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Resumen

El uso de correlaciones de rasgos distintivos gráficos en Rongorongo como recurso adicional para la elaboración de un catálogo de signos

Este artículo demuestra la existencia de una correlación fuerte entre los elementos gráficos de los signos rongorongo, tales como cantidad y forma de los brazos, cantidad y forma de las piernas, y también los elementos que se agreguen a los codos y otros partes de los signos antropomorfos. Estos datos permiten formular los criterios para definir la forma básica de algunos signos independientes. También se propone que el uso de las formas simétricas y no simétricas de los signos tiene una función auxiliar especial no fonética – tal como una cierta forma de puntuación o segmentación del texto.

Summary

This article demonstrates the existence of a strong correlation between the graphic elements of rongorongo signs, such as quantity and shape of hands/wings, heads, quantity and shape of legs/tails, and also the elements that are added to the elbows and other parts of human and bird glyphs. These data allow us to formulate the criteria to define the basic form of some independent signs. It is also proposed that the use of symmetric and non-symmetrical forms of signs has a special non-phonetic auxiliary function – such as a certain way of text segmentation.

The main problem addressed in this paper is very familiar to the people doing research in the field of *rongorongo*, and which attracted much attention since the very beginning of the studies of this writing system. Many of the signs – especially those depicting anthropomorphs and birds – are distinguished by a single graphical "feature" such as the shape of their body parts – hands/wings, heads, legs/tails. These distinctions were used as a basis for creation the most famous catalog of *rongorongo* 'signs' developed by Barthel (1958). Despite the existence of this, as well as some other catalogs (Pozdniakov and Pozdniakov 2007), some of the principal questions related to definition of the signs remain unsolved (Macri 1996). The main complications concern two principal questions: 1) for many of Barthel's signs it is unclear whether they should be further divided into elements, and if they do[1], how this sub-division has to be carried out? 2) The other acute question concerns the definition of allographs and variants of every independent sign.

The main base for construction of a catalog consists in careful comparison of parallel passages appearing in the different texts (Pozdniakov 1996, Horley 2007). However, this information source has its limitations: if the parallel fragments has variants or in one inscription the signs are written together and in the other they are separate, then we have luck. However, if the parallel fragments do not feature any 'stylistic' or other differences and the glyphs are written in the same way, they do not provide any additional information. There are other ways to obtain information about *rongorongo* signs (for example, different statistical methods), but their powers are also considerably limited.

In this paper I would like to emphasize another powerful information source for creation of the catalog, which, to my opinion, remains almost

[1]Barthel himself mentioned that his catalog, in addition to the independent signs includes many ligatures (Barthel 1958: 166).

unused. I am referring to the systematic analysis of correlations between the high-frequency graphical elements of the glyphs. The main aim of this paper is thus to outline some of the proceedings of such analysis and to illustrate their potential.

First of all, it will be useful to overview the main principles on which the Barthel's catalog is built, because they are not always obvious. Then I will provide several interesting sign correlations with the corresponding interpretations.

Basic classification principles used for human and bird signs in Barthel's catalog[2]

1. The upper digit – hundreds – in sign numbers

- Signs 200+: Anthropomorphic signs[3] with the head depicted frontally –  (200)[4] see also Appendix 1.
- Signs 300+: These are in general different only by the fact that the head is depicted in profile –  (300).

  The head can be facing to the right (most commonly) or to the left  , for which Barthel's catalog does not provide any special number, suggesting that these graphemes are allographs.
- More heterogeneous group of signs corresponds to Barthel's codes 600+. It includes different aviform signs:  (600).
- Signs with codes 400+ also depict birds with the main difference that the heads of the signs in this group (in their majority) are the same as those of the signs in the group 300+:  (400). If we assume in a way similar way to the group 300+ that the signs 400+ depict a kind of profile view, it is possible to suggest[5] that the signs 600+ are related to the signs 400+ in the way as the signs 200+ are related to signs 300+:

Therefore, the upper digit in the sign groups 200+, 300+, 400+ and 600+ of Barthel's catalog implement two main distinctive features: 1) human/bird body, 2) orientation of the head (possibly, frontal view/profile). It is important to emphasize that the percentage of the «profile» signs for the anthropomorphic and ornithomorphic signs is essentially the same (42% and 43%, respectively), which wants to say that the signs from the groups 200+ and 600+ are most commonly used scribal variants.

2. The lower digit – units – in sign numbers

The lower digits in the groups of interest are mainly used to discern different shapes of hands[6] – for the human and bird glyphs, respectively. The only difference of sign 204 from 200 is the hand of a specific shape:  (204), which is different from the other hand  (202). In full correspondence, the birds with these hands are de

[2]Here we consider only four sign groups, omitting the first hundred of signs (001-099), as well as sign groups 100+, 500+, 700+.

[3]Excluding the groups 280+ and 290+, which possibly depict turtles.

[4]This paper uses the rongorongo drawings and tracings by Paul Horley. The drawings of Barthel are illustrated by one page of his catalog (signs 200+) in Appendix 1.

[5]This opinion may not be shared by all specialists in the field, but it does not change the results of the present analysis.

[6]More exactly, we are talking about the signs with digits 1-7 in the lower position.

noted with numbers  (604) and  (602).

3. The middle digit – tens – in sign numbers

These digits are used to denote different 'modifications' of the base signs. Thus, signs 211+ (as well as 311+, 411+, 611+) differ from the sign 201+ in that they have two raised hands:  (214).

Signs 221+ are different from the signs 200+ by the presence of a wavy leg  (224).

Signs 231+ have different shape of the leg:  (232).

Signs 240+ have two wavy legs, making them quite similar to the signs 220+:  (244).
Signs 250+ have two wavy legs and two raised hands, which make them quite similar to the signs 240+:  (254).

Signs 260+ present another common modification of the foot shape  (260) and finally

signs 270+ (and 380+) depict sitting men in profile[7]:  (274),  (384).

In this way, the large part of Barthel's catalog transparently resembles the principle of a traditional 'phonological' table, documenting minimal distinctive features that differ the particular phoneme from the other in the same line or column.

It is also important to mention one of the important consequences from these strategies to define graphical modifications of the anthropomorphic and ornithomorphic signs. Namely, it is quite simple to transform the signs between different groups. For example, to convert the sign 603  into 403 only requires the change of the head shape  . This transformation is safe from creating any confusion with the sign 303  , because a bird is completely distinguished from a human by presence of tail and wings. However, we don't have an option to make the same transformation of, let us say, the sign 646  with two raised hands and two wavy legs into the signs *446, because the transformed sign completely coincides with the sign 356  that is interpreted as a depiction of man. First of all, namely this factor explains the systematic absence of 'proper' signs in the interval 420-470[8]. However, if the signs 400+ are indeed modified versions of the signs 600+, then the ancient scribes should have developed some mechanisms to avoid such graphical homonymy,

[7]Here the differences are formulated in a simplified form. In the reality, Barthel's catalog has many deviations from the described principles, partially because Barthel wanted to populate the empty space within the catalog with some particular signs.

[8]Barthel sometimes for economy purposes and without any reasoning assigns special signs to these places, but they are 'illegitimate'; thus, the sign 646 should rather have number 656, but in the catalog this position is taken by the sign  There is no basis for assigning the present numbers to the signs 462  , 474  , as well of many others in the aforementioned interval.

which would permit to discern human and bird glyphs by a certain characteristic components. For example, if we cannot transform the sign 646 into 446 (bird), because it coincides with the sign 346 (man), then we can change the graphical shape of feet, that is, to use the shape of feet that is not used neither in signs 300+, nor in signs 200+ (man). Maybe that was Barthel's hypothesis when assigning sign  to code 446. We will return to this particular question later, but now it is important to emphasize that depending on whether Barthel is right or wrong in this particular assumption (which he never explicitly discussed in the literature), his large merit remains in the fact that he was trying to find the possible filling in the systematic lacunas, unlike all other *rongorongo* scholars. Alas, Barthel rarely provided arguments in print for his multiple hypotheses, which are only hinted upon by the numbers of his sign catalog. For many of these, one can find considerable evidence; for others, there are much more counter-arguments than supporting evidence.

The defining graphical features include: the orientation of the head (frontal view, right and left profile), the number of heads (one or two), shapes of the hand/wing (including 5 to 7 different forms), the number and orientation of hands (none, right, left, both), the shape of the leg/tail (3–4 different shapes), the number of 'wavy legs' (none, right, left, both), the presence and the shape of appendages added to the hand/wing (0–4)[9], and some other features. If we would like to follow possible pair-wise correlations between such features, it will be necessary to study thousands of combinations. However, the presence/absence of these correlations forms an important information resource for sign catalog by allowing a) to distinguish ligatures from signs and b) to define non-standard allographs.

In this paper only some of these correlations are considered (both positive and negative) to establish the principles of their interpretation that bring us closer to the decipherment.

Examples of feature correlations between the signs depicting humans and birds

One of the most interesting directions to study the correlations is to focus on hands, wavy legs and heads, as well as the case of the absence of a marked hand under certain depictions of the head (Figure 1). In *rongorongo* we usually consider a set of marked hands/wings[10] that are illustrated in the header of Figure 1, ordered in accordance to their visual appearance.

1. Leg-head correlations

Twenty-one different anthropomorphic signs in Barthel's catalog feature two wavy legs (Figure 1: 240+ and 340+). Thirteen of these show the head frontally; the remaining eight positions are composed of signs with the head in profile. It turns out that in the *rongorongo* corpus the signs with two wavy legs and frontal head make 90% of the total number of occurrences, and those with profile heads to account for the remaining 10%. What does this positive correlation between two wavy legs and the frontal depiction of the head mean? To interpret this, it is necessary to define which feature is more important in correlation with the head shown frontally: the wavy shape of legs or the number of such legs?

[9]The appendages are described further in the paper.

[10]The pointed wing is not mentioned by Barthel as separate sign. It was introduced by Pozdniakov and Pozdniakov (2007) as sign *901 without detailed explanations. We consider here some arguments for and against such hypothesis.

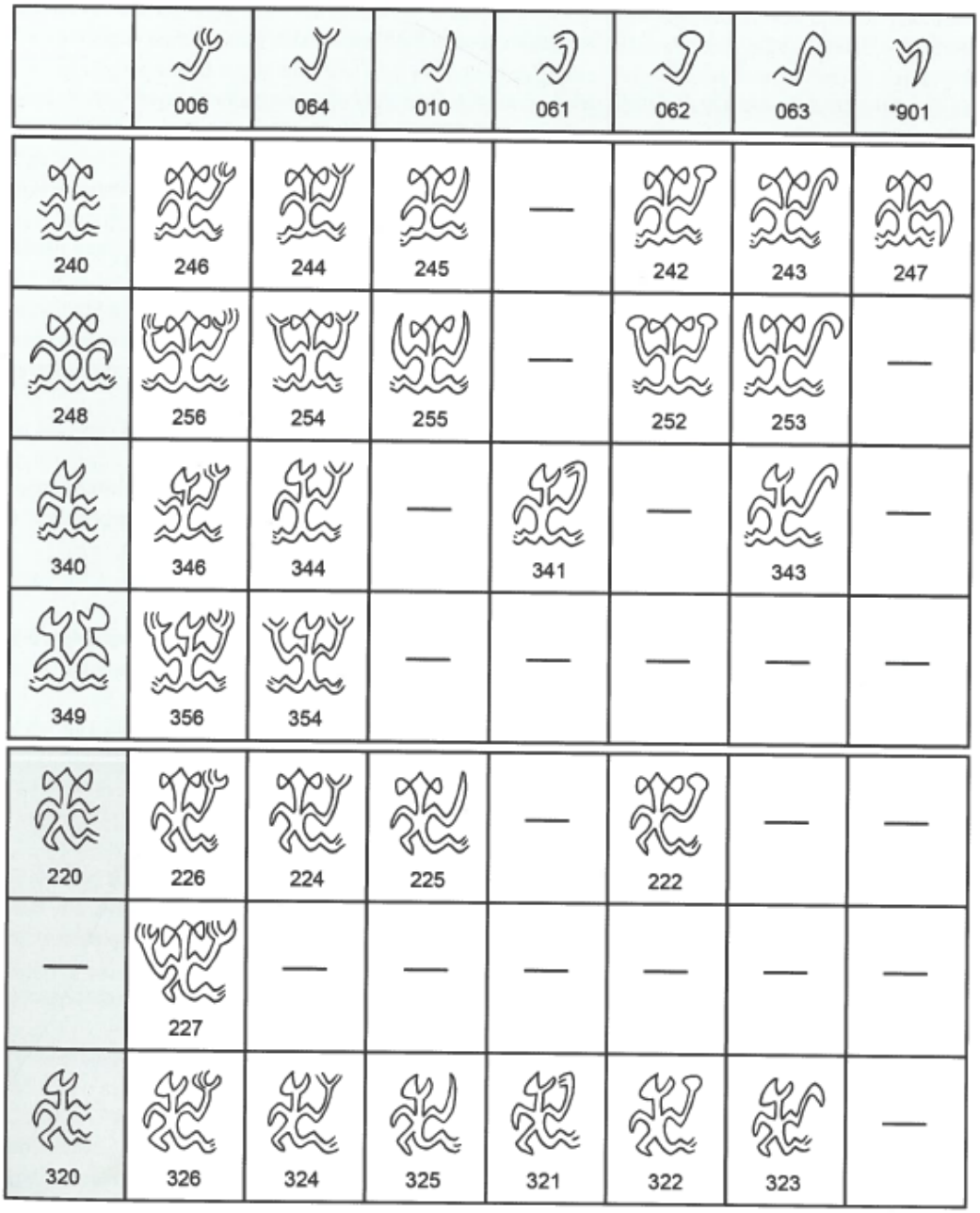

Figure 1. Analysis of correlations between hand and leg shapes (© K. Pozdniakov).

Further study may focus on the corresponding correlations of signs with one wavy leg: these are 13 available positions (Figure 1: 220+ and 320+). In this case an inverse distribution takes place, though it is somewhat milder: the signs with frontally depicted head  account for 40% of all occurrences, those with profile head  for 60%. That means that the correlation is focused on the number of legs rather than on their shape: for two wavy legs the default head depiction thus will be frontal. At this moment of analysis it is impossible to say for sure whether the two signs considered  /  are ligatures of signs 200/300  /  and special sign(s) of wavy leg(s)  / , or whether they are separate signs? To find the answer, it is important to consider another correlation between the number of wavy legs and the number of generic/raised hands.

2. Feet-hand correlations

The first observation concerns the fact that two wavy legs do not mix with raised hands, so that there are no signs  and  with the exception of four cases on the Santiago Staff[11]. Similarly, one wavy leg almost never occurs without a raised hand. These correlations were clearly known to Barthel, because the sign positions in his catalog are devoid from generic hands, but are rather clipped to add raised hands:  /  and  /  . This is the first argument to consider that raised hands and wavy legs are not independent features, which casts serious doubts on the possibility to have both wave legs and raised hands as separate signs. This observation is reinforced, as in the groups  and  the second lines (2 wavy legs) are filled up, while those in groups and are almost empty. It is possible to illustrate the principle 'one wavy leg + one hand' by the superposition of both oppositions.

3. Opposition 1 and opposition 2. The use of vertical symmetry/asymmetry

Is there any chance to combine two-dimensional puzzles 1 and 2 to produce a 3D picture? Is it possible to simultaneously meet the sign percentage requirements of the two groups? The answer is positive. The tree-feature opposition yields the preferred sign forms: two raised hands – two wavy legs – frontal depiction of the head (reference sign 256 ), which is similar to one raised hand – one wavy leg – profile head (reference sign  326), contrasting vertically symmetrical and vertically asymmetrical signs. The most critical difference is thus assigned to the hands but not to the legs or head, because standing symmetric glyphs with two hands  (216) are frequent in the corpus, but the signs with two wavy legs and generic hands  are anomalous, leading to radical conclusions: 1) there are no signs of man or bird with a wavy leg, neither man nor bird with two wavy legs; 2) there are neither special sign of wavy leg nor a special sign of two wavy legs .

[11]The exceptions seen on Santiago Staff are Ia02:81  , Ia03:60  , Ia05:22  , and Ia05:102  . The line numbering of the Staff is according to Horley (2011).

What is then the difference between signs  (216) and  (256)? It is unlikely that it can be phonetic. It may be more probable that the sign 256 (in comparison to sign 216) has a certain delimiter function, that is, two wavy legs, oriented in opposite directions not only to strengthen the vertical symmetry, but also to serve to divide textual fragments that are larger than a word. The other way of marking the end of the fragment can be the unusual left profile view of the head.

One more correlation corroborating the suggested sign symmetry is the shape of two hands in glyphs with two wavy legs: these are usually equal hands rather than different hands. The main counter-examples are shown in Figure 2 – the majority of them are from tablet Tahua (6 examples) and a few are from Santiago Staff (2 examples); minor contributions come from the Large Santiago and Small Washington tablets. This is an almost complete list of counter-examples; the list of signs pursuing the symmetry principle is much longer. Moreover, for many of those examples where the symmetry principle is not maintained (Ab4:60), the comparison of the parallel fragments reveals that this is a particular feature of text A (Figure 3).

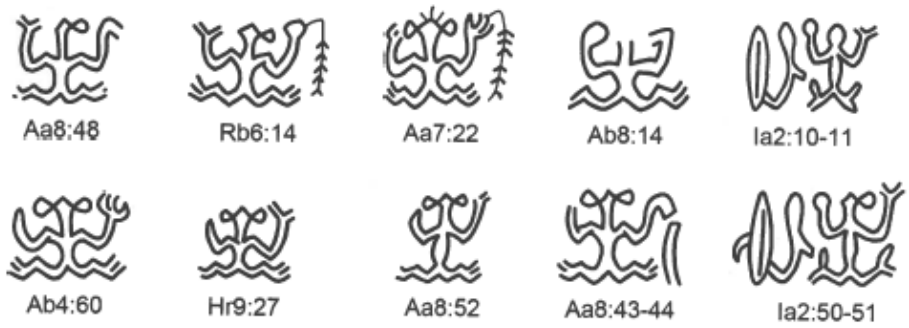

Figure 2. Examples of the anthropomorphic signs with mismatched hands (© K. Pozdniakov).

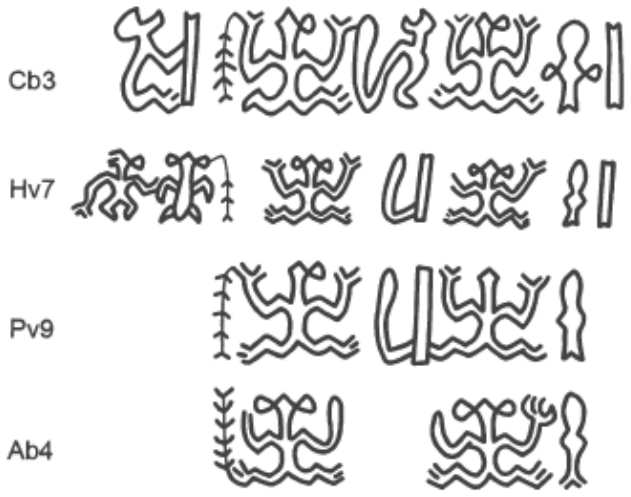

Figure 3. Mismatched hands signaling a ligature (© K. Pozdniakov).

This may mean that, taking into account the existence of a transparent rule requiring the signs with two wavy legs to be symmetrical by default, the cases characterized with different hands (Ab4) may signal the presence of a ligature such as + , which is clearly confirmed by the parallel fragments from Mamari and the Large St. Petersburg tablet!

I am publishing this conclusion with certain reservation. It does not fit into the catalog of signs that I was defending in previous publications (Pozdniakov and Pozdniakov 2007; Pozdniakov 2011), which, in particular, includes the sign (240). The acceptance of the current hypothesis may then require a revision of signs statistics, which will change considerably in certain positions. Other marked changes will appear in the indices of sign occurrence and other statistical characteristics. Therefore, by publishing these results, I would like to receive some feedback from the readers, preferably listing counter-arguments to the proposed hypothesis, which I am unable to find at the moment. Non-phonetic opposition 'symmetric/asymmetric glyph', the exact function of which is to be determined, definitely looks more convincing than a phonetic opposition of the signs, expressed by the presence/absence of wavy legs. However, one counter-argument exists (and, to my opinion, quite a serious one). It does not void the suggested hypothesis, rather shifting it into a completely new dimension.

4. Hands and hand-like elements

There is strong supporting evidence to consider hands as independent glyphs because they regularly go together with different *rongorongo* glyphs, including abstract geometric ones, illustrated here for an example of sign 001 (Figure 4). As one can see from the figure, the hands are ligatured to the main stick sign. However, there are other glyphs with elements *looking* like hands, which are attached to the main sign in places from which a hand should not branch. Some of such examples are listed in Figure 5.

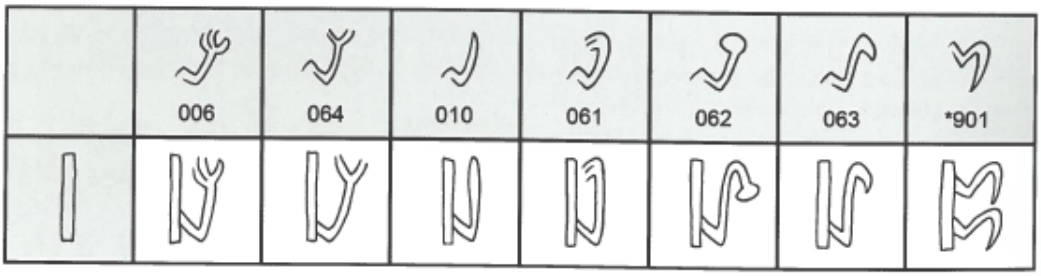

Figure 4. Combination of hand signs with a stick sign 001 (© K. Pozdniakov).

	006	064	010	061	062	063	*901
head or glyph top							
glyph back							
feet or glyph bottom							
attached to elbow of the main arm							

Figure 5.Hands like elements attached to different parts of the signs (© K. Pozdniakov).

Thus, a sign depicting a man with a wavy leg  can be likened to graphically similar glyphs, in which the legs have visual features reminiscent of hands (Figure 5: second row from the bottom). In the line above, similar elements are added to the back of the sitting man. Just under the header of the table, the hand-like elements are added to the upper part of non-anthropomorphic glyphs (for more details on these ligatures, see Pozdniakov 1996: 296, fig. 4a). The bottom line of Figure 5 illustrates so-called 'appendages' appearing under the elbows of anthropomorphic depictions, clearly resembling hand shapes themselves. It is unclear how these hand-like elements should be treated. No reasonable hypothesis was ever published focusing on these elements and attempting to place them into the sign catalog. In the first place this may be due to lacking methodology of their interpretation. One possible approach may assess correlations of the principal sign elements with these hand-like appendages.

5. Hand appendages

Let us consider first a round appendage under the elbow, which is characterized with the following correlations:

1) In anthropomorphic signs with this appendage, the head is almost universally depicted in profile,  Pv6:8. There are only four counter-examples, in particular  (Sb3:28–29), proving that eventually this appendage (usually added to the right arm) may also appear in asymmetric signs.

2) In bird signs ligatured with hands, this appendage does not occur frequently, with only seven examples in the corpus such as Pr8:18. In the majority of cases the round appendage appears with bird signs joined to a special – pointed – wing, and, in contrast to anthropomorphic signs, it does not appear under the wing but above it: Aa3. There are only two examples where a round appendage is attached to a generic wing: La1:23 and Ia7:94. In this case, might it be that the identified sign depicting a pointed wing (901) serves as a graphical base for attaching the round appendage in bird signs? In this case, it is unclear how to interpret pointed wings without appendages, for example, Ab1:52 or Ab2:37. Perhaps, this is a way to mark symmetry/asymmetry of the bird glyphs in analogy to marking symmetry/asymmetry of the anthropomorphic glyphs and

It is worth mentioning that glyph Ab2:37 appears in a fragment written with variations in text A (Figure 6: Ab2 and Aa3). These parallel passages suggest that the bird with a pointed wing corresponds to a graphically similar bird with a pointed beak. The latter glyph is usually considered as an independent sign with Barthel's code 660. One might ignore such sign concordance if it would be singular. However, it is a regular correspondence – in the same text A one finds parallel passages repeated four times (Figure 6: Ab1), illustrating the same replacements of the bird signs.

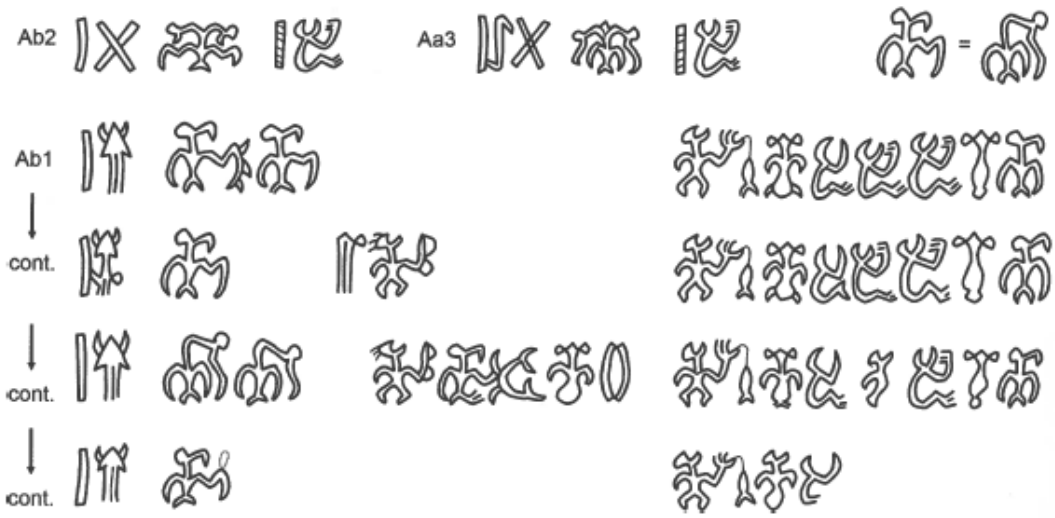

Figure 6. Potentially related bird signs with pointed wing and pointed beak (© K. Pozdniakov).

In connection with this, one can make a 'heretic' question: whether the phonetic sign 660 exists at all, or whether we are dealing with different ways to mark symmetry/asymmetry by depicting a bird with pointed beak/beaks or wing/wings as in the aforementioned parallel passages of Ab2 and Aa3?

Another related question: should we consider that glyph  (Sa3:36) contains two appendages, or whether the left appendage only amplifies graphical expression of the symmetry (for example, serving as a delimiter function), so that there is only one hand appendage? There are many questions like this, and we should not bother about them if there were no pronounced correlations between the shapes of appendages and the main hands of the signs (Figure 7).

	006	064	010	061	062	063	*901
062		—				—	—
	—	—	—	—	—	—	
010		—					—
		—		—	—	—	—
064				—			—
							—

Figure 7. Correlations between main hand type and hand appendages (© K. Pozdniakov).

As one can see from Figure 7, there is a marked variability of the hand appendage combined with main hands in the glyphs depicting a human and a bird. This should be taken into account by every researcher who is working on decipherment of *rongorongo*. If we calculate the probability of appearance of such combinations considering the occurrence of the hand-bearing signs and the hand appendages as independent phenomena, one will obtain a negligibly small probability. One of the remarkable details here is that the forked hand 064 does not allow other hand appendages except the one that is graphically similar; the other arm can display different hand appendages. In this case, do we have sufficient evidence to talk about an independent value of hand appendage 064?

Conclusion

Only a few 'minimal graphical pairs' were discussed in this paper. Beyond these, there are thousands of binary oppositions, among which there are many important hints for the construction of the sign catalog. For example, it is very interesting to consider the correlation of the shape of the hand and frontal/profile depiction of the head. In particular,

hand 061  is almost absent in combinations with anthropomorphic signs with frontal head depiction. On the contrary, it is excessively frequent in the signs with the head shown in profile, which is used in the common delimiter ligature 380.001 that includes

the sign of a sitting man  (Br1:29). The signs with this hand type also can go with a standing body  (Aa6:81). It seems that the systematic description of such correlations is one of the most promising directions in the study of Easter Island script, because even a superficial analysis reveals the principal importance of the symmetry/asymmetry characteristic.

Another rewarding subject of research is, to my opinion, the vertical symmetry/asymmetry of the glyphs. Similar to anthropomorphic signs, this type of triads can be attested to in abstract signs, illustrated here exemplarily by sign 59 (Figure 8): as one can see in the passages from Hv12, Bv12, and Ma2 the sign is shown frontally; in the passages from Ev6, Ra5m, Kr3, and Gr2 sign 59 is shown in profile.

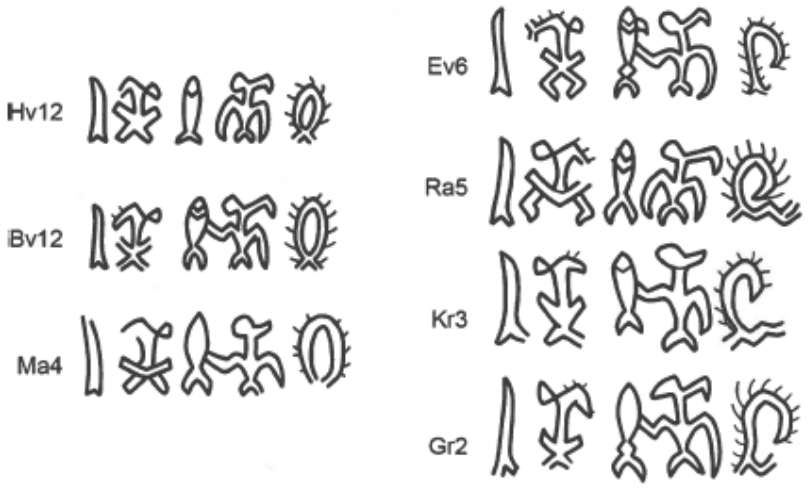

Figure 8. Parallel passages illustrating frontal and profile forms of the sign 59 (© K. Pozdniakov).

In a certain sense the formation of vertical ligatures can be interpreted as transformation of an asymmetric glyph composition (Figure 9: Pr4–Pr5) into a symmetric one (Figure 9: Hr5). One more elegant example of symmetric glyph comes from the Large St. Petersburg tablet (Figure 9: Pv10). The corresponding fragment in the Large Santiago tablet occurs at a line break, so that there was no possibility to employ a symmetric construction. This, in particular, makes one think whether the symmetric glyphs have some non-phonetic, perhaps, delimiting function[12]. In case that the functional relevancy of ligatures can be corroborated with other examples, our opinion about the sign catalog will require considerable revision.

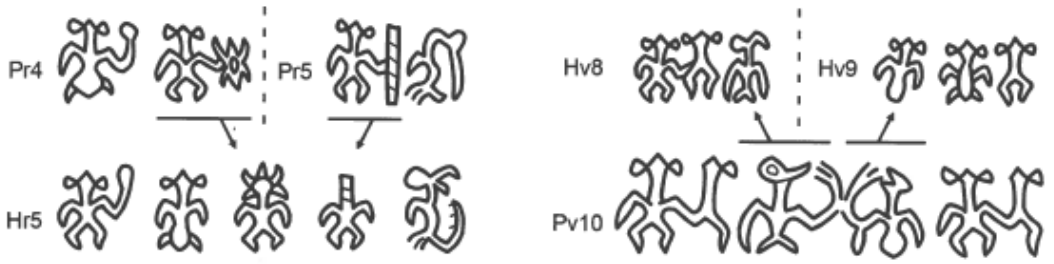

Figure 9. Symmetric and asymmetric ligatures (© K. Pozdniakov).

Thus, returning to Barthel's signs 240+, we, perhaps, will be able to answer with better argumentation whether it is necessary to read the glyph as  a single sign, or as a ligature composed of five signs 

, or as two signs () drawn in symmetric form.

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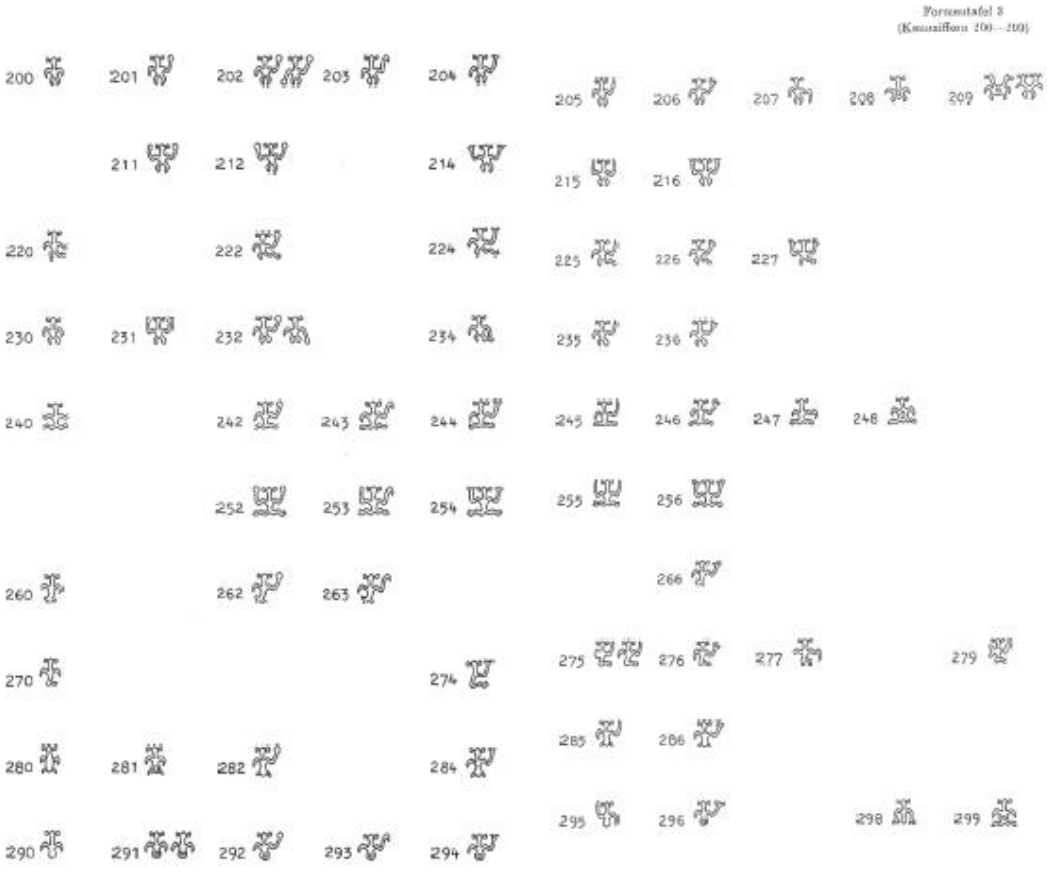
[12]Some other examples for using symmetry as delimiter of mini-texts were considered elsewhere (Pozdniakov 2011: 49, 58).



Appendix 1 : One page from Barthel's catalog: signs 200+ (from Barthel 1958 : Formentafel 3).