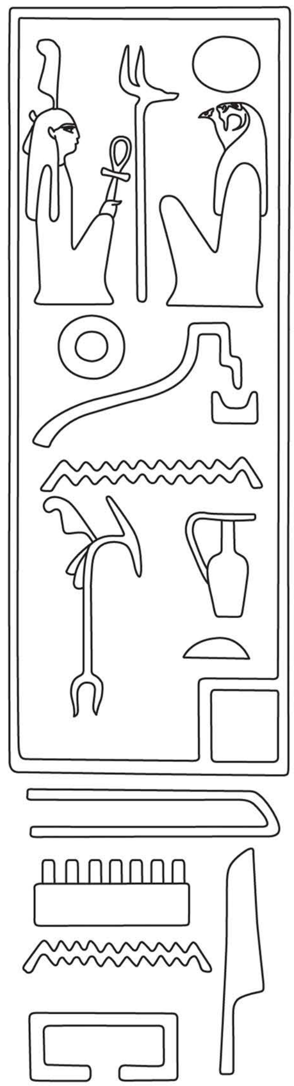
MEMNONIA

BULLETIN ÉDITÉ PAR L'ASSOCIATION POUR LA SAUVEGARDE DU RAMESSEUM



IV-V [1993-1994]

Hany Hellal, Stéphane Zantain, Mahmoud Aboushook

The first pylon of the Ramesseum: subsurface investigation.

THE FIRST PYLON OF THE RAMESSEUM : SUBSURFACE INVESTIGATION [Pl. XIV-XV]

Hany HELAL *, Stéphane ZANTAIN **
et Mahmoud ABOUSHOOK ***

INTRODUCTION

The Ramesseum temple, located on the west bank of the city of Luxor, stands at the limit between the Nile valley and the desert. This limit seems to be also a geological limit : the front of the temple is built on Nile alluvial fine deposits and the back on conglomerates. An outcrop of these conglomerates can be seen in the temple, at the level of the second court, 20 m., North from the Osiriac pillars.

Because of the asymmetric collapse of the pylon (only its eastern side has fallen down), an hypothesis was made by the CEDAE assuming that this geological limit could be parallel to the longer facade of the pylon and could pass right under it (see fig. 1). This foundation asymmetry could have explained the peculiar collapse of the pylon.

To check this hypothesis, it was necessary to know the exact stratification of the soil under the pylon. Therefore, a serie of eight mechanical boreholes has been drilled. In addition the drilling aimed to determinate more precisely the nature and the state of the pylon foundations. This report summarises the results and the analysis of these drilling campaigns.

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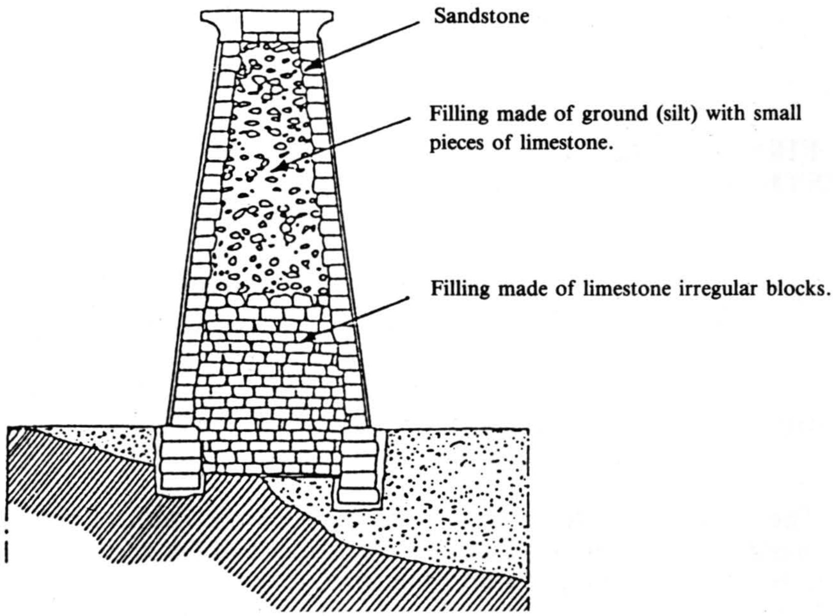

Fig. 1— Previous hypothesis concerning the geology under the pylon.

THE BOREHOLES SCHEME

In order to see if the nature of the underground was different on each side of the pylon, two boreholes were drilled in the west and two in the east between 10 m and 25 m away from the pylon (see fig. 2). In each case a deep drilling (more than 15 m) was made to try to reach the bed rock.

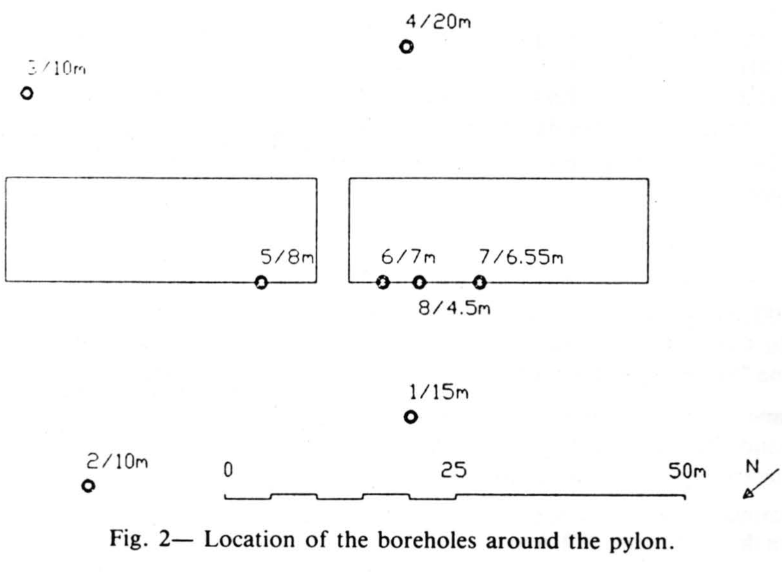

Fig. 2— Location of the boreholes around the pylon.

Boreholes have also been drilled in the foundation of the pylon itself (Pl. XIV). Unfortunately the eastern side of the foundation is covered with collapsed blocks of the eastern facade and therefore it was not possible to drill borehole on the side. Therefore, a serie of four boreholes has been drilled on the western side of the pylon. The drillings were inclined in order to try to reach the core of the foundation, and determine its nature.

THE BOREHOLES RESULTS

For each core, the nature of each soil was determined. Plate XV-A shows a core in the foundation, where the limit of the water table can be seen, while Plate XV-B shows the silty material of the subsoil. The analysis made on obtained cores are grouped in fig. 3.

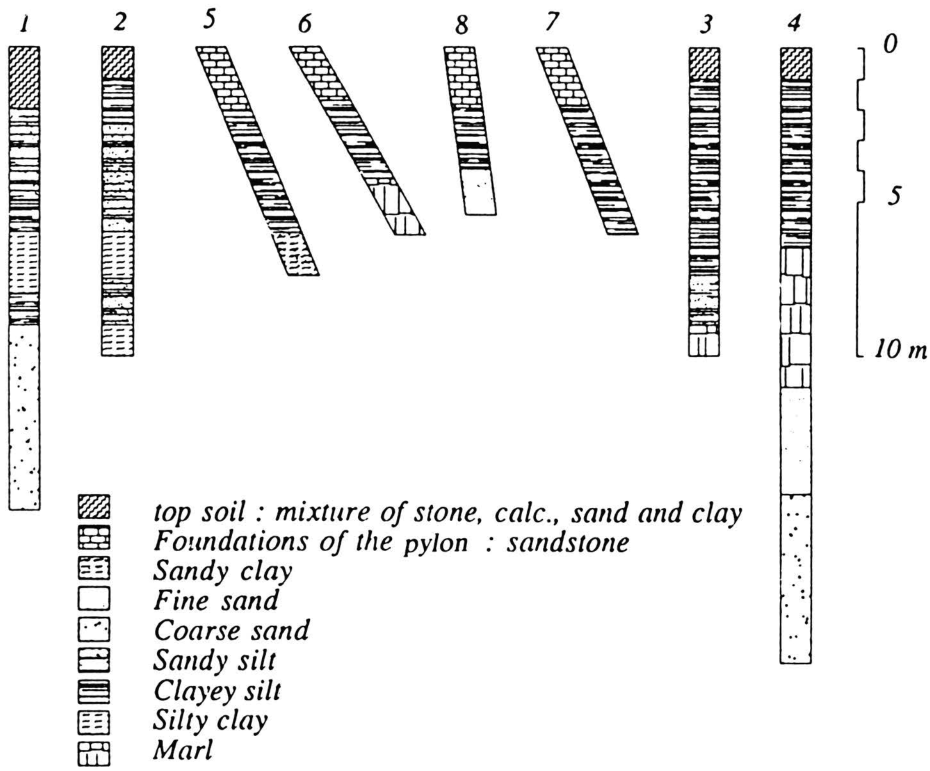

Fig. 3— Cross sections of the 8 drillings.

Each sample was analysed to determine its properties. Table 4 gives the results of the analysis.

As for the sand a granulometric study has been made and two types of sand were identified : coarse sand and fine sand.

Nature of the sample	borehole number	Water content in %	Volumic mass (dry) in gm/cm^3	Atterberg limits L.L in %	P.L in %	Unconfined compressive strength in kg/cm^2	Free swell in %	<micro in %
Silty clay	1					2 to 2,5		
	2	30	1,41	69,5	45,8	1 to 1,5	70	30,6
Clayey silt	1	29,8	1,6	78,1	43,6		40	14,7
	2	30,5	1,46	70,3	45,5	2 to 2,5	65	19,5
	3	29,1	1,5	65,8	38,5	1,5	60	10,7
	4	28,3	1,5	75,5	40,8	1 to 1,5	70	18,7
	5	30	1,5	75,5	42,8	1,5 to 2	70	18,6
	7	27,5	1,47	68,5	40,8	1,5 to 2,5	75	25,5
	8	30,07	1,48	70,5	52,8	3 to 3,5	60	14,7
Marl	4	76,5	1,58	65,8	30,5	1,5 to 2	70	18,7

Fig. 4— Results of the laboratory tests on the soils.

As for the foundations the same analysis was made.

Nature of the sample	borehole number	Water content in %	Volumic mass (dry) in gm/cm3	Unconfined compressive strength in kg/cm2
Foundation stone	5	5.2	1.8	60.2
	7	5.14	1.85	130.5
	8	6.5	1.8	90.2

Fig. 5— Results of the laboratory tests on the foundation stones.

DISCUSSION AND ANALYSIS

Typology of the sedimentation.

The results of the drillings are quite typical of river sedimentation with alternation of silt, sand and clay, probably distributed in lentils as no continuous layers can be observed. The comparison between the geological model of river deposit of fig. 6 and the deep boreholes [1] and [4] (see fig. 3) are relevant.

This type of lenticular sedimentation seems to be typical along the Nile valley. In 1960, L. Dubertret made a geological report on the region of Abu Simbel, for the French consulting engineering Company Coyne et Bellier, which was proposing at the time a project of huge weight protection dam around the temples (1). He was noticing : "major observation : the structure of the alluvial deposits of the Nile in their all, both that of the minor bed and that of the hight water, is indeed lenticular, and it is most probable that no bed of significant continuity or extension exist".

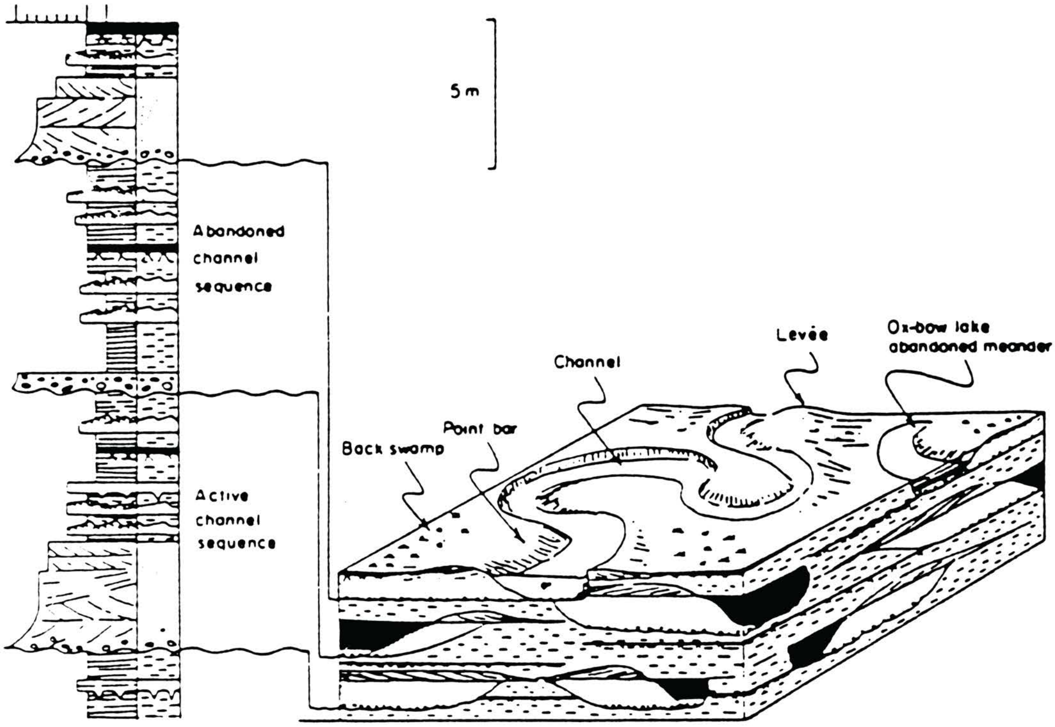

Fig. 6— Model of river sedimentation (with little inclined bed).
Ecole des Mines, B. Laumonier [1992].

Simplified sections of the geology under the pylon.

To simplify the vision of the soil under the pylon, a simple 2 dimensions model (cross sections) of the geology underneath the pylon was built.

In that purpose, the results of the analysis made on the samples were gathered, to see if global characteristic could be given to the various soil formations. As can be seen in the extensive results table, the characteristics were close for each nature of soil. In addition, the silty clay and the clay silt could be associated. Thus, two different soil formations were obtained : the silt-clay and the marl. It is worth also to notice that the properties of the marl are very close to that of the silt-clay except the water content. The average properties for the two types of soils are given in the following table.

Nature of the sample	Water content	Volumic mass (dry)	Atterberg limits		Unconfined compressive strength	Free swell	<micro
	in %	in gm/cm^3	L.L in %	P.L in %	in kg/cm^2	in %	in %
Silt - clay	29,4	1,49	72	44	1,96	70	19,12
Marl	76,5	1,58	65,8	30,5	1,5 to 2	70	18,7

State of the foundations

First, it has to be noticed that a 15 cm. layer was found right under the stone foundations. This technique which enable to drain water in clayey soils is still used nowadays.

Moreover, the value of the sandstone foundations compressive strength is very low (between 60,2 kg/cm^2 and 130,5 kg/cm^2). The Gebel Silsileh sandstone average compressive strength where the stones of the pylon come from is 200 kg/cm^2. Hence, the sandstone foundations can be called very degraded.

CONCLUSION

The analysis of the boreholes showed that the pylon is entirely built on the alluvial deposits of the Nile, away from the boundary between the alluvial deposits and the bed rock, as it was assumed before.

These alluvial deposits can be considered as a clay mud and silt with sand and marl lenses. Their average compressive strength is of 1,75 kg/cm^2. Knowing the initial height of the pylon (more than 20 m.) and its average density (between 1 and 2 gm/cm^3), this value of the underground strength seems to be very low. Further calculation has to be made to evaluate the pylon current stability taking into account the obtained results of the drilling.

As for the foundations, it was the first time that core samples from n ancient pylon foundation could be analysed precisely. It is now clear that the Ramesseum pylon foundations are superficial, and quite small with respect to the volume of the building. Besides, as no boreholes can be drilled on the western side of the pylon, further studies will be based on the symmetry of the pylon foundation.

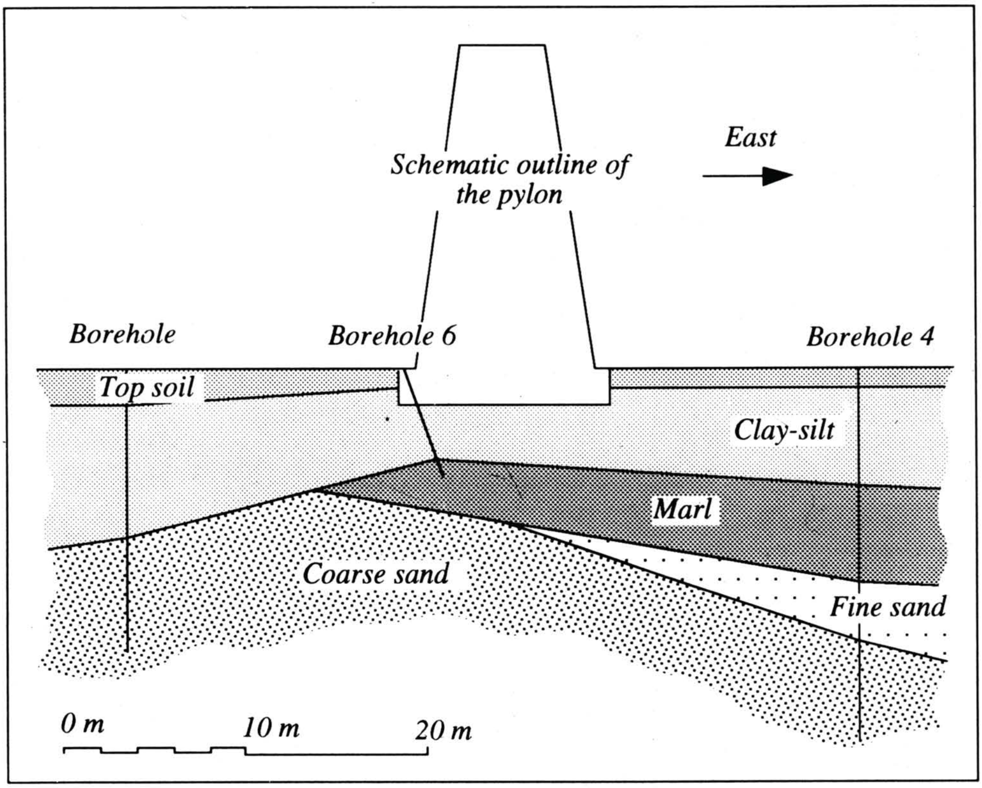

Fig. 7— Schematic section of the geology under the Southern mole of the pylon.

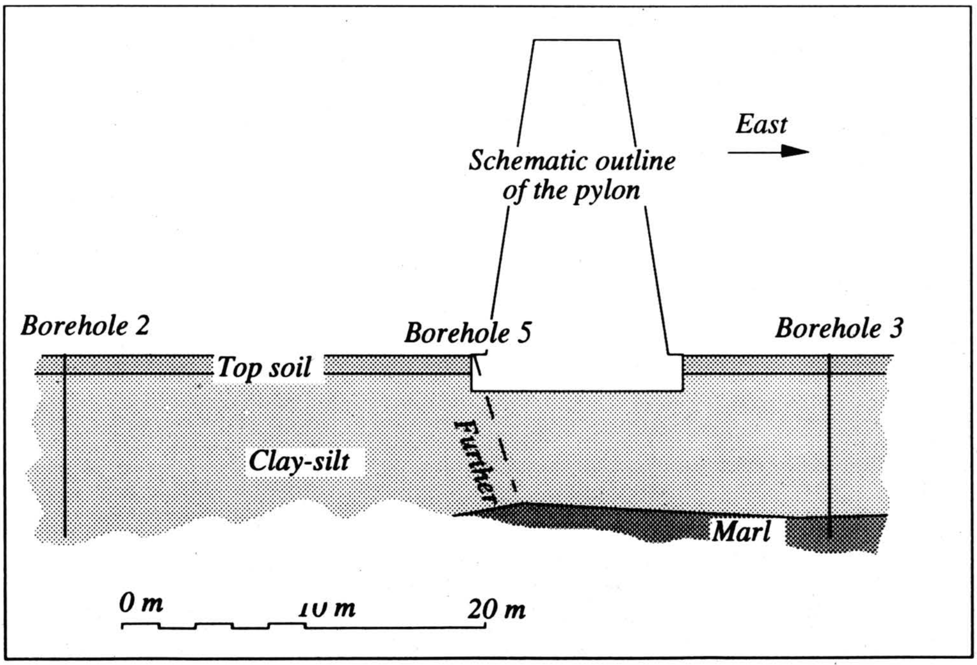

Fig. 8— Schematic section of the geology under the Northern mole of the pylon.

NOTE

(1) A. Coyne et J. Bellier, *Avant projet des ouvrages de protection des temples d'Abou Simbel* Paris [octobre] 1960.

planches

Inclined coring in the pylon foundation. [Cliché Hany Helal].

A.— Representative foundation core. [Cliché Hany Helal].

B.— Representative subsurface soils core. [Cliché Hany Helal].

TABLE DES MATIERES

Nouvelles et activités de l'Association

Etudes

Varia thebaïca

Supervision montage et impression : Moustapha Fayçal Soliman.