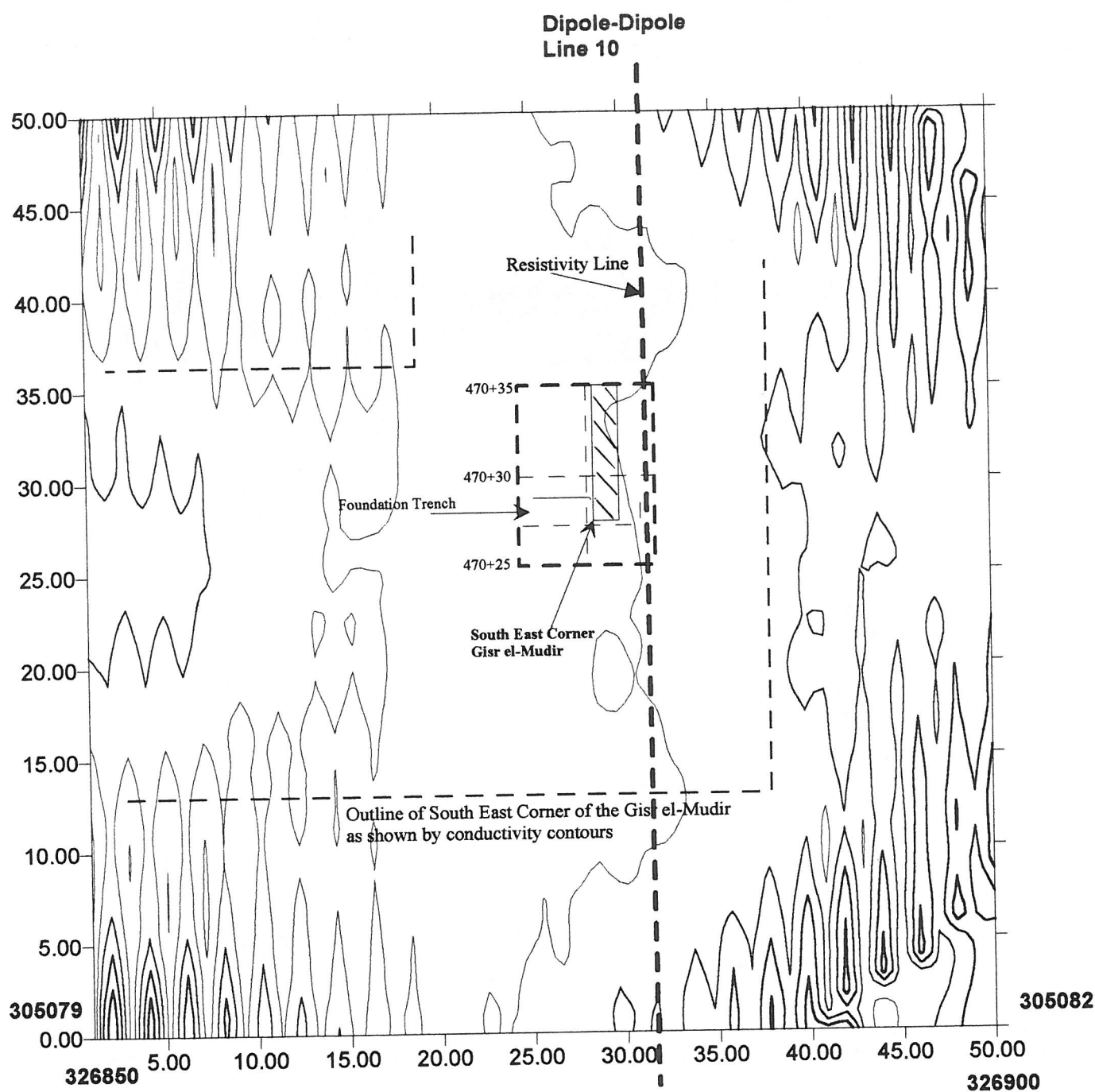


Gisr el-Mudir South Wall

Showing 1999 excavations & position of South Wall
with indicated positions from previous sensing surveys

Fig. 5

EM 31 Conductivity Contours



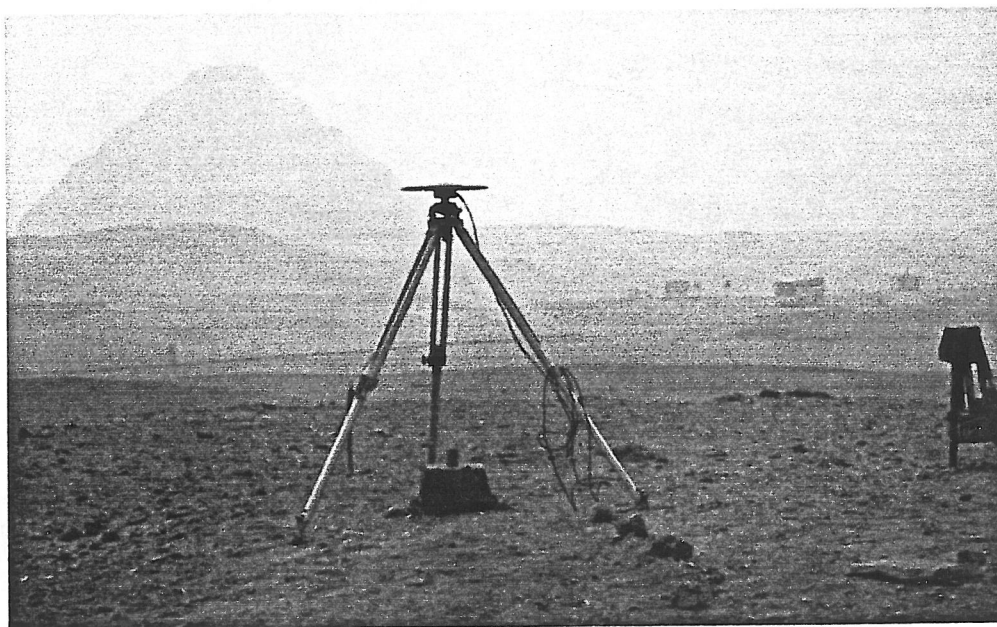
Gisir el-Mudir South Wall

Showing 1999 excavations & position of the South East Corner

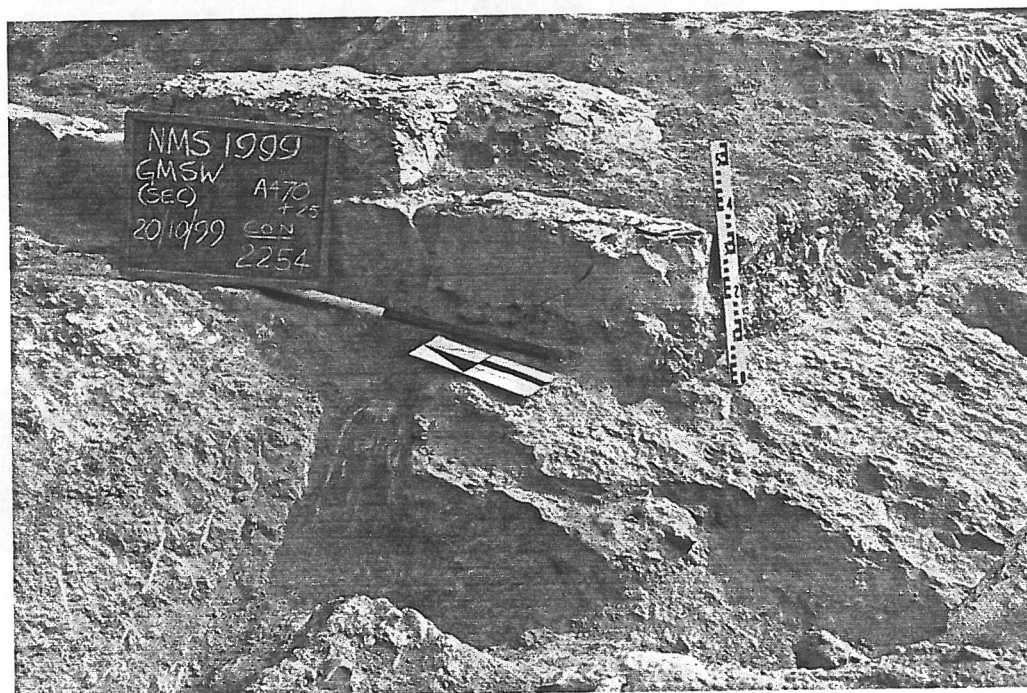
Fig. 6



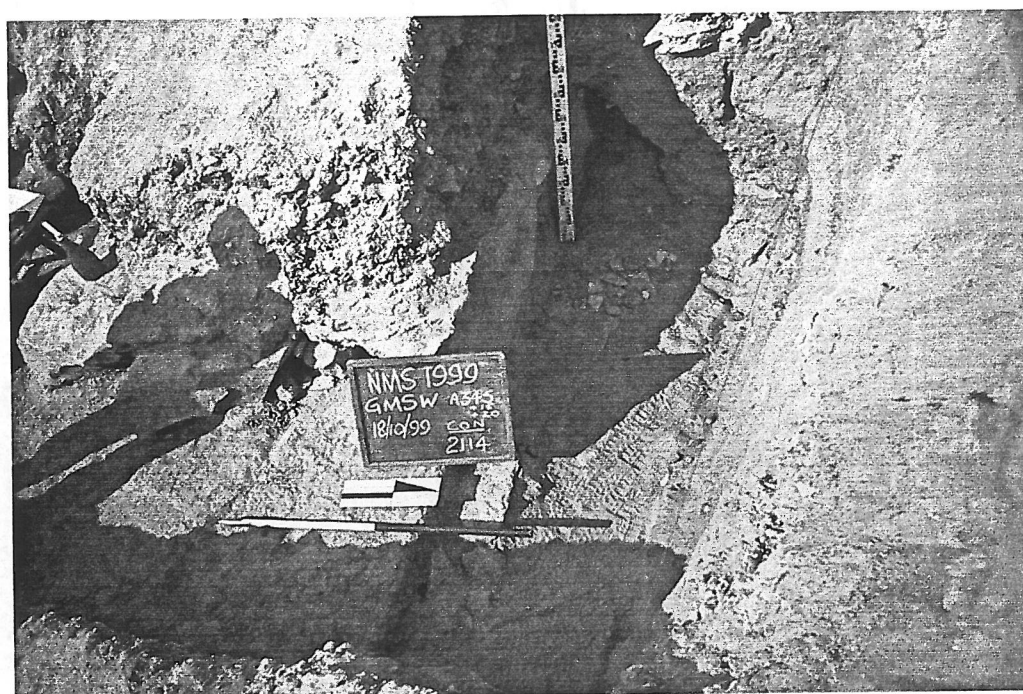
Ashtech Z-12 GPS Receiver on Unas Pyramid (a.)



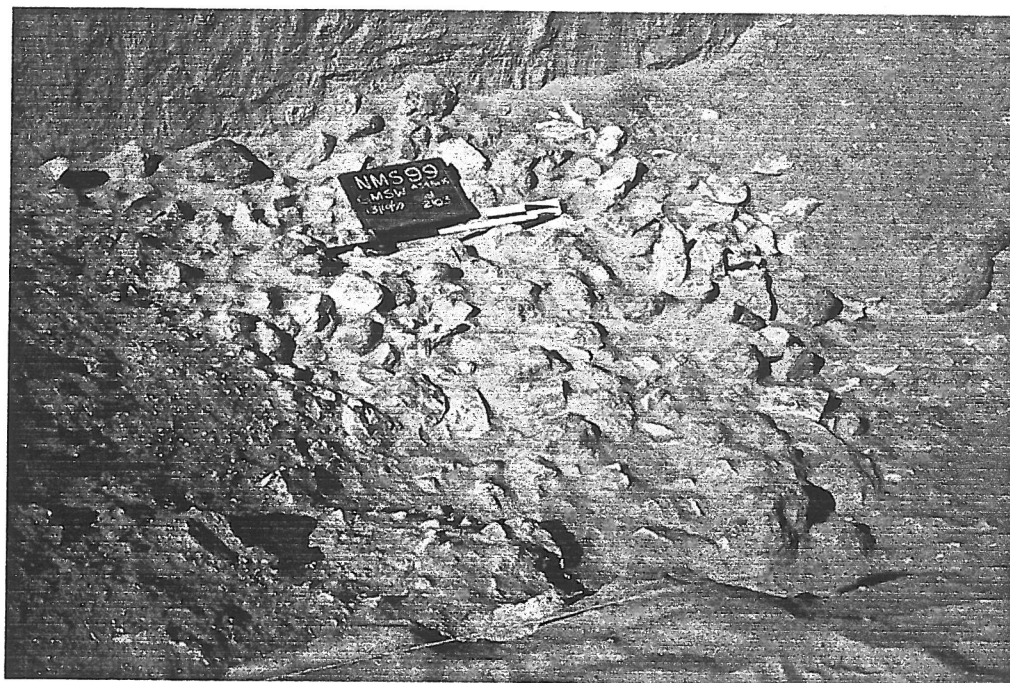
**Master GPS Station Cairo University Point T3
Metal pipe set in concrete on outcrop 300m East of the Serapeum (b.)**



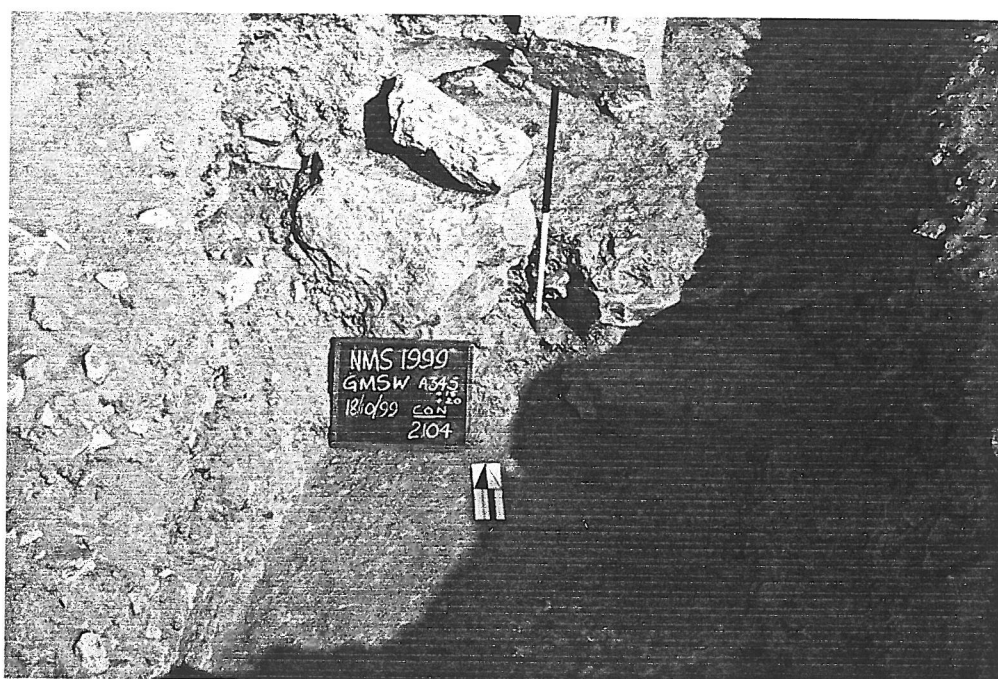
Gisir el-Mudir South East corner (a.)



**Gisir el-Mudir South Wall
Remains of first course & foundation (b.)**



Gisr el-Mudir South Wall
Debris from destruction of wall covering remains of first course (a.)



Gisr el-Mudir South Wall
Tafl bedrock pavement and fallen blocks (b.)