HAL
open science

PRELIMINARY RESULTS ON THE STUDY OF THE ORIENTATION OF THE TEMPLE OF RA-ATUM AT HELIOPOLIS AND THEIR HISTORICAL IMPLICATIONS (“Heliopolis Reports 1.1.”, ed. D. Raue)

Luc Gabolde, Damien Laisney

▶ **To cite this version:**

Luc Gabolde, Damien Laisney. PRELIMINARY RESULTS ON THE STUDY OF THE ORIENTATION OF THE TEMPLE OF RA-ATUM AT HELIOPOLIS AND THEIR HISTORICAL IMPLICATIONS (“Heliopolis Reports 1.1.”, ed. D. Raue). 2021. hal-03381302v1

HAL Id: hal-03381302

https://hal.science/hal-03381302v1

Preprint submitted on 16 Oct 2021 (v1), last revised 15 Sep 2024 (v2)

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

[Publication in Opensource as "Heliopolis Reports 1.1." End April 2018]

PRELIMINARY RESULTS ON THE STUDY OF THE ORIENTATION OF THE TEMPLE OF RA-ATUM AT HELIOPOLIS AND THEIR HISTORICAL IMPLICATIONS

Luc GABOLDE [1], *Damien LAISNEY* [2].

Abstract

A GPS campaign of measures on the site of Heliopolis was implemented in order to document precisely the orientation of the remaining structures of the temple of Atum and to determine the azimuth of its axis. This operation resulted in improved data which allowed to formulate some hypothesis about the date of the temple's foundation ceremony and its possible direct connexion with the sun rise on the date recorded in the Berliner Leather Roll during the reign of Senusret I.

Prolegomene

The study of the Egyptian temples' orientation is a field of researches which has already produced fruitful results [3]. However, reliable an accurate data on the precise azimuth of the archaeological remains is required before taking into account the possibility that this orientation was connected with potential astronomical events. A program labelled OrTempSol in the framework of the Labex-Archimede at Montpellier, led by L. Gabolde, was thus launched in 2013 with the aim to determine precisely the orientation of some of the Egyptian temples devoted to solar deities, along the same line of work already accomplished at Karnak [4] and at Tell el-Amarna [5]. The program focuses specifically on the temple of Atum at Heliopolis and the temple of Amun-Ra at Tanis [6]. The present chapter provides and summarizes the preliminary results obtained at Heliopolis.

---

1 Research director (DR2) at the French National Research Center (CNRS), UMR 5140 (CNRS – Université Paul-Valéry Montpellier 3), Archéologie des sociétés méditerranéennes, Montpellier-Lattes. E-mail : luc.gabolde@cnrs.fr.

2 Research ingeneer at the French National Research Center (CNRS), Maison de l'Orient et de la Méditerranée, FR 3747, Lyon. E-mail : dlaisney@gmail.com.

3 M. Shaltout, J.-A. Belmonte, 'On the Orientation of Ancient Egyptian Temples: (1) Upper Egypt and Lower Nubia', *JHA* 36 (2005), 273-298; M. Shaltout, J.-A. Belmonte, 'On the Orientation of Ancient Egyptian Temples: (2) New Experiments at the Oases of the Western Desert', *JHA* 37 (2006), 173-192; M. Shaltout, J.-A. Belmonte, M. Fekri, 'On the Orientation of Ancient Egyptian Temples: (3) Key Points at Lower Egypt and Siwa Oasis, Part I', *JHA* 38 (2007), 141-160; M. Shaltout, J.-A. Belmonte, M. Fekri, 'On the Orientation of Ancient Egyptian Temples: (4) Epilogue in Serabit el Khadem and Overview', *JHA* 39 (2008), 181-211. S. Cauville, with É. Aubourg, P. Deleuze, A. Lecler, 'Le temple d'Isis à Dendera', *BSFE* 123 (1992), 31-48; see also É. Aubourg, 'La date de conception du zodiaque du temple d'Hathor à Dendara', *BIFAO* 95 (1995), 1-10.

4 L. Gabolde, *Le "grand château d'Amon" de Sésostris Ier à Karnak*, *MAIBL* 17 (1998), sp. 123-137; L. Gabolde, 'Mise au point sur l'orientation du temple d'Amon-Rê à Karnak en direction du lever de soleil au solstice d'hiver', *Les cahiers de Karnak* XIII (2010), 243-256.

5 L. Gabolde, "'L'horizon d'Aton", exactement ?', *Verba Manent. Recueil d'études dédiées à Dimitri Meeks*, *CENiM* 2, 2009, 145-157. E. Castle has recently raised objections on the hypothesis that the foundation ceremony recorded in the year 5 and year 6 stelae could have been related to the small temple of Aten, arguing rightly that the great temple (*pr-Ỉtn*) was indeed mentioned in the text of stele K (E. Castle, 'The Foundation Ceremony at Akhetaten', *SAK* 44 (2015), 43-82). However, this occurrence is rather far from the descriptions of the foundation ceremony rites, which, thus, may as well have concerned the small temple of Aten.

6 Another mission aiming to survey the orientation of the great Amun temple at Tanis was conducted from the 24th to the 27th of May 2016. The results were conclusive and suggest a foundation ceremony occurring on the New-Year's day 1 *akhet* I, of the first regnal year of Psusennes I, corresponding to the 10th May in Julian calendar (= 30th April in gregorian calendar) of the year 1039 BC (=-1038). It was also a new moon. See L. Gabolde, D. Laisney, F. Leclère, Fr. Payraudeau, 'L'orientation du temple d'Amon-Rê à Tanis : données topographiques et archéologiques, hypothèses astronomiques et conséquences historiques', *in Hommages à Christiane Zivie-Coche* in print.

Aknowledgements

The mission was conducted with the financial support of the Labex-Archimede [7]. It benefitted of the scientific and logistical support of the joined mission of the Ministry of Antiquities of the Arab Republic of Egypt and of the Leipzig University Museum at Matariya / Heliopolis, of which it was part of, under the direction of Aiman Ashmawy and of Dietrich Raue. A differencial GPS was very kindly lent by the IFAO.

The surveying operations carried out on-site (fig. 1)

The main mission was conducted at Heliopolis from the 2nd to the 4th March 2014. Participants were L. Gabolde and D. Laisney with the extensive collaboration of the members of the Egyptian-German team.

Significant topographical points were taken on various parts of the site with the differential GPS, 170 :

— 56 on the western part which may correspond to the entrance
— 13 on the remains of the two southern precinct walls
— 6 on the standing obelisk of Senusret I
— 1 on the naos base near the obelisk
— 2 at the limits of the "high sand"
— 8 on the gate of Ramses III at Tell el Hisn
— 35 on the northern ruins of Tell el Hisn, on the site of the column of Menrenptah and on the remaining portion of the precinct wall.
— Existing stations were also recorded and reported on the new topographical grid.

The historical records and surveys

Various plans generated during previous archaeological or historical researches were gathered and scanned in order include them in the new grid :

Description de l'Egypte, *Antiquités* V, pl. 26, 1.
Ravioli 1841 (Raue, *Heliopolis*, pl. 5)
Hekeykian (British Library Additional Manuscripts 37458.20-21)
Lepsius, *Denkmaeler*, I, pl. 55.
Petrie's excavations, *Heliopolis*, Pl. I & II.
Abd el-Aziz Saleh, *Tell el Hisn*, pl. VI, fig. 6.
Cadastral map of Cairo.
Survey of Egypt 1/5 000 1977-78
Views from Googlemap.

[7] Labex-Archimede Montpellier, program 'Investissement d'Avenir', ANR-11-LABX-0032-01 AAP 2, 2014, Axe 2 'Pouvoirs : Espaces de pouvoirs et constructions territoriales'; 'OrTempSol' project (Orientation des Temples à divinité Solaire en Égypte).

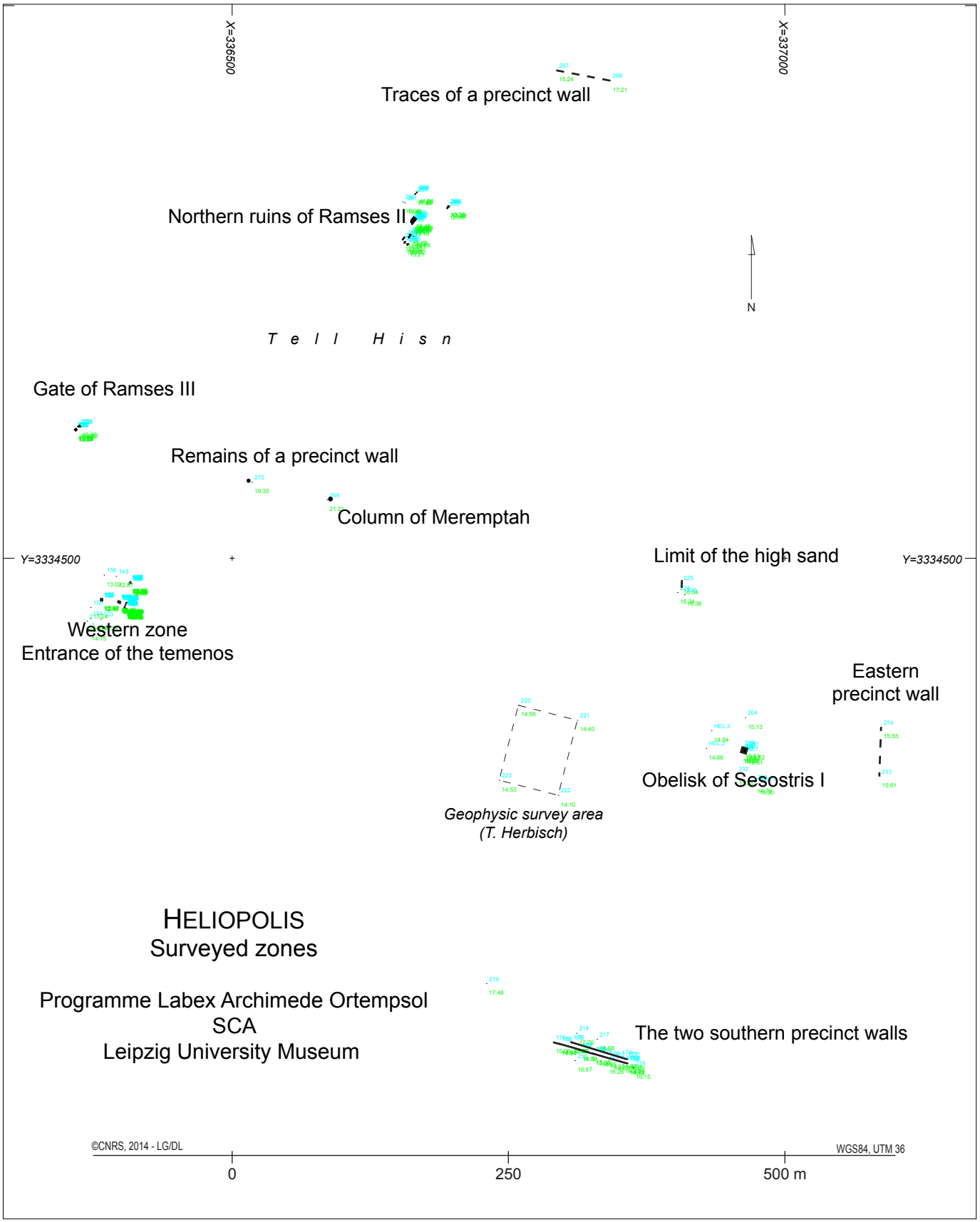


Fig. 1. Map showing the location of the structures surveyed by the mission OrTempSol.

The new archaeological grid

A new archaeological map was thus drawn by D. Laisney compiling the old and new data and providing the orientation of various structures (fig. 2)

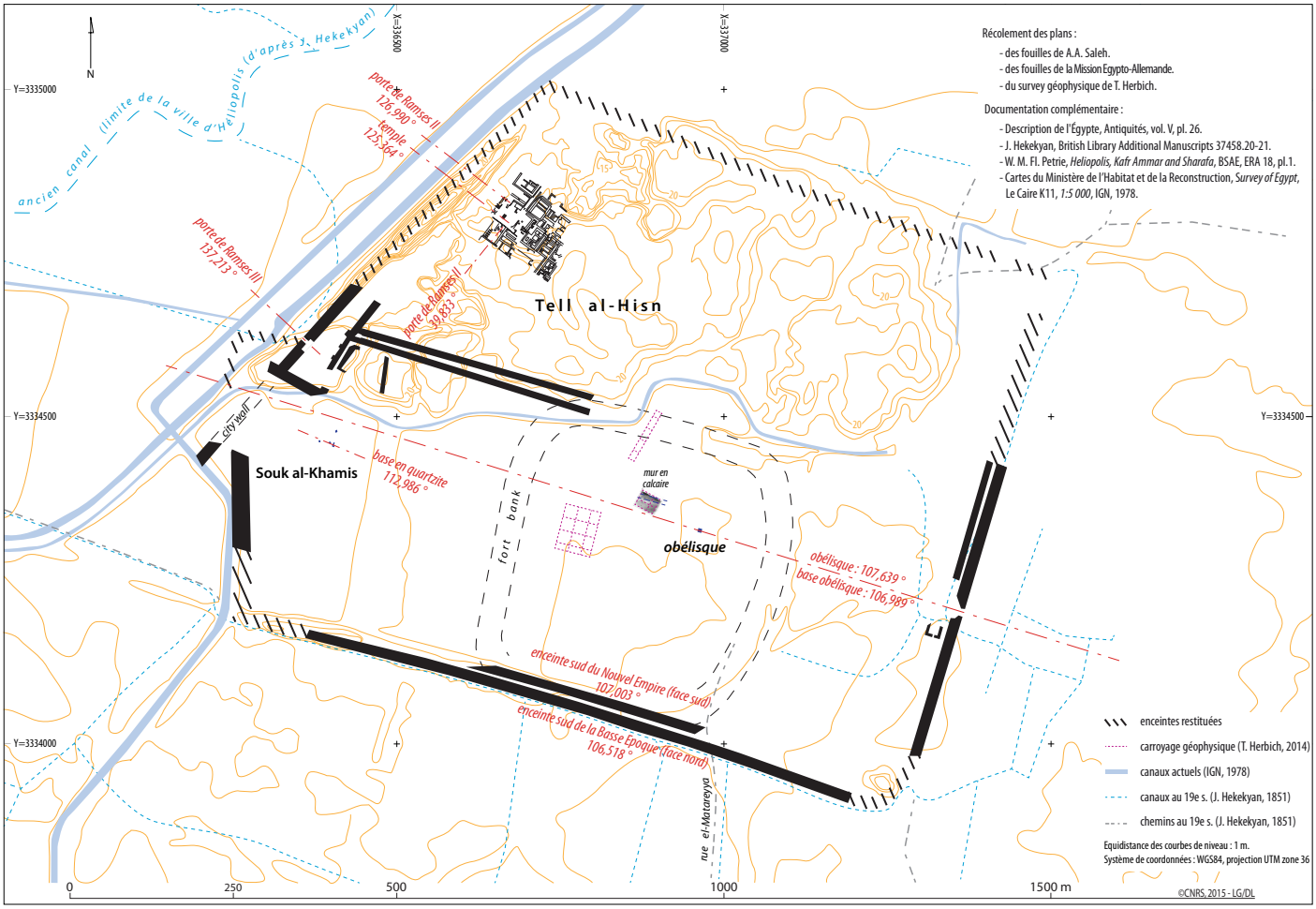


Fig. 2. The new archaeological grid realized by D. Laisney (OrTempSol Mission, Labex Archimède, Montpellier)

The results of the study of the orientations of the archaeological structures at the site.

The data related to the topographical orientation of the different archaeological structures at the site were then noted in detail on the new grid (fig. 3)

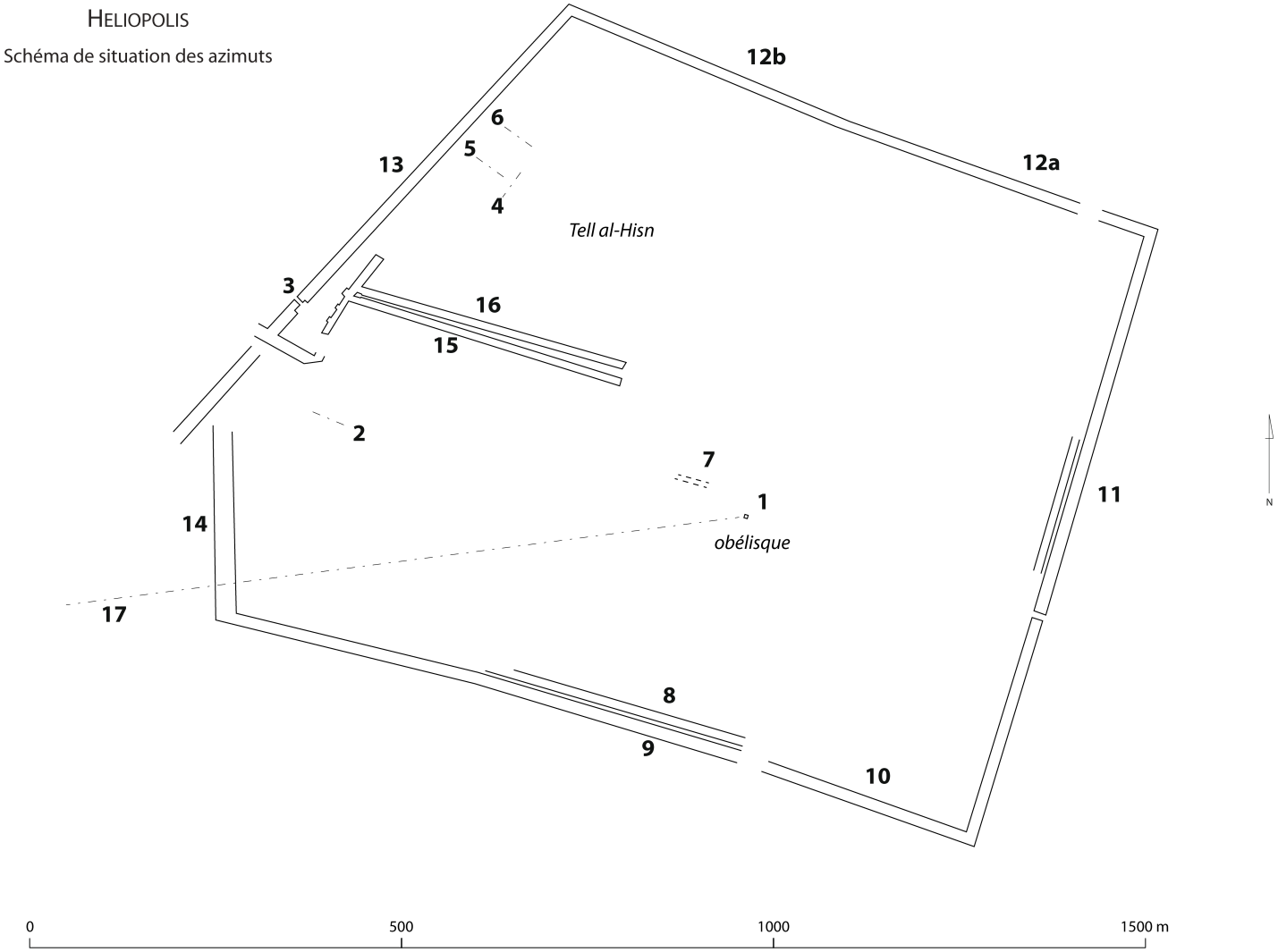


Fig. 3. Sites of the different archaeological structures which orientation could be determined and recorded during the 2014 mission.

The precise orientation of the surveyed structures is summarized in the following table 1.

Site	Azimut (in dec. Degrees)	Kind of azimut determination	Number on the map	Sources
Axis of the obelisk (Senusret I)	107.639	Measured *in situ* in 2014	1	Survey by D. Laisney
Base of the obelisk (modern)	106.989	Measured *in situ* in 2014	1	Survey by D. Laisney
Axis of the temple south of the obelisk	109.591	Graphical measure	1	J. Hekekyan (1851)
Corrected axis of the temple (north of the obelisk)	107.004	Graphical measure	1	L. Horner (1855)
Limestone wall (west of the obelisk)	105.205	Measures deducted from the survey *in situ* in 2014	7	Geophysical survey by T. Herbich (2014)
South New Kingdom Precinct wall (southern face)	107.003	Measured *in situ* in 2014	8	Excavations Ashmawy-Raue (2014); survey by D. Laisney

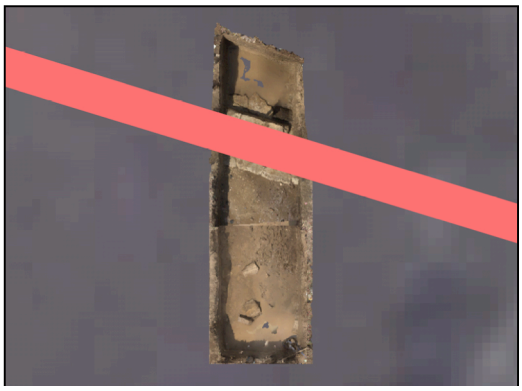
South New Kingdom Precinct wall	106.704	Graphical measure	8	W. M. Fl. Petrie (1911-1912)
South Late Period precinct wall (northern face)	106.518	Measured *in situ* in 2014	9	Excavations Ashmawy-Raue (2014); survey by D. Laisney
South Late Period precinct wall (western part)	104.905	Graphical measure	9	W. M. Fl. Petrie (1911-1912)
South precinct wall (western part)	103.207	Graphical measure	8 et 9	J. Hekekyan (1851)
South precinct wall (western part)	110.007	Graphical measure	8 et 9	Description de l'Égypte (1798-1802)
South Late Period precinct wall (eastern part)	108.685	Graphical measure (turned by 90°)	10	W. M. Fl. Petrie (1911-1912)
South precinct wall (eastern part)	106.334	Graphical measure	10	Description de l'Égypte (1798-1802)
Eastern precinct wall	106.706	Graphical measure (turned of 90°)	11	W. M. Fl. Petrie (1911-1912)
Eastern precinct wall	105.765	Graphical measure (turned by 90°)	11	Description de l'Égypte (1798-1802)
Northern precinct wall (south of Tell al-Hisn)	102.810	Graphical measure	15 et 16	J. Hekekyan (1851)
Northern precinct wall (southern wall)	107.385	Graphical measure	15	W. M. Fl. Petrie (1911-1912)
Northern precinct wall (northern wall)	105.988	Graphical measure	16	W. M. Fl. Petrie (1911-1912)
Quartzite base (Souk al-Khamis)	112.986	Measured *in situ* in 2014 (turned by 90°)	2	Excavations Ashmawy (2007-2008), survey by D. Laisney
Northern precinct wall (western part)	112.748	Graphical measure	12a	Description de l'Égypte (1798-1802)
Northern precinct wall (eastern part)	108.726	Graphical measure	12b	Description de l'Égypte (1798-1802)
Northern precinct wall	118.000	Data published by W. M. Fl. Petrie	12a et 12b	W. M. Fl. Petrie (1911-1912)
Western precinct wall (northern part)	133.609	Graphical measure (turned by 90°)	13	Description de l'Égypte (1798-1802)
Western precinct wall (northern part)	131.977	Graphical measure	13	W. M. Fl. Petrie (1911-1912)
Gate of Ramses III (Tell al-Hisn)	137.213	Measured *in situ* in 2014	3	Excavations A. A. Saleh (1976-1981)
Gate of Ramses II (Tell al-Hisn)	129.833	Measured *in situ* in 2014 (turned of 90°)	4	Excavations A. A. Saleh (1976-1981)
Temple (Tell al-Hisn)	125.364	Measured *in situ* in 2014	5	Excavations A. A. Saleh (1976-1981)
Gate of Ramses II (Tell al-Hisn)	126.990	Measured *in situ* in 2014	6	Excavations A. A. Saleh (1976-1981)
Western precinct wall, southern part	84.662	Graphical measure (turned by 90°)	14	Description de l'Égypte (1798-1802)
Western precinct wall, southern part	92.618	Graphical measure	14	J. Hekekyan (1851)
Western precinct wall, southern part	89.499	Graphical measure	14	W. M. Fl. Petrie (1911-1912)

Table 1. The geodesic orientations of the various structures identified on-site or adjusted on the grid from earlier publications (the decimals are only for calculation and they have no significance for the exactness of the buildings' orientation taken into account the actual accuracy of the field measures and the poor state of the remains.)

The mission of 2017 [8] has led to the discovery of the remains of a segment of a new limestone wall to the west-northwest of the obelisk, adding a new measure to the series (fig. 4-5-6) :

Segment of limestone wall found in situ in march 2017	≈ 106.50	Measured in situ by D. Raue 2017	7	Excavations SCA / Mus. Univ. Leipzig (2017)

Fig. 4-5-6. The segment of wall discovered in 2017 W-N-W of the obelisk (area 211) and it's general orientation. Photos D. Raue.



Among this series of measures, we have isolated those which are the most useful for our topic (i.e. the orientation of the temple of Atum, especially the buildings of Senustret I and the New Kingdom structures) and we balanced them taking into account their proper individual reliability (table 2).

[8] Since 2016, the mission has worked in cooperation with Kai-Christian Bruhn and the University of Applied Sciences / Mainz.

Site	Azimut (in dec. degrees)	Kind of azimut determination	Number on the map	Sources
Axis of the obelisk (Senusret I)	107.639	Measured *in situ* in 2014	1	Survey by D. Laisney
Corrected axis of the temple (north of the obelisk)	107.004	Graphical measure	1	L. Horner (1855)
Limestone wall (west of the obelisk)	105.205	Measures deducted from the survey *in situ* of 2014	7	Geophysical survey by T. Herbich (2014)
Segment of limestone wall found in situ in march 2017	≈ 106.50	Measured *in situ* in 2017	7	Excavations SCA / Mus. Univ. Leipzig (2017)
South New Kingdom Precinct wall (southern face)	107.003	Measured *in situ* in 2014	8	Excavations Ashmawy-Raue (2014) ; survey by D. Laisney
South New Kingdom Precinct wall	106.704	Graphical measure	8	W. M. Fl. Petrie (1911-1912)
South Late Period precinct wall (northern face)	106.518	Measured *in situ* in 2014	9	Excavations Ashmawy-Raue (2014) ; survey by D. Laisney
South Late Period precinct wall (western part)	104.905	Graphical measure	9	W. M. Fl. Petrie (1911-1912)
South precinct wall (western part)	103.207	Graphical measure	8 et 9	J. Hekekyan (1851)
South precinct wall (western part)	110.007	Graphical measure	8 et 9	Description de l'Égypte (1798-1802)
South Late Period precinct wall (eastern part)	108.685	Graphical measure (turned by 90°)	10	W. M. Fl. Petrie (1911-1912)
South precinct wall (eastern part)	106.334	Graphical measure	10	Description de l'Égypte (1798-1802)
Eastern precinct wall	106.706	Graphical measure (turned by 90°)	11	W. M. Fl. Petrie (1911-1912)
Eastern precinct wall	105.765	Graphical measure (turned by 90°)	11	Description de l'Égypte (1798-1802)
Northern precinct wall (south of Tell al-Hisn)	102.810	Graphical measure	15 et 16	J. Hekekyan (1851)
Northern precinct wall (southern wall)	107.385	Graphical measure	15	W. M. Fl. Petrie (1911-1912)
Northern precinct wall (northern wall)	105.988	Graphical measure	16	W. M. Fl. Petrie (1911-1912)
Northern precinct wall (eastern part)	108.726	Graphical measure	12b	Description de l'Égypte (1798-1802)
Northern precinct wall	*118. 000*	Data published by W. M. Fl. Petrie	12a et 12b	W. M. Fl. Petrie (1911-1912)

Table 2. The geodesic orientations of the structures in direct relation with the orientation of the temple of Atum of Senusret I (the decimals are only for calculation and they have no significance for the exactness of the buildings' orientation)

The historical issues

The importance of the different remains for our own set of problems has now to be evaluated. First we must be aware that, though the religious occupation of the site may date back to the prehistoric times, all the documents of the Old Kingdom discovered on-site were found in a reused context [9].

Thus, the oldest remain preserved and visible *in situ* appears to be the obelisk which dates to the reign of Senusret I. This monument was part of a huge building or rebuilding program that was launched by this king at Heliopolis. This wide-ranging program is known to us thanks to the

[9] R. Weill, 'Monuments royaux des premières dynasties. V. Un temple de Noutirkha-Zosir à Héliopolis', *Sphinx* 15, (1911-12), 9-19, sp. 9-10 ; K. Martin, *Ein Garant- symbol des Lebens. Untersuchungen zu Ursprung und Geschichte der alta'gyptischen Obelisken bis zum Ende des Neuen Reiches, HÄB* 3 (Hildesheim 1977) 42-43, fig. 3 ; L. Habachi, *The Obelisks of Egypt* (London, 1978), 42-43, fig. 7.

Berlin Leather Roll and through the *Annals of Senusret I* found at Bab el Tawfiq. This abundant documentation led us to specifically focus the potential astronomical researches on this epoch and on this reign.

From the *Berlin Leather Roll* [10] we know that the foundation of a new temple at Heliopolis was decided in year 3, IIIrd month of the inundation season *(akhet)*, day, 8; the *Annals* of Bab el-Tawfiq are not dated but from the mentions of the pair of obelisks and because of the connexion between the obelisks and the jubilee (mentioned on the shaft of the still standing one), we can assume that the pair of monoliths was probably erected around year 30-31 of the king [11].

Relative location of the standing obelisk in regard to the temple's axis

However, the question of the location of the standing obelisk "vis à vis" the temple has to be solved in order to correctly place the axis of the temple. Joseph Hekekyan in 1851-55 and David Jeffreys in 1999 [12] had concluded from their observations that the obelisk was most probably the northern one of a pair on the west-east axis (that is the left-hand one when entering from the west). They had in fact equated a structure found 17 m south of the standing obelisk with the base of its counterpart. Therefore, they drew an axis south of the standing obelisk. However, this situation is in obvious contradiction with the contemporary customs concerning the orientation of the royal inscriptions on each side of an obelisk, in respect to the end of the temples: according to the inscriptions, the obelisk should be either the right one of a pair marking an access west-east, or the left one of an access south-north, with no other possibility (fig. 7).

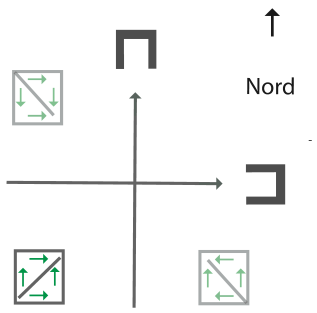


Fig. 7. The two location possibilities of the sanctcuary vis à vis the obelisks in regard to the orientations of the inscriptions on the standing obelisk.

D. Jeffrey then supposed that the temple could have been entered from the east and/or that the obelisk could have been rotated on its base later on. However, a closer look at what Hekekyan had found 17 m South of the obelisk, reveals that it could not be a pedestal for an obelisk (fig. 8). It is in fact a much thinner base for a naos with an engraving on the upper surface which was carved to match a more or less temple-shaped wooden shrine with a pylon façade.

---

10 Berlin inv. P.3029 : A. de Buck, *The Building Inscription of the Berlin Leather Roll*, in : *AnOr* 17 (1938), 48-57 ; H. Goedicke, 'The Berlin Leather Roll (P Berlin 3029)', *Festschrift zum 150jährigen Bestehen des Berliner Ägyptischen Museums, Mitteilungen aus der Ägyptischen Sammlung* 8, *Staatliche Museen zu Berlin* (Berlin, 1974), 87-104 ; M. Lichtheim, *Ancient Egyptian Literature* I, *The Old and Middle Kingdoms* (Berkeley-Los Angeles-London, 1973), 115-118.

11 L. Postel, I. Régen, 'Annales héliopolitaines de Sésostris Ier', *BIFAO* 105 (2005), 237, 266, n. kk ; 273.

12 D. Jeffreys, 'Joseph Hekekyan at Heliopolis', *in* : A. Leahy/J. Tait (eds), *Studies in honour of H.S. Smith. EES, Occasional Publication* 13, (London, 1999) 160, 166-168, fig. 3, 4 ; followed by F. Contardi, *Il naos di Sethi I da Eliopoli: un monumento per il culto del dio Sole (CGT 7002)*. Catalogo del Museo Egizio di Torino, serie prima - monumenti e testi. (Milan, 2009), 17.

Fig. 8. The structure found south of the standing obelisk which is not the pedestal of its counterpart but the base of a temple-shaped naos (photo L. Gabolde).

Subsequently, there is no more reason not to equate the standing obelisk with the southern one, that is the right-hand one when entering the temple from the west, as required by the texts orientation; nor need one suppose the obelisk was rotated.

It is appropriate to mention here the fact that the obelisk was raised by around 2,50m in 1957 by the Krupp company on behalf of the Egyptian Antiquities Organization [13], because it was threatened by the high water table. However this purely vertical motion of the monolith was accomplished with hydraulic cylinders. This operation did not affect, albeit very marginally, its orientation. It thus remains a good clue as to the orientation of Senusret Is' buildings.

Besides the obelisk, New-Kingdom mud-brick walls have equally survived on the southern border of the site. Their orientation has been measured and altogether they always point to an azimuth of around 107° with very minor discrepancies; these data were inserted in table 2.

Finally, as already mentioned, excavations carried out in 2017 have brought to light the remains of a limestone wall located to the west-northwest of the obelisk, and oriented east-west. Its azimuth appeared to be close to 106,50°.

The main orientation of the temple of Atum of Senusret I can thus be provisionally established at around :

107° (± 2/3°)

The vertical angle of the eastern horizon line in that direction (i.e. towards the sun rise) can be determined : 1. by the altitude of the soil dating to Senusret I (z = 13.00 m a.s.l.) [14] augmented by the altitude of the observer's eye (+ 1.50 m), resulting in z=14.50 m. 2. By the distance of the horizon (14 000 m) and its height (180 m).

The vertical angle (α) of observation is then calculated as follows :

Tangent (α) = (180-14.50)/14 000 = 0.011821429

Angle (α) = arc-tangent (0.011821429) = 0° 40' 38.23"

For such an angle (α), the refraction is of 0° 29' 26.61", implying an actual observation angle of 0° 40' 38.23" – 0° 29' 26.61" = 0° 11' 11.62".

In case of a solar observation, half of the solar diameter (0° 16') has also to be subtracted, resulting in a height under the horizon of 0° 11' 11.62" – 0° 16' 00" = – 0° 4' 48.38".

---

[13] L. Habachi, *Die unsterblichen Obelisken Ägyptens* (Mainz, 1982) 32 ; *id. The Obelisks of Egypt, Skyscrapers of the Past*, (Cairo, 1984), 49.

[14] Synthesis of the data of Hekekyan (Jeffrey, 'Joseph Hekekyan at Heliopolis', 162-163 and fig. 3-4 and http://collections.vam.ac.uk/item/O171844/sketch-of-the-foundation-and-drawing-simpson-william/ (11 nov. 2015)) and of L. Horner, 'An Account of Some Researches Near Cairo Undertaken with the View of Throwing Light upon the Geological History of the Alluvial Land of Egypt. I', *PTRSL* 145, (1855), 131-132.

The sun rise at Heliopolis in the reign of Senusret I.

Because the Lord of the temple, Ra-Atum, was a prominent solar deity, it is very likely that the azimuth of the sanctuary corresponds with a specific sun rise, as it was the case at Karnak [15], at Tell al-Amarna [16] and Tanis [17].

As the reign of Senusret I marked a major step in the building history of Heliopolis and, so far, provides the oldest architectural remains preserved *in-situ* we have chosen to focus our researches on this reign, and especially on the year 3 (8th day of the IIIrd month of the *akhet* season) of this king — which, as recorded in the *Berlin Leather Roll*, corresponds to the first building activity of Senusret I on the site —, in order to evaluate the potential concordances between the azimuth of the temple and the sun rise.

The reign of Senusret I in absolute chronology

The first question to solve is the calibration of the reign of Senusret I in absolute chronology. The anchor date for such a research is the heliacal rising of Sirius recorded in the year 7 of Senusret III and reported in the *Illahoun Archive* on the IVth month of the *peret* season, 17th day [18]. The first apparent difficulty lies in the determination of the number of years filling the gap between the date of Illahun and the date recorded in the *Berlin Leather Roll* in year 3 of Senusret I, as the exact length of the intermediate reigns is not definitely fixed. We have estimated it here at 89 years [19]. The second difficulty consists in finding the exact place of this reign in the second millennium BC. It depends, in fact, on which chronological theory (high, medium or low) is adopted for the fixing of the Illahun Sothic date. We shall examine here the results provided by the high chronology of U. Luft and those provided by the low chronology of R. Krauss.

In the chronological frame of U. Luft [20] the heliacal rising of Sirius in year 7 of Senusret III occurred on the 17th July (in Julian calendar = 1st July in Gregorian calendar) 1866 BC (=-1865). The year 3 of Senusret I would then correspond to 1955 BC (-1954).

In the chronological frame of R. Krauss [21] the heliacal rising of Sirius in year 7 of Senusret III occurred 36 years later, in 1830 BC. The year 3 of Senusret I would then correspond to 1919 BC (= -1918).

Now we can check the date of the sun rise on the temple axis in both systems. In 1955 BC (= -1954), following the chronological frame of U. Luft, the sun rises in the axis of the Heliopolis temple (at an azimuth of 106° 59' 30.6") on the 26th February (in Julian calendar, corresponding to the 9th February in Gregorian calendar). A retro-calculation based on the date of Censorinus shows that this day corresponds to the 4th day of the IIIrd month of the *akhet* season, i.e. 4 days before the date recorded in the *Berlin Leather Roll.*

In 1919 BC (= -1918), if we follow the chronological frame of R. Krauss, the sun rose in the axis of the Heliopolis temple (at an azimuth of 106° 53' 28.7") on the 26th February (in Julian calendar, corresponding to the 9th February in Gregorian calendar). A retro-calculation based on

---

15 *Supra* n. 2.

16 *Supra* n. 3.

17 *Supra* n. 4.

18 See bibliography in R. Krauss, 'Egyptian Sirius/Sothic Dates', in E. Hornung et *al.* (ed.), *Ancient Egyptian Chronology*, *HdO* 83 (Leyde – Boston, 2006), 448-450.

19 Based of the following regnal years succession : year 45 of Senusret I= year 1 of Amenemhet II ; year 35 of Amenemhet II = year 1 of Senusret II ; year 8 of Senusret II = year 1 of Senusret III. Coregencies hypothesis have been here discarded, following the convincing conclusions of R. Delia, 'A New Look at Some Old Dates : A Reexamination of Twelfth Dynasty Doubled Dated Inscriptions', *BES* 1 (1979), 15-28 ; id., 'Doubts about Double Dates and Coregencies', *BES* 4 (1982), 55-70 and Cl. Obsomer, *Sésostris Ier, étude chronologique du règne*, *CEA* 5 (Bruxelles, 1995), 149-152.

20 U. Luft, 'Remarks of a Philologist on Egyptian Chronology', *Ägypten und Levante* III (1992), 109-114 ; U. Luft, 'Die chronologische Fixierung des Ägyptischen Mittleren Reiches nach dem Tempelarchiv von Illahun', *SÖAW* n° 598 (1992) 224-229.

21 Krauss, in Hornung *et al.* (ed.), *HdO* 83, 448-450.

the date of Censorinus shows that this day corresponds to the 13th day of the IIIrd month of the *akhet* season, i.e. 5 days after the date recorded in the *Berlin Leather Roll*.

It is quite remarkable that these two evaluations appear to be very close — the first 4 days before and the second 5 days after — to the date registered in the *Berlin Leather Roll* as this document had genuinely recorded the day chosen by Senusret I to convene with his courtiers in order to specifically decide on and implement the rebuilding of the Atum temple at Heliopolis.

It is thus very tantalizing to propose an intermediate chronological frame, between 1955 and 1919 BC, in which the determination of the temple's axis on the sun rise during the foundation ceremony would have followed immediately the decision of the king to rebuilt the temple.

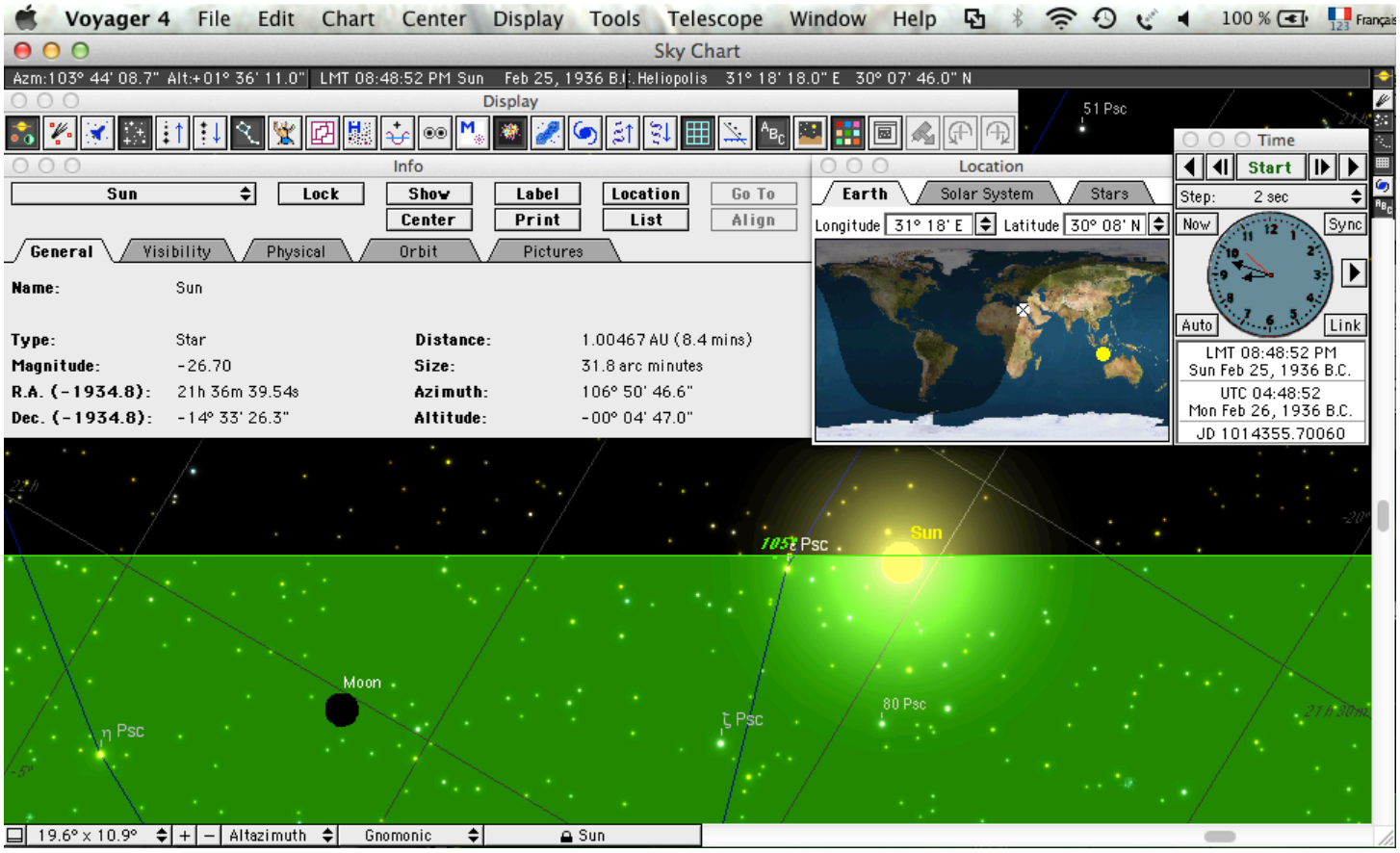


Fig. 9. Simulation on Voyager 4 ™ of the sun rise at Heliopolis on the 26th February in Julian calendar (= 9th February in Gregorian calendar) 1936 BC (= -1935)

Empirically, the date which better fits these requisits appears to be Monday the 26th February in Julian calendar (= 9th February in Gregorian calendar) 1936 BC (= -1935). In the Egyptian calendar, retro-calculated from the Censorinus date onwards, this day corresponds with the 9th day of the IIIrd month of the *akhet* season i.e. the days after the meeting of Senusret I with his courtiers. Astronomical computer calculations show that the sun rose on this very day at Heliopolis at an azimuth of 106° 50' 43,6" (fig. 9), a result which fits very well with the topographical data we have recorded above.

Note that, interestingly enough, this day corresponds with a new-moon, the new crescent being visible at twilight [22], a circumstance considered as propitious for the foundation ceremonies

[22] The actual *neomenia* had occurred on the 25th February (Julian calendar) at dawn.

as attested for the foundation date of the *Akhmenu* of Thutmose III at Karnak or that of the pylon of Ramses II at Luxor [23].

However, if we were to admit that several days — 5 for example — had elapsed, between the convening by Senusret I of his officials and the foundation ceremony of Heliopolis' temple, then, the date of the astronomical observation of the sun rise in order to set the temple's axis could fit with Krauss' chonological frame. The 3rd year of Senusret I's reign could thus correspond with 1919 BC.

Note, in that respect, that if we accept a relation between the *Berlin Leather Roll* text and the orientation of the temple of Heliopolis through a direct observation of the sun rise at dawn, then it implies to discard the high chronology system which U. Luft proposed. In this last, case, indeed, the orientation of the temple on the sun rise would have preceded of around 4 days the convening of the court by Senusret I in order decide on the rebuilding of the temple and on the implementation of the foundation ceremonies. However, such a circumstance, in fact, appears all but likely / plausible.

This statement is moreover in agreement with the chronological conclusions already drawn from the orientation of the small temple of Aten at Tell el-Amarna, orientation which mainly matched the low chronology system [24].

Conclusions

The new survey of the site and the recent excavations west of the obelisk have provided us with rather precise data regarding the original orientation of the temple of Atum, especially for the one rebuilt by Senustret I in the 3rd year of his reign.

Though there remain some uncertainties (length of the intermediate reigns between Senusret I and III; exact position of the Illahun Sothic date in absolute chronology), we could find an hypothesis suggesting a remarkable convergence between the orientation of the Atum temple and the azimuth of the sun rise at the date recorded in the *Berlin Leather Roll* during the reign of Senusret I. This conjunction can hardly be considered as a mere coincidence. Moreover, this date was of particular significance for the king as it was the second anniversary of this father's assassination and of his own accession to the throne. We can remember, in that respect, that it was undoubtedly not a coincidence that, 16 years later, the temple of the same Senusret I at Karnak was clearly aligned, on purpose, on the sunrise at winter solstice.

The most enciting chronological hypothesis for Heliopolis is to fix the foundation ceremony on the 26th February in Julian calendar (= 9th February in Gregorian calendar) 1936 BC (= -1935) at dawn. This day corresponds with the 9th day of the IIIrd month of the *akhet* season i.e. the day after the meeting between Senusret I and his courtiers. It was a new moon.

The other interesting possibility would imply a foundation ceremony delayed of 5 days after the meeting of Senusret as recorded in the *Berlin Leather Roll*. In that case, the event would have occurred on the 26th of February in Julian calendar (= 9th February in Gregorian calendar) 1919 BC corresponding to the 13th day of the IIIrd month of the *akhet* season and could match with the chronological system of R. Krauss. The convening of the court by Senusret I would have then occurred on the 21st of February (Julian), and was in correspondence with the reappearance of the moon crescent after the new moon (the true neomenia had taken place on the 18th of February and was a partial eclipse, but not visible from Egypt).

As already mentioned, the low chronology system favoured by these new data is confirmed by the results previously gained at Amarna [25].

---

23 *Akhmenu* : *Urk.* IV, 836,1-4 ; see J. von Beckerath, 'Ein Wunder des Amun bei der Tempelgrundung in Karnak', *MDAIK* 37 (1981) 41-51 ; Pylon of Ramses II at Luxor temple: K*RI* II, 346, 10-11 and K*RITA* II, 184.

24 L. Gabolde, "'L'horizon d'Aton", exactement ?', *Verba Manent. Recueil d'études dédiées à Dimitri Meeks*, *CENiM* 2, 2009, 153-154.

25 L. Gabolde, "'L'horizon d'Aton", exactement ?', *Verba Manent. Recueil d'études dédiées à Dimitri Meeks*, *CENiM* 2, 2009, 145-157. However, other scholars have recently argued for a high chronology system, based, for exemple,

If one of these hypothesis were to be confirmed and widely accepted it could constitute a new milestone for the Egyptian chronology.

Lyons, April 2018

on a reassesment of the Thera-Santorini eruption's date : R.K. Ritner, N. Moeller, 'The Ahmose 'Tempest Stela', Thera and Comparative Chronology', *JNES* 73-1 (2014), 1-19, sp. 13-17.

Captions

Fig. 1. Map showing the location of the structures surveyed by the mission OrTempSol.
Fig. 2. The new archaeological grid realized by D. Laisney (OrTempSol Mission, Labex Archimède, Montpellier)
Fig. 3. Sites of the different archaeological structures which orientation could be determined and recorded during the 2014 mission.
Fig. 4. The general orientation of the segment of wall discovered in 2017 W-N-W of the obelisk (area 211). Photos D. Raue.
Fig. 5. The general orientation of the segment of wall discovered in 2017 W-N-W of the obelisk (area 211), detail. Photos D. Raue.
Fig. 6. The segment of wall discovered in 2017 W-N-W of the obelisk (area 211). Photos D. Raue.
Fig. 7. The two location possibilities of the sanctuary vis à vis the obelisks in regard to the orientations of the inscriptions on the standing obelisk.
Fig. 8. The structure found south of the standing obelisk which is not the pedestal of its counterpart but the base of a temple-shaped naos (photo L. Gabolde).
Fig. 9. Simulation on Voyager 4 ™ of the sun rise at Heliopolis on the 26th February in Julian calendar (= 9th February in Gregorian calendar) 1936 BC (= -1935).

Bibliography

É. Aubourg, 'La date de conception du zodiaque du temple d'Hathor à Dendara', *BIFAO* 95 (1995), 1-10.

A. de Buck, *The Building Inscription of the Berlin Leather Roll*, in : *AnOr* 17 (1938), 48-57.

J. von Beckerath, 'Ein Wunder des Amun bei der Tempelgrundung in Karnak', *MDAIK* 37 (1981) 41-51.

E. Castle, 'The Foundation Ceremony at Akhetaten', *SAK* 44 (2015), 43-82.

S. Cauville, with É. Aubourg, P. Deleuze, A. Lecler, 'Le temple d'Isis à Dendera', *BSFE* 123 (1992), 31-48.

F. Contardi, *Il naos di Sethi I da Eliopoli: un monumento per il culto del dio Sole (CGT 7002)*. Catalogo del Museo Egizio di Torino, serie prima - monumenti e testi. Milan, 2009.

R. Delia, 'A New Look at Some Old Dates : A Reexamination of Twelfth Dynasty Doubled Dated Inscriptions', *BES* 1 (1979), 15-28.

R. Delia, 'Doubts about Double Dates and Coregencies', *BES* 4 (1982), 55-70.

L. Gabolde, *Le "grand château d'Amon" de Sésostris Ier à Karnak*, *MAIBL* 17 (1998).

L. Gabolde, 'Mise au point sur l'orientation du temple d'Amon-Rê à Karnak en direction du lever de soleil au solstice d'hiver', *Les cahiers de Karnak* XIII (2010), 243-256.

L. Gabolde, "'L'horizon d'Aton", exactement ?', *Verba Manent. Recueil d'études dédiées à Dimitri Meeks*, *CENiM* 2*,* 2009, 145-157.

L. Gabolde, D. Laisney, F. Leclère, Fr. Payraudeau, 'L'orientation du temple d'Amon-Rê à Tanis : données topographiques et archéologiques, hypothèses astronomiques et conséquences historiques'*, in Hommages à Christiane Zivie-Coche* in print.

H. Goedicke, 'The Berlin Leather Roll (P Berlin 3029)', *Festschrift zum 150jährigen Bestehen des Berliner Ägyptischen Museums, Mitteilungen aus der Ägyptischen Sammlung* 8*, Staatliche Museen zu Berlin* Berlin*,* 1974.

L. Habachi, *Die unsterblichen Obelisken Ägyptens*, Mainz, 1982.

L. Habachi, *The Obelisks of Egypt,* London, 1978.

L. Habachi, *The Obelisks of Egypt, Skyscrapers of the Past*, Cairo, 1984.

L. Horner, 'An Account of Some Researches Near Cairo Undertaken with the View of Throwing Light upon the Geological History of the Alluvial Land of Egypt. I', *PTRSL* 145, (1855), 105-136 and 233-240.

D. Jeffreys, 'Joseph Hekekyan at Heliopolis'*, in* : A. Leahy/J. Tait (eds), *Studies in honour of H.S. Smith. EES, Occasional Publication* 13, (London, 1999) 157-168.

K*RI* II = K.A. Kitchen, *Ramesside Inscriptions, Historical and Biographical* II. Oxford, 1979.

K*RITA* II = K.A. Kitchen, *Ramesside Inscriptions Translated and Annotated: Translations* II. Oxford-Chichester, 1996.

R. Krauss, 'Egyptian Sirius/Sothic Dates', in E. Hornung et *al.* (ed.), *Ancient Egyptian Chronology*, *HdO* 83 (Leyde – Boston, 2006), 439-457.

M. Lichtheim, *Ancient Egyptian Literature* I, *The Old and Middle Kingdoms*, Berkeley-Los Angeles-London, 1973.

U. Luft, 'Remarks of a Philologist on Egyptian Chronology', *Ägypten und Levante* III (1992), 109-114.

U. Luft, 'Die chronologische Fixierung des Ägyptischen Mittleren Reiches nach dem Tempelarchiv von Illahun', *SÖAW* n° 598 (1992) 224-229.

K. Martin, *Ein Garant- symbol des Lebens. Untersuchungen zu Ursprung und Geschichte der alta'gyptischen Obelisken bis zum Ende des Neuen Reiches, HÄB* 3, Hildesheim, 1977.

Cl. Obsomer, *Sésostris Ier, étude chronologique du règne*, *CEA* 5 (Bruxelles, 1995).

L. Postel, I. Régen, 'Annales héliopolitaines de Sésostris Ier', *BIFAO* 105 (2005), 237-273.

M. Shaltout, J.-A. Belmonte, 'On the Orientation of Ancient Egyptian Temples: (1) Upper Egypt and Lower Nubia', *JHA* 36 (2005), 273-298.

M. Shaltout, J.-A. Belmonte, 'On the Orientation of Ancient Egyptian Temples: (2) New Experiments at the Oases of the Western Desert', *JHA* 37 (2006), 173-192.

M. Shaltout, J.-A. Belmonte, M. Fekri, 'On the Orientation of Ancient Egyptian Temples: (3) Key Points at Lower Egypt and Siwa Oasis, Part I', *JHA* 38 (2007), 141-160.

M. Shaltout, J.-A. Belmonte, M. Fekri, 'On the Orientation of Ancient Egyptian Temples: (4) Epilogue in Serabit el Khadem and Overview', *JHA* 39 (2008), 181-211.

R. Weill, 'Monuments royaux des premières dynasties. V. Un temple de Noutirkha-Zosir à Héliopolis', *Sphinx* 15, (1911-12), 9-19.