# Beinecke MS 408

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

Alexander Max Bauer

# Contents

1	Intro	oduction	3
2	Transcription		4
3	Ana	Analysis	
	3.1	Glyph Frequencies	. 110
	3.2	Entropy	. 112

# 1 Introduction

In Section 2, 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 on a best guess basis. In total, I made changes in 394 places of Takahashi's transliteration. Changes to Takahashi's reading are highlighted in orange:

- Glyphs that I interpret in another way than Takahashi or that I add to the corpus are printed in orange, showing my interpretation.
- When a glyph has been deleted by me without replacement, this is indicated by  $\varkappa$ .
- Removed spaces are marked with  $\sim$  and added spaces are indicated by  $\sim$ .
- Added paragraphs are represented by ¶.

Especially the recognition of spaces in running text is, as Takahashi has already noted, sometimes very difficult. As is, in some cases, the distinction of some glyphs (e.g., a and o or a and conference, my adjustments in this—just as in any other—regard should be taken with a certain amount of caution.

Note that places where the writing is interrupted (e.g., by illustrations) are marked by em dashes (—). Each line of the transcription is preceded by a locator in square brackets, informing 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.

Of course, this revision would not have been possible without Takeshi Takahashi's incredible work. Hence, I would like to stress that this is not meant as a criticism of his transliteration; I am merely adding a few carefully selected new interpretations. This work is not comparable to the effort he has put in.

<sup>1</sup> Hence, changes that Takahashi made to his transliteration in subsequent versions are not included. Further note that 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

8000110

```
Paccos offax ar affarry door doro offeres of 1602 doorso
     Cos Faths Faths are Fath Willam Fill o Fo Faths ofoos
     OS UNIBSOS SSOND OF OBLIVE BOD ON DILO FO OPLIND FINDOS
     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 2005 ctog 2009
[T2, 10]
     psooff So Gras
[P3, 11]
     Sagabosta osos Prolle catta Saga Prissata 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 Vist Visses executes early sail and effective
     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 Chos
     coso farro coarro offog sarro far ctoog sarro ctoogsar
     gorceg ollag ollg sarry olloreg lollarry otorog llasorg sag
     Soco dos locas effe offers for for sag affor
     To Tox Toll Tollo Tollo
```

#### Folio 1, Verso

```
[P2, 5]
Tollog clos sand choose— sad cucy flosy offician decay follog chose sand choose — sad cucy flosy offician decay choose choose choose considerate points are choosed considerated as a considerate choosed considerated considerate choosed considerated considerated choosed considerated choosed considerated considerated choosed considerated considerated considerated choosed considerated consid
```

#### Folio 2, Recto

offox crop crop offrop 900 and cran — 2avvi crefts crofts 2axvi

to office one sand ortho

# Folio 2, Verso

#### Folio 3, Recto

[P3, 15]

The coaron to roop of the operation of the oper

[P4, 18]

Taccogoog acosally totacor totog otacog totog — ottogoog

[P4, 19]

otlacor og accor tocor salr totlag tolally — acor atlag

[P4, 20]

gaccor acog osally acog 2 ally otlogor as

#### Folio 3, Verso

[P2, 7]

There of other of the start of the start of other of the start of the star

#### Folio 4, Recto

#### Folio 4, Verso

[P2, 7]

Thoras accor and animal properties [P2, 8]

ogaco and and after an office after office of the properties and according according

# Folio 5, Recto

[P1, 1]

Microso Teros erlos oarro ogro eroso slico so
[P1, 2]

oeros olios tollarro do etlos etles eros olia\*or otlos
[P1, 3]

toarro otlar ero sarro otles eros otles otles otles so
[P1, 4]

# Folio 5, Verso

[P1, 1]

Notice of the of the

#### Folio 6, Recto

#### Folio 6, Verso

```
[P1, 1]

Noa? 9 2a? accila? toa? co? attag 2 aca? aa? offag

[P1, 2]

occ2 aco? actteg toclaa? aca2 obarro lace aco? acar.

[P1, 3]

toar? attg acox ooacoattg aclasog attg offox ?gaco?

[P1, 4]

g dettg gfacog 2o2 g babg bag bag offox offobg

garb da cobay bay offor offg boxboy
```

[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 arr offar after 89

[P2, 12] officeo2 ctg folfax cfftg 908a110 cttg 2 cto7 occ2 o7 tollof cros effeos flerasoso coeffeg S oS crg Savo o? oceg cttar cttar cttar cttag 9 ccarro ctrag ctrosas 39 officer officer and affect octogg fleto etg 807 gocco? coo? octtag

#### Folio 7, Recto

```
[P1, 1] facobarry tho — deg tool deeg adroad form for a deeg facobarry facobarry facobarry facobarry facobarry facobarry facobarry for a deeg facobarry deeg for a degree for
```

[P2, 0]

[Recognized to those control colored to the control c

#### 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
```

#### Folio 8, Recto

```
[P1, 1]
Those crop official crofts — choose crops described choose crops -
               Tictle of the case of office of the sand as
 _{\text{[P1, 4]}}^{\text{coba}} cto ^{2} γ ^{2} cto8a\\^{2} cto8a\\^{2} cto8a\
  tothor cror cror charge — scrop charges and frages _{	ext{P1, 5]}}
               offeco 80 ? ecces 89 lfg - Zero elfg elfooarry ero ffarry
               Tot offices of total of the court of the cou
cooto Parol coot 8a VI
               8000 8a118
              Through the faces face - ofaces staces the sall the
               8arry cross gos son — ce costro office sos sarra
ctor crossing sand so — offices cross cross offarno
olollcross
 [P3, 14]
               effice offices and possible of the sook of the contraction of the cont
. Screg effect crop crop field — crop cffoda 110 dog da 111 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 110 
  . . goves horollog ordes horo — docarro officare \frac{1}{[P3,17]}
ctor 8009 follar ctr — and ctcal off otar ctand _{[P3, 18]}
ola? ctaii) craii cq — 8aii cro? cra ?creaqeray
               Part cecard ctoop 8a? - coop llarry coop llarry sarllag
Scrop Sars
```

#### Folio 8, Verso

```
CHOOS COOCHE - SOS coop offer coop offercally offered with
               chille parless food by the food to the contract of the contrac
             7089 \text{ creas } 7089 \text{ creas} 
             8ctos ctos 8as cecas ettas ceaso 8avv ceaso
crop crop 8a? — official chair cofficient 8a? _{[P1,\,6]}
             Sallo Cital — offices coop fallo dalla
             Éco Paros — 8a7 Eco Ettar cootlavo 79
             offerog that — crop crop crop offer 1) sand
             द्रे०६ ०२८६ — टा०ीटि ट ८०६ टीटिं० राव११०
             80923 — occoso Marco tag charos
            G1B90S
[P2, 12]
             Foral oro log bag — Leal occollann orag bann
              Partie office office of the start of the sta
\frac{1}{2} choose sollarly — choose flor cras effects flore effects

ho9 fon ellsson fan G100 fon G200 G200 fon G200 fon
             GIVES on 6280n font 60216 — EDON EDON LOS
             8017 cccaf 80117
```

#### Folio 9, Recto

[P2, 6]
Throand official offic

#### Folio 9, Verso

[P2, 5]

Took ofteeg tottor ofter oretrogo the area with sanny

[P2, 6]

odor crop thecodo crodo — sand — otter — ethod — offe

[P2, 7]

tocror crop ether sanny — ottar — sor — sand

[P2, 8]

2011 danny totter rolled — sard

[P2, 9]

danny crop thore croft sard — ottore

sanny

[P2, 10]

off theore crop crop thoth

[P2, 11]

octor credity off thanny

critanny ethor

#### Folio 10, Recto

```
[P1, 1]

To cotting on other of octors to obey on the series of the seri
```

```
[P2, 6]
gocoo? effeg coo? effearry toeffeogg 89 — cog flarry etg
[P2, 7]
8ccg tollewog glecarry offg 8arry effe — 8arry 8arr ag
[P2, 8]
tollewor coo? offog crog crogo? — crog 8arry 8ar
[P2, 9]
oglicror coo? croq crogo? — crog 8arry 8ar
[P2, 10]
offoloo offor ceteg effeor ocarry offorry
[P2, 11]
Poollewo croo? tolloo effeor effeor ocarry
Poollewo croo? tolloo tolloo effeor offor
```

# Folio 10, Verso

[P1, 1]

Tand dand coo forces tothe dand offer offer dand offer offer and following the dand offer offer and the following offer of and following offer of and dand offer offer and dand offer offer offer of dand offer offer of offer of dand offer offer of offer off

[P2, 4]

totagtage con sand totage cottes of of sand

[P2, 5]

co office sand totage totage con sand totage

con office sand totage

con office sand totage

con office con con totage

# Folio 11, Recto

[P1, 1]

1 thicog 2 croag ctog ctog ctog ctog through choosing

[P1, 2]

2 octhoosy toso? 9 thicy sann offers offerolly through sann

[P1, 3]

totag crog ctog so? 9 those crotag sann crand sann ses

serog crog through so sann

[P2, 5]

There is the start of the start of

# Folio 11, Verso

[P1, 1]
Topderody cicting cooled total — cooperate day g

[P1, 2]
choop dy cicting cicting danny day — glicing danny derg

cooperate diction death of the day tolled — olly crop dy dy

tolled cooperate cicling day tolled — olly crop dy dy

tolled cooperate cooperate cooperate day

[P1, 4]
tolled cooperate cooperate day day — office the diction of day

[P1, 5]
Cooperate cooperate cooperate day day — office day are

percor licing door office day day

# Folio 12

Folio 12 is missing from the manuscript.

#### Folio 13, Recto

# Folio 13, Verso

```
[P1, 1]

floar? citlored offices offices offices offices

[P1, 2]

offices to floar crosses offices cities crosses

toffices to flos crosses offices cities

[P1, 4]

oge crosses offices offices

[P1, 5]

toffices darred
```

#### 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 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.

(P1, 8)

collano?

sann offano.

optano offano.

optano.

opt

#### Folio 15, Recto

```
[P1, 1]

The cor accomplete and according according
```

#### 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 P 8agg8ag of Tog force of Took of Took of Sagg8ag of Took of Sagge of Took of Took of Sagge of Took of Took of Sagge of Took of Too

# Folio 16, Verso

```
[P1, 1]

Terranno offeror enterox entercy 2 teroetly

[P1, 2]

offeror of the enterox followether tory

p1, 3]

offero so enother of the end to the total

[P1, 4]

secox enethers ettos enotion sax

[P1, 5]

offero enoting enor enox offero san

[P1, 6]

Zor entor other enterox sancy
```

#### Folio 17, Recto

```
[P1, 1]

**Theody da?as gda?ccos ofgdg gfod ccof office dodg ogdeffeg
[P1, 2]

gda.? ccolly ollety toda? effects do? office todeffeg od?

[P2, 4]

**Theos dog tollog to? oga... ofgdg — Zos gferg gfa.s

[P2, 5]

gocelleg effeg co? do? effec? effects og da.? effect tode

[P3, 7]

If de to tollec to cogde meteg

Bace dogera? Zoca? gferg

Zog ceffec o da? ccgferas

Bace dogera? dogeras

Bace dog
```

#### 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 G//210 90 G//210 90 90130 6112 So Fosso S110 Cost post Fos †ollcog llca? og 89 crog8a112 29 general feros erostanos os [P1, 10] ogto7 olco7 ola7 olog 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]

**Total Para Poss of goal offices sal o of ceeling—oction sage [P1, 2]

offices total conditions and the same offices of sal offices total conditions and the same offices offices offices offices sal offices sal offices of
```

## Folio 18, Verso

```
[P1, 1]

**Thogo coop office office of office offi
```

### Folio 19, Recto

## Folio 19, Verso

```
[P1, 1]
foca \\ \) cfto \ cottocolor ofcico fo loco foca \\ \) cfto \ cottocolor ofcico fo loco follow \\
[P1, 2]
follow flow 20\ follow \\
[P1, 3]
office coop sa\\\\ follow office sa\\\\\
[P1, 4]
office coeffe follow sa\\\\\
[P1, 5]
follow follow sa\\\\\\
[P1, 6]
occop loco\ coeffe coeffe \\
[P1, 7]
occo\ coeffe \\
[P1, 7]
```

### Folio 20, Recto

[P1, 1]

Notice of the control of th

[P2, 5]

Throoffing molloanny off mechy offers docanny?

[P2, 6]

mocco offero? follog mechy sanny may monny sanny

per, 7]

omogened sanny molleog mog sog etog offanny

[P2, 8]

Comosany moc ? mecoso

[P3, 9]

Toodeco dody tottong tottong toothy orothogogo

[P3, 10]

ootoall oroof dody toodall orothogogo orothy dog too

[P3, 11]

dool tottondy offers tottong domall orogody

[P3, 12]

doll oroody offers offers they tottong dall dark

[P3, 13]

ootall oroof oroof orony they

### Folio 20, Verso

#### Folio 21, Recto

[P1, 1]
Theor occoeffics objects offered to the code offered o

[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]

Top open fecosy took offers offs offs offs sann offers 2 octos
[P1, 2]

or on the tollers sann offs tollers sann offs offs sand effects
[P1, 3]

tollog softs no lot tollers sann offs offs sand offs offs softs.

[P3, 7]

Moros dos socos ello cesoso offarro of — offero etas

Boros offo sarro theoso tollo confarro confero — sorro secos

Boros offo sarro effecos ofarro

[P4, 10]
| Kocog ceof dann officent decof cecof tollog do — ofceog ogdang
| P4, 11]
| donn officed tollog olf offogdo off dog of — deceg dann
| P4, 12]
| odceann office olf ceof decog dann — oddann
| P4, 13]
| decof dogdan tollog olf ogolfan

### Folio 22, Verso

```
[P1, 1]

**ToZarrior office of
```

```
[P2, 6]

Thoo to the following the proof of the proof of
```

### Folio 23, Recto

[P2. 4]

tollogog ollariz ollariz ollariz ollariz ollariz ollariz ollariz ollariz

getor tollariz ollariz ollariz ollariz ollariz ollariz

getor tollariz ollariz ollariz

[P3, 6]

Thereographically offs and offs series sand offers seas?

[P3, 7]

offar operar tanno tollerog sar tollerog santo r og sanno agg

[P3, 8]

tolleroge car sanno tolland ogog toand offers 2 — sing offers

[P3, 9]

offog off to tollog so — sog stee tolleres og ogo — sanno sag

[P3, 10]

toll offand elleroge - offers osag erag so — sar offand

[P3, 11]

offollo sagoro

### Folio 23, Verso

### 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 Socos of S coco coche Sas too ceces too cear offeas S 208 20 Sosso Sosostao ट्टंबर जीटबर ठवर ठवर ठवर ollo posto pato pollo estis  ${\displaystyle \mathop{\mathsf{o}}_{\scriptscriptstyle{[P1,\,19]}}}^{\phantom{\dagger}}$  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? To 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 follo do sarry folloco offeco folloco? CoC

[P1, 2]

Seco? effeo? ero? sarry 2 offecarry sarry effeco? Soc

[P1, 3]

oreco feco? erox sarry effeco? sarry secret sarry

folloring folloco dos sarry effecar effecox sarry effecar

[P1, 4]

folloring follocox secox sarry effecar effecox sarry sarry

sar eroffecox secox secret focox sox ero sarry sarry

follocox ocox follocox follorax — erox erary secarry 2

odo erfecy sarrox sarry deeth — orecarry

### Folio 26, Recto

```
[P1, 1]

The colly obanged from the collection of the collection o
```

### Folio 26, Verso

#### Folio 27, Recto

```
[P1, 1]

[P0, 2]

89 coard tog sard sare togard togs— tos care
[P1, 3]

cos tog theorem tog tog tog tog tog theog sare
[P1, 4]

†olleg too tog tog theory
[P1, 5]

80? telee theo tog theory
[P1, 6]

cos theory
[P1, 6]

cos theory
[P2, 7]

fletog tog theory
[P2, 8]

9fletog tog theory
go theory
go
```

## Folio 27, Verso

```
[P1, 1]
Tocol col co do 2009 dos offico? ofco? fleoreo?
[P1, 2]
8cg colla? offico do sca sca? cosa officos do sca sca?
[P1, 3]
Ifaco fleo scollag scol sca? cosa officos do sca fleo soccos
[P1, 4]
offico co flecos cos cos flos — o offico soccos
[P1, 5]
tollo defico 2cosa? defos — coffico soccos
[P1, 6]
sho fleo to 2cosa? defos — cofficos
[P1, 7]
do do offico deso — sca cos — cofficos
[P1, 7]
do do offico deso — sca — collas
officos officos fleos
```

### Folio 28, Recto

[P1, 1]
Toosar dos coctos ofcos sanno — officos costo segente officor officor

### Folio 28, Verso

```
[P1, 1]

| ltdog toolly do? ttdolly detter tolly 89 do?9

[P1, 2]

olicogy tolly as 89 tolicog aco? ttag tolicos9 aco? o

[P1, 3]

co? acog acy acolly
```

[P2, 4]

11/2011 - The control of th

[P3, 7]

Toog ond ond the dand of the sand of the sand

### Folio 29, Recto

```
[P1, 1]

To2a11 & call off and total off and total off according [P1, 2]

8 of graph of and off and according and for any form total off and for all off according and for all off according and form of according to for according to for according to for according to according to
```

### Folio 29, Verso

### Folio 30, Recto

```
offectop acq dotacq tacosq deq they act so deq per 29 offectoq acq affectoq theorem according act so decq offectoq act offettoq act off
```

```
[P2, 8]
of trop of circles decree decree of trage — series decree of trage of trage — series decree decree
```

### Folio 30, Verso

[P1, 1]

cftc2cftcavd &co2avvd crocftce of or ctfce of decavvd

[P1, 2]

tottcoof ce of de tecof crof bloof of ce of davvd cftcoff

cooftcoof davvd cftcoff dove dovvd davvd crotfcoff dag cettorfte

[P1, 4]

oftce of davvd croff crocfte of tottcooff day cettorfte

[P1, 6]

tottcooff crotfoff cettoff

[P1, 7]

crotfce of crotfoff cettoff

[P1, 8]

ogde crotfoff cfcoavvd cftco

[P1, 8]

tottcooff croff croff davvd cftcoff

[P1, 10]

cooffce offce offce davvd

cooffce croffce davvd

[P1, 11]

#### Folio 31, Recto

offco? arrefteg

```
Probable to the South following the followin
         80000 January Collect S and collect total
tolleg ecco sand tolleg fant eccles sand seg
total ccg 8al so \leq al cccc llccox ccc80 tollcg [P1, 5]
         90010t 0800055 (111B
         Theolicoso tolicos tolicos ecctar ecoso ? and sag
per, 7]
glice da? Zarri cocofficos cocos folicos glicedo cocos gos
[P2, 8]
cocos folicos cocos cocos folicos cocos cocofficos
[P2, 9]
         80117 Ecco Ecttog offcog
[P3, 10]
        Those and offices tolless tolless tolless sar acording
oxéccox tollers dax ency decy lety lees offarrid splecy _{[P3,\ 12]}
†οαινθ 9σες ο Μεδο δες σες σεςδαινθ δα?
obsolo Gilbe obsos so Silos
octobar choog collo ollobar
```

### Folio 31, Verso

[P1, 1]
Toda \ ? &ccess offices offices toffogetee 2 a ? a? offices offices age
[P1, 2]
officeo octives officeo eccoss offices focoss sand eccoss focoss
[P1, 3]
officeo sand &csos offices offices offices offices offices
[P1, 4]
san? effices toffoss offices eccoss offices ag octives offices
[P1, 5]
office eccoss a? and

P2, 6]

Toccoso tot occos occition of occitions of occit again of a theo offar

[P2, 7]

og ficeday occi occi ficeog occition offag offag offa occided offar

[P2, 8]

off and occided offaces occided offaces occided offag

[P2, 9]

officecog occided offaces and antificed occided occided offaces

[P2, 10]

sar occided offaces occided offaces offaces offaces offaces

[P2, 10]

sar occided offaces occided offaces offaces offaces offaces

[P2, 11]

Zand offaces occided offaces offaces offaces

### Folio 32, Recto

```
[PI, I]

Toolid deglicos salvos salv — do too off too
             .2020 Potor Cocord clip sas — 8ctobar fothcos
   tollcrof crof ettrog crog sog — scrcosand sand
  toffers toffers sand
[P2, 6]

Laco Hace aces
   offor sox ox sar?
  †oa? 8a\\V 8a8
   8011cco2 8a29
[P2, 10]
8cto? cffco 8a\\\\
[P2, 11]

cto2 cccffcox \(\bar{V}\)

[P2, 12]
           ट्टें08a110 ट्रीं08
             office of sand sand cttog
 [P2, 14]

Cocco toll occo sand offer
 tollary tollog 80117 og [P2, 16]

Tollarog acco 2019
   [P2, 17]
  حدهالاده الادمال المراقع المر
los scros sas
```

### Folio 32, Verso

```
[P1, 1]

| The cosann cos | The cos follows of the same of the sam
```

[P2, 7]

Ilito cto? to tecanno officeo dan — tetto 2 odal

[P2, 8]

officeo danno danno effeo danno toffano — officeo de tea

[P2, 9]

tofficeo effeo effeo effeo danno effeano — danno

[P2, 10]

to lleo ero? ero danno effeo effeo da — a?

[P2, 11]

og to ero

### Folio 33, Recto

[P1, 1]

The sar also actes of the so of order of offered offered offered sand

[P1, 1]

offered to the action of a sand offered offered offered offered offered

sond of action of the so action offered offe

### Folio 33, Verso

```
[P2, 7]

**Thicks of the solution of the solut
```

#### Folio 34, Recto

```
[P1, 1]

**Tercoefferg oga? gg — gfo3g offe803g et03 ogog3g 3a? gffeg
911a7 &cco89 08a8 — octtcc89 offc89 cc8a10 081c9 ffc9 ffc9
toticog crotig crosses — 8a7 cros oticog totig olicog 8089 obg llag _{\mathrm{[P1,4]}}
      9tc89 8a11 cc9 a11 — co cctto 9
      folicoso coso coso og — olico a2 — oglicoco olicos sag cocilio
offeds welled welled ors — weld — offeeds well offed offed of 0
tollodg dag codg — ogcog — gllcoxg — dann collg tad and agg
      Lotterg tollg — ogli — ercetteg — glicog tollerog 2 at ogoan
9/10089 108 — a7 — ccott — atto — 92a 17 a 17 cco8a7 flag
      obsecto flosago offarro sarso
      There of cells of market and cells of the same of the 
†olicco & lagoarro — ceclo ctesago oticeso cetto 2011
.

cca? a\\dolon olfo? a? Hog — folfa? ccolfcg cc8ag lfc8 folfa? a? 8a\\dd 8a\\
gho sof occo oso — ollaso flocoso tolloso coof af a1110 8aso _{[P3,15]}
\stackrel{\cdot}{\circ} of at 9 lat og ag off — cross to lag cross crefteds creft satas
      2a17 acla? aclfo chell — acosaceso tolleso of accosacetto
```

### Folio 34, Verso

[P1, 1]
[Pacoso coso culturo deso totales desoso cuesares oftes cultus 2tanol [P1, 2]
Those tollows socies ollows cultus cultus custos cultus cultus could societ and order oftes cultus cultus

[P2, 6]
There da? Lea? to the day to the edge of the day of the da

### Folio 35, Recto

```
[P1, 1]

cffroo? crops cffrs croffs cra? 39

[P1, 2]

tollicann crollann tollicas anno

scanno cffrcs tollicus flann cffro?

[P1, 4]

tollicus chilicus cffros crocs sanno sanno

[P1, 5]

offro? cho flacces crocs sanno sanno

[P1, 6]

cranno cra? crad sanno

[P1, 7]

chollicus flanno sanno

[P2, 9]

tanno cranno cffro cracs cracs sanno

[P2, 10]

o anno cranno cffro cracs cracs sanno

[P2, 11]

chaccanno cros cffranno scanno scan san san san asso o

[P2, 12]

oso? cra cranno cra flanno flanno flanno

[P2, 13]

tollono cranno tollicus offro? sanno cffranno

[P2, 14]

cffros cros anno tollicus offro? sanno chos tollanno

[P2, 15]

ocro? 2 crnno sanno offano? sanno chos tollanno

pre, 15]

ocro? 2 crnno sanno offano
```

### Folio 35, Verso

fa? cco? ccocffcg ?oa\\dagger a? totlarg offaceg llaco? offa Boro For collo sally [P1, 4]
offce folice for offe Scroller croeffed creffed? Los flaces affecces actesive The golf os cos for Sarry 00110 Hero? to to the strong 8 9905 9aSon وعدماً †offceccann ceosann 8000110 80110 80110 809 8 . og cta? oð a? ctca? Mercan 29 Mar 3and olfog croog offerg ffer 98axid offcc9 8axid Barry gard cellago ceogo 8 000 Polices Possibot Pinas Scrolleg gloss cros sarry 80110 CO2 CO2

## Folio 36, Recto

```
[P2, 4] To 3a \ \? cft 9 to 9 fcc 0 x \frac{2}{9} cc 9 sc 9 fcc 8 a ? [P2, 5] 3a \ \) to ? cc 9 cft 0 x 9 ? \frac{2}{9} cc 9 sc 9 fcc 8 a ? \frac{2}{9} cc 9 sc 9 \frac{2}{9} cc 9 sa \frac{2}{9} cc 9 sa \frac{2}{9} cc 9 fa \frac{2}{9} cc 9 fa
```

## Folio 36, Verso

```
[P1, 1]
Tocalaly totology coannil therey exetting offannil efteal sannil
total engress sannil offannil totology offan octol exetty efteal son
[P1, 3]
sergificing offor 2 — offannil totology offan offerannil
[P1, 4]
totherol off to so — sannil efteal
```

```
[P2, 5]

Thereof effeon dann effecta?

[P2, 6]

Sann effeor sann sag sg2

[P2, 7]

Tolly leog offeror of ero can

[P2, 8]

offer goffer sog offes goff of goff of goffer goffer goff ero ero ero effect goff of ero effect gof
```

## Folio 37, Recto

```
[P1, 1]

1 foctog cannot tollor of cor off coro sanno offos or [P1, 2]

9 flonn cftcor offanno tollor offos tolland co offanno foctog tolland cftcor offanno
```

[P2, 4]

Toollog sann oftog sar ong sann — 98

[P2, 5]

9/19 tollog tollog offog

[P2, 6]

ctor ctor tollog tollogos — song sann

[P2, 7]

207 ong 1/07 tollor sann

[P3, 8]

No.10 ccorosg tollarid ctorg offag — ctor ctcor sar

[P3, 9]

gliccosg tollarg gliarid ccg tollor—sg — office gog sarid

tollo ollacoccor sacor ccg ctg sarid — gaccg llog sarir

ollacor sarid cffcg sard sarid

## Folio 37, Verso

```
[P1, 1]

| fictody toothey tothogogy croffsand cog [P1, 2]
| 80? crog ctro? o?cro cro? dann)
| folicrod cty crod dann dy decor defined decor decor dann)
| 8ctor defined decor dann
| P1, 6]
| golfor other offcand dann
| p1, 6]
| golfor other cannot offg
| p1, 7]
| tothcor dann
```

[P3, 14]

Thosand ctann ctropose

[P3, 15]

20110 ccollog sand sand

[P3, 16]

Tothor sand ccothand

[P3, 17]

201100 tothon dand sand osg

[P3, 18]

office sand sand osg

[P3, 19]

sand thond tothog sand

[P3, 20]

occothacy offor sand ctrope

[P3, 21]

occothacy offor sand ctrope

[P3, 22]

Tothog offord coothacy

[P3, 23]

# Folio 38, Recto

```
[P1, 1]

Thoso? crocifics — olly crown ollicos ogg olly

[P1, 2]

ollicos crosso? — ofform offarm offarm offarm

tollo? ollarm — offarm tollicos crollollo?

[P1, 4]

garoll cros crotit — cro cello? osam dann ogg

[P1, 5]

ollo? cros llard — cro? offo sand offogs

[P1, 6]

garo coo llo? — sand ollog crocro? sand
```

# Folio 38, Verso

```
[P1, 1]
  office of crop chotog offices offices of crop & and & and & [P1, 2]
  ctonn chotog fice cho on on offices and control offices for the crop offices fices and offices fices and offices fices and offices and offices and the control offices and the control offices and and and files fices fices fices and and and files for the control offices and and and files for the control offices and and and files for the control of the control o
```

#### Folio 39, Recto

[P1, 1]

The so are a cheer of as and each term of or and are than of other soft of the so

[P2, 6]

\*\*Tecology of the state of the stat

[P3, 10]

\*\*Tecolor decolor are anterested and anterested anterest

## Folio 39, Verso

[P1, 1]

#8a\? cc89 #8911a\D o? a\? &c911a\\\D o#c09 11a? o? a\\D &ox 119 o&&9

[P1, 2]

20? &g 110? cc0x totto 11cc89 ox 119 80? cc89 of 1a? ox 11c8a\\D o&9 89

8a\\D cc0? of 1a\D of 1a\\T cc089 2a\\D o? a\\D to 1a\\D of 1a\\D of 168a\\D of 168

9 of 1cc9 cc089 ccc0? a\\D of 1689 cc08ax of 1c89 to 1c89 8ax o? a\\D &f 1689

of 1c89 110? o? &c19 11a\D of 1a? o? a\\D of 1a\\D of 1a\\D of 1689

x 11c89 of 1cc9 &o? \tag{168} co cf 1689 cc of 1689

#### Folio 40, Recto

```
[P1, 1]

Taco Ilcosar agsgsg — tollg ollag 289 oglicsg offace ar orsanni

tollar ollar ollar sar — glaco Ilanni ollor aces ollar aragor

[P1, 3]

29 tollag as gar — glar ollor and ollogar tollar ollar

[P1, 4]

or and acellos sar — tollog ollanni ollar ollg ollogsg og

[P1, 5]

gollar tollar ollar — ollog og aces tollar ar ar or sag

[P1, 6]

Thor or ar and ollor of — ogaces tollar area Ilar oranni

gand acelland oll — gaces
```

[P2, 8]

| face | face & are are marked of and are face & are face

## Folio 40, Verso

```
[P1, 1]

Tocosand occtanno ogso
[P1, 2]

Thosa? tolland og aras
[P1, 3]

Z anr and olland otlas

[P1, 4]

Tharand olland occtar

[P1, 5]

Zogand ollar ogg occtar
[P1, 6]

tocos and og occso sand
[P1, 7]

chosy tollog occso ar
[P1, 7]

chosy tollog occso ar
[P1, 8]

chosy tollog occso ollag
[P1, 9]

Thocosand occlar ollar og
[P1, 10]

Thocosand focso folland
[P1, 11]

Zoccso tollog occso sagor antico
[P1, 12]

goccclicco sand olland

[P2, 13]
```

#### Folio 41, Recto

```
[P1, 1]

Taco licoarco olico acilica — otaco otaco talalicos polico araco olico technologia polico araco olico licoarco — otaco otaco otaco araco olico ilcoarco otaco o
```

[P2, 6]

checked formed folices melicos office — milimos offices for checks

[P2, 7]

farmes firmes offices folicos — offices milimos offices folices

farmes firmes offices folicos — offices milimos folices meets

and milimos folices melicos melicos — folicos melicos melicos folicos offices melicos melicos melicos melicos melicos melicos melicos melicos folicos folicos folicos folicos folicos folicos melicos melicos melicos melicos melicos melicos folicos folicos folicos melicos me

## Folio 41, Verso

```
[TI, 1]
| Mcc2odag
| [PI, 2]
| Taccodo totaccito otado atechado — otacedo acetacito adacedo totas da?
| [PI, 3]
| Sacedo taceo 2 and acetaco otado otago — sand otago oficeo oficeo sas
| [PI, 4]
| totado otago totacodo oraceo electro otago — eleccodo totaceo otago acede
| [PI, 5]
| oaceo oraceo sand or aced otago oraceo oraceo oraceo oraceo otago otago oraceo otago otago
```

```
Folio 42, Recto
 Costa to otalia patracetto offices forca?
 Osymbarry Cells offcarry carres
Tocto celleta ceollar cears &ag
 Fire Fab Siallow Fallow Fois
toldar croctly crotlor toldar
 807a17 cca?
 र्रिट० ८९ १८४० १० २०१४ १० ५००
octog crec2 ettog cto7 ctog ettog cra79
+ offceo? offceog cffco fceo8al cellceo?9
colfs dog lícico efferd offog efferg crog — crog da \sqrt{0} [P2, 11]
. Screeg crop chor crollann croelly scffg — sand sage _{[P2,\ 13]}
to like colf colary crosarry barry — 8ag _{[T2, \, 15]}
 Tocoso offices sosarry
```

# Folio 42, Verso

```
8chcg flowg g llowg colleg ctg 8al - 8al offog 8all
                  أوه ما الله و الله عنه من الله عنه الله على الله عنه الله على الله عنه الله عنه الله على الله عنه الل
 †offceg celloeg 2a2 8g — o8arrs — glloeg ollog 83
 collector cocy collar - of - of - of - or - of - of - or - of - or - of - or 
 offcollear creotlerar — 29 — Zarri ctrar 8ag
colf decolled less 8 — are less \frac{1}{[P1,\,8]}
                  GIIDS RDBOS
                 Total of the state of the state
                  \mathcal{S} cos offers \mathcal{S} of \mathcal{S} or \mathcal{S} or \mathcal{S} or \mathcal{S} or \mathcal{S}
to all tolless less energy offcos -8 — they feall 8 _{[P2,\ 12]}
 coffeecy cox ox early officered — either flaxly 9 _{\rm [P2,\ 13]}^{\rm [P2,\ 13]}
to acq floof they accounting savid — acolling savid
 tother one they offer choose — 2a^2a^2 are a^2a^2
                  حزهاادع حرمع ماادع
                  02280 Follo
```

#### Folio 43, Recto

[P1, 1]

The rose in the rose of the restrict of the restrict of the rose of t

## Folio 43, Verso

[P1, 1]

\*\*T82a\?9 &ax11cocc9 &a x9 ccc11 o? a?osx x11co ? a?a\\\) ottcs9 o toxs9

[P1, 2]

\*\*Ccc89 octto ottcs9 ccc89 &a? ccc2 to ottcs9 ott9 ottax89 toxs9 otta?

[P1, 3]

\*\*Toss9 toxs9 tott coctto cclf0 ott9 ccs9 ottcs9 ottax\\)

\*\*Toss9 ottos9 ccc2 a\\\)

\*\*Ccc11 o? a?osy x11cocs9 ottos9 ottax\\

\*\*Ccc11 o? a?osy x11cocs9 ottos9 ottax\\

\*\*Ccc11 o? a?osy ottos9 ccc11cocs9 ottos9 ottax\\

\*\*Toss9 ottos9 ottos9 ccc11cocs9

\*\*Toss9 ottos9 ottos9 ccc11cocs9

\*\*Toss9 ottos9 ottos9 ottos9 cct11cocs9

\*\*Toss9 ottos9 ottos9 ottos9

\*\*Toss9 ottos9 ottos9 ottos9

\*\*Toss9 ottos9 ottos9

\*\*Toss9 ottos9 ottos9

\*\*Toss9 ottos9 ottos9

\*\*Toss9 ottos9

\*\*Toss

[P2, 6]
Thoselicido olicoso tolicosos cicoso olicosos cicoso ticos os ticos os olicosos olicosos cicosos olicosos cicosos cicos cicos cicosos cicosos cicosos cicosos cicos ci

[P3, 10]

That coop at assat cos sassat colf offices coffees forces office offices off

## Folio 44, Recto

[P2, 5]

100 dopto toticog cood cacello decog offeg 8a\\0\
[P2, 6]

8dood offerog deg o ocacello toticog offer 8a\\0\
[P2, 7]

totlood ot8 deg totloog ooffg coog

[P3, 8]

They offered to free offered offered

## Folio 44, Verso

[P1, 1]

There to the control of the

[P2, 4]
golfagos canno cor coroso cello co offico oficos ofo
[P2, 5]
oand cog ctto ctanno officor officor officor ctand
[P2, 6]
flog sand offano sog officand offolicos officor offano sog
[P2, 7]
offo ficanno cttos so coop

[P3, 8]

The coop effect of ode to the coop effo — of ode — og [P3, 9]

8 ho of effect of ode the coop effo effect of ode of [P3, 10]

get o follow the often of offer o

## Folio 45, Recto

[P1, 1]

Tollosas cartes offs cas tot car ofcas ofcar ofcar

[P1, 2]

cor offs tollos tollarry cas cos slarry sar of

[P1, 3]

to cattes lacos sarry toarry offs carry slarry

gor of larry slarry

gor of larry slarry

gor of larry slarry

[P3, 8]

Therog effeg fodann effeg dand effecg offgdag dann of [P3, 9]

80? of erand dand glogodg offann fofferog log dg

[P3, 10]

olfann effeg folg lan? dagdg dago? ercog dag

[P3, 11]

g olfann olfero gagdad dagdann

## Folio 45, Verso

```
[P1, 1]

Notato culto Nox accop theory to the of offers so of the offers of the offers and offers a
```

#### Folio 46, Recto

[P1, 1]

Toccofteg totless octly so octloss of octloss ocanno dece totless sand dece so sags
[P1, 2]

Posanno decess took decotloss ocethes sanno decilident decs xor and decethes
sanno deor star octloss ocethes
sanno deor star octloss ocethes
totless density decilis dec

[P2, 6]

The soft of the soft

## Folio 46, Verso

## Folio 47, Recto

[P2, 6]

Tog? acg 20 acg cog and cog and cog asg agg agg

[P2, 7]

2acc2g Maco? attand acg acg acg acg acg attag

[P2, 8]

colleg ag Maco8 acg ac attag acg attag

[P2, 9]

Tollo Mo? and ollag acg sand ollag acg

[P2, 10]

ag ollag acg sand sag

[P2, 11]

sto atg sand sand

## Folio 47, Verso

```
[P1, 1]

The coll accor acordo at tag 2ag — 2arg

[P1, 2]

8th cop at a offico offico offico of acord — 8arro

[P1, 3]

Atop arar officos 8or officos at tag — 8arro

[P1, 4]

tothor according at tag — 6th officos at tag — 6th officos according at tag — 6th officos according at the first officos according acco
```

## Folio 48, Recto

[P1, 1]

The dann of the good of good

#### Folio 48, Verso

```
[P1, 1]

The coders deceds the edge of and streets and streets the edge of the
```

[P2, 7]

Tools are considered to the state of the state o

#### Folio 49. Recto

<sup>2</sup> There is a curlicue above  $\uparrow \circ$  as used in  $\mathcal{L}$ .

<sup>3</sup> There is a curlicue above the first c as used in  $\mathcal{A}$ .

<sup>4</sup> There is a curlicue above to as used in &.

<sup>5</sup> There is a curlicue above  $a_{\lambda}$  as used in  $\mathcal{A}$ .

<sup>6</sup> There is a curlicue above  $\uparrow \circ$  as used in  $\mathcal{A}$ .

#### Folio 49. Verso

```
1600 cos cholleros ceches
                                              tollag tollage to alto
[P1, 3]
                                              ccolleg ccolleg colleg colleg colleg colleg colleg college c
[P1, 4]
                                              ollcos—to colltos ost—sollo
 P1, 5]
                                              tog tosa110 tollera7^{10}
                                              tollag alolag alolg^{11}
[P1, 7]
                                              ट्यीट्य ट्याविक क्या
[B1' 8]
                                              208 (1128 025 S22) Pot
[P1, 9]
                                              ೦೮೦೪ ಕೇಂಬರಿ ಗೆಕೇಂತ್ರಿ
[P1, 10]
                                              to It cosa 10^{12} colleges of
                                              Scrop officer sally colly
[P1, 12]
                                              octolices offices sarry sarry coologo
9 -
[P1, 13]
                                             tollog crollogogoffog laoz crog sarri
[P2, 14]
                                              foothor — cSos gebosonto gooth good foothog
[P2, 15]
                                              sa s and another series of the second of the
[P2, 16]
                                            The office of the same of the 
[P2, 17]
                                             ರಿನಾ ಎಸ್ ೯೯೬೦ ರಾಯ
[P3, 18]
- 9
                                              follow occos ocos 2 oco ocollos os occos — ocollosos
[P3, 19]
                                              8/10t 6/128 — 68 6/12 8 600 Place 11000 Folds
9 - [P3, 20]
                                              oallo — celesti lilia sook coallo
[P3, 21]
                                              folicarry aco and acoffice flacox bard — aco barfry
[P3, 22]
                                              collarry co 8x2 carry barry carry co callco
 [P3, 23]
                                              S of the sol for for form of plan by
9 - [P3, 24]
                                              following the four following the manyle
[P3, 25]
                                              Cofolios — cllossilos espellos Sus Fos pos
[P3, 26]
              9 — glacollo ? acco sarri
```

<sup>7</sup> This line is preceded by a 1.

<sup>8</sup> This line is preceded by a 2.

<sup>9</sup> This line is preceded by a 3.

<sup>10</sup> This line is preceded by a 4.

<sup>11</sup> This line is preceded by a 5.

<sup>12</sup> There is a curlicue above  $\uparrow \circ$  as used in  $\mathcal{A}$ .

#### Folio 50, Recto

[P1, 1]

The cor of tax of the cost of the

## Folio 50, Verso

They so asa? collects tollects offeres tollog coop of a tarsay theosan occes offan tarsay theosan occes offan to coop offan tollects o

<sup>13</sup> There is a curlicue above  $\circ$  as used in  $\mathcal{A}$ .

#### Folio 51, Recto

```
[P1, 1]
 Sccoolarry efficaso efficaso coolo
9 800089 cttc9 off9 cttc08a7 tolf9
 8a117 office office occopy office occopy
 Thecoog tosann effecy toether flann
90008a110 008a110 9800-8a110 98a8
90002a7 crotteg loco tolorg totag
octos osavvi effeco effecoso tolles offoso
 Thos garry focogas gas togo toctlas
9/1000 807 cc09 tollcog loccy cog ollar
 flocosarry ctcoso tollor off.osarry llosoflas
gocc2 effeccy flog ecceas offco7 foethers ferodas
00117 ctros 916cos otrocos ctroosa117 9160989
tollox ccco? offcax 2 of axes — offax
```

## Folio 51, Verso

```
[P1, 1]
Tocoog to losa? cosann totay — scarce cands greet, 2]
scross attack totay to los sofann as — to log sann attack
[P1, 3]
Theroso attack to a other tos others — sann attack
[P1, 4]
offann tosay offax accosa? coso — offer sann attack
[P1, 5]
Thosann offos to tosay to and and accos and and accos and and accos offann attack
[P1, 6]
offor attack tosay to attack to to log to to and offann accos and and profess accos to a cos — others accos and and profess accos to log accos and and attack tosay to an accos of accos of a cos and and accos and and accos and and accos accos and and accos accos and and accos accos and and accos accos and
```

## Folio 52, Recto

```
[P1, 1]

The forcetty getting offer? Lar to to be and offered and
```

## Folio 52, Verso

```
[P1, 1]

Theorem cate of the control of the control
```

[P2, 7]

foccos cosonno cttos anno
[P2, 8]

flodanno cttos tollocos os
[P2, 9]

danno cttos cos tollos danno
[P2, 10]

gollocos tollodo cos dosd anno
[P2, 11]

danno cttos todanno cttos das
[P2, 12]

toclar cttos ollocos cttos
[P2, 13]

ollor ollanno cttocos danno
[P2, 14]

odar coollor cttocos

# Folio 53, Recto

# Folio 53, Verso

[P1, 1]

Thereof deep todethey etto of the sann to the period of the

#### Folio 54, Recto

[P1, 1]

1!08a\\V cto8ag totacog ctco8g — otacog acoctog
[P1, 2]

offo8a\\V offaceg offaceg toethoo 8ag — 20ctho8g 2a?
[P1, 3]

8a\\V offae8g offog cliaco8g og 2 of g — offaceg 8ag
[P1, 4]

flor octhog ctollag flog acog 2 — acog — offae0!flog
[P1, 5]

2ar ct offco8a\\V acollag

## Folio 54, Verso

```
[P1, 1]
To!cco8a? cetax oxovid effect 8a? tolleg effectavid 2ax
8ccca110 cta1!0 2 a2 ccco2 !!!!!!to8a110 cta1889 stca8
9a17 9lla7 olly cray cross 9llox!8a8 crcox a18
  8a7 cro7 crcllg crox olla/1) cro8g crox 8g
  80 S ess Fallot Brosof Grialle Grisso
  Tox croop choctes tosarry Peroso
  Sand choose of and tolley
  80 x office offer of sale offices
98a110 tocktog todag 918a8 ollag 89
  log c! lavid cectes tollag sag toctes
 oally foettes tollar
100 ccos c11cos 2
occos ollas octicos
 Pabea Pall coots Fall
[P1, 15]
07 agcco 99 dag cco80989
  8a11) ccox ox8a11)
```

# 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/Ba		
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	۶	10,518		
k	ľ	9,996		
r	5	$7,\!456$		
n	Э	6,141		
t	111	5,968		
q	1	5,423		
S	උ	4,501		
s	ተ ሪ የ	2,886		
p	#	1,406		
m	В	1,116		
T	Ħ	976		
K	ff	938		
f	₽*	425		
P	<b>¥</b>	224		
g	අ	96		
F	¥	80		
I	τ	72		
х	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  $\sigma$  and  $\tau$  are one glyph (i.e.,  $\sigma$ ). Likewise,  $\mathcal{C}$  and  $\tau$  could be interpreted as another glyph (i.e.,  $\mathcal{C}$ ). Additionally, one might interpret instances of  $\mathcal{C}$ ,  $\mathcal{C}$ ,  $\mathcal{C}$ , or  $\mathcal{C}$  as representing  $\sigma$  (or  $\mathcal{C}$ ), on the one hand, and  $\mathcal{C}$ , or  $\mathcal{C}$ , or the other. Concerning those "gallows" characters, as they have come to be called, it is not clear whether  $\mathcal{C}$  and  $\mathcal{C}$  and  $\mathcal{C}$  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  $\sigma$  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  $\iota$ , it is not clear whether instances like  $\iota\iota$  and  $\iota\iota\iota$  or combinations with  $\vartheta$  like  $\iota\vartheta$  or  $\iota\iota\vartheta$  represent separate glyphs. Table 3

Letter(s)	Glyph	Count		
		Takahashi	Takahashi/Bauer	
ch	CC	11,008		
Sh	ટે	$4,\!501$		
cTh	c <del>¶</del> c	950		
cKh	clfc	906		
cPh	c <del>t°</del> c	216		
cFh	ctc	74		
С	c	143		
СО	CO	9		
су	<b>c</b> 9	7		

Table 2: Glyph frequencies in Takahashi's transliteration for several  $\sigma$  combinations.

gives frequencies for several of those  $\chi$  combinations. Assuming there are three glyphs  $\chi$ ,  $\chi \partial_{\lambda}$ , 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 a,  $\delta$ , c,  $\delta$ ,  $\tau$ ,  $\varphi$ ,  $\delta$ , o,  $\uparrow$ ,  $\partial$ ,  $\lambda$ ,  $\lambda$ , and  $\varphi$  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  $\sigma c$  is counted every time  $\sigma$  and c appear consecutively, as well as in cases where there is #, #, #, or # between them.
- The glyph ff is counted every time ff or ff 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  $\iota$  is counted every time it is not part of  $\iota \Im$  or  $\iota \iota \Im$  as well as in instances of  $\tau$ .

Letter(s)	Glyph	Count (Percent)		
		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	$\alpha$	$13,\!154$	(8.076)	
d	8	12,973	(7.965)	
k	ľ	10,934	(6.713)	
1	۶	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	6,	1,752	(1.076)	
р	#	1,630	(1.001)	
i	\	1,240	(0.761)	
m	В	1,116	(0.685)	
f	<b>f</b>	505	(0.310)	
g	ද්	96	(0.059)	
x	χ.	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  $\alpha$  is represented by Sh in EVA. For calculating the entropy, every time S and h appear consecutively, they are replaced by 1
- The glyph  $\sigma \epsilon$  is represented by  $\epsilon h$  in EVA. Every time  $\epsilon$  and  $\epsilon$  appear consecutively, they are replaced by 2. Following the above stated rules for glyph counting,  $\sigma \epsilon$  is also believed to be present when  $\sigma$  and  $\epsilon$  are separated by f, f, or f, represented by f, f, or f are also present. They are represented by f, f, or f are also present. They are represented by f, f, or f are also present. They are represented by f, f, or f are also present. They are represented by f, f, f, or f 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  $\tau$ , represented by I in EVA, is counted as  $\iota$ , 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.