The Voynich Manuscript is Written in Natural Language: The Pahlavi Hypothesis

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Abstract

The late medieval Voynich Manuscript (VM) has resisted decryption and was considered a meaningless hoax or an unsolvable cipher. Here, we provide evidence that the VM is written in natural language by establishing a relation of the Voynich alphabet and the Iranian Pahlavi script. Many of the Voynich characters are upside-down versions of their Pahlavi counterparts, which may be an effect of different writing directions. Other Voynich letters can be explained as ligatures or departures from Pahlavi with the intent to cope with known problems due to the stupendous ambiguity of Pahlavi text. While a translation of the VM text is not attempted here, we can confirm the Voynich-Pahlavi relation at the character level by the transcription of many words from the VM illustrations and from parts of the main text. Many of the transcribed words can be identified as terms from Zoroastrian cosmology which is in line with the use of Pahlavi script in Zoroastrian communities from medieval times.

1 Why is Voynichese difficult?

All writing systems in the world require some effort in acquisition and use. While for some groups of languages, difficulty and differences may be comparatively small, in others the complexity of the script can appear forbidding for all but a minority of scribes. Religious observance, for example, may require the adherents to continue using a script or language that no longer adapts to its language environment and that may thus tend to become ambiguous or incomprehensible. In order to retain a unique pronunciation and, supported by extensive commentaries, continuing understandability, glyphs (diacritics) from were added to letters to distinguish them, or additional letters (matres lectionis) were inserted to represent sounds (such as vowels in the consonant-based (abjad) scripts. However, such additional efforts may not be considered necessary, if the oral tradition in the community is sufficiently strong, such that the texts do not have to be extracted from the writing itself, but are rather remembered while being read. If the Voynich Manuscript (VM, MS 408 in the Beinecke Rare Book & Manuscript Library at Yale University) derives from such a tradition, the difficulty in reading it may be understandable.
The Voynich Manuscript (VM, MS 408 in the Beinecke Rare Book & Manuscript Library at Yale University) which is written on more than 200 vellum pages has been dated between 1404 and 1438 (University of Arizona, 2011), but its history is largely unknown until the discovery by the bookseller Voynich in 1912. Apart from a few cautious attempts, such as Ref. [3], so far little progress has been achieved in deciphering the VM nor even a decision was reached whether the VM has any meaningful content at all [19].

Our hypothesis that the VM is written in natural language, is to be evidenced by showing that the script used in the VM is directly related to Pahlavi, a writing system that was in use for several Iranian languages from before the current era at least until 900 [9]. Pahlavi is a particular case of a language that is notoriously difficult to read. It was used in medieval scriptures, commentaries, and a few other texts [2] related to Zoroastrianism, the pre-Islamic religion of Persia. Over the few centuries of the language evolution, many Pahlavi letters have coalesced, e.g. for the phonemes \(d\), \(g\), \(j\), and \(y\), only a single letters is retained in Pahlavi. Moreover, letters are usually joined in Pahlavi script and can appear thus similar to other letters: E.g., in addition to its proper meaning, a letter can be indistinguishable from as much a sixteen different phoneme or letter combinations [11]. In some words, corrupted forms of letters have become a standard that is accepted to various degrees by the scribes. In addition to Persian words, Pahlavi contains also a large number of heterograms, i.e. around a thousand, partially very common words of Aramaic origin that are meant to be read in Persian (like the Latin abbreviation \(i.e.\) is read in English as \(that\ is\)). Finally, as for many other ancient texts, material decay, language drift, scribe errors, unfamiliarity with the original cultural context, and, possibly, the need of the writers to hide the content from contemporary hostility, also contribute to the difficulty of reading the text.

Concerning recent work on the VM, statistical approaches [1, 10, 14] that search for non-random features in data may be bound to fail if the target is quite random to begin with. The standard Voynich character set (EVA) [7] is not too helpful either, because it is unrelated to the phonemics, it breaks some of the letters into smaller parts, and fails to identify ligatures, all of which may further reduce the strength of the statistical analysis, cf. [20, 21, 19, 10]. In addition, the extensive 19th century literature dedicated to religious writing, see e.g. [15] was difficult to access until scanned copies became available online recently, and, finally, it may be construed that our academic habits thwart the systematic study of matters as obscure as the VM.

The Pahlavi hypothesis was proposed informally already in 2005 [18]. The hypothesis is based there on the similarity of the numbers of letters (“14 - 17”) in the Voynich and Pahlavi alphabets and on a general perception of a topical relation to the Bundahesh and the Denkard. Also a small sample of words lengths from a Pahlavi text was included, but was not compared to a transliteration of the Voynich text.

The present paper aims at providing evidence for the hypothesis that the VM is a readable text with an interest in itself. Our approach consists in establishing a relation between the Voynich and Pahlavi scripts (see Section 2). It will also become clear that only within a cooperation among experts in Pahlavi philology, Zoroastrianism, history of medicine, botany,

\[I\] was not aware of this news-group post until I found a Twitter comment on the first version of the current paper where Ref. [18] was mentioned.
astronomy and palaeography, the content of the VM can be revealed.

We will provide evidence for the proposed relation between the two alphabets by a number of examples from VM illustrations as well as from its running text (Section 3). Finally, we will draw (in Section 4) some rather speculative conclusions on the context in which the content of the VM may have originated.

2 Letters are reverted Pahlavi characters

Comparing the Voynichese and Pahlavi scripts, we find that many of the characters are upside-down versions of each other, see Table \[1\]. This may be due to the different writing direction of the two scripts. A similar effect that was observed also in the earlier sinistrodextral Brahmi script \[4\], in which also some of the letters appear as upside-down adoptions from its likely predecessor Aramaic (right to left). Pahlavi, that ultimately derives also from the Aramaic alphabet, has retained the dextrosinistral direction, while the VM is written in the opposite direction.

In this way, six of the about 20 Voynich letters can be explained directly (\(a\), \(h\), \(s\), \(S\), \(r\), in our notation, see Table \[1\] and \(K\), see Table \[2\]). Two more letters (\(d\), \(c\)) differ from \(s\) and \(S\), respectively, only by an inverted breve diacritic. In addition, there are three more letters that obtain by rotation about a different angle (\(t\), \(y\)) or by mirroring (\(z\)). The similarity of eleven out of the comparatively small number of letters of the two alphabets can be considered as a clear indication of a relation between Voynich (V) and Pahlavi (P). Below we will see that the relation extends also to the phonemic level. Two letters \(o\) and \(n\) that occur frequently in the VM, differ from their counterpart in the P alphabet. It is tempting to relate V \(o\) to P \(pe\), but we suggest rather an association to \(waw\). This also supported by the frequent use of \(o\) as a word separator in the VM. In Pahlavi a vertical bar is used for this purpose, which is of similar shape as P \(v\), while in the VM apparently the more distinctive letter \(o\) has been preferred. Further analysis of the V text will shown whether \(o\), \(y\) or \(a\) also have a grammatical function. Based on the phonetic content (Sect. 3) of the letters, we assume that, in contrast to Pahlavi, the nasal alveolar is not part of the spectrum of V \(o\), but is represented by V \(n\).

The remaining V letters are the “capitals” \(B\), \(K\), \(M\), \(P\), or occur only very rarely (see f57v for a number of other characters, some of which, however, occur nowhere else in the VM). The shape of the V “capitals” may have arisen from a fusion of the respective Pahlavi characters with a vertical stroke (P word separator). We do not consider the capitals to be functional ligatures, though, as they are used also within words or after the word separator (\(o\)).
| Voynich | B-Pahlavi | P-Pahlavi | transcription | name | # |
|---------|-----------|-----------|--------------|------|---|
| ![Image] | ![Image] | ![Image] | a, h, kh, š | aleph | a |
| ![Image] | ![Image] | ![Image] | b, a, h | beth | B |
| ![Image] | ![Image] | ![Image] | d, t | daleth | d |
| ![Image] | ![Image] | ![Image] | g | gimel | g |
| ![Image] | ![Image] | ![Image] | y, g, d, [k, b] | yod | y |
| ![Image] | ![Image] | ![Image] | v [b], o [a], u | waw | o |
| ![Image] | ![Image] | ![Image] | h, r, n, w, ı, [i, g] | he | h |
| ![Image] | ![Image] | ![Image] | ? | zayin | c |
| ![Image] | ![Image] | ![Image] | k, g | kaph | K |
| ![Image] | ![Image] | ![Image] | r, ı | resh | r |
| ![Image] | ![Image] | ![Image] | m, t | mem | M |
| ![Image] | ![Image] | ![Image] | n | nun | N |
| ![Image] | ![Image] | ![Image] | s, ĭ, [š, a, h] | samekh | s |
| ![Image] | ![Image] | ![Image] | p, f | pe | P |
| ![Image] | ![Image] | ![Image] | z, ĕ, p, [g, d, y] | sahde | z |
| ![Image] | ![Image] | ![Image] | ş, t | shin | S |
| ![Image] | ![Image] | ![Image] | t, s, [d, r] | tav | t |

Table 1: Voynich characters and initials together with variants of the corresponding Pahlavi letters. The last column shows the notation used here. See Box 1 for comments.
Box 1: Comments on Table 1
The letters are given in the order to the Aramaic alphabet with resh taking the place of phonetically similar lamed, and jod is placed near daleth and gimel with which it is interchangeable in Pahlavi. Frequently occurring corruptions are given in brackets [13]. Strokes from neighbouring characters are removed from the Voynich letters.

[a] Appears in B-Pahlavi as a raised character. \( \aleph \) represents a glottal stop.

[b] We could not find enough evidence for systematic use of two variants (B and H) of this character.

g] Occurs usually in final position, elsewhere \( y \) is used instead.

[\( \text{v} \)]\( \text{v} \) resembles Syriac \( \text{vav} \) (\( \text{v} \)), Pahlavi \( \text{vav} \) is identical to \( \text{resh} \)

[y] the letter represented here is daleth. The actual P-Pahlavi letter yod (\( \text{y} \)) shows an interesting similarity to the inverted breve diacritic of \( \text{Vd} \) and \( \text{Vc} \). Many words have an otiose \( y \) ending.

c] This character occurs rarely in the VM, the mere fact that we did not identify a distinctive character for \( \text{P c} \) does not justify the transliteration of \( \text{c} \) by \( \text{č} \).

[z] is often (or easily) confused with \( r \).

[P] occurs often at the beginning of paragraphs. It may be an abbreviation of \( \text{pad} \) for to, at, in or on.

3 Vocabulary relates to Zoroastrian religion

Voynichese and Pahlavi are not identical. By the introduction of a number of additional characters, such as to distinguish \( d, g, n \), reading a Voynichese text may have been easier than a Pahlavi text. It is not clear why the history of the deciphering of the VM, does not support this claim. Analysing plant and star names, Bax [3] has suggested a similar reading for some but not all of the letters. We base our transcription on a larger number of samples from the manuscript and compare the results with names from the Zoroastrian cosmological scripture Bundahesh [24, 11], which was composed in the 11th century, and with general vocabulary [13], such that we arrive at a more complete and more reliable transcription that is based not only on the similarity of the letter shapes. The translations given below should not be expected to do justice to the VM text. They are solely included to provide evidence for the proposed transcription.

3.1 Zodiac symbols

In the appendix, we show two sets of words from the manuscript. The first (App. A) gives the names of the zodiac symbols and the corresponding month names both of which were passed down in the Bundahesh [24, 11] in paragraphs II, 2 and XXV, 20, respectively. Based on the well known symbols shown in the centres of f70v1 – f73v, the identification with the Pahlavi names is straight-forward, expect for the two pages f71r and f72r1 which show the same symbols (Aries and Taurus) as f70v1 and f71v, respectively. We cannot answer the question whether the two repeated signs do in fact represent the missing Capricorn and
Table 2: Main ligatures and letter combinations from the VM. Only part of the implied phonemes are given in the third column. The last column refers to the transliteration in Table 1. The two or three strokes of $n$ or $m$ have a similar functions as $h$ in the final or penultimate position. Ligatures involving the letter V S (“table”) represent the succession of two consonants usually in the beginning of a word. In some cases it is $s$ rather than $S$ that is represented. While $sP$ and $sT$ are obvious from the vocabulary, the remaining combinations will have to be reconsidered. First part of $ko$ occurs rarely if ever alone. This ligature can represent $m$, $q$, $h$, $r$, $mn$, $mv$, $mr$, $mR$, etc. The combinations $cy$ and $co$ appear to represent single phonemes in some cases, see Appendix B. All ligatures are copied from f37r, the components in the second column are from Table 1. Strokes belonging to neighbouring characters were removed.

| Voynich | Components | Phon. | # |
|---------|------------|-------|---|
| ![Symbol] | $\begin{array}{c}2, \mu \end{array}$ | h, a, kh | $n$ |
| ![Symbol] | $\begin{array}{c}2, \mu \end{array}$ | $\bar{a}$, h, a, kh | $m$ |
| ![Symbol] | $\begin{array}{c}2, \mu \end{array}$ | sP | sP |
| ![Symbol] | $\begin{array}{c}2, \mu \end{array}$ | SK | SK |
| ![Symbol] | $\begin{array}{c}2, \mu \end{array}$ | sN, SN, sR? | sB |
| ![Symbol] | $\begin{array}{c}2, \mu \end{array}$ | sT | sT |
| ![Symbol] | $\begin{array}{c}2, \mu \end{array}$ | m, k + o | $ko$ |
| ![Symbol] | $\begin{array}{c}2, \mu \end{array}$ | e | cy |
| ![Symbol] | $\begin{array}{c}2, \mu \end{array}$ | $\bar{a}$, h | co |
Aquarius. Because two words (on f72r2 and f72v2) are unreadable due to creases, we are left with 18 words that are identifiable to a reasonable degree of certainty.

3.2 Plant names

Ancient plant names are occur in manifold variants and are often ambiguous. The same seems true for the plant drawings in the VM, where, in some case, it seems even plausible that the artist followed merely a verbal description rather than an own view or any original drawings. We can thus expect only a few characteristics to be identifiable. In addition, only a few plant names are included in the standard dictionaries (e.g. [13]), such that most of the VM plant depictions will require more research. We will first consider two plants (*henbane* and *cannabis*) whose names are easily identifiable and where a visual comparison, see Fig. 1 can be considered as additional evidence for the text-based identification. After this will report on some preliminary attempts, i.e. we are not attempting a botanical identification of the plants [23] and should take into account that, even in comparison to other medieval depictions, the drawings are far from perfect.

3.2.1 Henbane

The first word of f31r is *BccNcy* which can be transcribed as *bang*, see Tab. 1, which uniquely translates [13] as *henbane* (*hyoscyamus niger*), a poisonous plant of the nightshades family. The similarity of the drawing on f31r and the plant henbane is illustrated by Fig. 1 and can be considered as additional evidence for the translation.

3.2.2 Cannabis

The first word of f16r is *šcoN* which can be transcribed as *šan*, see Tab. 1, which uniquely translates [13] as hemp (*cannabis*). The similarity of the drawing on f16r and to the cannabis
plant is obvious: Leaves are neither clearly opposite nor alternating, they are shown to consist of seven to nine finger-like leaflets. The spike-shaped flowers are probably female and are riddled with elongated leaflets, see Fig. 2.

3.2.3 Further observations on the plant pages

Among the first words on the plant pages, we find often šPīg (sprout), dān (grain), or dār (tree) which may be a general term or a component of a plant name that consists of more than one word. E.g. on f17r we find don (dān) which here, however, may refer to buckwheat.

Folio 21r shows a plant similar to box (buxus) or P šimšār. The first word of the text is Sor (šār). Near the end of the 7th line we find šomšor (with the middle m and š as an odd ligature).

The first word of Folio 24r can be read as alālag which would mean anemone (anemone blanda (?)), but the picture does hardly match, although the anemone family has a wide variety of leaf shapes and numbers of petals. The must be said for f45v which starts with the same word. A problem with this reading is also that we otherwise ignored the waw after the initial “paragraph marker” P while it would be part of the plant name here.

Chick-pea in P is naxōd which can be found in the beginning of 5th line of 26v. While the leaves are may be plausible, the drawn flowers are less typical, perhaps chick-peas are mentioned only for comparison here and, therefore, not in the beginning of the text.

The drawing on f41v is identified as coriander (Coriandrum sativum) 3, or gišnīz in P. Ref. 13 gives also the variant kīšnīz. While the single word that makes up the first line is unrelated to this P word, the second line appears to give several variants, e.g. the 2nd word contains Kš, the third word reads Kšnd.

Date palm in P us mūγ 13 which can be found as the third word of the first line in f56r. The drawing shows a plant with at least the base of the stem and the lower pair of leaves reminiscent of a palm tree.
3.2.4 Plant parts

Folio 100r gives an overview of shape types, most likely of leaves. It contains six descriptive words for five pictures, see Fig. 3. We therefore, consider the first word in the upper row (dōspīg, i.e. double spouted) is seen as the last word of the previous text. The second word in the upper row Mht could be mih (false, opposite) or mahist (greatest). The four words in the second row are less ambiguous. We have Bīor (bahr, part) for a leaf consisting of three parts, rot (rōd, river) for a set of leaf stems that branch off like a river delta, tšhg, which may relate to (tašt, bowl), and Botr (BATR, a heterogram for pas [13], behind) for one leave behind the other. This again is to be seen as evidence for our main hypothesis rather than as an exercise in Pahlavi transcription.

3.3 Lunar mansions

In a similar way, it is possible to transcribe from the illustration on f69v most of the 28 lunar mansions that are also listed in Bundahesh II, 2 [11]. Because of the short and repeated Pahlavi names of the mansions, a unambiguous correspondence was possible for only 20 of the mansions, such that we did not include it here. Interestingly, the 1247 stone representation of the Suzhou star chart (1193) that shows the related 28 Chinese constellations has a “cartouche” title beginning with the ideogram for sky that can also be seen in a corrupted and reverted form on f1r of the VM. This is not implausible considering the continuous exchange between Persia and China in historic times.

3.4 Zoroastrian material

The four words in the center of f67v2 are (with transcription) zoahd (zohr), oBarao (bahr), zary (zōr) and natag (nihadag). The translation yields the words sacrifice, lot, power, foundation [13] that appear, given a Zoroastrian parentage, semantically related. The words are grouped around a small square-shaped picture of a swirl-radiating star which could represent a sacrificial fire.

App. B includes a transcription of words from the beginning of the third paragraph of f1r. This sample is included not only to show that the Pahlavi transcription applies to the main
text, too, but also to demonstrate the difficulty of a translation of the text, which has, however, been noted by all translators of Pahlavi documents.

In the illustration on f77v, we find the words *oBam yHat otBaNat orShNat oMot dhNy oMot* or *tor* which can be transcribed as *bım duxt wad-baxt rēšinad mīh dēn wizār* and is translated word-by-word as *fear daughter unfortunately wounded: false (alternative?) religion explanation* [13]. This sample, nevertheless, suggests that the “nudes” pages (f75r – f84v) represent medieval medical content. While the representation of nude bodies is rare in such contexts, similar scenes appear in contemporary miniatures from Mughal India, where, however, an erotic perspective is taken, which is not obvious in the VM.

### 3.5 The colophon (f116v)

Further evidence for the proposed transcription can be obtained from the “colophon” (f116v). The last line of the short text contains the words *arar dccy* that are, in contrast to the seemingly Latin script on this page, clearly readable. We propose the transcription *xwar day*, which would refer to the 11th day of the 10th month of the Zoroastrian calendar [13]. The question whether the character before the lacuna at the end of this line was originally the initial character of a year, cannot be answered without further analysis of the velum.

Based on the Pahlavi hypothesis presented here, it seems possible to extract more information from the colophon. In the App. C, we present an attempt to read the colophon, which, however, is largely speculative, even if we assume that the Pahlavi hypotheses is true.

### 4 Discussion

We have not been presented more than a few words, which is mainly due to the inherent difficulties in reading Pahlavi. Therefore, at this point it is not clear, whether the VM contains also words of a different idiom, such as the northwest Indian language Gujarati, whose Parsi dialect contains many Iranian words due to the Zoroastrian influence, although Gujarati does not itself identify as an Iranian language.

It is striking that the manuscript does not contain any obvious religious symbolism (apart from the crucifix on f79v, which may well be a later insertion) nor any other culturally identifiable elements. However, the astronomical charts of the VM are related to the world of the Zoroastrian culture in the middle East or South Asia. They do not show any awareness of (earlier?) Arabic astronomy, but seem to follow the cosmological view in the Bundahesh.

Finally, we want to emphasise that we have no evidence that the VM was produced in Persia (or perhaps even western India). It is also possible that it originates from the regions near the Black Sea where an exchange between Persia and the Italian cities of Genoa and Venice took place around the presupposed time of the production of the VM. Our opinion that the content of the VM is meaningful does not exclude the possibility that it is still a “hoax”, in the sense that it was copied to be sold rather than read. In this process or by later
action, foliae with critical content may have been removed to further obscure the origin of the manuscript.

Although the proposed transcription is obviously tentative, it is now possible to find many of the VM words in a Pahlavi dictionary [13 16 11] using Table [1] which will give at least partial insight into the content of the VM. We are also unable to provide a more precise phonemic account at this stage, although some of the differences (e.g. between V d and P t) may allow for such discussions. It will require a substantial effort to provide a complete translation of the VM, as it seems unlikely that large parts of the text have been passed down also from other sources, i.e. the VM does not appear to be identical to any of the better known Zoroastrism-related scriptures or commentaries, so its content may as well have an interest on its own.

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This is the second version of the paper. It differs from the first version by the deletion of some but not all superfluous text and by a reference [18] to an earlier mentioning of the Pahlavi hypothesis.

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A Zodiac pages (f70v1-f73v)

All descriptions were found within the V script around the margin (for f70v2, within the margin) of the central image that shows a depiction of the zodiacal sign.

★ Notes

♂ The centre image shows Aries in repetition of f70v1, but also the text does not show much evidence for the interpretation as Capricorn. The first letters of the V constellation are ignored, so the transcription is questionable.

♀ The centre image shows Taurus in repetition of f71v, but also the text does not show much evidence for the interpretation as Aquarius. The first letters of the V month and V constellation are ignored, so the transcription is questionable. Alternative spelling: Ašwahišt.

 strtok. Alternative spelling: Wahman.

∨ Alternative spelling: nemāsp.
| folio | Voynich | Pahlavi | transscr. | * | Latin | Voynich | Pahlavi | transscr. |
|-------|---------|---------|-----------|---|-------|---------|---------|-----------|
| f71r  |          | wahig   | ๒ | Capricorn? | ? | ๑๒๕๖๕ | frawardin |
| f72r1 |          | döl     | ๒ | Aquarius? | | | ardwahišt |
| f70v2 |          | mahig   | ๒ | Pisces   | | | hordad |
| f70v1 |          | warrag | ๒ | Aries    | | | tīr |
| f71v  | ๒ | gaw     | ๒ | Taurus   | | | amurdad |
| f72r2 |          | döpahikar | ๒ | Gemini   | (crease) | ๑๓ | shahrewar |
| f72r3 |          | karzang | ๒ | Cancer   | | | mihr |
| f72v3 |          | šagr    | ๒ | Leo      | | | aban |
| f72v2 | (crease) | hošag   | ๒ | Virgo    | | | adur |
| f72v1 |          | tarāzüg | ๒ | Libra    | | | day |
| f73r  |          | gazdum  | ๒ | Scorpio  | | | walmān[at] |
| f73v  |          | nemäsp  | ๒ | Sagittarius | | | spandarmad |
B  First folio text (f1r)

Passage from the beginning of the third paragraph of f1r. Not all translations from [13] are shown. Our transliteration shows several inconsistencies, which may be due to the complexity and development of the Pahlavi language and will require further analysis. E.g. V otr retains P t, while V dody uses d for P t in accordance with the transliteration [13]. Final o, as in P for dody, is often ignored as an otiose stroke [13], see also the final character of Spandarmad. In VM, more often leading o are otiose, e.g. in Spandarmad after the line break, while in V otr the leading o is considered as part of the word.

|   |   |   |   |   |   |
|---|---|---|---|---|---|
| V | yNahr | {śP}thrahm | otr | {śP}hg | yMahn | dody |
| p |   |   |   |   |   |   |
| Pt | gohr | spram | wider- | spig | yma/xon | dudag |
| E  | nature | flower/fragrant herb | pass by | sprout | blood | family |

|   |   |   |   |   |   |
|---|---|---|---|---|---|
| V | {śP}oN(a)thr-(o)Mdo | Mdo/Adwg | oMahrhn | oMhot |
| p |   |   |   |   |   |
| Pt | Spandarmad | ădug | mărăg | nimăyan |   |
| E  | Spenta Armaiti | capable | sensitive | guide |

|   |   |   |   |   |   |
|---|---|---|---|---|---|
| V | oBahdoNan | r + {SB}hg | Nahm | doy |
| p |   |   |   |   |   |
| Pt | wizihidan/baxtan | man + sahiq | năm / wihan | do / duš- |
| E  | separation / distribute | me + worthy | name / cause | two/evil |

|   |   |   |   |   |   |
|---|---|---|---|---|---|
| V |   |   |   |   |   |
| Pt | sti | bumīh | spig (?) | Spandarmad (?) |   |
| E  | being | beginning | sprout (?) | Spenta Armaiti (?) |   |
Notes

Curly brackets enclose {ligatures}. Square brackets indicate [inserted characters]. Round brackets indicate (ignored characters). A hyphen stands for a line break. Small strokes appearing in V either as c or i are transcribed here as h, i.e. are considered to indicate a lengthening of the nearest vowel.

To explain the ignored V a in Spandarmad, the P d could be considered as a contraction of V a and V t.

The chapter on The Nature Of Plants (Bundahesh, Ch. XXVII) mentions Spandarmad [24]

C The colophon of the Voynich manuscript

C.1 Introduction

The last page (f116v) of the Voynich Manuscript (VM) can be assumed to show a colophon, i.e. an addendum that occurs frequently usually on the final page of medieval manuscripts and early modern prints, which usually contains information on the author, production, provenance etc. Following the hypothesis of the main text that the VM is written in a Pahlavi-like script, we present a translation of most of the colophon text. We can identify a place of origin and a date, but not the year in which the manuscript was written. Also we believe to be able to identify the scribe’s name which may refer to a female writer from a medieval Zoroastrian community possible in the city of Trebisonta, the a gateway between Persia, Byzantium and early renaissance Italy.

Figure 4: Full view of the relevant part of the colophon page (f116v).

The interpretation is in large part speculative and in need of further research, but is included here in order to stimulate further study as well as to provide in turn additional evidence for the Pahlavi hypothesis.
Below we will consider the last page of the VM line-by-line in some detail based on the Pahlavi hypothesis. This will enable us to draw some conclusions on the context in which the content of the VM may have originated.

C.2 Background

C.2.1 Pahlavi hypothesis

The claim that the VM is written in natural language rests on the observations that most of the Voynich (V) characters have counterparts in the middle-Iranian Pahlavi script that was used in medieval Zoroastrian scriptures, commentaries, and a few other texts [2]. Some of the V characters are upside-down versions of their Pahlavi counterparts, which may be an effect of different writing directions. Other V letters are related in another obvious way or can be explained as ligatures. Finally, two letters are added, but are easily identifiable from the vocabulary. In principle, it is thus possible to translate Voynich words using a Pahlavi dictionary such as Ref. [13]. Although this process is in many cases successful, is is not always straightforward.

The colophon of the Voynich manuscript contains only a few Voynichese letters. Most of the characters resemble Latin letters, but the awkwardness of their shapes contrasts strikingly with the fluency of the proper Voynichese letters. This indicates the possibility that the colophon text was written by a scribe not well acquainted with in Latin letters. Also the impossibility of identifying any other of the language that typically uses Latin script, justifies the attempt to identify the Latin letters as transcription from Voynichese.

C.2.2 Colophon

A colophon in medieval European manuscripts usually starts with the explicit that contains the Latin phrase explicit liber (the book is “spread out”, i.e. finished), although since early modern times the words colophon and explicit are used interchangeably. After the explicit, the colophon may give information about content, author, place, date, producer, commissioner, the publication process etc.

Figure 5: The “title” of the colophon page.
C.3 First line

C.3.1 Explicit

The beginning of colophons often reads *explicit liber*. We will try to identify a similar Pahlavi expression in the beginning of the first line.

With this bias, we propose to read the first word as *mādayān* (*book*). The letters *a* in the manuscript are seen to indicate lengthening of the vowel that is not written in abjad alphabets. The first *a* touches the following letter and the second one is corrected ā by an overlapping *o*. The *i* is meant to represent Pahlavi *y*.

The word “be finished” in Pahlavi is *frazaftan* (alternatively *hanjaftan*), which we can read in the second word of the line. We need to assume the leading *o* is not a word separator but stands as a *waw* for the *f* sound (usually *f* is expressed by *p* in Pahlavi). Reading the second letter as *r* is consistent with all occurrences of this character on this page. Another critical assumption is the interpretation of the sixth letter as a ligature of *f* and *t* or by an omission of one of the two letter. Also the other letters are unambiguous including the final figure-8 character that always represents an *n*. We should note again, that an interpretation of the first two words without being biased by the expectation of the *explicit*, would be very difficult.

The last word in Fig. 7 is read as Pahlavi *mārdan* (spelt with *t*) for perceive, notice or feel. Also here a correction of a (the penultimate) letter is seen. It may emphasise the fact stated by the first to words or could, in the sense of done at relate to the place name that is seen to follow in this line, see Fig. 8.

Figure 7: First part of the first line. This figures as well as the following ones have the same scale.
C.3.2 Trabzon

Today’s Trabzon, was the antique town Trapezos (Τραπεζος) on the south-eastern shore of the Black Sea. It had an important role as a trade gateway to Persia and was regularly called at by Venetian trading ships during 13th and 14th centuries. As the capital of the Empire of Trebisonta was a melting pot of religions. In this way it would be a plausible location for a Zoroastrian book to be transferred from Persia to Europe.

In Fig. 8, we note that first two characters (with a + sign between them) appear as unsuccessful attempts to construct a ligature that does not exist in Pahlavi. The combination šr does not occur in initial position [13], where ligatures are mostly used in other parts of the VM. Only at the third attempt, the c-shape is correctly placed between the legs of the π-shape that is usually expressing the sound š, but appears here to represent t. Although there is evidence elsewhere for this corruption, it is clearly a weak point of the interpretation. Also the split of the word into the parts treb and isonta casts doubts on the identification. The final n (figure 8-shape) is less critical as it can be seen as a locative ending. We, nevertheless, propose Trebisonta as the putative location of the production of the VM.

For the last letter of the first line, M, refer to Sect. C.7

![Figure 8: Second part of the first line.](image)

C.4 Second line

If we take the beginning of the second line (Figs. [9] and [10]) as a direct continuation of the first one (see, however, Sect. C.7) and identify the first letter as an r (compare Sect. C.5.3), which is also used to denote the number 20 [13]. It may not seem straightforward to explain why the Pahlavi numeral is followed by a Roman IX (Pahlavi for number 9 would be 333), but it is not fully unexpected considering the organisation of the Pahlavi tens in steps of 20. In combination with the M in the preceding line leads to an year 1029 which can refer (based on the date in Sect. C.5.1) to the Christian (11th of November 1029), the Muslim (9th of September 1620) or the Zoroastrian era (19th of July, 18th of August, or 26th of December in 1660, resp., for the Kadmi, Shenshay or Fasli calendars [12]). However, from the dating of the velum to 14th century, neither of these dates appears likely. One possibility is to use the velum date to justify a lost Roman CD after the M at the end of the first line, such that a date of 1429 is implied, which is, however, highly speculative and contradicts the use of the Zoroastrian calendar for the month (Sect. C.5.1). Whether or not the space after the M contains indeed the minuscule letters cd cannot be decided from the available scans of the VM.
In the remainder of the line, we can identify in this line three attempts to write the word māḥ meaning moon or month. It consists of the letter m followed by a for the lengthening of the vowel and three strokes representing h. In the second occurrence of the word instead of a the letter o is written. The first two occurrences precede what appears to be the Roman numeral X. The third occurrence of māḥ follows a word with the possible spelling abha (Fig. 10). The reading is not clear, but the word may be Latin for the Zoroastrian day name xwar that occurs also in the third line, see Sect. C.5.1.

C.5 Third line

C.5.1 Date

The last line of the short text starts with the words aror dcy, see Fig. 11 which are, in contrast to most of the awkward Latin script on this page, unambiguously identifiable: The letters a, o and r can express the same Latin phonemes. The combination cc is a single letter which can refer to s or ģ and the last character is the ambiguous d-g-y letter mentioned in the introduction. The remaining letter ṭ functions as a d. The Pahlavi correspondence is nevertheless more complicated, but suggests unambiguously the irregular transcription xwar day, which refers to the 11th day of the 10th month of the Zoroastrian calendar [13, p. 142]. After the mediocre attempts to give the date in Latin script in the previous line, it seemed necessary to return to the more familiar and less ambiguous Voynichese expression.
C.5.2 Name

Observing the descenders in the two initials in Fig. 12, we read two first letters of the words as $g$, as in the “title” of the folio f116v. The forth letter of the first word is, as in Figs. 7 and 8, an $n$, and the following letter an $r$, see Fig. 11. Considering the remaining characters as Latin letters, we can identify the string $Galnr Gbrey$. The Persian name $Golnar$ refers to the flower of a pomegranate tree, and is used since medieval times, as obvious from its prevalence among the Parsis in India. Since Pahlavi uses essentially an abjad alphabet, it seems natural that the vowel between the Voynichese letters is omitted. Likewise, the second letter ($a$) does not stand for the vowel $o$, but expresses the lengthening of the sound.

$Gbrey$ is a Pahlavi from of $Gabr$ or $Gabri$, a term that was used for non-Muslim people in Iran. It seems to have been applied mainly to members of the Zoroastrian faith [22]. Considering that, when the VM was written, it would not have had the later pejorative meaning, it could be have well been used as a byname, and in fact has survived in several variants as a surname.

$Golnar Gabri$ is likely to a female name, although also unisex names with the compound $Gol$ (rose) exist. If the scribe was indeed one of the rare female authors or writers from that time, then the preservation of the VM is indeed very interesting, even if we do not yet have much insight into the actual content of the manuscript.

Figure 12: Second part of the third line. Phrase interpreted as the name of the author: $Golnar Gabri$.

C.5.3 Finis

As the least phrase of the colophon is particularly obscure, it is hard to resist reading the last words of the colophon, Fig. 13 as the German phrase $So nimm gar mich$. ($Thus$ $take$ $even$ $me$), which appears to be out of context. However, the identification of the first letter as an descending $s$ and of the similar letter in the middle as an $r$ is not entirely inconsistent within the Pahlavi hypothesis, although we would expect the writer to return rather to the Voynichese $r$ in case of ambiguity.

A slightly more likely alternative reading can be found by considering the phrase in Fig. 13 again as Pahlavi written in Latin letters. In this case we would ignore the first part

If we read the first letter as $b$, then we can identify the first word as $band$ which refers to $bastan$ and is occasionally written as $bn$ [13], noting that the letter $waw$ ($o$) and $nun$ ($n$) are of identical shape in Pahlavi. The word $bastan$ means $tie$ or $bind$. Other options of starting with $b$ would require the presence of a third letter.
We prefer to read the first letter as $r$ (as in the third word in Fig. 13), for which MacKenzie [13] suggests the transliteration $raw$ which then refers to $raftan$ meaning $go$ or $move$. The following words can be transcribed [13] as $nim\{ay\} (nimudan)$ meaning guard, $gor$ for nature (or jewel) and $mizd$ which can mean reward.

Although the rough translation of the phrase as “Go, guard nature’s reward!” appears utterly anachronistic, it would be within context and could be considered as a final message of the author to posterity. Nevertheless, as many of our conclusions are rather speculative, this translation is even more so.

Figure 13: Final phrase of the colophon.

C.6 Drawings

The velum of the last page has tear that apparently has been mended before the use of the page. The scribe used the large part right of the tear for text of the colophon, and decorated the margin left of the tear by a few small drawings, see Fig. 14.

The top picture (Fig. 14 left) has a conspicuous likeness to a chicken corpse. The middle picture represents a billy goat or a similar animal. The bottom picture is a female nude in the style of the figures in the “nudes” pages (f75r – f84v). It would be strange to assume that it represents the author.

Although we are unable to give a interpretation of the pictures here, we note the letters in the top figure (Fig. 14 left). Although the first letter as a similarity with $F$, we should stay with the earlier reading of the character as $r$, which is followed by $a$ (or $o$) and $n$ (figure-8 shape). The word $ran$ means fight [13], but our confidence in this reading is low.

C.7 Illegible characters on right margin

One of the most important information to obtain from a colophon would be the year of the production of the document. We have touched upon this question above, but are unable to give a definite answer. Fig. 15 shows the ending of the first line of the colophon and the right margin of the page next to the colophon. It is possible that characters after the letter $M$ are lost, although they may become visible in a multi-spectral analysis of the velum.

In the left middle and lower part of Fig. 15 a few blurred characters (such as a question mark) can be seen, but due to the difference in the strokes and unrelatedness to the main part of the colophon, they should be considered as later additions.
Figure 14: Drawings on left margin of f116v. The three images (left to right) are positioned on top of each other and separated from the main text by a repaired tear in the velum.

Figure 15: Ending of the first line of the colophon and lacuna due to abrasion at the right margin of f116v.

C.8 Conclusion

All of the presented results from our reading of the colophon are to a larger or lesser extent speculative, but at least we should admit that the combined evidence provided here shows that the text on f116v indeed represents a colophon. Further analysis of the text as well as of the material document may lead to more reliable information about the manuscript.

Colophons occur already on Ancient Near East clay tablets, but in the case of the VM, the addition of a colophon appears as an ineffectual attempt to adopt a Western custom, which may have been seen as suboptimal when taken, but we can now appreciate it as potentially very useful.