Beinecke MS 408

A Transcription Based on a Revised Version of Takeshi Takahashi's Transliteration

Alexander Max Bauer

1 Introduction

In Section 2 of this document, mainly to promote easier readability and comparability, a transcription of *Beinecke MS 408* is currently being developed, based on a transliteration by Takahashi (1999). To achieve this, Takahashi's transliteration is obtained in an automatically capitalized version of the *European* or *Extensible Voynich Alphabet* (EVA) using the *Interlinear Transcription Archive Extractor* by Schwerdtfeger (2004). It is then converted back into glyphs using a font by Bettencourt (2019).

Using the manuscript's reproduction in Clemens (2016) and the scans provided by Yale University's Beinecke Rare Book and Manuscript Library (2004), Takahashi's transliteration is compared with what I am able to make out of the manuscript. Glyphs that I interpret in another way than Takahashi are printed in orange, showing my interpretation. When a glyph has been deleted by me without replacement, this is indicated by ... Removed spaces are marked with and added spaces are indicated by ... For the sake of simplicity, places where the writing is interrupted by illustrations are also marked by spaces. Especially the recognition of spaces in running text is sometimes very difficult; therefore, my adjustments in this – just as in any other – regard should be taken with a certain amount of caution. In total, I made changes in 180 places of Takahashi's transliteration.

Each transcription line is preceded by a locator in square brackets, informing the reader about the element a line is part of (i.e., paragraph, title, or label) and assigning the line a number. For example, a line located at [P2, 9] is part of the page's second paragraph (P2) and is counted as the overall ninth line (9) on this page.

Additionally, in Section 3, some basic analyses are presented. First, in Section 3.1, glyph frequencies are counted. In Section 3.2, then, entropy is calculated.

Schwerdtfeger (2004) builds on an online archive of Voynich transcriptions maintained by Jorge Stolfi (1998). For a general overview of transcription efforts, see Zandbergen (2023).

2 Transcription

Folio 1, Recto

```
Paccos offax ar affarry door doro offeres of 1602 doorso
     Cos Feath Feath 250 Feathall of 60 Feath of Co
     OS UNIBSOS SSOND OF OBLIVE BOD ON DELO PO OPLIVE FILED
    Callo 90 GIIA GIIAS 910209 Sooto pooto GIIO
    8017-9 ccca? ctally ctall 6015
    980701259
    920 Fo.2 (1.08) office of the coeffice of the coeffice of the coefficient of the coeffici
    8011 202 ctog 2089
[T2, 10]
    psooff So Gras
[P3, 11]
    Sagabosta obos Proffe osts Sago Prosats Probe Y
    UNDER 629122 Crosoco Collo 20216 Cresto 6021 021/10
    tog effecy fosarry effect effects arrived the ogsarry s
     Said only cros osand crosand cros offand sad after fos
    8a110 detheog too coop dog coop coop lot cag
    to cros todal lity licy sof crosall to lices
900 flower ochlard the $9898 offer 8aroffer
    Stepths Grasses grants established san got offe
     8cca? &cotta 110 olla 117 ccco Pcco tollog ctros 8aoctla
    coll coop crop sand office
[T3, 21]
    GIII 2010
    os os es essent es essenta essentantes essentantes estas
    Feath 2022 Fab Unia Past Sab Rash Unas 2020 Cross
    coso farro coarro offog sarro far ctoog sarro ctoogsar
     gorceg ollag ollg sarry olloreg lollarry otorog llasorg sag
     Soco dos locas etto ollaro loco loco sas allo
    To Tox Toll Tollo Tollo
```

Folio 1, Verso

[P1, 1]

Mcco crabarro or orthogo crao ctar ab

[P1, 2]

office, crao or occ, beco shobs oblobar crobs

[P1, 3]

bo ether ether ether des blichers ether hotheroby bas

[P1, 4]

box crolles bar? bab corres crollobs

[P2, 5]
Totlog chos sand ctroas sad creg those offeann chocks

[P2, 6]
crolle cros ctros chos offas sosceres crose sos cre ctros

[P2, 7]
to os croced crees sos ctrees offes sos sose offes so scrose

[P2, 8]
offes chos for flecte cros fle cros ctros crose sann

[P2, 9]
chod offes cros sos fle sad chos scrod offes sad chose

[P2, 10]
that croffers say crose decorate the crose consideration of the crose sad chose

that croffers say crose decorate the crose consideration of the crose consideration of the crose say crose the crose consideration of the crose c

Folio 2, Recto

[L1, 8] 910a\qc* [L2, 9] ***av

Folio 2, Verso

Folio 3, Recto

[P2, 11]

**Teccos & os Zosz & cos & cos
[P2, 12]

ollabarro folleco? follobo folleco coso
[P2, 13]

folleco foll & cos follobo folleco coso
[P2, 14]

coo? fosar? olleco folleco

[P3, 15]

The coaron took of or or opering the offered of or of offered or of or of

[P4, 18]

Tocogeog coesann totoof totog of coes totog offosog policies to the offosog of coes of the offosog to the offosog to the offosog coes of the offosog coesance of the offosog

Folio 3, Verso

[P2, 7]

Theor offeray cror etern 2

[P2, 8]

offero fleor cror eethor offa

[P2, 9]

offercar offer ethosoary cror ethop

offercar offer ethosoary cror offa

[P2, 10]

ocror sann tolletor sann cror offa

from the cross offer theory cross offa

(P2, 11)

cto choeffer etho fleor cross offa

(P2, 12)

oct cross offer fleor fleor fleas

(P2, 13)

ctar chiann tollers offs ethas cells

[P2, 14]

sand chean offers

Folio 4, Recto

```
[P1, 1]

Nosagang atas accor of accor total solve and story office solve and story attemption and story attemption and story according and solve a
```

Folio 4, Verso

Folio 5, Recto

[P1, 1]

Notice of the open open of the open of the open of the open of the open open open

Folio 5, Verso

[P1, 1]

Notice? The first of the stands of

Folio 6, Recto

```
[P1, 1]

Toar of chox cross core core core contrave offices of the core of the core of the core core of the core of the
```

Folio 6, Verso

```
[P1, 1]

Noa? 9 2a? accila? toa? co? at tag 2 acca? at office
[P1, 2]

occ2 aco? acoffice tocilare? acca? osanni Nacces aco? acon
[P1, 3]

toan? after acos ooccoaftes accilates after ollos ?gaco?
[P1, 4]

9 chaftes offices 2o2 9 sass say say offoss offoss
[P1, 5]

san? cha acosas say offor offs sossos
```

[P2, 6] 1 cost coeffice coeffice 9000 90009 8a110 ctros 809 9000 000 01000 tolog occo 809 cto7 cto8 S 10 (cc. 20)

tollarod gazar lasg

[P2, 11]

gor are offer offer sq. officeo2 ctg folfax cfftg 908a110 cttg 2 cto7 occ2 o7 tollof cros effeos florasoso coeffeg S oS crg Savo o? oceg cttar cttar cttar cttag 9 ccarro ctrag ctrosas 39 officer officer and affect 000000 Per 20] gocco? coo? octtag

Folio 7, Recto

[P1, 1]
Toodarry the deg tool deeg caroog
[P1, 2]
Souce flood door door door flood deeg caroog
[P1, 3]
occeed accodarry deeg flood to tage
[P1, 4]
toffee ac gover darry gary flood odarry
[P1, 5]
oarry offerry

[P2, 6]

Mctogoctco toffocco collogog officer acoally

Betog affice acog officer day took acoffee

officer decede acoff toffae took flee acoff day

toffee ogacoll acog affee acomp fleed

[P2, 9]

toffee ogacoll acog affee acomp fleed

Catall acof dayl acoffee

Folio 7, Verso

[P1, 1]
Toggico cico fictoso totas officos so sann fictososo
[P1, 2]
crocro ctro sann tollo cretico sann ctros ctro ctros
[P1, 3]
tollos sollos critico licto lo so creco os crecos so
[P1, 4]
croffeced occar crocro sand cho licto chos secce sos
[P1, 5]
secosann tolloso creco ficeo

[P2, 6]

| Maror choos choose \(\) choose \(\) office \(\) store \(\) sore \(\) sore \(\) cos \(\) choose \(\) cos \(\) choose \(\) choos

Folio 8, Recto

```
[P1, 1]
Those crop offices croff offices cross to offices crops
                     .-!
Tallo & lacage do olac 80 8ag 8aW ag
  حده کوم کوم کوم دره کومالی کره الحدم حده کوم الحدم الحدم کوم کومالیک الحدم کرم کومالیک کرمالیک کرمالی
    10162 007 007 2003 8009 2003 001 001 808
                      Office of the only office of the constant of t
                      Took offerers for togget for the court of the formal for the formal formal for the formal formal for the formal for the formal formal for the formal formal formal for the formal for the formal formal formal formal formal formal formal formal for the formal formal
crotto Mcroad croos 8a17
                      8000 8a118
                     Theort to their party ofters steers tox-sarry too?
                      coop a coosann sann so offeros a colf offerning offerning for the colf of the
 tocoobarry confollobo conformation [T2,\,13]
                      olollcross
  [P3, 14]
                      etto etter dos cotos dos coros líces soso cosas
 Screg effeog erog ereg flere erg effosarrid sog sarriverg effeg ^{(P3, 16]}
    . .
gozeg PoroPorg ceSeg Porg Screavid cthaverar ctheg 8ar
[P3, 17]
 crop being follow ere and exadeff or a crand [P3, 18]
                      olla? Acarra con Poor Ca rain carrage
                      Zar? cocard officer sar took larry took larry sarlag
 \underset{[T3,\,21]}{\circ \hat{\forall}} \text{ crolleccy cheg offag crag}
                      Scrop Sars
```

Folio 8, Verso

```
[P1, 1]
cffcos Zoocffc Zoo ctor offor cror officanno offosanno Zanno
[P1, 2]
ctcffcar Zar cror ctcanno ctor cropilers offanno cffg
[P1, 3]
toos cror zo cror ctcar ctor canno ctanno compare
[P1, 4]
schor ctor sar cror cffcar ctcars sanno crars
[P1, 6]
cror cror sar officar cffanno sanno
ctor il cror sar ctor cffcar croffano ro
[P1, 7]
ctor il cror cror cror cffcanno
[P1, 8]
officar croffcar croffano
[P1, 9]
ctor orce cror cror cffcanno
[P1, 10]
Zcrarco occoos il cror fcar cffcaro
[P1, 11]
Zorano
[P1, 11]
```

[P2, 12]

Therefore the content of t

Folio 9, Recto

[P1, 1]

Tookso cross officer orcing 2 deg obann 2arg dor office officer conficer cross officer officers officer officers officers officers officers officers officers officers officers read the conficers officers officers

[P2, 6]
Thoomand officially officially officially official officia

Folio 9, Verso

```
[P1, 1]
Tocco? otology off cool sand totogether totogether sand
[P1, 2]
Seco? toand elland ettor cooperor ettogether soft tology sand
glicy cool gland sand ettogether off occol sand
glicy tology the sand ettogether off off occol sand
glicy they there there off off off
```

[P2, 5]

Took offeely totok offee oxettoxy the at celly salling period offeely the at celly salling period offeely the attention of the attent

Folio 10, Recto

[P1, 1]

The coefficts of offices and colors for the second control of the second colors of t

[P2, 6]
gcc20? cffcg cco? cffca\\dagger\dagg

Folio 10, Verso

[P1, 1]

Tand dand coo foces follo dand officer offodo cand
[P1, 2]

dand dand officer ocottoor ocond follo ocodand officer dand
[P1, 3]

does office foces officer ocos do

[P2, 4]

totlogotor conn sand totlog coffees offor sand

[P2, 5]

co offees sand totlog totlor cox sand totlogotor

[P2, 6]

conn cor coffee totlo totlond totlog corand

[P2, 7]

Folio 11, Recto

[P1, 1]

Therog zeroag etg ct goda \ \lambda \ etg ccg theody cooffg

[P1, 2]

Zocthody todo? g they dann offer gotherolly theog dann

[P1, 3]

tothy cros ethy do? gligery crothy dann crann dann ded

derog cry they do? gligery

[P2, 5]

There is the start of the start of

Folio 11, Verso

Folio 12

Folio 12 is missing from the manuscript.

Folio 13, Recto

[P2, 5]

choroso de fleto l'acox staro totaro ottaro de cheox so l'acoroso de cheox so l'acoroso de con tara ottaro ottaro de cheox so l'acoroso de con totaro de contra de co

Folio 13, Verso

[P1, 1]
| Noar? cettorry offices office offices
| P1, 2]
| office to flow ceodage offices offices cettoge ceoffs
| P1, 3]
| to flees to flood cess offices offices
| P1, 4]
| oge cecss office oarry offices to office
| P1, 5]
| to flos darry

Folio 14, Recto

Folio 14, Verso

[P1, 1]

Toganon No offodan offodo of offano? Sann log offano?

oliano? Sang that only and attention offano?

oliano? Sang that only and attention offano?

open of offano offano offano?

offano offano offano?

offano offano?

offano offano offano offano offano

(P1, 6)

totto attention offano offano offano offano

(P1, 6)

optano offano offano offano offano offano

(P1, 7)

optano offano offano offano offano offano

optano offano offano offano offano

(P1, 8)

collano offano offano offano offano

sano offano

optano offano

sano off

Folio 15, Recto

[P1, 1]

The cor tees thereof to go offer to go offer to flow offer to flow of the cor offer of the cor offer to flow of the cor offer offer of the cor offer offe

Folio 15, Verso

[P1, 1]
To Por orchy connot offer or so [P1, 2]
**cor or oro or annothing than offer or so [P1, 3]
cftor sand tollor offer offer offand
[P1, 4]
sond collo con tollo tollor offer or offer or cor offer or cftor offer or cftor offer or cftor offer or cor offer or cftor offer or cor offer or cftor or offer or cor or offer or or or or offer or or or or offer or or or or offer or sand
[P1, 8]
offer or cor or or only off cor sand
[P1, 9]
offer or cor cor cor cor cor offand
[P1, 10]
Cor cor cftond cftor tolland
[P1, 11]
Corond cftor cor cor sand find
[P1, 12]
sand cftor cor cor cor

Folio 16, Recto

[P2, 5]

There of the continuous force of the figure of th

[P3, 10]

To Po Po Sagger of the force of the office of th

Folio 16, Verso

```
[P1, 1]

Terranno offeror enterox entercy 2 teroetly

[P1, 2]

offeror of the enterox followether tory

pland by enough total end to the end of the end of
```

[P2, 7]
To cotte of the policy of the offer o

Folio 17, Recto

```
[P1, 1]

Thooso saray osarcon otoso otos cot others soso oxsettes
[P1, 2]

osarr collo olicto tosar etheoso sor others tosettes osc
[P1, 3]

crox or cro tosan ollor cror olicron

[P2, 4]

thereon chos tollon tor oxarri others

[P2, 5]

occilica ethe cror chor etheor etheory

[P3, 7]

licteo tollero cronsecto methes

secure soccer reales

[P3, 8]

Secure soccer reales

[P3, 9]

Cog crette o sar crotters

[P3, 10]

sar crear secer saro of sore
[P3, 11]

offero ether olicror sore sarry

sar
```

Folio 17, Verso

occes less ctodas olos obarro ollas 0,000 lloco? Pocos oftos osocios ollocos gcros cros 80scrccg Hcros 8a7 cHzg $_{[P1,\,6]}$ 8 C//210 90 C//210 90 90120 6112 So Fosso S110 Cost post Fos †ollcog llca? og 89 crog8a112 29 general feros erostanos os [P1, 10] ogto7 ofco7 ofa7 ofox 80117a8 †ollaco †ollovi? attacog acog 00 ct09 loarry crefteg of ct07 9 1/co? cros cros ctos ctos cros cto? ctos oro ? officeox crosarry officer ffcro?9 . 90007 cthg accellg acco othor othogo [P1, 16] offercos cros offcos effcos offercosos toand Saf to sox to fearn cottoo Sus fo for cos gos ao follo 8ail ccco toail cttod ccox ccox 9/cc9 offcc9 cco7 ccox co 98a110 Jus Fossits of Eccept Fosos Fosos †016cc 8a7 ccc9 16cc07 cccc09 cffccc9 cffc9 80sllo 9as Fosllo posllo

Folio 18, Recto

```
[P1, 1]

**T87a\789 8a708ct* 90a7 916cox 8a7 0 8 cectes octeo? 8ax

[P1, 2]

otteox tolecox cestes olecax 8a\1) 89 ceox 8\1\0

**Tolecor ceor cettes oreces tolecox 89 9thear 8

[P1, 4]

cor etteor oleor ottoox ola\0
```

[P2, 5]

Theore took effective effective engage engages of the solution of the second effective of the solution of the second effective of the solution of the second effective of the second of the second effective ending the second of the second of the second effective ef

Folio 18, Verso

Folio 19, Recto

Folio 19, Verso

[P2, 8]

Thog there to see to here? sor

[P2, 9]

getor ollo etor offer etor ollo ssor

[P2, 10]

Sann cor sann ollo of ssor

[P2, 11]

totor sor olletor sann effer offer

foffer olletoses sann or offer

[P2, 12]

offer olletoses sann or offer

[P2, 13]

gec? gheor off offer offer

offerose off offer

offerose off offer

Folio 20, Recto

[P1, 1]

Notice of the control of th

[P2, 5]

Throoffing molfoann of meccol offices docann ?

[P2, 6]

moccol officer foffices meccy sann meson solution annotation most solution of mecol solution of mecol solution measurements.

[P2, 7]

omogened sann moffices mos sos dos offann

[P2, 8]

Comosan meson of mecols

[P3, 9]

Toodec dodg tollarg tollarg toetig arollogdg

[P3, 10]

octoall aro? Codg taodall arollodg arollogdg

[P3, 11]

datod tollarodg glarg tollarg datall arogodg

[P3, 12]

aroll arollodg ollarg ollarg tollarg tollarg datall

octoll aro? aro? arceg targ

Folio 20, Verso

```
[P1, 1]

tarrow and office of totocco office to to to together office of the control of the cont
```

[P2, 5]

There for to get of the dog to the order of the square for the square fo

Folio 21, Recto

[P1, 1]
Theor occoeffics of gency offeres to the code offer of gency of the code of the co

[P2, 4]

Toology dann offern offern forces for the force of the force

[P3, 8]

The older offor the operation of the objective of the objective ofform office office

Folio 21, Verso

[P1, 1]

Those of a color of the control of the con

Folio 22, Recto

[P1, 1]

To go oxity through those offers offer offers and offers a oction of the control of the control offers and offer

[P3, 7]

Marox took officed the asoke officed that [P3, 8]

Sacror offe sail offices follo acollail acounts soil sacror

[P3, 9]

osail sail office officer orallail

[P4, 10]

| fccop cco? 3a\\\) cfco\\\) 8cco? ccc9 to fog 39 ofccop og 3a\\
| 80\\\\) goffco39 to fccop offg offg 39 of 8cccq 3a\\\\)
| 80\\\\) goffco39 to fccop offg 30 offg 30 of 8cccq 3a\\\\)
| 80\\\\) cffco39 to fccop fccop 3ccop 3a\\\\)
| 8cco\\\ 393a\\\\) to ffcop offg 3fog offa\\\
| 8cco\\\ 393a\\\\) to ffcop offg 3fog offa\\\\

Folio 22, Verso

```
[P1, 1]

**ToZarrior of car of flee offs 202 ct of tos

[P1, 2]

**Sarrior offs flee offes secor geg

**Sarrior offs flee offes offes offs

[P1, 4]

**Offs flee offs tolfs Zarrior offs

**Political Color offs

**Political
```

```
Theorem the following following the following the following following the following foll
```

Folio 23, Recto

[P2. 4]

tollogog ollariz ollariz ollariz ollariz ollariz ollariz ollariz ollariz

getor tollariz ollariz ollariz ollariz ollariz ollariz ollariz

getor tollariz ollariz ollariz

[P3, 6]

Thereographically offs and offs seech sallage say offer george
[P3, 7]

offar operar tally tollerog sar tollerog salvo r og salvy agg

[P3, 8]

tolleroge car salve tollally ogoge toally offers 2 slig offers

[P3, 9]

offoge off to tolloge so soge seech tollerer og salvy offers

[P3, 10]

tollollally effers 2 offerr osage erage so sar offall

[P3, 11]

offollo sagoro

Folio 23, Verso

```
[P1, 1]
Toda ( For oda ) ( ) ( ) coases often off of og cuttes follera? 2

[P1, 2]

totle off of our offerases for foller og offer og cuttes offered

[P1, 3]

gero offa ( ) offere cuc ogsa ( ) offeror say offereg

[P1, 4]

offereg san? Losos ogsas offeror sar

[P1, 5]

sor cucar Lor sog ogsas?
```

Folio 24, Recto

[P1, 1]

107079 cco7 ofca7 &c cco9 8a110 o7 totally of obard offartheas offartheas offartheas 9 cttca? cttcax olfox tottar cttcg of cectleago ettea? coo? cecce 8a 1807 cro 7 crcg cttg cttc 1608 occco2 ctlco7 otlag toctlcog tollg *162 cc162 ccc02 cttog todog octo7 2 08 toca7 8a110 tollcog 08a110 clicar toda1 the soc dag 7. 07 cta? co? 2 a8 ccotla/10 89
[P1, 11]
[P1, 11]
[P1, 12]
[P1, 1 tollers tollers flog flos effes Soco of S crop croft Saso too ccco too ccar offcas S 208 20 Sosso Sosostao ट्टंबर जीटबर ठवर ठवर ठवर ollo posto pato pollo estis ${\displaystyle \mathop{\mathsf{o}}_{\scriptscriptstyle{[P1,\,19]}}}^{}$ cros cros 8a11) cros 8 909 for crop tog offarteg Sagczoggo

Folio 24, Verso

```
Horosar crockes ofor those crokes of those of the solution of the second of the secon
 ossilo sossilo Sossil
 octtog oscocco occarco ollas coctto
 98ag & olfog olfarry 08arry 890S
                   090 900 110 Accas 090
  [P2, 6]
                  Mocros coo characo
 .
gczcog da\d da? ogog
[P2, 8]
                    Poclo cotto cos Savo
 9009 cros of crofos
offoco? cffcco8 cco9 ffcog
 98a110 ccco? todog oloda110 [P2, 12]
                   lico toa? etto do tolle ollege
 occes acor as odo? Lo do offorodag _{[P2, \ 14]}
 80117 ccco8a8 to to 89
offcog 08a118
```

Folio 25, Recto

[PI, 1]

Tooges cooks sand office toos sand occors ofters of conformation office toos of compassion office office

Folio 25, Verso

[P1, 1]
Toccarry tolly deg sarry tollecg offeco tolleco tolleco coc
[P1, 2]
Seco? effeo? ero? sarry 2 offeco offeco tolleco sarry
oreco feco? erox sarry defeo? sarry secto sarry
oreco feco? erox sarry defeo? sarry secto sarry
tollorry tolleco deox sarry effeca? effeox sarry effeca?
[P1, 4]
tollorry tolleco deox sarry effeca? effeox sarry sarry
sar erofleco seco? seco? tollecox tollorax erox eraxy secarry 2
[P1, 6]
tolleco ? oecy tollecy tollorax erox eraxy secarry 2
[P1, 7]
odo erfecy sarrox sarry deeth offerax

Folio 26, Recto

[P1, 1]

The colly osant top of toos coffees of the so and coffee the so
[P1, 2]

Second sand ascess of ceffees aces of the so so acethers of the so of the solution of the so

Folio 26, Verso

Folio 27, Recto

Folio 27, Verso

[P1, 1]
Tomot mot mo to copy top offeror of more ferore.

[P1, 2]
8 mg mlar offers to to say say stay larg mus say say
[P1, 3]
If may smollers sto say most of the cost of the say
[P1, 4]
offero my flaces my moy hos o offer some call of the some cost
[P1, 5]
tolly these costs they mothers aftersore
[P1, 6]
sto larrer offers smollers call of the some costs
[P1, 7]
to to to show the

Folio 28, Recto

[P1, 1]

Tooda? Los cocto of cox sann officer copto sop
[P1, 2]

officer officer officer officer sor sor called sop
[P1, 3]

tofficann correction officer correction floward
[P1, 4]

coofficer officer officer officer officer officer
[P1, 5]

officer officer conficer officer officer
[P1, 6]

tofficer tosann officers sor sor tofficer officer
[P1, 7]

coofficer tosann officers sor sor sor sor sor sor
[P1, 8]

occofficer sorticer coofficer officers sor sor sor
[P1, 8]

occofficer sorticer flow son sorticer
[P1, 9]

officer sorticer sorticer sorticer sorticer officers
[P1, 9]

3 Analysis

3.1 Glyph Frequencies

Based on a transliteration by Takahashi (see Section 1), a first basic analysis of frequencies can be performed, by simply counting each Latin letter of the transliteration. This results in Table 1, listing all letters that are used.

Letter	Glyph	Count		
		Takahashi	Takahashi/Bauer	
0	0	25,468		
е	С	20,070		
h	5	17,856		
У	9	17,655		
a	а	14,281		
С	c	13,314		
d	8	12,973		
i	\	11,660		
1	9	10,518		
k	ľ	9,996		
r	5	$7,\!456$		
n	จ	6,141		
t	11	5,968		
q	1	$5,\!423$		
S	₽ 2 ₽	$4,\!501$		
S	S	$2,\!886$		
p		1,406		
m	В	1,116		
T	Ħ	976		
K	ff	938		
f	₽*	425		
P	#	224		
g	අ	96		
F	₽*	80		
I	τ	72		
x	ᆽ	35		
v	٨	9		
Z	ъ	2		

Table 1: Letter frequencies in Takahashi's transliteration.

Determining what counts as one glyph, though, is in some cases an interpretative act. It seems straightforward to assume that σ and $\mathfrak c$ are one glyph (i.e., σ). Likewise, $\mathcal C$ and $\mathfrak c$ could be interpreted as another glyph (i.e., $\mathcal A$). Additionally, one might interpret instances of the, offe, of as representing σ (or $\mathcal A$), on the one hand, and $\mathfrak f$, $\mathfrak f$, or $\mathfrak f$, on the other. Concerning those "gallows" characters, as they have come to be called, it is not clear whether $\mathfrak f$ and $\mathfrak f$ or $\mathfrak f$ and $\mathfrak f$ are variations of the same glyphs, only diverging in one small loop (as Tiltman 1967 seems to have interpreted them). In the following, the four gallows will be treated as distinct glyphs, as has become customary. Accordingly, Table 2 gives frequencies for several σ combinations, taking into account four forms of "pedestalled gallows". The table also includes three instances that bear some resemblance to Latin abbreviations (also see D'Imperio 1978, p. 95).

Furthermore, while there are instances of a single ι , it is not clear whether instances like $\iota\iota$ and $\iota\iota\iota$ or combinations with ϑ like $\iota\vartheta$ or $\iota\iota\vartheta$ represent separate glyphs. Table 3

Letter(s)	Glyph	Count		
		Takahashi	Takahashi/Bauer	
ch	CC	11,008		
Sh	ત્ત	$4,\!501$		
cTh	c ¶c	950		
cKh	clfc	906		
cPh	ct c	216		
cFh	ctc	74		
С	C	143		
со	CO	9		
су	c 9	7		

Table 2: Glyph frequencies in Takahashi's transliteration for several σ combinations.

gives frequencies for several of those χ combinations. Assuming there are three glyphs χ , $\chi \partial_{\lambda}$, and $\chi \chi \partial_{\lambda}$, it is of course difficult to determine when there actually is a $\chi \partial_{\lambda}$ or a $\chi \chi \partial_{\lambda}$.

Letter(s)	Glyph	Count		
		Takahashi	Takahashi/Bauer	
i	١	590		
ii	\\	195		
iii	111	10		
n	J	148		
in	٧)	1,752		
iin	611	4,076		
iiin	1119	154		
iiiin	61111	2		

Table 3: Glyph frequencies in Takahashi's transliteration for several v combinations.

This being said, I tentatively stipulate a set of 22 glyphs. Table 4 gives frequencies for those glyphs. They are counted according to the following rules:

- The glyphs α , δ , c, δ , τ , φ , δ , o, \uparrow , δ , λ , λ , and ϕ are simply counted as before. Hence, frequencies are identical with Table 1.
- The glyph \mathcal{Z} is counted every time \mathcal{Z} and \mathfrak{c} appear consecutively.
- The glyph σc is counted every time σ and c appear consecutively, as well as in cases where there is #, #, #, or # between them.
- The glyph of is counted every time of appears.
- The glyph If is counted every time If, If, or If appears.
- The glyph f is counted every time f or f appears.
- The glyph f is counted every time f or f appears.
- The glyph $\sqrt{3}$ is counted every time $\sqrt{3}$ appear consecutively without there being a preceding second $\sqrt{3}$.
- The glyph \mathcal{N} is counted every time \mathcal{N} , \mathcal{N} , and \mathcal{I} appear consecutively.
- The glyph ι is counted every time it is not part of $\iota \Im$ or $\iota \iota \Im$ as well as in instances of τ .

Letter(s)	Glyph	Count (Percent)		
	0.1	Takahashi		Takahashi/Bauer
0	0	25,468	(15.636)	
е	С	20,070	(12.322)	
У	9	$17,\!655$	(10.839)	
a	α	$14,\!281$	(8.768)	
ch	cc	$13,\!154$	(8.076)	
d	රී	12,973	(7.965)	
k	ľ	10,934	(6.713)	
1	9	10,518	(6.458)	
r	5	$7,\!456$	(4.578)	
t	11	6,944	(4.263)	
q	†	$5,\!423$	(3.329)	
Sh	ત્ત	4,501	(2.763)	
iin	110	4,232	(2.598)	
s	S	$2,\!886$	(1.772)	
in	61	1,752	(1.076)	
р	#	1,630	(1.001)	
i	\	1,240	(0.761)	
m	В	1,116	(0.685)	
f	₽*	505	(0.310)	
g	ද්	96	(0.059)	
x	ᆽ	35	(0.021)	
V	٨	9	(<0.001)	
		162,878		

Table 4: Glyph frequencies in Takahashi's transliteration

3.2 Entropy

Next, let's take a look at the manuscript's entropy. To this end, I utilize the conceptualization of information entropy by Shannon (1948), basically measuring the variability of glyphs in the manuscript. Entropy H can be defined as shown in (1), where p_z denotes the probability of z, with z being an element of the alphabet Z.

$$H = -\sum_{z \in Z} p_z \log_2 p_z \tag{1}$$

To calculate the entropy, I suppose the above stipulated glyphs to form alphabet Z (see Table 4). Accordingly, changes to the corpus are made so that each stipulated glyph has a single corresponding character in the transliteration. Changes are made according to the following rules:

- The glyph α is represented by Sh in EVA. For calculating the entropy, every time S and h appear consecutively, they are replaced by 1
- The glyph σ is represented by ch in EVA. Every time c and h appear consecutively, they are replaced by 2. Following the above stated rules for glyph counting, σ is also believed to be present when σ and c are separated by ff, ff, or ff, represented by ff, ff, or ff are also present. They are represented by ff, ff, or ff are also present. They are represented by ff, ff, or ff are also present. They are represented by ff, ff, or ff are also present. They are represented by ff, ff, ff, or ff are also present. They are represented by ff, ff, ff, or ff are also present.
- The glyph of, represented by z in EVA, is counted as ff, represented by k in EVA. Hence, every z is replaced by k.

- The glyph $\sqrt{3}$ is represented by in in EVA. Every time i and n appear consecutively, they are replaced by 4.
- Lastly, the glyph τ , represented by I in EVA, is counted as ι , represented by i in EVA. Hence, every I is replaced by i.

Calculating the entropy for this converted corpus results in H=3.866. As comparisons, Table 5 also offers the entropy values for the unconverted transliteration as well as for a randomly generated text consisting of 22 different characters and being 234,956 characters long (just as the converted transliteration).

Corpus	H
Takahashi	4.021
Takahashi (converted)	3.866
Takahashi/Bauer	
Takahashi/Bauer (converted)	
Random text	4.459

Table 5: Entropy (H) for different transliterations.

References

- Beinecke Rare Book and Manuscript Library. 2004. "Cipher manuscript (Voynich manuscript)." Accessed February 14, 2023. https://collections.library.yale.edu/catalog/2002046/.
- Bettencourt, Rebecca. 2019. "Voynich unicode." Accessed January 30, 2023. https://www.kreativekorp.com/software/fonts/voynich/.
- Clemens, Raymond, ed. 2016. *The Voynich manuscript*. New Haven and London: Yale University Press.
- D'Imperio, Mary. 1978. The Voynich manuscript. An elegant enigma. Maryland: National Security Agency/Central Security Service.
- Schwerdtfeger, Elias. 2004. "Voynich information browser." Accessed January 30, 2023. http://voynich.freie-literatur.de/.
- Shannon, Claude Elwood. 1948. "A mathematical theory of communication." *Bell System Technical Journal* 27 (3): 379–423.
- Stolfi, Jorge. 1998. "Reeds/Landini's interlinear file in EVA, version 1.6e6." Accessed February 12, 2023. https://www.ic.unicamp.br/~stolfi/voynich/98-12-28-interln16e6/.
- Takahashi, Takeshi. 1999. "Voynich manuscript-transcription." Accessed January 30, 2023. http://www.voynich.com/pages/index.htm.
- Tiltman, John. 1967. "The Voynich manuscript. The most mysterious manuscript in the world." NSA Technical Journal 12:41–85.
- Zandbergen, René. 2023. "Text analysis. Transliteration of the text." Accessed February 2, 2023. http://www.voynich.nu/transcr.html.