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The satellite pyramid of Meidum and the problem of the pyramids attributed to Snefru

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Since¹ their partial clearance by Ernest Mackay in 1910,² the insubstantial remains of the satellite pyramid at Meidum have invoked only occasional comment, which usually only repeats the original excavation report. Fifty years after its excavation, architects Vito Maragioglio and Celeste Rinaldi did propose a reconstruction, but since then no one has focused on the monument, which now lies under the sands once again.³

A new analysis of the data collected by the British archaeologist, however, raised some questions which led me to revise and correct aspects of the reconstruction. To better understand the situation of the satellite pyramid within the complex, I was then forced to review opinions regarding the probable identity of the owner of the main Meidum pyramid itself.



Fig. 1. The remains of the satellite pyramid of Meidum (on the right in the photograph) are located at the foot of the larger monument, and are now completely covered by sand (Photo: Franck Monnier).

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- 1 I would like to thank Felix Arnold and Hana Navrátilová for helping me to improve this article. I'm also grateful to David Ian Lightbody and Sandra Rosendahl for proof-reading the English text of the manuscript and to Daniel Malnati and Michel Michel for proof-reading the French version. Any remaining mistakes are the author's responsibility.
 - 2 Petrie *et al.* (1910), pp. 10-11, pl. VII-IX.
 - 3 Maragioglio and Rinaldi (1964), pp. 26-28, tav. 7.

The scope of my investigation then widened to include all the pyramids attributed to Snefru and the chronological build sequence that produced those structures, which has been the subject of many debates. The product of this architectural and historical research project is a plausible and coherent scenario regarding the giant architectural projects undertaken by the king throughout his reign.⁴

Description and reconstruction of the satellite pyramid of Meidum

Description of the archaeological remains by Ernest Mackay (1910)

The remnants of the satellite pyramid had been spotted by Petrie in 1891, a short distance south of the main pyramid.⁵ Later, in 1909, Ernest Mackay was commissioned to completely clear the remains of the monument, which allowed him to identify its main characteristics.⁶

The internal chambers are now reduced to an excavation pit dug into the bedrock, but the few remaining elements of masonry reveal a very simple layout. A descending passage enters the structure from the north and runs straight south to a point where two superimposed closing blocks seal the access to a short horizontal corridor. This corridor, which is covered with horizontal lintels, eventually opens into what seems to have been a small funerary chamber.⁷ The walls have disappeared, but the boundaries of the pit reveal a ground plan that was certainly square or slightly rectangular. A tunnel dug by early explorers enters on the south side of the excavation area. It continues south for almost 7 m before reaching the surface through a vertical shaft. This passage may have been dug in a later period by Egyptians who re-used the monument for burials. Two bodies were found in the small horizontal corridor, lying over a mound of backfill which Mackay dated to the 22nd Dynasty.⁸

Only a few elements of the superstructure remained, but enough to give an idea of its original appearance. Mackay uncovered a few scattered masonry elements on the east and west sides of the pyramid including two or three rows of blocks, scarcely squared and mortared in place. They were inclined at 30° to the horizontal, and rested on rocky ground which was also sloped to support them.⁹

The locations of the architectural remnants on the site indicate that the monument had a square base of approximately 50 cubits length on each side.¹⁰ Mackay concluded it was a small pyramid which was intended to be used to bury a member of the royal family.¹¹ A small fragment of carved stone was unearthed on the eastern side. A falcon, of which only the two legs remain, had been engraved on it, suggesting that at least one stele had been erected there.¹²

According to the plan drawn by the British Egyptologist, the northern side of the satellite pyramid was less than 5 m from the south side of the main pyramid, and its east side was 16 m west of the north-south axis of the main pyramid.¹³

4 The general outline of this study appears in the chapters devoted to Snefru's pyramids in my book *L'ère des géants. Une description détaillée des grandes pyramides d'Égypte* (Monnier (2017), pp. 64-111). This article gives me the opportunity to present more comprehensive details of this particular study.

5 Petrie (1892), p. 10.

6 Petrie *et al.* (1910), pp. 10-11.

7 Petrie *et al.* (1910), pp. 10-11. The largest lintel is 4.72 m long, 1.06 m high and approximately 0.56 m thick.

8 Petrie *et al.* (1910), p. 10.

9 Petrie *et al.* (1910), p. 11.

10 Petrie *et al.* (1910), p. 11.

11 Petrie *et al.* (1910), p. 11.

12 Petrie *et al.* (1910), pp. 11-12.

13 Petrie *et al.* (1910), pl. VIII.

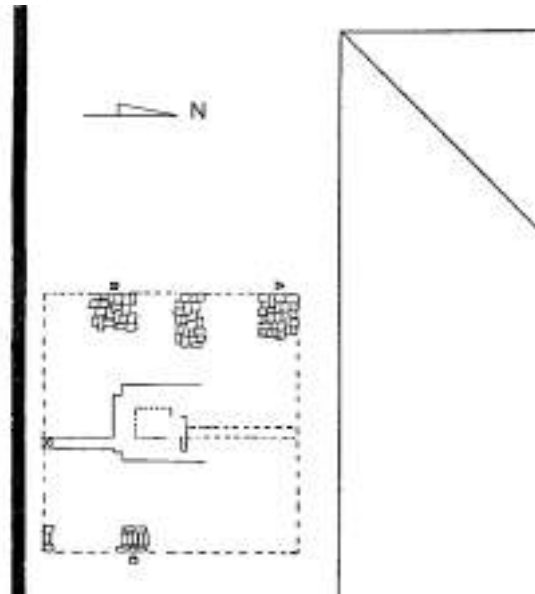


Fig. 2. Site plan of the satellite pyramid of Meidum (after Petrie *et al.* (1910), pl. VIII, scale: 1/800).

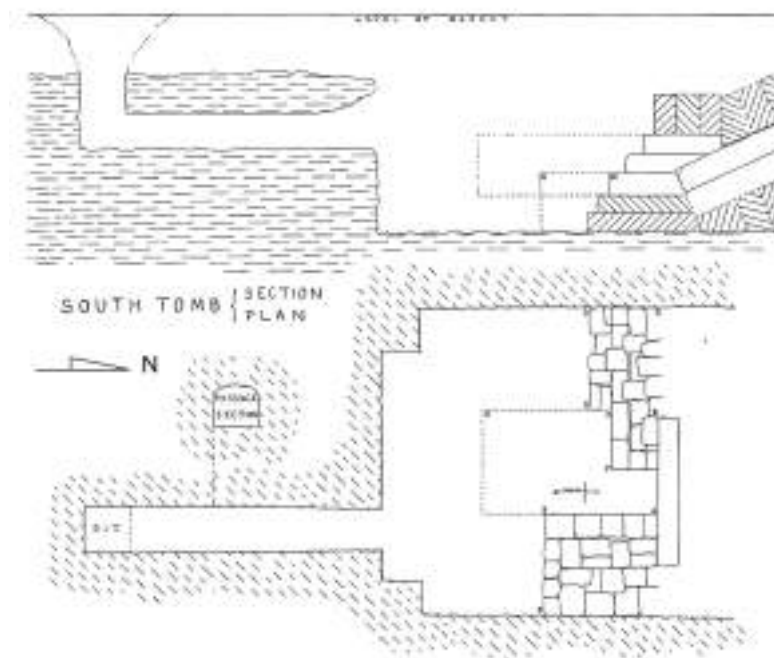


Fig. 3. Cross-section and plan view of the satellite pyramid of Meidum (after Petrie *et al.* (1910), pl. IX, scale: 1/200).



Fig. 4. Remains of the satellite pyramid of Meidum
(after Petrie *et al.* (1910), pl. VII (1-3)).

Description of the archaeological remains and reconstruction by Maragioglio and Rinaldi (1964)

In 1963, architects Vito Maragioglio and Celeste Rinaldi described the monument by repeating the information collected by Mackay.¹⁴ They do not appear to have recorded any additional details from the site themselves, probably because sand had mostly covered it since the excavations carried out at the beginning of the 20th century. Their plans were almost identical to those produced by Mackay, with only dimensions having been added (Figs. 5 and 6). Their main contribution was to comment and interpret the archaeological documentation and to offer a reconstruction of the monument based on those documents.

They found that Mackay's proposed inclination for the descending passage of approximately 25° was problematic, as it implied an entrance situated at ground level and not in the north face, as was normal practice for such monuments at the beginning of the 4th Dynasty.¹⁵ Although there are exceptions to almost every architectural rule made at that time, their concerns seem justified in view of the fact that the masonry layers of the superstructure were also inclined. The plans in the report published by Petrie and Mackay were rudimentary and unclear in certain respects, but after analyzing their data, I am inclined to think that, to reduce the volume of stone cutting and setting operations required, the slope of the descending passage followed that of the construction layers, which were inclined at 30°. Consequently, the corridor was also inclined at 30°, and this is how Maragioglio and Rinaldi reconstructed it in their plan.¹⁶

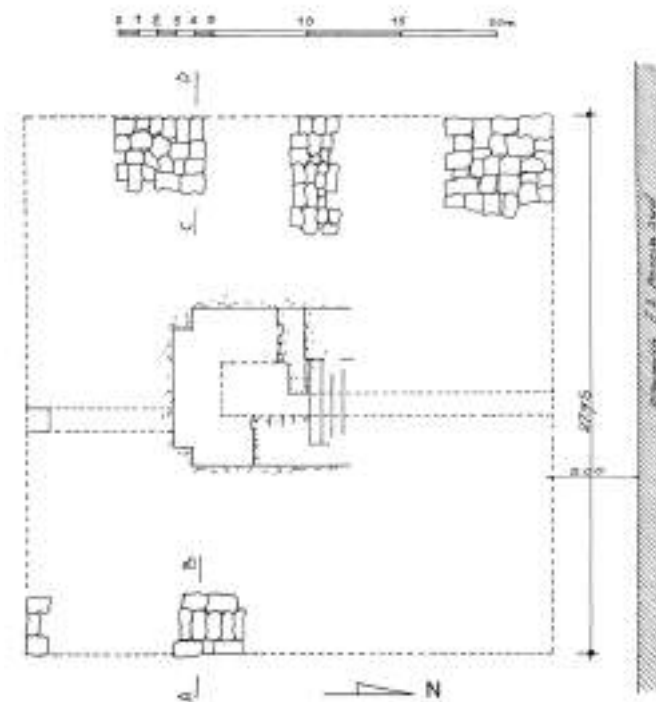


Fig. 5. Plan of the satellite pyramid of Meidum (after Maragioglio and Rinaldi (1964), tav. 7 (fig. 2)).

¹⁴ Maragioglio and Rinaldi (1964), pp. 26-28, tav. 7.

¹⁵ Maragioglio and Rinaldi (1964), p. 48 (obs. 28).

¹⁶ Maragioglio and Rinaldi (1964), tav. 7 (fig. 6).

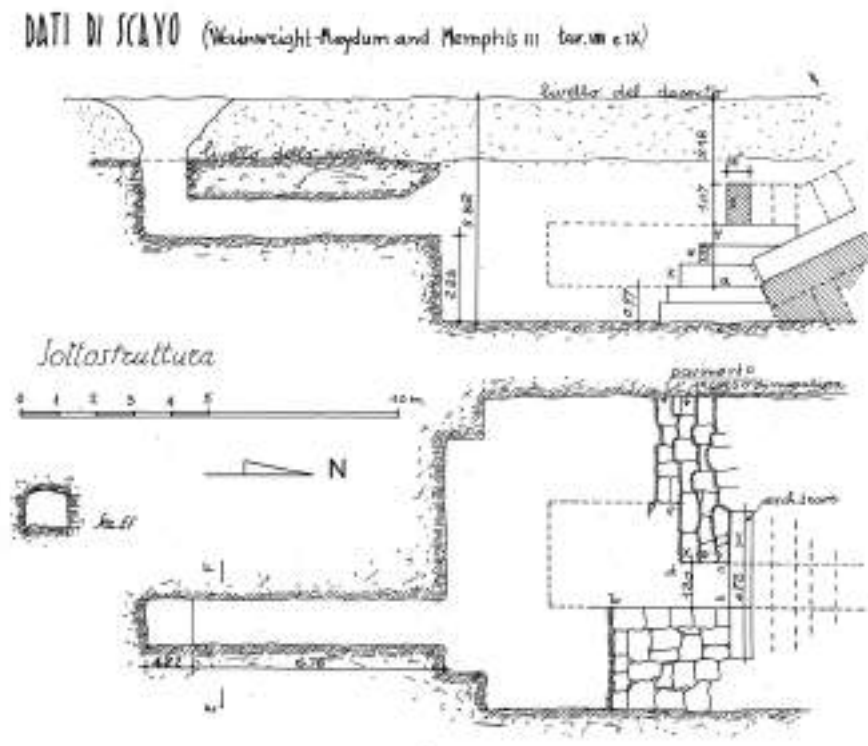


Fig. 6. Cross-section and plan view of the satellite pyramid of Meidum (after Maragioglio and Rinaldi (1964), tav. 7 (fig. 1)).

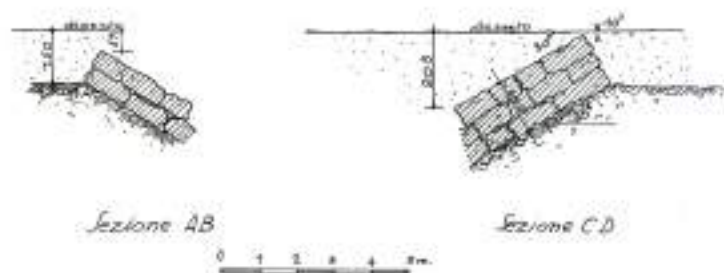


Fig. 7. Cross-section of the blocks on the edge of the satellite pyramid of Meidum (after Maragioglio and Rinaldi (1964), tav. 7 (fig. 4)).

Another significant point raised by the Italian architects was the unusual proximity of the satellite pyramid to the main pyramid of less than 5 m.¹⁷ Again I share their opinion when they dated the satellite pyramid's construction to before the so-called 'E3' stage of the main pyramid's construction, that is to say shortly after or during one of the first two stages which are known as 'E1' and 'E2'.¹⁸

¹⁷ Maragioglio and Rinaldi (1964), p. 46 (obs. 25).

¹⁸ Ludwig Borchardt was the first to discern and understand the three different states of the monument he named E1, E2 and E3 (Borchardt (1928)). The first two consist of a step pyramid which was enlarged once. The third is the one that turned the monument into a smooth-sided pyramid.

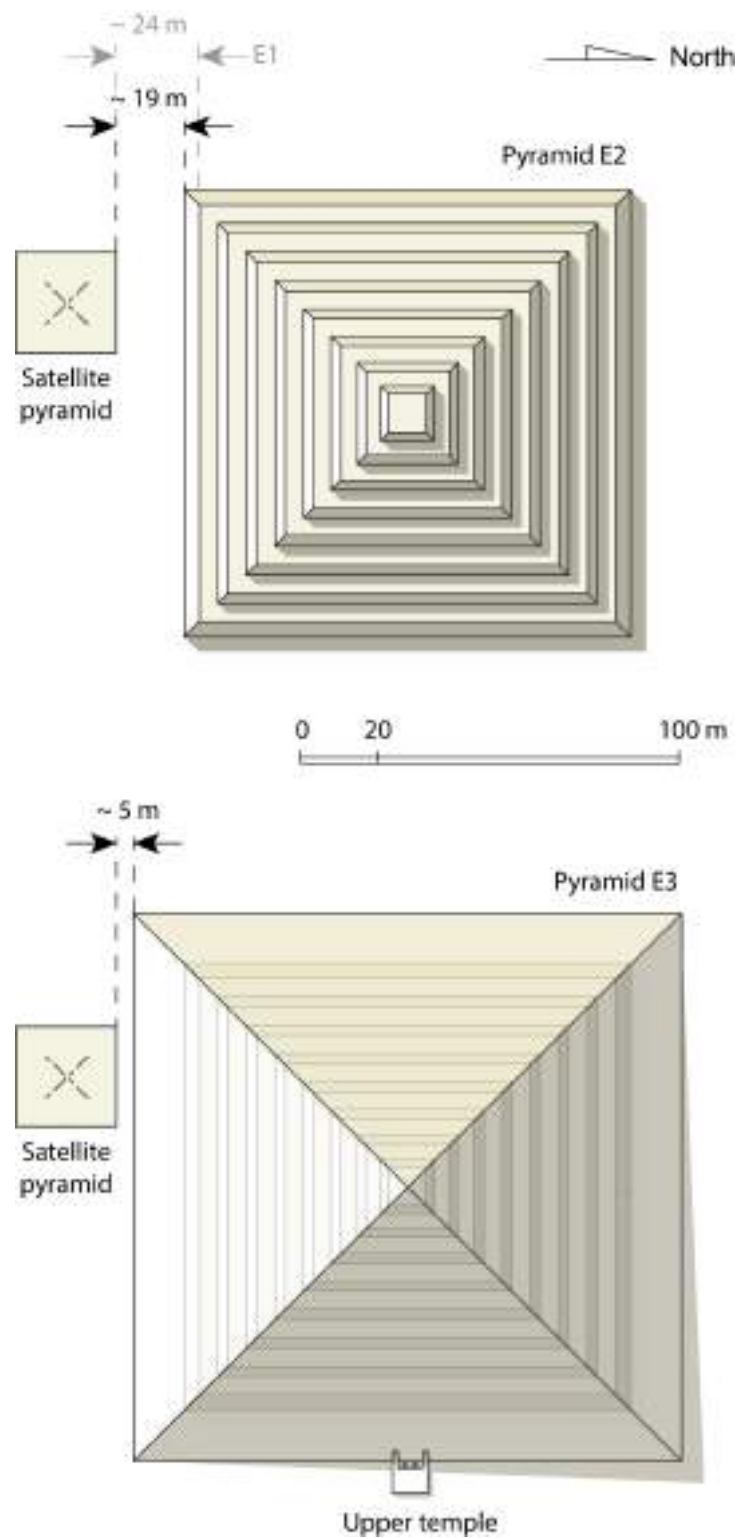


Fig. 8. Position of the satellite pyramid as it related to the construction phases of the pyramid of Meidum.

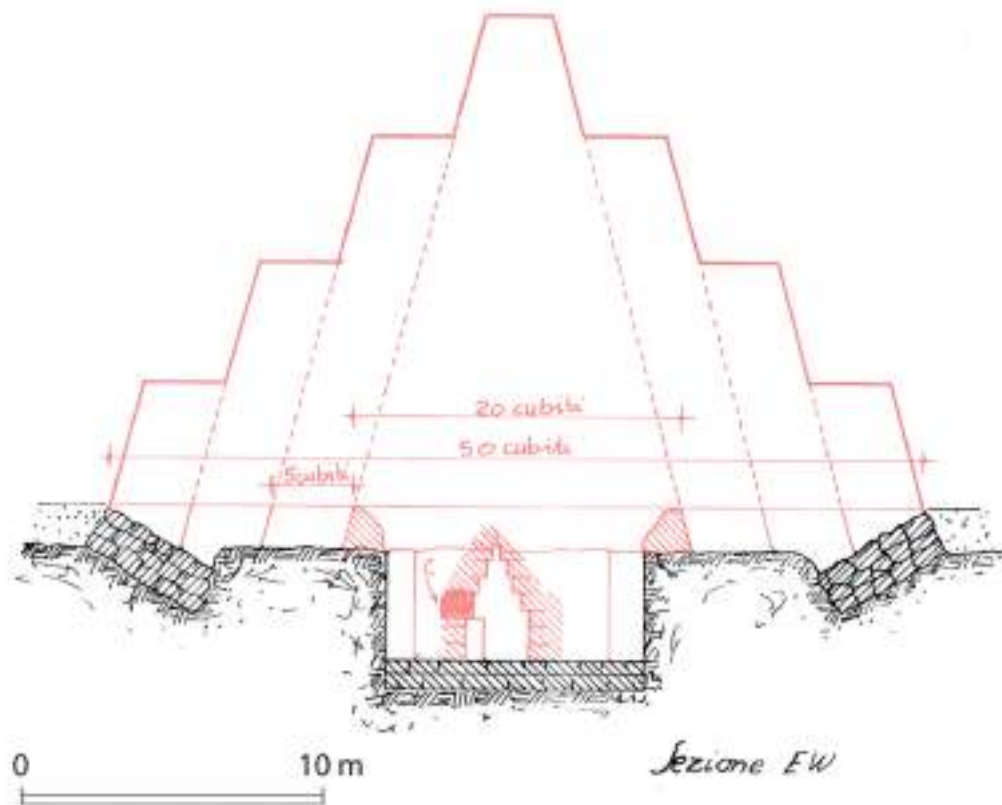


Fig. 9. Reconstructed section of the satellite pyramid of Meidum according to Maragioglio and Rinaldi ((1964), tav. 7 (fig. 3)). The reconstructed part is shown in red. The blocks at the base of the central core are hypothetical.

In the earlier phases, the satellite pyramid would have been located at 24 and 19 m respectively from the side of the larger pyramid. These distances are much more conventional, and would have facilitated the construction of the satellite pyramid by leaving a reasonably large clear space for the builders.¹⁹

With this in mind, Maragioglio and Rinaldi referred to the characteristics of the main pyramid to reconstruct the superstructure of the smaller building. The core layers inclined at 30° revealed a construction technique similar to that of the main pyramid, where the masonry elements were inclined towards the center of the monument by 15° with respect to the horizontal.²⁰

This comparison led them to reconstruct the subsidiary pyramid with a stepped structure similar to that of its larger neighbor, that is to say, with three consecutive outer layers sloped at 75° to the horizontal, leaning against a central core.

¹⁹ A fragment of stele engraved with a hawk was discovered near this monument. That steles of the upper temple relating to the final stage E3 were not decorated is another argument suggesting that the satellite pyramid is at a stage prior to E3 (Maragioglio and Rinaldi (1964), p. 46 (obs. 27)).

²⁰ Maragioglio and Rinaldi (1964), pp. 12-14.

A proposed reconstruction

The observations made by the Italian architects were pertinent, but I do not agree with the reasoning that led them to reconstruct the small pyramid with stepped, steeply inclined outer layers, inclined at 75° . If that had been the case, the inclination of the foundation elements discussed earlier, constructed around the perimeter of the base, would not have followed the observed angle of 30° , but would have been at an angle of 15° ($90-75=15$).

A structure of this general configuration, but with foundations inclined at 30° , leads me to conclude that the external faces of the pyramid had a slope of 60° .²¹ Sloping-layer structures were developed during the reign of Djoser,²² and were replicated up to the time when the early stages of the Meidum pyramid were being built. The form increased the stability of the structure while avoiding labor-intensive slope cutting of casing block faces. While the general arrangement of the cross-section proposed by Maragioglio and Rinaldi was interesting in some respects, it is clear that the inclination of the outer layers of their putative superstructure did not match the inclination of the foundation blocks found *in situ*. Furthermore, only the periphery of the base was cut to receive inclined stones. The core rests entirely on a leveled foundation, and this invalidates the part of their hypothesis which envisaged several concentric layers.

In the light of these facts, it seems that the satellite pyramid was more probably a true pyramid, with flat and steeply inclined faces in comparison with other monuments of this kind.²³ It remains a

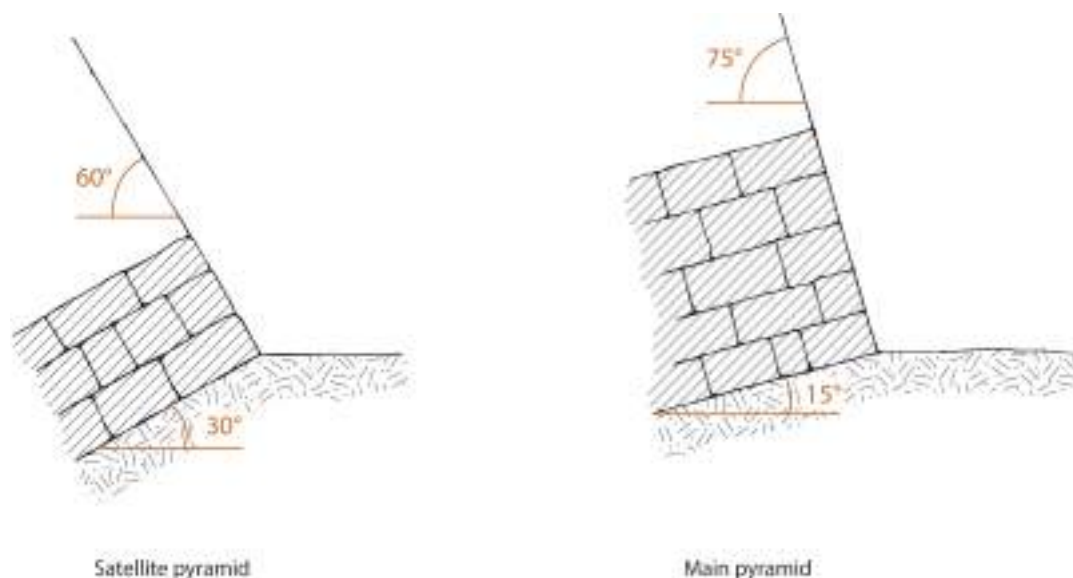


Fig. 10. Construction techniques with sloping layers applied at Meidum.

²¹ The slope of the faces is always perpendicular to the laying beds of the blocks in the layer pyramids. There is a cutting of the facing blocks when this technique is occasionally used in later periods, especially in Dahshur-South (Maragioglio and Rinaldi (1964), pp. 56-58) and Abu Rawash (Valloggia (2011), p. 42). Mackay did not report anything like that at Meidum. If there was such an adjustment, the faces would have been even more inclined, moving them even further away from the model established by Maragioglio and Rinaldi (fig. 7).

²² Lauer (1936), p. 17.

²³ I have already set out this view in Monnier (2017), p. 73, excluding the possibility of an atypical two-step pyramid with sloping faces of 60° , the height of which would not exceed 12 m.

The Italian architects had rejected the hypothesis of flat faces arguing that the inclined beds were used only in the step pyramids (Maragioglio and Rinaldi (1964), p. 45 (obs. 25)). The outer envelope of the Dahshur-South pyramid entirely invalidates this argument. Their error of judgment was induced by the proximity of the step pyramid E1 or E2.

matter of discussion why the Egyptian architects would have chosen to erect a small ‘true’ pyramid next to the pyramid of Meidum, which in its earlier phases was only a step pyramid.

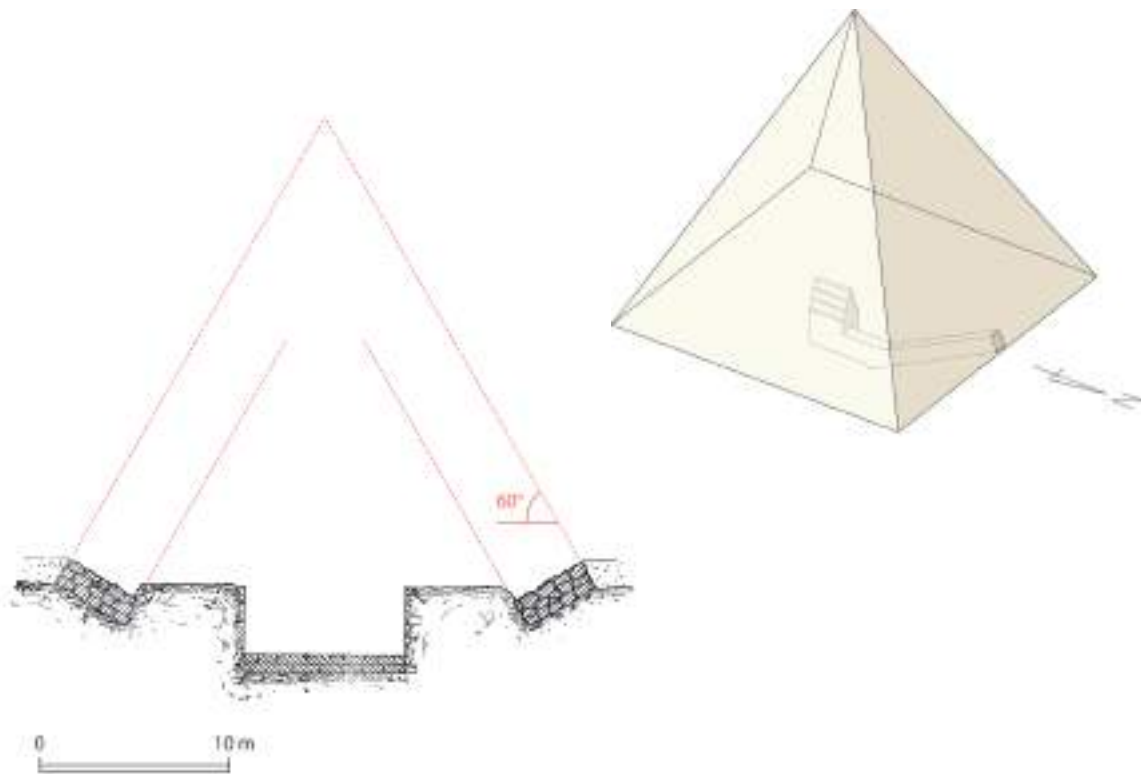


Fig. 11. Reconstruction of the satellite pyramid of Meidum proposed by the author (East-West cross section and isometric view).

Positioning the satellite pyramid in the chronology of Snefru's building projects

The attribution of the Meidum pyramid

The debate surrounding the ownership of the Meidum pyramid divides scholars into two main camps. On the one hand are supporters of a single attribution to Snefru,²⁴ and on the other hand is a group who believes that Huni first built a step pyramid and then completed its second stage, and that Snefru then completed a third phase of construction during which the monument was transformed into a smooth-sided pyramid.²⁵ If there were once scholars who attributed the Meidum pyramid to Huni alone,²⁶ such a viewpoint is rarely expressed today.²⁷

None of the hypotheses can be stated definitively due to a lack of documentary evidence, but it will be argued here that the evidence available is clearly in favor of one of them.

²⁴ Lehner (1997), p. 97; Verner (2001a), pp. 166-168; Stadelmann (2010), pp. 31-38; Monnier (2017), pp. 64-67.

²⁵ Lauer (1962), pp. 218-220; Edwards suggests such a possibility ((1992, pp. 120-122); Vercoutter (1992), pp.265-266; Reader (2015), p. 221.

²⁶ Maragioglio and Rinaldi (1964), p. 8.

²⁷ Harpur (2001), p. 25.

Some authors find it unlikely that Snefru, the first king of the 4th Dynasty, who commissioned two large pyramids at Dahshur,²⁸ could also have overseen the construction of a third monument of similar magnitude, given that his reign was not, apparently, particularly long.²⁹ It therefore became conventional to claim that his father Huni first built a step pyramid at Meidum, which was then modified to acquire the form of a true pyramid with smooth faces.³⁰

But as Rainer Stadelmann recalled in a recent publication,³¹ no mention of Huni has ever been found anywhere near the site of Meidum. Admittedly, no inscriptions mentioning Snefru have been found that can be dated to the period of the pyramid's construction either, but the Egyptians of the New Kingdom regarded Snefru as the sole owner of the monument. Some of the graffiti left on the walls of the funerary temple during the New Kingdom refers to the 'temple of Snefru'³² (*hwt ntr Snfrw*). Other texts that appear to date back to the 6th Dynasty also mention the name of Snefru.³³ Another notable piece of evidence is the name of a domain called 'Snefru is stable' (*dd Snfrw*) that sometimes designated a town, and sometimes a pyramid.³⁴ According to Jean Yoyotte, based on the few examples recovered so far, the location associated with the toponym should be at Meidum,³⁵ and this point of view is now generally accepted.³⁶

It is worth noting that officials who served during the reign of Snefru, such as Nefermaat, Rahotep, and Ranefer, were buried in large mastabas located at Meidum.³⁷ By studying the monuments belonging to the first of these officials, Nefermaat, archaeologist Yvonne Harpur appears to have reached conclusions that undermine any hypothesis that attributes all of the construction phases of the Meidum pyramid to Snefru.³⁸ Her conclusions also reinforce those hypotheses which are in opposition to such a proposal.³⁹

By carrying out a detailed archaeological survey of the mastabas of the Meidum necropolis, and in particular of mastaba n°16 which belonged to Nefermaat and Atet, the American archaeologist was able to confirm the existence of several construction phases, which included modifications and enlargements.⁴⁰ The decoration within the tomb and arranged in the outer chapel also showed, by the diversity of the techniques used and variations in the themes represented, that construction continued over a long period of time. The decoration also made it possible to deduce genealogical information about the tomb's owners, and threw further light on the era as a whole.

Described in his tomb as the 'eldest son of the king's body',⁴¹ Nefermaat is known to have officiated as a vizier and overseer of all the royal building works, and although the king in question is not named, Nefermaat's period of service is almost universally placed chronologically during the reign of Snefru.⁴² This conclusion is reinforced due to the mention of Snefru in an inscription made in

28 Read Monnier (2017), pp. 106-111.

29 Lauer (1962), pp. 218-220.

30 Lauer (1962), pp. 218-220; Reader (1995), p. 221.

31 Stadelmann (2010), pp. 31-38.

32 Navrátilová (2011), p. 117.

33 Petrie (1892), pl. XXXII (n°1). Their dates remain to be confirmed.

34 Posener-Kriéger (1976), pp. 268, 623-624; Baud (1999), II, p. 404.

35 Yoyotte (1963), pp. 92-98.

36 For example: Lehner (1997), p. 97; Verner (2001a), p. 166-168. See also the bibliography in Harpur (2001), p. 275 (n. 5).

37 Petrie (1892), pp. 11-21, pls. 5-7; Harpur (2001).

38 Harpur (2001), pp. 21-33.

39 See note 24.

40 Harpur (2001), pp. 35-47.

41 Petrie (1892), p. 39.

42 LÄ IV, 376-377 (William Kelly Simpson); Strudwick (1985), pp. 110-111 (n°86); Baud (1999a), II, p. 490.



Fig. 12. The mastaba of Nefermaat at Meidum. The pyramid is in the background.
(Photo: Franck Monnier)

a niche of the tomb of the vizier, which refers to a domain founded during his reign called ‘the nurse of Snefru’ (*mnꜥt Snfrw*).⁴³

Uncertainty remains as to Nefermaat’s filial relationship with the king. While he is referred to as son of the king’s body, he is not mentioned anywhere in recovered texts as the son of Snefru in particular. According to Harpur, the fact that the vizier is referred to as eldest royal son is also problematic.⁴⁴ The logic behind the archaeologist’s conclusions is as follows: could he be the son of Snefru, since texts made in his tomb at the time he was buried at Meidum state that his offspring totaled fifteen children, nine of whom had already reached adulthood?⁴⁵

Since a child at that time reached adulthood at about 15 years, and assuming that Nefermaat began to conceive offspring when he was 15 or 16 years old, then he must have died at a minimum age of 39 or 40 years. This is the minimum age of the eldest son added to the minimum age of Nefermaat when he first became a father (24 + 15 or 16).⁴⁶

Furthermore, if Snefru also saw his eldest son born in his 16th or 17^h year, then this implies that he must have been at least 55 years old (15 or 16 plus 39 or 40) when Nefermaat died. By that time, the great burial site of the sovereign at Meidum had already undergone many changes.⁴⁷ Harpur also thinks that Nefermaat must have been buried at Meidum before the royal necropolis had been transferred to Dahshur, otherwise he would have wished to relocate his tomb to be close to the

⁴³ Petrie (1892), p. 39, pl. XIX.

⁴⁴ Harpur (2001), p. 29.

⁴⁵ Harpur (2001), p. 28.

⁴⁶ Harpur (2001), p. 29.

⁴⁷ Read Monnier (2017), pp. 64-111.

sovereign's new funerary site. Based on these calculations, Harpur concluded that the vizier died in Snefru's fifteenth regnal year which corresponds to the 8th census year of his reign.⁴⁸ Finally, if we suppose a quasi-constant biennial rate of censuses,⁴⁹ and given the existence of a count which refers to Snefru's 24th census year in Dahshur, the implication is that the king survived until he was at least 85 years old.⁵⁰

Harpur considered that it was unlikely that the king lived to this relatively old age,⁵¹ and doubted that Nefermaat was Snefru's son. She suggested, instead, that Nefermaat's father was the king Huni, who preceded Snefru. This in turn led her to the conclusion that construction of the pyramid at Meidum was begun during the reign of Huni, and the vizier wanted to be buried near his father, for whom the original step pyramid of Meidum had been erected. Huni, the last king of the 3rd Dynasty, would therefore be responsible for the early stages of the monument, while his successor Snefru subsequently transformed it into a true pyramid in an act of filial piety.⁵²

The rigorous analysis set out by Yvonne Harpur means that estimates of the contribution made by Snefru to the total quantity of construction achieved at Meidum could be reduced, and it indicates that Huni could indeed have been buried there.

Despite the undeniable value of the argumentation, there are many separate hypotheses put forward in order to reach such a conclusion. For example, there is no evidence that the fifteen children represented in Nefermaat's tomb all have the same mother, who was assumed to have been Atet, since another probable wife, Neb, is represented twice in their tomb, including one occurrence with the vizier.⁵³ Although Neb never appears with children, it cannot be excluded that she is the mother of at least one of Nefermaat's.

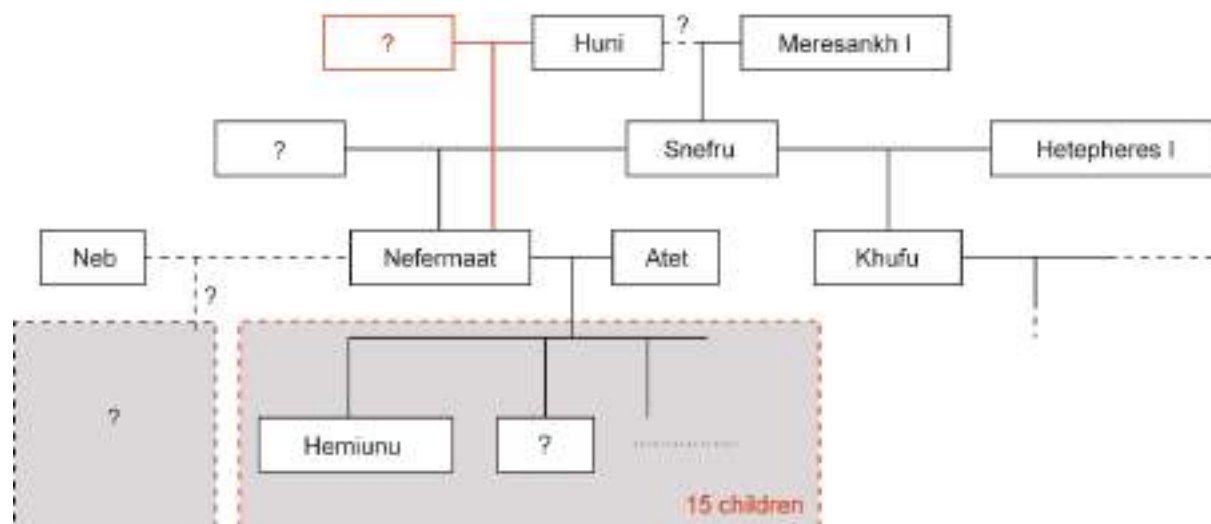


Fig. 13. Genealogy related to Nefermaat
(in red is the hypothesis by Harpur ((2001), pp. 21-33)).

48 Harpur (2001), p. 25.

49 Harpur (2001), p. 29. The biannual rate of censuses suffers from at least one exception during the reign of Snefru (see below).

50 Harpur (2001), p. 29. It seems to me that the calculation of Yvonne Harpur should give $55+16 \times 2$, or 87 years.

51 Harpur (2001), p. 29.

52 Reader (2015), p. 221.

53 Harpur (2001), p. 30.

His children are depicted twice in the mastaba. The older scene displays fifteen children, including six who are shown as adults, while the second depiction raises the number of adults to nine.⁵⁴ That implies that an interval of at least three years had elapsed between the two phases of decoration, meaning that the construction of the tomb took a substantial length of time. Given this level of commitment at Meidum, it is conceivable that Nefermaat would have been reluctant to commence building an equivalent eternal dwelling place in Dahshur. Furthermore it is not certain that he possessed the right to undertake the construction of a second tomb at all, or that he ever expressed a wish to be buried at the new site of Dahshur with Snefru, while the Meidum complex was still considered part of the main funerary domain (cf. below).

In conclusion, placing the vizier's death prior to the inauguration of the necropolis at Dahshur is a hypothesis which remains possible, but involves a substantial degree of uncertainty. The margin of error is considerably increased by all the possibilities offered by the offspring, who cannot be certified as coming from the same mother.⁵⁵ Furthermore, the minimum age of Snefru is calculated based on a census system that is supposed to be biannual and regular; something that is not confirmed by related documents.⁵⁶

The information is therefore too vague to state definitely that Snefru lived a minimum of 85 years. The real length of time was probably less, but even if he did live this long, is such an age so unlikely that the possibility should be ruled out? Other, even longer reigns during the Old Kingdom suggest that it was possible.⁵⁷

It is known that funerary temples could host cultic activities for several generations. They were maintained and supplied by domains founded for the purpose. However, the upper temple of Meidum shows no trace of such activities, and this seems incompatible with the proposal that Huni, or any king, was ever buried in the adjacent pyramid.⁵⁸

The internal structure of the pyramid is made up of successive sloping layers, and is typical of the construction technique used for pyramids during the 3rd Dynasty. Many researchers are therefore convinced that the internal structure of the Meidum pyramid must date back to the end of the 3rd Dynasty, and that, consequently, Huni initiated its construction.⁵⁹ However, the archaeological evidence does not support dating this construction technique to the 3rd Dynasty alone. For example, Snefru had a small provincial pyramid erected at Seila with this structural form.⁶⁰ There is no architectural evidence to prevent the proposal that Snefru commissioned the Meidum pyramid, and then asked his architects to modify the project twice. In fact, there is nothing dating to the Old Kingdom which indicates that a sovereign could appropriate the burial of his predecessor.⁶¹ At most, there is some evidence of spoliation, or the destruction of older structures for re-use in later funerary complexes.⁶²

54 Harpur (2001), p. 28.

55 'La longueur d'un règne est cependant très variable, de même que l'âge de l'accession au trône, ce qui brouille les données, d'autant plus que ces informations sont inconnues pour cette période. Cela rend donc tout calcul référent à la succession des générations très largement artificiel, surtout que le règne de Snéfrou est particulièrement long' (Baud (1999a), II, p. 490).

56 Especially because of the 7th and 8th counts which do not include any odd census (royal annals of the Palermo stone (Wilkinson (2001), pp. 143-146; Jiménez Serrano (2004), p. 54). Read Baud, (1999b), pp. 120-121. The short synthesis proposed by Miroslav Verner offers a very useful bibliography on the subject (Verner (2008), p. 39).

57 The reigns of Pepi I and Pepi II would have lasted respectively at least 50 and 60 years (Gourdon (2016), pp. 34-41).

58 It is also doubtful whether Snefru wanted to stop any religious activity dedicated to his father for several decades with the sole aim of modifying his supposed pyramid for purely aesthetic reasons.

59 Lauer (1962), pp. 218-220.

60 Swelim (2010).

61 Stadelmann (1985), p. 80.

62 The pyramids of Amenemhat I and Senusret I at Licht (Goedicke (1971) and also Harpur (2001), p. 24).

The chronological calculations seem to indicate that Snefru ruled for a maximum of 46 years,⁶³ so would he have been able to construct all three giant pyramid projects in this limited period of time?

A comparison can be made with the pyramid of Khufu, whose construction is better studied. With a volume of nearly 2,600,000 m³, the Great Pyramid was apparently completed in less than 27 years.⁶⁴ A simple calculation of proportionality based on this figure suggests that the 'Red' pyramid, at 1,750,000 m³, may not have required more than 18 years of construction activity. This estimate should perhaps be revised downwards, considering the size and number of buildings that were annexed to the pyramid of Khufu, as well as its funerary chambers that were far more complex than those of the pyramids of Dahshur-North.⁶⁵ Based on this calculation, all of Snefru's projects could, therefore, have been completed in around forty years. There is nothing to prevent us from thinking that Snefru could have built all three of these great pyramids during his reign.

While there is no convincing evidence that Huni was the builder of the Meidum pyramid, there is substantial evidence in favor of Snefru, and the vast majority of researchers no longer seek to 'remove him from the equation'. Despite this, there are scholars who still assign only the third stage of the site's construction (E3) to Snefru's reign. Given the absence of any text which mentions Huni, this point of view remains a subjective appraisal, which can only be defended by undermining the arguments in favor of his successor. While the various pieces of evidence available are more or less solid, all of them lead in the direction of Snefru.⁶⁶

The chronology of the three building sites of Snefru and the position of the satellite pyramid of Meidum

Assuming then that Snefru built all three giant pyramids of Meidum and Dahshur from beginning to end, the sequence of operations remains to be determined. Where should each project be placed within the chronology of his reign? The intention here is not to analyze all of the architectural evidence and all documentation relating to the pyramids of Meidum and Dahshur, since I have already set out the results of my research on this subject in recent publications.⁶⁷ Here I shall restrict myself to summarizing the essential points with respect to the objectives of this article.

It is known that Snefru laid the foundations of the 'Red' pyramid during the 15th census year,⁶⁸ while the highest census year reference ever collected for his reign refers to the 24th census.⁶⁹ Another inscription referring to the 15th count, found on a foundation block of the valley temple in Dahshur-South,⁷⁰ seems to show that the Bent pyramid was completed, or almost completed, in its current form by that time.⁷¹

⁶³ We know that there is no odd year between the seventh and eighth counts. All the dates collected at Meidum present a serious imbalance between the years of the census and the years after the census (the so-called 'années intercalaires'), the latter being much fewer (Verner (2001b), pp. 365-372). However, no one is yet in a position to respond satisfactorily to this problem. A rule of 46 years is a maximum limit and it is possible that it was lower. I have demonstrated with a very simple calculation that 40 years would have been enough to accomplish his projects. Also, I give myself a safety margin by working with this value.

⁶⁴ 27 years is the highest possible length on the assumption of a regular biannual count, given that the year following the 13th count is the highest ever recorded for the reign of Khufu, and probably the one that marks the end of his reign (Tallet (2017), pp. 5-10).

⁶⁵ I cannot share the assumptions and conclusions of Rolf Krauss that Snefru would have reigned only 24 years and the 'Red' pyramid would have required only ten years of work (Krauss (1996)). It would be to admit a strictly annual account for the censuses, which the documentation refutes.

⁶⁶ Removing the first two stages of the Meidum pyramid would not bring anything fundamental to the problem. This would only remove 13% of the total volume of the three pyramids, i.e. only 5 years of work from the supposed 40 years.

⁶⁷ Monnier and Puchkov (2016) and Monnier (2017).

⁶⁸ Stadelmann (1986), p. 234, fig. 1.

⁶⁹ Stadelmann (2008), pp. 104-110.

⁷⁰ Stadelmann (2011), p. 741.

⁷¹ Monnier (2017), p. 107.

Many dated masons' marks, similar to those found on the Dahshur plateau, were discovered at the Meidum pyramid.⁷² The dates exhibit great heterogeneity, and all are between the 7th and the 23rd count.⁷³ No earlier dates have been found, but this can be explained by the origin of the blocks, which were all extracted from the outer layers of the building completed during phases E2 and E3.⁷⁴ The evidence suggests that construction was carried out continuously throughout the reign, and in a way that meant a burial place was always available at short notice, even if it proved impossible to finish the newer projects due to the premature death of the king.

Nearly 18 years would have been required to complete the 'Red' pyramid, which represents 45% of the total volume of masonry used in all of Snefru's funerary projects. By postulating that quarrying, transport, and construction continued throughout his reign, then this leaves 22 years for the Dahshur-South and Meidum projects.

Volume						
Seila	Meidum (Satellite pyramid)	Meidum ⁷⁵	Dahshur-South (Satellite pyramid)	Dahshur-South (Bent pyramid)	Dahshur-North (‘Red’ pyramid)	Total
6,000 m ³	6,000 m ³	640,000 m ³	24,000 m ³	1,467,000 m ³	1,750,000 m ³	3,893,000 m ³
0.15%	0.15%	16.44%	0.62%	37.68%	44.95%	100%

Table 1. Volume of the pyramids attributed to Snefru.

During the 7th census year, Snefru launched a raid into Nubia and brought back 4,000 men, 3,000 women, and 200,000 head of cattle,⁷⁶ and there is little doubt that this booty was required to satisfy the growing need for provisions and manpower at the increasingly large building sites. Phase E2 of the step pyramid of Meidum had certainly been completed by that time; its 500,000 m³ could have been laid in approximately 5 years.

Building work was then moved to Dahshur-South. The project was to construct a pyramid with smooth and sloping faces of 60°, the very first of its kind.⁷⁷ When building work had reached a minimum height of 26 m, it was decided to enlarge its base by enclosing it with masonry outer layers, arranged in slightly inclined beds. Both parts of the project were able to reach a height of 136 m.⁷⁸ To do this, the outer faces of the second stage were inclined by approximately 55°. However, structural movement in the enveloping masonry then compelled the architects to abruptly diminish the outer inclination to avoid further overloading the structure.⁷⁹

From that moment on, it was decided to build the upper part following a slope of approximately 44°. Until recently, most scholars agreed that the bent shape was the final shape desired by the builders, but there were no clear reasons for reaching such a conclusion. The research I conducted

⁷² Rowe (1931), p. 26, pl. 38 (fig. 2); Posener-Kriéger (1991); Petrie *et al.* (1910), p. 9, pl. V.

⁷³ Verner (2001b), pp. 365-368.

⁷⁴ Lauer (1976), p. 79.

⁷⁵ The volume indicated for this pyramid was calculated with a height of 91.90 m, a value determined by Petrie (Petrie (1892), p. 6). The measures of Maragioglio and Rinaldi lead to the value of 94.50 m (Maragioglio and Rinaldi (1964), p. 16).

⁷⁶ Wilkinson 2000, pp. 141-142; Jiménez Serrano (2004), p. 54.

⁷⁷ Gilles Dormion and Jean-Yves Verd'hurt recently proposed a complete revision of the chronology of the Snefru construction sites, the pyramids attributed to him, as well as the shapes adopted by each project (Dormion and Verd'hurt (2016)). See my review: Monnier (2017b).

⁷⁸ Monnier and Puchkov (2016), p. 29 (fig. 13).

⁷⁹ Monnier and Puchkov (2016), pp. 28-33.

jointly with Alexander Puchkov, however, revealed that extending the lines of the upper part generates the exact profile of the 'Red' pyramid, and identical dimensions overall.⁸⁰

We concluded that the bent form was only created as a result of the abandonment of the project before its completion. It seems clear that Snefru's second great project, the Bent pyramid, should eventually have had the silhouette of a true pyramid, with sloping faces of approximately 44°. The upper part was, apparently, to be completed first, and this was surely due to the existence of a construction ramp which enveloped the lower part. The builders would have intended to complete the lower outer layer last, after dismantling the scaffolding and ramp. In the end, repeated subsidence within the structure overcame the motivation of the overseers of works, and they completed the upper part of the pyramid, but refrained from adding the lower outer layer with a slope of 44°. The construction ramp was dismantled, the faces were finished, and the pyramid finally acquired its bent shape.⁸¹ It was then decided to build another pyramid, but in Dahshur-North, with the intended form already defined.

It may seem curious that a satellite pyramid with sloping-faces, identical in form to that of the 'Red' pyramid of Dahshur-North, was erected at Dahshur-South, and not near the former. But there are some characteristics that favor a close chronological relationship between the two monuments. The similar quality of the masonry, stones laid with horizontal layers,⁸² and the existence of two-sided corbelled chambers with finely cut protrusions in both monuments⁸³ lead me to think that the satellite pyramid of Dahshur-South was erected either during the last phase of the Bent pyramid's construction, or during the construction of the 'Red' pyramid. Its position, approximately 52 m (or 100 cubits)⁸⁴ from the south side of the Bent pyramid makes me inclined to accept the second alternative, since the base around the Bent pyramid had to be clear in order to set out a ground plan at this precise distance.⁸⁵ The sequence of construction phases was perhaps challenging for establishing such a large subsidiary building on the outskirts of a great pyramid which was still under construction, but they may have persevered to ensure that the king had a satellite pyramid ready in the event of his premature death.

Whatever the reason for building it, it seems that the satellite pyramid did not have to be in the immediate vicinity of the intended final burial place of Snefru. Its construction made it sacred, so it could fulfill its intended function, which remains mysterious as we still do not know the exact role that satellite pyramids held within funerary complexes.⁸⁶

In this context, the observation made by Jean-Philippe Lauer that the profiles of the satellite pyramids had to be identical to those of the main pyramids, at least during the 4th Dynasty, is significant.⁸⁷ It can be observed that this relationship held for the funerary complexes of Khufu,⁸⁸

80 Monnier and Puchkov (2016), p. 29 (fig. 13).

81 Monnier and Puchkov (2016), p. 32.

82 According to Howard Vyse, the upper part of the Bent pyramid of Dahshur-South is made of sloping beds being inclined 3° 30' downward (Vyse (1842), p. 66).

83 Maragioglio and Rinaldi (1964), p. 74-80, tav. 15; Monnier (2017), pp. 97-99.

84 Same value as the length of each side of the monument (Maragioglio and Rinaldi (1964), p. 76, tav. 15).

85 Fakhry (1959), pp. 89-96; Maragioglio and Rinaldi (1964), tav. 8 (fig. 2). There is also a great similarity between the chambers of this satellite pyramid and those of Khufu's pyramid at Giza (Monnier (2017), pp. 124-147), indicating a direct succession in the history of this dynasty.

86 They are to be distinguished from the subsidiary queens' pyramids. Herbert Ricke, following Gustave Jéquier, considered them as Ka tombs (Jéquier (1936), 9 and Ricke (1950), pp. 106-107) and not as burials, an opinion often expressed, although being nuanced (Arnold (1997), p.70). That regular worship could be celebrated there is not established. Read Lehner (1985), pp. 74-85 and Jánosi (1996), pp. 5-30, 181-183, 280-287.

87 Lauer (1968), p. 106.

88 Hawass (1996), p. 385-386.

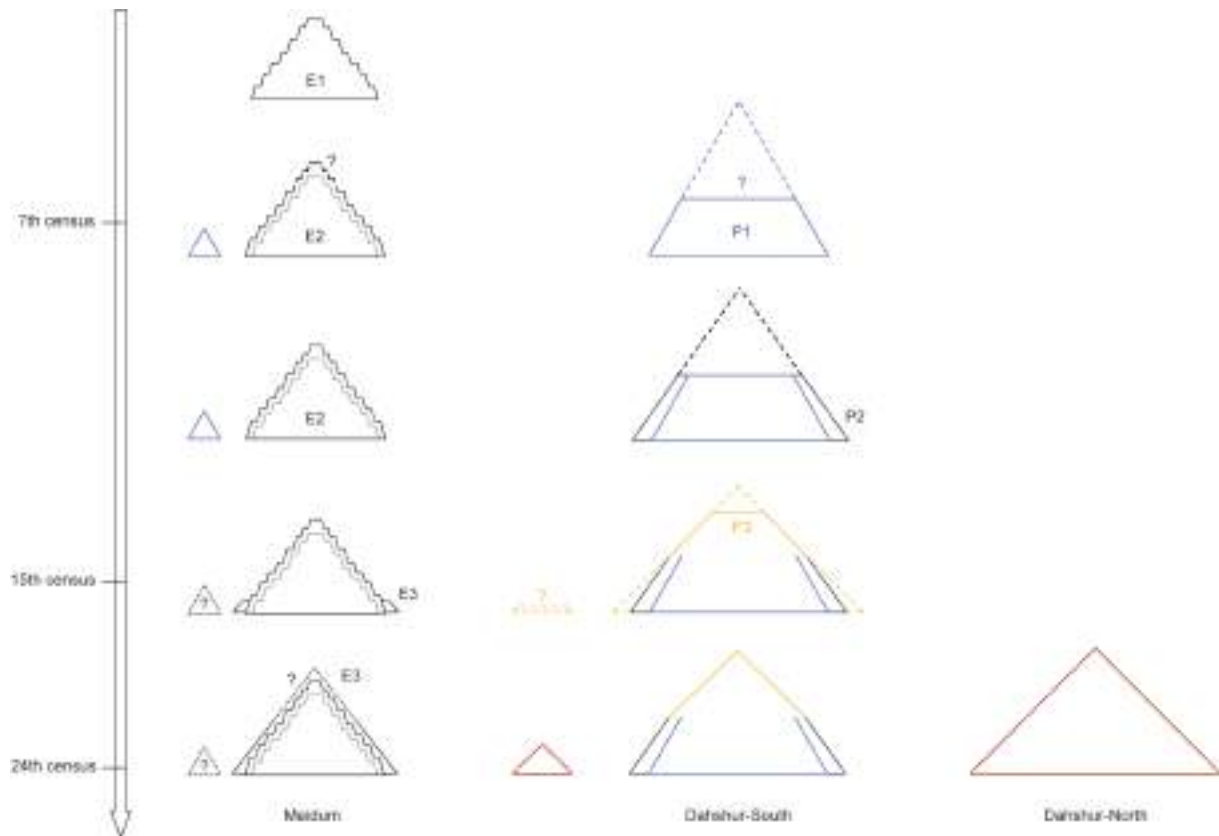


Fig. 14. . Chronological sequence of Snefru's construction sites according to the author.

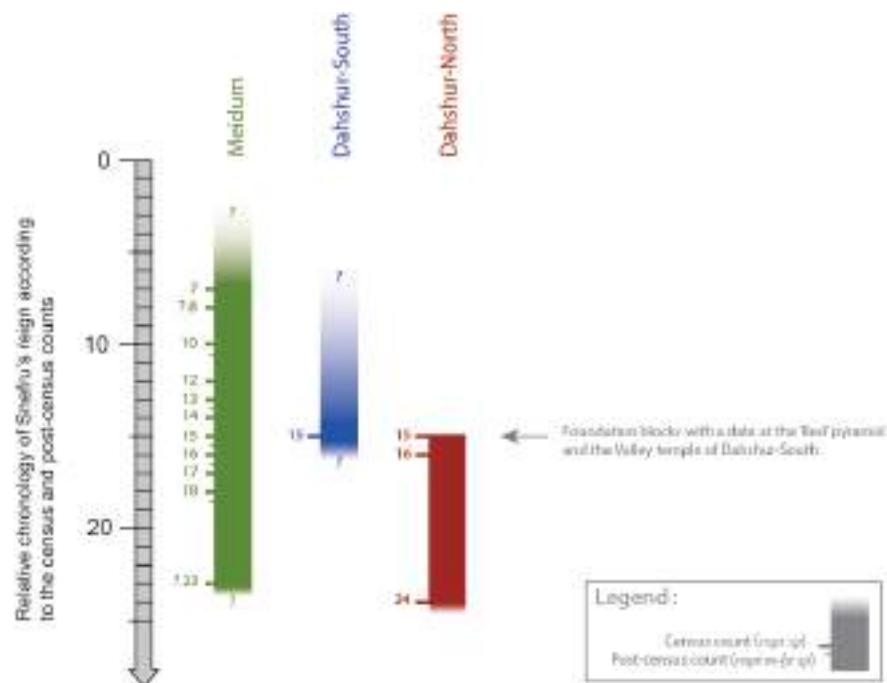


Fig. 15. Chronological sequence of Snefru's construction projects according to the census dates recorded at the sites (Regarding the dates discovered at Meidum and Dahshur, read Posener-Kriéger (1991), pp. 17-21, pl. 7-12; Stadelmann (1986), pp. 236-238; Stadelmann (2008), pp. 104-110; Verner (2001b), pp. 365-368 and Gundacker (2007), pp. 24-30. See also Monnier (2017), pp. 106-111).

Khafre⁸⁹ and Menkaure.⁹⁰ Jéquier also noted it at the queen pyramids of the complex of Pepy II at Saqqara.⁹¹

It is on the basis of all this evidence that I think it is possible to position the satellite pyramid of Meidum within the wider chronology and construction logic of Snefru's construction sites. Firstly, the stela fragment found on the site is reminiscent of the steles engraved with the Horus name of Snefru found in the complex of Dahshur-South, still oriented towards the east. In addition, the inclination of the Meidum satellite pyramid's faces is only paralleled by those of the first phase of Dahshur-South.⁹² So if the satellite pyramid associated with the 'Red' pyramid was established near the monument which directly precedes it in the chronology of the major building sites, then I am led to think that the satellite pyramid at Meidum was associated with the first phase of the Bent pyramid project at Dahshur-South.

Locating a 'satellite pyramid' at such a distance may seem like a surprising hypothesis, but all of the evidence indicates that a completed pyramid was always considered an integral part of any great funeral complex, whatever the distance and the later modifications.

Finally, there are several other notable observations that are worth setting out here. Dahshur-North and Dahshur-South were sometimes considered to be a pair, as one site, sometimes designated as '[The two pyramids] of Snefru are rising',⁹³ and sometimes separately as '[The southern pyramid] of Snefru is rising'⁹⁴ and (probably) '[The northern pyramid] of Snefru is rising'.⁹⁵ Ultimately, Snefru was certainly buried in the 'Red' pyramid at Dahshur-North,⁹⁶ while the upper temple at Meidum remained unfinished, probably because of the king's death.

While the 'Red' pyramid complex was hastily completed using brick as a building material,⁹⁷ evidence from the upper temple and the valley temple of the Bent pyramid at Dahshur-South indicates a lengthy period of cult activity dedicated to the king.⁹⁸ No monument was thus definitively abandoned, and all of the temple buildings retained the functions for which they were originally founded, provided that they were completed. With respect to the pyramids, each new project relegated the previous one to the rank of a cenotaph.

Due to its proximity to the main pyramid, the satellite pyramid of Meidum could have been dismantled, or in the worst case, damaged by the final construction phase which converted the Meidum monument into a smooth-faced pyramid (the final stage E3). Following the logic of the construction phases described here, the last transformation at Meidum was probably a contingency against the sudden death of a sovereign who, knowing himself to be ageing would have feared

89 Hölcher (1912), pp. 34–35, 57, 64; Maragioglio and Rinaldi (1966), pp. 90–91, 130–131, tav. 17.

90 Reisner (1931), pp. 55–68.

91 Jéquier (1933), pp. 10–11.

92 It is therefore legitimate to ask whether the internal structure of the Bent pyramid does not have this same section with sloping beds of 30°. Indeed, one can imagine that the transition from the step pyramid to the smooth-faced pyramid took place gradually, again using at least one outer sloping layer. The enlargement of the first Dahshur-South project was carried out by means of an inclined bed envelope, but with less slope. The 'Red' pyramid and its satellite pyramid are thus perhaps the first to have been entirely built in horizontal layers.

93 Cited in the Dahshur decree of the year 21 of Pepy I (Borchardt (1905), p. 1–2; Strudwick (2005), pp. 103–105).

94 Maspero (1885), p. 190.

95 This distinction is not attested, but is proved by the existence of the 'southern pyramid' (Monnier (2017), p. 106).

96 Human remains were discovered in the 'Red' pyramid and analyzed by Ahmed Batrawy who dated them to the Old Kingdom (Batrawy (1951), pp. 435–440). But the invalidation of some of his conclusions leaves room for doubt (Monnier (2017), pp. 99, 105). Although it is possible that we are dealing with a late reoccupation of the burial site (Maragioglio and Rinaldi (1964), p. 132), the 'Red' pyramid was the best candidate to receive the king's remains.

97 Stadelmann (1993).

98 Fakhry (1959), pp. 75–87, 97–104, 106–117 and Fakhry (1961).

that his new tomb at Dahshur-North might not be completed in time. It was therefore expedient to finish off the step pyramid as a true pyramid, while all the layers of the new giant pyramid at Dahshur-North were still under construction.



Fig. 16. The three giant pyramids attributed to Snefru: Meidum (on the left), Dahshur-South (in the middle) and Dahshur-North (on the right) (Photos: Franck Monnier).

Conclusion

In this gigantic puzzle of evidence relating to the funerary domains of Snefru, there are many remaining questions to be answered.⁹⁹ Any conclusions drawn are founded on assumptions, but these limitations do not negate the existence of some solid facts. It is now established that Snefru initiated the two pyramid projects at Dahshur. Numerous indications suggest that he also built the Meidum pyramid. He certainly completed the Meidum pyramid, and there is a lack of evidence to say that Huni erected the first stages of that monument. Contrary to widespread opinion, it was quite possible for Snefru to build all three giant projects at Meidum and Dahshur. If one can accept that Khufu completed his huge funerary complex in around 27 years, there is nothing to say that Snefru could not complete his three pyramids in forty years, following a similar system of quarrying, transport, and installation of stone blocks.

The symbolic hypothesis made by others concerning a supposed duality observed in the architecture at Dahshur¹⁰⁰ (the two-part shape of the Bent pyramid, the two pyramids on the site) is contradicted in the first instance by a structural analysis of the Bent pyramid, which suffered many small subsidence events during its construction, and underwent many modifications as a result;¹⁰¹ and secondly by the chronological sequence of the construction of the two buildings. If the original intention had been to create a bipartite domain at Dahshur, it is likely that the two monuments would have been erected simultaneously and not successively. Moreover, there is absolutely no textual or iconographic evidence that supports such a hypothesis. This does not, however, mean that the two monuments did not eventually constitute a coherent whole in the eyes of the Egyptians, and the choice of the second site did not mean the total abandonment of the first. The earlier monument had been consecrated by the foundation rituals,¹⁰² and it was undoubtedly still considered an effective part of a funerary domain that was becoming more and more extensive.¹⁰³ A similar sequence of events was most likely followed when the construction site was transferred from Meidum to Dahshur-South.

⁹⁹ Some uncertainties remain with regard to the translation of fragmentary census dates which were discovered at Meidum and Dahshur, especially those which are related to the 23th and 24th counts (Arnold (in print), pp. 52-54). This does not change fundamentally the overall construction sequence proposed here.

¹⁰⁰ Varille (1947), pp. 7-8; Nuzzolo (2015).

¹⁰¹ Monnier and Puchkov (2016); Monnier (2017).

¹⁰² Montet (1960), pp. 172-180.

¹⁰³ This is also confirmed by the Pepy I decree (dated to year 21) which considers the two pyramids of Dahshur as one and the same site (Borchardt (1905), p. 1-2; Strudwick (2005), pp. 103-105).

The structural analysis and comparative analysis of the monuments studied in this article led me to reconstruct a general chronological outline, a plausible and coherent sequence of reasoning that the architects of Snefru followed in response to design innovations, and modifications to those designs that were required.¹⁰⁴

A reconsideration of the archaeological evidence from the Meidum satellite pyramid also allowed me to propose a corrected and revised reconstruction of that building. The Meidum monument should have had the same profile as the first phase of the Dahshur-South project, while the satellite pyramid later established at Dahshur-South is a miniature replica of the 'Red' pyramid of Dahshur-North. I suggest that the construction processes and the king's fear of departing for the netherworld before the completion of his pyramids may have forced him to establish distant satellite pyramids, although still located in his funerary domain. I therefore date the construction of the satellite pyramid of Dahshur-South to the end of the king's reign, and the construction of the satellite pyramid of Meidum to around the 7th census year during his reign, when the masonry courses of the first project at Dahshur were just beginning to rise.

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¹⁰⁴ Mistrust is common when analyzing changes made in the pyramids, while they are quickly accepted for other types of buildings. If the pyramid of Meidum was reshaped twice, then there is nothing to exclude that other projects were also changed. '(...) discuter d'erreurs éventuelles serait se méprendre sur la nature même des changements imprimés. Une modification survenant en cours de chantier ne traduit pas obligatoirement une faute, une maladresse ou un comportement hasardeux, mais très souvent une innovation ou une amélioration, voire tout simplement une volonté différente. Ce type de chantiers ayant duré plusieurs décennies, il n'aurait guère été étonnant de voir le maître d'ouvrage ou le maître d'œuvre, après plusieurs années de réflexions, prendre quelques décisions visant à se détourner des choix édictés au début du règne, si tant est qu'elles fussent réalisables. C'est aussi en cela que résident toute l'habileté et la puissance des architectes égyptiens' (Monnier (2017), p. 146).

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