

THE MATHEMATICS OF THE PHAISTOR DISC

1. Introduction [1]

The so called "Phaistos disc" has been described as "the world's most difficult crossword puzzle" [2]. To date it has proven impossible to decipher. The author of this article is not able to present a complete solution but believes he has come one step closer to solving the puzzle.

Background information [3]

The disc was discovered in 1908 by Luigi Pernier in a Minoan building complex. It is a clay disc which is inscribed on both sides. Its diameter measures 16cm and it is 2cm thick. The surface is divided into 61 fields: 31 on side A, 30 on side B. Before the clay was fired 242 symbols, consisting of 45 different symbols, were imprinted on the 61 fields. People, animals and plants, among other things, are depicted on the disc. The disc is currently on display in the archaeological museum in Heraklion [4]:

Results of research to date [5]

Research to date concerning the meaning of the symbols on the disc has come to the conclusion that the symbols comprise a text. There have been efforts made in the past to interpret the symbols differently, e.g. as music notes. These interpretations have failed, however, to gain general acceptance. There is no consensus regarding the content of the text. Even the question, as to whether it should be read from left to right, or from right to left, is disputed. There is also dissension on the question of whether the symbols comprise an alphabet consisting of letters, syllables, pictures or a combination of these. Furthermore, it is unclear what the individual symbols represent. Various translation attempts have been made in the past but none of these has been persuasive in specialist circles. In the mean time, many consider that the disc is not decipherable, because the number of symbols (242) available for

analysis is too small. According to this view, it will not be possible to decode the text's content without further finds.

2. Thesis

The author of this article proposed a way to explain the composition of the symbols with a mathematical rule in an archaeological journal in 2004 [6]. Since then he has succeeded in significantly reducing the complexity of this rule and its proof [7]. He would like to present his new proposal to specialist circles in this article.

The thesis to be proven is that the composition of the symbols on the disc can be explained by the following rule: "The symbols on the Phaistos disc are, with the exception of the left symbol of each field, arranged in alphabetical order."

This means the following: if one imagined that all the symbols on the disc are letters and all the fields are words, then, according to the proposed thesis, the letters of each word (excluding each first letter) would be arranged alphabetically. The word "disc" would, for example, be spelt "(d)cis", the word "Berlin" "(B)eilnr", the word "water" "(w)aert", the word "Washington" "(W)aghinnost", etc. The symbols on the disc would be arranged in the same way.














































These examples show how the thesis can be verified. The alphabet to which the symbols belong must be reconstructed and the spelling of the words compared with the reconstructed alphabet. If the spelling of the words corresponds with the reconstructed alphabet, the thesis and the alphabet will be proven to be correct. Accordingly, each of the 45 symbols will be assigned a number which corresponds with its position in the alphabet. Subsequently, all 242 symbols shall be translated into these numbers. If the thesis is correct, regularity in the number sequence will become apparent.

3. Verification

Reconstruction of the alphabet

The first step in the verification is the reconstruction of the alphabet to which the symbols belong. It must be noted that it is possible to reconstruct more than one alphabet. This is a result of the fact that, due to the limited data available for analysis,

the position of each symbol in the alphabet cannot be determined with certainty. This is however, not of relevance for the further steps in verifying the thesis. One possible reconstruction is as follows [8]:

01	07	13	19	25	31	37	43
							
02	08	14	20	26	32	38	44
							
03	09	15	21	27	33	39	45
							
04	10	16	22	28	34	40	
							
05	11	17	23	29	35	41	
							
06	12	18	24	30	36	42	
							

Transcription of the symbols into the numbers of the alphabet

In the next step the symbols on the disc must be transcribed into the numbers of the reconstructed alphabet. The result is the following number sequence (the symbol described with "XX" is illegible):

Side A:

43 - 41 - 28 | 21 - 20 | 44 - 29 - 18 - 13 - 13 - 02 - 01 | 43 - 41 - 28 | 18 - 39 - 34 | 21 - 20 - 02 - 01 | 02 - 08 - 07 | 39 - 36 - 35 - 06 | 13 - 35 - 26 - 17 - 13 - 02 - 01 | 08 - 07 - 02 - 01 | 21 - 12 | 35 - 34 - 28 - 24 - 13 - 01 | 08 - 07 - 02 - 01 | 34 - 33 | 44 - 29 - 18 -

13 - 13 - 02 - 01 | 08 - 07 - 02 - 01 | 21 - 12 | 35 - 34 - 28 - 24 - 13 - 01 | 40 - 27 | 43 -
34 - 26 - 02 - 01 | 19 - 32 - 22 - 21 | 18 - 39 - 22 - 02 - 01 | 18 - 08 - 07 | XX - 35 - 06 -
02 - 01 | 37 - 16 - 13 | 02 - 19 - 23 - 13 | 33 - 32 - 31 - 02 - 01 | 15 - 04 - 04 | 19 - 23 -
04 | 02 - 32 - 25 | 35 - 21 - 20 - 02 - 01 ||

Side B:

19 - 23 | 24 - 34 - 15 - 04 | 19 - 34 - 18 - 06 - 01 | 19 - 35 - 27 - 14 - 05 | 37 - 19 - 09 -
04 - 03 | 25 - 35 - 34 - 19 | 19 - 23 - 19 | 18 - 35 - 19 | 24 - 34 - 15 - 13 | 37 - 19 - 09 -
04 - 03 | 19 - 23 - 04 | 20 - 37 - 04 | 37 - 19 - 09 - 04 | 21 - 13 - 05 - 01 | 33 - 27 - 26 -
18 - 06 | 21 - 33 - 04 | 35 - 17 - 10 | 18 - 38 - 25 - 25 - 04 | 21 - 43 - 24 - 13 | 32 - 09 -
08 - 01 | 18 - 32 - 25 - 19 | 24 - 30 - 29 - 03 | 35 - 21 - 20 - 19 - 11 | 33 - 27 - 21 - 20 |
42 - 35 - 34 - 10 | 02 - 38 - 25 - 33 | 13 - 24 - 03 | 45 - 34 - 29 - 01 | 18 - 19 - 23 - 13 |
19 - 32 - 03 - 02 - 01 ||

Analysis of the number sequence

Whilst analysing the number sequence, it is conspicuous that almost all of the numbers are arranged in descending order. This means that most of the symbols on the disc are arranged in the order of the reconstructed alphabet. This is not the case with 29 of the 242 symbols, which represents a margin of error of 12%. The errors are highlighted in the following graphics:

Side A:

43 - 41 - 28 | 21 - 20 | 44 - 29 - 18 - 13 - 13 - 02 - 01 | 43 - 41 - 28 | 18 - 39 - 34 | 21 -
20 - 02 - 01 | 02 - 08 - 07 | 39 - 36 - 35 - 06 | 13 - 35 - 26 - 17 - 13 - 02 - 01 | 08 - 07 -
02 - 01 | 21 - 12 | 35 - 34 - 28 - 24 - 13 - 01 | 08 - 07 - 02 - 01 | 34 - 33 | 44 - 29 - 18 -
13 - 13 - 02 - 01 | 08 - 07 - 02 - 01 | 21 - 12 | 35 - 34 - 28 - 24 - 13 - 01 | 40 - 27 | 43 -
34 - 26 - 02 - 01 | 19 - 32 - 22 - 21 | 18 - 39 - 22 - 02 - 01 | 18 - 08 - 07 | XX - 35 - 06 -
02 - 01 | 37 - 16 - 13 | 02 - 19 - 23 - 13 | 33 - 32 - 31 - 02 - 01 | 15 - 04 - 04 | 19 - 23 -
04 | 02 - 32 - 25 | 35 - 21 - 20 - 02 - 01 ||

Side B:

19 - 23 | 24 - 34 - 15 - 04 | 19 - 34 - 18 - 06 - 01 | 19 - 35 - 27 - 14 - 05 | 37 - 19 - 09 -
04 - 03 | 25 - 35 - 34 - 19 | 19 - 23 - 19 | 18 - 35 - 19 | 24 - 34 - 15 - 13 | 37 - 19 - 09 -
04 - 03 | 19 - 23 - 04 | 20 - 37 - 04 | 37 - 19 - 09 - 04 | 21 - 13 - 05 - 01 | 33 - 27 - 26 -
18 - 06 | 21 - 33 - 04 | 35 - 17 - 10 | 18 - 38 - 25 - 25 - 04 | 21 - 43 - 24 - 13 | 32 - 09 -
08 - 01 | 18 - 32 - 25 - 19 | 24 - 30 - 29 - 03 | 35 - 21 - 20 - 19 - 11 | 33 - 27 - 21 - 20 |

42 - 35 - 34 - 10 | 02 - 38 - 25 - 33 | 13 - 24 - 03 | 45 - 34 - 29 - 01 | 18 - 19 - 23 - 13 |
19 - 32 - 03 - 02 - 01 ||

Elimination of the first symbol in each field

Looking at the series, one observes that the errors are almost exclusively to be found in the left symbol of a field. This has already been taken into consideration in the thesis. The assertion of alphabetical arrangement is only valid for symbols which are not on the left of a field. Therefore the next step in the verification of the thesis is the elimination of the left symbols in the fields. The result is as follows:

Side A:

41 - 28 | 20 | 29 - 18 - 13 - 13 - 02 - 01 | 41 - 28 | 39 - 34 | 20 - 02 - 01 | 08 - 07 | 36 -
35 - 06 | 35 - 26 - 17 - 13 - 02 - 01 | 07 - 02 - 01 | 12 | 34 - 28 - 24 - 13 - 01 | 07 - 02 -
01 | 33 | 29 - 18 - 13 - 13 - 02 - 01 | 07 - 02 - 01 | 12 | 34 - 28 - 24 - 13 - 01 | 27 | 34 -
26 - 02 - 01 | 32 - 22 - 21 | 39 - 22 - 02 - 01 | 08 - 07 | 35 - 06 - 02 - 01 | 16 - 13 | 19 -
23 - 13 | 32 - 31 - 02 - 01 | 04 - 04 | 23 - 04 | 32 - 25 | 21 - 20 - 02 - 01 ||

Side B:

23 | 34 - 15 - 04 | 34 - 18 - 06 - 01 | 35 - 27 - 14 - 05 | 19 - 09 - 04 - 03 | 35 - 34 - 19 |
23 - 19 | 35 - 19 | 34 - 15 - 13 | 19 - 09 - 04 - 03 | 23 - 04 | 37 - 04 | 19 - 09 - 04 | 13 -
05 - 01 | 27 - 26 - 18 - 06 | 33 - 04 | 17 - 10 | 38 - 25 - 25 - 04 | 43 - 24 - 13 | 09 - 08 -
01 | 32 - 25 - 19 | 30 - 29 - 03 | 21 - 20 - 19 - 11 | 27 - 21 - 20 | 35 - 34 - 10 | 38 - 25 -
33 | 24 - 03 | 34 - 29 - 01 | 19 - 23 - 13 | 32 - 03 - 02 - 01 ||

Margin of error

The margin of error of the thesis lies - as can be seen in the graphics above - now only at 2 out of 242 fields and therefore under 1%. The margin of error is therefore negligible. It can be reduced to 0%, if the thesis is modified in the following way: "The symbols on the Phaistos disc are, with the exception of the left symbol of each field and the symbol No. 19, arranged in alphabetical order." In the opinion of the author, these low margins of error verify the thesis presented.

4. Outlook

A question which has still to be clarified is: which conclusions can be drawn from the regular arrangement of the symbols. This is a question which must be answered by

others. An explanation for the disc should, at least, include a plausible explanation for the regular arrangement of the symbols. It is improbable that the symbols on the disc comprise a flowing text. The author of this article, at least, is unaware of the existence of a language, in which single text elements are arranged in alphabetical order, as on the disc. On the other hand, the thesis would be consistent with an interpretation of the disc as a calendar, in which certain periods of time (represented by the fields) are connected with certain people (represented by the symbols). The people could be arranged in the fields according to social hierarchy. The left symbol in each field would have a special meaning. An interpretation of the disc as a religious object that shows how many times certain people are to pray on certain days, would, for instance, be consistent with the results. The person depicted on the left of the field would be a type of prayer leader. This is, however, only one of many interpretation possibilities.

[1] I would like to thank Ms Genevieve Baker for translating this article into English.

[2] See for example Dittmer, Otto: Das Rätsel des Diskos von Phaistos. Das schwerste Kreuzworträtsel der Welt, 2002.

[3] Information from Balistiere, Thomas: The Phaistos disc, 2000, pp. 10ff., with further references.

[4] To avoid infringement of copyrights, a photograph of a replica of the Phaistos disc is depicted. This is, however, not relevant for the thesis nor the evidence to be presented in the article. Source: <http://de.wikipedia.org/wiki/Bild:PhaistosDiskLarge.jpg>

[5] For results of research to date refer to Balistiere, Thomas: The Phaistos disc, 2000, with further references.

[6] Henke, Christoph; Die Entdeckung der Hierarchie der Zeichen auf dem Diskus von Phaistos, Göttinger Forum für Altertumswissenschaften 7 (2004), pp. 203-212.

[7] Professor Gerrit Kloss pointed out that the errors shown in C.3 are almost all to be found in the left symbol of a field. Before this I assumed that the errors could be explained by a double meaning of certain characters, which mathematically is possible, but leads to a far greater complexity of the thesis. I would like to again thank Professor Gerrit Kloss for his advice at this point.

[8] My own alphabet, based on a depiction of the individual symbols in Balistiere, Thomas: The Phaistos disc, 2000, with further references.

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This article should be cited like this: Ch. Henke, The Mathematics of the Phaistos Disc, Forum Archaeologiae 48/IX/2008 (<http://farch.net>).