1. Topographical Setting

1.1 Preliminary Results on the Study of the Orientation of the Temple of Ra-Atum at Heliopolis and Their Historical Implications.

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Preliminary Results on the Study of the Orientation of the Temple of Ra-Atum at Heliopolis and Their Historical Implications.

Luc Gabolde[1] and Damien Laisney[2]

Abstract

A GPS campaign at 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 the formulation of some hypotheses about the date of the temple's foundation ceremony and its possible direct connection with the sunrise on the date recorded in the Berlin Leather Roll during the reign of Senusret I.

Prolegomena

The study of the Egyptian temples' orientation is a field of research which has already produced fruitful results[3]. However, reliable and 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 programme labelled OrTempSol within the framework of the Labex-Archimède 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 programme 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.

Acknowledgements

The mission was conducted with the financial support of the Labex-Archimède[7]. It benefited from the scientific and logistical support of the joint mission of the Ministry of Antiquities of the Arab Republic of Egypt and of the Leipzig University at Matariya / Heliopolis, of which it was a part under the direction of Aiman Ashmawy and Dietrich Raue. A differential GPS was very kindly lent to us by the IFAO.

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[3] Shaltout / Belmonte 2005, 273–298; Id. 2006, 173–192; Shaltout / Belmonte / Fekri 2007, 141–160; Id. 2008, 181–211; Cauville et al. 1992, 31–48; see also Aubourg 1995, 1–10.

[4] Gabolde 1998, sp. 123–137; Id. 2010, 243–256.

[5] Gabolde 2009, 145–157. E. Castle has recently raised objections to the hypothesis that the foundation ceremony recorded on 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 (Castle 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 of May in the Julian calendar (= 30th April in the Gregorian calendar) of the year 1039 BC (= -1038). It was also a new moon. See Gabolde et al. 2021, sp. p. 346-349.

1.1 The Surveying Operations Carried out on Site (Fig. 1)

The main mission was conducted at Heliopolis from 2nd to 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 site on the naos base near the obelisk.
- 2 at the limits of the “high sand”.
- 8 on the gate of Ramesses III at Tell el-Hisn.
- 35 on the northern ruins of Tell el-Hisn, on the site of the column of Merenptah and on the remaining portion of the precinct wall.
- Existing stations were also recorded and noted on the new topographical grid.

The Historical Records and Surveys

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

- Description de l’Égypte, *Antiquités* V, pl. 26, 1.
- Ravioli 1841 (Raue, *Heliopolis*, pl. 5).
- Hekekyan (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-Archimède 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).

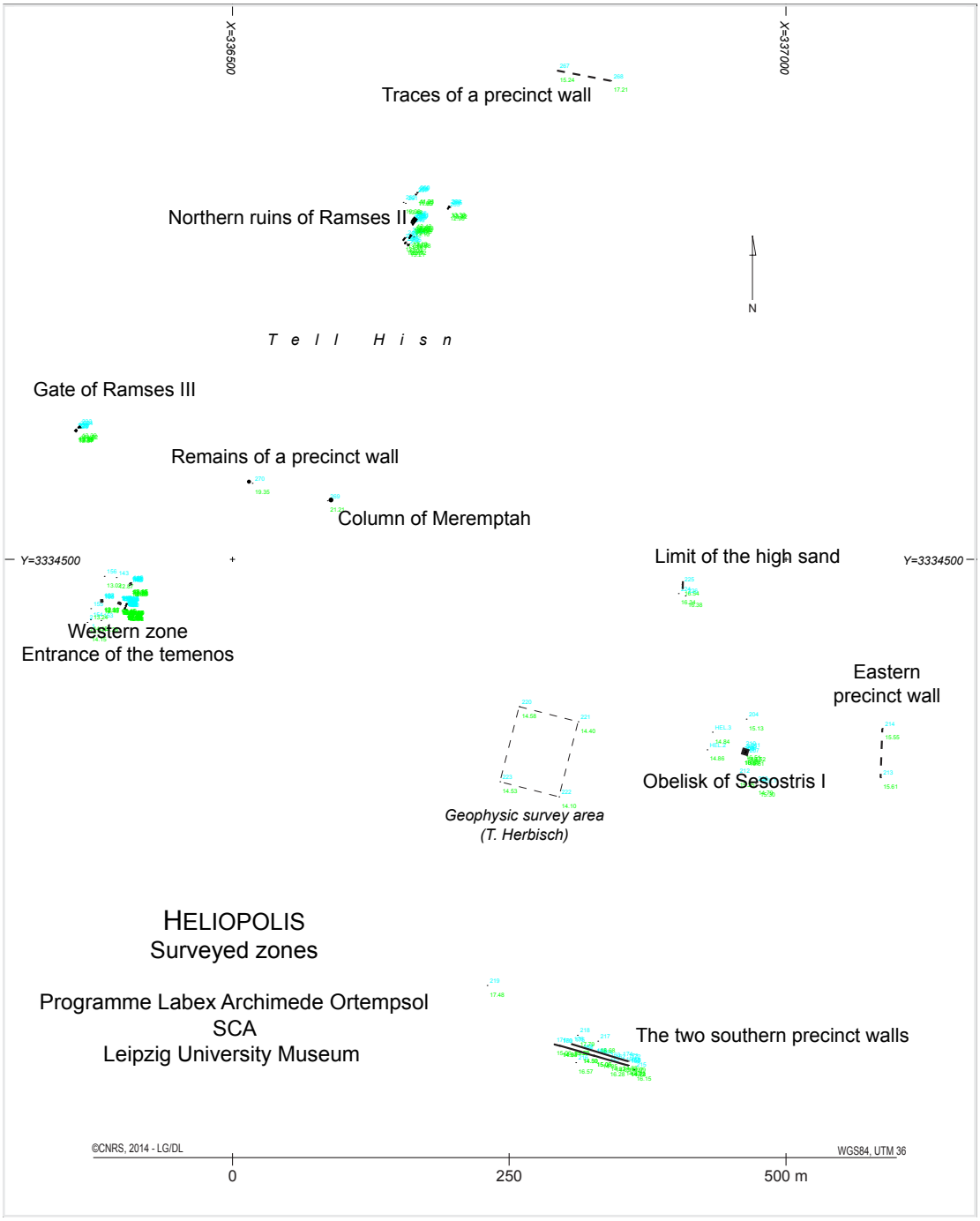

Fig. 1:
Map showing the location of the structures surveyed by the mission OrTempSol.

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).

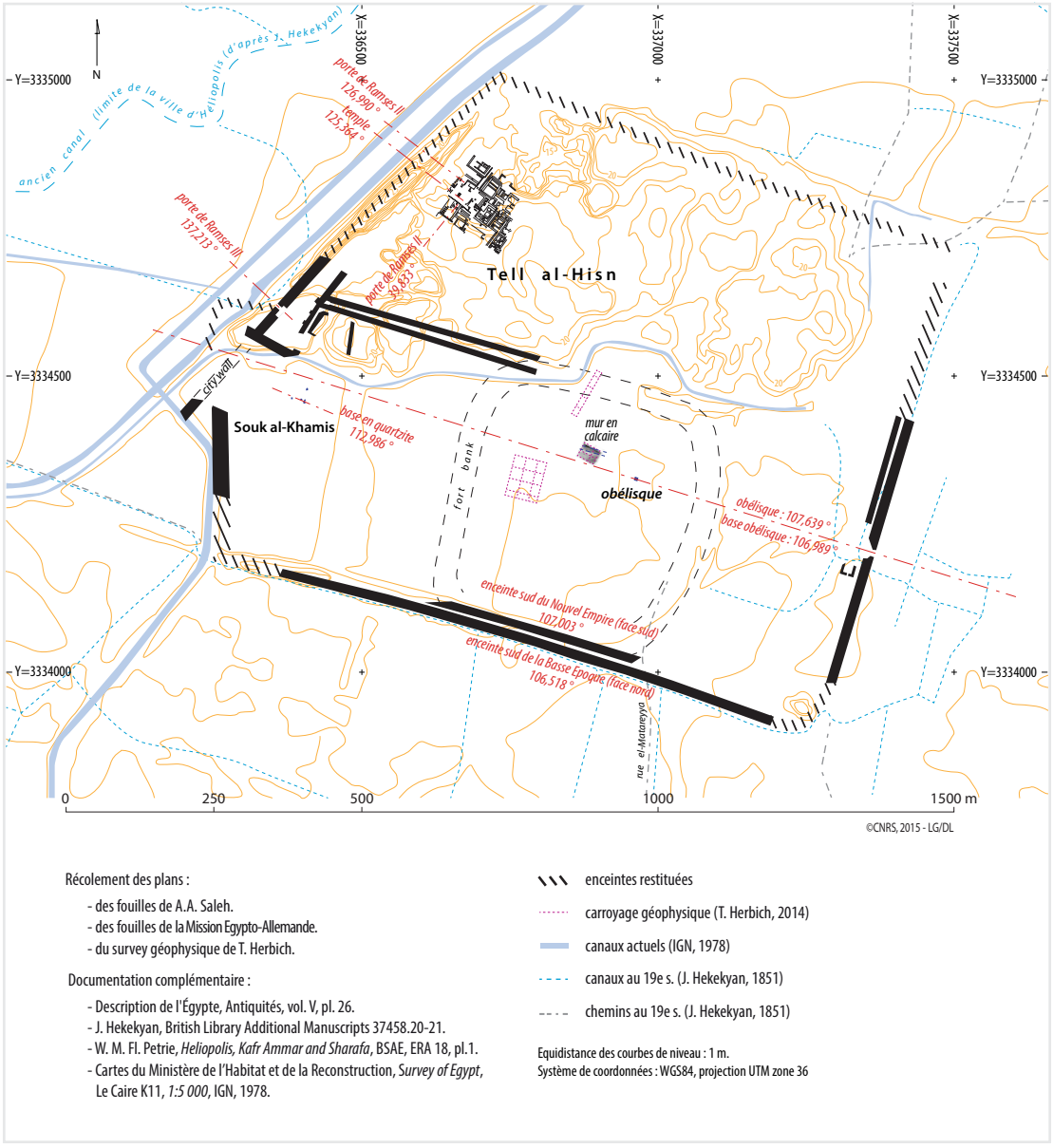

Fig. 2:
The new archaeological grid realized by D. Laisney (OrTempSol Mission, Labex-Archimède, Montpellier).

1.1 The Results of the Study of the Orientation 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).

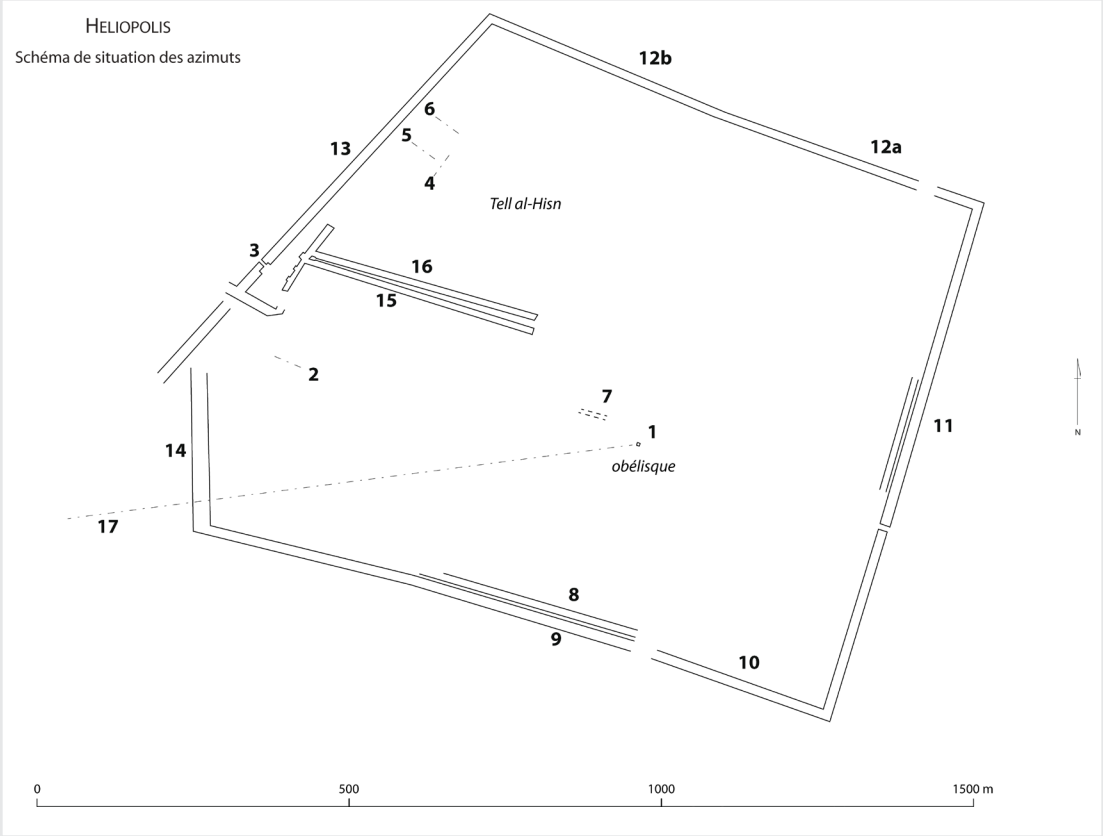

Fig. 3:
Sites of the different archaeological structures whose orientation could be determined and recorded during the 2014 mission.

1.1

The precise orientation of the surveyed structures is summarized in the following (Tab. 1)

The geodesic orientation 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 taking into account the actual accuracy of the field measures and the poor state of the remains).

Site	**Azimuth** (in dec. degrees)	**Kind of azimuth 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	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. F. 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. F. Petrie (1911 – 1912)
South precinct wall (western part)	103.207	Graphical measure	8 + 9	J. Hekekyan (1851)
South precinct wall (western part)	110.007	Graphical measure	8 + 9	Description de l'Égypte (1798 – 1802)
South Late Period precinct wall (eastern part)	108.685	Graphical measure (turned by 90°)	10	W. M. F. Petrie (1911 – 1912)
South precinct wall (eastern part)	106.334	Graphical measure	10	Description de l'Égypte (1798 – 1802)

Tab. 1 (continued)

Eastern precinct wall	106.706	Graphical measure (turned of 90°)	11	W. M. F. 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 el-Hisn)	102.810	Graphical measure	15 + 16	J. Hekekyan (1851)
Northern precinct wall (southern wall)	107.385	Graphical measure	15	W. M. F. Petrie (1911–1912)
Northern precinct wall (northern wall)	105.988	Graphical measure	16	W. M. F. 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. F. Petrie	12a + 12b	W. M. F. 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. F. Petrie (1911–1912)
Gate of Ramesses III (Tell el-Hisn)	137.213	Measured *in situ* in 2014	3	Excavations A. A. Saleh (1976–1981)
Gate of Ramesses II (Tell el-Hisn)	129.833	Measured *in situ* in 2014 (turned by 90°)	4	Excavations A. A. Saleh (1976–1981)
Temple (Tell el-Hisn)	125.364	Measured *in situ* in 2014	5	Excavations A. A. Saleh (1976–1981)
Gate of Ramesses II (Tell el-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. F. Petrie (1911–1912)

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

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The mission of 2017 has led to the discovery of the remains of a segment of a new limestone wall located west-northwest of the obelisk, adding a new measurement to the series (Fig. 4 - 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)

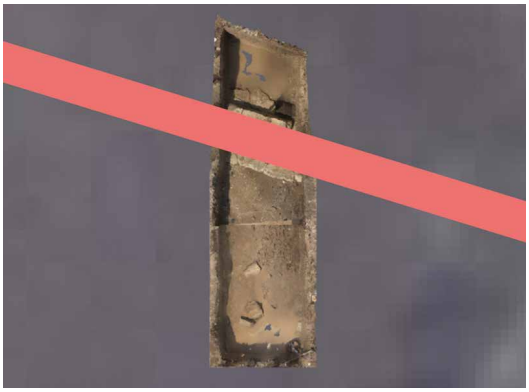

Fig. 4 – 6:
The segment of wall discovered in 2017 W-N-W of the obelisk (Area 211) and its general orientation; Photos: C. Breninek.

1.1

Among this series of measurements, 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 Senusret I and the New Kingdom structures) and we balanced them taking into account their proper individual reliability (Tab. 2).

The geodesic orientation of the structures in direct relation to 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).

Site	**Azimuth** (in dec. degrees)	**Kind of azimuth 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	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. F. Petrie (1911–1912)
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South Late Period precinct wall (western part)	104.905	Graphical measure	9	W. M. F. Petrie (1911–1912)
South precinct wall (western part)	103.207	Graphical measure	8 + 9	J. Hekekyan (1851)
South precinct wall (western part)	110.007	Graphical measure	8 + 9	Description de l'Égypte (1798–1802)
South Late Period precinct wall (eastern part)	108.685	Graphical measure (turned by 90°)	10	W. M. F. Petrie (1911–1912)
South precinct wall (eastern part)	106.334	Graphical measure	10	Description de l'Égypte (1798–1802)

Tab. 2 (continued)

Eastern precinct wall	106.706	Graphical measure (turned by 90°)	11	W. M. F. 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 el-Hisn)	102.810	Graphical measure	15 + 16	J. Hekekyan (1851)
Northern precinct wall (southern wall)	107.385	Graphical measure	15	W. M. F. Petrie (1911–1912)
Northern precinct wall (northern wall)	105.988	Graphical measure	16	W. M. F. 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. F. Petrie	12a + 12b	W. M. F. Petrie (1911–1912)

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 prehistoric times, all the documents of the Old Kingdom discovered on-site were found in a reused context[9].

Thus, the oldest monument, 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 programme that was launched by this king at Heliopolis. This wide-ranging program is known to us thanks to the *Berlin Leather Roll* and through the *Annals of Senusret* I found at Bab el-Tawfiq. This abundant documentation led us to focus the potential astronomical research 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 connection 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 (Postel / Régen 2005, 237, 266, note kk, 273).

[9] Weill 1911/12, 9–19, sp. 9–10; Martin 1977, 42–43, fig. 3; Habachi 1978, 42–43, fig. 7.

[10] Berlin Inv. P. 3029: De Buck 1938, 48–57; Goedicke 1974, 87–104; Lichtheim 1973, 115–118.

1.1 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 (Jeffreys 1999, 160, 166–168, fig. 3–4; followed by Contardi 2009, 17) 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).

D. Jeffreys 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 have been 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

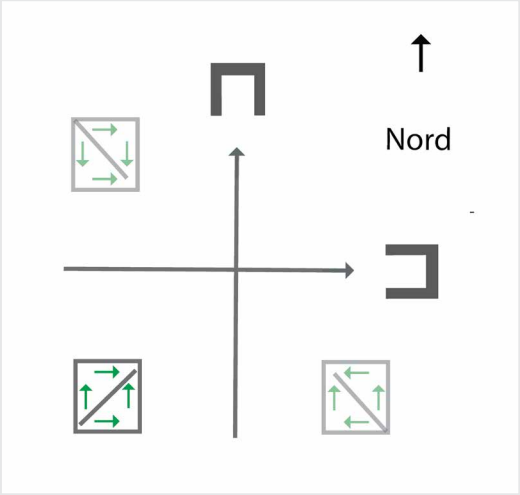

Fig. 7: The two location possibilities of the sanctuary vis-à-vis the obelisks in regard to the orientation of the inscriptions on the standing obelisk.

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)

less temple-shaped wooden shrine with a pylon façade.

Subsequently, there is no 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 2.50 m in 1957 by the Krupp Company on behalf of the Egyptian Antiquities Organization (Habachi 1982, 32; Id. 1984, 49), 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 I's buildings.

Besides the obelisk, New Kingdom mud-brick walls have also 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 Tab. 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 sunrise) can be determined: 1. by the altitude of the soil dating to Senusret I (z = 13.00 m a.s.l.)[11] 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 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°.

[11] Synthesis of the data of Hekekyan (Jeffreys 1999, 162–163 and fig. 3–4 and *http://collections.vam.ac.uk/item/O171844/sketch-of-the-foundation-and-drawing-simpson-william/* (11 November 2015)) and of Horner 1855, 131–132.

1.1 The Sunrise 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 sunrise, as it was the case at Karnak[12], at Tell el-Amarna[13] and Tanis[14].

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 research 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 at the site — in order to evaluate the potential concordances between the azimuth of the temple and the sunrise.

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 study is the heliacal rising of Sirius recorded in year 7 of Senusret III and reported in the *Illahoun Archive* on the IVth month of the *peret* season, 17th day (see bibliography in Krauss 2006, 448–450). 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[15]. The second difficulty consists in finding the exact place of this reign in the 2nd 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 (Luft 1992a, 109–114; Id. 1992b, 224–229), the heliacal rising of Sirius in year 7 of Senusret III occurred on the 17th of July (in the Julian calendar = 1st July in the Gregorian calendar) 1866 BC (= -1865). Year 3 of Senusret I would then correspond to 1955 BC (= - 1954).

In the chronological frame of R. Krauss (Krauss 2006, 448–450), the heliacal rising of Sirius in

[12] *Supra* note 3.

[13] *Supra* note 4.

[14] *Supra* note 5.

[15] Based on 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. Hypotheses of coregencies have been discarded here, following the convincing conclusions of Delia 1979, 15–28; Id. 1982, 55–70 and Obsomer 1995, 149–152.

year 7 of Senusret III occurred 36 years later, in 1830 BC. Year 3 of Senusret I would then correspond to 1919 BC (= -1918).

Now we can check the date of the sunrise on the temple axis in both systems. In 1955 BC (= -1954), following the chronological frame of U. Luft, the sun rose in the axis of the Heliopolis temple (at an azimuth of 106° 59° 30.6°) on the 26th of February (in the Julian calendar, corresponding to the 9th of February in the 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 of February (in the Julian calendar, corresponding to the 9th of February in the Gregorian calendar). A retro-calculation based on 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 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 sunrise during the foundation ceremony would have immediately followed the decision of the king to rebuild the temple.

Empirically, the date which better fits these requisites appears to be Monday the 26th of February in the Julian calendar (= 9th February in the 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 day 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° 51.1° (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[16], a circumstance considered propitious for the foundation ceremonies as attested for the foundation date of the *Akhmenu* of Thutmose III at Karnak or that of the pylon of Ramesses II at Luxor[17].

However, if we were to admit that several days — 5 for example — had elapsed between the convening of Senusret I with his officials and the foundation ceremony of Heliopolis' temple, then the date of the astronomical observation of the sunrise used for establishing the temple's axis

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

[17] *Akhmenu:* Urk. IV, 836.1–4; see Beckerath 1981, 41–51; Pylon of Ramses II at Luxor temple: KRI II, 346, 10–11 and KRITA II, 184.

could fit in with Krauss' chronological 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 sunrise at dawn, we would have to discard the high chronology system which U. Luft proposed. In that case, the orientation of the temple based on the sunrise would have preceded by approximately 4 days the convening of the court by Senusret I in order to decide on the rebuilding of the temple and on the implementation of the foundation ceremonies. However, such a circumstance seems very unlikely.

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, an orientation which mainly matched the low chronology system (Gabolde 2009, 153–154).

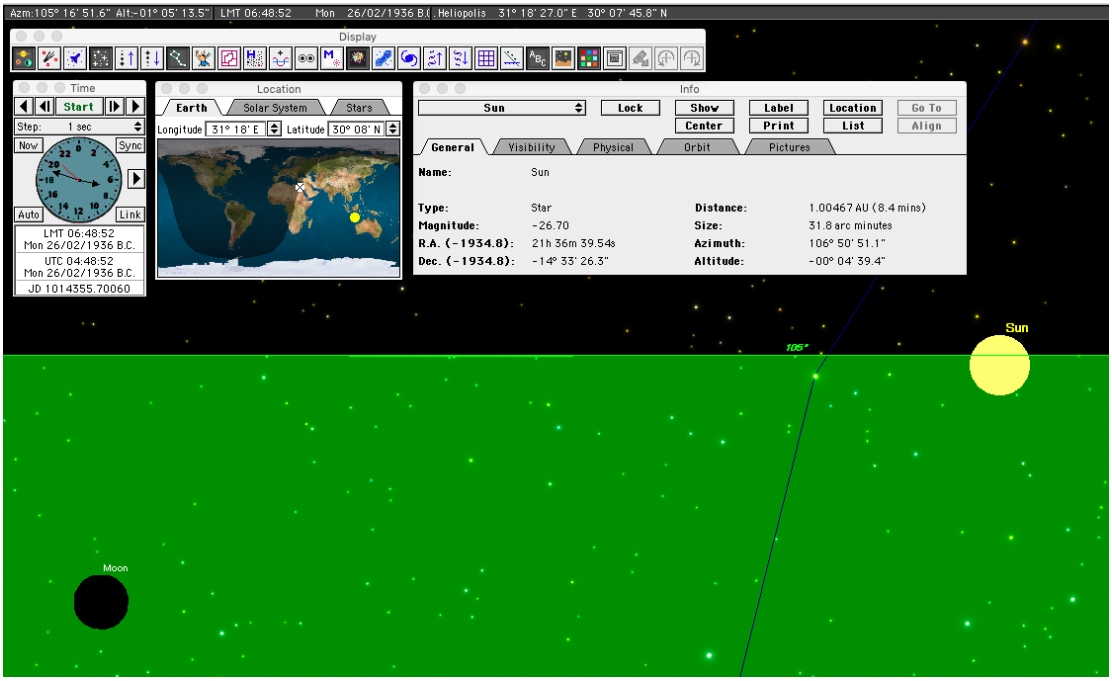

Fig. 9:
Screen-shot from Voyager 3 simulation of the sun rise at Heliopolis on the 26th of February in Julian calendar (= 9th February in Gregorian calendar) 1936 BC (= -1935).

1.1 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 Senusret 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 can propose a hypothesis suggesting a remarkable convergence between the orientation of the Atum temple and the azimuth of the sunrise on the date recorded in the *Berlin Leather Roll* during the reign of Senusret I. This conjunction can hardly be considered a mere coincidence. Moreover, this date was of particular significance for the king as it was the second anniversary of his father's assassination and of his own accession to the throne. In this respect 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 enticing chronological hypothesis for Heliopolis is to fix the foundation ceremony on the 26th of February in the Julian calendar (= 9th February in the 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 by 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 the Julian calendar (= 9th February in the Gregorian calendar) 1919 BC corresponding to the 13th day of the IIIrd month of the *akhet* season and could match 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 (Gabolde 2009, 145–157)[18].

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

[18] However, other scholars have recently argued for a high chronology system, based, for example, on a reassessment of the Thera-Santorini eruption's date: Ritner / Moeller 2014, 1–19, sp. 13–17.

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