Cuneiform Digital Library Bulletin 2026:01
<https://cdli.earth/articles/cdlb/2026-1 >
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ISSN 1540-8779
Version: 20 January 2026

Improving Legibility: Visual Strategies for Four Unpublished Cuneiform Objects from Ghent University

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Abstract: This article presents the edition of four unpublished Ur III objects from the Ghent University Museum and introduces a new visualization method for their publication. Using image editing software to overlay the "Shaded" and "Sketch 1" filters from 2D+ models generated with the PLD Viewer, the resulting composite images enhance the legibility of cuneiform signs and seal impressions while preserving morphological details. This simple yet effective approach enables more accurate and detailed analysis of the inscriptions and proves especially effective for publication, offering clear and readable images suitable for both print and digital formats.

Keywords: Clay Sealings; 2D+ models; Ur III period; Digital epigraphy

§1. Introduction

§1.1. The Ghent University Museum (GUM) houses a collection of over three hundred cuneiform epigraphic materials, including tablets, bullae, sealings, and tags (pisan-dub-ba), which remain unpublished and are currently under academic study. Originally acquired from the Paris antiquities market between the 1920s and 1930s by François Thureau-Dangin (1872–1944), these artifacts were later passed to Georges Dossin (1896–1983), who subsequently donated them to his pupil, Léon De Meyer (1928–2006), professor of Assyriology at Ghent University.[1] Ultimately, the Ghent University Museum became the final repository of this significant collection.

§1.2. This study focuses on two bullae (LW21.CUN.29 and 109), one tag (pisan-dub-ba) (LW21.CUN.65), and one sealing (LW21.CUN.173).[2] These items were selected for three main reasons. First, their complex shapes present specific challenges for both documentation and epigraphic analysis. Second, they all served administrative purposes and were likely used to close containers. Third, they date to the Ur III period (ca. 2100–2000 BCE). These functionally and chronologically related artifacts are particularly suitable for comparative analysis, while their morphological complexity makes them ideal for testing new visualization strategies aimed at enhancing the legibility of inscriptions and seal impressions.

* This research is supported by the Fonds Wetenschappelijk Onderzoek – Vlaanderen (FWO grant number: 11B8824N).

[1] For a biography of François Thureau-Dangin, see Maspero 1944; for further details on Georges Dossin and Léon De Meyer, see De Graef 2020, 254–257.

[2] The abbreviation "LW21.CUN." followed by a number denotes the inventory number assigned to cuneiform epigraphic materials kept at the Ghent University Museum. Abbreviations for administrative texts follow the conventions used by the Cuneiform Digital Library Initiative (CDLI). Additionally, the following abbreviations are employed: Š = Šulgi, AS = Amar-Suen, ŠS = Šu-Suen, IS = Ibbi-Suen.

§2. Digitization of the collection

§2.1. The entire Ghent collection has been digitized using the Portable Light Dome (PLD), which implements the PTM (Polynomial Texture Mapping) algorithm for the creation of 2D+ models (for the PLD, see Hameeuw and Willems 2011).[3] These 2D+ models are generated from a series of photographs taken from a fixed camera position, each with a different light direction. Based on the lighting information captured in these images, a polynomial mathematical model of the surface reflectance is calculated, which enables the user to inspect the object by re-lighting it interactively (see, e.g., Malzbender et al. 2000; Mudge et al. 2006; for advances in PTM compression and web visualization, see, e.g., Ponchio, Corsini, and Scopigno 2018). The 2D+ models of the Ghent epigraphic materials can be visualized through the PLD Viewer application (for the PLD Viewer, see Hameeuw and Willems 2011).

§2.2. One of the key advantages of the PLD Viewer lies in its ability to allow users to dynamically adjust the intensity, direction, and angle of illumination in order to highlight subtle surface features. The PLD Viewer also offers various visualization filters. The "Shaded" and "Sketch 1" filters are particularly valuable for epigraphic analysis, each with distinct characteristics: the "Shaded" filter enhances contrast by removing the natural color of the clay while preserving depth information and surface morphology, while the "Sketch 1" filter renders cuneiform signs in high-contrast black on white, allowing immediate readability but flattening the spatial dimension of the artifacts. However, when 2D+ models are converted into static images for academic dissemination, whether in printed or digital form, two main issues arise: the interactive re-lighting capability is inherently lost, and each individual filter presents specific limitations that can be problematic for comprehensive epigraphic documentation.

§2.3. To address these challenges, this study proposes a composite visualization method applied to four unpublished objects from the Ghent collection (LW21.CUN.29, 109, 65, and 173), all of which present irregular shapes and complex surface features. The bulla LW21.CUN.29 and the tag LW21.CUN.65 serve as representative examples to illustrate the specific visualization challenges that this method addresses. By overlaying the "Shaded" and "Sketch 1" filters from the PLD Viewer outputs using image editing software (Adobe Photoshop), a composite image is created. The resulting images combine the depth perception of the "Shaded" filter with the enhanced sign clarity of the "Sketch 1" filter (Figure 1).



Figure 1: Composite visualization of the bulla LW21.CUN.29 (left) and the tag LW21.CUN.65 (right), generated by overlaying "Shaded" and "Sketch 1" filters.

§2.4. Specifically, the "Sketch 1" visualization serves as the base layer, with the "Shaded" filter version superimposed at 50% opacity. The resulting visualization is comparable in terms of legibility and clarity to ammonium chloride treatment (Vandecasteele et al. 2005), but achieved non-invasively through digital processing. This integrated method provides an optimal repre-

[3] I thank Hendrik Hameeuw (KU Leuven) for his support in setting up and making the Portable Light Dome available for use.

sentation of the epigraphic material: the cuneiform signs remain as legible as in a hand copy, while seal impressions and extraneous elements (such as surface damage) retain their three-dimensional depth, enabling more effective examination.

§2.5. The bulla LW21.CUN.29, when viewed in its standard color visualization through PLD Viewer, presents an uneven geometrical surface created by the seal impressions, where light and shadow do not distribute consistently, making certain cuneiform signs difficult to distinguish. Additionally, the bulla's irregular shape, sloping downward on the right side, poses challenges for achieving even illumination. When the light source is positioned at a shallow angle from the left, the right side remains in shadow. Conversely, when the light is placed on the right, the left side becomes obscured. To enhance visibility, the light must be positioned at a low angle from the left but slightly toward the center to maximize contrast across all signs (Figure 2, left). However, even this adjustment does not fully resolve the issue, as some areas on the right side remain difficult to read.

§2.6. A similar but distinct set of challenges is observed with the tablet container tag LW21.CUN.65. While adjusting the light to enhance the contrast of the signs on the right side, the left side near the break remains poorly contrasted. Moreover, in order to achieve optimal visibility of the cuneiform signs, the light must be positioned at a low angle from the upper left. However, this placement casts shadows over the lower part of the tag, which, despite being damaged, still preserves negative impressions of a cord. These impressions become difficult to discern when the lighting is optimized for the cuneiform signs, highlighting the inherent limitations of single-angle illumination for irregularly shaped artifacts (Figure 2, right).



Figure 2: Obverse views of bulla LW21.CUN.29 (left) and tag LW21.CUN.65 (right) (color visualization on PLD Viewer).

§2.7. Single-filter approaches prove insufficient for these complex artifacts. The "Shaded" filter, while enhancing contrast by removing the natural color of the clay, does not eliminate legibility issues caused by irregular surfaces. Despite careful lighting adjustments, signs on the right side of the bulla remain difficult to discern due to seal impressions disrupting uniform illumination (Figure 3, left). Similarly, the tablet container tag shows some improvement compared to the standard color visualization, but the inherent surface irregularities continue to pose problems, preventing an evenly illuminated and fully legible representation of the inscription and of the negative impressions (Figure 3, right).

§2.8. Conversely, the "Sketch 1" filter allows for an immediate and clear reading of the cuneiform signs by rendering them in high-contrast black on a white background. However, this comes at the expense of the spatial dimension of the artifacts. Morphological details become flattened: the base of the bulla (clearly distinguishable on the left side in the previous visualizations) appears visually merged with the rest of the surface in the "Sketch 1" rendering. Additionally, some morphological details of the seal impression become flattened, making it difficult to differentiate between the edges of the iconography and the vertical or horizontal wedges of the cuneiform signs (Figure 4, left). A similar issue arises with the tag LW21.CUN.65. While the cuneiform signs are now perfectly read-



Figure 3: Obverse views of bulla LW21.CUN.29 (left) and tag LW21.CUN.65 (right) ("Shaded" visualization on PLD Viewer).

able, the flattening effect creates ambiguity in distinguishing between the tablet's inscribed surface and the broken lower section, which contains negative impressions of a string. The upper and lower sections appear to be at the same depth, and the negative impressions are indistinguishable from general surface damage (Figure 4, right). This loss of depth perception introduces potential misinterpretations when studying the artifact's physical characteristics alongside its inscriptions.



Figure 4: Obverse views of bulla LW21.CUN.29 (left) and tag LW21.CUN.65 (right) ("Sketch 1" visualization on PLD Viewer).

§2.9. The composite method presented here resolves these limitations by preserving both sign clarity and morphological detail. This approach is both simple and highly effective: once 2D+ static outputs with both filters are generated, the overlay process and export require less than five minutes per artifact. This makes it particularly suitable for static publication in both printed and digital editions. Moreover, the application of this methodology has enabled more effective analysis of texts in the Ghent collection, especially where color and preservation state made direct examination with the naked eye challenging. This is especially evident for bulla LW21.CUN.109, where the worn surface significantly hampers readability. In addition, the 2D+ model made it possible to identify and read seal impression legends, which remain barely visible to the naked eye, on both LW21.CUN.109 and LW21.CUN.173. Finally, this approach provides clear and valuable output offering significant advantages for publication.

§2.10. The following sections present the analysis of two bullae (LW21.CUN.29 and 109), one pisan-dub-ba (LW21.CUN.65), and one sealing (LW21.CUN.173), with composite visualizations generated through the combined application of the "Shaded" and "Sketch 1" filters. These images illustrate the improvements in legibility and detail achieved with this method.

§2.11. All four objects examined in this study preserve negative impressions of the materials to which they were once attached. Specifically, the sealing (LW21.CUN.173) bears the impression of a leather bag, while the two bullae (LW21.CUN.29 and 109) and the tag (LW21.CUN.65) preserve negative impressions of cordage. The technical analysis of these latter three impressions employs standard rope-making terminology (see, e.g., Wendrich 1991; Veldmeijer 2009): twist direction is indicated by 'S' or 'Z' based on the visual correspondence between the letter's diagonal stroke and the angle of the twisted fibers, while 'I' indicates untwisted roving. Lowercase letters (s, z) indicate yarn twist, uppercase (S, Z) indicate ply twist, and numbers indicate quantity (e.g., sZ_2 = two s-twisted yarns plied in Z-direction). Detailed analysis of these negative impressions using 3D digital casting methodology is presented in Surdi (forthcoming).

§3. Objects

§3.1. Bulla: LW21.CUN.29

Dimensions: 38 mm (wide side) to 20 mm (narrow side) × 42 × 28 mm
Provenance: Puzriš-Dagān (mod. Drehem)
Date: AS.05.05.00
Negative impressions analysis: Cordage (roving) with I-twist direction and average diameter of 9 mm.

§3.1.1 Physical Description. Only two sides of the bulla remain intact, while the rest of the object is broken off and now missing (Plate 1). Nevertheless, based on the remaining surfaces and overall geometry, it is possible to reconstruct its original shape as a three-sided polyhedron with a triangular base, featuring a hole in the upper, narrower part of the bulla. From the broken section, internal impressions of rope fibers, approximately 9 mm in diameter, are visible, extending about 30 mm into the bulla and ending in a knot or, more accurately, a tangled mass likely intended to secure the two rope ends. The rope appears to be composed of slightly twisted, loose, and frayed vegetal fibers (for an analysis of the negative impressions of the bulla, see Surdi, forthcoming). These rope traces confirm its historical function as an archival label attached to a container.

§3.1.1.2. As Tsouparopoulou has shown (Tsouparopoulou 2013; 2017, 619–620; see also Tsouparopoulou 2015), the shape of these polyhedral labels corresponds closely to their contents: they probably sealed the cords used to fasten leather bags containing tablets destined for the archival depot in Puzriš-Dagān. Typically, these bullae sealed bags documenting monthly expenditures, so the precise day-date was often omitted: this practice is evident in bulla LW21.CUN.29 as well.

§3.1.1.3. A seal was impressed multiple times on the bulla, and a cuneiform text was then written over those seal impressions without particular regard for the orientation. In this specific example, the seal impression appears upside down relative to the standard reading orientation of the text.

§3.1.1.4. There is no evidence that the bullae discussed here were fired in modern times. LW21.CUN.29 feels solid, not very dusty, and slightly glossy. This suggests that the bulla was fired in antiquity, aligning with administrative practices in Puzriš-Dagān, where the polyhedral bullae were purposefully fired after fulfilling their function (Tsouparopoulou 2017, 619).

§3.1.2 Transliteration

(Side A not preserved)

Side B
1. [^{d}]⌜šul-gi⌝-uru-mu
2. ⌈šu⌋ ba-ti
3. kišib$_3$ ba-ba-ti
4. ⌜iti ezem-^{d}nin-a-zu⌝

Side C
1. ⌜mu en-unu$_6$-gal⌝
2. ^{d}inanna ⌜unu^{ki}⌝ ba-hun

(Side D: Traces of seal impression)

Seal
i col.
1. ^{d}amar-^{d}suen
2. nita kala-ga
3. lugal uri$_5$/^{ki}-ma
4. lugal an-ub/-da limmu$_2$-ba

ii col.
1. ba-ba-ti
2. dub-sar
3. arad$_2$-zu

§3.1.3 Translation

Text: (Side A not preserved) [...]; (B) Šulgi-urumu has received. Sealed tablet of Babati. The month of the festival of Ninazu (month V). (C) Year:

"Enunugal(ana), (the *en*-priest of) Inanna was installed in Uruk".

Seal: i) Amar-Suen, the mighty man, the king of Ur, the king of the four quarters; ii) Babati, the scribe, (is) your servant.

§3.1.4 Commentary The bulla employs the so-called *Reichskalender* (royal calendar) best attested in texts from Ur, Puzriš-Dagān, and GARšana (Cohen 2015, 85; Sallaberger 1999, 235f.). Some bullae from Puzriš-Dagān bear Babati's seal impression, while others feature Babati's seal impression alongside references to Šulgi-urumu in the text.[4] Since these two individuals frequently appear together in documents exclusively from Puzriš-Dagān, their presence on the Ghent bulla strongly suggests its provenance from this site. Unfortunately, the first part of the text is missing. However, the bullae from Puzriš-Dagān that feature both Babati's seal and references to Šulgi-urumu commonly document livestock transactions. This parallel strongly suggests that the missing portion of the text likewise pertained to a receipt of animals.

§3.1.5 Šulgi-urumu headed the "office for dead animals"[5] from AS.03 until the central agency ceased to function (Tsouparopoulou 2013, 166). The individuals from whom Šulgi-urumu received animals were likely mentioned in the first part of the text, which unfortunately has not been preserved. Such bullae were typically used to seal cords that bound leather bags containing all the tablets issued in a given month (Tsouparopoulou 2013; 2017). In the case of LW21.CUN.29, references to the fifth month of the fifth year of Amas-Suen (AS.5.5.00) suggest that it sealed a bag containing the records of the fifth month with tablets that mentioned Šulgi-urumu.

§3.1.6 The available documentation shows that the tablets dated to the fifth month of AS.05, in which Šulgi-urumu is cited as the recipient, mention animals from En-dingir-mu,[6] Šulgi-ajamu,[7] Ahu-Wer,[8] and Tūram-Dagān.[9] Therefore, the bulla was attached to a leather bag that collected tablets indicating that Šulgi-urumu had received animals from those individuals. By the end of the fifth month of AS.05, the tablets documenting the animal transfers from one of the aforementioned officials to Šulgi-urumu were placed into a leather bag. The official Babati would likely have attached a presealed polyhedral-shaped bulla to the cord closing the leather bag, noting that the bag held the expenditures of one of the officials whose transfers were received and recorded by Šulgi-urumu.

§3.1.7 Beyond his seal impression on this bulla, Babati was a crucial figure in the administration of Puzriš-Dagān, rising to prominence during the reigns of Amar-Suen and Šu-Suen. As the brother of Queen Abi-Simti and thus the uncle of Šu-Suen (Whiting 1976, 182), he was an "outsider" who assumed significant administrative responsibilities closely linked to the royal court. Babati managed financial accounts for certain officials, and his tenure at Puzriš-Dagān highlights the fusion of administrative oversight and diplomatic engagement, underscoring the strategic importance of his position within the operations of the Ur III dynasty's central livestock agency (Tsouparopoulou 2013). Babati owned two distinct seals: one, the seal impressed on the Ghent bulla, was crafted during the reign of Amar-Suen and later recarved between AS.07 and AS.09 to include the name of the new ruler, Šu-Suen (Tsouparopoulou 2015, 157). The second seal was a royal gift seal granted to him by Šu-Suen, outstanding both for its large size and for the numerous titles accorded to Babati (Mayr and Owen 2004, 150; see also Walker 1983), signifying his important role within the state apparatus (for a description of both seals see Tsouparopoulou 2015, 157-159).

§3.2. Pisan-dub-ba: LW21.CUN.65
Dimensions: 33 × 39 × 19 mm
Provenance: unknown
Date: unknown
Negative impressions analysis: cordage with sZ_2-twist, ca. 30° twist angle, and average diameter of 4.5 mm.

[4] BbJ 2, no. 11 [P361750]; AVO 20, 175 Kat. 69 [P512812]; DIA 19.024.05 [P461499]; Hermitage 3, 561 [P212305]; NYPL 354 [P122892]; PDT 1, 0398 [P125814]; PPAC 4, 121 + 122 [P332042].

[5] For this definition see Tsouparopoulou 2013, 151.

[6] Hirose 197 [P109668].

[7] Aegyptus 29, 107, 36 [P100269]; Hirose 199 [P109670]; Hirose 200 [P109671]; OIP 121, 053 [P123783].

[8] Nisaba 08, 096 [P320516]; TCND 338 [P133960]; Hirose 201 [P109672].

[9] BPOA 06, 0044 [P210115].

§3.2.1 Physical Description. The pisan-dub-ba (tag for a tablet container) (Plate 2) exhibits impressions from two ropes, which are most likely the ends of the cord used to close the container of tablets, sealed by the pisan-dub-ba. The deeper, more distinctly preserved impression extends approximately 28 mm into the tablet. Traces of the other rope's end are shallower, reaching just 16 mm inside (see Surdi, forthcoming for the analysis of the negative impressions). The tablet exhibits black spots across its surface caused by manganese precipitation (Uchida and Watanabe 2014; see also Laurito, Mezzasalma, and Verderame 2008, 101 fn. 6).

§3.2.2 Transliteration

Obverse
1. ⌜pisan⌝-dub-ba
2. im inim inim-ma

(rest broken)

Reverse
(beginning of the tablet broken, rest is blank)

§3.2.3 Translation

Tablet container (containing) the tablets of the legal case [...].

§3.2.4 Commentary The function of the artifact as a label is indicated not only by the negative impressions left by the string to which it was attached but also by the text, which explicitly identifies it as a pisan-dub-ba, or "tag for a tablet container" (see Nelson 1976; 1979; Sallaberger 1999, 214–16).

§3.2.5 The expression inim inim-ma should be understood as "matter, affair, legal case" (for a detailed analysis, see Molina 2014, 404–405). However, due to the fragmentary state of the text and the lack of additional details, it is not possible to determine which legal case tablets this tag originally referred to.

§3.3. Bulla: LW21.CUN.109

Dimensions: 39 × 58 × 21 mm
Provenance: Umma
Date: ŠS.05.xx.xx
Negative impressions analysis: s-spun yarn with an average diameter of 3 mm.

§3.3.1 Physical Description. The bulla (Plate 3) is damaged, and only one side is preserved. The original artifact was a three-sided polyhedral bulla similar to LW21.CUN.29 (cf. **§3.1**). Due to the break, the object reveals negative impressions of a string, indicating that it was once attached to a container. The string originally measured about 3 mm in diameter and was characterized by an s-twisted yarn, extending approximately 30 mm into the bulla before ending in a 15 mm tangle of fibers (for a complete analysis of the string, see Surdi, forthcoming). The bulla was sealed multiple times on the preserved side before the cuneiform text was written. Notably, the impressions focus primarily on the legend of the seal rather than its iconographic motif. As with LW21.CUN.29, LW21.CUN.109 feels solid, exhibits minimal surface dust, and is slightly glossy. These features, combined with the lack of evidence for modern firing, point to ancient firing. Additionally, like LW21.CUN.65, this bulla exhibits black spots across its surface, likely caused by manganese precipitation (cf. **§3.2.1** with bibliography).

§3.3.2 Transliteration

(Side A and B not preserved)
Side C
1. [kišib$_3$] ⌜lu$_2$-kal-la⌝
2. u$_3$ ur-⌜d⌝nun-gal⌝
3. mu ⌜us$_2$-sa d⌝šu-suen
4. ⌜lugal uri$_5$⌝ki-⌜ma⌝/-[ke$_4$] bad$_3$ mar-tu
5. [mu-ri]-⌜iq⌝-ti-id/-[ni-im mu]-⌜du$_3$⌝

Side D
(traces of seal impression)

Seal 1
1. [ur]-dnun-gal
2. [dub]-⌜sar⌝
3. [dumu] ⌜ur⌝-dšara$_2$
4. [GA$_2$]-⌜dub⌝-ba-ka

Seal 2
1 [lu$_2$-kal-la]
2 [dub-sar]
3 ⌜dumu⌝ [ur-e$_{11}$-e šuš$_3$]

§3.3.3 Translation

Text: (Side A and B not preserved) [...]; (C) Sealed tablet of Lukala and Ur-Nungal. Year after the year: "Šu-Suen, the king of Ur, built the *Amurru* wall (called) *Muriq Tidnim* [i.e. 'that keep the *Tidnum* at bay']".
Seal 1: Ur-Nungal, the scribe, son of Ur-Šara, the archivist.
Seal 2: Lukala, the scribe, son of Ur-E'e, chief livestock administrator.

§3.3.4 Commentary. The seal impressions are barely legible due to the worn surface of the bulla and the natural color of the clay. However, the use of the PLD Viewer allowed for the application of various filters and light angles, enhancing the visibility of faint traces, which made it possible to identify some signs and reconstruct the legend of Ur-Nungal's seal (for a description of the seal see Mayr 2005, 428 no. 1025 B).

§3.3.5 Traces of Lukala's seal are virtually unidentifiable to the naked eye. However, through the 2D+ model, it was possible to identify a portion of the sign dumu along with part of the frame that encloses the legend. Notably, this frame forms a right angle, indicating that dumu was placed in the final row of the inscription, marking the closure of the frame (Figure 5, left). This feature is absent in Ur-Nungal's seal impression, where the sign dumu is followed by an additional row of text. In contrast, the right-angled frame enclosing dumu is a characteristic feature of Lukala's two attested seals, 421 A and B (Mayr 2005, 272-273). Immediately to the left of this right angle is the iconographic apparatus; however, due to the worn state of the impression, it is impossible to determine which of Lukala's two known seals was used on this bulla, as both seals exhibit the same legend structure and frame design (Figure 5, right). According to Borrelli and Felli (2022, 233, fn. 23), most polyhedral bullae bearing Lukala's seal appear to have been sealed with seal 421 B, while seal 421 A is attested exclusively on tablets, on bullae where Lukala's seal was the only one applied, or on bullae of a different type, such as triangular tags. Mayr (2005, 272-275) further notes that seal 421 A appears on documents from the reign of Šulgi to the last year of Amar-Suen (AS.09), whereas seal 421 B is found on documents from Amar-Suen through the final years of Šu-Suen. Given that LW21.CUN.109 is a polyhedral bulla dated to ŠS.05, it was most likely sealed with seal 421 B.

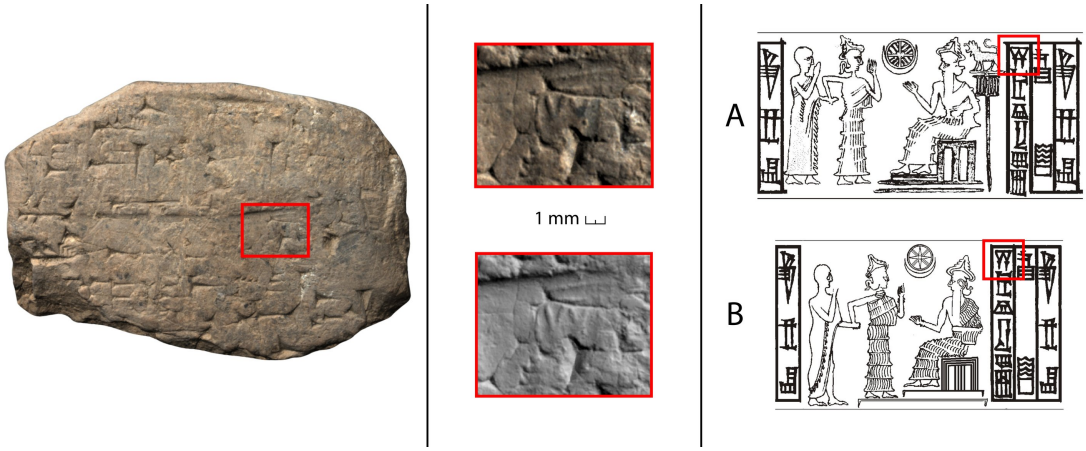


Figure 5: Left: Bulla LW21.CUN.109 (obverse) and a detailed view of the selected area, visualized in PLD Viewer with optimal light in normal color (top) and the "Shaded" filter (bottom). Right: The two seals of Lukala: (A) Seal 421 A and (B) Seal 421 B, with the dumu sign highlighted in red (adapted from Mayr 2005, 272–273).

§3.3.6 The reference to Lukala and Ur-Nungal, along with their seal impressions, strongly suggests that the Ghent bulla originated from Umma.[10] The polyhedral shape is well documented at Umma, where such bullae served as labels attached to containers holding tablets that recorded the delivery of various goods. According to Laurito, Mezzasalma, and Verderame 2008, these bullae fall into three administrative categories based on their textual structure and dating formulas. The first category comprises bullae attached to containers of messenger texts (sa_2-du_{11} kas_4 "regular delivery for messenger(s)"; on the translation of sa_2-du_{11} as "regular delivery" see

[10] See, e.g., the bullae ASJ 03, 191 6 [P102131]; BRM 3, 012 [P107242]; BRM 3, 025 [P107249]; CHEU 099 [P107530]; CST 782 [P108289]; Hermitage 3, 521 [P212258]; Nisaba 33, 422 [P362192]; Nisaba 33, 497 [P362286]; SET 185 [P129595]; UTI 6, 3777 [P141774].

Dahl 2020, 30 fn. 30), which generally record the year, month, and day, although some record only the year and month. The second category includes bullae for regular deliveries to the gods (sa_2-du_{11} digir-re-ne), which record the year and month. The third category consists of annual bullae that omit the sa_2-du_{11} formula but still record livestock and workmen, along with equipment related to the *sikkum* ("stable"), i.e., a service for the benefit of royal messengers on their travels (see Heimpel 1994), and these annual bullae record only the year.

§3.3.7 The Ghent bulla records only the year in its date formula, clearly placing it within the third category. This classification is further supported by the text, which, although incomplete, does not preserve any traces of the sa_2-du_{11} formula characteristic of the first two categories.

§3.4. Sealing: LW21.CUN.173
Dimensions: 40 × from 15 (narrow side) to 41 (wide side) × 20 mm
Provenance: Umma
Date: Š.46-AS.01?
Negative impressions analysis: neck of leather bag closed with leather strings (2.5 mm wide)

§3.4.1 Physical Description. Only half of the conical trunk sealing is preserved, and no written text is visible on the remaining portion (Plate 4). The obverse bears multiple seal impressions, though their legibility is limited due to the condition of the surface. Notably, only the impressions on the broken circular base remain distinctly discernible. The reverse exhibits a negative impression of the neck of the leather bag and the leather strings that were wrapped around its opening (for an analysis of the negative impression, see Surdi, forthcoming).

§3.4.2 Transliteration
Seal
1. šeš-sa_6-ga
2. dub-sar
3. dumu lugal-gu_3-de_2

§3.4.3 Translation
Šešaga, the scribe, son of Lugal-gude.

§3.4.4 Commentary. Mayr 2005 identified and realized accurate copies of Šešaga's four seals, designated as 804 A, B, C, and D. They all bear the same legend ("Šešaga, the scribe, son of Lugal-gude") but feature distinct, though similar, iconographies (see Mayr 2005, 376–377 for a description of the seal impressions) (Figure 6). The Ghent sealing was impressed multiple times with seal 804 A, according to Mayr's classification.

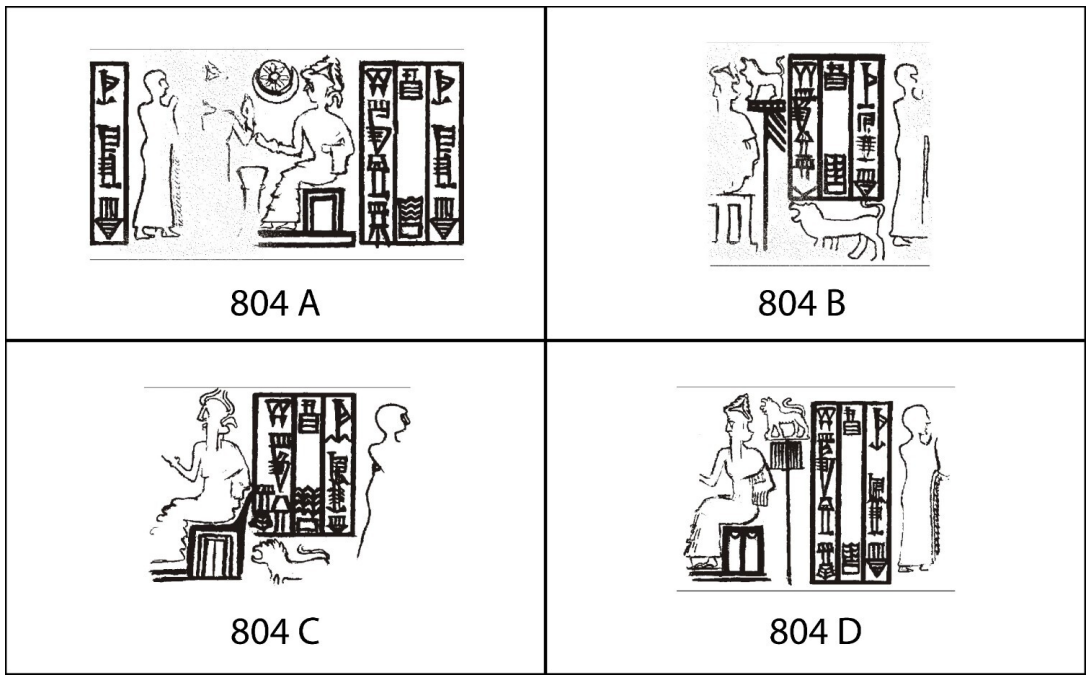


Figure 6: The four seal impressions of Šešaga (adapted from Mayr 2005, 376–377).

§3.4.4 There are 46 documents that bear the four seal impressions of Šešaga,[11] dating from Š.46[12] to ŠS.07.[13] Based on current evidence, it appears that Šešaga regularly used only seal 804 A in the last years of the reign of Šulgi (Š.46–47)[14] and at least until the first year of Amar-Suen's reign (AS.01).[15]

§3.4.6 Two texts, TCNU 662 [P135508] dated to Š.47 and TCNU 663 [P135509] dated to Š.48, seem to be exceptions. According to Bergamini 1995 (394 no. S.51), these tablets exhibit a seal impression with "a T-shaped standard to the left of the legend, with a walking lion on top, facing left in profile and three oblique tufts on the shaft" [translation of the author],[16] i.e., seal 804 B according to Mayr's classification.[17] However, Bergamini's information on Šešaga's seals was incomplete at the time. In fact, 804 B also exhibits a lion beneath the legend, an element not included in Bergamini's description and copy of the seals (Figure 7).

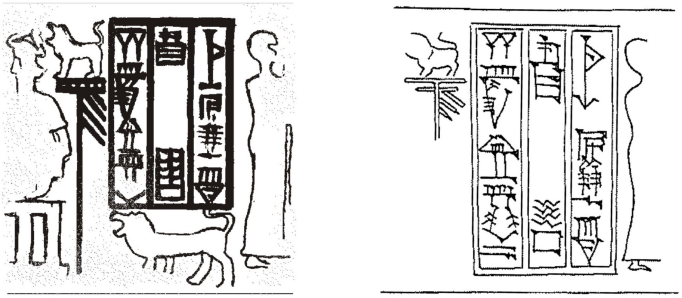


Figure 7: Comparison between Mayr's (left) and Bergamini's (right) copies of Šešaga's seal 804 B (adapted from Mayr 2005, 376, and Bergamini 1995, 394).

§3.4.7 Furthermore, TCNU 662 [P135508] exhibits the legend extending from the upper to the lower edge of the seal impression without any lion beneath it (Figure 8.1), which excludes seals 804 B and 804 C, leaving either seals 804 A or 804 D as possibilities. Despite the faint traces, certain details like the shape of the signs (like šeš, de_2, and dub) occur only in the seal 804 A legend.

§3.4.8 In the case of TCNU 663 [P135509], seal 804 C can be definitively excluded because the frame of the last line of the legend (dumu lugal-gu_3-de_2) shows no extra space, whereas seal 804 C includes additional room to accommodate de_2 on the next line (Figure 8.2). Among the remaining three seals (804 A, B, and D), only 804 A matches the shape of the dumu sign (with two distinct, wedge-like strokes) and the shape of the first part of the lugal sign, which differs in 804 B and 804 D.

§3.4.9 Thus, in conclusion, the available evidence indicates that all published documents from Š.46–48 bear seal 804 A, which continued to be used at least until AS.01. Around that same year, another of Šešaga's seals (804 B) begins to appear on texts dated to the early years of Amar-Suen. One possible hypothesis is that Šešaga discarded seal 804 A after Šulgi's death and replaced it with a new seal (804 B) shortly after Amar-Suen's accession to the throne. However, based on current

[11] Data retrieved from http://bdtns.filol.csic.es/ (accessed on 19th of February, 2025).

[12] BPOA 06, 0899 [P211029] and NBC 10937 [P301698].

[13] Tavolette 021 [P131806].

[14] Š46: BPOA 06, 0899 [P211029]; NBC 10937 [P301698]. Š.47: NBC 04292 [P293847]; SAT 2, 0550 [P143750]; Syracuse 232 [P130783].

[15] PPAC 4, 155 [P332074]; Akkadica 135/1, 082-083 05 [P480069].

[16] Bergamini 1995, 394: "a sinistra della leggenda, EMBLEMA a T, con sopra un LEONE passante, di profilo verso sinistra. Tre barbette oblique sullo stelo".

[17] Mayr 2005 (376–377) also reports that the two seals on these tablets correspond to seal 804 B.

data, it appears that from Š.46 to AS.01, 804 A was the only seal Šešaga used.[18] Since sealing LW21.CUN.173 also bears seal 804 A, a date between Š.46 and AS.01 is suggested for it, although new evidence may refine this conclusion.

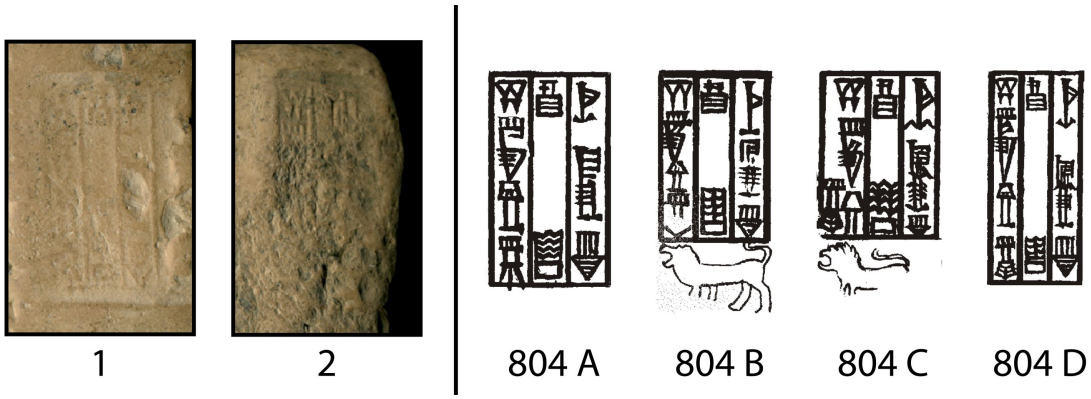


Figure 8: Left: Seal impressions on (1) TCNU 662 and (2) TCNU 663. Right: Legends of Šešaga's four seals (adapted from https://cdli.mpiwg-berlin.mpg.de/ and Mayr 2005, 376-377)

§4. Conclusions. The composite visualization method combining the "Shaded" and "Sketch 1" filters has demonstrated its effectiveness in enhancing both the legibility and interpretability of cuneiform inscriptions and seal impressions. Successfully applied to four unpublished epigraphic objects from the Ghent collection, this approach has proven particularly valuable in cases of poor surface preservation. Its application not only facilitates clearer publication but also improves philological analysis. Future research may extend this methodology to larger corpora and other documentation contexts facing similar challenges.

[18] The data published in Mayr 2005, 376 also allow for the conclusion that all the texts bearing the impression of seal 804 A can be dated to Šulgi.

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Plate 1



Plate 1: Bulla LW21.CUN.29 (overlay of the "Shaded" and "Sketch 1" filters)

Plate 2

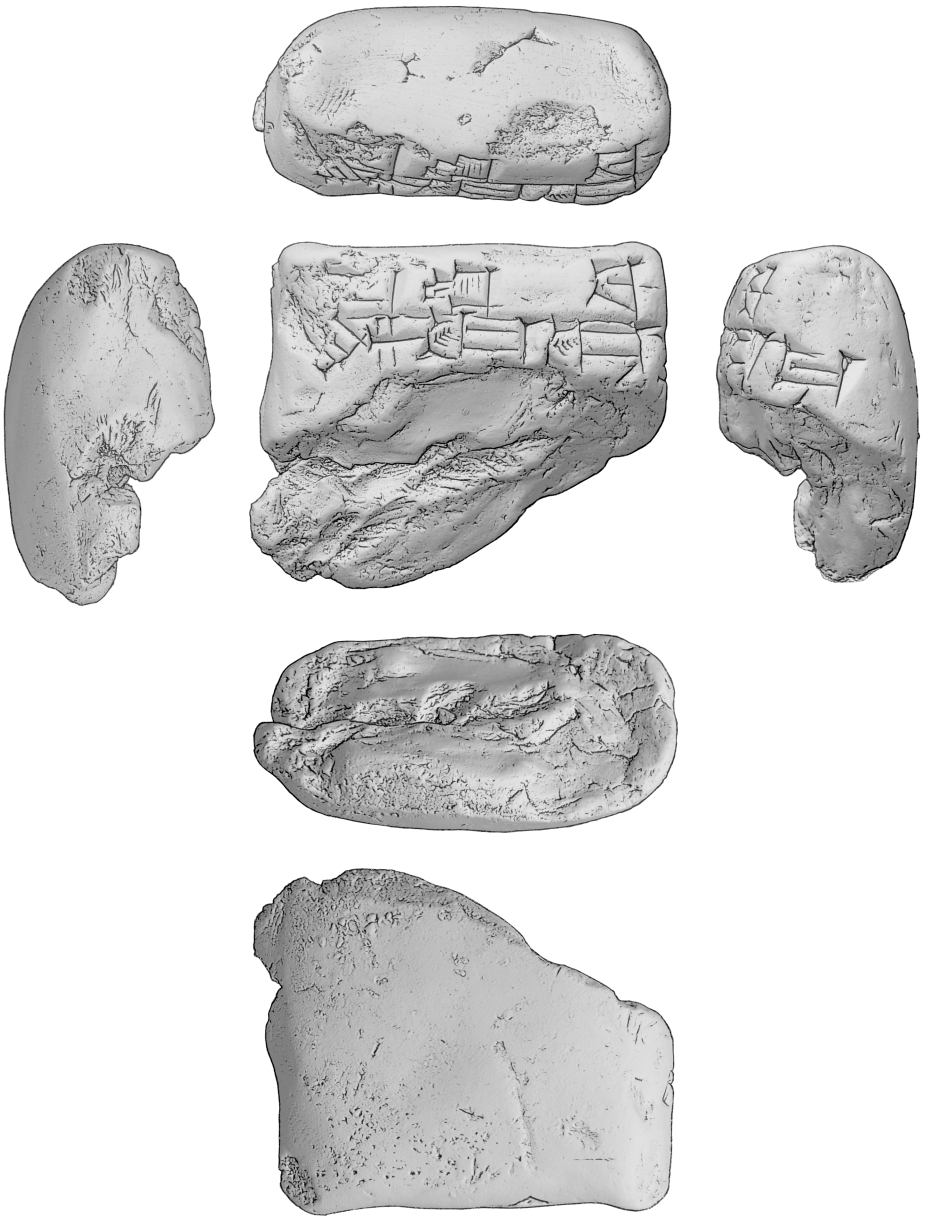


Plate 2: Pisan-dub-ba LW21.CUN.65 (overlay of the "Shaded" and "Sketch 1" filters)

Plate 3



Plate 3: Bulla LW21.CUN.109 (overlay of the "Shaded" and "Sketch 1" filters)

Plate 4



Plate 4: Sealing LW21.CUN.173 (overlay of the "Shaded" and "Sketch 1" filters)