

Palaeographic analysis of the Santiago Staff

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The Santiago Staff is a special *rongorongo* artifact. It is the only surviving inscribed staff, bearing the longest known *rongorongo* text of circa 2320 glyphs (Barthel 1958: 24) separated in segments with vertical line markers. The staff was brought to Santiago by Corvette O'Higgins in 1870 as a gift from Dutrou Bornier. Philippi (1875: 676) gives an account of the acquisition and meaning of the staff:

"The staff with hieroglyphs from the Easter Island was presented by the foreigner who lives on the island (Sr. Borguer [*sic*]), who told us that it belonged to the kings of that place, believing it was [used as] a weapon; but we, when asked the explanations from the natives about the aforementioned staff, were pointed at the sky and at the hieroglyphs that [the staff] had with such reverence that makes me more inclined to believe that these hieroglyphs recall something sacred."

The artifact was deposited in the Museo Nacional de Historia Natural (MNHN). In 1875, the museum's director Rodolfo A. Philippi published a preliminary study of all three *rongorongo* artifacts belonging to MNHN collections. Philippi mentions that plaster casts of the Large and Small Santiago tablets were made and sent to various museums in Europe; however, "it was difficult to make a plaster cast of the stick without obtaining very uncomfortable and fragile mould due to its form" (Philippi 1875: 676). To remedy this, Philippi published an accurate drawing of the staff's inscription separated into 13 lines running from left to right, while his drawings of MNHN tablets show both sides of the artifacts with boustrophedon arrangement of lines. The starting line of inscription was chosen arbitrarily (*ibid.*: 676-677), observing curious duplication of line XII (noted erroneously as XI on p. 677) as useful to determine the beginning of the inscription. Philippi's tracings of the Santiago Staff were reproduced by Brown (1924) and Heyerdahl (1965).

Thomas S. Barthel published new tracings of the staff, separating Philippi's double line and thus achieving a line count of 14; at the same time, "the arbitrary line order designated by Philippi was maintained; subsequent studies will have to clarify where the real beginning of this remarkable text was" (Barthel 1958: 44). Regarding the possible contents of the inscription, Barthel wrote (*ibid.*: 322): "the staff is connected with procreation, birth, and maturation and is closely connected to customs for the

initiation of the first-born son." However, Barthel's (1990: 79) view changed:

"My decipherment proposed that [sign] 69 = *po* came from the observation of its contrasting use in relation to [sign] 9 = *rangi*: "the underworld" versus "the sky" ... The Santiago staff offers a control experiment, because its text has just 29 occurrences of [sign] 69 and its ligatures ... [so that] it may be concerned as the inventory for all the "nights" (*po*) of a synodic month."

To develop this interpretation further, Barthel had to reverse the line order of the Santiago Staff, the implications of which will be discussed in detail below.

The third set of tracings of the Santiago Staff were published by Steven R. Fischer (1997: 451-454), who studied the original artifact in the MNHN and the polyurethane replica thereof in the collections of the Institute of Polynesian Languages and Literatures, Auckland. Paying attention to the worn marks of the staff, Fischer established that the text should start with Barthel's line I12, keeping the "forward" line numbering suggested by Philippi (1875). Segmenting the text of the staff into triads starting with a glyph bearing a "phallic appendage" and comparing the obtained structure with the recitation *Atua Mata Riri* recorded on Easter Island during the *Mohican* expedition, Fischer (1997: 457) "... was able to posit the structural decipherment of the text of the complete "Staff" as [triads X'YZ] X copulated with Y: there issued forth Z.... This led to the subsequent identification of many *rongorongo* inscriptions as similar procreation chants, most of which dispense, however, with the phallus suffix on the X glyph."

The alternative theory about the possible contents of the staff is based on the information obtained by Katherine Routledge (1919: 248): "there was a *kohau* of the "ika", the murdered men". The discovery of a possible genealogy on the Small Santiago tablet by Butinov and Knorozov (1957: 15) suggested that the inscription of the staff may represent a list of names. Barthel (1958: 287) wrote that "... [in a] section of the Santiago staff ... [there are] characters that can symbolize "the slain" or "human sacrifice", namely, signs 700 = *ika*". This idea was further developed by Jacques Guy (1998: 109):

"It is difficult at this stage to resist the temptation of a partial decipherment of that sequence [appearing on the

staff]: "Killed (700): So-and-so (8) son of So-and-So (90.76)". The Santiago Staff, then, would be a *ta'u*... It is natural and reasonable to expect a chieftain's baton engraved with writing to contain either his genealogy or the war exploits of his tribe."

More recently, Albert Davletshin (2002: 7) suggested that the staff may contain a list of names accompanied with their corresponding titles. Apart from different hypotheses concerning the contents of this remarkable artifact, the inscription of the staff was subjected to statistical studies. Richard Sproat (2003) found that:

"...the Santiago Staff seems to be an isolate, matching with almost nothing else except itself. The reason for this is presumably the abundance in this text of the "phallus" glyph (Barthel [code] 76) ...and of the vertical separator... We computed the same string matches for a version of the corpus where glyph 76 ...had been removed. The results ...were the same... – the Santiago staff still appears as an isolate."

The work of Tomas Melka (2009: 44) has shown that a "known [triad] classification X¹YZ [appears] to be predominant over the rest of the sequences [on the staff] at the ratio [of about] 60:40 out of 100%." Similar results have been published before by Andrew Robinson (2002: 241). However, it is important to emphasize that although triad glyph arrangement is not universally maintained throughout the staff's text, it is beyond any doubt that its inscription is clearly and carefully segmented into individual structural

units, *each* one starting either with glyph 76 or with a sign appended with glyph 76.

Although considerable progress has been achieved in the studies of the Santiago Staff, many questions still remain unanswered. In the following, I offer a partial solution for some of them by means of palaeographic analysis of the staff's inscription. Barthel's (1958) nomenclature is used throughout the paper for addressing *rongo* artifacts, lines and glyphs. The tracings shown in the figures were drawn by the author modeled after the rubbings of the staff once belonging to Barthel's archives.

Documentation of the staff

Due to its shape, the staff poses considerable complications for complete documentation. While numerous publications contain photos of the staff, these usually show a general view of the artifact (Heyerdahl 1989: 82) or present a detailed close-up to a particular section (van Hoorebeeck 1979: Pl. 22; Klein 1988: 163; Flenley & Bahn 2002: 189). Therefore, to study the complete text of the staff, one should turn to the tracings of Philippi (1875), Barthel (1958) and Fischer (1997). However, the tracings do not present information about the mutual position of the lines (except for Philippi's tracings of doubled line XII that in Barthel's nomenclature was split into lines I12-13), which is very important for palaeographic analysis. Luckily, several replicas of the staff made of plaster, plastic or polyurethane resin are scattered around in museums and private collections (Fischer

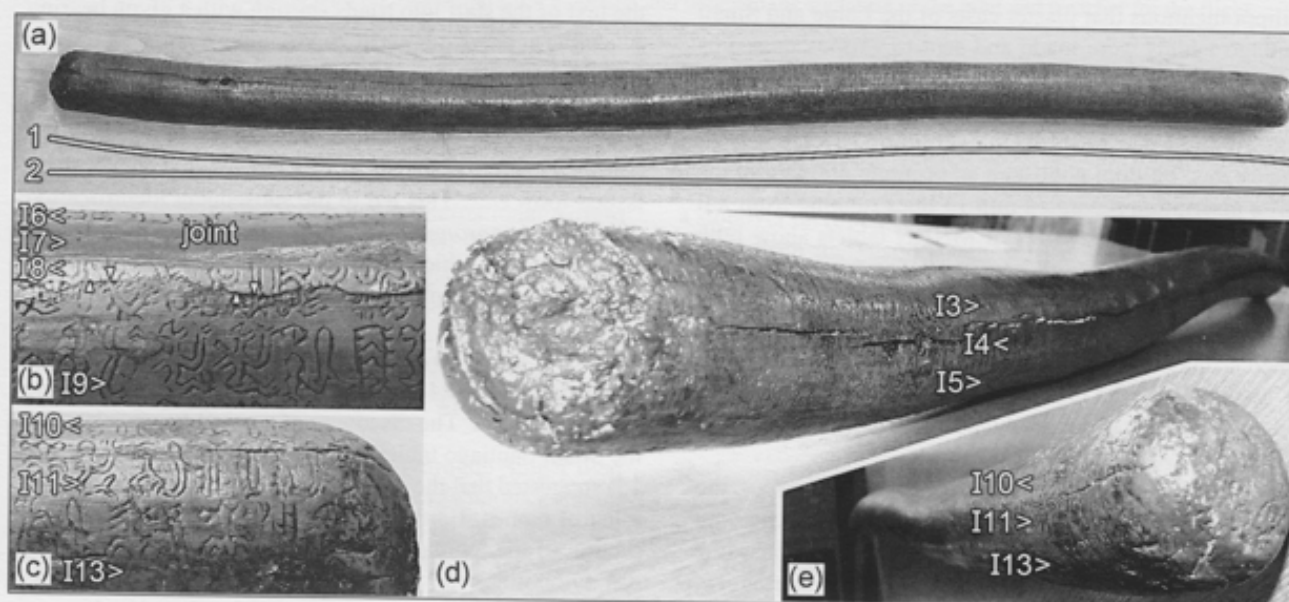


Figure 1. Views of the Tübingen replica of the Santiago Staff: a) general view with two possible measures – following the shape of artifact (curve 1) or projection thereof on a straight line (curve 2); b) close-up to the joint covering line I7, with some "displaced" characters in line I8 (contour correspondence points are marked with arrows); c) close-up to non-boustrophedon lines I11 and I13 at the thinner end of the staff; d) perspective view from the damaged thick end (profile view thereof is given in Figure 3b) with series of large cracks cutting through the lines I3 and I4; e) perspective view from the less worn thin end.

1997: 455). The Department of Ethnology and Cultural Anthropology of Tübingen University has a plastic cast of the Santiago Staff that belonged to Thomas S. Barthel. Thanks to the kind permission of Volker Harms and Roland Hardenberg, the author had the honor to study this cast in Tübingen Castle on April 22-25, 2009.

The cast was made of brown plastic in the late 1980s (Harms, pers. comm. 2010) and renders the object with high accuracy (Figure 1a). For the sake of contrast enhancement, the inscription was filled with a darker substance. The replica is heavy and consists of two parts; the joints are covered thoroughly by some kind of resin. Due to this, several lines (I7-8 and I13-14) are partially or completely illegible. In some places, the mold (or the cast) was damaged in the areas adjacent to the joint, "tearing" some glyphs apart (Figure 1b).

The study of the Tübingen replica was complimented by an analysis of the rubbings of the original staff, covering all fourteen lines. These rubbings were presumably made in the 1950s by José Imbelloni (Bettocchi 2009: 58-59)

and were used by Barthel in preparation of his *Grundlagen*. Later, the rubbings were donated by Barthel to the C.E.I.P.P. together with his *rongo-rongo* papers. The author is grateful to Jacques Guy for his most kind help with a scanned version of these rubbings.

Fischer (1997: 455) reports that the staff is 126cm long; the diameters of its ends are 6.4cm and 5.7cm, respectively. The resulting difference in circumference π ($6.4 - 5.7\text{cm} \approx 2.2\text{cm}$) allowed the carver to fit 14 lines at the thicker end and 13 at the thinner one, resulting in two non-boustrophedon lines I11 and I13 at its thinner extremity (Figure 1c). The variation between staff length values reported by different authors is easily understandable due to curvature of the object (Figure 1a). Thus, the measurement obtained following the contours of the artifact would be slightly larger than those read from a ruler stretched between its extremities (see curves 1 and 2, Figure 1a). The thicker end of the staff is considerably damaged (Figure 1d, Figure 3b), while the thinner one is in a better state of preservation (Figure 1c, Figure 1e).



Figure 2. Surface defects on the Santiago Staff: a) a hole pre-dating the inscription, line I4; b) large crack post-dating the inscription, cutting through line I3; c) small cracks post-dating the inscription, line I9; d) the thicker end with a damaged part of line I9, most probably post-dating the inscription and e) comparatively recent crescent-shape scar on lines I11 and I12. The rubbings made by Imbelloni in 1950s are presented below the photographs, illustrating expansion of large cracks (Figure 2a, b), and relative stability of the small cracks (Figure 2c). The crescent-shaped damage to the staff occurred after the 1950s and before the late 1980s, as it is absent in the rubbings but is present on the cast (Figure 2e).

Several important facts can be deduced from the study of the staff's surface. There is a peculiar small hole located at line I4; its contours are smooth, but the replica does not show any concentric wood structure allowing it to be classified as a natural knot (Figure 2a). Moreover, a large crack goes directly through this hole, while for a knot, one would expect the crack to go around the hole following the wood fibers, as the hardness of the knot is usually higher than that of the surrounding wood. Bettocchi (2009: 61) mentions this surface defect as a "mysterious profound hole ([used] for hanging?)", which is questionable as the hole does not penetrate the staff and actually is not very deep. What is more, it definitely predates the inscription, as the signs are carved to the left and to the right of it, but the place above the hole remains unused (Figure 2a).

Bettocchi suggests (*ibid.*) that deep cracks of the staff were caused by drastic environmental change:

"After a humid cave to [the place of] its conservation in the Museum of Santiago, it [the staff] could not resist – a large fissure started from the End I [the thickest one], cutting into ... a large quantity of very beautiful signs. This fissure is more than 1.2cm deep ..."

It is difficult to ascertain whether the cracks passing through lines I3 and I4 (Figure 1c) appeared after the artifact left Rapa Nui (one should have the images of the staff pre-dating its deposition in the museum to verify this fact, but, to the best of the knowledge of the author, such images do not exist). It is true that Philippi was careful to document worn portions of the text and holes between the glyphs in his tracings published in 1875, as these obliterated the signs. To the contrary, the glyphs cut in half by a crack remain perfectly legible, so that it is natural to assume that Philippi might have decided to omit the cracks for clearer presentation. One can be sure that the cracks in lines I3 and I4 post-date the text, as glyph contours continue in the very same fashion from one side of the crack to another (Figure 2a, Figure 2b). If the fissure was there prior to the carving, it is far more probable that carver would have avoided them by "nesting" figures between the lines. If this were impossible to achieve, the contours of the glyphs on both sides of the fissure should have been different, as the shark tooth used to deepen the outlines would easily slip into the crack, changing both local depth and orientation of the contour. In addition to the large cracks mentioned, there are many smaller ones (Figure 2c), also evidently post-dating the inscription. An interesting conclusion can be made by comparing the Tübingen replica with Imbelloni's rubbings (Figure 2a, Figure 2b, Figure 2c) that document the condition of the staff separated almost by 40 years – large cracks definitely became wider, while the tiny cracks are more stable and have not expanded that much.

Minor traces of wood-eaters activity are noticeable on the artifact (Bettocchi 2009: 61), some of which are

seen to the right of the hole in line I4 shown in Figure 2a. The beginning of line I9 is significantly worn (Figure 2d); Bettocchi (*ibid.*) states that this damage is caused by "the remains of combustion [that] have been cleared, defacing the writing." Curiously, the staff features a crescent-shaped scar that seems to post-date the 1950s, as it is absent on Imbelloni's rubbings (Figure 2c). One may suggest that the scar is a characteristic of the Tübingen cast only but does not appear on the artifact; however, the footage of the original staff in the documentary "*La mémoire perdue de l'île de Pâques*" (Ragobert 2001) clearly confirms the presence of this particular crescent mark.

The Wood of the Santiago Staff

One important question concerns the identification of the wood from which the staff was carved. According to Chauvet (as cited by Fischer, 1997: 653, note 23), the staff is made of *Sophora toromiro*. The latest research by Catherine Orliac (2010: 133) has shown that contrary to early beliefs assuming that *rongorongo* artifacts were predominantly carved from *toromiro*, the actual material of choice for the tablets was Portia tree or Pacific rosewood (*Thespesia populnea*), known by the Rapanui name *mako'i*. At least six out of eleven artifacts with identified wood are made of *mako'i* (*Aruku Kurenga*, *Mamari*, London, Large Santiago, Small Santiago, and Small St. Petersburg tablets). Five other tablets are made of wood that was foreign to Rapa Nui – which may have arrived as driftwood or was brought by the first visitors, such as *Fraxinus* sp. (tablet *Tahua*) and *Podocarpus* sp. (*Echancrée*, Small Vienna, Large St. Petersburg and Large Washington tablets).

Judging from the good surface state of the Santiago Staff, it seems that a driftwood hypothesis can be safely discarded. If the staff was made from a local wood, the two most probable options are *Sophora toromiro* and *Thespesia populnea*. The tentative identification of the staff's material can be accomplished if, in addition to its dimensions (that appear in almost every publication mentioning it), one would know its weight and the density of its wood. The former parameter is supplied by Fischer (1995: 305): "the 'Staff' ... is a two-kilogram sceptre." A recent book by Orliac and Orliac (2008) presents the excellent documentation of Rapa Nui artifacts belonging to the Collections of the Congregation of the Sacred Hearts of Jesus and Mary (SS.CC.), including data about dimensions and weight of eleven *tahonga* pendants made of different wood. Seven of these (catalogue numbers P013-P019; Orliac & Orliac 2008: 209-221) have a simple ovoid form, which can be approximately treated as an ellipsoid with radii *a*, *b* and *c*. The volume thereof is $\frac{4}{3}\pi abc$, allowing the estimation of wood density as summarized in Table 1.

Tahonga P013 is slightly denser than the rest of *mako'i* artifacts P014-P017. The average density of the latter is 544.23kg/m³; the total average using all *mako'i* pendants

Artifact	Wood	Dimensions, cm	Weight, g	Density, kg/m ³
P013	<i>mako'i</i>	9.9×8.1×7.9	200	602.95
P014	<i>mako'i</i>	10.8×9.6×9.6	289	554.54
P015	<i>mako'i</i>	11×9.5×9.5	289	555.98
P016	<i>mako'i</i>	7.55×6.8×6.9	102	549.91
P017	<i>mako'i</i>	8.05×6.1×6.25	83	516.50
P018	<i>toromiro</i>	9.2×6.7×6.9	206	925.03
P019	unknown	10.05×8.1×8.25	213	605.74

Table 1. Wood density estimated for SS.CC. *tahonga*.

yields a slightly higher density of 556kg/m³. This result agrees well with the data supplied by Friday and Okano (2006: 10) that “the specific gravity ... [of] air-dried [Portia tree wood is] averaging around 0.6 [600kg/m³].” In contrast, *toromiro* is far denser – about 1.66 times the density of *mako'i*. This heavy weight, hardness, incorruptibility, fine-grained structure and dark red color of aged wood made *toromiro* a prized material for carving (Orliac & Orliac 2008: 264).

Using Fischer's (1997: 455) measurements – length 126cm and average diameter 6cm – and treating the staff as a cylinder, one can estimate its weight as 1.98kg (using *mako'i* density of 556 kg/m³) or 3.3kg (*toromiro* density). The 2kg weight of the original artifact (Fischer 1995: 305) perfectly fits the estimation calculated using the density of *mako'i*. Keeping in mind that two other MNHN tablets are made of *mako'i* (Orliac 2010: 133), one becomes inclined to think that it is likely that the Santiago Staff is also made of this wood.

Handling the cast of the staff, one cannot avoid asking the question of how “compatible” it is with a popular concept that a reading of *rongorongo* text arranged in reverse boustrophedon required the rotation of the object upon passing from one line to another. While this action is easily accomplishable with a moderately-sized tablet, rotation of the staff is completely another matter. Of course, the easiest way to turn the staff around would be by holding it close to its middle part. But, in this process one may easily lose the line that was just read, so that it should be found again before proceeding to the neighboring line. In order to avoid these troubles, one has to rotate the staff around one of its extremities, which is quite cumbersome and require a good deal of free space (some 2.5m in diameter) around.

However, if early inquiries among Rapanui yielded information without many exaggerative embellishments, there were even larger (and heavier) *rongorongo* artifacts (Routledge 1919: 244):

“The tablets were of all sizes up to 6 feet. It was a picturesque sight to see an old man pick up a piece of banana-stem, larger than himself, ...and stagger along with it to show what it meant to carry a tablet, though... the sides of the tablet were flat, not round like the stem.”

The “lost tablet” of Father Zumbohm had the dimensions 105 by 40cm (Orliac & Orliac 2008: 71). Assuming that its thickness is approximately 2cm (similar to other tablets, *ibid.*: 244), one can estimate its weight as 4.7kg (*mako'i*) – making one curious about how easily such an artifact could be held in outstretched arms during its reading, saying nothing about rotating it around one of its extremities. Guy (2008) made an insightful comment on this point:

“Two possibilities [are] there: ...the tablets were held “standing.” You started at the bottom, once you reached the top, you continued down, starting at the top of the next column.... No need for gymnastics as when you are reading horizontally and must either turn the tablet at each line (one is one yard long!) or “right” the upside-down glyphs in your mind’s eye. [The other option is that the] ...reading was done by two chanters, facing each other. One read one line, the other take over, and so on.”

Reading Order for the Staff's Inscription

One of the important points in studying an unknown inscription concerns proper identification of its beginning and reading order. Philippi (1875: 676-677) chose the starting line of the staff's inscription arbitrarily; however, he observed the bifurcation / doubling of line XII in his drawings, pointing out that (*ibid.*: 678)

“...we can suppose that the doubled lines of the thickest end are the last ones; in this case, the line... XIII will be the first one. In this assumption one should start reading from the thicker end, but, as one can see, all of this is no more than possibilities.”

Barthel (1958: 24) follows Philippi's line order in his *Grundlagen*, mentioning that “the beginning and the end of the text can be established by the bifurcation of lines XIII-XIV [*sic.*, these are lines I12-I13].” Years later, Barthel (1990:79) suggested that the staff is an extended version of the lunar calendar. The search for the beginning of the lunar cycle brought him to the following conclusion (*ibid.*: 80):

“For the two moonless nights... [on the] Santiago staff one has to resort to the general Polynesian concept that the moon has become visible ... by bathing in the “water of life” (*vai ora*).... Let us check whether [sign] 70 = *vai* appears adjacent to [night glyph 69] *po*. An unexpected and satisfying result comes to light: [the desired combination] is found in I1; in the case of clockwise reading of the lines (from I13, I14 to I1) it will come directly after the beginning of the nights [cycle, identified by Barthel as 20.10-69 = *hakamata-po*, line I13 (*ibid.*: 79)]! Here we came to a contradiction; our [night order] system conflicts with adopted reading order. The contradiction can be solved... by abandonment of the traditional ...reading

order. Verification [of this]... solution resulted in supporting findings ... By accepting I13 as a starting point for the series of 29 *po*-occurrences, one will reach with [reversed reading order] ... the end for the [Moon] series ... in [line] I1! Such a reversed line order does not mean the change of normal left-to-right [reading] sequence of RR-signs within each individual line. It affects only the [reading] sequence of the neighboring lines."

While the interpretation of the staff's text as a moon calendar is debatable (as well as proposed readings of the signs 69 and 70 as *po* and *vai*, respectively), the possible change of line sequence for the Santiago Staff is an important issue. By adopting Philippi's line order, Barthel did not mention that "Philippi in his numbering of the lines (downwards) ... [went] against the known reading direction of the tablets (upwards)" (Guy 2004: 40). Thus, "reversed" line order may actually represent a proper line sequence for the Santiago Staff.

Studying the original artifact, Fischer (1997: 455) paid special attention to the wear marks on the staff:

"The damage on one half of the thick end evidently came from resting this end diagonally on stony ground for many years, probably each time the bearer stood with the artifact ... the "Staff" shows minor pitting, most seriously just below the start line I [Barthel's line I12], as if the thumb acids have corroded the wood."

Figure 3a shows the possible way the staff was held according to Fischer. The diagonally worn thick end of the staff is illustrated in Figure 3b. The close-up to the worn area adjacent to line I12 is presented in Figure 3c. It is indeed possible that the thicker end of the artifact was damaged by contact with stony ground. Alternatively, the staff might have been leaning against a wall in a place with damp soil for a considerable time, so that a part of its thicker end became wet and thus eroded faster. Basing his observations on the tentative reconstruction of the way in which the artifact was held, Fischer wrote (1997: 456):

"My own investigations of the original "Staff" have identified as the text's first line Philippi's / Barthel's line 12 – the three-quarter line that commences with an exceptional half-sized glyph some 35cm in from the thin end of the "Staff". This is just below the point where the thumb of a c. 190cm-tall, right-handed man would touch the artifact whose thick end is resting on the ground, next to the instep of the left foot."

It is unclear why the most comfortable hold on the artifact should correspond to the beginning of its text – for a priest who knew how to read the inscription it would be no problem to find any particular fragment, including the starting point (as we can easily find the necessary phrase on a journal page).



Figure 3. The way of holding the Santiago Staff: a) the cast held by Volker Harms according to Fischer's description; b) close-up of the thicker end of the staff worn at an angle supposedly due to frequent contacts with stony ground; c) worn area in line I11, which can be tentatively associated with position of bearer's thumb.

From this point of view, there was no special need to keep one's thumb by the first glyph of the inscription. It is also curious why the writing has to start at a considerable distance from the staff's extremity, while the surviving tablets usually have their first lines running directly from the edge.

This question was further discussed by Guy, who studied the possible reading order of the Santiago Staff based on Philippi's tracings (Guy 2004: 41):

"If reading started from line 12, as Fischer holds, the scribe would have begun with half-sized glyphs, gradually increasing to full size at the end of the line. Once he had reached the end of line 12, he may have moved up (to line 13) or down (to line 11). It is far more likely that he moved up, as did all the scribes who wrote the tablets. If so, having started line 13 with full-sized glyphs, he would have reduced them gradually to half size until he reached the

point where he had begun writing line 12. Then, suddenly, he would have reverted to full-sized glyphs with sign 67, the "palm tree".

While Guy was definitely trying to reinforce the foundation for the hypothesis that line I12 was the first line of the staff, there are still many questions and discrepancies. If the scribe started writing with small glyphs – presumably to make economic use of space – why would he have increased the glyph size approaching the end of line I12? Why should he decrease glyph size again in line I13? If we assume that it was the second line to be written on the staff, there was plenty of space for full-size glyphs. But, these were not employed until the scribe passed the beginning of line I12. Why couldn't the scribe have continued writing line I13 in small glyphs until the end of the line? All these questions seemingly point to a different scenario. Sign miniaturization in other *rongorongo* inscriptions usually occurs when there is a need to fit the text into available tight space, inclining one to think that lines I13 and I12 were squeezed into the remaining free surface of the staff, actually being the two *last* lines of the inscription, as suggested by Philippi (1875: 678).

Recently, Bettocchi proposed her solution to the problem after study of the original staff. She identifies *fifteen* lines, treating the non-boustrophedon part of line I13 as an independent line following I12 (2009: 62):

"... to insert the 13th and 14th sections [part of line I13 and line I12], the master [carver] confronted a problem: he has to cover an irregular surface [measuring] 3cm [on thicker extremity] ... versus 1.7cm [on thinner one]. It's where he made a complete turn in boustrophedon writing using the signs of smaller and smaller height, from 1.4-1.2cm in the beginning to only 1-0.8cm at the turning point ... for the final section [of the text], the transition sign is 067a, the palm which can represent *Jubaea chilensis*."

As line I12 finishes the "boustrophedon part", Bettocchi suggests that the beginning of the text should be line I11 with the following reasoning (*ibid.*: 64):

"The 11th line ... is the most perfect and starts the inscription from the plainest side of the object. The starting signs are ... the most beautiful and the most even (in size and depth) of all *rongorongo* corpus. The carver is a great master."

It is worth noting that the beauty of the signs alone is insufficient proof for the beginning of the text. It is true that more elaborate glyph contours can be carved over the plain and comfortable surfaces – like the central area of the tablet. However, it does not make those lines the starting lines of the inscription. To the contrary, the text of the tablets starts with the glyphs written on edges that were difficult to carve, and these initial signs can be small and distorted. In any case, the

inscription of the staff indeed starts with line I11 and ends with line I12, and there is *evidence* for this both in carving techniques and structure of the text.

The most obvious place to be analyzed first is the beginning of the wedged line I12 (Figure 4a), featuring half-sized glyphs and a headless bird ligature 547.76. Despite the fact that bird glyphs are frequent in *rongorongo*, the only other headless bird (sign 546) appears on tablet *Mamari*, line Cb9. At the same time, the staff presents 36 bird glyphs with raised hands, of both long-beak (glyphs 606 / 604) and short-beak (406 / 404) varieties. Under these circumstances it is natural to assume that glyph 547 in line I12 should also have its head – just as sign 606 in line I13 does. The rubbings reveal that line I12 is set very close to I13 and the place above glyph 547 is occupied with a fish sign 700.

If line I12 was the first carved on the staff, there would be no limitations to depict the bird 547 in its full form. However, if line I12 was carved *after* I13, the headless ligature 547.76 is easily explained by lack of space to carve the bird's head. This evidence suggests that Philippi's line order is incorrect and *should* be reversed, which immediately supplies a simple and logical explanation to the observed variation of sign size: the carver was working on line I13 starting from the thicker end of the staff, where he obviously had enough space to carve another line. The available space gradually shrunk by approaching the thinner end; the *tangata rongorongo* tried at first to cope with this problem by carving smaller glyphs "pushed" towards the preceding line I14. The wedged fragment shown in Figure 4 displays the evidence for this – a long-necked bird 670 got one of its wings "sacrificed" to save a place for carving its head in the lowest position possible (compare it with full-size two-headed bird 680 from line I11). Also, glyphs 90.76-255 apparently took advantage of spaces between the signs of the previous line – please note how glyph 90 fits between signs 76 and 17 of line I14. Upon carving sign 255 it became obvious that further miniaturization is useless – the remaining space allowed only a single line. Hence, starting from glyphs 67-606.76 the scribe returned to full-size signs, resulting in non-boustrophedon lines I11 and I13 at the thinner end (see Figure 1c).

Bettocchi emphasizes her confirmation of this unusual line arrangement (2009: 60 and 62): "[by] demonstration with image ... we can prove the existence of non-boustrophedon writing of the section Is15 [end of line I13] in relation to section Is1 [I11]". Actually, only even numbers of lines are "compatible" with reverse boustrophedon on a closed surface – which can be illustrated with the 14 lines carved on the thicker end of the staff. For *any* odd line number covering a cylinder, there *should* be a pair of non-boustrophedon lines. At the same time, a far more important point about the need to reverse Philippi's line order is scarcely mentioned (Bettocchi 2009: 64): "the direction of writing [of the staff] is from left to right, [and] from bottom to top, according to the observations of Msgr. Tepano Jaussen at the end of 19th century". It should be noted that while "from left to right" concerns the

(a) Wedging of line 12



I11 > 𐄎𐄎𐄎𐄎𐄎𐄎 680 𐄎𐄎𐄎𐄎𐄎𐄎
 I12 < 𐄎𐄎𐄎𐄎𐄎𐄎 547 𐄎𐄎𐄎𐄎𐄎𐄎 53 𐄎𐄎𐄎𐄎𐄎𐄎 606
 I13 > 𐄎𐄎𐄎𐄎𐄎𐄎 670 𐄎𐄎𐄎𐄎𐄎𐄎 90 𐄎𐄎𐄎𐄎𐄎𐄎 255 𐄎𐄎𐄎𐄎𐄎𐄎 67
 I14 < 𐄎𐄎𐄎𐄎𐄎𐄎 17 𐄎𐄎𐄎𐄎𐄎𐄎 76 𐄎𐄎𐄎𐄎𐄎𐄎 17 𐄎𐄎𐄎𐄎𐄎𐄎 76 𐄎𐄎𐄎𐄎𐄎𐄎 17 𐄎𐄎𐄎𐄎𐄎𐄎 76

(b) "Palm tree" glyph 76 on Santiago staff

I2 𐄎𐄎𐄎 I3 𐄎𐄎𐄎 𐄎𐄎𐄎 I6 𐄎𐄎𐄎 𐄎𐄎𐄎 I14 𐄎𐄎𐄎 I13 𐄎𐄎𐄎 I7 𐄎𐄎𐄎
 sequence-initial median sequence-final

(c) Space-saving by glyph stacking

I11 𐄎𐄎𐄎 I10 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 I9 𐄎𐄎𐄎 I8 𐄎𐄎𐄎
 189 499.6 600.1 90.76.2.76 499.6t 519 50.42
 I7 𐄎𐄎𐄎 I6 𐄎𐄎𐄎 I4 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎
 194.76 149-518 73f.490 158-8.7 490.22 600.90 599b
 I2 𐄎𐄎𐄎 I1 𐄎𐄎𐄎 I14 𐄎𐄎𐄎 I13 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎
 430.76-71h 21.49f 600.90.76-50h 380.380 470.700t 82b 21.90.76 700.42 2.76-55
 I12 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎
 547.76 23.76-470-50t 208.76.62.52 9.90-8.7.76 29.69 2007 2.76-55 76.11 50.90 11.440.76-670.27 70h-99.90

(d) Continuity of the topic

I5 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎
 I4 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎
 71.76-10.79f-71 71.76-10.79f-522f-2 71.76-10.79f-90 72.76-10.79f-90

(e) Peculiarities of text delimiters

I11 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 I10 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎
 continued >
 I10 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 I9 𐄎𐄎𐄎 𐄎𐄎𐄎
 > continued continued >
 I9 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎 𐄎𐄎𐄎
 > continued

Figure 4. Determining the reading order of the Santiago Staff: a) wedged line I12 in Imbelloni's rubbings and tracing with a legend; b) proof of the unbreakable nature of triad 90.76-255-67; c) intensive symbol stacking in line I12 (in comparison with other lines) suggests that it is the last line of the inscription, with line I11 starting the text. Under such "reversed" reading order (relative to that proposed by Philippi), one detects d) a continuous topic given by four entries starting with 71(72). 76-10.79f and e) peculiar segmentation of the text, with a long undivided fragment covering line I11 and three quarters of line I10, followed by a sequence of isolated triads passing to line I9.

glyphs in a line, “from bottom to top”, reflects glyph order in vertical ligatures (Guy 1982: 447; Pozdniakov 1996: 297) is actually unrelated to them, addressing instead the sequence in which the lines should be read. And one has to remember that Philippi numbered the lines “downwards” (Guy 2004: 40) to figure out that Bettocchi’s comment on reading “from bottom to top” actually intends to convey that Philippi’s line order should be reversed.

Is there a 15th segment starting with glyph 67 as suggested by Bettocchi (2009: 64)? Most probably not, because introduction of this sequence would break the predominant triadic structure of the staff (Fischer 1995: 307; Melka 2009: 44) *exactly* at the turning point, with the last small-size glyphs 90.76-255 of line I13 lacking their closing Z-glyph (according to Fischer’s formula X^1YZ), as line I12 starts with another triad with X-glyph 53 (Figure 4a). Moreover, if the hypothesis about Bettocchi’s 15th segment was correct, it would be natural to expect that line I12 (supposedly preceding it, Bettocchi 2009: 64) should end with X^1Y glyphs so that the sign 67 in her 15th segment will act as Z-glyph closing that triad. However, line I12 already ends with a complete triad featuring a compound sign 99:90 as Z-glyph (Figure 4c). Additional proof can be found in studying the usage patterns of the “palm glyph”, which are very particular in the Santiago Staff inscription (Figure 4b). The sign in question appears only eight times in this text; in five cases, it takes the place of X glyph. These sequence-initial patterns are quite restrictive – they either start with 67.76-4f (lines I2 and I3) or 67.76-149 (line I6). One odd example features a median position of the “palm tree” sign (Figure 4b, I14). Finally, there are two sequence-final occurrences of glyph 67. One example from line I7 starts with 90.76 and includes an anthropomorphic Y-glyph. Under such specific use of sign 67 on the staff, one becomes inclined to think that the “palm glyph” from line I13 (where it is definitely sequence-final) would follow the similar pattern by forming a triad 90.76-255-67 with the same X-glyph 90, rather than expanding the *already complete* triad ending line I12 starting with a distinct sign 430. Therefore, inscription structure and usage peculiarities of sign 67 prove that line I13 is continuous and runs uninterruptedly from the thicker end of the staff to the thinner one in complete agreement with tracings published by Barthel (1958) and Fischer (1997), confirming that the Santiago Staff has only fourteen lines.

More supporting evidence favoring the conclusion that line I12 is the final part of the inscription comes from observations of the stacking and clustering of the glyphs (Figure 4c). The inscription outside line I12 contains several examples of stacked glyphs (line I11 – sign 189; line I10 – 600:1 and 90.76:?:76; line I9 – 519; line I8 – 50:42; line I7 – signs 194.76, 518 and 73f:490; line I6 – 8:7; line I4 – 600:90 and 599b; line I2 – 21.49f and 600:90; line I14 – 82b; line I13 – 21:90 and 700:42). There are also a couple of other space-saving constructions, such as a subscript arm in sign group 499.6t (Figure 4c, line I10; compare with the

full form 499.6 illustrated in the beginning of the same line in the figure), subscript fish in 470.700t (Figure 4c, line I1) and a gaping mouth head in 490.22 (Figure 4c, line I4), as well as superscript signs 71h and 50h (Figure 4c, line I2). The “spiked oval” glyph 70 sometimes feature another glyph inscribed (Figure 4c, line I7, glyph 149; Figure 4b, line I6) or “retract” the spikes inside the oval (Figure 4c, line I6, glyph 158) for space saving. But all these “scribal tricks” illustrated for *ten* lines of the staff are clearly surpassed by “tight-packing” occurrences from a *single* line I12 (Figure 4c): glyph stacking (9:90, 8:7, 29:69, 2:76, 76:11, 50:90, 99:90), subscript / superscript symbols (470-50t, 70h), head omission (glyph 547) and pronounced clustering (208.76.62.52, 11:440.76-670:27). The urge for sign compacting can be illustrated by sequence 2.76-55, written in full in line I13, with that of I12 where it discards the bottom “lozenge” of glyph 2 to stack it over sign 76, allowing to put glyph 55 closer (Figure 4c). Such pronounced increase of sign “packing” in line I12 strongly indicates that it is the *last* line of the text, so that the approaching end of writing media forced the scribe to compact the glyphs as much as possible.

With last line I12 and pre-last line I13, the text of the staff should start with line I11. The resulting line order I11 – I10 – I9 – I8 – I7 – I6 – I5 – I4 – I3 – I2 – I1 – I14 – I13 – I12 has considerable supporting evidence. First is the discovery made by Guy (2004: 39):

“sign 11 was preceded by sign 76 on the Santiago Staff in 28 occurrences out of 35, and ... this digraph, 76-11, occurred only on lines 1, 2, 3, 4, 12, 13, and 14. The Staff bearing 14 lines, this suggests that these seven lines constituted a continuous text starting on line 12.”

The inscription ending with line 12 also satisfies Guy’s hypothesis that lines I4-I12 form a continuous text. Apart from that, one can observe the continuity of the topic by four entries (separated by vertical lines) starting with the same glyphic group 71(72).76-10.79f (Figure 4d). As two of these appear in the end of line I5 and two – in the beginning of line I4, they also strongly support the notion that I5 precedes I4.

Yet another confirmation comes from the segmentation of the staff’s inscription. Barthel (1990:78) noticed that “in one exceptional case ([line] I11) no segmentation is found [at all].” The phenomenon is actually deeper – the next line I10 also features a non-segmented passage spanning from the beginning for about three quarters of its length. The rest of line I10 – and the beginning of line I9 – present a set of triads isolated with vertical markers (Figure 4c, upper brackets). It is worth noting that both line transitions – from I11 to I10 and from I10 to I9 – preserve the triad structure as $[X^1Y / \text{line break} / Z]$ and $[X^1 / \text{line break} / YZ]$, respectively (Figure 4c, lower brackets). Curiously, the division marker between the triads forming a sequence continuing from I10 to I9 is absent. However, this phenomenon can be tentatively

explained by the very uncomfortable surface for carving – there was no place to incise X¹ glyphs 48-76 of the last triad on the side surface of the staff, so these were carved on the artifact's extremity (Figure 2d, also see Bettocchi 2009: Figure 3). Even with this “transitional” sequence joining two triads, the inscription flowing from I10 to I9 is unique in that it contains the highest number of isolated triads directly adjacent to each other (8 ending line I10 and 6 starting line I9). Apart from this passage, the staff has only two groups containing a maximum of two adjacent isolated triads, both of which occur in line I5 (one of these is shown

in Figure 4d). Therefore, the author is inclined to consider such unusual groupings of isolated triads in lines I10 – I9 as evidence supporting the “reversed” line order.

Based on described peculiarities, one can hypothesize that the staff's inscription started with a continuous text which came to a logical end at three quarters of the second line (I10). The scribe went on writing, perhaps on another topic, marking the boundary between “old” and “new” inscription with a vertical line. For some reason (perhaps, to improve “visibility” of textual fragments) he was employing the division lines after each triad – or, alternatively, we are



Figure 5. Scribal corrections on the Santiago Staff. Lines marked with an asterisk show pre-incised hairline contours; lines without asterisk correspond to finalized inscription. Selected scribal corrections are illustrated with close-up images of Tübingen replica.

dealing here with a number of short separate entries added after the main block of text. Be that as it may, the further sections delimited with vertical lines usually include several structural units (triads).

Calligraphy and Scribal Corrections

The Santiago Staff is renowned for its high-quality calligraphy (Fischer 1997: 455). The glyphs are carved beautifully and carefully, with attention to details and composition. However, at several instances the *tangata rongorongo* had to use a particular form to fit the corresponding glyph element into a tight space or to correct sign omissions. As the staff is remarkable for its high usage of the “phallic” glyph 76, some carving peculiarities naturally involve this sign. Perhaps the most perplexing is the “unsexed” triad (Figure 5a, line I7₁) described by Melka (2009: 70) as

“striking in the sense that it is enclosed between the “division markers” ... with the component “X” lacking its mandatory “phallic” suffix “1”. In Fischer’s reproduction ... glyph 090 appears in company of the assumed “phallus” 076. To ensure that there is no accidental incongruity... I appealed to Barthel’s (1990: 85) latest replica of Item I... [and] facsimile of an earlier work of R. Philippi.... The subsequent examination in both sources shows the “phallus” to be missing in this particular ... unsexed triad. A propos the glyph 076 in Fischer (1997: 453), if it is misplaced, or if gone off track by sheer inertia, this is guesswork I cannot afford to make.”

Fischer’s earlier paper shows that he was fully aware of this “unsexed” triad (Fischer 1995: 318, note 5), but later changed his mind (judging from his tracings published in 1997, shown here in Figure 5a) presumably after studies of the original artifact or a resin replica thereof.

Alas, line I7 in the Tübingen cast is marred by the substance joining its parts together. Thus, the only information additional to the tracings known from the literature can be extracted from pencil rubbings of the original staff (Figure 5a). As one can see, the triad in question is associated with a surface defect roughly centered over glyph 2. While the wood to the right of sign 90 is damaged, there are definite traces of a rounded contour reaching almost to the “ear” of the glyph; at the lower part, one can see a fainter connection outline, both of which are characteristic of the “phallic” sign appearing in 90.76 ligatures (Figure 5b, lines I6₂ and I5₁). Therefore, this particular triad does not constitute an “unsexed” exception – it is also “equipped” with sign 76 in complete agreement with Fischer’s tracings (1997: 453).

Actually, it seems that “phallic” glyphs are an important and indispensable part of the inscription – each time when they were accidentally omitted, the scribe carefully carved them in tight contact (or even overlapping) with already finished signs (Figure 5b, lines I6₁, I6₂ and I5₁). To save

precious space, glyph 76 was sometimes simplified to a version resembling the gaping mouth head (e.g., Figure 5b, lines I5₂ and I8₁; Figure 4c, lines I6, I2, and I12; Figure 4e). Guy (1998: 60) questioned whether it is reasonable to identify this “crab claw” suffix as sign 76, to which Fischer (1998: 233) correctly responded “the glyph Guy recognizes as a form “en pince de crabe” is merely a scribal variant, employed for want of space.”

The allographic nature of simplified sign 76 can be proved by observing that it appears attached to the first glyph after a vertical division marker – as in the 5th section of line I10, 2nd (Figure 4e) and 12th sections of line I9, 8th section on line I8 and pre-last section of line I6. Especially elegant illustration of this fact is found in line I5, where an isolated triad with X-glyph 406 features a “crab claw” (Figure 5b, I5₂). As all glyphs opening structural units of the Santiago Staff bear “phallic” appendages or represent sign 76 themselves (see Figure 4e, 5th triad of line I9; other examples are: 5th section of line I13, 11th section of line I9 and 3rd section of line I7), it is safe to conclude that “crab claw” is a scribal variant of sign 76. When the space became much limited, the “crab claw” form of sign 76 was simplified even further (Figure 5b, I7₂ and I7₃).

Despite the high artistic skills of the carver, the Santiago Staff contains several scribal corrections. Fisher (1997: 455) noted that “much thin outlining of glyphs, [made] using obsidian flakes, was subsequently covered with other glyphs using a shark’s tooth, leaving the traces of the unused outlines.” To the best of my knowledge, these outlines on the Santiago Staff were never published before. At the same time, “such errors are important for the decipherer: they can suggest principally the presence of homonyms” (Fischer 1997: 648, note 15).

The scribal corrections of the Santiago Staff are presented in Figure 5c and Figure 5d. It is necessary to emphasize that the author had a chance to study only the plastic cast and pencil rubbings of the staff; analysis of the original artifact may reveal a larger number of scribal corrections. One of the common correction types consists in pre-term writing (Horley 2009: 252–253, 2010: 51). This term was proposed (in Horley 2009) as denoting a particular case of overwriting closely related to immediately following glyph(s), when the scribe eventually “jumped” over a sign by mistake during the pre-incision stage. The pre-term glyphs observed on the Santiago Staff are shown in Figure 5c. In the simplest case (Figure 5c, I3₁) the upper side of glyph IV was carved in characteristic chevron curve, corresponding to the next sign 69. Further in the same line, the carver pre-incised the triad 205-70-380?, and, noticing that the “phallic” sign 76 was omitted, abandoned the hairline contours to write the text 205.76-70-430.61 (Figure 5e, I3₂). The example from line I8 (Figure 5c, I8₁) explains the circular outlines inside glyph 290 – they come from pre-incised ligature 62.76, which is written in full size immediately adjacent to sign 290. The strange appendage to glyph 90 identified by Barthel (1958:71) as

sign 92 (Figure 5d) is a result of confusion with an unused outline of sign 90; the finalized text passage consists in triplicate ligature 90.76.

There are some minor corrections on the staff, such as traces of the rounded head of aviform sign 631 (Figure 5d, I10₁), which has a strange star-shape head and became sign 598a. In two instances, both located in line I10, the ligature 4.6.76.75 was pre-incised with sign 75 looking up (and hence, corresponding to glyph 117 in Barthel's nomenclature, Figure 5d, I10₂ and I10₆). It is curious that the scribe corrected glyph orientation in both cases, suggesting that vertical flipping of a *rongorongo* sign may modify its reading. Other minor changes include a full-size outline of a thumb-and-fingers hand under a fork-shaped hand (which are long known to be allographs, see Pozdniakov 1996: 295) of sign 535 (Figure 5, I2₄) and a pre-incised hand under the rounded fist of glyph 382 (Figure 5, line I2₃). The similar scribal "adjustments" of glyph elements are known from other inscriptions (Horley 2009: 251-252).

Surprisingly, the Santiago Staff presents a number of corrections without straightforward visual relation to surrounding glyphs; such corrections were not observed on any other *rongorongo* artifact subjected to palaeographic analysis by the author (*Tahua*, *Aruku Kurenga*, *Mamari*, *Keiti*, and Small Vienna tablets). Perhaps, the scribe of the staff was "rephrasing" the text. Another possible explanation is the presence of homonyms (Fischer 1997: 648, note 15) or syllabic signs corresponding to similar sounds. Be that as it may, the types of scribal corrections include: pre-incised contours of sign 53 (Figure 5d, I10₁) or sign 67 under the solid outline of glyph 1 (Figure 5d, I9₂); as well as a possible contour of lizard sign 760 centered under glyph 69 (Figure 5d, I10₃). Surprisingly, the hands 61 "embracing" the fish glyph 700 (Figure 5d, I10₄) were pre-incised as a "double crescent" 142 – the ligature occurring two times on the staff, in the 2nd triad of line I9 (Figure 4e) and 3rd segment of line I13. This observation poses a very intriguing question: could it be that the *both* arms 61 represent a *single* glyph element, which was erroneously pre-incised as sign 142? The fish glyph from line I7 got its cross-hatching from underlying sign 519 (Figure 5d), otherwise appearing only once in the whole *rongorongo* corpus (Figure 4c, line I9).

In line I9 one can see the traces of anthropomorphic sign 244 under "barbed" glyph 73f, as well as possible sign 30x under tentatively identified glyph 19f (Figure 5d, I9₁ and I9₃, respectively). Line I4 offers an illustration of interchangeability of glyphs 2 and 20 (Horley 2010: 55), as well as traces of "female" sign 532 under "sitting man" 244 (Figure 5d, I4₂). There are two discarded outlines of sign 70 in line I1 – one under the hand glyph 6 and (a superscript form) after the bird ligature (Figure 5d, I1₁ and I1₂, respectively). The bottom part of sign 374 perhaps contains outlines of glyph 99 (Figure 5d, I1₂). Sign 70 in line I14 has two circles situated to the left and to the right of it; a careful examination reveals hairline curves connecting

these to the body of the glyph, which can be the evidence of pre-incised sign 34 (Figure 5d, I14).

The longest correction found on the Santiago Staff is the glyphic group 406.76-440?.20, pre-incised contours of which are visible under totally distinct final text 90.76-600 (Figs. 5d and 5e, line I2₁). The tracings published by Barthel include a part of discarded sign 20; Fischer corrected this error, presenting the final inscription only (1997: 452). The other corrections in line I2 include a possible "cross sign" 36 and some extra connection curves, perhaps intended for a ligature 4.64 (Figure 5d, I2₂ and I2₃, respectively). Further in the same line, one can spot the traces of sign 532 under glyph 50 (Figure 5d, I2₆; also Figure 5e). These contours intermix in the tracings published by Philippi, Barthel and Fischer, which show glyph 50 with diagonal hatching. In the evidence of abandoned pre-incised contours, the final inscription should contain only plain sign 50 without any extra adornments.

Conclusions

The study of the plastic replica and pencil rubbings of the Santiago Staff allowed detection of the starting line (I11) and proper reading order, which is reverse to that suggested by Philippi (1875). The need to change the reading order is suggested by palaeographic and structural observations. The differences between the times when the rubbings and cast were made illustrate the slight expansion of large fissures, while small surface cracks seem to be more stable. Scribal corrections on the staff include the insertion of signs and pre-term writing, known from other artifacts. Surprisingly, there is a whole group of corrections that are not visually related to the surrounding glyphs. Finally, in calculating the staff's weight using densities of dry *toromiro* and *mako'i*, it was shown that the latter wood has a considerable chance of being the type of wood from which the staff was made.

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