Qualitative and Quantitative Validation of *Rongorongo* Glyph Strings on Easter Island Artefacts

Gordon Berthin

Abstract. Six *rongorongo* artefacts were evaluated for authenticity including the San Diego Tablet (SDT), the Rangitoki Bark-cloth Fragment (RBF), the Madrid (*Îka*) Fish Sculpture (MFI), and the 1770 Treaty Document (CST) between the Spanish and Rapanui people. Two apparently modern productions were also examined to determine if their RR-like inscriptions reproduced authentic but otherwise unknown texts. Metrics of evaluation were provenance and production technique, 'handwriting' quality, glyph vocabulary, conformity to Zipf's law (character frequency analysis), internal verse pattern, and item-specific special features. It was found that provenance/production technique and verse pattern were the most reliable predictors of authenticity. A suspected imitation piece conformed more closely to Zipfs Law than deemed-authentic artefacts. The SDT, RBF and, final two rows of the CST exhibited good evidence of authenticity and should be evaluated further. The possibility of evolved glyph definitions upon the MFI (a *ta'u rongorongo* object) may limit its usefulness somewhat in decipherment of *rongorongo*.

1. Introduction

Kohau rongorongo (RR) is the undeciphered signwriting of the indigenous peoples of Rapa Nui—remote South Pacific Easter Island (land of the *mo'ai*: monolithic human-figure stone statues). Most RR scribes and cantors were kidnapped or later perished in the genocide and disease, accompanying Rapa Nui's colonization (Fischer, 1997, pp. 8–9). By June 1869, when Bishop Tepano Jaussen discovered, subsequently studied, and publicized RR (ibid., p. 22), it is presumed that few interpreters remained alive.

RR contains about 120 unique (base) characters depicting everyday island objects, creatures, and astronomical signs. The bases may

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be linked /fused together within the inscriptions, producing hundreds of different compound forms (Barthel, 1958, pp. 314–315). Barthel (ibid., pp. 40–42) created a widely used and subsequently modified catalog, which classifies the RR glyphs. Table 1 summarizes Barthel's system. Catalogue Numbers run between 1 and 799 (#999 added later). Alphabetic-like suffixes 'i', 'j', 'k' denote locations of "lozenges" (perhaps "eyes" or "ears") attached to glyphs (see Table 1). Suffix 'f' denotes glyphs having attached hair-like follicles (Anonymous, n.d.).

TABLE 1. Barthel Cataloguing System (based upon glyph motif) Ref. Barthel (1958, pp. 40–41)

Catalogue Numbers	Category of Shape
1 thru 99	Frequent geometric shapes
100 thru 199	Infrequent or personalized geometric shapes
200 thru 299	Hominid shapes with fronting heads
300 thru 399	Hominid shapes in profile, gaping mouth
400 thru 499	Hominid shapes in profile, gaping mouth, expressive body (pantomiming)
500 thru 599	Various head shapes
600 thru 699	Heads of birds
700 thru 799	Shapes of other animals
i, j, k, f Modifications	

When cataloguing glyph sequences, distinct glyphs are separated by dashes '-'. Horizontally linked glyphs are separated by a period '.'. Vertically linked glyphs are numbered top-down (traditionally read bottom up) and separated by a colon ':'. RR glyph numbers or sequences are here introduced with 'RR'.

Steven Fischer defines an authentic RR text as the "creative transcription by a RR expert" of "a sequence of *two or more glyphs*, fulfilling a communicatory function" (Fischer, 1995, p. 509). (I will accept as authentic, compositions of a RR 'journeyman' also).[1] Authentic remnants (of RR) are documented upon 25 or 26 wooden slabs or objects, typically in tidy, seamless (unpunctuated) rows. Artefacts are designated by capital letters or common names: often, Rapanui words such as C—"*Mamari*" (egg) or specimen domicile (viz. I—"Santiago Staff") (Barthel, 1958, pp. 14–33). The RR corpus comprises approximately 14,000 signs.

The standard format for RR artefacts of trusted provenance is inverse boustrophedon (ox-turning) (Thomson, 1891, p. 516). Per Figure 1, in-

1. Solo glyphs are found on human skulls and wood and stone carvings. Some of these might also be of epigraphic utility if their glyph is contextually relevant (a contemporary example would be the metric size indicators [7, 8, 9, ...] upon modern Allen keys).

scriptions are read beginning bottom left and thence proceeding left to right with a 180° board turn around at line end to properly orient the next line for continuing (left to right) reading.[2]

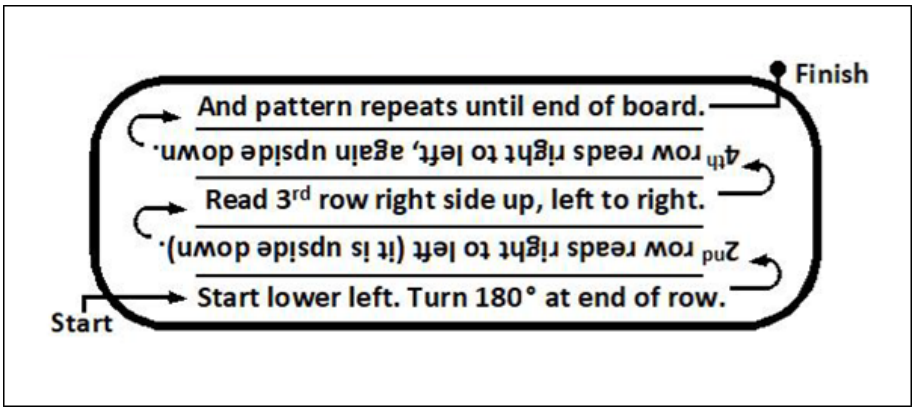


FIGURE 1. Inverse boustrophedon text—the standard layout for RR tablets of trusted provenance

Rongorongo artefacts are scarce. Only 26 items are usually listed (including Keiti Tablet photographs and transcriptions of the original board, which was destroyed by fire in 1914) (Fischer, 1997, p. 435). The debate remains open as to just how many authentic artefacts should be on the list. The surviving corpus is comprised of (wooden) tablets, a tablet fragment, an inscribed statuette, a staff, a snuff box, and two *rei miro* (gorgets or breast ornaments). Additionally, there exist a few human skulls and wood and stone carvings, each having a single rongorongo symbol etched into them (Poussart, 2010, pp. 81, 111, 113–115; Melka and Schoch, 2021, p. 139). Many stones, boards, or sculptures, adorned with RR glyphs, have been created for sale to island visitors or tourists. Production of such artefacts continues to this day. RR forgeries might be innocently imitated or purposefully deceiving (Melka and Schoch, 2021, p. 509). However, those parts of imitations, which quote directly from authentic (but now lost) texts, should be appended to the validated corpus. In view of this, some obviously modern productions

2. Forgers may also craft fake RR artefacts in reverse boustrophedon text layout to validate their wares. The famous Mazière tablet would be an example of such a deception. (Ref. Mazière (1968). Trans. by Wm. Collins Sons. New York: W. W. Norton, Company, Inc. With photographs by the author, p. 64. Originally published as *Fantastique île de Pâques*: *Des yeux regardent les étoiles...*, Robert Laffont, 1965.)

are analyzed here to determine if their RR-like inscriptions reproduce authentic but otherwise unknown texts.

2. Methodology

As Stephen Houston (2004, p. 231) well notes: "... the dissemination of retrieved epigraphic texts promote[s] scholarship." Yet authentication of artefacts remains an ongoing challenge as the meanings of the often exquisitely crafted RR inscriptions almost always remain enigmatic. To quote prominent ethnographer Alfred Métraux,

> Wooden tablets, covered with rows of small figures, are a puzzle to science and constitute the most complicated problem of Easter Island culture. (Métraux, 1938, p. 392)

With an eye toward enlargement of the validated RR corpus, this paper evaluates six artefacts for authenticity: three short inscriptions and three longer ones (>45 characters). The metrics of evaluation are *provenance and production technique* (indigenous or modern), *calligraphy* ('handwriting' quality), *vernacular* (glyph vocabulary), *conformity to Zipf's law* (character frequency analysis), *internal verse pattern*, and assessment of item-specific *special features*.

Verse patterns are found within all authentic RR inscriptions longer than 10 characters, be it by restating stanzas or parsing sections with recurrent single glyphs, bigrams or trigrams. Sproat (2003) has provided an algorithm-based list including intra board repetitive (or near repetitive) phrases of five glyphs or more. Horley (2005, p. 108) has presented sketches of A, B, C, D, E, G, H, N, P, R, S *rongorongo* boards showing locations of repeating glyph patterns (*note:* omitted board Q is a near-copy of boards H and P). Barthel (1958, pp. 151–157) and Guy (2006, pp. 53–66) have thoroughly discussed many of the different verse patterns, which are found in RR.

Lengthy RR inscriptions may be related to Zipf's general function of rank frequency distribution for languages (*Zipf's Law*) (Zipf, 1949). If the RR is underpinned by natural language then the successively ranked glyph frequencies should be linear or near-linear when plotted as a log-log relationship. Pozdniakov (1996, p. 303), theorizing RR to be a glyph syllabary, generated a rank-frequency graph comparing the classical poem *Apai* (written in old Rapanui language) to a traditionally associated glyph inscription upon the Keiti Tablet (Thomson, 1891, pp. 517–518). The plotted data sets corresponded almost exactly. Horley (2005, p. 108) compared rank frequencies for Barthel's RR sign inventory and Rapanui folklore manuscripts. both datasets conformed well to Zipf's Law. A note of caution is appropriate:

many alternative processes such as music and visual art also have stochastic component so conformity to Zipf's law is *necessary but not sufficient* proof of language (my emphasis) (Berthin and Berthin, 2006, p. 88).

3. The San Diego Tablet (SDT)[3]

FIGURE 2. The San Diego Tablet Side a. Reprinted with permission of the anonymous SDT owner. Photograph courtesy R. M. Schoch and T. S. Melka (2020, p. 483)

3.1. Provenance and Production

In 2016 the SDT (Figure 2) was purchased at an antique and junk dealership in Prescott, Arizona (Melka and Schoch, 2020, p. 483). The proprietor appraised the tablet as "a curious piece of wood with some carvings on it, which he did recognize as from Easter Island, but no real value was attached to it" (ibid., p. 504). He reported having acquired the item from an old San Diego, California estate (ibid., p. 483). Melka and Schoch posit the SDT to possibly be the Calligan tablet (ibid., pp. 504–505) (a specimen procured by Patrick John Calligan, mate on the 26 tonne *Caroline*, which went aground on Rapa Nui in 1873). Calligan later mailed

3. Inscriptions of greater length would be desirable as would specimens of richly diverse provenance (two of these artefacts were first reported by T. S. Melka and R. M. Schoch). Perhaps one day, additional materials of extended length will be happened upon, warranting careful analysis. The material chosen here is what it is, and what matters most is the expansion of the epigraphic corpus through assiduous scholarship, irrespective of each artefact or its pathway to discovery.

the RR board to his wife in California, but the tablet disappeared after that (Fischer, 1997, p. 521).

More than one researcher has searched for, or yet now continues to seek out "lost" RR artefacts or even castings of artefacts (Wieczorek and Horley, 2015, p. 127). Fischer (2010, pp. 51, 57), for example, mentions another missing artefact, the so-called and apparently 'misplaced' / 'lost' "Barthel Tablet". Most probably, such artefacts should be recognized as traditionally authentic if and when they are found. Of possible topical relevance to the SDT it is noteworthy that sleuth work (albeit unsuccessful) by Fischer (1997, p. 521) and Meroz (2003, pp. 122–125) did eventually trace the footprints of the Calligan Tablet as far as California—the same locale whence (according to the antique dealer) the ownership of the mysterious RR board originated.

The SDT has dimensions: 16.7 cm long, 6.4 cm wide, and 1.4 cm thick. Most glyph heights range from 10.0 to 12.0 mm; A few leadoff glyphs are as small as 5.5 mm (Melka and Schoch, 2020, p. 490). This board exhibits evidence of inscription by traditional methods, a strength in validating its authenticity. Per Barthel (1971, pp. 1168–1169), Fischer (1997, pp. 386–387), RR glyphs were often laid out first on banana leaves, scribed with a bone or pointed stick stylus between the leaf veins (just as one writes characters between the lines on a ruled paper sheet). Natural banana leaf vein spacing is between 10 and 15 mm (Barthel, 1971, p. 1169), the same as the height of RR glyphs upon surviving wooden specimens. RR copy was traced from leaf to wooden board surface using a sharp obsidian flake. Deep pin holes were next punched into the obsidian etching. Lastly, a deep scoring was applied with a hafted shark tooth, following the pathway of the perforations. Figure 3 shows specific indigenous tooling possibly associated with this production process: a bone awl and an obsidian graver or flake. An SDT glyph close up (Figure 3, right) reveals deep perforations in some areas.

One side of the SDT presents 5 lines of glyphs in inverse boustrophedon reading order. The other side is utterly damaged (Fischer, 1997, p. 490), possibly the result of having been stored in damp soil, a "family storage cave" or a "rock hole"—cf. Honolulu B.3629 Tablet (Métraux, 1938, p. 1) or the Great Vienna Tablet (Fischer, 1997, p. 504). Unlike several other RR boards, the SDT glyph lines are not fluted. There are traces of horizontal guiding lines akin to modern lined writing paper (Melka and Schoch, 2020, p. 494).

3.2. Calligraphy

Whereas the SDT glyphs are easily identifiable and better drawn than those upon other lengthy RR artefacts studied here (Warren Anderson Tablet or Madrid Fish Inscription), Melka and Schoch nevertheless

FIGURE 3. Indigenous graver tools and board etching details. Reprinted with permission of the anonymous owner.Photographs courtesy of R. M. Schoch and T. S. Melka (2020, pp. 522, 525)

grade the caliber of SDT glyph drawing as close to the *Verfallszeit* (declining period) (ibid., p. 510). They draw an analogy with the London Tablet (Barthel, 1958, p. 158; Fischer, 1997, p. 488), generally deemed to be an authentic, but a late period RR inscription. The SDT incorporates several lengthy parallel curving lines. Horley (2009, p. 251), scrutinizing textual corrections yet visible upon certain RR artefacts, noted that depictions of "graceful anthropomorphic signs with long necks or curved backs were quite difficult." Possessing just mediocre handwriting skill, I have determined that several of the more demanding glyph constructions (such as frigatebird heads and lengthy concentric curves) might nowadays be reproduced acceptably by importing them into a Computer Aided Drafting program and there redrawing or tracing. Therefore, at the present time, it would not be difficult to construct an artefact presenting a standard of calligraphy that imitates the work of the master scribes of old Rapa Nui.

3.3. Verse Patterns

The First (bottom) SDT row is bounded at its initial and final ends by vertical-edge glyphs "|" and "||" respectively (Rjabchikov, 2020, p. 1). From a semiotic perspective these forms resemble barriers or fences. They may or may not add additional communicatory value. Be that as it may, the prima facie appearance of the first line is of similar verticals symbols bookending an enclosed text into a single section. Lead-off glyphs of Rows 1 and 2 are, as illustrated in Figure 4, nearly parallel phrases, suggesting that each row begins with a similar refrain.

Row 3 recapitulates a version of this very same refrain into its concluding glyphs.

The third glyph-row seemingly progresses into Rows 4 and 5 since all three of these inscriptions show commonality amongst their introductory glyphs (Figure 4). The two full-belly *honu* ("sea-turtle"-like) forms (Barthel, 1958, p. 203),  which introduce Row 4, appear to be cognate variants (perhaps antonyms) of the "hollow belly" (Wieczorek, 2011, pp. 31–32)  at the beginning of Row 3. Furthermore, the 'hollow belly' detail within the hominid glyph introducing Row 3, is redrawn as the concentric circle 'bullseye'  at the start of Row 5. Upon the SDT, the 'bullseye' and 'hollow belly' or full belly '*honu*' motifs occur only at the outsets of Rows 3, 4, 5: never elsewhere. This supports the hypothesis that these forms uniquely introduce each of the last three texts/rows.

The SDT also presents 'bird-hominid' parallel passages and a grouping (Row 4) of three bigrams. As shown in Figure 4, the 'bird-hominid' inscriptions occur on both Row 4, and Row 5. The three bigrams extend to the end of Row 4 but do not 'wrap' to Row 5. Thus, even though Rows 4 and 5 appear to be closely related, there is a case for them being semantically independent of each other. Importantly, the inverse boustrophedon layout of the SDT *hides* its repetition patterns. Repeating phrases occur on adjacent lines: upside down one versus the other. If the SDT were spurious, one might expect the associable phrases to be displayed conspicuously, to satisfy the critical gaze of tablet appraisers. This could have been done by presenting the patterns *right side up* with respect to each other: i.e., by situating the two near-parallel phrases on adjacent lines of similar orientation (with a single upside-down line intervening between).

Because of wood scarcity upon Rapa Nui (Eggertsson, 2011, p. 114), a transcription of some master text would have been constrained by the dimensions of available clean boards. Consequently, the SDT text could not have been a direct row-by-row copying of some master manuscript. It has required intelligent editing.

3.4. Vernacular

Four of the ten most frequently used SDT glyphs (RR700, RR1, RR5, RR600) are also listed by Barthel (1958, p. 165) as being among the top 20 most frequently occurring signs within the classical corpus. The "cardioid" ❤ and "split circle" 'ᗡᗤ' glyphs are irregular and their usage is, perhaps, consistent with apparent novelty of subject matter upon the SDT or the vernacular style of the scribe. Moreover, such usage conforms to observable glyph selection processes across classical RR tablets. For example, the common RR76 "penis"-form (Fischer, 1995, p. 303) occurs 513 times (Melka, 2009, p. 42) upon the Santiago Staff but not

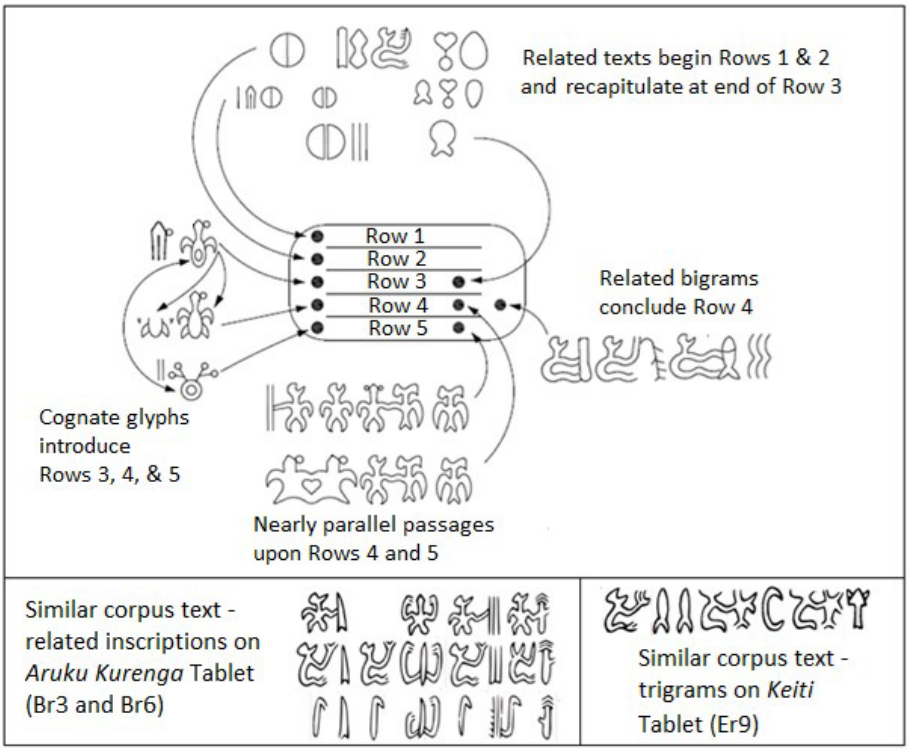


FIGURE 4. Morphologically related texts of the San Diego Tablet

even once upon the oft-studied *Mamari* board. Upon a fake artefact, one might expect to find a very commonplace glyph vocabulary rather than a slightly idiosyncratic one.

3.5. Zipf's Law

The 7th through 10th most common characters of the SDT are overrepresented (the Figure 5—Zipf's Law graph—bulges upward in this area). This is, perhaps, due to the usage of these glyphs in restated phrases or in repeating of bigrams (*viz.* the 'ᑎᑎ' form and the RR200 hominid forms).

3.6. Conclusion

The SDT scores favourably on many metrics of authenticity: familiar vernacular, elaborate display of verse patterns, and development of

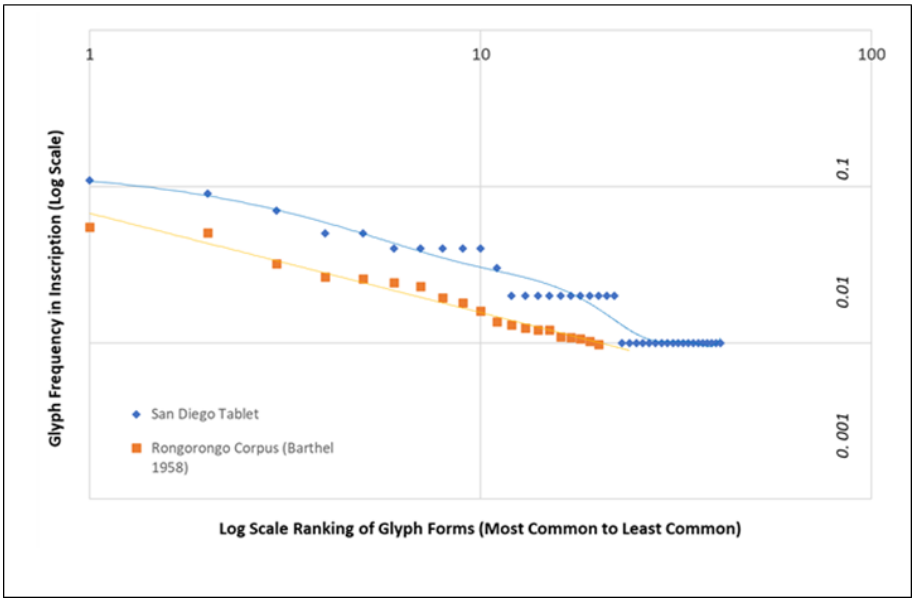


FIGURE 5. San Diego Tablet and *rongorongo* corpus conformity to Zipf's Law

bigrams, plus evidence of traditional board production technique. In one important area—provenance—the tablet is weak. In this regard the SDT is comparable to the 'deemed-authentic' Paris Snuffbox (cf. Barthel (1963, p. 176) or Pozdniakov (1996, p. 294)). This box—according to its original owners—had been held in the family for 80 years (since approximately 1880) but lacked traceability to Rapa Nui prior to that. Moreover, the Snuffbox may have been inscribed using a steel tool, indeed betraying a very latter period of production. In the opinion of this author the SDT matches or exceeds the Snuffbox in all of our metrics. Whereas the SDT may be a bit weak with respect to its glyph calligraphy, it is not markedly substandard. Considering all information at hand, the SDT should be acknowledged as an authentic RR artefact, whether made at some point during the late pre-missionary or early missionary times, i.e., pre-/post-1864/66.

4. Warren Anderson Tablet

4.1. Provenance and Production

Warren Anderson wrote that:

FIGURE 6. The Warren Anderson Tablet (a-face [top], b-face [middle], banding strap detail [bottom]). Photographs courtesy Anderson (2008)

> The board was part of the estate of my father, who died in 2005. He must have acquired it a long time ago—probably around 1960. It is an old piece so if it is a copy or a fake made for tourists it's an old one. (Anderson, 2008)

If dated before the opening of the Rapa Nui airport in 1967 then the board (shown in Figure 6) may have been traded or sold to a crew member of one of the annual supply ships from Chile (Fischer, 1997, pp. 528–529) or acquired by a visiting merchantman or member of a scientific expedition *viz.* Franco-Belgian (1934) (ibid., pp. 158–162), Norwegian (1955-56) (ibid., p. 188), German-Chilean (1957–58) (Fischer, 2010, pp. 47–57) or Canadian (1964-65) (Reid, 1965). The dimensions of this tablet are 102 mm × 400 mm. Glyph heights are about 25 mm (probably not pre-drawn on banana leaves). The WAT is atypical of RR artefacts in that its long edges are perfectly parallel, indicating that the raw board was likely trimmed using a non-indigenous technology.

4.2. Vernacular

Six of the nine most encountered glyphs upon WAT—simple forms RR1, RR2, RR4, RR5, RR8, RR10—are also listed by Barthel (1958, p. 165) as being among the top 20 most frequently occurring signs within the recognized corpus. Glyph selection by the author of the WAT tablet mirrors the vocabulary choices made by authors of classical RR artefacts.

4.3. Verse Structure

Almost none of the WAT inscription has been parsed into short, concise, glyphic verses. In this respect the WAT differs from all known authentic RR inscriptions of significant length. Per Figure 7 (left), there are three RR22 and two (morphologically similar) RR19 glyph-pairs, spaced irregularly throughout the tablet. There are also two widely separated RR380.1.3 trigrams, a triad that may have been used to parse glyph sections upon authentic boards (cf. Melka (2016, p. 223)). However, the RR1 glyph of the second trigram is poorly carved and might easily be mistaken for an elliptical-shaped RR22.

4.4. Calligraphy

The quality of glyph carving upon the WAT is poor. Nowhere do the anthropoid types display arms or legs drawn attractively with gracefully curving concentric lines. Seated hominids show no outstretched leg—only blobbed torsos. It is impossible to distinguish between the high aspect ratio ellipses (RR22 form) and the more generously proportioned (albeit rare) RR'big O' forms. Generally, the WAT appearance is of an artefact carved in haste with little display of the artistic beauty that is hallmark of classical RR and exemplified particularly by the Aruku Kurenga or Small Santiago boards.

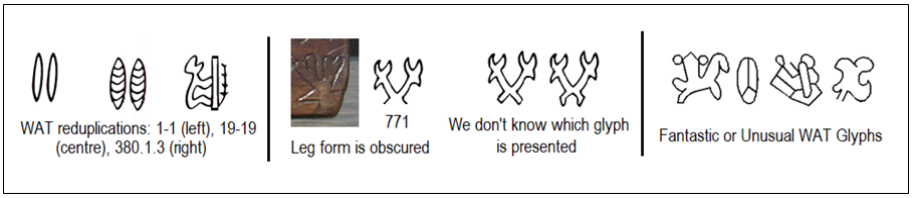


FIGURE 7. Warren Anderson Tablet glyph features - Reduplications (left), the RR771 conundrum (centre), fantastic or unusual glyphs (right)

4.5. Other

The uncommon RR771 occurs twice: at the end of the first line and in second-last position at the end of the final (3rd) line. On the first line (first reading position) the RR771 is partially obscured (Figure 7)—running off the board end—whereas the third-line form is fully visible. One would expect to find the full RR771 ahead of a partial copy, giving the board reader every chance to interpret the correct allograph of the rare form, the first time that it is encountered in reading. The WAT presents four unusual or fantastic glyph forms (Figure 7—right).

There is an imprint of a reinforced strap (Figure 6—bottom) between lines b2 and b3 (right side), indicating that the board may have been part of a packing crate. Use of polymer-reinforced strapping would preclude a board production date before the 1940s. Of note (Figure 8), there is a 6-sign phrase on WAT a3 that seems to be a *re-arranged* excerpt from the *Échancrée* (notched) tablet Db2.

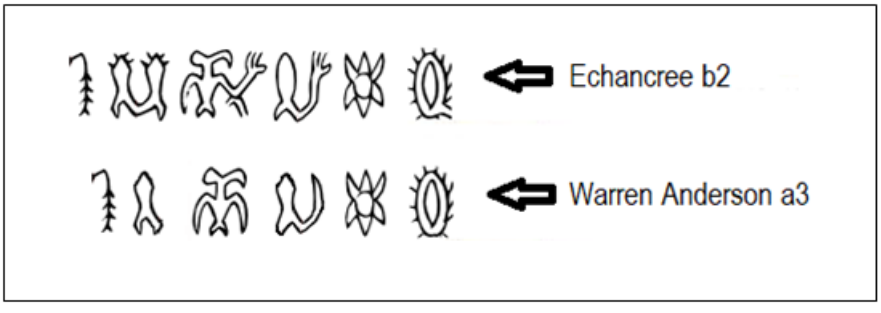


FIGURE 8. Échancrée *rongorongo* text 'quoted' on Warren Anderson Tablet

4.6. Zipf's Law

The straight-line relationship in Figure 9 indicates that the WAT conforms quite well to Zipf's law.

4.7. Conclusion

Conformance of the text to Zipf's law and correspondence of vernacular to other authentic RR artefacts is good. However, there remain serious issues with the WAT. The imprint of reinforced strapping tape (*circa* 1940s or later) on its "b" side precludes it from being a period piece.

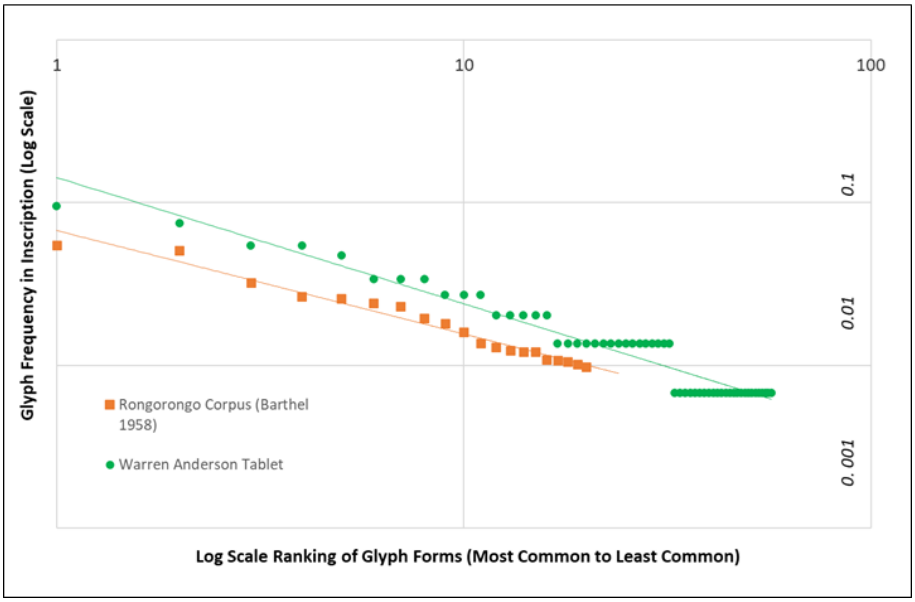


FIGURE 9. Zipf's Law conformity of Warren Anderson Tablet and *rongorongo* corpus

There is no internal verse structure, a usual hallmark of all other lengthy classical RR inscriptions. There is evidence for a short glyph section having been copied from text upon the *Échancrée* tablet. Given the conspicuously poor quality of glyph carving, it may be posited that the author of the WAT was etching in haste with probable goal of producing an artefact for sale and personal profit.

5. Madrid Fish (Îka) MFI

5.1. Provenance and Production

The MFI (Figure 10) is a fish-shaped sculpture having—on each side—"an eye, mouth and dorsal fin. The tail is cut at an angle." Glyphs are incised in 4 lines (27 signs) on the obverse side and 3 lines (21 signs) on the reverse. It has dimensions of $39.3 \times 12.3 \times 1.8$ cm (Blanco, 1996, p. 57). MFI glyphs are laid out from left to right; exclusively right side up as opposed to inverse boustrophedon. This is a characteristic of the latter *ta'u* form of RR, produced after 1877 (Fischer, 1997, p. 528).

The MFI is believed to have been carved between 1900 and 1920. It formerly belonged to Chilean president Arturo Alessandri Palma (1868–

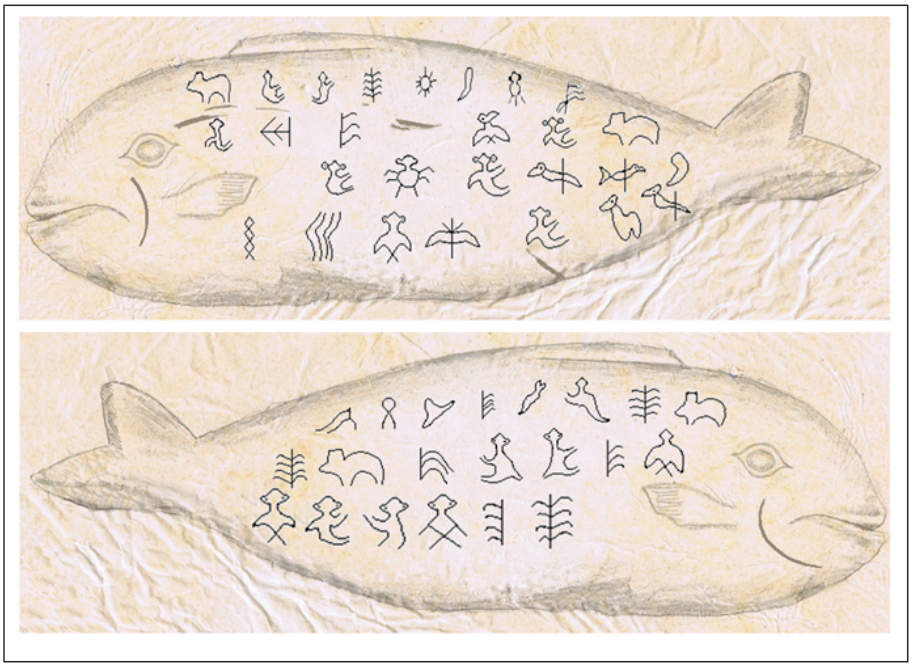


FIGURE 10. The Madrid Fish Image (sculpture) a-face at top, b-face at bottom. Artwork of Author. After photograph and sketches by Blanco (1996, pp. 57, 59)

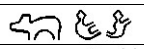
1950) who gave it to the present owners-residents of Madrid, Spain (ibid., p. 57). Garshin (2022) attributes authorship of the Madrid "fish" image to Tomenika[4]—an elderly Rapanui literate in the *ta'u* script (an imitative trade-driven form of RR created in the 1880s). Katherine Routledge, while visiting Easter Island in 1914, met with and interviewed Tomenika during his last months of life. By then his intellect had faded: "most of what the old man knew he had forgotten, and what he dimly remembered he was incapable of explaining" (Routledge, 1919, p. 253). Yet, if Tomenika had lived a normal human lifespan of 70 years (and Routledge does describe him as being "old") then he would have been in his 20s when most of the last RR men died in the 1860s. There would have been ample years of youth for Tomenika to have gleaned information about RR. Even if he had been just a journeyman with respect to RR skills, his work would remain invaluable to modern epigraphers (who, compared to former RR masters, yet understand very little of Rapanui's indigenous glyphic script).

4. If this determination is correct, then the latest reasonable date for the creation of the Madrid "fish" would be several years before Tomenika's death in 1914.

5.2. Verse Pattern

Verses appear to be laid out in a sequentially regular pattern (see Table 2) with several lines presenting one or more of a plant-glyph, then a reclining hominid, and then a hominid/zoomorphic pair of near-twins. There are certain plant signs (that I have underlined) at the start or conclusion of initial or final glyph lines, which appear to incorporate semiotic functionality. These could have been used to clarify the proper reading order for the inscription. It is uncertain as to whether these underlined signs have a dual function and are also integral to the core communication. Irina Fedorova does include them in her proposed, but unverified, translation of the MFI glyph-text (Blanco, 1996, pp. 58–59).

TABLE 2. MFI 'stanzas' are characterized by related glyph sequences.

Side a Line a1							 *(some before much following)*
Line a2							
Line a3							
Line a4							
Side b Line b1 *(some before)*							
Line b2							
Line b2 and b3							 *(well filled)*

The MFI inscription includes one reduplicated glyph-pair and additionally, each glyph line seems to present a single verse of a greater communication. There is one exception. Line b2 does wrap to the start of b3 indicating, perhaps, that the text was pre-composed and later fitted to the confines of the sculpture. In any event there was apparently no rigid imperative to parse the glyph-lines verse by verse upon the sculpture.

5.3. Vernacular

No frequently occurring glyph upon the MFI is found within Barthel's list of the top 20 most common signs in the RR corpus (Barthel, 1958, p. 165). This indicates that the text content of the artefact is different from the collective of recognized RR objects. In the late 19th century, pursuant to interactions with overseas visitors and settlers, Rapanui experienced lifestyle changes (*viz.* introduction of livestock and adoption of wood-framed housing). Some traditional glyph designs may have become dated and possibly replaced with new motifs. The extent to which

original RR glyph definitions have been modified in the *ta'u* script is not known.

5.4. Zipf's Law

Because many MFI glyphs are repeated in the development of the verse structure upon the board, the Zipf's Law graph exhibits curvature (Figure 11) *versus* the corpus plot: the third through eighth most common MFI signs are overrepresented.

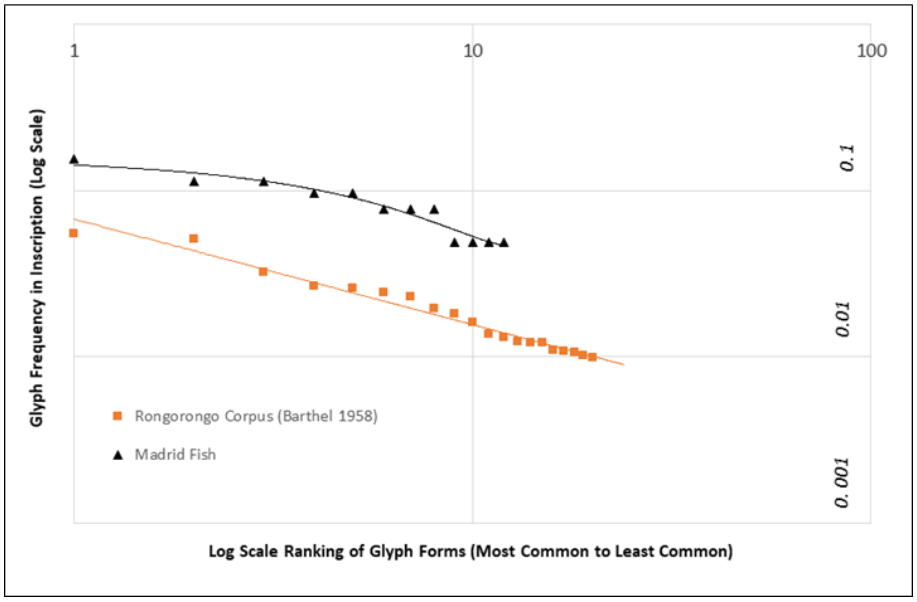


FIGURE 11. Zipf's Law conformity of Madrid Fish Image and rongorongo corpus

5.5. Calligraphy

Glyphs are drawn without an eye for artistry and a few of them appear as 'fantastic' forms. However, they are rendered just well enough to be traceable / decipherable.

5.6. Conclusion

The lovely verse structure of the MFI plus its semiotic direction markers intuits of it containing an underlying communication. This supports Fischer (1997, p. 531)'s hypothesis that the *ta'u* RR script may have been utilized as a form of writing in and of itself. If meanings of the glyphs of the MFI are similar to their equivalent classical RR forms, then the MFI may be a useful epigraphic reference.

6. Hawai'i (Polynesian Cultural Centre) Signage (HPS)

FIGURE 12. Informational Hawai'i Polynesian signage at the Oahu Cultural Centre (top) and its *rongorongo* glyphs (detailed at bottom). Photo courtesy Brenda Dinardo (2016).

6.1. Provenance & Production

The HPS (Figure 12) is a single line of 27 RR–style characters painted upon a reinforced-plastic information plaque at the entrance to a replica of a Rapanui elliptical-like canoe house (*hare vaka, hare paenga*) at the Polynesian Cultural Centre, Oahu, Hawai'i. There is no authorship information. Each of the characters is approximately 35 millimeters height.

6.2. Vernacular

The HPS vocabulary conforms to classical inscriptions. Three of its 8 different glyphs (RR1, RR430, RR76) are listed among the top 20 most common signs appearing throughout the corpus. Indeed, RR1 and RR76 are the most frequently used glyphs of all.

6.3. Verse Structure

The HPS inscription consists of one line of text containing three consecutive, identical 9-glyph verses. Single glyphs or bigrams may be duplicated three times or more, consecutively, in RR. However (and surprisingly), much longer corpus texts are never restated without variations (*viz.* the 8-character repeating sequences of the *Mamari* "lunar calendar" shown in Figure 13). Pertaining to artworks, J. M. Eisenberg (1992, p. 11) cautions that "monotonous repetition of elements—without a direct bearing on the theme" can be an indicator of a spurious creation.

6.4. Calligraphy

The HPS is the most beautifully drawn of the six artefacts investigated. Its calligraphy matches the standard of the best classical period pieces.

6.5. Other

The three identical RR "statements" comprising the HPS glyph string (Figure 12) intuit of invocations or choruses whereas the accompanying English description presents descriptive and technical data pertaining to the *hare vaka/hare paenga* (indigenous Rapanui houses). The RR text does not seem to be a translation of the companion English signage. Furthermore, each of the three identical HPS statements almost entirely

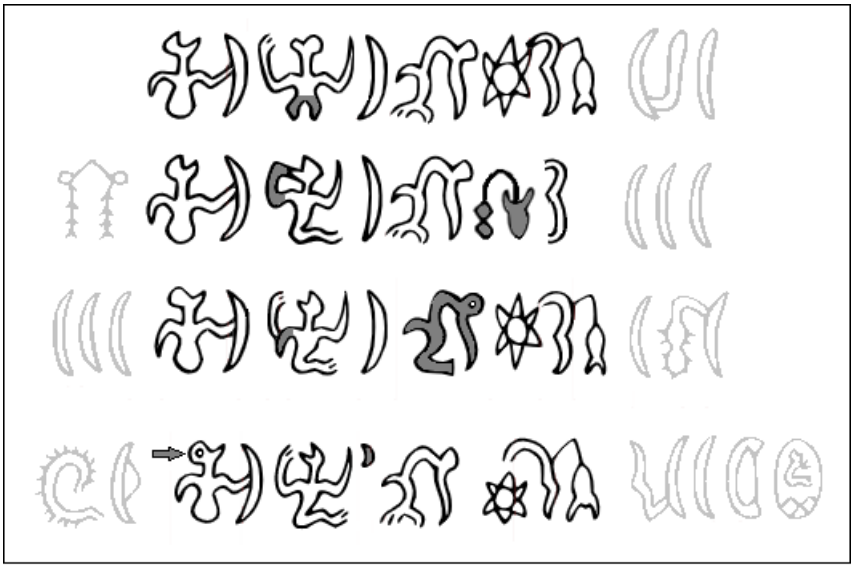


FIGURE 13. A typical lengthy, near-parallel, authentic KRR inscription set (the *Mamari* lunar calendar passages) displays variations (shown above as dark-shaded glyphs) and the related sequences are parsed by disparate glyphs (shown above in light-colour).

'quotes' from a subsection of the Small Santiago (Gv3) tablet text: RR90-430.76-670-256?-44 (shown in the Figure 14 underlined glyphs). The HPS statements then conclude with the rare characters RR: a reduplicated hapax (occurring only this one time in the corpus). However, inspection of the parallel Gv3 passage reveals that its concluding RR44 glyph is not a "stand alone". It is physically joined (presumably, therefore, connected with respect to information disclosure) to the next two linked glyphs that follow: a gaping mouthed birdman and a penis form (Figure 14, shaded glyphs). Thus, the HPS and Bv3 parallel texts diverge markedly at their endings. When considering its entire preceding quoted statement, one must conclude that the HPS offers no guidance to the RR reader in eliciting the meaning of its culminating hapax forms. Our best assumption would be that the hapax forms are synonyms of the birdman plus penis glyphs (which follow the same quoted statement as it occurs on Gv3). But there is nothing (not even morphological glyph resemblance) confirming that this (or anything else, for that matter) is the case. Here, the interpretive guidance about the hapax, provided to RR readers by the author of the HPS, is definitely inadequate.

FIGURE 14. Small Santiago (Gv3) glyph line. The Hawai'i Polynesian signage 'quotes' the underlined text.

6.6. Conclusion

The HPS is substantially an excerpt of Small Santiago Gv3 text and not a creative literary adaptation. As illustrated by the indecipherability of its hapax forms, the HPS passage is of no value to RR epigraphy.

The HPS is a forgery (or, more generously, artistic usage of RR in modern context) presenting a short text copied from a classical RR object. When assessing artefacts for authenticity, it is vital to possess a thorough knowledge of the contents of the classical RR boards, or to be supported by an algorithm (akin to the one developed by Sproat (2003)), which can match newly uncovered string catalog numbers to sequences from the known corpus.

7. Rangitoki Bark-cloth Fragment (RBF)

7.1. Provenance and Production

The RBF (Figure 15) presents ten glyphs, painted with indigenous reddish mineral pigment (Khamnueva, Mieth, Dreibrodt, and Out, 2018, p. 253) on a 15.5 cm by 4.5 cm strip of traditional tapa (bark-cloth) (R. Schoch and T. Melka, 2019, p. 120). It was gifted to Albert van Houten (AVH), a sailor who visited Easter Island in March 1869. He won the affections of a local young woman, Rangitoki, who gave him a souvenir: a small glyph-painted bark-cloth strip from her skirt. AVH retained the bark-cloth (coiled up and secured by twine) inside a pocket watchcase along with two tiny skull ornament beads (carved from bone) plus a short note of explanation in his native German language, approximately translated: "A piece from the skirt of my beloved precious Rangitoki. Given to me as a present—March 1869" (Khamnueva, Mieth, Dreibrodt, and Out, 2018, p. 123).

In 2018, Robert M. Schoch assisted with the sale of the antique pocket watch (ibid., pp. 117–118) and noted:

> the dealer who was involved with negotiations between the descendants of AVH and the new (anonymous) owner at one point implied that the watchcase might be more desirable, and thus more valuable, than its actual contents

FIGURE 15. Rangitoki Bark-cloth Fragment and glyph transcription. Photograph reprinted with the permission of the anonymous owner, courtesy of R. Schoch and T. Melka (2020, p. 113)

> (that is, the German note, two bone beads, and the bark-cloth [RR] fragment). (R. Schoch and T. Melka, 2020, p. 35)

7.2. Vernacular

The RBF vocabulary conforms to the classical corpus. Four of its 9 different glyphs (RR76, RR200, RR600, RR700) are listed among the top 20 most common signs to be found in the full RR corpus. RR76 is the second most frequently used glyph in all RR inscriptions. It contrasts with two heretofore unknown glyph variants, a claw-shaped version of RR27 and a "leaf-topped" version of the bullseye form RR107.

7.3. Verse Structure

Within the RBF are two discernable couplets (which I have parsed with vertical blue lines). Each couplet concludes with the RR76 "penis"-like glyph. If these two couplets present successive stanzas, then the entire sequence appears to be a short, Limerick-like composition of no fewer than 4 lines.

7.4. Calligraphy

The inscription is legible but glyph drawing technique is—prima facie—*Verfallszeit* (declining period). The poor detail of handwriting may be excused, given the limitations of the bark-cloth medium and the inscription method (reddish pigment applied with brush). These would have been ill-suited to any thru-tracing of a perfected copy, already scribed on banana leaf media. The final [RR39$_{Top}$:107] glyph-compound is effaced on account of a tear in the bark cloth.

7.5. Conclusion

The verse structure, evident even in this short inscription, leads one to posit that Rangitoki and her scribe invested a bit of time in its composition, perhaps generating drafts on disposable banana-leaf media before copying the final creation onto the bark-cloth. This is a delightful specimen in all respects, and I judge it to be an authentic product of the *RR* tradition.

8. Chiefs' Spanish Treaty Document of 1770 (CST)

Chiefs' Spanish Treaty Document of 1770 (CST)

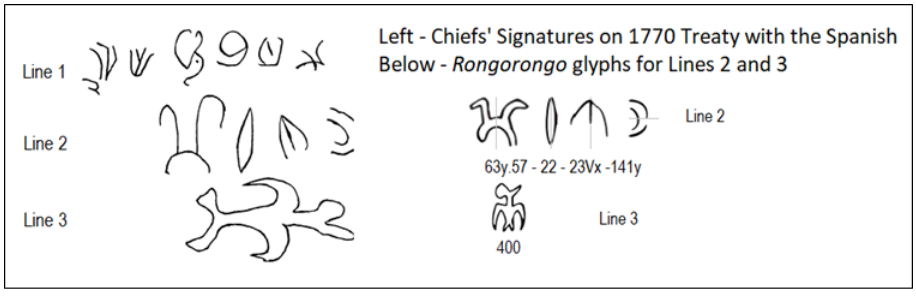


FIGURE 16. Chiefs' Spanish Treaty, document and glyph transcription. Treaty signature sketches from Harrison (1874, p. 528 and plate 27)

8.1. Provenance and Production

The treaty between the Spanish and the Rapanui was signed when the Spanish took possession of the island. The ceremony was a "religious-

military act in the Poíke area to the NE of the island" (Blanco, 2008) in which three crosses were raised on hilltops to commemorate the event. Spanish officers and three Rapanui chiefs signed the treaty document. Per commander Felipe González "… with which this act was completed, signing the possession of the corresponding individuals and three Indians of whom there were about 300" (ibid.). The Rapanui signatures are glyphic or imagined characters.

Peruvian José Toribio Gonzalez de La Rosa first showed a copy of the treaty glyphs (see Figure 16, left) to "the Anthropological Institute in London on 9 December 1873" (Langdon and Fischer, 1996, pp. 110–111). Although the original version of the chiefs' signatures has never been found, the RR epigraphic community widely regards these signature reproductions as being reliable representations. The treaty document would have been created using both ink and paper of European manufacture and each chief appears to have signed by creating a different line of glyphs.

The first line of CST signs exhibits no relationship to RR. The third line presents only one character—a birdman (RR400)—perhaps a symbol related to a chief (ibid., p. 114). The enigmatic second line contains four characters: all of them plausible RR signs. Further discussion of the chief signature document shall focus upon the second line of the treaty inscription.

8.2. Historic Analogues (New Zealand Treaty of *Waitangi*; Mayan syllabary writing shown to Spanish Friar Diego de Landa)

There are documented situations in which indigenous writers (or 'letterists') produced possible heritage inscriptions in the presence of European observers. Two of these afford relevant comparisons to the signing of the CST.

In New Zealand, in 1840, 132 chiefs—not necessarily literate in English—signed the well-preserved Henry Williams (Bay of Islands) page[5] of the Treaty of Waitangi, using either indigenous symbols or ad hoc scrawls. Only one signature of the 132 bears even coincidental resemblance to RR. Therefore, the one-off probability of correctly printing a row of four RR signs by simple chance, (without knowing the writing) would seem small.

In Central America (circa. 1566) Spanish Friar Diego de Landa transcribed Mayan characters written by his informants (Houston, Stuart, and Mazariegos, 2001, pp. 29, 33). Vis-à-vis the elegant Mayan inscriptions upon monuments, manuscripts, or pottery (Figure 17, lower row),

5. New Zealand Ministry for Culture and Heritage 2021.

de Landa's copy (Figure 17, upper row) is noticeably simplified. The '*ma*' and '*ne*' symbols are expressed as stick figures.

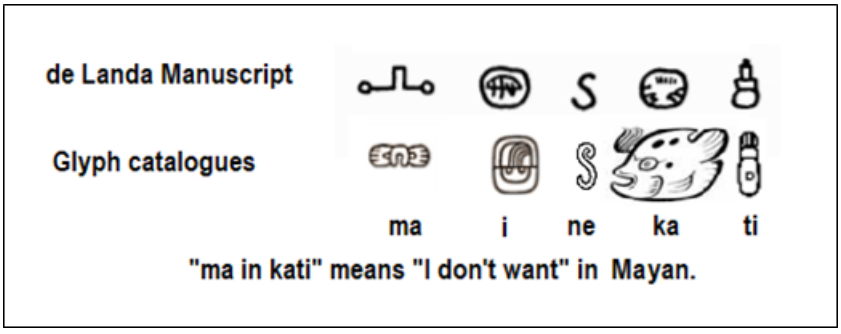


FIGURE 17. Shorthand Mayan inscription (top) compared to their more formal script calligraphy (bottom). Top row glyphs after manuscript by Diego de Landa (1566). Relación de las cosas de Yucatán (open access)

Writing ad hoc, with unfamiliar stylus and upon foreign media, the treaty-signing Rapanui chiefs might be excused for using simplified forms or stick figures in the manner of de Landa's informants. In a 2005 paper, Horley (2005, p. 115) (to cite an example) treats the CST line 2 lead off glyph as a stick figure and he redraws it as a fuller sign form.

8.3. Vernacular

None of the five RR characters on the Spanish treaty document are among the top 20 most common in the accepted corpus. However, its theme (a peace pact) may well be quite different from the exploits, which inspired production of the classical RR pieces. There is one unusual compound glyph (RR63y:57), but the base glyphs from which it was derived are easily recognizable and occur elsewhere within the corpus.

8.4. Calligraphy

Glyphs are drawn without artistic panache but well enough to be deciphered/traceable. The compound RR63y:57 is a stick figure. All second line glyphs exhibit an axis of symmetry. If it is acknowledged that RR incorporated a component of artistry as well as a simple communicative function—a perspective taken by Fischer (1997, p. 559), for example—then the conspicuous symmetry of the second line may augur for it being authentic RR. Especially, the orderly second line stands in sharp

TABLE 3. Authenticating RR Objects—Report Card

Object	Zipf's Law	Provenance and Production	Vernacular	Verse Structure	Calligraphy	Special Features	Decision
SDT	🟡	🟡	🟢	🟢	🟡	🟢	☺
WAT	🟢	🔴	🟡	🔴	🔴	🔴	☹
MFI	🟡	🟡	🔴	🟢	🟡	🟢	😐
HPS	N/A	🔴	🟢	🟡	🟢	🔴	☹
RBF	N/A	🟢	🟢	🟢	🟢/🟡	N/A	☺
CST	N/A	🟢	🔴	N/A	🟡	🟢	☺
🟢 = positive, 🟡 = questionable, 🔴 = negative							

contrast to the row of asymmetric signs upon the first line of the CST. Per the insights of Eisenberg (1992, p. 11) into art forgeries, a lack of symmetry may portend spurious work.

8.5. Conclusion

Many epigraphers do not recognize the Line 2 signs of the CST as *rongorongo*. Fischer (1997, pp. 4–6) even references this credibly dated (1770) specimen to support the theory that RR did *not* exist when the Spanish first visited Rapa Nui. On the other hand, the unusual circumstances of production of the CST ought to justify much of its abnormal vernacular and calligraphy. Ultimately, this inscription presents five consecutive, legitimate RR characters (the entire last two rows). All Line 2 signs exhibit axes of symmetry: atypical for consecutive scrawls. That said, the meaning of these characters remains enigmatic, possibly related to the event at hand, or other. This passage may ultimately be of corroborative utility in affirming RR character values that might one day be determined through epigraphy of the lengthier inscriptions.

9. Conclusions with Respect to the Authenticity of the Six Artefacts

The SDT, RBF and CST receive positive ratings (see Table 3) in most metrics of authenticity. These, therefore, appear to be genuine RR inscriptions and further investigation is warranted.

The provenances of the WAT and HPS cannot be linked to authentic RR authorship by the Rapanui. Moreover, certain special features of these two objects are unsettling. On the WAT there is a notable lack of

internal verse pattern plus an imprint of a modern reinforced strap. The HPS is mostly three identical copies of an inscription from the Small Santiago board. It is both notable and surprising that within the recognized corpus, lengthy glyph sequences (eight characters or more) never repeat identically on the same artefact.

The MFI seems to encode an intelligent communication. However, it is a *ta'u rongorongo* object. Its glyphs may or may not have the same meanings as similar forms upon earlier RR artefacts. One should use caution when drawing on material from this board for development of RR epigraphy.

In this study, provenance/production and verse structure were the most reliable means for determining whether an item is genuine. These metrics of appraisal should, therefore, be recognized for their critical importance in future assessments of artefact authenticity.

The seemingly authentic SDT and MFI do not conform well to Zipf's law. For shorter inscriptions (45 to 100 glyphs length) the rigorous verse structure, ubiquitous in RR, produces a bulge in the log-log Zipf plot, here notable in the region of the 7th and 8th most frequently occurring glyphs. By contrast, the apparently spurious (WAT) displays quite impressive log-log rank frequency linearity. In the limited context of the artefacts studied here, a yellow dot (questionable conformity) for Zipf's Law potentially indicates an authentic RR inscription, whereas a green dot (good conformity) is more likely to occur with a counterfeit. Zipf (1949) rationalized his law (indeed it is the title of his treatise) as the natural result of expending least effort to produce a successful result. Money-driven forgers would surely strive to output minimum effort in crafting convincing deceptions and perhaps that accounts for the good Zipf's law conformity displayed by the WAT.

Acknowledgment

I am indebted to the work of Philip Spaelti in authoring and sponsoring the website `http://kohaumotu.org/` (Rongorongo Tablets). This site served me well as a source for high-quality glyph images (reproduced from inscription rubbings originally obtained by Thomas Barthel (1958, End Attachments)).

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