Egyptian Temple Orientation

Astronomical Alignments in the Temples of Egypt

by

David Furlong

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Introduction and Acknowledgements

Egypt, since my early childhood, has been an enduring source of fascination, inspiration and enjoyment. Perhaps it is the appeal of reaching into the minds of those long departed people, whose perception and search of truth and reality, was so like and yet so very different from our own. Without doubt it is a country rich in enigma, and for the enquiring mind this is ever intriguing.

This present work is but a small step in trying to understand one of those Egyptian mysteries. What was the impulse that established the orientation of their temples? The ability to explore this question has only very recently become available to us, with the advent of home computers. It has come in two forms. The first is a number of reliable astronomical programmes and the second is an easy to use mapping facility. Without doubt the Google Earth map projection is one of the wonders of the modern computer age. This work could not have been achieved without it. I am sure that much more will be revealed when its full potential is realised.

By way of thanks I first wish to acknowledge the directors of Google for what they have made available and secondly all of the many individuals who have developed the various computer programmes that have provided us with such powerful tools.

Finally I would like to thank my different teachers, who have shared their perceptions and understanding of Ancient Egypt so willingly. And in this to thank also the Egyptian people for their open-heartedness and generosity that has always made my many trips in this country such a pleasurable experience. This work is dedicated to the enduring spirit of Egypt.

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Abstract

This paper considers the possible astronomical orientation of eleven temple sites in Upper Egypt. These are:

Karnak:

1. Main Amun Temple (Ipet-isut)
2. Mut Temple
3. Ptah Temple

Luxor:

1. Amenhotep III Temple
2. Ramses II temple + Avenue of Sphinxes

Deir El Bahari:

Hatshepsut Temple

Medinet Habu:

Ramses III Temple

Qurna:

1. Seti 1 Temple
2. Amenhotep III Temple

Denderah:

Hathor Temple

Edfu:

Horus Temple

It suggests that many, though not all, of these temples can be shown to align to significant astronomical events that includes the mid-winter sunrise; the southern major standstill of the Moon and in some cases to either stars or constellations. In the context of all of the temples of Upper Egypt this is but a small sample. Nevertheless it does support the view that astronomical alignment played a significant part in the orientation of some temples. The study makes use of modern computing techniques that includes the Google Earth mapping programme.

Background

Since Sir Norman Lockyer first published his discoveries in his book *The Dawn of Astronomy* (1894)[1] highlighting the possible astronomical alignment of Egyptian temples, there has been unresolved speculation about their orientation. Researchers that have stood in the arrow straight avenue of the central aisle of the vast temple of Amun at Karnak or the looked out from the inner sanctuary of a temple like that of Hathor at Denderah cannot help but have wondered at the alignment intention of their Ancient Egyptian builders. We know that the Egyptians were competent surveyors[2], a skill required by the annual flooding of the Nile, which destroyed the crop and land boundaries every season. They were also clearly capable of very accurate orientation to the cardinal points of the compass as evidence in the construction of the Old Kingdom pyramids[3], yet the temple orientation has proved more problematic for a number of very good reasons.

Firstly before the advent of modern computing and GPS technology calculating the exact azimuth alignment of a temple was not an easy matter. To be fully accurate requires sophisticated surveying techniques using a theodolite combined with careful observation to the Sun and stars to pin point true north. All of this would need to be backed up by some extensive mathematical calculations. One only has to read about Petrie's two year survey of the Giza plateau[4] to appreciate what a time consuming task this would be.

Secondly, since the time of the pharaohs, the star positions have changed considerably in their precessional orbits. Although solar and lunar alignments would still work today, assessing stellar alignments would require a further set of complicated calculations. This range of skills lies beyond the normal Egyptologist and as such a study of the astronomic alignment of the temples never gained much favour[5].

Computers have completely changed this situation. With mapping programmes such as Google Earth and astronomical programmes like Redshift, Starry Night or StarCalc[6] it is now possible for anybody with a little understanding to both assess temple orientations as well as consider the night skies of the Ancient Egyptians. This present study draws heavily upon such resources. The advantage of this approach is that anyone with the necessary programmes can easily check these findings for themselves.

Shaltout and Belmonte Study on the Orientation of Egyptian Temples

This paper also draws upon a detailed study carried out in 2005 by M Shaltout and J.A Belmonte entitled the Orientation of Ancient Egyptian Temples 1: Upper Egypt and Lower Nubia (JHA 36 (2005), 274-98)[7]. This study has catalogued one hundred and thirty-three temple sites, in probably the most extensive single survey of this type carried out on the Egyptian temples. The methods used for checking the azimuths were based on prismatic compass readings, which the authors claim are accurate to within ± ½°. These readings are compared within this present study with those based on map projections. The Shaltout and Belmonte study looks, in some depth, at four different temple sites, which support a link between temple orientation and astronomical events, the most notable of which is towards the mid-winter sunrise. The calculated azimuths within this present work can be calibrated to minutes and seconds of arc[8]. However I would not want to claim a greater level of accuracy than that given by Shaltout and Belmonte.

Hereafter this study will be referred to as SB or the SB study. Details of this study can be found at: ftp://ftp.ll.iac.es/pub/research/preprints/PP05003.pdf

Potential Astronomical Alignments

If we discount the planets, astronomical alignments fall into three main categories:

- Solar
- Lunar
- Stellar

The Sun

Solar alignments principally include the solstices of mid-summer and mid-winter as well as the spring and autumn equinoxes. In practice these latter alignments rarely feature in ancient monuments because of the difficulty of their accurate assessment[9]. Mid-winter and mid-summer sunrises and sunsets, when the Sun 'stands still', the true meaning of the word solstice, are by far the most common solar phenomena to be observed and recorded. Falling annually these can be easily checked by site observation on the relevant days. As has been shown with so many ancient monuments, the Sun alignments still work today with the same precision perceived many thousands of years ago.

In the case of Egypt there is one other well known solar alignment that attracts many hundreds of visitors each year. It is to be found at the temple of Abu Simbel built by Ramses II as a cult temple to himself. Despite being rescued in 1972 from the rising waters behind the Aswan dam, the solar illumination of the inner sanctuary of the temple can be still be witnessed today around 22nd of February and October each year[10]. These two dates do not mark any specific solar position and are relevant only to the Ramses temple and his cult status as a god.

The solar alignments for Luxor can be shown as[11]:

- Mid-winter sunrise - 116.81°[12]
- Mid-winter sunset - 243° (In practice would be affected by proximity of the Theban Hills.)
- Mid-summer sunrise - 63.48°
- Mid-summer sunset - 297° (In practice would be affected by proximity of the Theban Hills.)

All temples in Upper Egypt would fall within a degree of these figures assuming a level horizon. Actual site azimuths are always dependent upon the exact height of the horizon when viewed from a temple.

The Moon

The lunar cycles are much more complex. They oscillate over a period of 19 years known as the 'Metonic' cycle, named after the 5th century bc Greek astronomer Meton[13]. Unlike the Sun, whose measured progress across the horizon can be checked on a daily basis the Moon's movements appear more erratic, rising and setting in what appears to be arbitrary positions each day. Effectively it swings back and forth across the ecliptic over the space of one month, as opposed to the Sun's annual journey, which is why the Ancient Egyptians called this celestial body "the wander". Like the Sun the Moon does eventually reach an extreme northerly and southerly position, where the amplitude of the swing is at its greatest, but only after 254 synodic months, the Metonic cycle. We have four relevant principle positions which involve both the rising and setting positions of the Moon.

- Northernmost major standstill (most northerly limit of the Moon's position)
- Northernmost minor standstill
- Southernmost minor standstill
- Southernmost major standstill (most southerly limit of the Moon's position)

Half way through the nineteen year cycle of the maximum amplitude of the swing, the oscillation is at its smallest. This is known as the 'minor' standstill position. This effectively means that there are eight potential sighting positions for the Moon if we include both its rising and setting azimuths. There is evidence that monuments like Stonehenge[14] in Wiltshire, England and a number of sites in Scotland such as Caithness accurately measured some of these positions[15]. Like the Sun alignments, lunar alignments still work today, although observing them is often much more difficult, because the cycles are much longer.

There is no accepted textual evidence that the Ancient Egyptians were able to predict eclipses[16] and by inference then the Metonic cycle, although there is no practical reason why the lunar movements could not have been part of Egyptian temple orientation. Certainly the Moon took less precedence than the Sun in Egyptian mythology, nevertheless it was still regarded as an important body and there were a number of gods such as Thoth, Khonsu and Iah[17] that were associated with it. As we shall see there is evidence of the possibility of more than one temple being aligned to one or other of the major lunar standstills.

The Stars

The stellar map of the sky, consistent on an annual basis, only slowly changes through a process known as precession. This is where the stars rotate in relation to the Earth over a period of time of approximately twenty-six thousand years[18]. In practice the rising position of a star, in the course of the average life span, moves by about one degree. Effectively then, any star observations used at the setting out of a temple, known as the 'stretching of the cord' or '*pedj shes'*[19], would no longer be relevant several hundred years later. Because the regnum dates of the different kings are known it is possible to work out the construction dates of their mortuary temples at least within a few years. Cult temples, dedicated to a specific god or goddess, are another matter for we can never be fully sure when the orientation of a temple was established, even if the construction date of the extant temple is known. It might well have been set by an earlier temple built on the same site. Therefore stellar orientations, without textual corroboration, have to remain speculative. However, even here, as we shall see at Denderah, textual information might still not tell the whole story.

Problems

There are a number of problems that confront any study looking at deliberate astronomical orientation of the temples of Egypt. Firstly it is clear that the Ancient Egyptians were not consistent in their temples alignments, which point to many different azimuths and as such to different potential astronomical events[20]. In the case of stellar alignments, the most obvious contenders are the first magnitude stars like Sirius, Canopus, Vega and Arcturus, although constellation groupings like Orion, Cassiopeia and Ursa Major could also have been used. Unless the dating of a temple is accurately known possible star orientations can be notoriously difficult to assess. Time changes of several hundred years can considerably alter potential stellar alignments.

On another level computer assessments are only as good as the algorithms that have been woven into them. As these become more sophisticated the possibility for error becomes reduced, nevertheless the potential for inaccuracy is still there. In assessing several different astronomical software programs as part of this paper, differences of several degrees were found in star declinations, particularly when travelling back in time to the Ancient Egyptian epoch. Cross checking between programmes can help to minimise these errors[21]. What this principally affects, in the case of all stellar orientations, is the precise dating of the monument or alignment orientation[22].

The alignments that can be easily checked today are those connected to the Sun, of which the winter solstice is most in evidence. It occurs in three of our study sites and potentially in a further five temples in the SB study.

Finally this article principally considers astronomical alignments, although it does offer some suggestions for the alignment, when the astronomical events are not apparent. It does not preclude the possibility that other factors, such as the position of the Nile or an alignment to a specific site feature might have been the primary reason for a particular temple orientation.

Methodology

Using the sophisticated tools of today the correct way to check the azimuth of a temple orientation would be to take a series of GPS readings at say the mid point at the back of the temple (point A); move forward to a second position on the axis of the temple, such as the front entrance and then take a further series of readings at the new location (point B). These readings can then be calibrated with local GPS base stations to provide exact latitude and longitude co-ordinates for (A) and (B). It is then possible to calculate accurately the bearing between these two points. This is how all modern mapping is carried out[23]. Even so to do this accurately for each temple site would entail many onsite observations.

Fortunately there is now a simplified way to get around this problem, yet still providing a sufficient level of accuracy to assess the potential astronomical alignment of a temple. This is by using a similar technique based on the alignment projections from a computer mapping programme like Google Earth[24]. In the case of Egypt the clarity is sufficiently good to be able to project temple orientations, in some cases over several kilometres and then take the latitude and longitude co-ordinates at the two terminal points. These projections have been backed up, on occasions, with GPS readings[25] taken on site visits in Egypt[26]. The alignments revealed using this method correspond reasonably closely with the SB study that used a prismatic compass. Where differences occur these have been highlighted.

Explaining, why differences should have occurred in some cases between these two methods is a little more complex. It is clear that in broad terms the azimuths discovered from the map projections, whether north/south (Edfu temple to Horus) or east/west (Karnak Temple) conform sufficiently closely to validate the findings of both methods. The differences where they occur could be down to minor variations, within a temple complex, not obviously perceived from a map projection.

Solar Alignments

The Karnak Temple (Plan 1)

The main alignment of vast temple of Amun known as Ipet-isut[27] on the east bank of the Nile, faces west towards the setting Sun of the Theban hills. Its calculated azimuth of 296º - 53' (SB study suggested 296.75°) corresponds with a mid-summer sunset on a level horizon. This is what Sir Norman Lockyer suggested in 1894[28]. However the height of the cliffs on the far bank of the Nile precludes the observation of such a phenomenon. It is possible that this solar alignment is simply chance, because the temple axis is broadly at right-angles to the Nile at this point so that it could have been the river rather than any astronomical events that determined the temple's axis. This might be a tenable hypothesis if it were not for the fact that a number of other temples in Ancient Thebes and elsewhere in Egypt are aligned, to within ±1° on the same axial azimuth[29]. This degree of precision supports the astronomical argument for the orientation, for a meandering river orientation would never have been as exact, as is evident from Plan 3.

Fig. 1.
Amun Sanctuary at Karnak. The horizon can very nearly be seen beyond The Festival Hall of Thutmose III

In the case of Ipet-isut, a more plausible explanation is that the temple orientation was set to the opposite solar event of the mid-winter sunrise, which is a case that has been argued elsewhere[30]. The solstice phenomenon could have been observed when the original temple was laid out, however the construction of the 'holy of holies' sanctuary and other buildings to the east, such as the Festival Hall of Tutmosis III, would appear to have blocked this phenomenon being observed at ground level, particularly from the central avenue of the temple.

Unlike Newgrange in Ireland[31], where the golden light of the rising mid-winter Sun slowly illuminates the inner chamber, the Karnak alignment could not obviously work in the same way. At first observation the Sun shining from behind the sanctuary would only symbolically appear to illuminate the aisle of the temple. However, unlike almost every other temple in Egypt, the present sanctuary of Amun has two doorways; a main door that faces out to central aisle of the temple and a secondary rear doorway, opposite the first, facing east towards the morning Sun. Despite the visual obstructions of the "Festival Hall" of Tutmosis III and Nectanenbo's Gateway, a point close to the horizon can still be seen in the Fig 1 picture, and as such, the mid-winter solstice could possibly have been witnessed from within the sanctuary[32]. One might speculate that at special moments, such as the mid-winter sunrise both doors could have been opened to allow dazzling sunlight to flood the aisle from behind the 'golden statue of Amun. Such an effect could have been awesome.

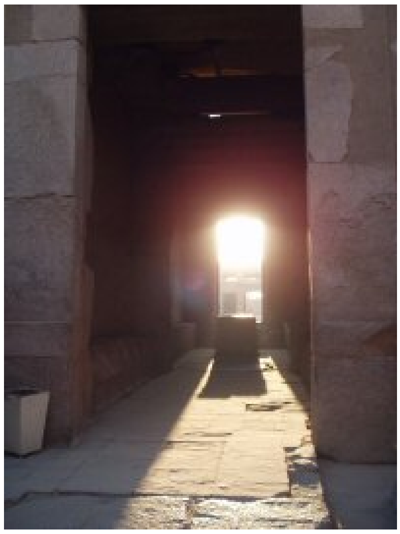

Fig. 2.
Sunrise shining through the back of the Amun-Ra Sanctuary.

The present "holy of holies", was built circa 323 bc by Philip Arrhidaeus[33] the half brother of Alexander the Great. It is the last of a number of shrines that have stood on this sacred spot for it known that, at the very least, both Thutmose III and Hatshepsut had erected shrines to Amun here. One of these shrines still exists. Fortuitously we now know from its reconstruction that Hatshepsut's Red Chapel[34], which originally stood on the site, also had a rear door like the existing sanctuary. It would seem, therefore that the present chapel, with its two doors, was following a much older tradition. If this is the case, based on the present photographic evidence, it would seem that the mid-winter sunrise could have been observed, from within the sanctuary dating back, at least to the New Kingdom period around 1460bc. What might have happened prior to that time is difficult to determine; yet if the solstice sunrise was an important feature within the temple we might expect this event to have featured from the earliest period of its construction.

Although the Amun sanctuary is very unusual in having two sets of doors it does raise the possibility that other temple axes could have been established irrespective of the facing direction of the inner sanctuary, which generally, although not always, points towards the Nile. Therefore in looking for astronomical alignments it would seem prudent to look in both directions, along the axial line of the temple.

Before leaving the Karnak complex it is worth noting that the SB study suggests three other, directly facing, mid-winter alignments in the Karnak temple that look towards the rising Sun. These are the "high room of the sun" on the roof of Festival Hall of Tutmosis III; the Amun-Ra shrine built by Queen Hatshepsut and the shrine of Re-Horakhty[35]. This present paper suggests that the sanctuary should also be added to this list.

Hatshepsut Temple at Deir El Bahari (Plan 2)

On the opposite bank of the Nile, on an almost exact reciprocal bearing to the Karnak temple is the beautiful mortuary temple of Queen Hatshepsut[36] built by her architect Senenmut during her reign which lasted from 1473–1458 bc[37]. The azimuths of these two temples are offset from each other by about three hundred and eighty-five metres. The SB study suggests that the orientation of Hatshepsut's temple is 115.5 º, against the calculated Google Earth azimuth of 116 º - 53'[38]. When projecting both the

Hatshepsut and Karnak` alignments across the landscape one is immediately struck by their parallel nature (see Plan 3).

Fig. 3
Hatshepsut Temple – Deir El Bahari

Queen Hatshepsut perceived herself as the divine daughter of Amun-Ra, which is how she asserted her claim to the throne of Egypt. It is hardly surprising then that her temple should mirror, in its alignment, that of Amun's temple on the opposite bank of the Nile. There can be little doubt that the alignment to the mid-winter sunrise was clearly intended in the orientation of this temple. This has been confirmed to me by the site guards but not yet witnessed by me personally. The view from the upper terrace level provides a panoramic outlook towards the far distant eastern horizon and there is every indication that the rising sun of mid-winter would illuminate the inner recesses of the central chapel.

Amenhotep III Temple at Qurna (Plan 4)

About a kilometre and a half south of Hatshepsut's temple lies the scattered remains of the temple of Amenhotep III, who reigned from 1390 – 1352bc[39]. Little now is left of this once great temple saving two famous statues of the king, known as the Colossi of Memnon that stand as huge sentinels, looking out towards the morning mid-winter sun, at its eastern end. Its orientation, however, can be easily established both through the statues and from a road that abuts the temple and runs straight for three and a half kilometres to the bank of the Nile. The calculated azimuth of the temple is 116° - 25' against the SB study of 117°, making this another mid-winter sunrise alignment in the Luxor area.

Other Solar Orientated Temples

Other temples that point towards a mid-winter sunrise include:[40]

- Horus Temple — 117° (Thoth Hill)
- Montuhotep — 117° (Deir El Bahari)
- Amenhotep 1 — 115½º (Deir Medina)
- Satet — 118½º (Elephantine)
- Re-Horakhty — 117º (Abu Simbel)

Lunar Alignments

At the latitude of Luxor or ancient Thebes the four major lunar alignments, assuming a level horizon, are as follows:[41]

Northern major standstill Moon rise -	58º ± 0.3º
Southern major standstill Moon rise -	123.5º ± 0.3º
Southern major standstill Moon set -	236.5º ± 0.3º
Northern major standstill Moon set -	302º ± 0.3º

The proximity of the Theban Hills, on the west bank of the Nile would affect the setting azimuths, which could only be checked against specific temple orientations. Looking east the horizon is more even, however hills about thirty-three and a half kilometres to the east of Luxor[42] could also slightly affect the sighting azimuth. One temple that points towards one of the Moon rise azimuths is the Qurna mortuary temple of King Seti I, who reigned from c. 1294 – 1279 bc[43].

Seti 1 Temple - Qurna (Plan 5)

The placement of this temple is intriguing for the projected central axis alignment from the Amun's temple at Karnak very nearly hits the entrance gateway of Seti's temple[44]. It would seem that this connection was deliberate, linking Seti with his cult temple and the god Amun-Ra. Seti was responsible for setting out the Great Hypostyle Hall that was finished by his son Ramses II and would therefore have been intimately aware of the Karnak temple's alignment. The distance between the two entrances is a little over three kilometres and involves the crossing of the Nile. This would not have been a problem for the Ancient Egyptian surveyors, and some form of causeway must have linked the two temples, not unlike the one that connected the Luxor temple with Karnak, for the Seti's temple was the first stop in the "Beautiful Feast of the Valley" festival[45].

This being the case it would seem logical for Seti to have followed this same mid-winter sunrise azimuth for the orientation of his mortuary temple as did Hatshepsut before him. He chose instead to align his temple on an azimuth of 124°[46], which happens to be very close to the azimuth of the lunar rise at its most southerly limit. Was this a coincidence or could it have been intentional?

There seems to be no limiting site factors that would affect the orientation of the temple, nor does it appear to be orientated to any significant stellar events. The only significant astronomical orientation is to the Moon and here we hit a problem for, as already stated, there is no textual evidence that the Ancient Egyptians were aware of the 'Metonic' cycle (19 years), or indeed that they could predict eclipses[47], which is another lunar phenomenon.

We will never know what was lost in the great burnings of the Alexandrian library but as I have argued elsewhere in relation to pyramid geometry and the 3:4:5 triangle[48], the lack of textual evidence does not prove that the Ancient Egyptians were not fully cognisant of such things.

In the cult triad of Karnak (Amun, Mut and Khonsu) the god Khonsu[49] was associated with the Moon, which also set a pattern of time sequences that established the lunar months of the Egyptian calendar. With their clear ability to observe, record and name the major stars and constellations of the night sky, it would be strange if the Egyptian priesthood did not track the rising and setting positions of the Moon.

Did Seti like Hatshepsut before him, perceive himself as the son of the god Amun-Ra and therefore, in his case, identify himself with Khonsu, with its lunar association? In returning Egypt back to the 'established order' after the Armana revolution one is forced to the conclusion that there had to be a very good reason why Seti chose a different orientation for his temple from that of Amun's temple on the opposite side of the Nile. It is also a curious fact that one of the suggested years of the Seti's accession to the throne, in 1306bc[50], the Moon just happened to be at its extreme southerly limit[51]. This might suggest that the link to this southern major standstill of the Moon was a lucky coincidence but for another intriguing fact.

Fig. 4
The Ptah Temple – Karnak.
This temple is aligned to a significant lunar position, known as the southernmost major Moon standstill.

Seti's full name from his cartouche was *Seti Merenptah*, which translated means "Seti beloved of Ptah"; Ptah being one of the creator gods of Egypt. Within the Karnak complex there is a small temple dedicated to Ptah. It is recorded on the temple walls that a previous wooden temple of Ptah temple was re-built in stone by Tutmosis III, who preceded Seti by some one hundred and seventy years. This small temple is orientated on an azimuth of 304º, which makes it another potential lunar orientated site. However like the Karnak alignment it faces the Nile and the hills opposite would have precluded any sighting of a Moonset. The orientation of the temple could therefore have been set to the Moonrise azimuth, at its extreme southern limit of 124º, which corresponds neatly with Seti's temple alignment[52]. That these two temples are on similar azimuths, yet separated in time by nearly two centuries suggests that something other than the Sun[53] or the stars must have determined these temple orientations.

In addition to this the northern perimeter wall of Karnak, which runs alongside of the Ptah temple, follows for a large part the same azimuth. This suggests that the Karnak temple incorporated alignments to both the Sun and the Moon in its orientation and construction, which is logical bearing in mind the association of Amun-Ra to the Sun and Khonsu with the Moon (see Plan 1).

There is not space within the context of this article to explore the relationship between Ptah and the Moon, except to state that there are similarities in the depiction of Ptah and Khonsu. However Khonsu's own sanctuary at Karnak is not aligned to any lunar event.

Other Lunar Orientated Temples

From the SB study there is one other temple that suggests a possible lunar azimuth:

Khnum Temple 56º (Esna).

This could align to the Northernmost Maximum Moon rise, depending on the eastern horizon view, from the Esna temple. This has not yet been checked.

Stellar Alignments

For the reasons already given stellar alignments are much more difficult to determine. The following section highlights these problems and offers some suggestions and possibilities on how the Ancient Egyptians might have used the stars in the setting out of their temples.

Ramses III Temple at Medinet Habu (Plan 6)

The first temple we shall look at was built by Ramses III at place now known as Medinet Habu, which is in the Luxor area. The alignment of this temple highlights all of the problems associated with assessing stellar associations. Its calculated azimuth is 138º - 42'; whilst the SB study suggests a marginally smaller figure of 137.5º. We can therefore assume that any major stars or astronomical events close to 138º or to its converse angle of 318º (looking in the opposite direction), would fit a possible stellar alignment. As these azimuths lie outside of the plane of the ecliptic we can discount any relationship to the Sun or Moon. Any associations, if they exist, must be to the stars.

Fig. 4
Ramses III Temple – Medinet Habu. The visual alignment can be clearly seen with the Theban cliffs just showing in the background beyond the temple.

Ramses ruled from 1184bc to 1153bc[54] so these are likely to be the key dates for the temple's orientation. However other temples existed on the site so we cannot discount the possibility that the temple's orientation had already been determined at an earlier time[55].

The astronomy programme was first run to the 138º azimuth, towards the eastern horizon. It showed no possible major star rising alignments or constellations for a period extending from 1160bc to 2000bc and beyond; looking in the opposite direction on a 318° azimuth, towards the Theban hills, initially appeared more hopeful.

The two potential alignments emerged for the stars Vega and Arcturus, which are both within the top seven brightest stars in the sky. Looking west towards the hills affects the visual extinction of the stars, which through calculation would have to be at a height of just over 9 degrees from a level horizon. Watching stars drop behind a hill, as opposed to disappearing on a level horizon has some advantages. It avoids a problem known as atmospheric extinction, where the density of the atmosphere affects the luminosity of any celestial body. The closer to the horizon the denser the atmosphere becomes, which is why it is possible to watch the rising or setting Sun. In a country like Egypt bright stars will disappear from a level horizon around a height of 2 degrees[56] and fainter stars a degree or two higher. Star alignments have to take this extinction effect into account.

The figures for two different astronomical programmes are shown below for a height of 9 degrees:

Temple azimuth = 318 º

Redshift:

1190 bc	Vega	311 º
1190 bc	Arcturus	309 º
2000 bc	Vega	314 º
2000 bc	Arcturus	315 º
2700 bc	Vega	316 º
2700 bc	Arcturus	320 º

StarCalc:

1190 bc	Vega	310 º
1190 bc	Arcturus	308 º
2000 bc	Vega	312 º
2000 bc	Arcturus	313 º
2700 bc	Vega	314 º
2700 bc	Arcturus	318 º - The temple azimuth.

From these figures it is clear that the only possible 1st magnitude star that fits is Arcturus but only if we travel back in time, more than fourteen hundred years to the Old Kingdom period and this seems very improbable. So does this mean that there are no other possible stellar choices?

If we turn instead to look at the constellations there is one possible option; Cassiopeia, known for its giant 'W' formation in the sky, sets on the required bearing. Around 1190bc the last tail star of the formation known as Segin, disappears on an azimuth of 318º.

If stars played a part in the orientation of Ramses temple it must be to the faint star Segin and the constellation of Cassiopeia that we have to look and like the Karnak temple the azimuth was not aligned to face the star but away from it. Clearly in these cases it is the Nile that determines primary direction of the temples orientation.

Amenhotep III Temple - Luxor (Plan 7)

The next temple that forms part of this study is the Luxor temple of Amen-Re. A Middle kingdom temple[57] originally stood on this site but the temple was substantially rebuilt by Amenhotep III. Known to the Egyptians as Ipet-resyt and to us as the Luxor temple it was extensively surveyed by Schwaller de Lubitcz[58] in 1937 who suggested many subtle aspects woven into its design, including that of precession, for a later king, Ramses II, added an extension to the temple on a slightly different azimuth, making this temple almost unique.

The calculated main temple axis of Amenhotep III is 33º - 44'; which agrees with the SB findings. The Ramses additions are aligned with an avenue of sphinxes which runs directly through to the Karnak temple, more than 2.8 km away. Effectively this extension skews the axis of the temple by about 11° to a new azimuth of 44º - 36'. The SB study shows this at 42.5º. On these azimuths both the temple and sphinx avenue could only be aligned to the stars.

Unfortunately in the case of Amenhotep's temple there are no 1st magnitude stars, or principle constellations that fit construction dates, whether looking towards the north or south. Schwaller de Lubitcz suggested that orientation was set on the rising of Vega. For this to have worked the temple construction would need to have been laid out around 3600bc, a very improbable date. The best that can be offered, by way of astronomical orientation, is the stars of the Southern-Cross that broadly fits the southern azimuth but this would have been too high in the sky to produce an exact alignment. Despite de Lubitcz assertions, one is forced to the conclusion that the stars were not a principal factor in the alignment of this temple; rather it was the association to the Nile that established its orientation, for the river is both close and runs parallel to the axis of the temple. Naturally we cannot be certain that this was the case in Amenhotep's time but it does offer the most plausible explanation (see plan 3).

Ramses II Temple and the Avenue of the Sphinxes (Plan 8)

We can now turn to Ramses II temple and the avenue of sphinxes leading to the Karnak temple. On an azimuth 44 º – 36' the rising of the 1st magnitude star Vega very neatly fits the assumed construction date c. 1279bc[59]. The avenue of sphinxes, as has been stated, runs in a straight line from the entrance of the Ramses II temple to the south-west corner of the boundary wall of the Karnak temple, where it joins a secondary avenue of sphinxes from the Mut temple.

At first glance the sighting to Vega suggests this had to be a primary element in the alignment of the avenue. However, by hypothetically projecting the avenue a little further, one finds that it is exactly aligned to the main sanctuary of Amun-Ra at the heart of the Karnak complex. Even in Ramses' time there would be no direct line of the sight, but a mythic bow shot from the sanctuary roof in Karnak, would exactly follow the avenue of sphinxes, through the entrance gateway of Ramses temple to the middle of its far end. This alignment could easily have been established through simple surveying techniques and may therefore have nothing to do with star alignments.

Here again one faced with another level to the problem in assessing star alignments. What takes precedence? Was the alignment to Vega a fortuitous co-incidence or was it deliberate? These are insuperable questions and may never be satisfactorily answered, even if it is possible to establish the precise date when the avenue that linked the two temples was first laid down.

Mut Temple at Karnak (Plan 9)

Before moving away from the Karnak area one other temple and its attendant alignment deserves mention. A temple dedicated to the goddess Mut, built by a succession of pharaohs, that included Hatshepsut, lies a little way to the south of the main Karnak temple complex[60]. To the rear of the Mut temple there is a horse shoe lake, which must have created a beautiful setting for this now much ruined structure. An avenue of sphinxes also runs from its gateway towards the Karnak complex, which is then picked up by additional buildings so that a straight alignment can be walked for two thirds of a kilometre. Before reaching the central axis of the Karnak temple the alignment deviates to being at right-angles to the median line, but if uninterrupted would have hit the middle of the great Hypostyle Hall.

Fig. 6
The Sphinx Avenue from the temple of Mut at Karnak

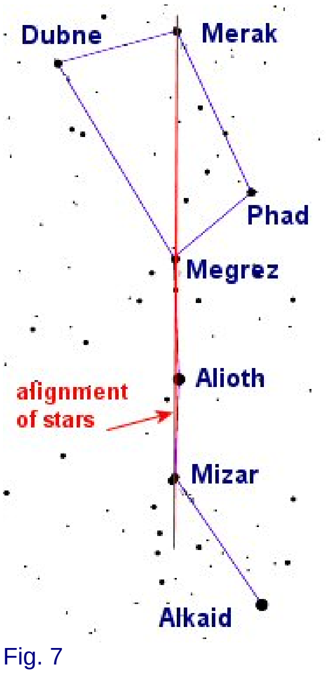

Fig. 7
Alignment of stars in Ursa Major. The Ancient Egyptians called this grouping *Meskhetu.*

The calculated alignment azimuth is 19º- 14' as opposed to the SB calculation of 18 degrees. The proximity to north suggests an orientation towards the tail stars of Ursa Major or the Great Bear, which we know as the 'Big Dipper' or 'Plough' but to the Ancient Egyptian was known as *Meskhetu*[61]*.* This star grouping was perceived as the thigh and leg of a bull. To ancient minds the stars that never set were generally regarded with special awe; to the Ancient Egyptians they were the imperishable ones. We know from textual references[62] (see Denderah temple) that these stars were used in the setting out of temples, but quite how is still unclear. Obviously it is not possible to sight to their rising or setting positions, so how might this constellation have been used. When observing the tail stars of Ursa Major, it becomes apparent that at certain times they are in vertical alignment to the ground. Indeed four of the seven stars, Merek, Megrez, Alioth and Mizar, very nearly line up in this way. Being high in the sky about twenty degrees above the horizon and in an arc of only twenty degrees they are not difficult to observe. By using a simple weighted plumb bob, which the Egyptian called the *Merkhet*[63], it would have been easy task to establish an orientation, when these stars were in vertical alignment. If we take a date of around 1190 bc for the main temple construction we find such an alignment to *Meskhetu* on an azimuth of just under 19°, which neatly fits the temple and sphinx avenue orientation. The difficulty here is that this alignment only works close to a date of around 1200 bc. Three hundred years earlier, during the reign of Hatshepsut, the *Meskhetu* alignment would have been two degrees off the bearing.

The Mut temple, along with its attendant sphinx avenue could have been astronomically aligned to the suggested stars of constellation of Ursa Major or *Meskhetu* for the dates given. The other possibility is that the intended alignment was to the centre of the Great Hypostyle Hall and as such had nothing to do with the stars.

Hathor Temple at Denderah (Plan 10)

The dating of this magnificent temple can be very precisely set to 54bc because of textual information[64]. However we also know that an early Middle Kingdom temple resided on this site so any alignment might have been set at a prior time. The temple is on an azimuth of 18º - 7' which accords with the SB study. Textual information of the setting out of the temple tells us that the alignment was to *Meskhetu* or the Ursa Major stars. At the latitude of Denderah not all of the stars of Ursa Major are visible all of the time, with the tail of the constellation, the star Alkaid, disappearing briefly at its lowest descent before re-appearing again as the constellation climbs back up into the heavens. Around 54bc this reappearance would have been very close to 18 degrees and therefore this is the most likely orientation for the temple. The SB study put this forward as the main contender[65].

However there are two other possibilities. Firstly, as already mentioned, the extant temple was but the latest incarnation of other temples that have stood on this site. If we project back in time to the Middle Kingdom then other possibilities with orientations to the '*Meskhetu*' become possible. Around 1400bc a similar alignment to that suggested for the Mut temple would certainly have worked.

Secondly, at the rear of the Hathor temple and orientated at 90 degrees to it lies the temple of Isis. The azimuth of this temple is 108º- 29' and at 54bc the star Sirius, so important to the Ancient Egyptians, would have been seen rising on the eastern horizon on the same azimuth. We therefore have three possible contenders for astronomical orientation for this temple. The most likely, particularly because it is backed up by textual evidence is that put forward in the SB study, namely the orientation to the re-emergence of Alkaid after its descent below the horizon. This is still, at best, an educated guess.

Horus Temple at Edfu (Plan 11)

This temple is dated textually to 272bc. It is the best preserved of all of the Egyptian temples and lies approximately on a north/south axis. Like the Hathor temple it was built on a site that had been used since antiquity. The calculated Google Earth alignment from sanctuary to entrance is on a bearing of 181º- 58' which accords well with the SB study of 181.75º. Had the temple been set to an exact north/south meridian the alignment conclusion would be that it was simply orientated to the cardinal points of the compass. This would have been following the traditions of the Old Kingdom pyramids[66] and recognition perhaps of Horus' ancient mythological roots that stretched back into the Archaic period[67]. An error of half a degree or even one degree might have been acceptable but one and three-quarter degrees would seem deliberate, bearing in mind that in the case of the Great Pyramid the Ancient Egyptian were able to obtain accuracies down to seven minutes of arc.

The problem with such an orientation is that there is no obvious astronomical fit. The 'stretching of the cord' ceremony, depicted on the temple walls, suggests an orientation towards *Meskhetu* or Ursa Major. Unlike the Denderah temple, where the reappearance of Alkaid could have set the alignment, nothing of a similar nature occurs on Edfu temple's azimuth, for at this location Alkaid rises on an azimuth close to 17°. It is just possible that the bucket stars of Merak or Phad could have set the orientation, for, at this latitude, these stars also disappear or come very close to it, through atmospheric extinction. Of the two Merak is the most likely contender but this would be very difficult to demonstrate, with any certainty today.

It is possible that the temple is orientated on some other basis that is now lost to us, or perhaps we need to look in a different direction for the orientation, possibly at right angles to the present main axis. Even here would require a jump back in time to make sense of a stellar alignment. Around 770bc Betelgeuse, one of the main stars of Orion could be found descending on the western horizon on an azimuth of 272°. Going further back in time to the 2nd Intermediate period around 1700bc this same star could be found rising towards the east on an azimuth of 93°. Neither of these alignments is very convincing.

Topographically the Edfu temple is situated in level terrain, and runs very approximately parallel to a bend in the Nile some one kilometre away. The surrounding countryside is flat, so there are no obvious hills on which the temple is sighted. Its north/south axis is close to its twin temple of Hathor at Denderah but not sufficiently close to be an obvious match. The Horus temple faces towards the south, while the Hathor temple points to the north, the difference between the two entrances being about 164 degrees. Whether there is some long lost esoteric significance in the difference in these azimuths we are unlikely ever to know. Frustratingly the Edfu temple does not appear to have any obvious clear alignments, excepting as stated and in this sense it is reminiscent of the Luxor temple. Yet because of the distance from the Nile it is difficult to see how the river could have been instrumental in the setting out of the temple.

With the incredible skill and attention to detail shown in the Edfu temple it is hard to credit that the alignment was arbitrary. The most likely explanation is that the alignment was set from some subtle combination of the *Meskhetu* stars. Without further information this has to remain entirely speculative.

Summary

This study has attempted to provide some insight into the setting out of different temples in Egypt using the Google Earth programme. Clearly in some cases topographical features played a prominent part; in others astronomical alignments were also significant. Those temples orientated towards the Sun or Moon would still work today perhaps requiring only the right time to check them out. Stellar alignments are likely to be much more suspect because of precessional changes and the difficulty in fixing dates. Some star based temples, such as that of Denderah are backed up by textual information and this certainly helps in any interpretation.

The temples studied here only scratch the surface in relation to the many extant temples in Egypt. Further work is required in this area, which fortunately now can be extensively done with the aid of computers.

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[2] Paulson, Joel – Surveying in Ancient Egypt WSHS 2.2 FIG Working Week 2005
[3] Lehner, Mark – The Complete Pyramids (Thames and Hudson 1997)
[4] Petrie, Sir William Flinders – The Pyramids and Temples of Gizeh (London) 1983
[5] This is fully discussed in the paper by Shaltout M. Belmonte J A – On the Orientation of Ancient Egyptian Temples 1: Upper Egypt and Nubia ref: JHA 36 (2005), 274-98.
[6] See p.15 - Astronomy Programmes in Computer Programmes of this study
[7] Shaltout M. Belmonte J A – On the Orientation of Ancient Egyptian Temples 1: Upper Egypt and Nubia published in JHA 2005
[8] The calculated azimuths are based on the latitude and longitude co-ordinates at each end of the alignment derived from the Google Earth mapping programme. As such the azimuth can be calculated to seconds of arc.
[9] North, John – Stonehenge (Harper Collins, 1996) Appendix 6 p. 579
[10] Wilkinson, Richard – The Complete Temples of Ancient Egypt (Thames and Hudson 2000) p. 226
[11] This was originally based on the SB study but has been confirmed by the astronomical computer programmes.
[12] Based on an excellent online calculator can be found at http://www.iol.ie/~geniet/eng/decli.htm
[13] Royal Greenwich Observatory Information Leaflet No. 5: 'The Metonic Cycle and the Saros'.
[14] Heath, Robin – Sun, Moon & Stonehenge (Bluestone Press 1998) p.49
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[16] Smith, David G – Total solar eclipses in Ancient Egypt – a new interpretation of some New Kingdom texts http://www.egiptomania.com/EEF/Blindness.pdf
[17] Wilkinson, Richard – The Complete Gods and Goddesses of Ancient Egypt (Thames and Hudson 2003)
[18] Cornelius , Geoffrey and Devereux, Paul – The Secret Language of the Stars and Planets (Pavilion 1996) p.22-23
[19] Paulson, Joel *op cit* (ref. 2)
[20] Shaltout M. Belmonte J A *op cit* (ref. 7)
[21] The only evaluation of different astronomical programmes that I could locate can be found at web address: http://www.iol.ie/~geniet/eng/skyprog.htm . The programmes used in this study were Redshift 5.1; Starry Night Deluxe Edition 6; StarCalc ver 5.73 and MyStars ver 2.7 . The initial assessment was generally made using StarCalc because of its ease of use and then checked back against two or more of the other programmes. Both StarCalc and Starry Night performed slightly better than Redshift 5.1 and MyStars was not evaluated.
[22] Establishing a precise dating with a stellar alignment is exceptionally difficult for many different factors need to be considered, not least of which is the accuracy of the computer programme. Best estimates would probably be no better than ± 100 years.
[23] The Ordnance Survey Department of the United Kingdom produces a series of online pages detailing many different aspects of surveying methods including the use of GPS equipment. See http://www.ordnancesurvey.co.uk
[24] For Google Earth programme see http://earth.google.com/
[25] Readings from a few temples were taken when I was interested in an approximate idea of the temple orientation. In these cases only one reading was taken for each point and therefore subject to a greater degree of error, yet still giving an idea of the orientation. For example the Karnak temple showed a GPS azimuth of 296° - 5'-23.1" against Google Earth 297°-44' and the SB study of 296.75°.
[26] Being a relatively modern system I can find no detailed examination of the accuracy of Google Earth in determining an alignment azimuth. Two tests that I have carried out in the UK using a Garmin 12 XL GPS suggest errors no greater than ± 10' of arc. Test 1 over a distance of 1391 metres on an approximate north/south bearing gave an azimuth for the GPS of 344° - 32'- 24.28" against 344° - 26'- 45.83" for Google Earth. Test 2 over a distance of 986 metres on an approximate west/east bearing gave an azimuth for the GPS of 84° - 25'- 18.66" against 84° - 27'- 34.94" for Google Earth. In each case ten separate GPS readings were taken for each point and the co-ordinates averaged to produce the best datum fix. This normally produces accuracy down to ± 3 metres. Over a one kilometre distance the deviation would be ± 21 minutes of arc. This area does need to be further checked preferably on site in Egypt, However an assessment of the accuracy of the azimuths being ± 30 minutes or 0.5 degrees seems reasonable.
[27] Wilkinson, Richard *op cit* (ref. 10) p.154
[28] Lockyer, Sir Norman *op cit* (ref.1)
[29] Shaltout M. Belmonte J A *op cit* (ref. 7)
[30] Shaltout M. Belmonte J A *op cit* (ref. 7)
[31] Cornelius , Geoffrey and Devereux, Paul *op cit* (ref. 18) p.130-131
[32] The construction of houses in the village behind the temple and changes in ground level from the time when the temple fell into disuse would preclude this event being witnessed today.
[33] Wilkinson, Richard *op cit* (ref. 10) p.158
[34] Partridge, Bob – The Red Chapel of Hatshepsut (Ancient Egypt Magazine Vol 2 issue 6)
[35] Shaltout M. Belmonte J A *op cit* (ref. 7)
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[37] Rice, Michael – Who's Who in Ancient Egypt (Routledge 1999) p.80
[38] The difference in orientation between this study and the SB study here can be explained because the façade of Hatshepsut's temple is skewed by a little over 1° from the alignment of the causeway and ramped entrance.
[39] Rice, Michael *op cit* (ref. 35) p.15
[40] These azimuths have been taken from the SB study and not checked against the Google Earth programme.
[41] Based on an excellent online calculator can be found at http://www.iol.ie/~geniet/eng/decli.htm
[42] This has been checked using the Google Earth programme.
[43] Rice, Michael *op cit* (ref. 35) p.187 [It is appreciated that different views are held about the accession date of Seti I – see Towards an Absolute Chronology for Ancient Egypt by William Murray]
[44] The calculated offset from the Google Earth programme of the extant temple is 21.81 metres. Some form of causewayed entrance would need to extend for about 166 metres from Seti's temple for the alignments to match.
[45] Wilkinson, Richard *op cit* (ref. 10) p.174
[46] The SB study shows this as 124°, whilst the Google Earth projection is 124° - 51'
[47] There is much discussion on this theme in Jane Sellers book "The Death of Gods in Ancient Egypt" and elsewhere.
[48] Furlong, David - Sekeds and the Geometry of Egyptian Temples: http://www.kch42.dial.pipex.com/sekes0.htm
[49] Lurker, Manfred – The Gods and Symbols of Ancient Egypt (Thames and Hudson 1974) p.74
[50] West, John Anthony – the Travellers Key to Ancient Egypt (Quest Books) p.443
[51] See Nasa's online lunar ephemeris http://ssd.jpl.nasa.gov/horizons.cgi
[52] The calculated Google Earth azimuth for the Ptah temple orientation is 124° - 54', which makes difference in azimuth between Ptah and Seti's temple only 3 minutes of arc.
[53] At 124° the azimuth lies too far south to be a solar alignment.
[54] Rice, Michael *op cit* (ref. 35) p.166
[55] Wilkinson, Richard *op cit* (ref. 10) p.193
[56] Schaefer, Bradley E – J.H.A. xxxiii (2002) "For an extinction coefficient of 0.25 magnitude of airmass (a clear sky), the extinction angle is 1.5°, 2.0°, 2.8°, 4.2°, 6.6° and 13.5° for stars of 0, 1, 2, 3, 4 and 5 magnitude brightness."

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[58] Schwaller de lubitcz, R. A. – The Temple of Man (reprint: Inner Traditions Bear and Company 1982)
[59] Rice, Michael *op cit* (ref. 35) p.165 – The accession date of Ramses II
[60] Wilkinson, Richard *op cit* (ref. 10) p.163
[61] Lull, José – La antique constelcaión egipcia de Mesjetiu (Aqueoastronomia – Huygens No. 61) p.8-14
[62] Shaltout M. Belmonte J A *op cit* (ref. 7)
[63] Paulson, Joel *op cit* (ref. 2)
[64] Shaltout M. Belmonte J A *op cit* (ref. 7)
[65] Shaltout M. Belmonte J A *op cit* (ref. 7)
[66] Magli, Giulio – On the Astronomical Orientation of the IV dynasty Egyptian Pyramids and the dating of the Second Giza Pyramid – (Departmentio di Matematica, Polotecnico) et al.
[67] Lurker, Manfred – The Gods and Symbols of Ancient Egypt (Thames and Hudson 1974) p.65-7

Computer Programmes

Astronomy Programmes

Starry Night	Complete Space and Astronomy Park Deluxe Edition 6
Red Shift	Deluxe Edition 5.1
StarCalc	ver 5.73
MyStars	ver 2.7

Mapping

Google Earth Plus	ver 3.0.0762

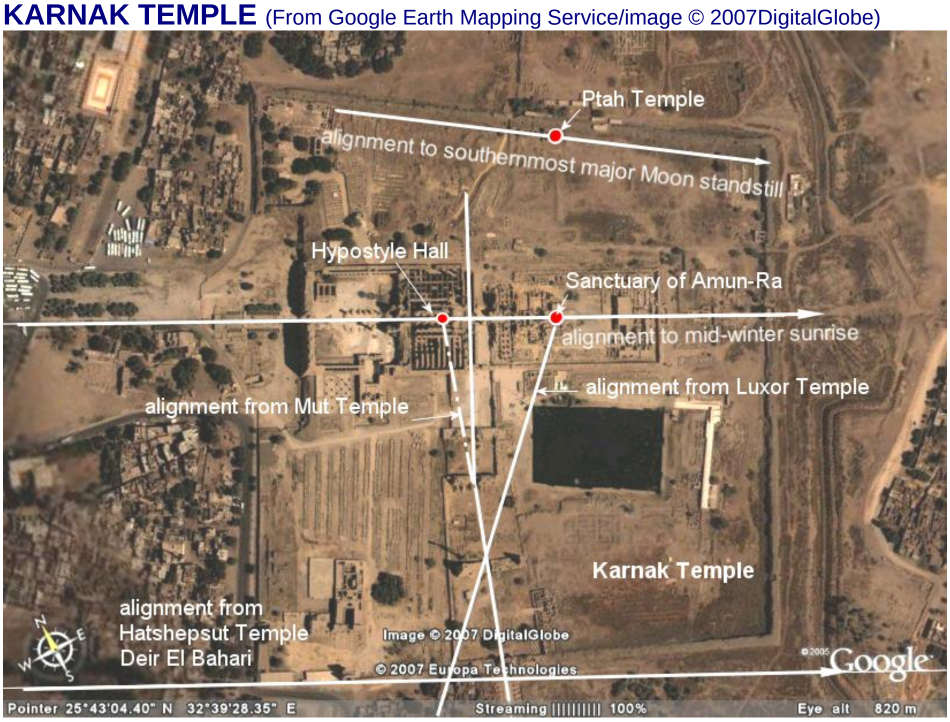
Azimuth Calculator

http://www.wherearewe.co.nz/greatcircle.html

Plans

Plans of the different Temple sites taken from Google Earth mapping Programme.
See http://earth.google.com/download-earth.html

KARNAK TEMPLE (From Google Earth Mapping Service/image © 2007DigitalGlobe)

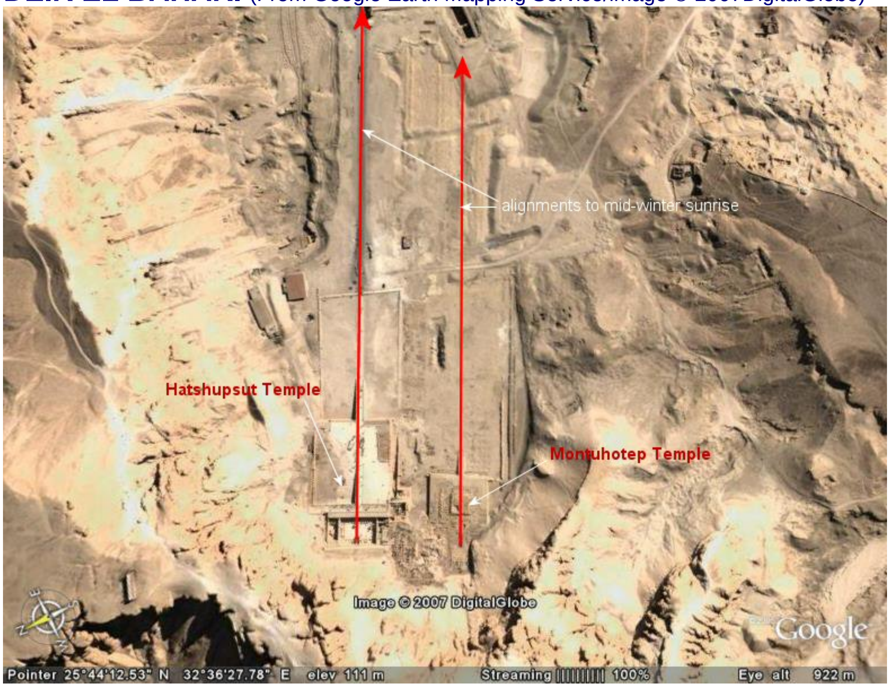


Plan 1

Karnak Temple - The plans shows the main temple axis alignment to mid-winter sunrise. A secondary alignment to southern major standstill moonrise is shown on the north of the plan. This alignment coincides with the orientation of the temple of Ptah and also runs parallel with the boundary wall of the temple.

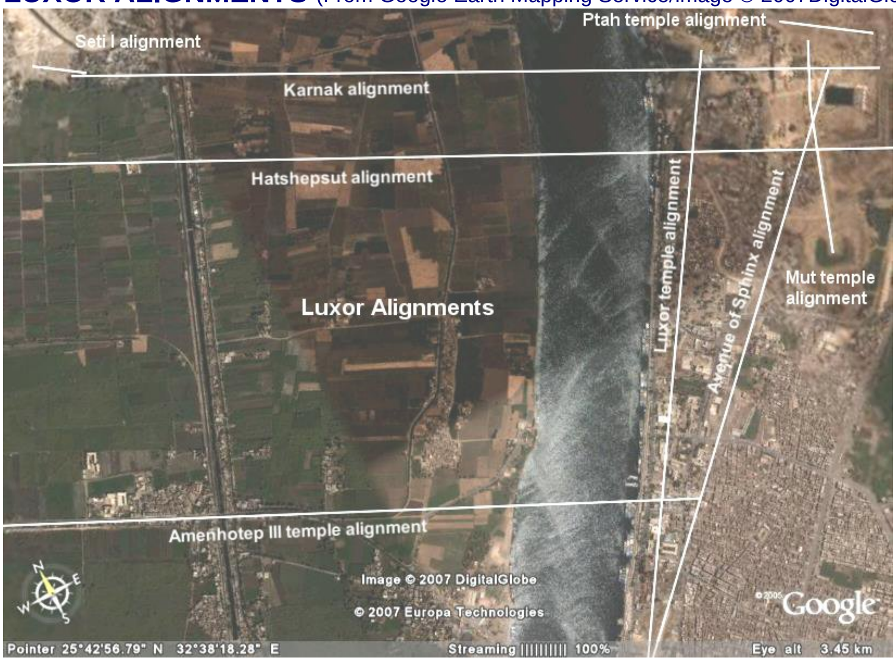
Other projected alignments are also shown running from the Luxor Temple, the Mut temple and Hatshepsut's temple in Deir El Bahari.

DEIR EL BAHARI (From Google Earth Mapping Service/image © 2007DigitalGlobe)



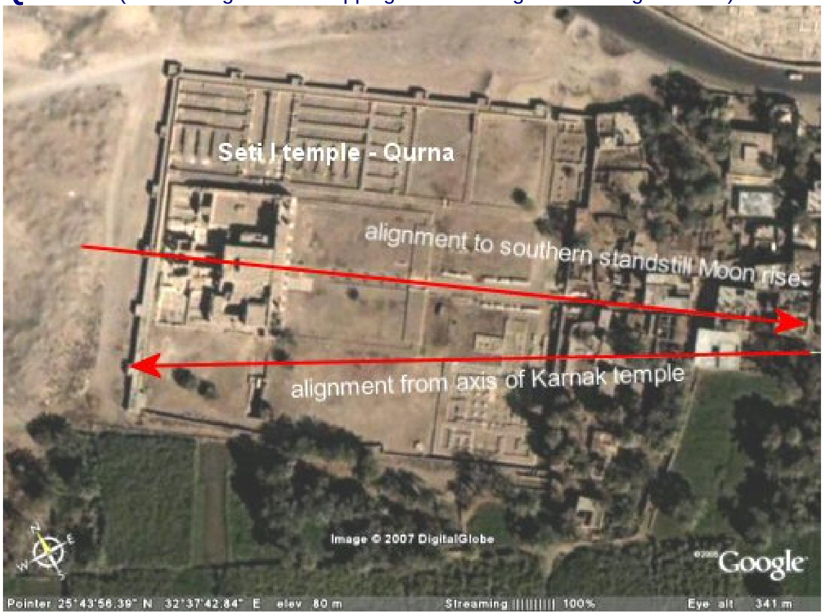
Plan 2.
Hatshepsut and Montuhotep temples at Deir El Bahari are both aligned to the mid-winter sunrise.

LUXOR ALIGNMENTS (From Google Earth Mapping Service/image © 2007DigitalGlobe)



Plan 3
Plan of the Luxor area showing the alignment projections from the different temple sites. The alignments from the temples of Karnak, Hatshepsut and Amenhotep III are all related to the mid-winter sunrise. The alignment from Seti I temple and the Ptah temple relate to the southernmost major standstill of the Moon. Note also that the alignment from the Luxor temple runs parallel with the Nile. It was this feature the probably determined the axis of the temple.

QURNA (From Google Earth Mapping Service/image © 2007DigitalGlobe)



Plan 5

Seti I Mortuary Temple aligned to the southern major standstill moonrise. The change in axis from the Karnak temple is clearly visible.
The plan shows the alignment from the temple of Karnak just missing the entrance gateway of Seti's temple.

MEDINET HABU (From Google Earth Mapping Service/image © 2007DigitalGlobe)

Plan 6

There is a very clear alignment that runs for the full length of the temple of Ramses III at Medinet Habu. The axis of the temple is on an azimuth of 138°, which does not have any obvious astronomical alignments. The converse angle, looking towards the Theban Hills shows an alignment to Segin, one of the stars of the constellation of Cassiopeia.

LUXOR (From Google Earth Mapping Service/image © 2007DigitalGlobe)

Plan 7

The alignment for the sanctuary and Amenhotep III part of the Luxor temple can be clearly shown. The only possible alignment would be towards the south to the stars of the Southern Cross but this is not very convincing.

The change of axis for Ramses II temple is shown together with the link with the Sphinx Avenue. This does align with the star Vega. However it is also aligned to the sanctuary of Amun in the Karnak temple. Without clear textual evidence it is impossible to say what the intentions of the original architect might have been in this alignment.

Plan 8

The alignment of the Ramses II part of the Luxor temple connected with the Avenue of Sphinxes is clearly apparent.

MUT TEMPLE AT KARNAK (From Google Earth Mapping Service/image © 2007DigitalGlobe)

Plan 9

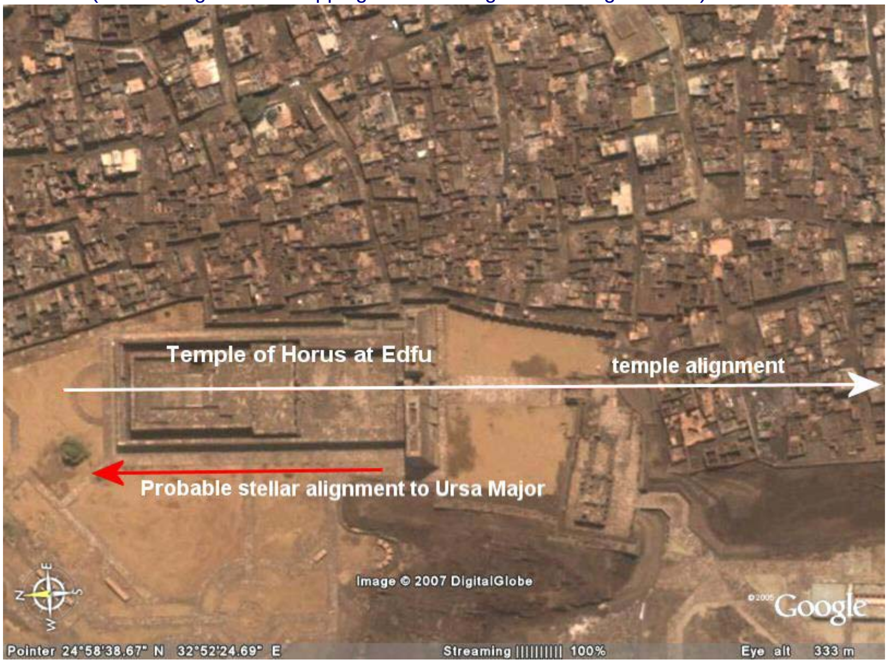
The Mut temple along with the connecting Sphinx Avenue is aligned to the tail stars of Ursa Major known to the Ancient Egyptians as *Meskhetu*. However this alignment also follows through to the Great Hypostyle Hall of the Karnak temple. It is possible that it was this latter topographical alignment was the intended orientation.

DENDERAH (From Google Earth Mapping Service/image © 2007DigitalGlobe)

Plan 10

The alignment of the Hathor temple of Denderah can be clearly seen. Built in 54 bc its orientation points towards the rising azimuth of the Alkaid, the tail star of Ursa Major known as *Meskhetu.* The Hathor temple is full of astronomical and astrological signs and originally included the famous Denderah zodiac, which is now in the Louvre museum in Paris. To the rear of the Hathor temple is a small temple dedicated to Isis. This is aligned to the rising of Sirius at the time of the temple's foundation.

EDFU (From Google Earth Mapping Service/image © 2007DigitalGlobe)

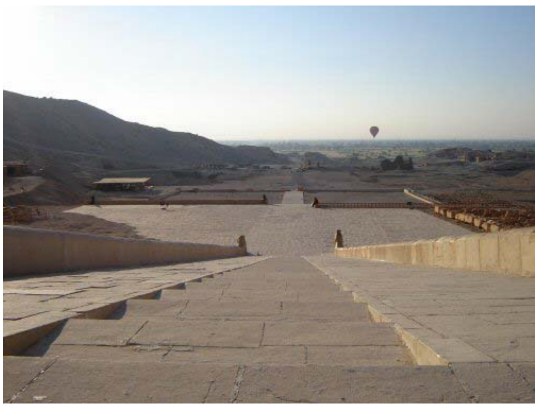


Plan 11

The Edfu temple is aligned within 2° of a north/south axis. The probable alignment is to the stars of Ursa Major, but how this was done on the temple axis is unclear.

Other Pictures

Astronomical and Astrological signs in the ceiling of the temple of Denderah.



View from the Upper Terrace of Hatshepsut's temple at Deir El Bahari looking towards the mid-winter rising Sun azimuth.

APPENDIX 1

Temple	Axis	Degree Longitude	Minute	Second	Degree Latitude	Minute	Second	Degree Bearing	Minute	Shaltout & Belmonte Study	Alignment
Amun-Ra Karnak	Axis 1	25	43	1.36	32	39	39.13	297	44	296.75	Mid-winter sunrise
	Axis 2	25	42	55.58	32	37	44.66	117	44		
Hatshepsut Deir El Bahari	Axis 1	25	44	18.11	32	36	22.73	116	53	115.5	Mid-winter sunrise
	Axis 2	25	44	47.14	32	39	41.81				
Amenhotep III Qurna	Axis 1	25	43	20.37	32	36	19.05	116	25	117	Mid-winter sunrise
	Axis 2	25	42	16.68	32	38	41.29				
Seti 1 Qurna	Axis 1	25	43	58.95	32	37	39.28	124	16	124	Southern-most major lunar standstill
	Axis 2	25	43	55.69	32	37	44.59				
Ptah Temple Karnak	Axis 1	25	43	14.07	32	39	28.29	304	44	304	Southern-most major lunar standstill
	Axis	25	43	6.24	32	39	40.82	124	44		
Ramses III Medinet Habu	Axis 1	25	43	17.06	32	35	57.09	138	51	137.5	Cassiopeia - star Segin
	Axis 2	25	43	5.05	32	36	8.74	318	51		
Luxor Temple Amenhotep III	Axis 1	25	41	54.6	32	38	16.75	33	44	34	Southern Cross (?)
	Axis 2	25	42	58,12	32	38	19.36				
Luxor Temple Ramses II + Sphinx Ave.	Axis 1	25	41	59.64	32	38	20.54	44	29	42.5	Vega
	Axis 2	25	42	7.27	32	38	28.86				
Mut Temple Karnak	Axis 1	25	42	43.6	32	39	15.62	19	14	18	Ursa Major
	Axis 2	25	43	1.45	32	39	26.56				
Hathor Denderah	Axis 1	26	8	29.15	32	40	11.82	18	8	18	Ursa Major
	Axis 2	26	8	35.32	32	40	14.07				
Horus Edfu	Axis 1	24	58	43.62	32	52	24.08	181	58	181.75	Ursa Major(?)
	Axis 2	24	58	38.35	32	52	23.88				

Note:
The Axis co-ordinates are taken from the map projections of the Google Earth programme. Calculating the Great Circle bearing between the two sets of co-ordinates determines the orientation of the temple.

As can be seen from these figures the bearings worked out through this method correspond reasonably well with the on-site prismatic compass survey carried out in the 2002 Shaltout and Belmonte study.

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http://www.atlanta-association.com