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A Potentially Significant Dimension Recorded on an Old Kingdom Papyrus from Saqqara

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At a conference in June 2013¹ Professor Philippe Collombert of the University of Geneva gave a presentation of his work with a highly fragmented Old Kingdom papyrus.² The previously unstudied papyrus was found by Collombert in an archive at the IFAO in Cairo. An initial examination established that the text had been written in a hieratic script characteristic of the Old Kingdom. Modern notes associated with the papyrus fragments indicated that they had been collected at the pyramid of Unas at North Saqqara, leading Collombert to suggest that they had most likely been discovered during work undertaken sporadically at that pyramid by J. P. Lauer, sometime between January 1937 and May 1939.³ Given the limited examples of Old Kingdom papyri known,⁴ the potential importance of these unpublished fragments (hereafter referred to as the Teti Papyrus) was recognised immediately by Collombert. Despite its highly fragmentary state he separated and individually mounted a significant proportion of the fragments onto a series of seventeen plates.

Although it was clear from the outset that the condition of the Teti Papyrus precluded a comprehensive restoration and translation, a number of significant features were recognised by Collombert. On the basis of the most frequently occurring words and phrases, the papyrus appeared to be an account of a construction project. Recurring references to Teti (the first king of the Sixth Dynasty), and to funerary structures, led Collombert to the conclusion that the fragments represent a record of the construction of Teti's pyramid complex at Saqqara.⁵

One of the significant features that Collombert identified on the Teti Papyrus are references to specific dimensions that may have been used in the specification of the Teti funerary complex. For example, Collombert compares a dimension of 200 cubits given in the Teti Papyrus with one of the principal dimensions of the pyramid enclosure (see 'Width of the pyramid enclosure', Table 1 below).⁶ In the general context of Old Kingdom pyramid construction, and the Teti pyramid complex in particular, the current author considers that a reference to a dimension of 441 cubits,⁷ may also have particular significance.

1 Ancient World Conference, London, 8 & 9th June 2013.

2 Collombert (2011).

3 Collombert (2011), p. 17.

4 For a brief summary of the previously identified Old Kingdom papyri, see Collombert (2011), p. 19. Note that Collombert (2011) predates the discovery of papyri from the reign of Khufu, that were found on the western shore of the Red Sea, for which see Tallet and Marouard (2014) and Tallet (2016).

5 Collombert (2011), p. 25.

6 Collombert (2011), p. 27.

7 Collombert (2011), p. 20.



Fig. 1. The Teti pyramid (photo: Franck Monnier).

The Teti Pyramid Complex

As reconstructed,⁸ the Teti pyramid complex consists of a main pyramid within a walled enclosure, with a single ‘cult’ pyramid in the south east corner (figs. 2 and 3). Although a number of elements of the pyramid temple lie within the enclosure wall, the foreparts of the temple extend some distance eastward beyond the enclosure, to connect with the upper end of the pyramid causeway. The only remains of the causeway that have been identified are at the point where it meets the pyramid temple, at a position that is offset to the south of the central temple axis. It is also notable from published reconstructions that the surviving upper elements of the causeway are orientated to the south of due east (figs. 2 and 3).⁹ The position and alignment of the pyramid causeway (as indicated by the remains of its upper elements) may have been designed to avoid the nearby pyramid Lepsius XXIX, which is located to the east (fig. 2). Its construction has been dated to the earlier reign of Menkauhor.¹⁰ In addition to Lepsius XXIX, at least two other small pyramid complexes (attributed to Iput and Khuit, royal women associated with the reign of Teti) have been found in separate enclosures to the north of the pharaoh’s funerary complex. No evidence of a valley temple associated with the Teti funerary complex has so-far been identified.¹¹

⁸ See for example, Lehner (1997), pp. 156-157.

⁹ Lehner (1997), p. 157.

¹⁰ Collombert (2011), p. 29.

¹¹ Lehner (1997), pp. 156-157.

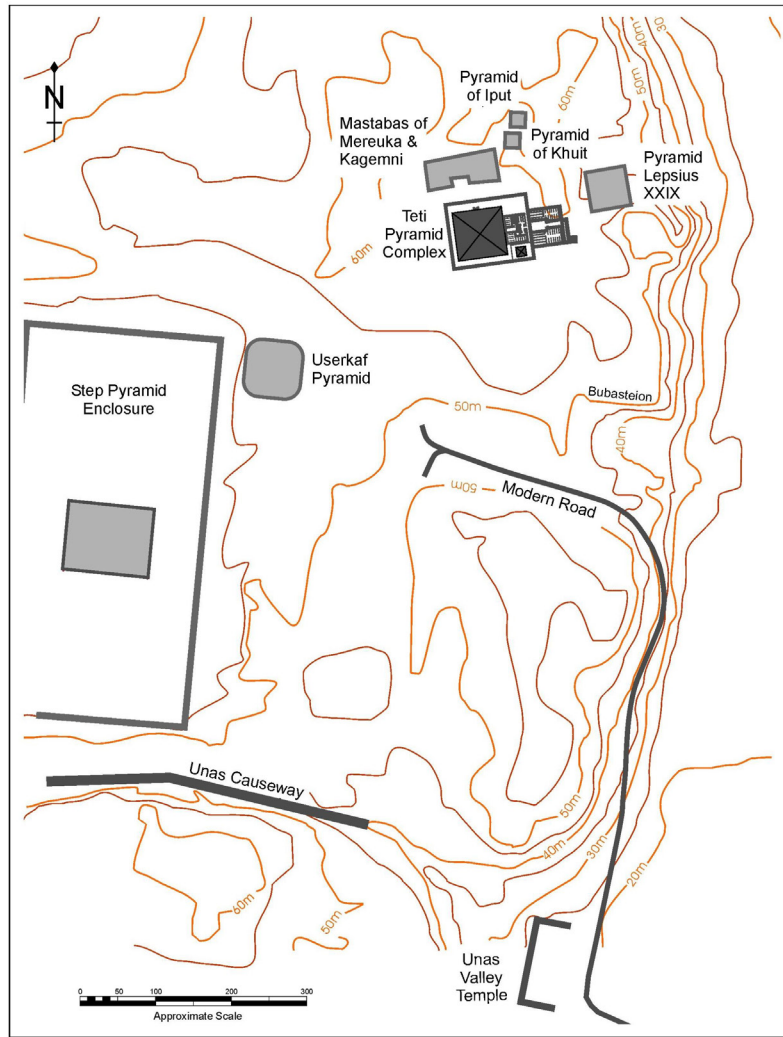


Fig. 2. Overview of North Saqqara showing the relative location of the Teti Pyramid complex (after Egyptian Ministry of Housing and Reconstruction, Sheet Cairo H22).

Feature	Dimension (cubits)	Dimension (m)
Base length of the main pyramid	150 ¹²	78.75
Vertical height of the main pyramid	100	52.5 ⁹
Base length of the satellite pyramid	30 ¹²	15.75
Length of the pyramid enclosure (N-S)	243 ⁹	127.58
Width of the pyramid enclosure (E-W)	200 ⁹	105
Maximum dimension from western enclosure wall to eastern limit of the pyramid temple.	356	187 ¹³

Table 1. Principal dimensions of the Teti Pyramid Complex. Figures given in bold have been taken from published sources, figures in plain text have been calculated using the value of 52.5 cm to 1 cubit (Rossi (2007), Table 2).

¹² Rossi (2007), Appendix.

¹³ Scaled from Lehner (1997), p. 157, Figure.

Table 1 summarises the key dimensions of the Teti Pyramid Complex. When compared with this data, the figure of 441 cubits (231.53 m) identified by Collombert in the Teti Papyrus, evidently represents a more substantial feature. The current author considers that there are two commonly recognised elements of pyramid complexes which could have had such large dimensions:

1. The pyramid causeway.
2. A temporary linear ramp used in the building of the main pyramid.

The Teti Causeway

As discussed above, little is known of the Teti pyramid causeway except for the point at which it meets the south east corner of the pyramid temple, and indications of an alignment for the upper elements. Given that no location for the Teti valley temple has been identified, the length of the Teti causeway remains unknown. Mark Lehner points out that the Teti pyramid stands at a relatively elevated position near the eastern edge of the Saqqara escarpment. Lehner also states that a causeway serving the elevated site of the Teti pyramid would have needed ‘an enormous’ embankment to carry it from the low-lying inundation plain to the edge of the escarpment.¹⁴

Based on the photogrammetric maps issued by the Egyptian Ministry of Housing and Reconstruction,¹⁵ the ground level at the Teti pyramid is approximately 58 m (figs. 2 and 3).¹⁶ The position of the undiscovered Teti valley temple can only be inferred, based on considerations of topography and comparisons with nearby pyramid complexes. The valley temple of the preceding pharaoh, Unas lies just below the 25 m contour at the edge of the inundation plain at Saqqara (fig. 2). It is generally understood that one of the roles of the valley temple was to serve as a functioning interface between the pyramid complex and the system of canals and harbours that connected it with the Nile. Given that water within any specific section of the Old Kingdom canal system can be assumed to have stood at the same general level, it is considered likely that all the valley temples at Saqqara will have been built at the same general elevation.¹⁷

Given these considerations, a number of factors can be identified which allow a general location for the Teti valley temple to be inferred. In turn, these factors allow us to speculate on a suitable route along which the Teti causeway may have been built. These factors are:

- The elevation at the site of the Teti valley temple, which is likely to have been comparable with the elevation of the Unas valley temple.
- The alignment of the upper end of the Teti causeway, as suggested in published reconstructions of the Teti pyramid complex.
- The location of Lepsius Pyramid XXIX, which is generally assumed to have pre-dated the reign of Teti.
- The local topography, inferred from modern photogrammetric data.

¹⁴ Lehner (1997), p. 156.

¹⁵ Arab Republic of Egypt, Ministry of Housing and Reconstruction, Topographic sheets, Cairo H22, 1:5000.

¹⁶ Note the ground elevation at the site of the Teti pyramid taken from the relevant maps differs slightly from the value of ground elevation given by Google Earth, which for consistency in the data, has been used in Table 2.

¹⁷ In this regard, it is interesting to note that the elevations for valley temple locations given in Table 2, all lie within the range 20-23 m amsl.

On the basis of these considerations a possible alignment for the Teti causeway is shown in Figure 3. By scaling from the available maps it can be determined that this causeway would have been approximately 263 m long (approximately 500 cubits).

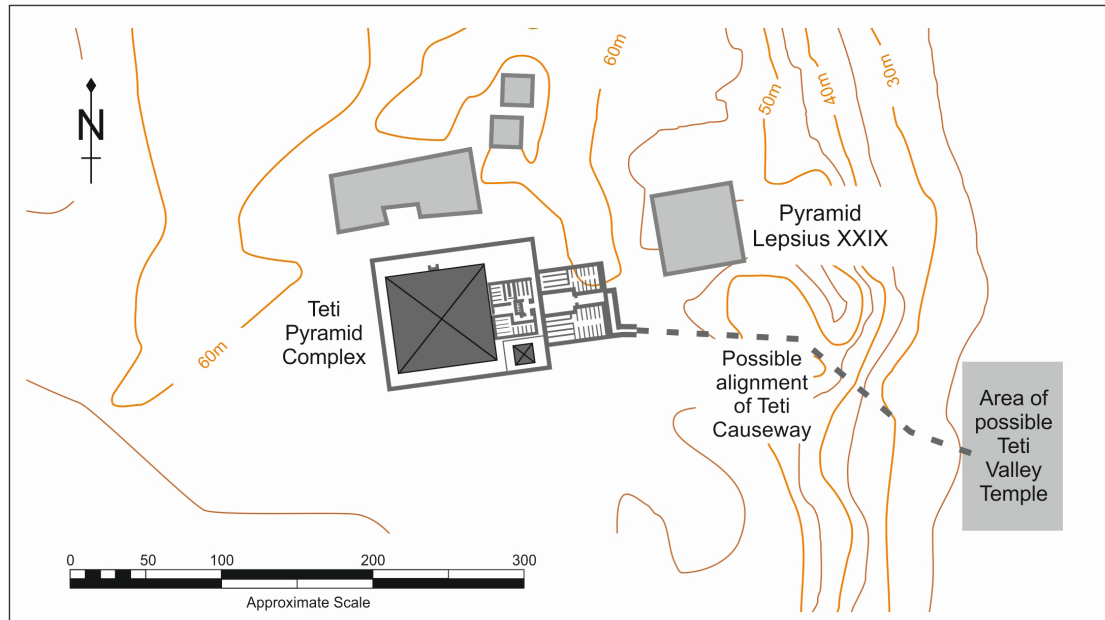


Fig. 3. The area of the Teti Pyramid complex showing the inferred locations for the valley temple and causeway.

The proposed causeway shown on Figure 3 follows one of several possible alignments, and it may differ in a number of respects from what was originally planned or built. It is important to note, however, that the 500 cubit figure derived above is likely to represent a minimum length for the Teti causeway. None of the possible routes that the causeway could have followed significantly reduce the inferred length much below the 500 cubit figure. Furthermore, given the difference in elevation between the inferred position of the valley temple and the site of the Teti pyramid complex, a 500 cubit-long causeway which followed an alignment similar to that shown on Figure 3, would have had an average gradient in the order of 1 in 8 (13% - Table 2).¹⁸ When such a causeway is compared with other causeways from this period (Table 2), this gradient appears to be rather steep. If by contrast, the form of the Teti causeway had been determined primarily on the basis of gradient, conservatively taking the 1 in 12 gradient calculated in Table 2 for Khafra, then the Teti causeway would have been approximately 731 cubits long (approximately 384 m).¹⁹ Given these considerations and if it was built, the Teti causeway is likely to have been significantly longer than the 441 cubit dimension referred to in the Teti Papyrus.

¹⁸ Assuming a causeway some 500 cubits long (263 m), with ground levels at the lower (valley temple) end of ca. 23 m and ground levels at the upper (pyramid) end of 55 m, gives a fall for the causeway of 32 m vertically over 263 m horizontally, or 1 in 8 (i.e. approx 13%).

¹⁹ Vertical separation is 32 m (see note 18). A 1 in 12 gradient (8%) gives a horizontal distance of $32 \times 12 = 384$ m or 731 cubits.

Pyramid	Causeway length (m) ²⁰	Approx elevation at pyramid temple (m) ²¹	Approx elevation at valley temple (m) ²¹	Gradient	Gradient (%)
Teti (postulated)	263	55	23	1 in 8	13
Khufu	740	60	22	1 in 19	5
Khafra	495	61	20	1 in 12	8
Menkaura	608	68	21	1 in 13	8
Sahura	235	37	21	1 in 15	7
Unas	750	57	23	1 in 22	5

Table 2. Data for a selection of Old Kingdom pyramid causeways and the resulting gradients.

Linear Construction Ramp

The methods used by the Ancient Egyptians to raise the blocks of stone used in pyramid construction remain a matter of some debate. Most of the details of the debate lie outside the scope of the current paper,²² but the use of temporary ramps in a number of possible forms has been proposed.²³ One of the perceived disadvantages of ramps is that their construction would have required the placement and subsequent removal of significant volumes of fill material.²⁴ However, given that the Ancient Egyptians placed millions of tonnes of masonry and mudbrick when building the Old and Middle Kingdom pyramids however, the current author does not consider that the additional resources required for the construction of temporary ramps precludes their use. Furthermore, if compared with other hypotheses that have been put forwards (e.g. the use of levers, pulley systems etc.), it seems likely that any disadvantages associated with the construction of temporary ramps would have been offset by their versatility and relatively straightforward operation.

If for the purposes of the current paper then, the use of temporary ramps is accepted, there remains the issue of the form these ramps took. A spiral ramp would have required a much smaller volume of material compared to a linear ramp capable of reaching the equivalent height, as it would have relied in part on the underlying pyramid for support. On the other hand, the main disadvantage of a ramp wrapped around the growing form of a pyramid (i.e. a spiral ramp) would have been that any temporary structure would have covered the underlying pyramid masonry and would therefore have prevented the masons from using sight-lines along the sides and down the corners of the pyramid, to control the shape of the structure as building works progressed. A linear ramp would have left the corners of the pyramid exposed, allowing the shape of the growing structure to be constantly checked, something considered essential given the levels of accuracy evident in the construction of the major pyramids, most significantly, the Great Pyramid of Khufu.

The Great Pyramid has been subject to more detailed scrutiny than any other Egyptian pyramid, with some of the discussions focussing on the possible form of temporary ramps used in its construction. The Great Pyramid is built close to the northern edge of the Giza plateau and so the northern approaches to the pyramid would have been unsuitable locations for linear construction

²⁰ Lehner (1997), except for Teti which as described in the text, has been inferred.

²¹ For consistency, all elevation data in Table 2 is taken from Google Earth, accessed 27th December 2016.

²² For further discussions see *inter alia* Lehner (1997), pp. 215-217, Arnold (1991), p. 79 *et seq*, Isler (2001), pp. 211-221.

²³ Arnold (1991), pp. 98-101 and fig. 3.53.

²⁴ Hodges (1989), pp. 10-16.

ramps. In addition, the entrance to the pyramid was located in the northern face and would have been obscured by a large linear ramp approaching from the north.²⁵ To the east and west of the Great Pyramid are the major necropolises built for the members of Khufu's court, so these areas were under development at the same time that the pyramid was being built.²⁶ In addition, to the east was the mortuary temple and causeway. Given these developmental restrictions, it seems unlikely that a temporary ramp would have approached the Great Pyramid from either the east or west. The features to the south of the Great Pyramid (including the two boat burials and a series of mastaba tombs), however, were built shortly after the reign of Khufu.²⁷ Lehner has already indicated that, in his view, a ramp was used in the construction of the Great Pyramid, and that it approached the structure from the south.²⁸

Returning to North Saqqara, in addition to the pyramids of the two royal women, a group of Old Kingdom tombs were found to the north of the Teti pyramid, including the tomb of Mereruka, a senior courtier and vizier to Teti (fig. 2). We can assume that construction of these tombs was underway contemporaneously with the construction of the Teti pyramid complex, and that a construction ramp could not, therefore, have approached the pyramid from the north. To the east of the Teti pyramid were other elements of the pyramid complex, the presence of which are also likely to have precluded the use of the area for a temporary construction ramp. The areas to the immediate west and south of the Teti pyramid, however, are currently understood to be free of substantial archaeological features which are contemporaneous with, or pre-date the Teti pyramid. The areas to the west and south could, therefore, have provided suitable areas in which to construct a temporary ramp.²⁹

Given the need to import granite from Aswan for the pyramid chambers, basalt for the sarcophagus, and Tura-quality limestone for the casing of the Teti pyramid, a construction ramp approaching the pyramid from the west would have been less practical, in several respects, than a ramp located to the south of the pyramid. A linear construction ramp approaching from the west would have required a flow of imported goods; a main transport artery for imported stone, that first led around to the far side of the construction site, away from the Nile.

To the south of the Teti pyramid is a wadi through which the modern road connects the tourist entrance to Saqqara with the archaeological zones (fig. 2). Part of this wadi has been the focus of recent excavations by the French Archaeological Mission to the Bubasteion.³⁰ This wadi would have allowed construction materials brought to Saqqara by river and canal to be transferred to the elevated surface of the plateau. It would then have been possible to link the upper end of the wadi to the Teti pyramid complex by means of a linear construction ramp which approached the pyramid from the south (fig. 4). Photogrammetric maps³¹ show that the modern road through the centre of the wadi lies approximately 270 m south of the foot of the Teti pyramid. The 50 m contour to the north of the modern road lies above the floor of the wadi and is some 220 m south of the pyramid. As shown on Figure 3, the foot of a 441 cubit ramp (approximately 250 m long) would have been located towards the centre of this wadi.

25 Another disadvantage of a spiral ramp is that as it wrapped around all four faces of the pyramid, it would have blocked the entrance to the internal passages and chambers, delaying the construction of these important elements of the pyramid.

26 Lehner (1985), p. 118, item B2 (Western Cemetery) and B3 (Eastern Cemetery).

27 Porter and Moss (1974), pp. 216-228 and plan XIX.

28 Lehner (1985), p. 128, item C15.

29 The area immediately south of the Teti pyramid has been subject to geophysical survey and 'no large mastaba type structures' were found. See Mathieson (2007), figs. 2 and 4.

30 Zivie (2007).

31 Arab Republic of Egypt, Ministry of Housing and Reconstruction, Topographic sheets, Cairo H22, 1:5000.

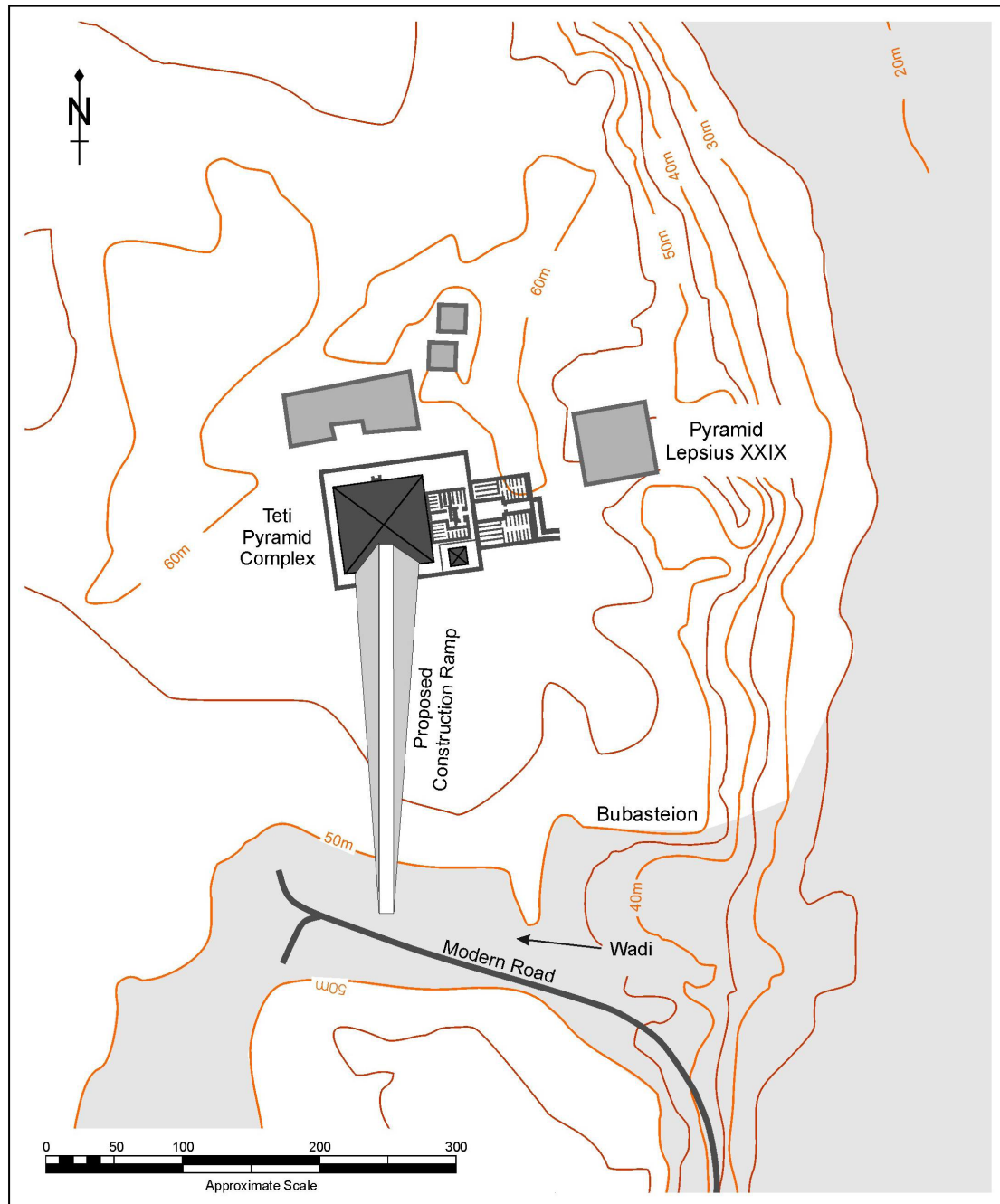


Fig. 4. The area of the Teti Pyramid complex showing a linear construction ramp approaching from the south.

Conclusion

The current paper was based on a purely desk-based analysis and it was necessary to use a combination of scale maps and other publications to obtain and compile relevant data. Notwithstanding the use of a number of different sources of information, it is reasonable to say that the data on which this paper is based are sufficiently accurate to support the general conclusions that have been reached.

Although a causeway approximately 500 cubits long can be postulated (fig. 3), when the topography of the area around the Teti pyramid is considered, the gradient of the resulting causeway (1 in 8 or 13%) would have been rather steep. On the other hand, if the gradient of the Teti causeway was consistent with those of other, more typical Old Kingdom causeways, its overall length would have been substantially greater than the 441 cubit figure referred to in the Teti Papyrus. On this basis, it seems reasonable to conclude that the reference to 441 cubits identified on the papyrus by Collombert is not a reference to the Teti causeway.

The foot of a 441 cubit linear ramp which approached the Teti pyramid from the south would have been located in the wadi which today carries the modern road from the inundation plain to the surface of the Saqqara plateau. During the construction of the Teti pyramid complex this wadi would have provided ready access for imported stone brought along the Nile and its associated canals from Aswan, Tura and other quarries.

Given the congruence between the information provided on the Teti Papyrus fragment which refers to a feature associated with the Teti pyramid that was some 441 cubits long, and the geomorphology of the Saqqara plateau, in particular the position of the wadi lying at this general distance to the south of the Teti pyramid, it is concluded that the Teti Papyrus could present rare evidence for the use of a linear construction ramp on an Old Kingdom pyramid building project.

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