UNIVERSITY OF CAMBRIDGE

FACULTY OF ORIENTAL STUDIES

Telephone
OCA3 62253

Sidgwick Avenue
Cambridge
CB3 9DA

6 June 1972.

Dear Beth,

I understand from David O'Connor that you will be coming to Malkata next season to carry out the magnetometer survey. I am very eager to see this done, and hope that the notes I wrote on this are intelligible to you. I was pleasantly surprised to hear from David that, given satisfactory conditions, your work will probably take much less time than I had anticipated. If this proves to be so and you are not too pressed for time there is one other area where a survey would be valuable: this is along the 'harbour edge' - a long narrow strip of dry desert which I imagine would present no problem at all. But we can go into this when on the site.

My main reason for writing to you at this point is to ask you to complete the enclosed security form and return it to me with five (5) passport-type photographs of yourself. I would ask you to do this as soon as you can since the forms should be sent off by the end of June.

Yours sincerely,

Barry J. Kemp

Enc.

Dr. Beth Ralph,
MASCA,
University Museum,
33rd and Spruce Streets,
Philadelphia, Pa., 19104,
U.S.A.

replied 6/24/72
Will send as soon as I return.

Dosimeters
& archaeomagnetic measurements

January 3, 1973

Dr. Zaky Iskander
Department of Antiquities
Tahrir Square
Cairo
EGYPT

Dear Zaky:

Thank you very much for your attractive card and good wishes.

At long last, I am planning to come to Egypt to work with our magnetometers at Malkata. Unfortunately, I do not know exactly when I shall land in Cairo, but it will probably be during the first week of February.

I hope that I shall see you, either upon arrival or upon my return from Luxor. Our address will be: Pennsylvania Expedition, Habu Hotel, Gurna.

While I am in Egypt, I am wondering if it will be possible to install the dosimeters in some tombs - The ones that Henry Michael brought about a year ago. We are eager to try to date Faience by thermoluminescence, but we need first to measure the natural background radiation in the tombs by means of the dosimeters.

I am looking forward to seeing you.

With best wishes for the New Year,

Elizabeth K. Ralph

EKR/11

January 18, 1973

Dr. B. J. Kemp
c/o Pennsylvania Expedition
Habu Hotel
Gurna, Egypt

Dear Barry,

Thank you for your letter of December 11th, and please forgive me for not answering it sooner. David O'Connor had told me that he was going to telephone you in England, so I did not bother to write.

The situation has changed a little since David cabled and Lanny Bell left. I am now scheduled to go on an AIA lecture tour in the States starting on April 1st. Therefore, I think that I should arrive in Egypt not later than mid-February. I hope that this will allow sufficient time to do the magnetometer survey.

For archaeomagnetic dampling, I shall bring the requisite compass. I assume that we can obtain materials for making small frames and plaster of Paris locally.

I am planning tentatively to land in Cairo on February 15th (probably stay at Hotel Hilton), and to come by air to Luxor, arriving on Saturday at 3:35 p.m. However, I shall cable you from Cairo.

If there has been a delay in getting the magnetometers out of customs, and I need to do something about them in Cairo, please let me know.

I am looking forward to working with you.

Sincerely yours,

Elizabeth K. Ralph

ER/sa

n OBA 2/13/73

Cable
Probably not arriving
before Feb. 19th
Luxor

THE UNIVERSITY MUSEUM

UNIVERSITY OF PENNSYLVANIA
THIRTY-THIRD AND SPRUCE STREETS
PHILADELPHIA, PA. 19104

CABLE ADDRESS "ANTIQUE"
TELEPHONE: EVERGREEN 6-7400
(AREA CODE 215)

Professor Dr. Mohammed
Gamal el-Din Mukhtar
President of the Organization
of Egyptian Antiquities
Ramsis Street
Cairo, EGYPT

February 7, 1973

Dear Dr. Mukhtar:

This letter will reach you with my old friend and most distinguished physicist Dr. Elizabeth Ralph, the Associate Director of the Applied Science Center for Archaeology in the University Museum of the University of Pennsylvania. Dr. Ralph is already well known all over the world for her new experiments on dating the ancient objects: one of her latest achievements is in dating faience by thermoluminescense (TL). She will be in Egypt for at least one month to join the Expedition of Malqata at Western Thebes. Miss Ralph wants to install very small dosimeters or better say pellets in five of the Theban tombs to measure the natural background radiation in those tombs in order to date the faience which was found in those tombs previously excavated by the University Museum.

These small pellets are supposed to be left in the tombs for one year, the analysis of the data will be completed later on in Philadelphia.

I have not the slightest doubt that you are keen as I am to give science its chance to help us in the study of our civilization, and I am sure that Dr. Ralph will find all help and assistance in her important researches, and that you shall do your best to get for her the needed permission if it is necessary.

I arrived with Mrs. Fakhry at Philadelphia on January 31st, 1973: it seems that the relaxation which I was looking forward to having is not easy to get. I have already a heavy schedule of lectures in the States and in Canada, please pray for me.

I shall be writing to you soon: if you need anything to be done here please write to me at the above address. I will not leave the United States before the end of April.

With my sincere greeting and my best wishes,

Very sincerely yours,

Ahmed Fakhry

(Ahmed Fakhry)

AF/11

P.O. No. Iran [FEB, 1973]

Send cable

TWA

Faculty of Oriental Studies
Sidgwick Ave
Cambridge
CB3 9DA

Cairo

Penn
Pennsylvania Exp.

~~Hebu H~~
HABU HOTEL
GURNA.

air freight ticket

30 £

Dear Beth,

Just a brief word about Malkata. I do not know when you are planning to come, although I imagine that David has discussed this with you. But if you send me a telegram to the Habu Hotel telling me when you will be arriving in Luxor I will arrange for you to be met at the airport or railway station.

With regard to the work, you should have seen the outline proposals I sent David which included a map of the area where I think a magnetic survey would be most useful. A survey along part of the harbour edge might also be valuable.

Since the site is itself closely dated on the Egyptian historical scheme I think it would be valuable also to obtain samples for radiocarbon dating, and also ~~barbaro~~, from any hearths or kilns, which are a distinct possibility, dates for

archaeomagnetic dating. I would be grateful if you could also come prepared to deal or assist with these, especially the latter. I understand that for such early periods the variation in the earth's magnetic field has not been fully plotted, and I would imagine, therefore, that an already dated site would be of useful contribution. I look forward very much to seeing you, and to making your stay as comfortable as possible.

Yours sincerely Barry J Kemp

TO OPEN SLIT HERE

SENDER'S NAME AND ADDRESS

B. Kemp
Faculty of Oriental Studies
Sidgwick Ave
Cambridge

AN AIR LETTER SHOULD
NOT CONTAIN ANY ENCLOSURE;
IF IT DOES IT MAY BE SURCHARGED
OR SENT BY ORDINARY MAIL

SECOND FOLD HERE

BY AIR MAIL
AIR LETTER
PAR AVION AEROGRAMME

REMEMBER
to use the
POST CODE!

5p

VC10

11 DEC 1972

B

Dr. Beth Ralph
MASCA
The University Museum
33rd and Spruce Streets
Philadelphia Pennsylvania
PA 19104 U.S.A.

David -
Please return

Hakn Hotel
Gouna
West Bank
28 March 1973

Dear Beth,

I hope you had a safe and pleasant return journey. Did Badawy and the others see you off?

My principal reason for writing is to express my appreciation for all the work you accomplished. I am sorry that not all the arrangements you had hoped for at the beginning were prepared, but I am sure that you will be aware of some of the difficulties under which I have been working. You will be pleased to know that the linear anomaly near Linda's site has turned out to be something of considerable interest - a well with emplacements for some form of water lifting apparatus clearly of some considerable antiquity. When the trench over the well reached a depth of just over 4 metres the work was stopped and now the sections have been drawn. In the next season the excavation must be considerably widened to allow the

full depth of the well to be exposed, which may yield something more explicit on its date, which one might easily suspect is contemporary with the Eighteenth Dynasty village.

For the rest I look forward very much to receiving copies of the magnetic contour plans which have their own contribution to make to the interpretation of the whole site. I would also be grateful to receive details of the carbon-14 dates of the two samples from Malkata. I for my part will send you a copy of the inked-in contour plan of Linda's site, and any information from the archaeomagnetic sample.

Thank you once more for all your work, and for accommodating yourself so readily to our routine. I trust we may meet in the future. Yours sincerely

Barry J. Kemp

First fold here

AIR LETTER • AEROGRAMME

AIR MAIL PAR AVION

DR. ELIZABETH K. RALPH
MASCA
UNIVERSITY MUSEUM OF PENNSYLVANIA
33RD & SPRUCE STREETS
PHILADELPHIA, PENN. PA 19104
U.S.A.

Second fold here

AN AIR LETTER SHOULD NOT CONTAIN ANY ENCLOSURE; IF IT DOES IT WILL BE SURCHARGED OR SENT BY ORDINARY MAIL

Sender's name and address:

B.J. Kemp
HABU HOTEL GOURNA
LUXOR

To open cut here

May 23rd, 1973

Dr/ B. J. Kemp
Faculty of Oriental Studies
Cambridge University
Sidgwick Avenue
Cambridge CB3 9DA
England

Dear Barry,

Many thanks for your good letter of March 28th. I hope that you will forgive my delay in replying and sending my report. It always takes longer than I think to prepare the figures.

About your question, yes, Badauy and Hamedy saw me off, but the police wouldn't let Hamedy go to the airport - no papers.

The description of Linda's anomaly could follow page 7, but I did not include what you wrote to me because I am not sure exactly which one it was. I hope that you or Linda can fill this in. I haven't seen Linda around.

Fig. 8, a big map 6 feet long, will follow under separate cover. It has all of the "desert" grids pasted upon Sykes' contour map.

The C-14 samples are in process, but we probably will not finish counting them for another month. Also, within a month, we should have some accurate correction factors for C-14 dates.

David O'Connor has suggested that we get yours and my report put together for the Smithsonian sometime this summer.

With best regards.

Elizabeth K. Ralph

August 3, 1973

Dr. Lambert Dolphin
Stanford Research Institute
Menlo Park, California
94025

Dear Dr. Dolphin:

Work in Egypt has to be arranged with an Egyptologist or Archaeologist who has a permit to prospect and excavate in a certain area. A few that I know about to whom you might want to write are as follows:

Dr. C. Traunecker (speaks no English)
Centre France-Égyptien D'Études D'Archéologie
et D'Architecture des Temples de Karnak
Luxor

Dr. B. J. Kemp
Faculty of Oriental Studies
Cambridge University
Sidgwick Avenue
Cambridge CB3 9DA, England
(Plans to excavate again at Malkata near Gurna, on the west bank opposite Luxor).

Dr. Donald Redford
Department of Near Eastern Studies
University of Toronto
Canada
(Plans to excavate at Karnak in December-January, 1973-74).

Dr. Dieter Arnold
German Archaeological Institute
Cairo - Zamaiek
22 sh. Gezira el-Wusta

Or in the summer: CH-3983 Morel-Breitan,
Haus Huwiz
(Switzerland or Germany?)
(Plans to excavate near Valley of the Kings, west bank opposite Luxor.)

In December and January I may be working with our magnetometers at both Dr. Arnold's and Dr. Redford's sites. Perhaps, we could work together.

Sincerely yours,

Elizabeth K. Ralph

EKR/11

Roland-Claude TRAUNECKER

Centre Franco-Egyptien
d'Etudes d'Archéologie et d'Architecture
des Temples de Karnak

LOUQSOR (R. A. U.)
Tél. 2072

*

37, rue de Didenheim
68200 Mulhouse

Dornach
Haut Rhin
République
Française

Mulhouse, le 3 Septembre 1973

Docteur RALPH K. Elisabeth
Museum Applied Science Center for Archaeology
The University Museum
33rd & Spruce Streets

386-7400 (Area Code 215)

Chère Madame,

Je suis un peu honteux de ne vous répondre qu'à présent, mais j'espérais avoir de bonnes nouvelles à vous annoncer.

En effet, le C. N. R. S. nous a laissé entrevoir la possibilité du prêt d'un magnétomètre à proton pour nos travaux à Karnak. Malheureusement, je crois que nous devons renoncer à ce prêt. De toute façon, nous ferons un sondage dans la zone où vous avez détecté une anomalie magnétique négative et nous vous tiendrons au courant des résultats de cette fouille.

En Avril, au cours du Congrès sur la Physique des solides, nous avons eu l'occasion de rencontrer les Docteurs AITKEN et HALL qui nons ont donné de précieux renseignements sur leurs magnétomètres. Nous envisageons l'éventualité de l'achat d'un de ces appareils pour l'année prochaine.

Aurons-nous à nouveau le plaisir de votre Visite en Egypte ? Nous gardons un excellent souvenir de votre passage à KARNAK et nous espérons que ce plaisir sera renouvelé au cours de 1973/74. Nous vous tiendrons au courant de nos activités magnétiques.

Nous terminons notre lettre en vous priant de croire Chère Madame, à nos sentiments reconnaissants.

C. Traunecker

FROM THE SUB-DEPARTMENT OF GEOPHYSICS

OLIVER LODGE LABORATORY OXFORD STREET P.O. BOX 147 LIVERPOOL L69 3BX TEL: 051 – 709 - 6022

The University of Liverpool

22 October, 1973.

Dr.B.J.Kemp,
Faculty of Oriental Studies,
University of Cambridge,
Sidgwick Avenue,
Cambridge CB3 9DA

Dear Dr.Kemp,

I have attempted to determine both paleodirections and paleo-intensities from the 'Malkata' sample. Unfortunately the material is very 'loose' and sandy, and tends to break up when moved or heated. Consequently no experiments could be carried out on this sample. If you can obtain more consolidated samples, I would be willing to carry out further experiments.

Yours sincerely,

John Shaw

J.Shaw

MAGNETOMETER SURVEY AT MALKATA, EGYPT
19 February to 22 March, 1973

by
Elizabeth K. Ralph

I. INTRODUCTION

The site called "Malkata" is located about 2 km south of the modern town of Gurna on the west bank of the Nile River, opposite Luxor. More specifically, it begins about 1 km southwest of the 20th Dynasty Temple of Medinet Habu and extends southwest and south for about 2.5 km in each direction (see Fig. 1). The site consists of a possible harbor area bounded by four sets of mounds. On the "inland" or northwest side of the harbor are two parellel rows of mounds, presumably piled up from the dredging of the harbor. Within and behind some of these mounds (in the desert), mud-brick structures dating from the mid-18th Dynasty have been found, and are presently being excavated.

At the invitation of David O'Connor, Curator of Egyptology, University Museum, University of Pennsylvania, it was arranged for a representative of the

Museum Applied Science Center for Archaeology — namely, Elizabeth K. Ralph, Associate Director, to come to Egypt to do a magnetometer survey at the site. During this season (Winter, 1973) the excavations and the magnetometer survey have been conducted under the direction of Barry Kemp (Lecturer in Egyptology, University of Cambridge), Field Director for the Pennsylvania Expedition for 1973.

The purpose of the magnetometer survey was to locate features more rapidly than could be accomplished by excavation at this large site. The primary target was the harbor with the hope of delineating its precise position, its channel, etc. Secondarily, was the search for structures in the mounds and desert.

II. MAGNETOMETERS

The instrument employed at Malkata was the Precision Portable Cesium Magnetometer ? Model V- which was manufactured by Varian Associates (Palo Alto, California) specifically for the University Museum. The basic principle of cesium and other alkali vapor magnetometers is that the electronic energy states of an alkali vapor exhibit spitting (Zeeman effect) which is proportional to the strength of the magnetic field intensity. To detect this, the cesium is first vaporized by means of a heater; the electronic levels of energy are then energized by optical pumping; excited further by an R-F frequency; and are then ready to produce the frequencies of interest which are detected in units of magnetic intensity. (Once started, this process goes on continuously.) The principles & methods of operation are explained in greater detail by Ralph, Morrison, and O'Brien, Geoexploration, ? vol. ___, pp. ___ (1966).

The instrument consists of two main parts - the "sensor" and the "readout". The sensor with the cesium cell, heater, lamp, etc. is housed in a cylindrical container at one end of a staff with its associated electronic circuits in a rectangular box at the other end.

This is connected by a coaxial cable to the readout in which the numbers of interest appear. Power is supplied by batteries connected to the readout. These components are shown in Fig. 2. When operated with one sensor, the readings appear directly in gammas (1 gamma = 10^{-5} oersteds).

This instrument has the capability of being operated with two sensors in a differential configuration. In practice the second sensor is located in a fixed position, usually in the center of the grid being traversed. In this mode of operation the second sensor becomes the reference oscillator (instead of the normal 100 khz oscillator in the readout) and serves to cancel out diurnal and other external changes in magnetic intensity. The readings, then, are dependent only upon what is detected under the ground by the moving (or first) sensor. Due to the design of the circuits, the readings are no longer in gammas, but may be related by the equation:

$$1 \text{ UNIT} = \frac{\text{Field with One Sensor (in Gammas)}}{80,000}$$

At Malkata, where the normal field is 41050 γ,

1 UNIT = 0.52 γ, or 1 UNIT is approximately

equal to ½ gamma. The maximum sensitivity of the instrument is then 0.05 γ or 20-fold greater than that of proton magnetometers. This plus the greater speed of operation make alkali vapor magnetometers superior to proton ones. (Proton magnetometers cannot be operated continuously because of the necessity of a polarizing cycle of 3 to 6 seconds duration before taking each reading).

Note: A simplified Audio Readout was also brought to Malkata. This is useful for rapid preliminary exploration & for pinpointing the exact locations of anomalies. It had just been repaired by Varian Associates, but it had a bad defect which damaged the voltage regulator circuits of the sensors. The sensors were, therefore, repaired, and the "Audio" was not tried again.

III. PROCEDURE IN THE FIELD

A. GRIDS

Grids were made at 2-meter intervals. Each grid was usually 100 meters long and its width was dictated by the space to be covered or the space available. Grids were laid out by sighting the positions of the corner stakes with a prismatic compass. A 100-meter rope, calibrated with bands of colored tape at 2-meter intervals, was then laid lenthwise between two of the corner stakes. For the positions "width-wise", 30-meter tape measures were used. After the "0", "2", and "4"-meter lines had been traversed, the calibrated rope was then moved to temporary 10-meter stakes at each end of the grid, and so on until the grid had been completed. (See sketch of this system, Fig. 3).

~~Where~~ The differential 2-sensor system was used most of the time. Exceptions were when the space available was so narrow that the placing and replacing of the second sensor became time-consuming and also diurnal changes were not large due to the short time required to do a narrow grid.

In a few other grids, only one sensor was used due to breakdown of one of the sensors. (These defects were subsequently repaired for use the next day).

When the 2-sensor system was employed, the fixed sensor was placed in the center of the grid and connected to the readout by a 100-meter coaxial cable. A small magnetic "anomaly" such as a compass or penknife was placed near the fixed sensor in such a position as to adjust the initial reading above the 80,000-UNIT base reading of the instrument. Readings which appear in the grids as "10", "20", "30", etc. are actually 80,010, 80,020, and 80,030 UNITS. Lower, i.e., less magnetic readings such as "990", "980", "970", etc. are actually 79,990, 79,980, and 79,970 UNITS respectively. By means of the small anomaly of iron near the fixed sensor, readings in the next adjacent grid could be adjusted to the same reference value as those in the first. To accomplish this the moving sensor was placed temporarily in a fixed position (on a stake) on the borderline of the two grids and the reading in the new one was adjusted to match that in the one just completed.

{Grids, continued}

In doing a grid, the man carrying the movable sensor paused at each 2-meter marker while the man carrying the readout and batteries called out the reading*. This was then recorded by the writer in a notebook oriented in the same way that the grid was being traversed. A fourth person took care of the 100-meter cable, and our small procession of four moved along regularly and slowly until the grid was completed.

Afterwards (in the hotel Habu) the pages of the notebook were pasted together to form the completed grids. Then, contours of equal magnetic intensity were drawn. The contours of grids made with the 2-sensor differential system were drawn at intervals of 10 UNITS, and those made with one sensor, at intervals of 5 gammas. All grids were recorded at the scale of 1 to 200 (1 cm = 2 M).

* I am indebted to Badawy Mohammed Hassan from Gurna (readout man) and to Zahkry Ehtrhome and Hamedy Hassan Mohammed from Malkata (who alternated with sensor and cable) for their capable assistance.

B. LINES

Where it was not practical to lay out grids or where rapid exploration was required, long lines were run by pacing at 2-meter intervals (with one sensor). The results, of course, were less precise, but gave an indication of the magnetic variations of the terrain which was traversed.

IV RESULTS OF MAGNETOMETER SURVEY

A. HARBOR

Since the area of the harbor is part of the fertile alluvial plain, it is covered with crops — sugar cane, clover, beans, lentils, etc. At this time of the year very few had been harvested, and there were, therefore, few fields open for magnetometer work. As a start, long lines were made along the existing tracks and ditches (see Fig. 4). Line A was a traverse from NW to SE from one irrigation canal to the other. It is illustrated in Fig. 5. One sees large disturbances due to magnetic pipes in ditches. The large dip at the SE end is due to the modern bridge over the canal. Even without these man-made disturbances, however, the magnetic variations due to the alluvial soil itself are very pronounced. Line E (Fig. 6) was made along a track on the inner side of the possible harbor entrance. Again, pronounced rapid variations in magnetic intensity are exhibited. The downward trend in values toward the NE end of the line is due to the increasing proximity

of the village mound, also made of the alluvial soil). (Magnetic anomalies are displaced to the south with the amount dependent upon the angle of inclination, which explains why this effect was greater from the mound to the north of the line than from that to the south).

These results were discouraging, but a few open fields were found in which to do grids. The first two, Grids #4 and #5 (Fig. 7), located also in Fig. 4, were made where the sugar cane had been cut and burned. It was learned from the owner of the field of Grid #4 that there is an extensive system of drainage pipes under the plain, about 1½ meters deep, and probably at about 50-meter intervals. The pipes are concrete, but they appeared to have iron joints. At any rate strong magnetic gradients, as evidenced by closely spaced contours of equal magnetic intensity, are associated with these pipes. The gradients, however, as shown in both Grids #4 and #5, were almost equally as strong where there were probably no modern pipes.

Five other narrow grids (10 by 100 meters each, Grid Nos. 6, 7, 8, 9, and 10, were made in clover fields (see Fig. 4 for locations) where John Taylor had begun "sondage" nos. N-1 and N-2 on March 3rd. Except for the first (Grid #6), they were made with one sensor because of the narrowness of the space. These five grids also contain closely spaced & variable contours with no meaningful interpretation other than the variations in the extremely magnetic soil.

The cause of this unusually high magnetic alluvial soil was explained by Hesse ? ref. {Leave space for reference}

The Nile waters have an exceptionally high iron content, and as a consequence the soils of the flood plains are abnormally magnetic.

Susceptibilities

{Leave space for these measurements}

B. DESERT AND SPACES BETWEEN MOUNDS

The first grid (run ~~parallel to those of the harbor~~) was made in the desert NW of the two parallel rows of mounds (see Fig. 8). The south corner of Grid No. 1 (Fig. 9) coincides with ~~the~~ a north corner of John McDonald's excavation ao-17, Site K. There are pronounced magnetic disturbances from the edge of the mound in the SW part of the grid, and in lines 0 and 2 (from another adjacent mound) near the middle of the grid. Otherwise, the grid is comparatively magnetically "quiet" except for two small magnetic anomalies, one centered on line 8 at 63 m; the other, line 44, 24 m. Both were excavated and found to contain nothing of interest other than a few mud bricks, which were probably the causes of the anomalies.

Grid No. 2 (Fig. 10) is mostly very quiet magnetically. The sand pits in the north corner caused little disturbance. The effect of a mound is seen again on the SE side of the grid as well as a few anti-magnetic anomalies in the eastern corner. The appearance of a small linear feature there was encouraging, but it

petered out in adjacent grids. At least, it was illustrated in Grid No. 2 that desert areas, not in the proximity of the magnetic mounds, were "quiet", & that there would be some hope of detecting mud-brick structures in these areas.

This was borne out in Grid No. 3 (Fig. 11). In the north central part, pronounced disturbances are seen which were caused by the mud-brick structures in Linda Popelish's excavations (site J) — squares ba-40, 41, and 42, bb-39, 41, and 42, bc-40 and bc-42, plus the upper area of excavation. Presumably the large disturbances, both anti-magnetic (readings below "0" UNITS) and magnetic (above "30" UNITS) extending both north and in a long broad row south of the excavations, also represent mud-brick structures beneath the desert sands.

Grid No. 11 (Fig. 12) is an extension of Grid No. 3 to the NW. The limit of the anomalies found in Grid No. 3 appears in the NE corner. There

are also slight disturbances from the sand pits on the NW side of the grid. Fairly long parallel contours running in line with the 100-meter length of the grid are obvious, especially, in the central part of the grid. These are undoubtedly due to diurnal changes since this grid was made with one sensor only.

The next grids (see Fig. 8 for their locations) were made between mounds. Grid No. 12 (Fig. 13) spanned the distance from the junction of Grid Nos. 2 and 3 NW of the mounds to the NW edge of the SE row of mounds. In Grid No. 12, one sees very strong magnetic gradients due to the effect of the mounds. This indicates without doubt that the mounds were made of the magnetic alluvial soil. (They have subsequently become covered with sand except for outcrops of consolidated soil. However, the soil tends to be more evident on the western slopes where the sand has been blown away by wind, and for the same reason the deposits of sand on the eastern slopes are deeper). Because of the effect of the magnetic mounds, there remains only a width of 6 meters which

is undisturbed except for each end of the grid, both of which are somewhat away from the mounds. In the northern corner of this grid (Fig. 13) there is possibly a significant anomaly which is shown by the cross-hatched areas. The central part is magnetic & this is bordered by anti-magnetic regions, both north and south of it.

Linda's
Site J Trench 1

GRIDS ~~BETWEEN~~ BETWEEN THE MOUNDS

A

Grid No. 12 spanned the distance from the desert (NW of the mounds) to the aisle between the parallel rows of mounds. Grids were then made running the length of this aisle. (See Fig. 8 for their locations). Starting with Grid No. 23 (Fig. _) at the NE end, we see large magnetic disturbances due to the dumps of sand and thousands (or millions) of sherds from previous excavations. The effects from these are comparable to those from the mounds of Nile alluvium as illustrated and explained for Grid No. 12. One interesting thing about Grid No. 23 is that the readings throughout most of the grid tend to be lower (almost all "990" or less), that is, lower in magnetic intensity. These low readings extend into Grid No. 22 (Fig. _) to the border of Excavation

Sand ?

It is possible that a test trench to the NE of this one in the regions of lower magnetic intensity might reveal different soil conditions.

Grid Nos. 21, 16, 15, 13, and 14 (Figs.) show again the effects of the magnetic mounds (on the lengthwise sides of each grid). In the central portions, away from the magnetic fields of the mounds, there are a few small magnetic anomalies (in Grid Nos. 21, 16, and 15) which are probably caused by pockets or levels of magnetic earth closer to the surface than normal (as in the test trench in Grid No. 12). The readings in Grid No. 16 tend to be less magnetic than those in Grid No. 21, but it is possible that the base reading ~~was~~ for these two grids was not adjusted to the same value. Grid No. 13 has a very strong anti-magnetic anomaly within the edge of a mound (south corner of grid) which must be the reaction from something within the mound that is very magnetic. In both Grid Nos. 13 and 14, there are small anti-magnetic and magnetic anomalies that are probably not significant.

Due to the fact that the space between the mounds became narrower and also because it seemed to be useless to continue to record the effects of the magnetic mounds by traversing

their lower slopes, the subsequent Grid Nos. 17, 18, 19, 20, 26, 27, 28, and 29 covered only the more or less flat spaces between the mounds. Since each one was narrow and could be completed quickly, there was no need to correct for diurnal changes. Therefore, one sensor only was used which speeded up their completion since it would have been time-consuming to move the fixed sensor for each small grid. For simplicity, also, the magnetic contours of these grids were drawn at intervals of 10 γ (gammas). In Grid No. 17 there are a few small magnetic and anti-magnetic anomalies, but as we progress from this grid to the SW end of the aisle (Grid No. 28), the anomalies tend to peter out. In Grid No. 29, made perpendicularly at the SW end of the mounds (see Fig. 8 for location), we see no anomalies at all.

D

DUMPS AND DESERT

(Fig. —)

With Grid No. 24A, we returned to the desert from the NW edge of the mounds. The NE part of Grid No. 24 was mostly on the flat desert whereas the south corner ~~Especially~~ was made over mounds of dumps of former excavations. These dumps consisted largely of sherds and again caused very pronounced magnetic gradients with both magnetic and anti-magnetic centers. Away from the dumps and into Grid No. 25, the situation is again magnetically "quiet", and indicates that there may be no features of archaeological interest.

MAGNETOMETER SURVEY AT MALKATA, EGYPT

19th February to 22nd March, 1973

by

Elizabeth K. Ralph

I. INTRODUCTION

The site called "Malkata" is located about 2 km south of the modern town of Gurna on the west bank of the Nile River, opposite Luxor. More specifically, it begins about 1 km southwest of the 20th Dynasty Temple of Medinet Habu and extends southwest and south for about 2.5 km in each direction (see Fig. 1). The site consists of a possible harbor area bounded by four sets of mounds. On the "inland" or northwest side of the harbor are two parellel rows of mounds, presumably piled up from the dredging of the harbor. Within and behind some of these mounds (in the desert), mud-brick structures dating from the mid-18th Dynasty have been found, and are presently being excavated.

At the invitation of David O'Connor, Curator of Egyptology, University Museum, University of Pennsylvania, it was arranged for a representative of the Museum Applied Science Center for Archaeology - namely, Elizabeth K. Ralph, Associate Director, to come to Egypt to do a magnetometer survey at the site. During this season (Winter, 1973) the excavations and the magnetometer survey have been conducted under the direction of Barry Kemp (Lecturer in Egyptology, University of Cambridge), Field Director for the Pennsylvania Expedition for 1973.

The purpose of the magnetometer survey was to locate features more rapidly than could be accomplished by excavation at this large site. The primary target was the harbor with the hope of delineating its precise position, its channel, etc. Secondarily, was the search for structures in the mounds and desert.

II. MAGNETOMETERS

The instrument employed at Malkata was the Precision Portable Cesium Magnetometer Model V - 4920 which was manufactured by Varian Associates (Palo Alto, California) specifically for the University Museum. The basic principle of cesium and other alkali vapor magnetometers is that the

electronic energy states of an alkali vapor exhibit spitting (Zeeman effect) which is proportional to the strength of the magnetic field intensity. To detect this, the cesium is first vaporized by means of a heater; the electronic levels of energy are then energized by optical pumping; excited further by an R-F frequency; and are then ready to produce the frequencies of interest which are detected in units of magnetic intensity. Once started, this process goes on continuously. The principles and methods of operation are explained in greater detail by Ralph, Morrison, and O'Brien, Geoexploration, vol. 6, pp. 109-122 (1966).

The instrument consists of two main parts - the "sensor" and the "readout". The sensor with the cesium cell, heater, lamp, etc. is housed in a cylindrical container at one end of a staff with its associated electronic circuits in a rectangular box at the other end. This is connected by a coaxial cable to the readout in which the numbers of interest appear. Power is supplied by batteries connected to the readout. These components are shown in Fig. 2. When operated with one sensor, the readings appear directly in gammas (1 gamma = 10^{-5} oersteds).

This instrument has the capability of being operated with two sensors in a differential configuration. In practice the second sensor is located in a fixed position, usually in the center of the grid being traversed. In this mode of operation the second sensor becomes the reference oscillator (instead of the normal 100 Khz oscillator in the readout) and serves to cancel out diurnal and other external changes in magnetic intensity. The readings, then, are dependent only upon what is detected under the ground by the moving (or first) sensor. Due to the design of the circuits, the readings are no longer in gammas, but may be related by the equation:

$$1 \text{ UNIT} = \frac{\text{Field with One Sensor (in gammas)}}{80{,}000}$$

At Malkata, where the normal field is 41050 γ, 1 UNIT = 0.52 γ, or 1 UNIT is approximately equal to ½ gamma. The maximum sensitivity of the instrument is then 0.05 γ or 20 - fold greater than that of proton magnetometers. This plus the greater speed of operation make alkali vapor magnetometers superior to proton ones. (Proton magnetometers cannot be operated continuously because of the necessity of a polarizing cycle of 3 to 6 seconds before taking each reading).

Note: A simplified Audio Readout was also brought to Malkata. This is useful for rapid preliminary exploration and for pinpointing the exact locations of anomalies. It had just been repaired by Varian Associates, but it had a bad defect which damanged the voltage regulator circuits of the sensors. The sensors were, therefore, repaired, and the "Audio" was not tried again.

III. PROCEDURE IN THE FIELD

A. GRIDS

Grids were made at 2-meter intervals. Each grid was usually 100 meters long and its width was dictated by the space to be covered or the space available. Grids were laid out by sighting the positions of the corner stakes with a prismatic compass. A 100-meter rope, calibrated with bands of colored tape at 2-meter intervals, was then laid lengthwise between two of the corner stakes. For the positions "width-wise", 30-meter tape measures were used. After the "0", "2", and "4" meter lines had been traversed, the calibrated rope was then moved to temporary 10-meter stakes at each end of the grid, and so on until the grid had been completed. (See sketch of this system, Fig. 3).

The differential 2-sensor system was used most of the time. Exceptions were when the space available was so narrow that the placing and replacing of the second sensor became time-consuming and also diurnal changes were not large due to the short time required to do a narrow grid.

In a few other grids, only one sensor was used due to breakdown of one of the sensors. (These defects were subsequently repaired for use the next day).

When the 2-sensor system was employed, the fixed sensor was placed in the center of the grid and connected to the readout by a 100-meter coaxial cable. A small magnetic "anomaly" such as a compass or penknife was placed near the fixed sensor in such a position as to adjust the initial reading above the 80,000-UNIT base reading of the instrument. Readings which appear in the grids as "10", "20", "30", etc. are actually 80,010, 80,020, and 80,030 UNITS. Lower i.e. less magnetic readings such as "990", "980", "970", etc. are actually 79,990, 79,980,

and 79,970 UNITS respectively. By means of the small anomaly of iron near the fixed sensor, readings in the next adjacent grid could be adjusted to the same reference value as those in the first. To accomplish this the moving sensor was placed temporarily in a fixed position (on a stake) on the borderline of the two grids and the reading in the new one was adjusted to match that in the one just completed.

In doing a grid, the man carrying the moveable sensor paused at each 2-meter marker while the man carrying the readout and batteries called out the reading.+ This was then recorded by the writer in a notebook oriented in the same way that the grid was being traversed. A fourth person took care of the 100-meter cable, and our small procession of four moved along regularly and slowly until the grid was completed.

Afterwards (in the hotel Habu) the pages of the notebook were pasted together to form the completed grids. Then, contours of equal magnetic intensity were drawn. The contours of most of the grids made with the 2-sensor differential system were drawn at intervals of 10 UNITS, and those made with one sensor, at intervals of either 5 or 10 gammas. All grids were recorded at the scale of 1 to 200 (1 cm = 2m).

+I am indebted to Badauy Mohammed Hassan from Gurna (readout man) and to Zahkry Ehfrhame and Hamedy Hassan Mohammed from Malkata (who alternated with sensor and cable) for their capable assistance.

B. LINES

Where it was not practical to lay out grids or where rapid exploration was required, long lines were run by pacing at 2-meter intervals (with one sensor). The results, of course, were less precise, but gave an indication of the magnetic variations of the terrain which was traversed.

IV RESULTS OF MAGNETOMETER SURVEY

A. HARBOR

Since the area of the harbor is part of the fertile alluvial plain, it is covered with crops - sugar cane, clover, beans, lentils, etc. At this time of the year very few had been harvested, and there were, therefore, few fields open for magnetometer work. As a start, long lines were made along the existing tracks and ditches (see Fig. 4). Line A was

a traverse from NW to SE from one irrigation canal to the other. It is illustrated in Fig. 5. One sees large disturbances due to magnetic pipes in ditches. The large dip at the SE end is due to the modern bridge over the canal. Even without these man-made disturbances, however, the magnetic variations due to the alluvial soil itself are very pronounced. Line E (Fig. 6) was made along a track on the inner side of the possible harbor entrance. Again, pronounced rapid variations in magnetic intensity are exhibited. The downward trend in values toward the NE end of the line is due to the increasing proximity of the village mound, also made of the alluvial soil. (Magnetic anomalies are displaced to the south with the amount dependent upon the angle of inclination, which explains why this effect was greater from the mound to the north of the line than from that to the south).

These results were discouraging, but a few open fields were found in which to do grids. The first two, Grids #4 and #5 (Fig. 7), located also in Fig. 4, were made where the sugarcane had been cut and burned. It was learned from the owner of the field of Grid #4 that there is an extensive system of drainage pipes under the plain, about 1½ m deep, and probably at about 50-meter intervals. The pipes are concrete, but they appeared to have iron joints. At any rate strong magnetic gradients, as evidenced by closely spaced contours of equal magnetic intensity, are associated with these pipes. The gradients, however, as shown in both Grids #4 and #5, were almost equally as strong where there were probably no modern pipes.

Five other narrow grids (10 by 100 meters each), Grid Nos. 6, 7, 8, 9, 10 (Fig.7a)were made in clover fields (see Fig. 4 for locations) where John Taylor had begun "sondage" nos. N-1 and N-2 on March 3rd. Except for the first (Grid #6), they were made with one sensor because of the narrowness of the space. These five grids also contain closely spaced and variable contours with no meaningful interpretation other than the variations in the extremely magnetic soil.

The cause of this unusually magnetic alluvial soil was explained by A. Hesse in an article entitled "Mesures et interprétation en prospection géophysique des sites archéologique du Nil" (Prospezioni Archeologiche, vol. 2, 1967, pp. 43-48.

The deposits carried by the Nile waters have exceptionally high iron contents and as a consequence the soils of the flood plains are abnormally magnetic.

Susceptibilities as measured by Hesse, are in the range of 100 to 375 x 10^{-6} e.m.u.

B. DESERT AND SPACES BETWEEN MOUNDS

1. Desert

The first grid (run before those of the harbor) was made in the desert NW of the two parallel rows of mounds (see Fig. 8). The south corner of Grid No. 1 (Fig. 9) coincides with a north corner of John McDonald's excavation ao-17, Site K. There are pronounced magnetic disturbances from the edge of the mound in the SW part of the grid, and in lines 0 and 2 (from another adjacent mound) near the middle of the grid. Otherwise, the grid is comparatively magnetically "quiet" except for two small magnetic anomalies, one centered on line 8 at 63 m; the other, line 44, 24 m. Both were excavated and found to contain nothing of interest other than a few mud bricks, which were probably the causes of the anomalies.

Grid No. 2 (Fig. 10) is mostly very quiet magnetically. The sand pits in the north corner caused little disturbance. The effect of a mound is seen again on the SE side of the grid as well as a few anti-magnetic anomalies in the eastern corner. The appearance of a small linear feature there was encouraging, but it petered out in adjacent grids. At least, it was illustrated in Grid No. 2 that desert areas, not in the proximity of the magnetic mounds, were "quiet", and that there would be some hope of detecting mud-brick structures in these areas.

This was borne out in Grid No. 3 (Fig. 11). In the north central part, pronounced disturbances are seen which were caused by the mud-brick structures in Linda Popelish's excavations (site J) - squares ba-40, 41 and 42, bb-39, 41, and 42, bc-40 and bc-42, plus the upper area of excavation. Presumably the large disturbances, both anti-magnetic (readings below "0" UNITS) and magnetic (above "30" UNITS) extending both north and in a long broad row south of the excavations, also represent mud-brick structures beneath the desert sands.

Grid No. 11 (Fig. 12) is an extension of Grid No. 3 to the NW. The limit of the anomalies found in Grid No. 3 appears in the NE corner. There are also slight disturbances from the sand pits on the NW side of the grid. Fairly long parallel contours running in line with the 100-meter length of the grid are obvious, especially, in the central part of the grid. These are undoubtedly due to diurnal changes since this grid was made with one sensor only.

2. Dumps and Desert

With Grid No. 24 (see locations in Fig. 8), we returned to the desert from the NW edge of the mounds. The NW part of Grid No. 24 was mostly on the flat desert whereas the south corner was made over mounds of dumps of former excavations. These dumps consisted largely of sherds and again caused very pronounced magnetic gradients with both magnetic and anti-magnetic centers. Away from the dumps and into Grid No. 25, the situation is again magnetically "quiet", and indicates that there may be no features of archaeological interest in this area.

3. Grids between the mounds

Many long, narrow grids (see Fig. 8 for their locations) were made between mounds. Grid No. 12 (Fig. 13) spanned the distance from the junction of Grid Nos. 2 and 3 NW of the mounds to the NW edge of the SE row of mounds. In Grid No. 12, one sees very strong magnetic gradients due to the effect of the mounds. This indicates without doubt that these mounds were made of the magnetic alluvial soil. (They have subsequently become covered with sand except for outcrops of consolidated soil. However, the soil tends to be more evident on the western slopes where the sand has been blown away by wind, and for the same reason the deposits of sand on the eastern slopes are deeper). Because of the effect of the magnetic mounds, there remains only a width of 6 meters which is undisturbed except for each end of the grid, both of which are somewhat away from the mounds. In the northern corner of this grid (Fig. 13) there is possibly a significant anomaly which is shown by the cross-hatched areas. The central part is magnetic and this is bordered by anti-magnetic regions, both north and south of it.

Grid No. 12 spanned the distance from the desert (NW of the mounds) to the aisle between the parallel rows of mounds. Grids were then made running the length of this aisle. (See Fig. 8 for their locations). Starting with Grid No. 23 at the NE end, we see large magnetic disturbances due to the dumps of sand and thousands (or millions) of sherds from previous excavations. The effects from these are comparable to those from the mounds of Nile alluvium as illustrated and explained for Grid. No. 12. One interesting thing about Grid No. 23 is that the readings throughout most of the grid tend to be lower (almost all "990" or less), that is, lower magnetic intensity. These low readings extend into Grid No. 22 to the border of John Taylor's trench No. N-4. It is possible that a test trench to the NE of this one in the regions of lower magnetic intensity might reveal different soil conditions.

Grid Nos. 21, 16, 15, 13, and 14 show again the effects of the magnetic mounds (on the lengthwise sides of each grid). In the central portions, away from the magnetic fields of the mounds, there are a few magnetic anomalies (in Grid Nos. 21, 16, and 15) which are probably caused by pockets or levels of magnetic earth closer to the surface than normal (as in the test trench in Grid No. 12). The readings in Grid No. 16 tend to be less magnetic than those in Grid No. 21, but it is possible that the base reading for these two grids was not adjusted to the same value. Grid No. 13 has a very strong anti-magnetic anomaly within the edge of a mound (south corner of grid) which must be the reaction from something within the mound that is very magnetic. In both Grid Nos. 13 and 14, there are small anti-magnetic and magnetic anomalies that are probably not significant.

Due to the fact that the space between the mounds became narrower and also because it seemed to be useless to continue to record the effects of the magnetic mounds by traversing their lower slopes, the subsequent Grid Nos. 17, 18, 19, 20, 26, 27, 28, and 29 covered only the more or less flat spaces between the mounds. Since each one was narrow and could be completed quickly, there was no need to correct for diurnal changes. Therefore, one sensor only was used which speeded up their completion since it would have been time-consuming to move the fixed sensor for each small grid. For simplicity, also, the magnetic contours of these grids were drawn at intervals of 10 γ (gammas). In Grid No. 17 there are a few small magnetic and anti-magnetic anomalies, but as we progress from this grid to the end of the aisle (Grid No. 28), the anomalies tend to peter out.

In Grid No. 29, made perpendicularly at the SW end of the mounds (see Fig. 8 for location), we see no anomalies at all.

V CONCLUSIONS

At Malkata the so-called harbor area was unsuitable for magnetic prospecting due to the unusually magnetic alluvial soil. For the same reason, all but two of the mounds caused strong magnetic anomalies. Between the rows of mounds and on the inner or "harbor" side, no anomalies of archaeological significance seem to have been found. However, the fact that the last two mounds (SW limit) on the inner side are not magnetic may provide an important clue. This, plus the observation by Peter Tallon of deposits of coarse gravel at the NW end at the adjacent village mound, tend to suggest that a channel was made here either earlier or at a different time from that of the alluvial mounds. It is my suggestion that test trenches be made at the edge of the limit of the "harbor" spanning the distance between the two "sandy" mounds, that is, in the corner bounded by these two mounds and the NW end of the village mound.

The desert area, NW of the parallel rows of mounds, was found to be more suitable for magnetic prospecting. Most of the area covered by Grid Nos. 1,2,11,24 and 25 (see Fig. 8) was magnetically very quiet and this eliminates the possibility of finding mud-brick structures in these regions. In contrast, many anomalies were found in Grid No. 3 (Fig. 11). Strong magnetic gradients were caused by the mud-brick structures exposed in Linda Popelish's excavations, and similar anomalies extend both north and south of her trenches. Presumably, these represent more mud-brick structures. In this region, the magnetic soil was an asset in that it enabled the detection of mud-brick structures buried under sand.

To confirm the fact that the mounds adjacent to Grid No. 29 were not causing magnetic disturbances, lines were made around the lower slopes, encircling the mounds, and no anomalies were detected. These two mounds are the ones at the southwestern limit of the inner (or "harbor") row of mounds, the last one of which has curious large boulders at its base on

the western side. Both are near the village mound at the southwestern edge of the "harbor" area where Peter Tallon, expedition geologist (University of London) has observed deposits of coarse gravel.

Magnetometer lines made in the sandy track leading to the village revealed nothing, and led us to Grid No. 30, the start of a long series of grids on the "harbor" side of the mounds. Grid No. 30 is also magnetically quiet and without anomalies. We then observed that these last two mounds in the row are very different from the others - they are higher, more conical, more massive, and appear to consist of sand only, which is confirmed by the lack of magnetic anomalies. It is possible that this difference may provide a clue with respect to the original dredging of the harbor.

Continuing NE on the "inner" side of the mounds, Grid Nos. 31 to 42 were then made (see Fig. 8 for locations). These grids did not extend up the slopes of the mounds in most cases, but in each we see some magnetic disturbances due to the alluvial mounds or spillage from them. All are "noisy" compared with Grid Nos. 29 and 30. In the region of Grid No. 37 there were many small pits which had been dug in the sand. Since these pits caused minor anomalies, it seems likely that some alluvial soil has been mixed with the sand. (Pits in non-magnetic sand alone would not be expected to cause anomalies). Grid Nos. 40 and 41 were comparatively quiet, but both were also very narrow due to the limited space available.

Finally, with Grid No. 42 we worked in a barnyard beside Hamedy's house. (The spaces between Grid Nos. 36 and 37, Nos. 40 and 41, and Nos. 41 and 42 were skipped because of mud-brick sheds, etc.). Here we see the effects of "civilization", especially in two areas of the grid with strong reactions to modern iron, the one in the SW central part of the grid so large that magnetometer readings were unreliable.

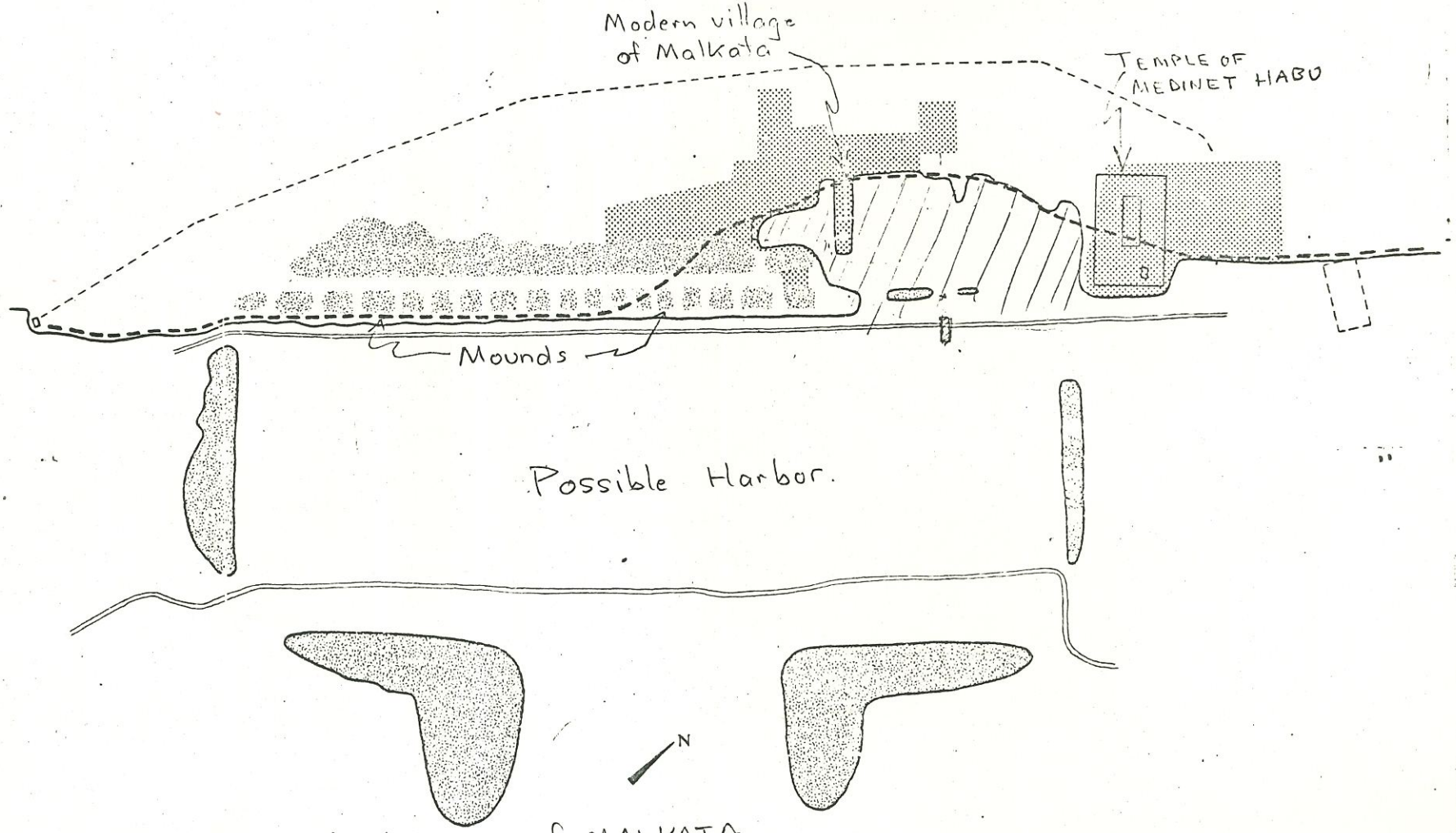


FIG. 1. Plan of the site of MALKATA

Fig. 2 Cesium Magnetometer and Crew at Malkata. Left to right: Hamedy with cable, Badauy with readout, Beth with notebook, and Zahkry with sensor.

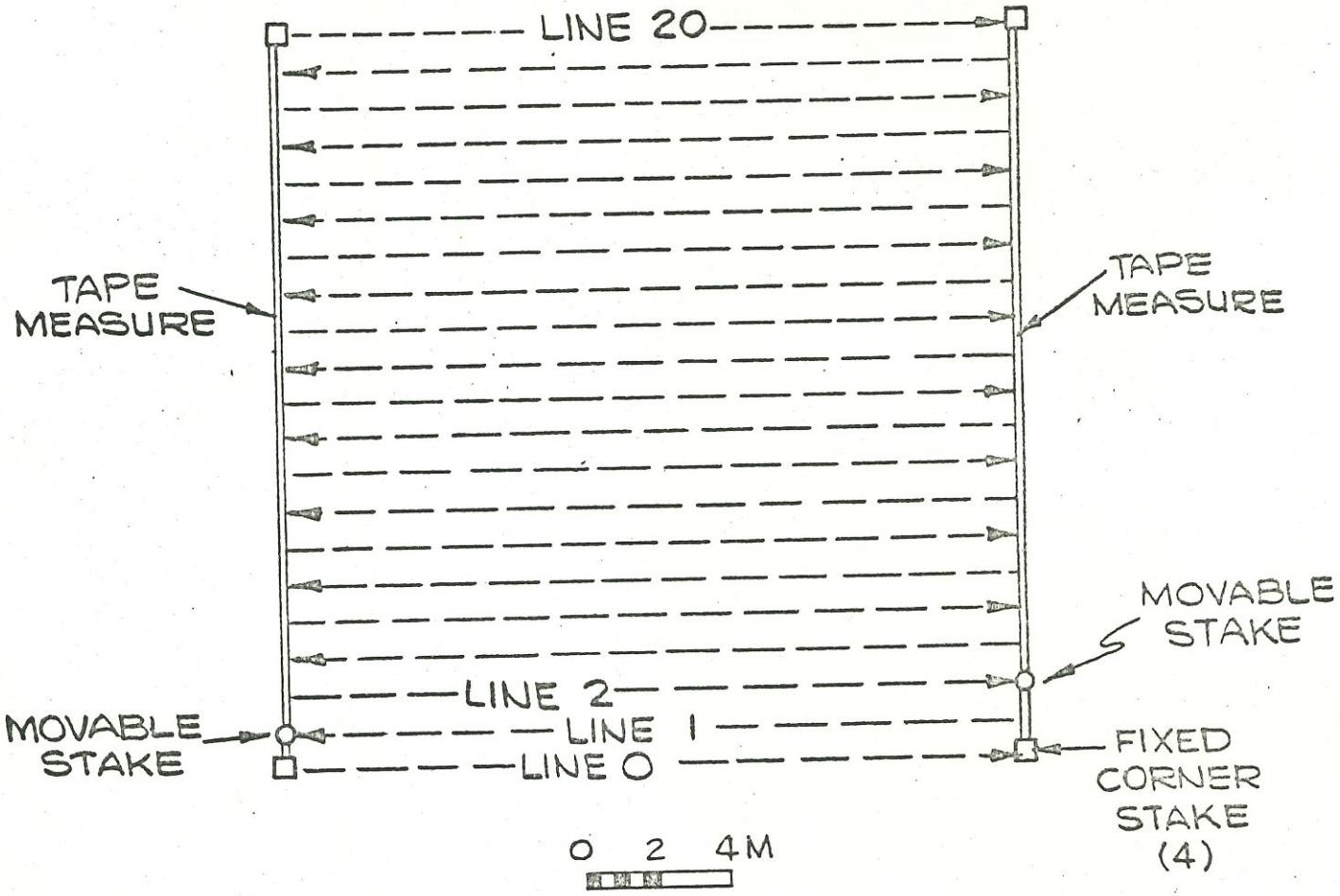


FIG. 3. Explanation of method of doing a grid with a calibrated rope.

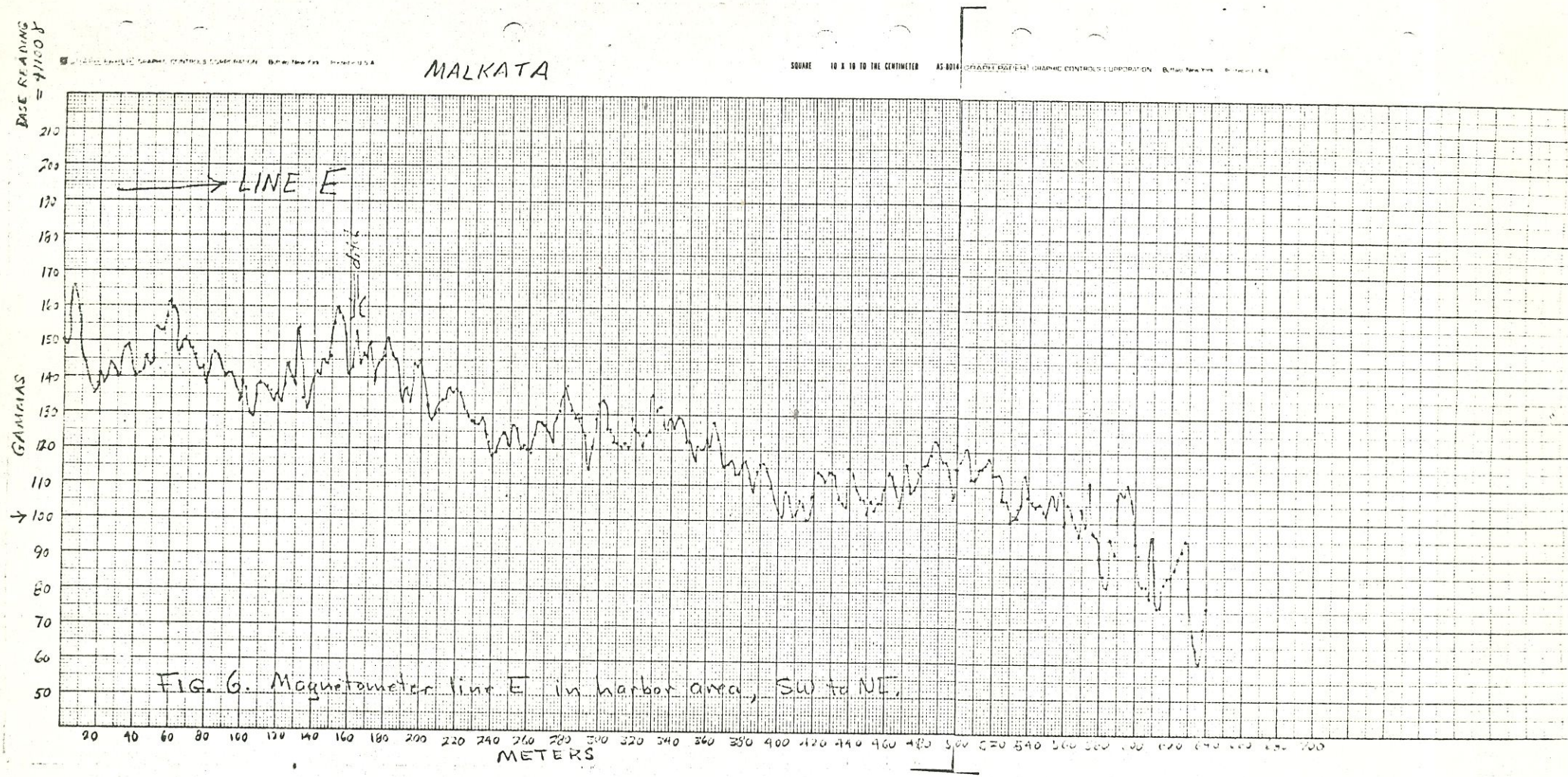


FIG. 6. Magnetometer line E in harbor area, SW to NE.

Adjacent to the house on the south-west are a series of very small rooms belonging to a unit whose full nature will be revealed only when adjacent squares are opened up. On the other side of the house are several irregular courtyards containing ovens or kilns. These courtyards contained a rich deposit of organic material containing bones and seeds. These were separated by sieving and flotation.

The combination of plan, pottery and organic remains invite a serious attempt to reconstruct how the village operated as a living unit. As a step towards making the living conditions easier to imagine it was decided to experiment with rebuilding parts of it. The central house unit was chosen, and as soon as recording was complete a start was made. Bricks of the correct ancient size were made locally, and by the end of the season the walls were virtually complete. Since the operation is a relatively inexpensive one, it is to be hoped that as more of the village is uncovered it will be extended. The previous excavated parts of Malkata make very little sense to any but the most determined visitor, the same being true of el-Amarna, and makes even more worthwhile this attempt to infuse a little life into what would otherwise rapidly deterioate into a confused jumble.

The full extent of the village can be judged from the magnetometer survey, which seems to suggest that perhaps four fifths remains to be opened. The magnetometer survey of the site J area identified a linear feature near the entrance to the gap between mounds B7 and B8. A trench cut across this disclosed a narrow cutting in the hard desert surface descending to about 2.5 metres below it. At one end it opened into a circular shaft which descended even lower, although to have followed it to a greater depth would have meant expanding the excavation, which time did not permit. Enough has been found however, to identify this as a well, from which water seems to have been raised in two stages: the first, not yet identified, must have raised it to the channel, the second must have lifted it to the ground level by a device for which a pair of sockets were cut in the gravel. It will be important to complete excavation of th is feature, particularly since the stratigraphy and associated sherds make it likely to have been contemporary with the Eighteenth Dynasty village.

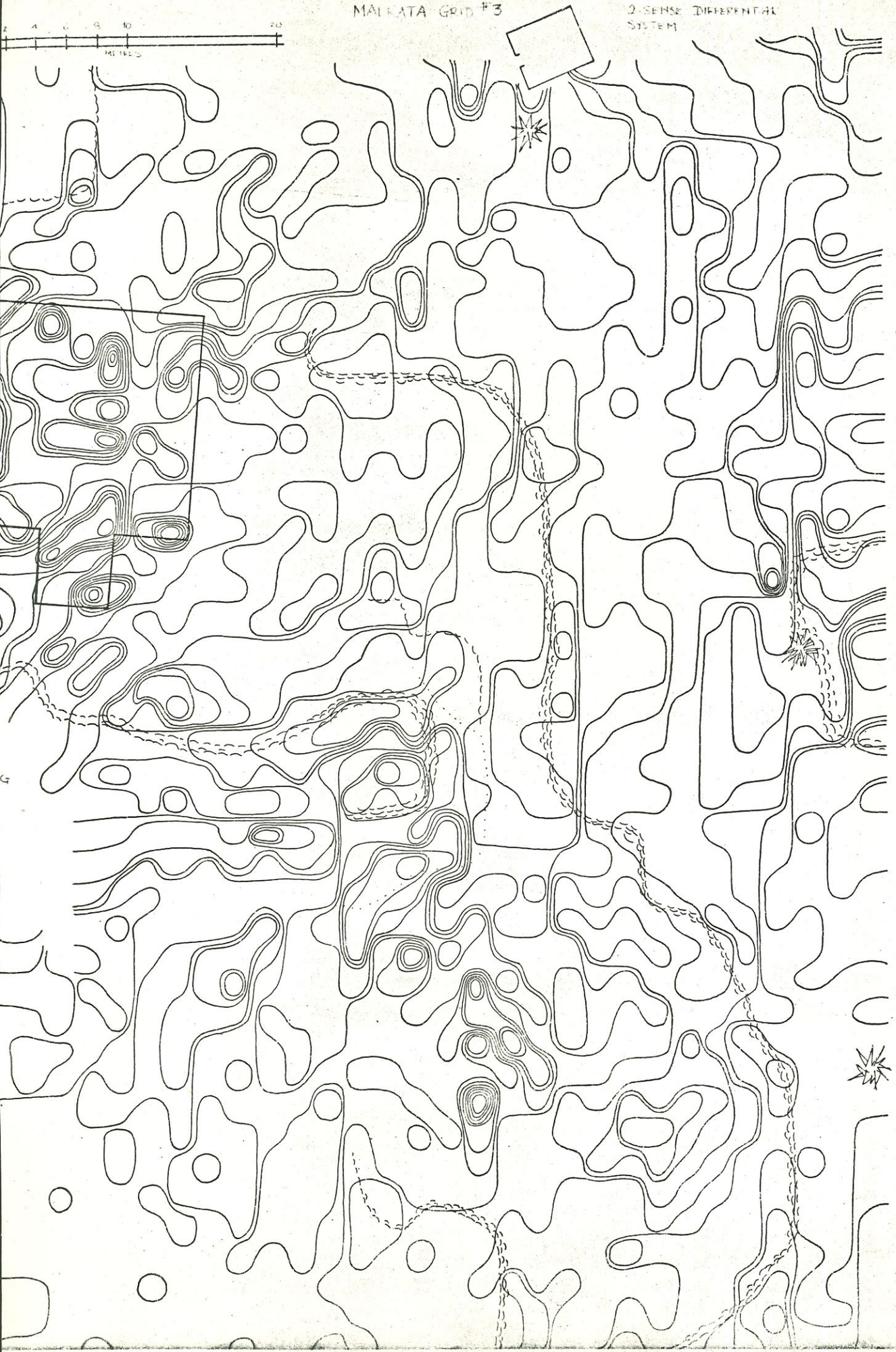
Apart from the normal work of planning and recording, a number of tasks may be singled out for mention:

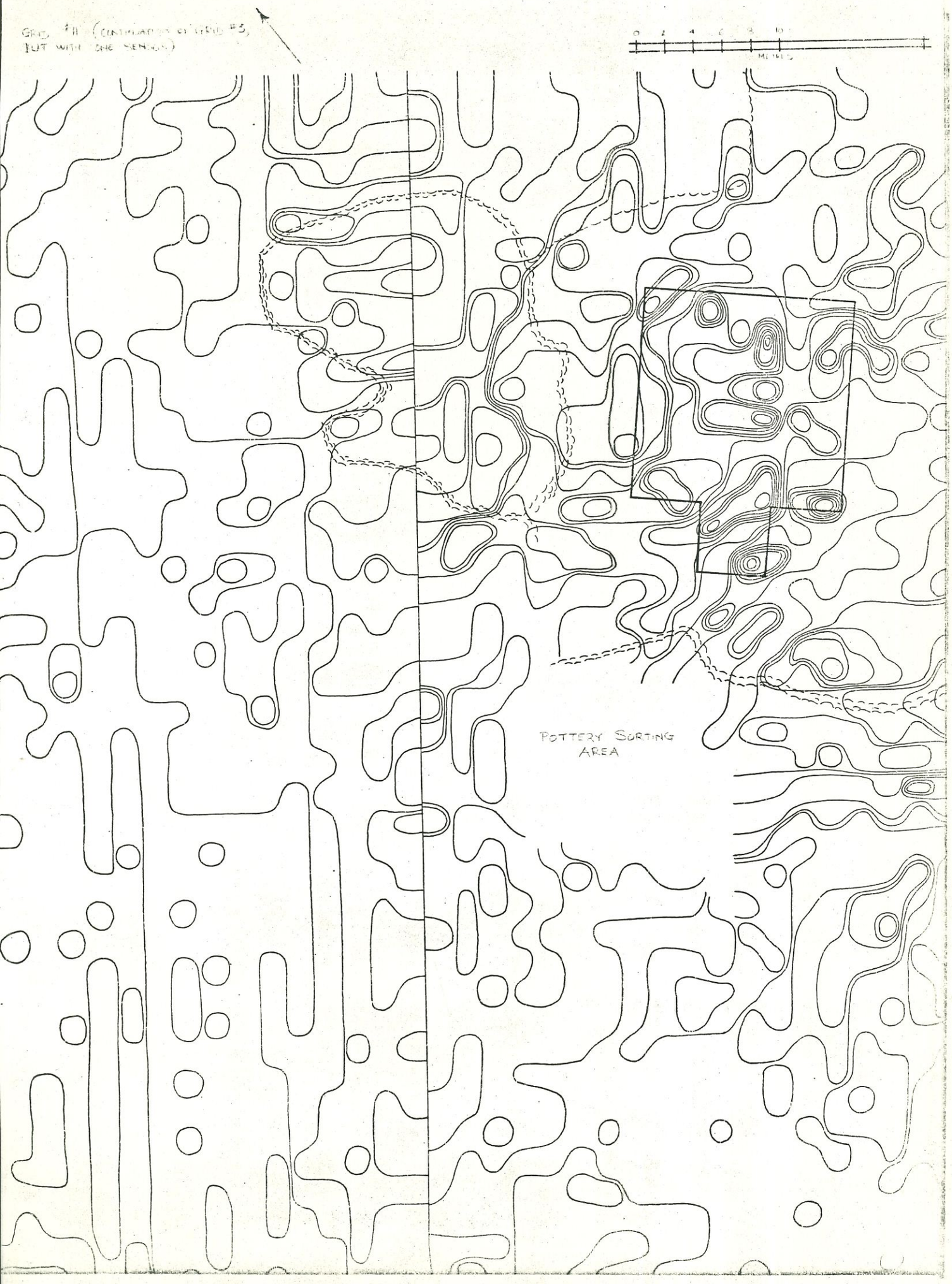
1) The pottery. A procedure was worked out for the initial handling of sherds in bulk, which provided a record of essential features without seriously impeding the progress of the work. The procedure was empirically based, but represents the realities of handling the material, and produced results which have immediate value for the interpretation of various aspects of the site. For although a one-period site the pottery repertoire varies considerably from area to area and even stratum to stratum. As an indication of the method the results from site K are included as a specimen, see Appendix 1.

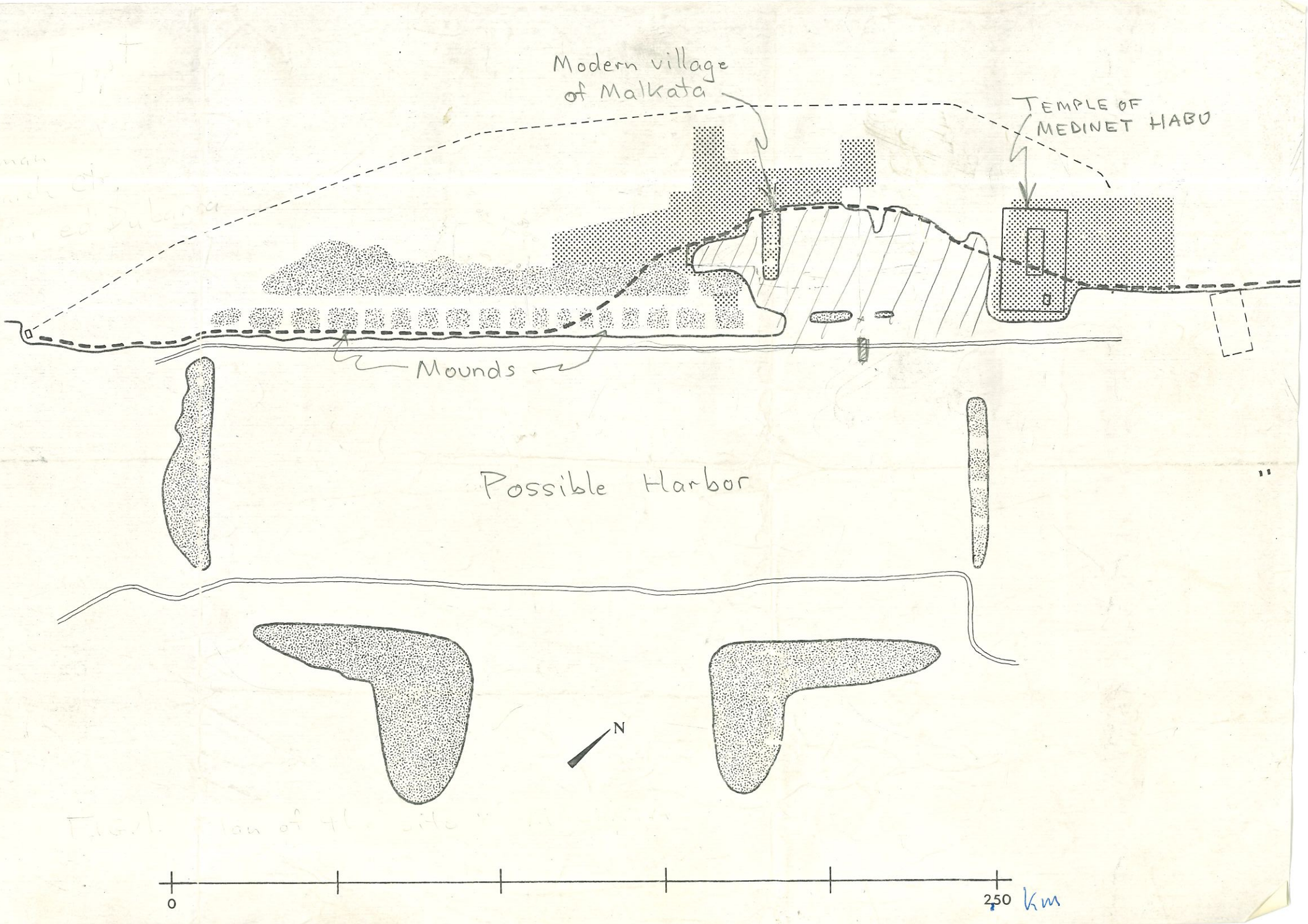
2) The painted plaster. Large amounts, in a very fragmented state were recovered from the rubble of site K. The expedition artist, Miss Concordia, made facsimiles of all distinctive pieces and a selection of the remainder, using a technique with crayons which accurately records both colours and textures. Her report is included as Appendix 2, but much work needs to be done on identifying the motifs present.

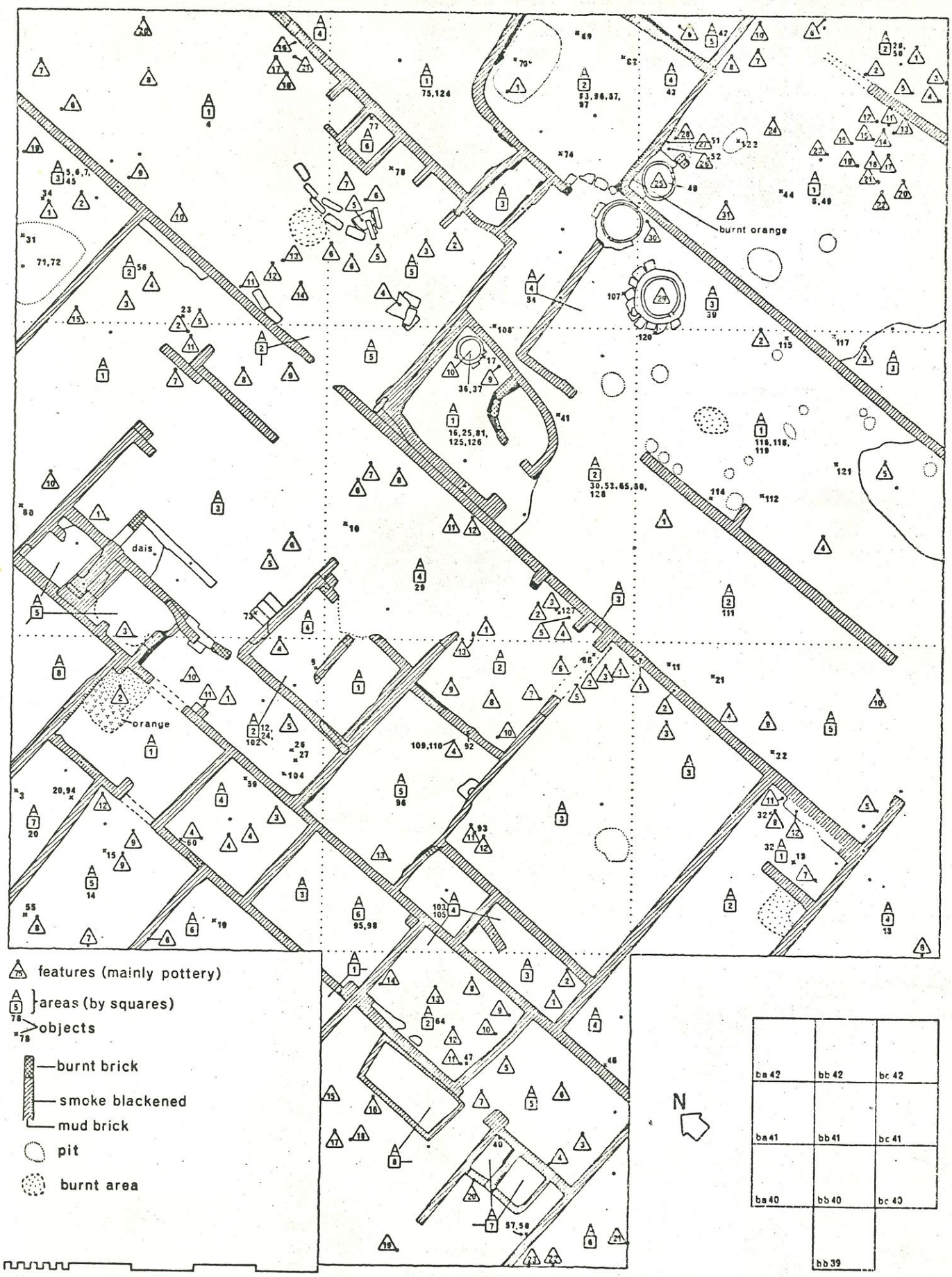
3) Bones and seeds. All the sites produced quantities of organic material, especially sites E and J. At the latter, particular care was taken with collection in view of the importance of having found a virtually uncontaminated site. Both sieving and floating were attempted. The Cairo Museum very generously allowed virtually all of the organic material to be retained by the Expedition, and it was subsequently shipped to the University of Cambridge. Delays in shipping meant that it did not arrive until late in the summer,

MALKATA GRID #3




GRID #11 (CONTINUATION OF GRID #3, BUT WITH ONE SENSOR)
0 2 4 6 8 10
METERS
POTTERY SORTING AREA


Modern village of Malkata
TEMPLE OF MEDINET HABU
Mounds
Possible Harbor
N
0
250 km



Site J : 1973 excavations
(Spot heights not yet added)

Ministry of Culture
Security Office

Investigation form for foreigners working with the Antiquities Services of U.A.R.

Name(Surname, father & Grandfather in Capital Latin letters) RALPH, PAUL JUSTUS, JUSTUS EDWARD

Nationality U.S.A. Religion Episcopalian

Date & Place of Birth 5 February 1921, Trenton, New Jersey, U.S.A.

Profession physicist

Address of residence in U.A.R. c/o Antiquities Service, Pennsylvania Expedition, Luxor (Malkata).

Date & No. of Passport 8 December, 1970 A2115165

Cause of visit Archaeological Research

Duration of visit 3 months

Which organization sent for you & why? University Museum, Pennsylvania Archaeological Research

What is your relation with the Antiquities Service? Working on expedition permitted by antiquities service

Where & what is your job now? Associate Director Applied Science Center for Archaeology, University Museum, Philadelphia, Pennsylvania

Do you belong to any foreign mission? Yes.

What mission is it? Pennsylvania Expedition, Luxor, Malkata

What is the address of that mission? c/o Antiquities Service, Pennsylvania Expedition, Luxor (Malkata)

For whom do you work here? Pennsylvania Expedition, Luxor (Malkata)

How long do you intend to stay? January 1, 1973 - March 30, 1973

Have you ever visited U.A.R.? When & why? August 1950, one night, en route from South Africa to Rome, Italy.

Who pays you and how much? Not salaried in Egypt

Any information about.....from the Antiquities Department.

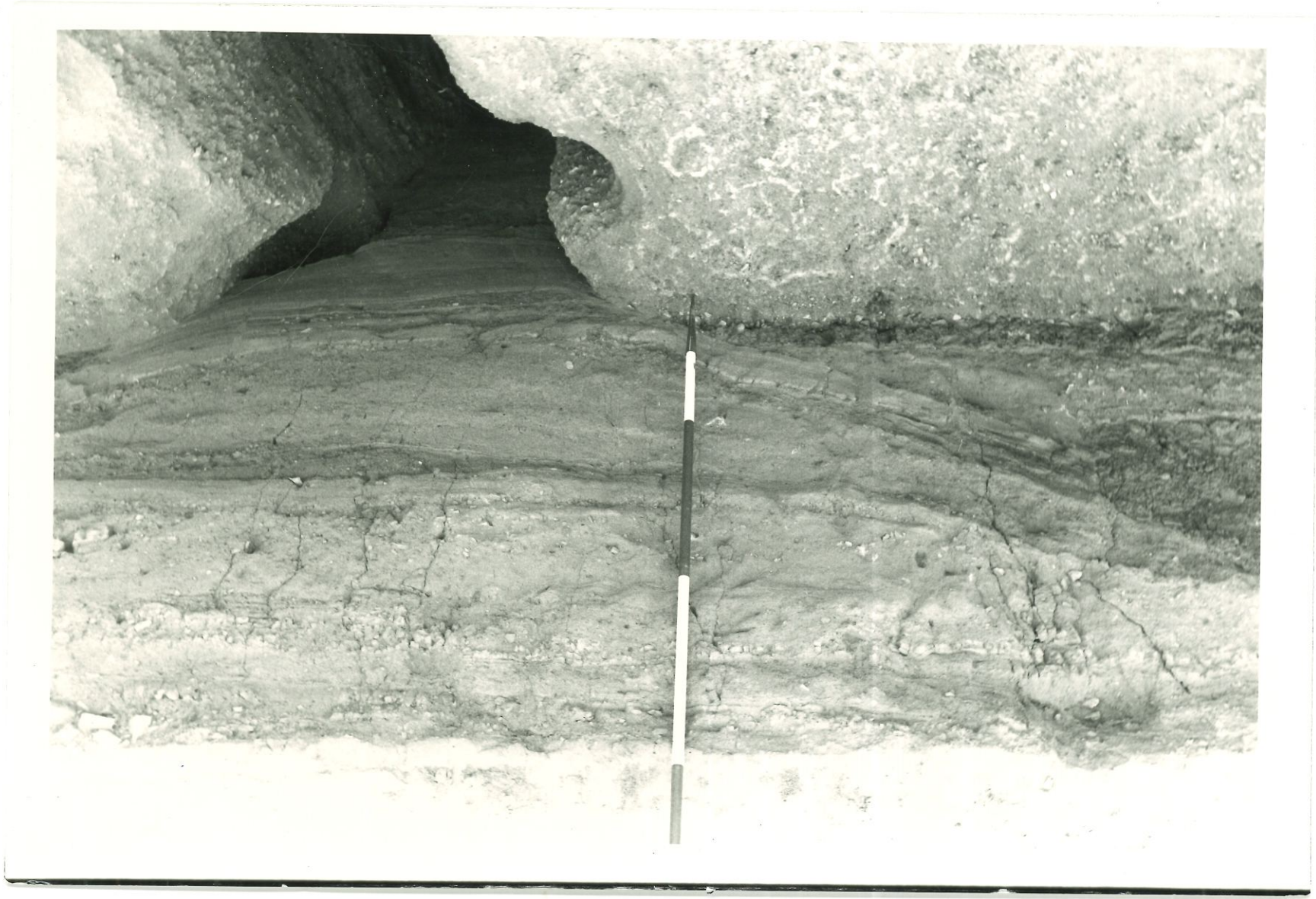
General Director.

Signature of the Foreigner

Site J

M73

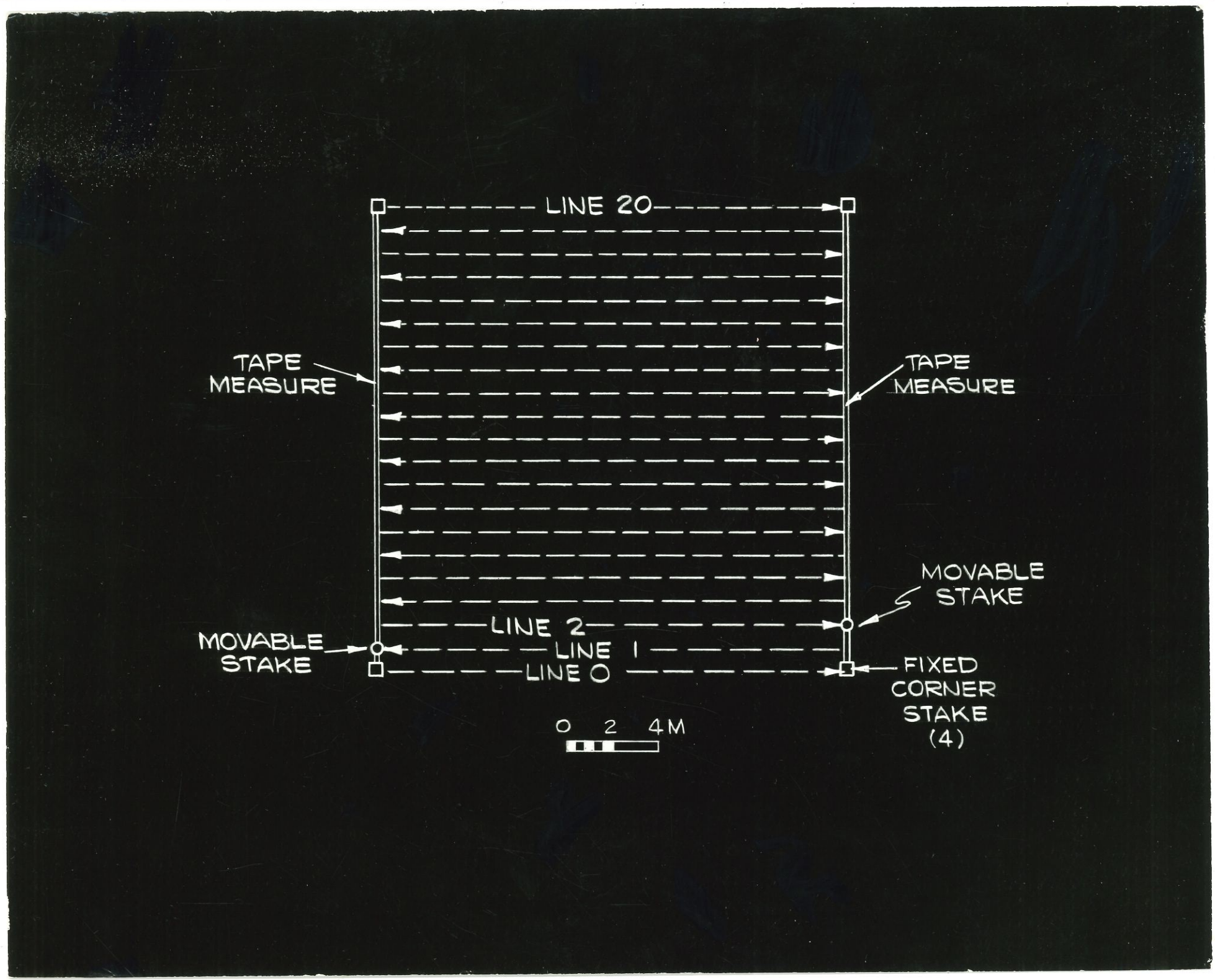
Trench JX1 containing the well. This picture is taking looking towards the well shaft itself.



Site J

M73

Trench JX1 containing the well. In this picture the channel is visible, with the twin grooves for a lifting device


LINE 20
TAPE MEASURE
TAPE MEASURE
MOVABLE STAKE
LINE 2
LINE 1
LINE 0
MOVABLE STAKE
FIXED CORNER STAKE (4)
0 2 4M

MASCA
Projects
Malkata, Egypt
Photographs
Figures

PHOTOS FIG.S (1 NEG FOR FIG 4.)

Fig. 2 Cesium Magnetometer and Crew at Malkata. Left to right: Hamedy with cable, Badauy with readout, Beth with notebook, and Zahkry with sensor.

Fig. 2 Cesium Magnetometer and Crew at Malkata. Left to right: Hamedy with cable, Badauy with readout, Beth with notebook, and Zahkry with sensor.

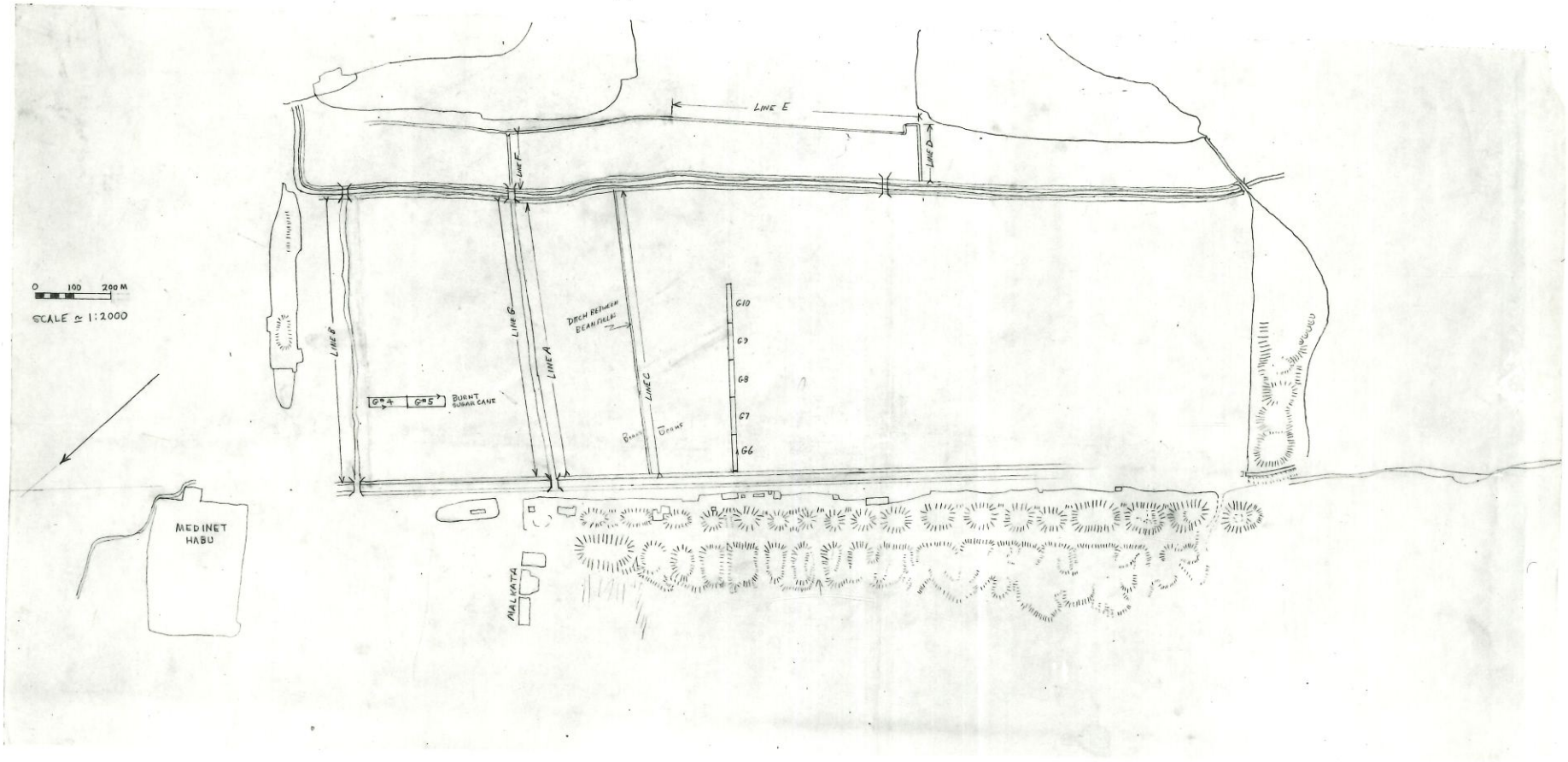
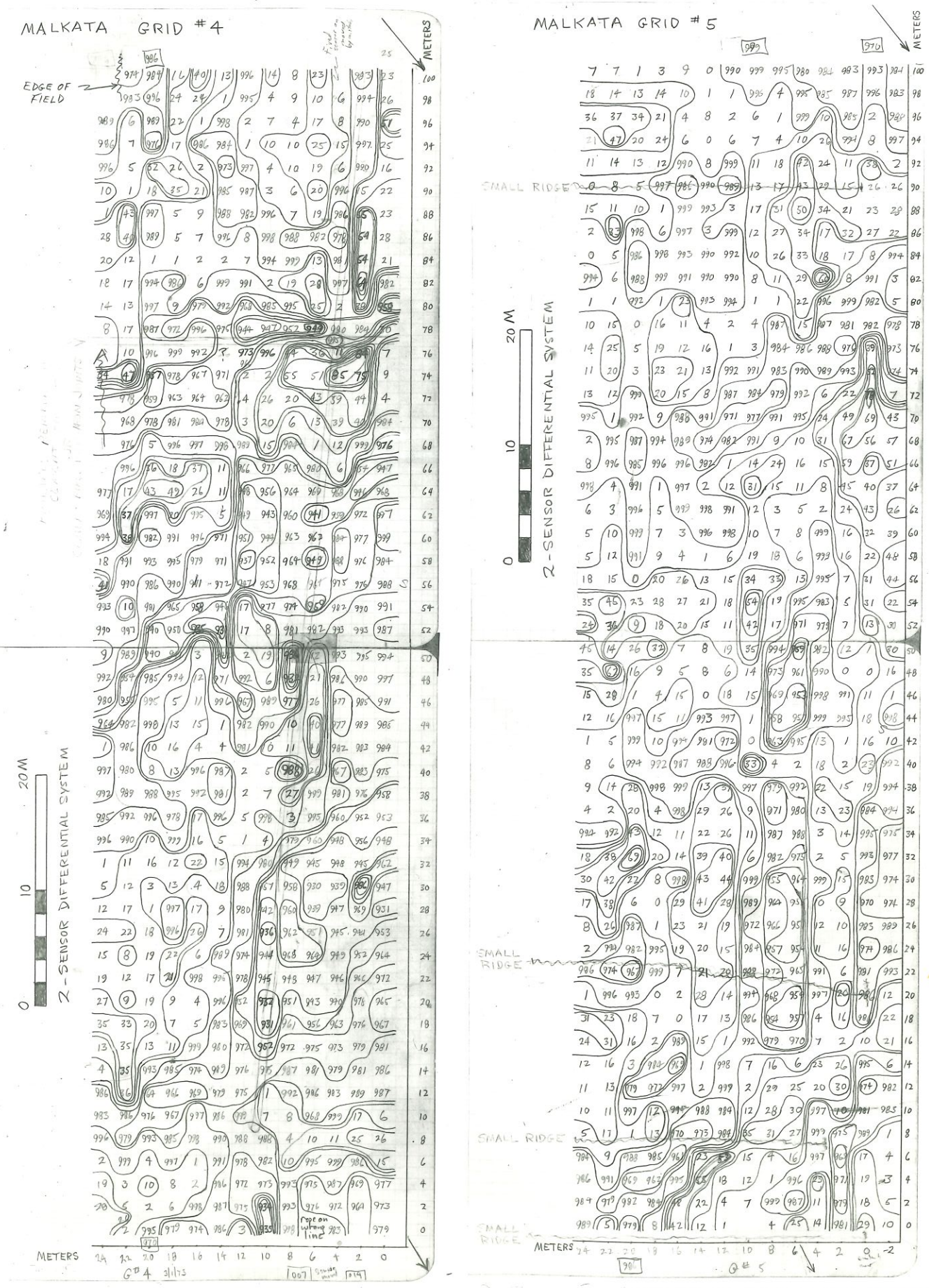


FIG. 4. Map of Malkata showing magnetometer lines and grids in "harbor" area.

FIGURE 7; GRIDS 4 AND 5



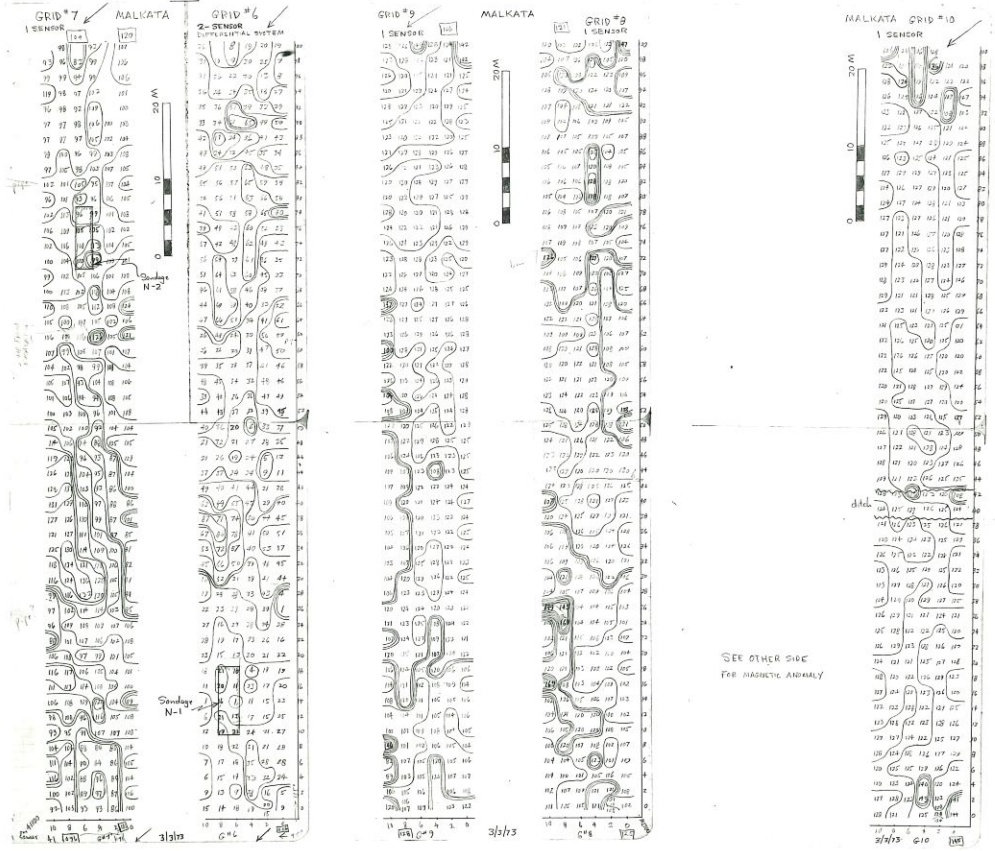


Fig. 7a
Photo of Grids
#6, 7, 8, 9, 10 together
8 x 10 print

FIG. 7a. Grids #6,7,8,9,10

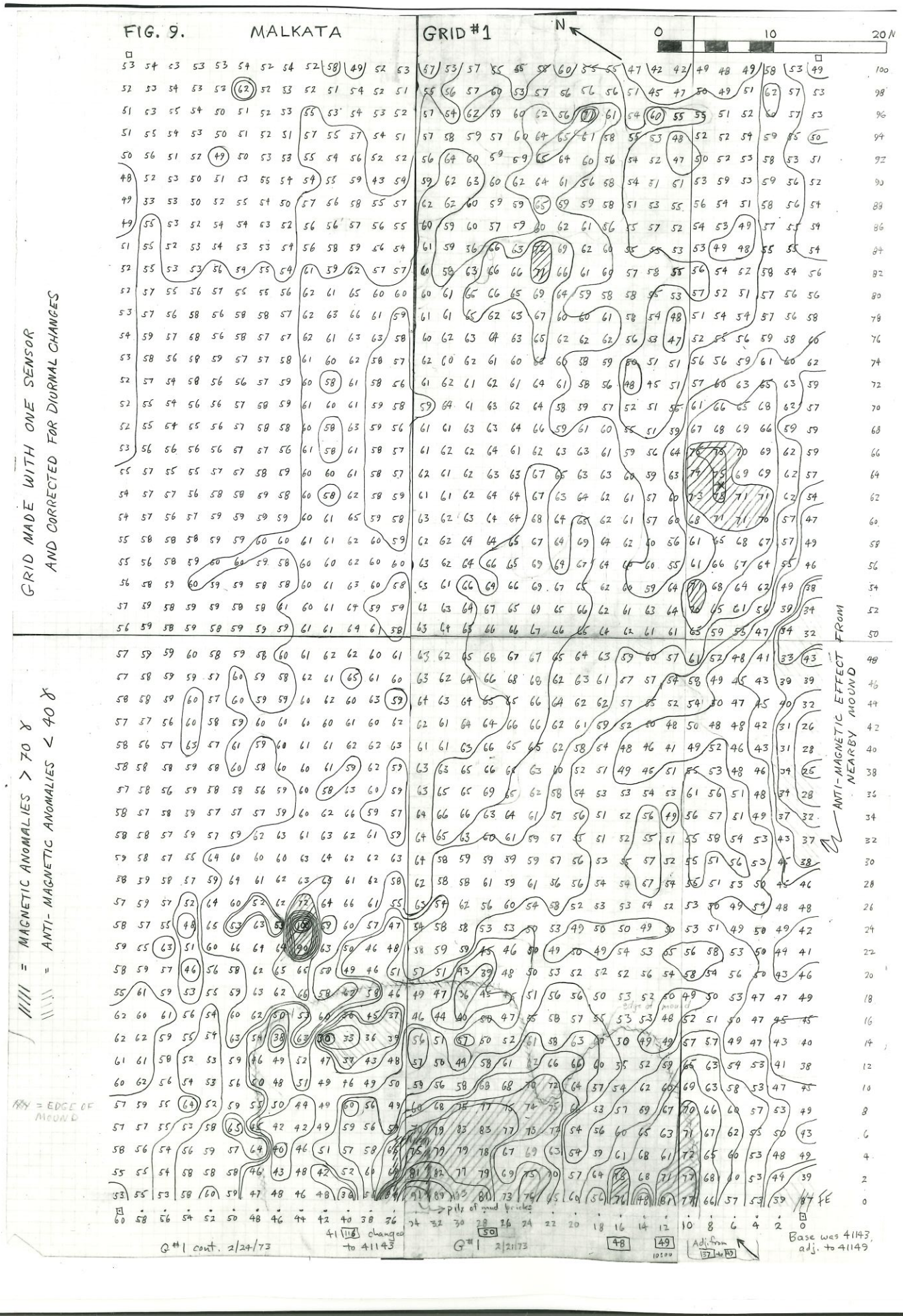
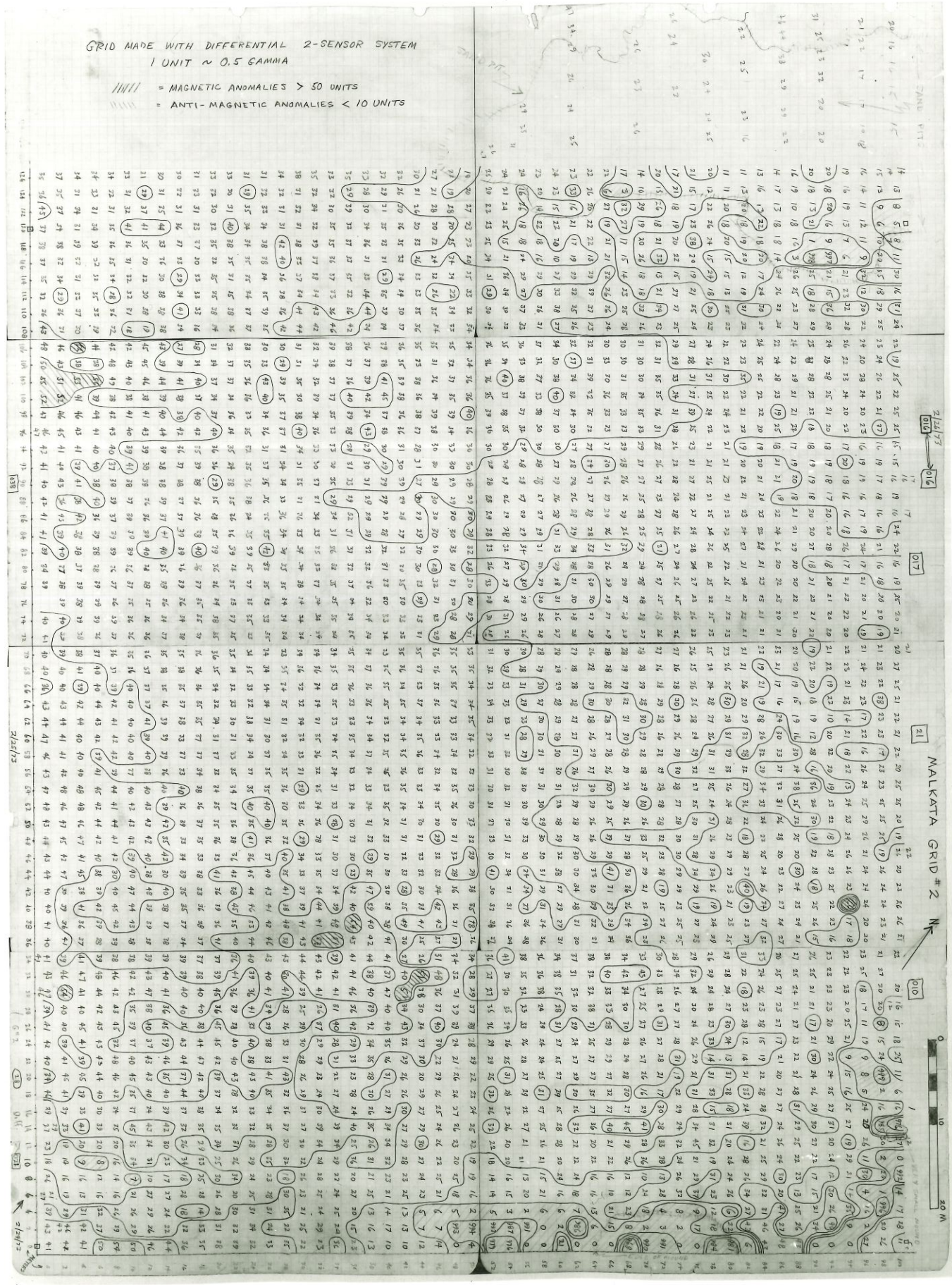


FIG. 9. MALKATA
GRID #1
N
0
10
20 N
GRID MADE WITH ONE SENSOR
AND CORRECTED FOR DIURNAL CHANGES
//// = MAGNETIC ANOMALIES > 70 γ
\\\\ = ANTI-MAGNETIC ANOMALIES < 40 γ
ANTI-MAGNETIC EFFECT FROM NEARBY MOUND
XXX = EDGE OF MOUND
Pits of sand bricks
edge of mound
41 118 changed to 41143
G#1 cont. 2/24/73
G#1 2/21/73
Adj. from 137 to 149
Base was 41143, adj. to 41149

FIG. 10. Grid No. 2



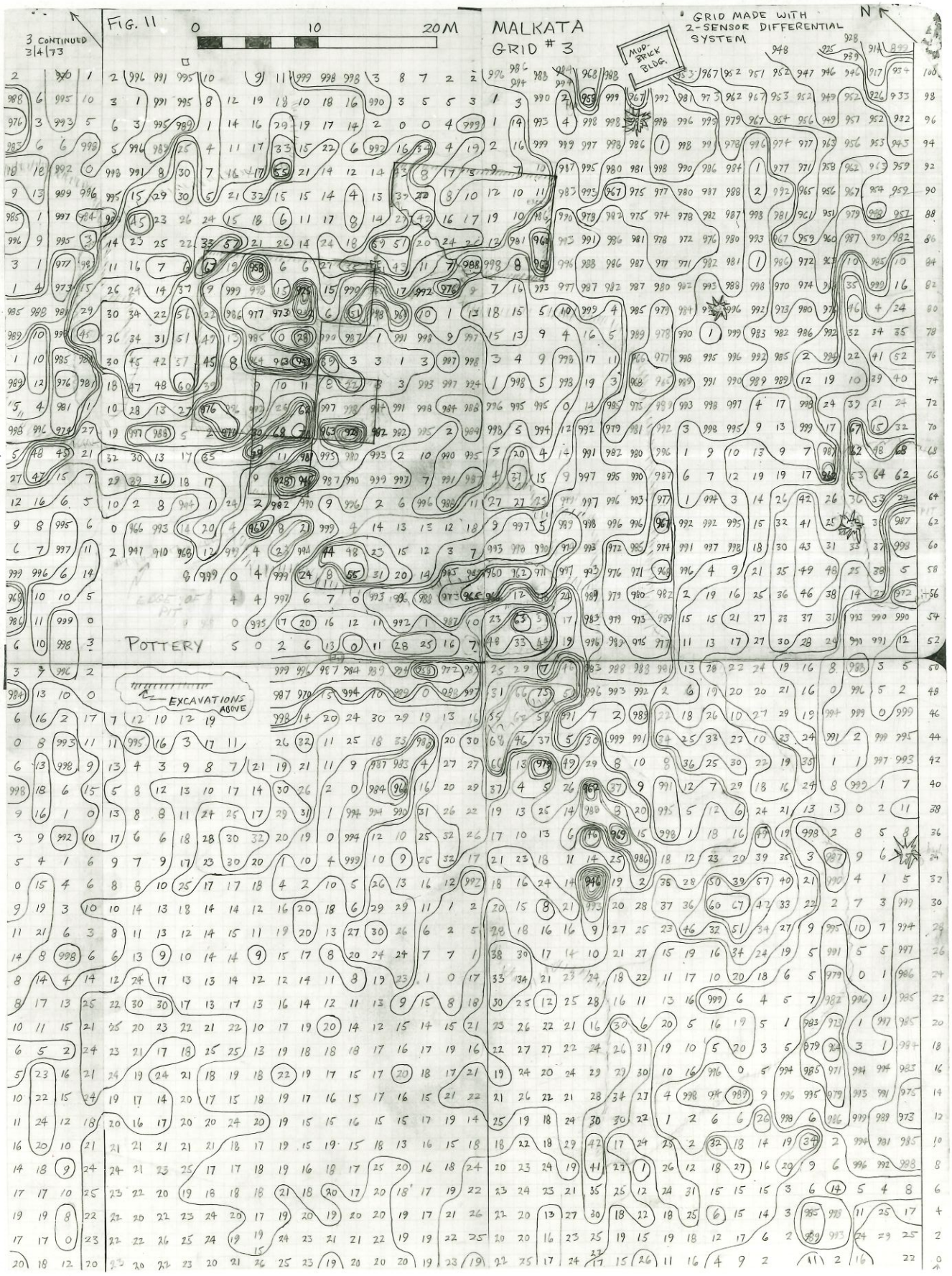


FIG. 11
0
10
20M
MALKATA
GRID # 3
3 CONTINUED
3/4/73
GRID MADE WITH
2-SENSOR DIFFERENTIAL
SYSTEM
N
MUD-BRICK BLDG.
POTTERY
EXCAVATIONS ABOVE

FIG. 12. Grid No. 11.

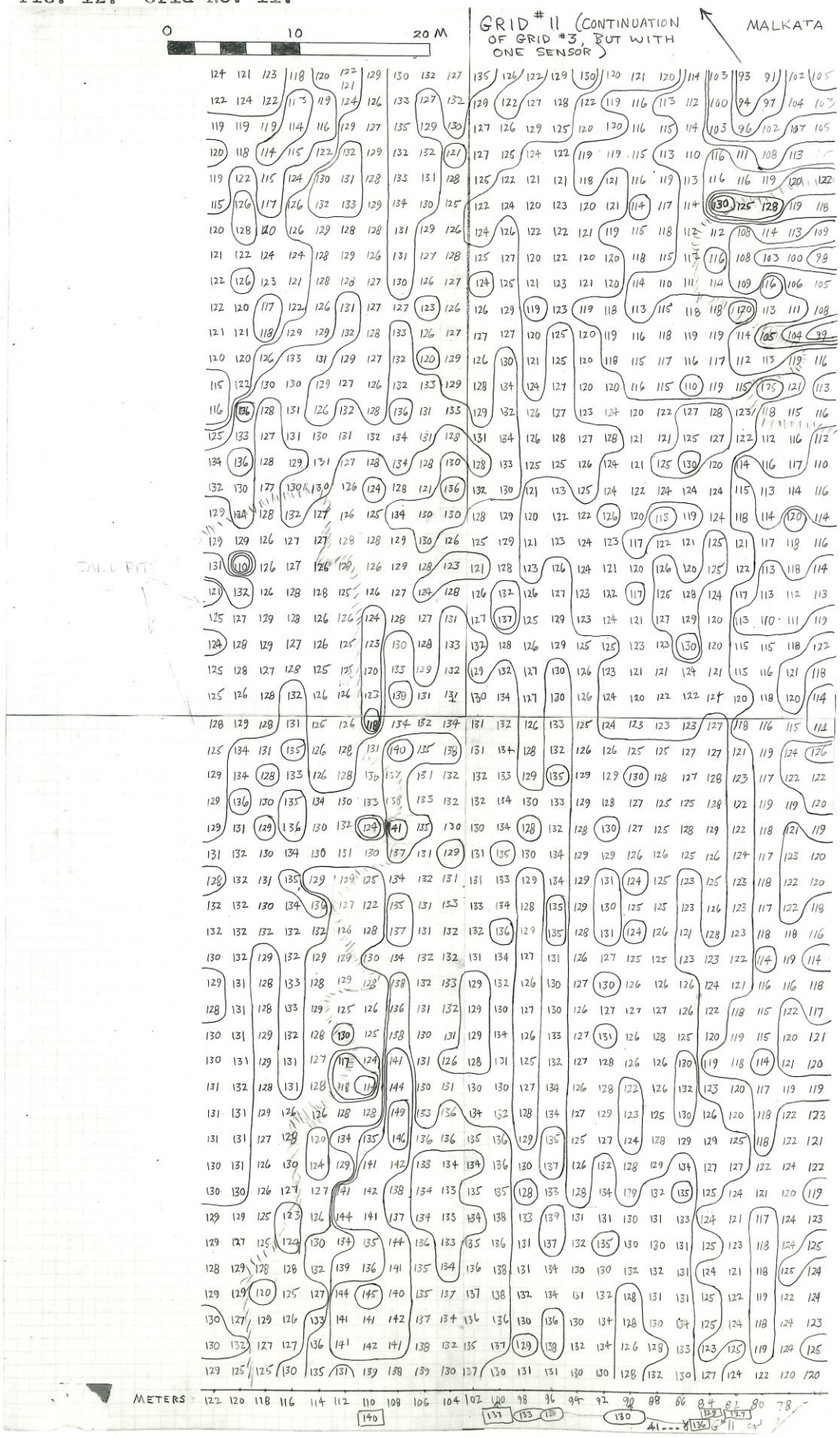
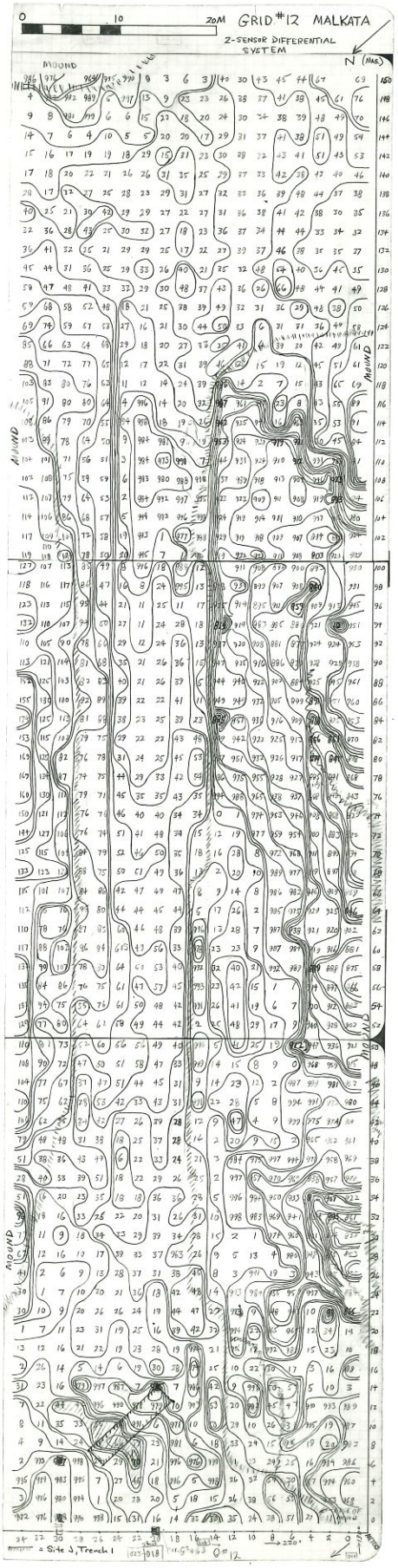


FIG. 13. Grid No. 12.



MASCA
MALKATA, EGYPT (FIG 2)