ancient iran

Cosmology, Mythology, History

By Iraj Bashiri

University of Minnesota—Twin Cities

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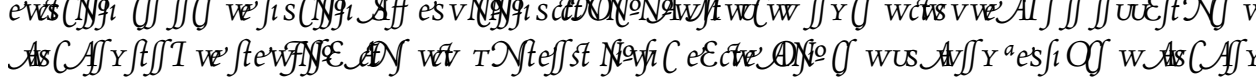
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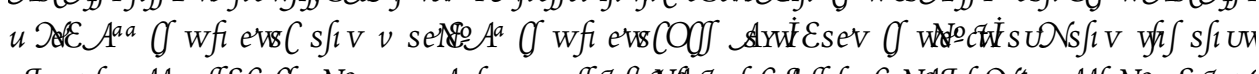
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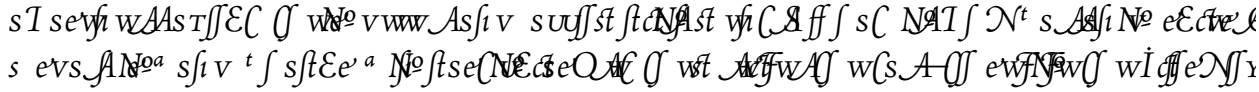
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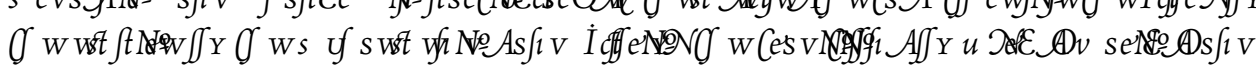
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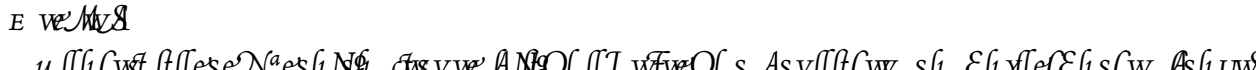


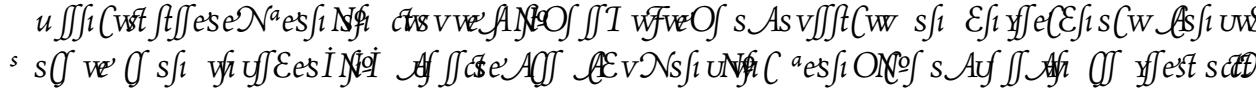


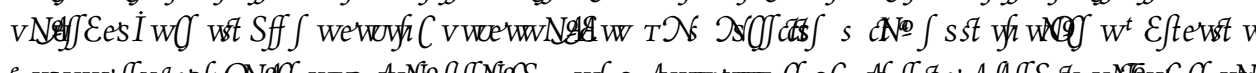


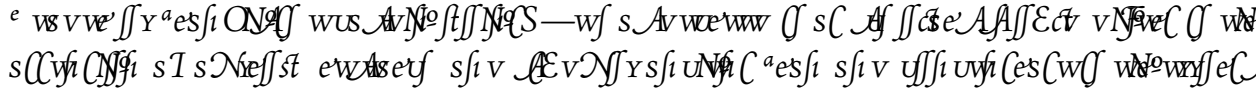


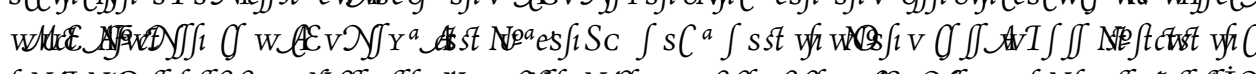


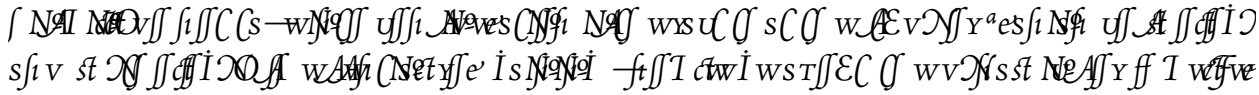


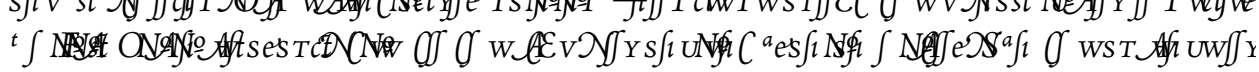


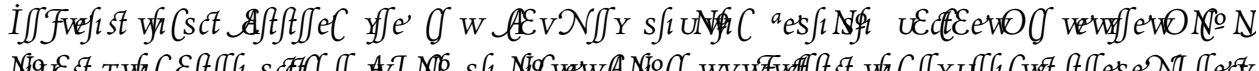


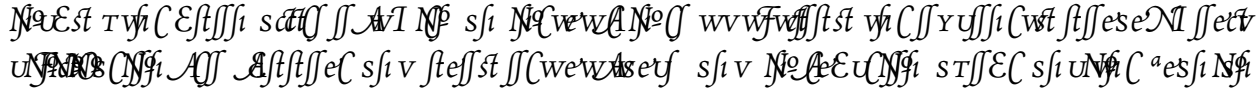


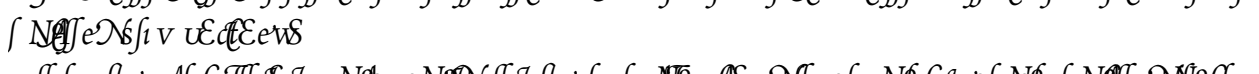


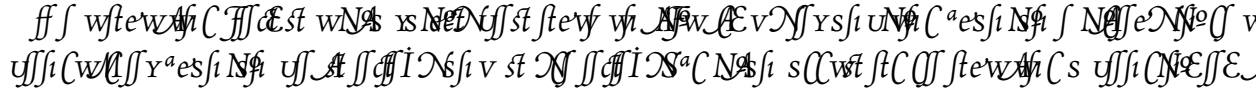


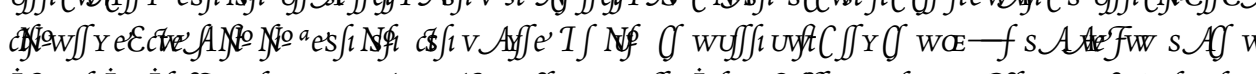


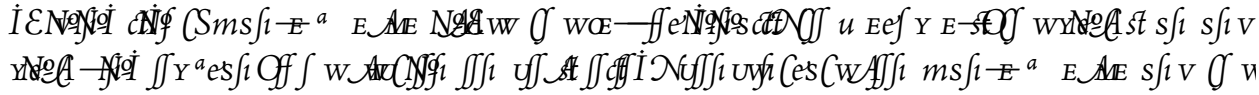


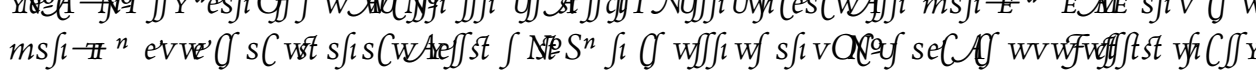


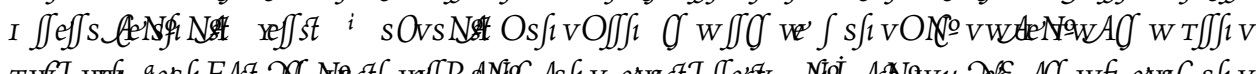


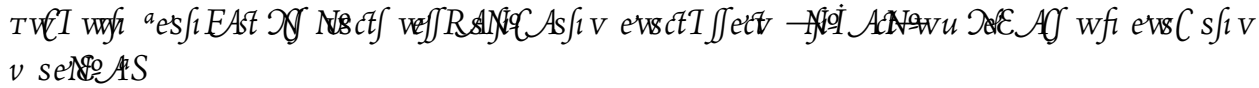


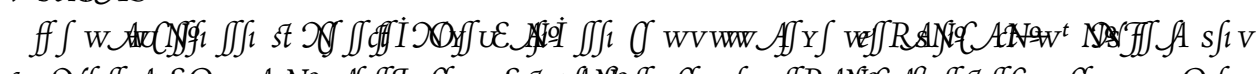


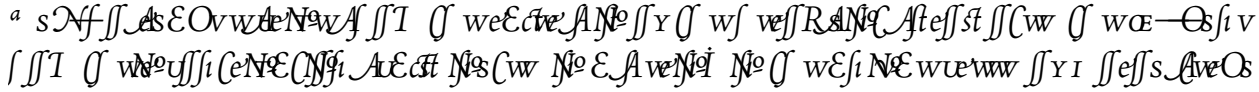


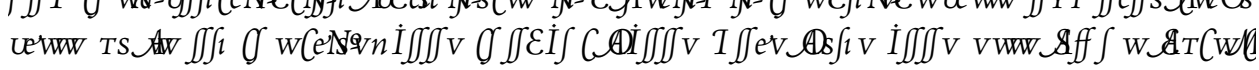












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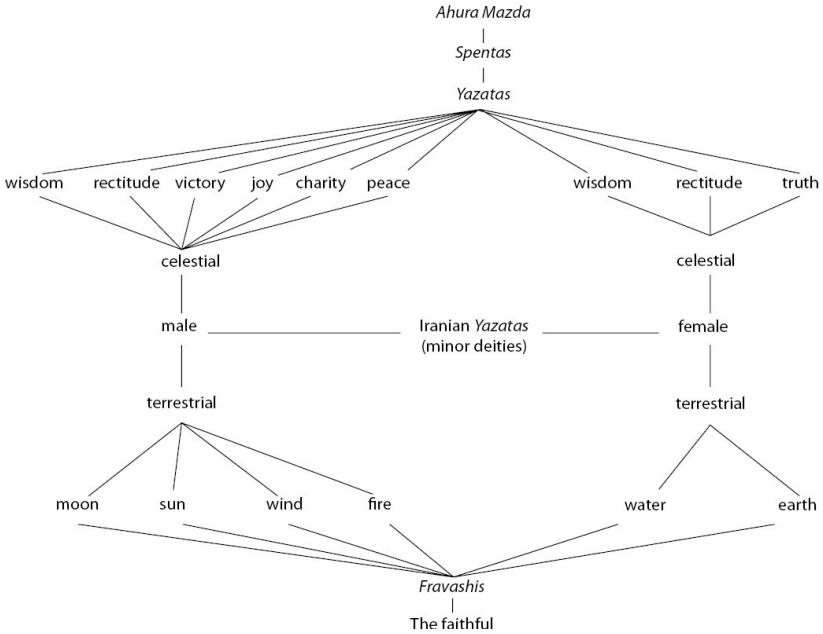
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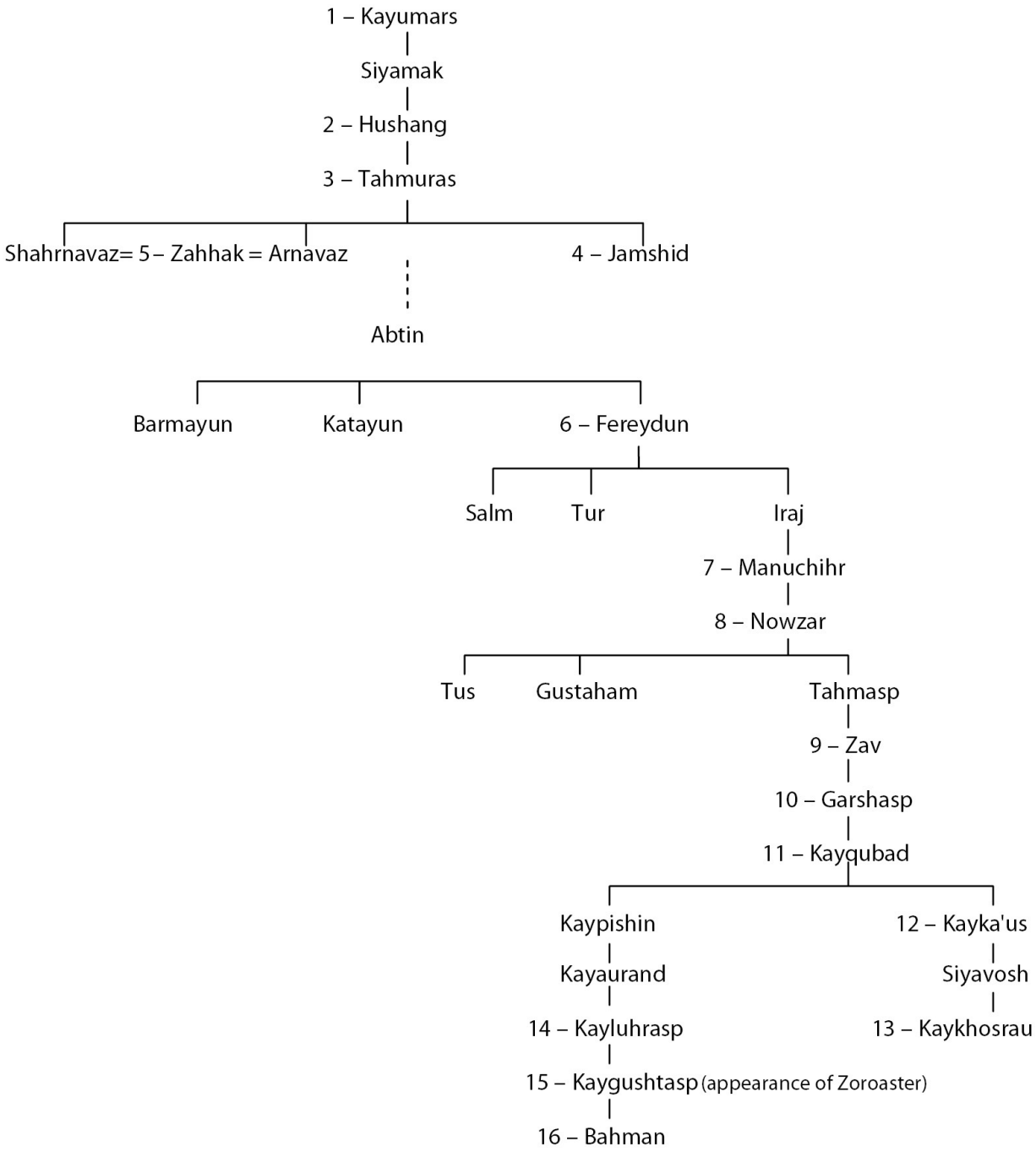
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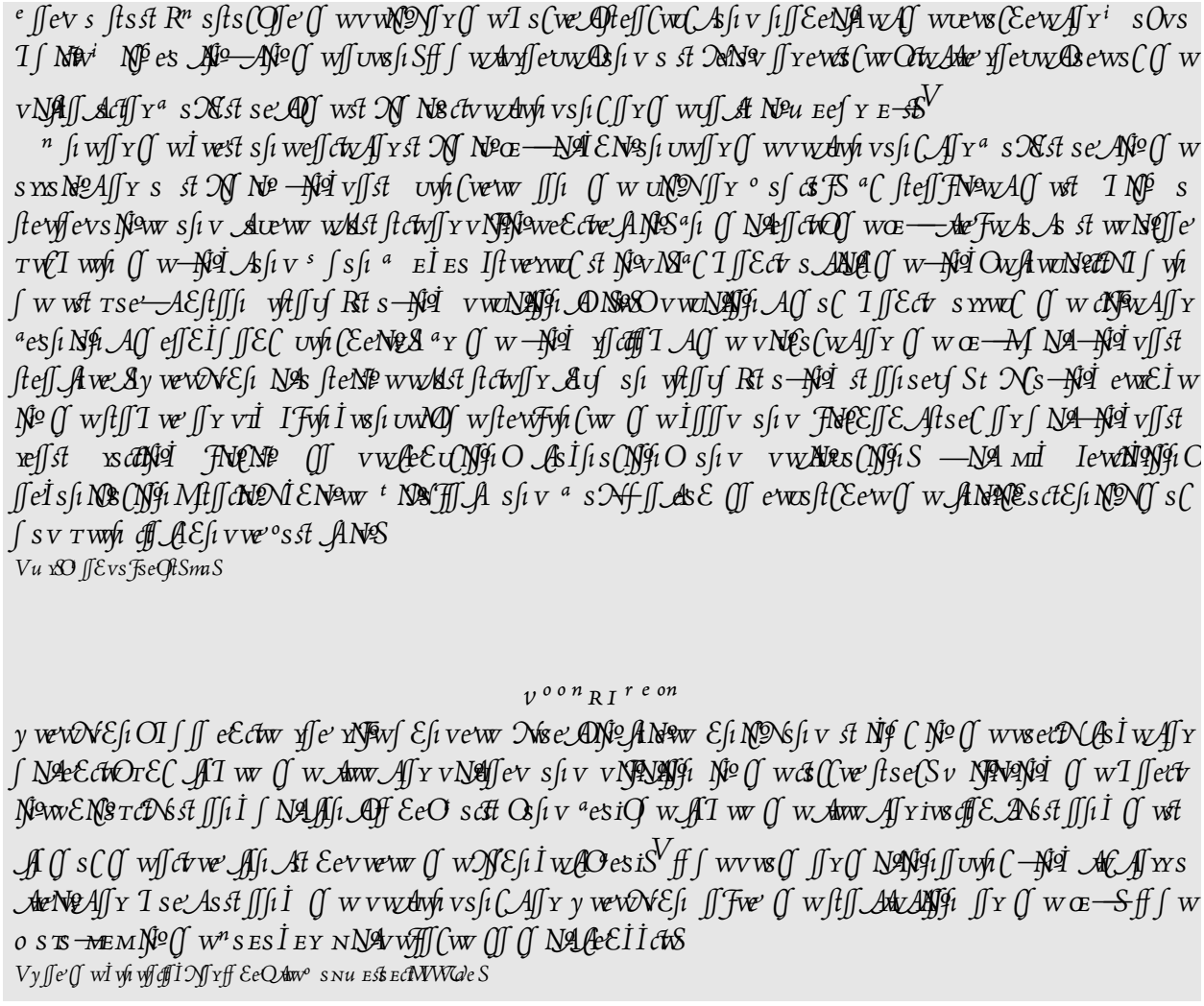
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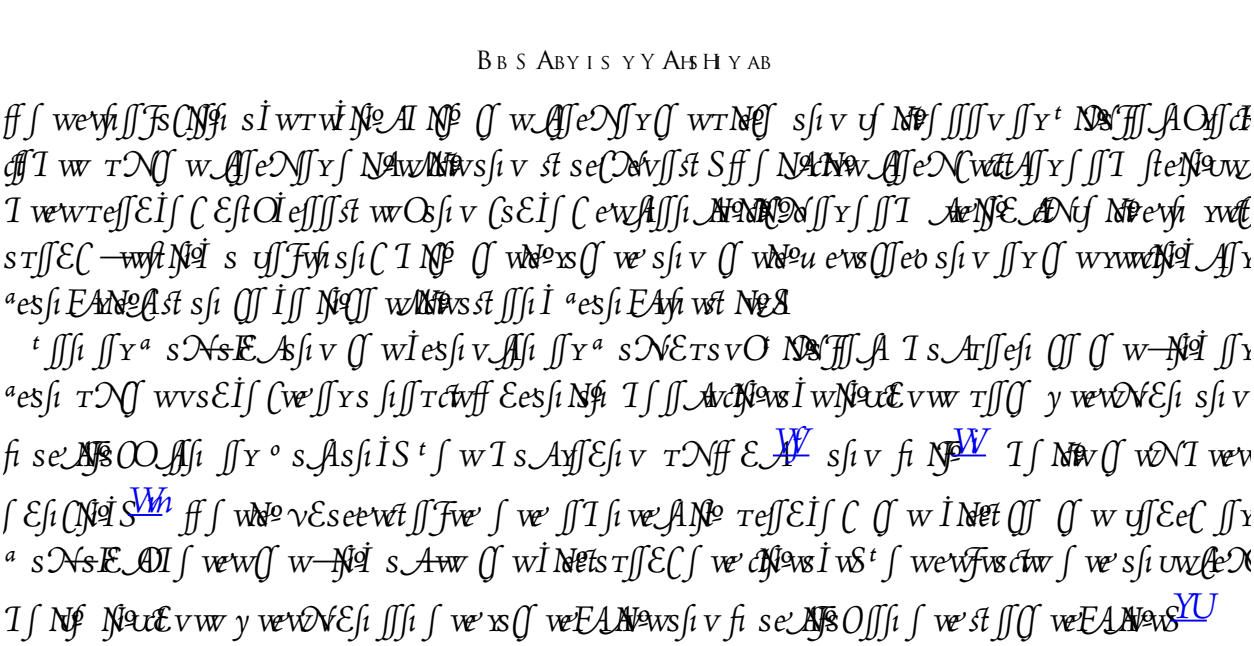
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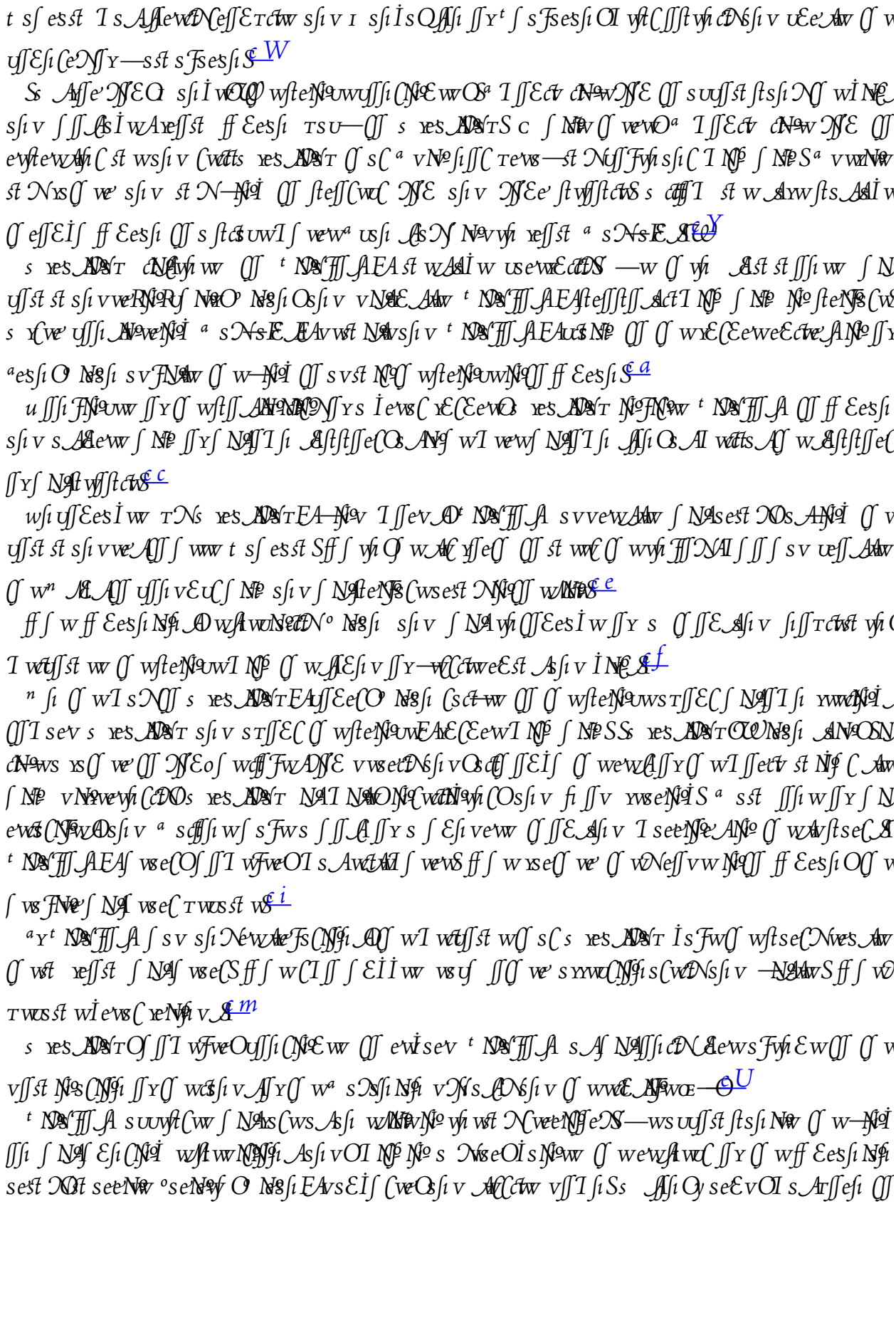
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u ffEeC N‰CeNEwe'vsf ww fiwI ∫ wNf CAI ∫ yi fi se'AfiSO T sAst svwQ wcN¼Nffffi TvCI wyi Q wftscstuvzS—wuffffiuffuCww wFyiCAffffi Tffff AwvADsfiv JAT ww vN¼ffe'v vse' sfiv T N‰ fi se'AfiSOEAevyttfeCAst svws ves ADS TOI ∫ff T sAscevsvN‰sT wffY t NDS'ffff JAOeN‰ CyiwwffY s vsXO‰Q wfiwse'vECEevCQ sC t NDS'ffff JA T ffEcv Teve'Affff Eesfi sTsN¼effst ∫ N‰S

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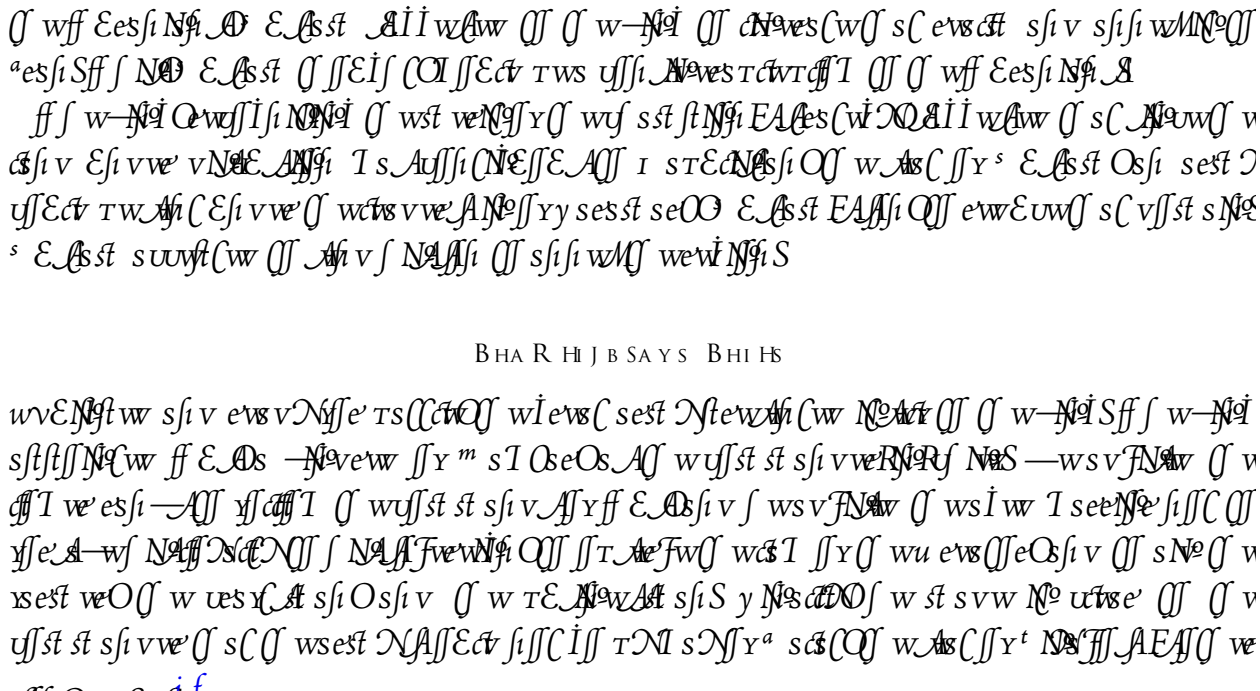
ffi ſtſſſi ſ N¹⁹As Awyh Aſſſi QſſſQ w Q eſſſi w ſſ ʸ esſi Oª sN⁹f ſſ Aes E cs Esi uf ww s ſteſſ İes st ſſ ʏ e'wſſes t Ac N⁹ Q w s AN⁹Qsi uw ſſ ʏ Q w ſi ſſ Tc'w Asi v ſtſſ Cwh Cs Cw Q ſ we'w E N⁹ Q w u N⁹ Ve vwfs Qs Cww T N Q w st si Ns Aa E c t A ſſ ʏ Q wff Ees i N⁹ h se st N⁹ Q Ovw Qe ſſ N⁹ ww Q w ſ sEſi C A ſſ ʏ vwst ſſ i A r N w Mtsſi v N⁹ i uEc t N⁹ s C N⁹ h N⁹ QſſQ w I s Aw st ſi v Qs ſi v E A we'ww N⁹ İ ſſ ſſ v I N⁹ tsſi v Ce E Qs t wſſe'w cſſ İ O ª esſi e'wi s N⁹ ww Q w İ cſſe N N⁹ ſ sv wh iſſ N ww Esi vve' ºss t A N⁹ sſi v y we'w N Esi sſi v T see'ww s ſ e N⁹ sſi xeſſst N⁹ xE wh uN⁹ i s ys N⁹ a fU

ı sc y Q w A Aſſi ſſ ʏ t sst sſi v İes i v A Aſſi ſſ ʏ m se N⁹ sſi fV y ſ N⁹ A Aſſi O s E Asst Osſi v Q w ſi ſſ T c'w A ſſ ʏ ª s T E c N⁹ sſi see N⁹ ww N⁹ ª esſi sſi v I we'w I w t ſſ st ww T N fi N⁹ fi E v se OOsſi v ff E ff ſ w A N⁹ f C ſſ ʏ s E Asst O N⁹ as Q we'E st wh QſſeOst ſſ Fww ª sN⁹f ſſ Aes E sſi v T eſſ EİſſC Cwse'A ſſ ſ N⁹ A wOw a s E Asst ſts N⁹ ſſ st sİ w T N N⁹ N⁹ i Q w İ eſſ Esi v T w ſſe'w Q w N⁹ i S ff ſ w N⁹ i ſtes N⁹ ww s E Asst ſteſſ x E A N sſi v us c w ſ N⁹ Q w I N⁹ as sſi v Ae'wh wst wh Qſſe'ſſ ʏ t N⁹ ſſ A s fW

s y Cve's y w I vs N A ſſ ʏ e'w Asſi v İ w C N⁹ i s uv Es N⁹ Cww T N⁹ sc t Q w F N⁹ A ſſ e'A I ſ ſſ ſ sv uſſst v QſſſtsN Q w N⁹ e'w A ww C Asſi v sſi ſi Esi uw Q w N⁹ A ſtſtſſe C Q w N⁹ i A C ſſ E C ſſ i s ſ Esi C N⁹ i w N⁹ ſtw N⁹ N⁹ i S — we'ww E w C ww Q sC s E Asst suſſst ſtsſi N ſ N⁹ S fY ff ſ w ſ Esi C Q ſſ T w F ve O Ae'F ww s A s uſ F ve' y ſſe' Q w N⁹ i E A e'w sc t N⁹ C wh C N⁹ i y A s x E c t R c w İ ww A e'F w N ſ ʏ Q w ª esſi N⁹ fi st se'ſ w sſi v ſſ ʏ Q wv wfs Qs Cww cs ſi v Ss y Cve' Q N⁹ as A w A st wh CO ª sN⁹f ſſ Aes E T wh C ſſ i s A t wh v N⁹ i A te'ww S — w ſſe'v ve'ww uN⁹ e A Q sC ſ sv xs c t wh ſſ i TsV CN⁹ e w A Q ſſ Twe'w E e'T N⁹ A ww sſi v uN⁹ e wh T ſſ ſ sv cſſ A Q ws⁹ teſſ ſt we C N Q ſſ Twe'w N⁹ e T E e' A w S ff ſ w Q ſſ T ſi R r N⁹ Q ſſ T ſi N⁹ A w C N⁹ i y N⁹ s c t Teſſ EİſſC ª sN⁹f ſſ Aes E Q ſſ s Ove'Tsi N⁹ ſi S fa — we'w ſ w F N⁹ A e w Q ws Oseİ s As A t y e'w Cwst ſtc w T ſ we'w ſ wſtes N w Q ſ Q wu e'ws Q ſſ es fc

n ſi ſ N⁹ I s N e ſſ st s Ove'Ts N⁹ ſi Oª sN⁹f ſſ Aes E F N⁹ e ª sN⁹ s E A ff ſ w C I ſſ — N⁹ i A ws ſ xs ſi — w T N N⁹ ſ sst ſt N⁹ i A st w C sſi v Csc t — w s T ſſ E C Q wv wfs Qs C N⁹ i Q sC s y es A N⁹ T ſ sv F N⁹ e w ſſ ſi Q ws ſi v S fe

ª sN⁹f ſſ Aes E A ſſ e'w T N Q wy N⁹ e w Q sC ſ w I ſſ E c v T w A ws v xs A N⁹ ſ N⁹ e'w A c ſſ ws ſi v Q sC ſi ſſ Q N⁹ i I ſſ E c v v N⁹ es u C ſ N⁹ xeſſst s F wh İ N⁹ i Q wv ws Q ſſ ʏ ſ N⁹ as Q we Q i ſſ C wfs wh s y es A N T E A — N⁹ A N⁹ Q ſſ ſ N⁹ ff s As Q — wh ſſ ʏ ſ N⁹ Ce E Q x c ſi w A Q ſ wst sv ws A c t wst ſi ſtc w İ w Q ſſ Q sC wx w C si v ſ sv N⁹ e'w ſſ e'vw N⁹ Q w º sſ cs F N⁹ si İ Es İ ws ſi v I N⁹ fi w A w T N E Asst O sc t si v Q w ſſ Q we' ª esſi N⁹ fi I see N⁹ e A fi s E Asst I s A İ N⁹ wh Q w u E A ſſ v N ſſ ʏ Q w I e N⁹ fm



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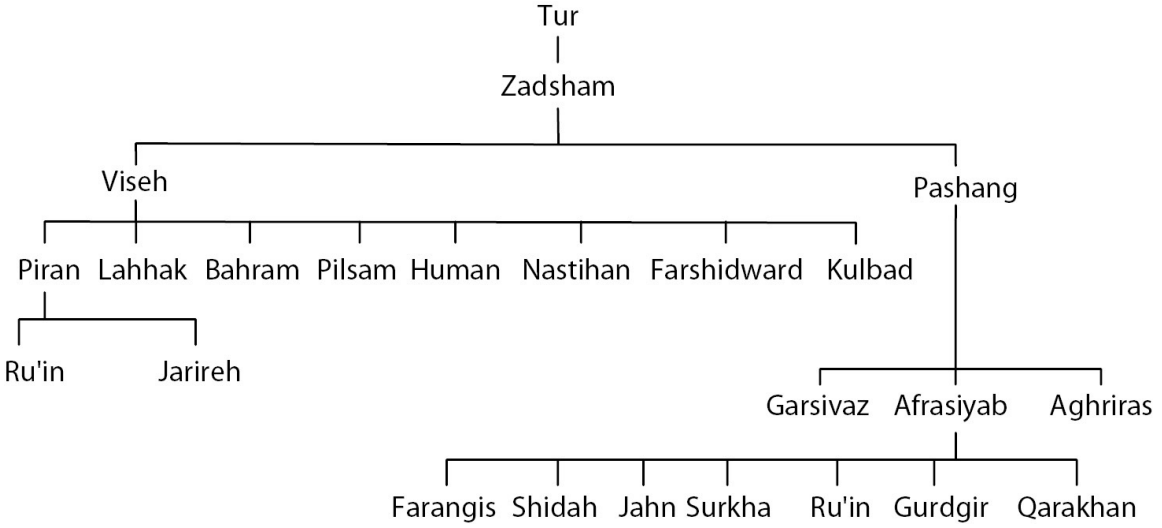
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i e E TRS t o i TR t e F

Turan	Iran	Result
Gorvy	Giv	Gorvy was captured
Kulbad	Fariburz	Kulbad (Piran's brother) killed
Barman	Runham	Barman (Piran's brother) killed
Siyamak	Gorazeh	Siyamak killed
Andariman	Gurgin	Andariman killed
Ru'in	Bizhan	Ru'in (Piran's only son) killed
Zangaleh	Faruhal	Zangaleh killed
Ukhast	Zange	Ukhast killed
Kahram	Bartah	Kahram killed
Sepahram	Hazhir	Sepahram killed



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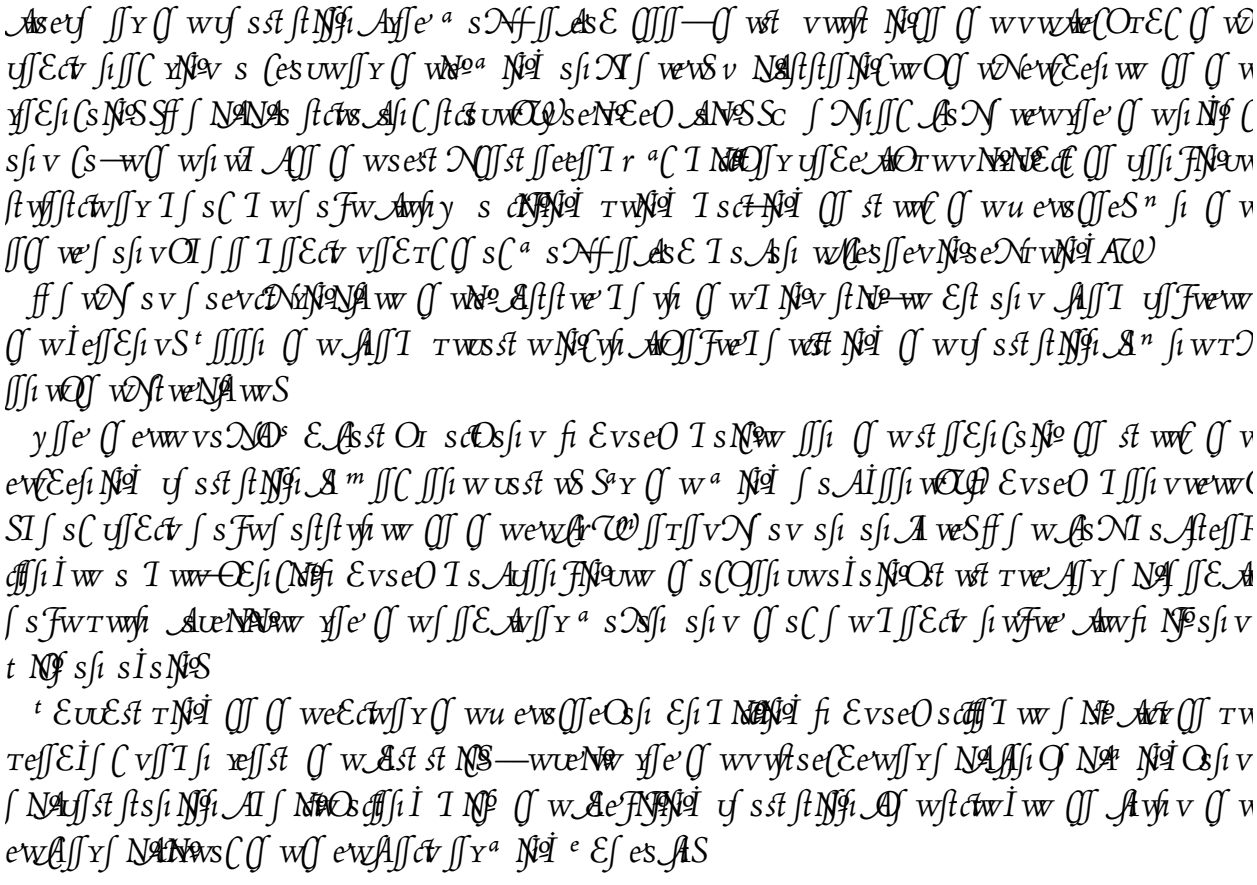
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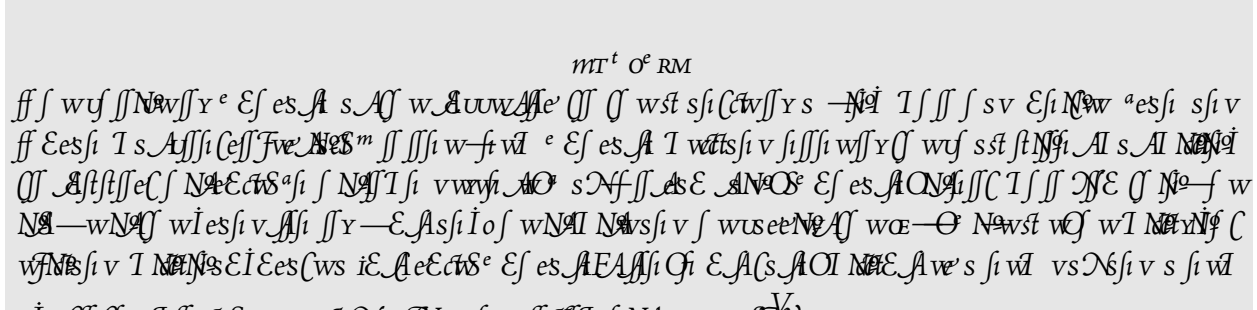
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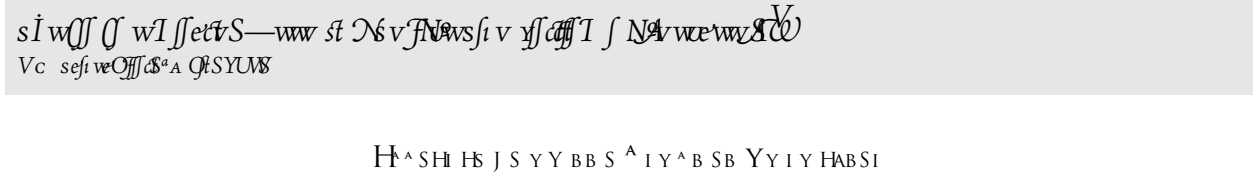
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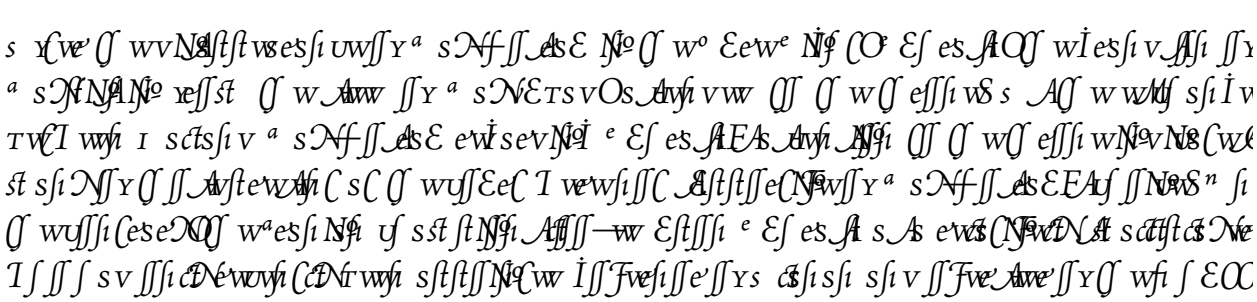
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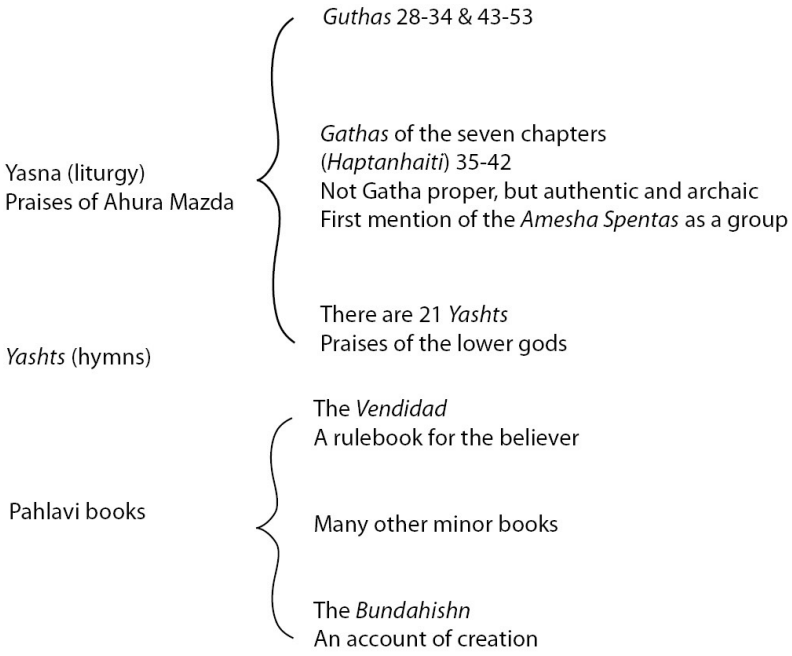


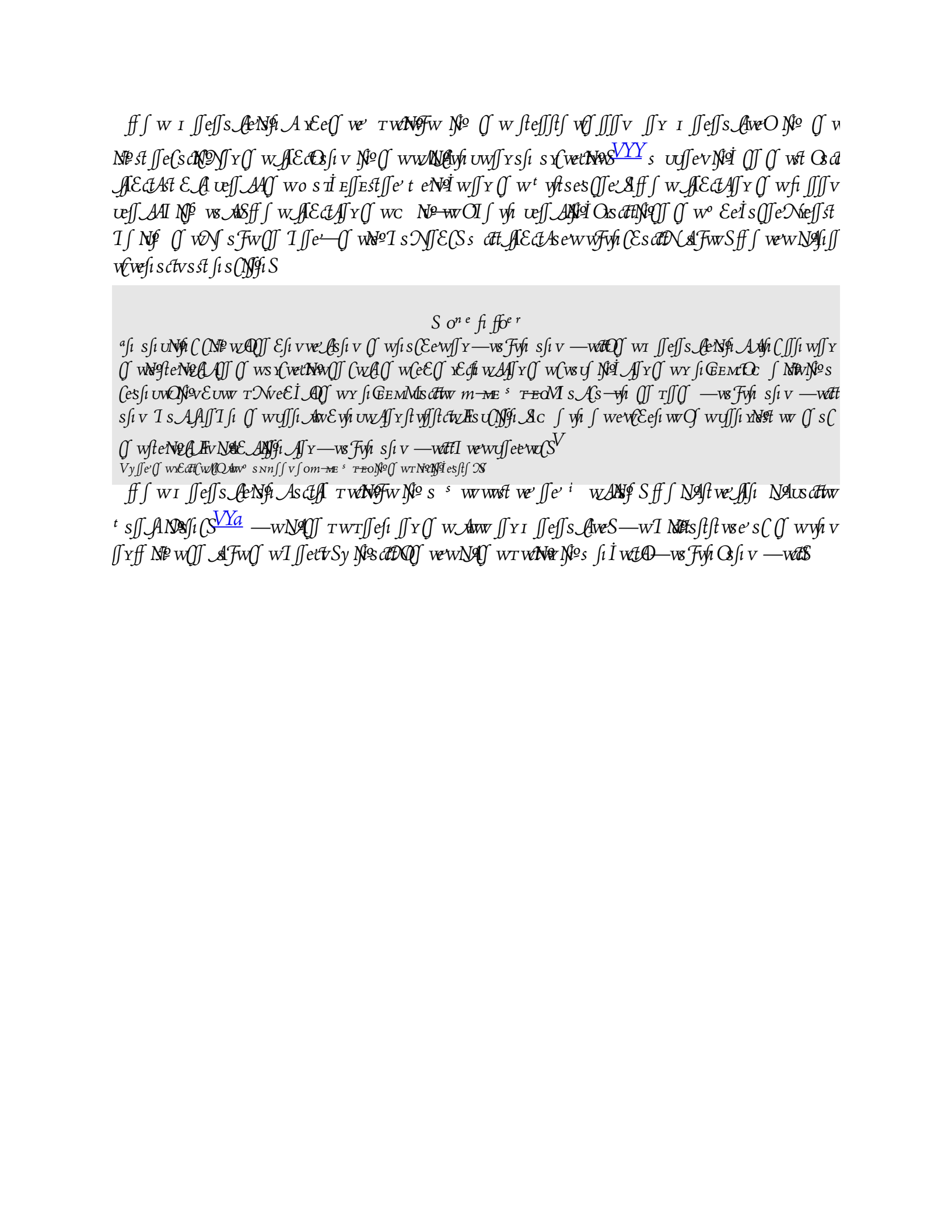




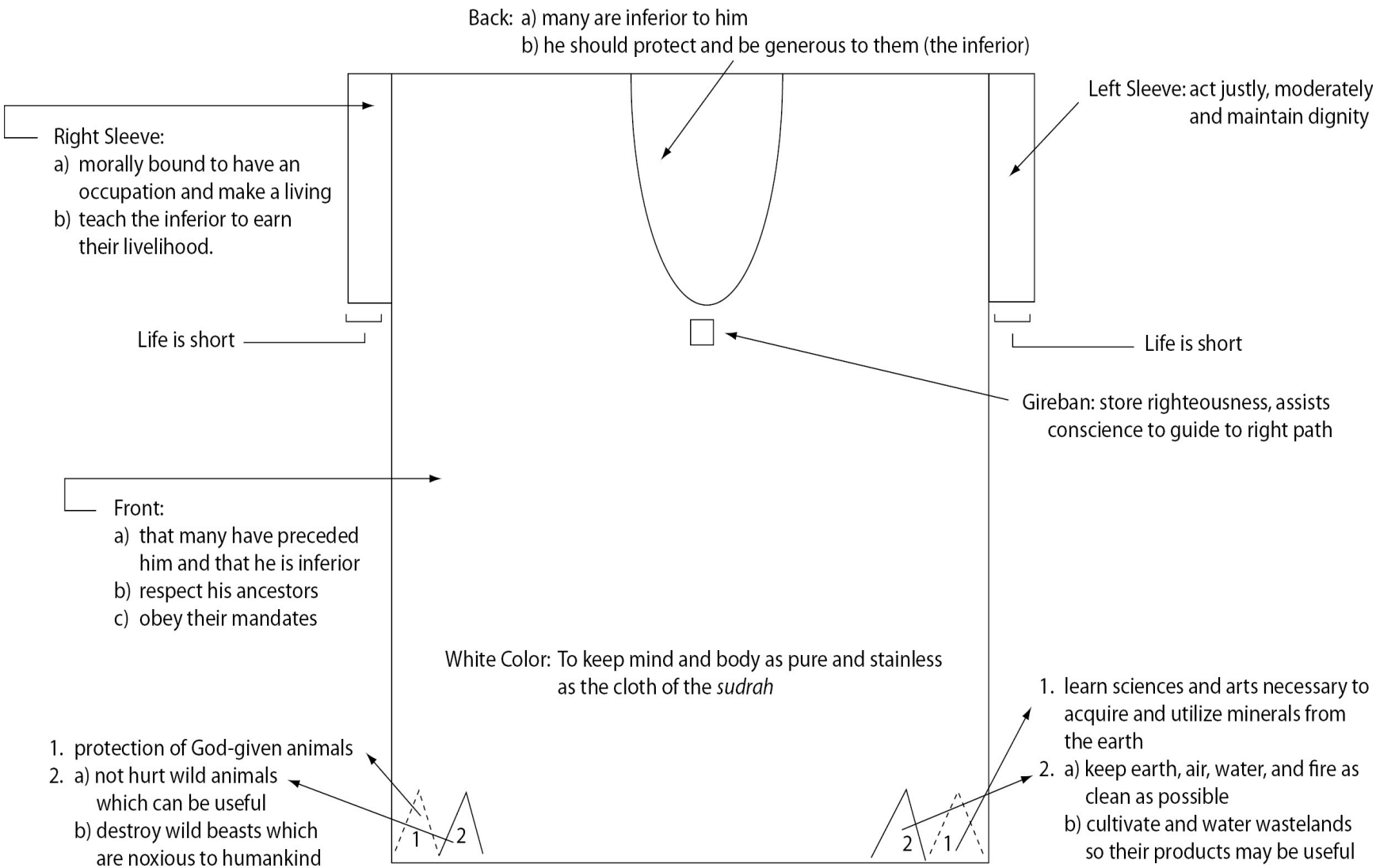
Yasna Haptanghaiti

1. I will worship and honour the Amesha Spentas, the Holy Immortals, who are pure and who dwell in the realm of Asha, the realm of truth and righteousness. I will worship and honour Ahura Mazda, the Wise Lord, who is the greatest, the best, the most beautiful, the most glorious, the most perfect, the most powerful, the most intelligent, the most effective, the most bountiful, the most generous, the most kind, the most loving, the most merciful, the most forgiving, the most just, the most righteous, the most holy, the most pure, the most perfect, the most wise, the most knowing, the most powerful, the most glorious, the most beautiful, the most perfect, the most good


Yasna (liturgy)
Praises of Ahura Mazda
Guthas 28-34 & 43-53
Gathas of the seven chapters
(Haptanhaiti) 35-42
Not Gatha proper, but authentic and archaic
First mention of the Amesha Spentas as a group
Yashts (hymns)
There are 21 Yashts
Praises of the lower gods
Pahlavi books
The Vendidad
A rulebook for the believer
Many other minor books
The Bundahishn
An account of creation

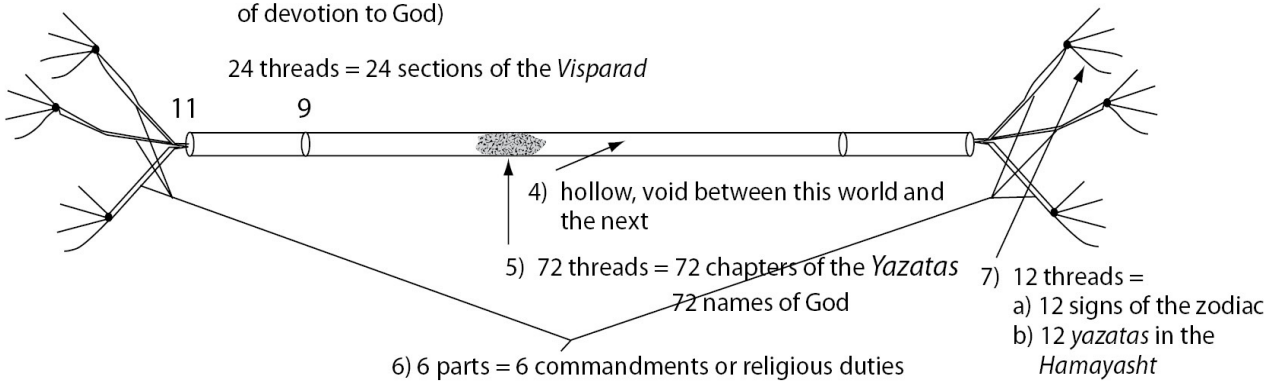


SUDRAH = *sud* 'profit' + *rah* 'road'
(The Spiritual guide of the Mazdayasnian to heaven)



Kusti

a) made from wool of a sheep
b) a hollow, cylindrical string, its warp consists of 72 threads and its weit of one unbroken thread (uncure of devotion to God)



1) wool: Zoroastrian must be as innocent and harmless as a lamb
2) minuteness of threads: earth is composed of minute molecules
3) twisting and doubling: connection of this world to unseen world
8) turning inside out = at resurrection material world will be turned into a paradise
9) loosening of the knots to reach heaven
10) three tassels - 6 *Gahambar* or seasons of the solar year (laris)
11) the final knots indicate universal brotherhood or union

Six Commandments or religious duties:

1. observe the three fundamental principles of the religion, viz good thoughts, good words, good deeds
2. pray five times a day
3. celebrate the *rapithawan* (vernal) feast once a year
4. observe the *Gahambar* ceremonies once in the five days of each of the six *Gahambars*
5. celebrate the twelve monthly *jashans*
6. perform ceremonies on the 19th day of each month and during the ten days at the end of the year for the benefit of the souls of departed ancestors and relations.

f mc seſıveOJJfcS aaaQftSWWS
i Uc seſıveOJJfcS aaaQftSWWS
i Vc seſıveOJJfcS aaaQftSWuS
i Wc seſıveOJJfcS aaaQftSWrS
i Yº NsſıQJ wvJfveRJteveyhCufJststsſıvveRJNºRJ NveJJYff EesſıOIsJNºvNdesuwsCJ wCNºwJJYª sNfJJJAsEEJteyhtsesCJNJfi
JJ NºJfsvwff EesſıSª sNfJJJesEONºJAJJEctv twstyhCJNJfiwOIsJJ wusEJwJJYJ NJAvNdesuwTwusEJwº NsſıſsvvsuNJNºCwv
ſ NJAcNJf CxeJJstff EesſıS
i a v yf fJJvs Isſıv JJJ ve º ve JNJf JJEeuwJMvJJwJıJJCİNJfwJ NJANJfve s vwJNºNºwJfusCJNJfiS—wstveweDNevhCJNJNeJNJfCİNJf
ff EesſıstſıvTNJf J wJNºuNevhCNºJ wmsEsİEY nEſıvveVNdeJJJfiſ ve vSt wvv yf fJJvsO wCCve ª sxJff yfesſıOVYYmS
e wt CesſıİwOIſNdvſ wvJJwJıJJCstyhCJNJfi wNºve ª sJJf s EvNe fNſeeweusCwſNJAvNdeJJJfiJJJ ſ wmsEsİEY nMvNJd
uEJJvAs İJJeİwJNºTſNJf J wftNdvJJYTJJJJv JJ TwJJCsTEsOwTJhnSn ſıwstseuſ ſıJJeJJ RI wJJJ
ff NstNJf OJJſı J weJJsv JJ ª NJA sſıv m s fJJAsT Nº t EİſvOTsAJ wJJTſı ſſY —sJNPinevOs ſtcsuwJJY JJstv
NPſtJJe(sſıuwNºJ waJ MUJ NUvh(Ee'XOsſıv CIJJ stseuſ wJıJJeJ JJYJ NJAJ weJJsvJtsJJvJ eJJEİſ J wvsstJJEJteJJJı
fi s(vS
SffſNJAvwnsNJvNºJ wstJJEſı(sNºAIsJvwJdeNewTNJ wufJNºwJv(esFwtveO—Tyh ffſJsJıİOIſJJsJstEvvſNJJtNPeNP
FNJNºw ªſıvNºNºuweVWSffſwsestİwJJIesſtſve'JJJvs—ſſYs JJTſıſvewOsıvFsFvETNJsstwJNºJ wuNºNJYJ wªeJJJı
fi s(wIi svNºsſ tsTRscR—svNevNJJYTſNJfſwsctJJİNJfwJJ wº ve'JJJfi yJestOv se's ſsſıNºSTOwwe wt CesſıİwOVmf fJtS
aaVS
ff NstNJf NJAJJı J ws stEv se'NSffſwİJJe'İwOJ vewJJevONJJe'wwst seuſ wJJfiJJeJ RiJJeJ T wJJJYff NstNJf Sc ſsCJJJ ve
eNJfve'J sſı J wºwONEſı JJe'J ws stEusſı ª sJJf s EvTwe wt CesſıİwxEeJ ve'JJTJe'FwJJ sCSI NJf J ws esTJe'NJfve'
T vewFve'NJJststJJJıcDNisstwxeJJst J wİe'wsCuNJNeJJJı J wNºTsſı—JJ yhuwJ ws stEv se'NOJ wª NJfve'JJYs stEOscJJJ
T sJJYcyh uscJwwJ wt scJf ª NJfveOscJJ JJEİſ J sCuNJNJsſıvJJJstwstNeJJvNJJsſıCxeJJst NºJJJEJ vesı TsſıSTW
yJJe'ª sJJf s EvEJe'wsCNJfi J ª sJ QJwv yf fJJvsO wCCve ª sxS
i c c seſıveOJJfcS aaaQftSWWS
i e c seſıveOJJfcS aaaQftJtSYUTCYVS
i f c seſıveOJJfcS aaaQftJtSYmTa'UbyJJe'J wcNeJJJe'NJYy seEv sſıv ſ NJAe'wsCNJfi J ºNsſıQJwwJJstNeJJvEJsſıOVmi c C
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i i c seſıveOJJfcS aaaQftSaUS
i mffſwJJwJYJ NJAyJJeCe'wJJANJAJseNJEJJNeyh(NeNeT NJª scs(CNºsvveNQsTJJEC J NJENstNeJJJıJJeJ JJYi wJJwsſıv
T NJª scs(CNJfſNesNeNºJJEC vsJJveſı s yİJ sſıNJJsſıS mwJNºve'JJY J wJJvcJJusCJNJfiAyNºAyNeJJJT JJJvwJeNJNJfiSffſw
yJestve'NJJ wNeJteWJsıstTwyJJeCe'wJJJ sCİs Fws cwJJıvve'ſ NJAJseJJYvNeNJEcJNJwOwsıİwtEOVmf i OftSi i MsſıvTſNJf
u EeCJJſı uJJſıJJeve'JJJſıwJJYJ wstJJJwJJesJJevNºse'Nis(EescJftf yhJJstyhs NºJ wİJJetvOsıvxstJJEJwJJyh NºJ NJAsſıvJJ
stJJEJ(sNºxsJJıwJJsıvNeJteWJsıstTwvwNeJJJe'NJNsuwJJNJNeNJsıvsstsONJİſıs(EesctJe'yhİJ TUuEeCJJſıOVmeOftS
VVYNJffſNJAyJJeCe'wJJOJJTwJveONJAſıJJC cJJusCwJJſıt yhNºª EſOJ wstJJEJ(sNJfJEJeWJNJfi JJECJTwJJJYs yİJ sſı
ff Ee—NJAsſıSª scs(CNJfſNesNeNJJJJxse'xJJstª sJJf s Evsſıv cwsvJJJ J wºEJıisTesJ ve'J sſı JJ J wn MtJJsſıv
t EİſvSffſNJAsEJJe'TwJNJfwJJsCJJuwyseEvEJJe(NJAsJNJfiNJAſJJCeWiseVww sJJstsiJe'yJeCy J wªesſıNJfi sestJvNd
ſıJJCJs'Fws ſsev JNºwusſt(EeNJfİNº NºNJAs iEwGJJstvIJ ve'wJJſıJ wtwNºª EſTvC1 wyh J wyJe'—TvJJſıv —ves(
TJ ve'wJ w(esFwtve'ſsJJJ vwNJwTſwJJ ve'JJ uJJJJJwJJ wstJJEJ(sNJfJEJeWJNJfi JJYs yİJ sſı ff Ee—NJAsſıJJ e'wsJ J ws stE
JJe'yh(ve'J w' ses r EstvwJdeCSffEJJJJJJJwJJ wyJestveSffſsCJ wuJJJJJwJJ NJAeJJE(wJNºJJNJwJJYJ NJAftJJTctwİwJs(
NºuJJJJwJJstsſıNJNJEJsſıv vscwJvEeJJ ve'JeyhİJ yhJJ wseİEstyhCJ sCJ wQJJJ—JNJAsestJNJeJJEİJ ſıJJeJJ veſı
s yİJ sſıNJAsſıNºJ wvNJwNJfiJJYJ ws stES
t wwsctJJi Ss Eewtt (wJNºOVmfJo Vmf c OftSYfOIJ ve'wJ wsCeNJECwJJfsJvEevsſıJJ s xesJJNJTSffſNJAJJſıwJJTve'N
dNJwJNJJs'FwTwyhJwJNJwJJYy seEvEJJsJJwOwJJwJNJJJNJfiEJJeJJJJwJ wnJJJJJsJJYff NstNJf Sy EeJJ vestJJeJwJJv
se'vs vwJdeNJw sTJJFwJsJJYcyh TwyhNºff EesſıNJfiJſsſıvJJſJNJwJ wJJJJ ve'CIJJ cJJusCJNJfiJJsFwEJJscJJNJrwyhNºªesſıNJfi
sſıvJJJJ ve'ſsſıvJJ
mUc seſıveOJJfcS aaaQftSaeS
mVc seſıveOJJfcS aaaQftScUS
mWc seſıveOJJfcS aaaQftScVS
mYc seſıveSJJfcS aaaQftSciS
mm c seſıveOJJfcS aaaQftSeUS

BBS BABYIHJ HAS

BBS HIHSHHS AJHBSHH

RNNNSI ONNNTUW

NAJeNscaDOJ wewiNJi vhuJStJtsAAHi ºseJNOi wNsOsiv wsAvesi ºveAºINsS
JtewAhCRvsNesiOs yiJsiNAsiOsiv t scEuJNAsiNBsAI watsAJ wwsAvesi AJJtwJJY
J wI siesJA JJEsi(sNºONeJwJJIsiNhw sAJ weesiNsi ºcs(wsESffJwI wAvesi AJJtwJJYJ v
I siesJAi JJEsi(sNºONºucEvNoi J wJtcsNºJJY aJEONAsiONeiseVww sAs (esiANJi
TwCI whi J wi wAJtJJ(sstNsi siv J weesiNsi JtcsCwsE[VYf]

c J vhi I wvNdEAAtNwNº aesiOwFvhi siuNhC aesiOI wEAscaDNCewsC J wewiNJi sAN
aesiNsi AJ sFwscaI sNANJ sTNºw J s(JtseCJJY J wIJetvOsiv J s(J N4sewsJ sAscaI sN
TwvhusctwaesiSs uCe'JJeNAeFwNJY J wJtsAJ NAJeNJY J wJtcsCwsE NºvNs(wAJ s(J v
NJi sTNsi(AJY J wJtcsCwsEJsvJsv s cNwJJY J wsºJJIsi yJe'st siNuvh(eNeArwJJew v
seeNscJJY J waesiNsi (eNºwAs wvwh(seJswJJcfJNscTyNºvAvhJsiuwJJEe'Esivve'AsivNoi
JJY J wJtcsCwsE sivJteJJFNºws TwCve'JtwAwCNswJJi J wvwFwfJJstvh(CJJYNºAEcdCewAs[VYi]

s JJst si fiJNºAst siOIJJ st svwwMsFs(NJi As(ff vJtwt Nset—Nº VmYY'CYaOsiv siNsNºNº
VmYfOJ sAJtewAh(ww AJst wFve'NNºJJestsCNJw vs(s sJiv vs(s sJisc4NAeWiseVNoi J v
ewiNJi S[VYm]t wCI whi Vmmmsiv WULaOesiNsi seJswJJcfJiNAsctAJsFwNºFwCNsCww J w
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Ast wJJ we'uJstst EJiNeAs(J wCNewJJY wsJtJtwsesiuwJJY ws e'sJiA

ffJwffvhtwt Nset—uJstJtcWMuJJiANAAJY(IJJNAAIAE(siv JiJJe(NJscTs—NJstwCve
sJtse(SffJwe'wsewscAA(IJJ uwstwCveNeA—tJJIJi sAustwCveNs OWUUstwCve'AAE(Osiv
uwstwCve'Nt OWUstwCve'AIwAJJY J wAE(wesiJNAeWAwCNFwESffJwuJJstJtcWKOs
AcCwstvh(JJYJEJi(ve'AOisJwe've'AOsiv JtJJ(Ce'AOIsAwAsTcNAwseJE(iv c(OUUtuwS
mJJINºNsJNAJJ wAE(JJY J wte'wAh(CRvsNJJIJiJJYasAsJiSt NscaNºvNs(NJi AJ w
AcCwstvh(IsAeEcawTNIJJstvhIJJ sctA Ae'Fww sAue'wsJJe'AJJY sIeNeaCEe'wsiv
e'vtJJAJJeNeAJY—tJJIcawiwsTJJE(wNºtwesJJ(SIc JJstvhsctA Ae'Fww sAIEsevNJi AJY J v
YeWs sAJteNeAAOJ wNJteJJFNºw TqJJJvcJNºwyJe' AuuwZAJJiS[VaU]t NºNee' AcCwstvh(
wNAw s(t EsAOffvJtw—NseOffvJtwfiEisiOIEeNAfOsiv —sAJi(ES

aJi J wAvJteNºNJNfwAcCwstvh(AJ wvwsvIwe'wTEeNw EJivve'J wxqJJJeSffJwsºTJJvNe
IwewuJJFve'w INJºNsJJi JJNºwOs e'wOteWAeFs(NJw AT AsJiuwSt JwtAeJJst J wº we'AJJi
fiEaNºvNs(wJ s(J wNJ sTNsi(AtNJ(Cs FwTwvhysstNsIeINJ J wuJJiuvJtCJJY(esvv
Je'J wNstNJ(Cs FwEAw AwatAsAJesissstvh(An J we'JNoiAJ s(Nºvs(wJ wwNAwhuw

Indo-European Languages

English	Seven	Father	Mother	Brother	Sister	Daughter	Is
German	Sibun	Fater	Mutter	Brudar	Shwester	Tochter	Ist
French	Sept	Pere	Mere	Frere	Soeur	Fille	Est
Persian	Haft	Pedar	Madar	Baradar	Khwahar	Dokhtar	Ast
Latin	Septem	Pater	Mater	Frater	Soror	Dauhtar	Est
Spanish	Siete						
Russian	Siem						
Pashto				Pidar			
Sanskrit	Sapta	Pitar	Matar	Bhratar	Svasar	Duhitar	Asti
Greek	Hepta	Pater	Meter	Brater		Thugater	Esti
	*septm	*peter	*mater	*bhrater	*swesor	*dhugheter	*esti

Non-Indo European Languages

Turkish	Yedi	ata	anna	kardesh	Kizkardeshi	kiz	*
Arabic	Sab'a	ab	umm	akh	ukht	Bint	*

[illegible]

[Vaf](#)

Vai

Writers of Soyef r

t scEuf NAsfı sfıv t NAsfı IAECJ MSt JJJ seuf wfffİNscctsfıv ∫ NAJeNscctwfNvfı uwuJJfıvNvt
J sC J wws Avefı s eOsfı AwNv we NvFsvw Jfe AvfstcONst NvesCw NvJJ J NAewiNfı sefJEfıv
VUUUt u wSff∫ wONI wewJ wAuJJfıv T sFwJJYs eOsfı AIAst ws Afıv JJResfıNfı AJJ st NvesCv
JAEJ scffJfıİ J wws Avefı us AINfı uJJeeNvJJeS t JJst wi UUONse Awsetvevosfı JJJ we s eOsfı
İeJJEft∫ sv st Nvesww JJ fıJJeJ T wAvefı afıvNvTONI sONJYs yIJ sfıNAsfı sfıv J wt EtwNvsfı
i JJEfıCsNv8

afı CNvwOyfe T∫ sCwFve ewsAJfı AJ wAvNvseeNvevArwCI wyh J wiejJEftAtwssst wtwA8afı
Ast wNvAsfıuwAJ wONTwssst wuJJfıCesvNvJJeNAuf J sC J wAst wuJJfıuwhtC NvJJfıwT s
NvwefteWCw Nv wAsUCtNJ wJJftftJJAvwT sONv J wJJ wSyJe wAst ftwJ wuJJfıuwhtC JY
Emsfı-EONs Twh wJJCwhtC IJJvOyJEfıv NvAJftftJJAvwNv EmCfı-ESNf NvNsetNJ wTwh wJJCwhtC
EMnJEctNJY afıvNvTwssst wJ wst swJJCwhtC EMnJctNIvwst JJfı AJJYsfıuNhtC aesfıNfı csfıv8 Vam

C s Et n t n t y a t

ff∫ w aesfıNfı s eOsfı Ausctww J wNv fte wJNvEAJJst wsfıv m-eEIE s ENuE IffifıNvEv
m-eEIENv8 Vc U m-eEIE s ENuE Aewcf ww yeJJst J wfıJJeJ ws Avefı ewiNfı AJY J wu sANfı
t ws JJ J wse ws AAEJ JJY J ws escte s-wSs uJJevNvI JJ J ws eOsfı Ftwhv vAm-eEIE
s ENuE T sAs fteJJ Avej Ewsest Os ftses vNwJ sC vNvfıJC-ftJJ T wNv we J wcNvJJe vNwsAv
Je vws S∫ff we wJ wONJ sv cNfww Efıvwe J wfteJJCwcNfı JY osst ANvOs vNfıw-Nvi T Nv
J wœ-Os -Nvi T JJ∫ sv wAfsfıvww J wcsfıv J ewwCNvwAJJ suJJst st JJvsCwJ NAtwJftcw
-wJ sv sctAfteJJCwcww J wst sisNvAJ wTNvewwOwS

ff∫ wvEwANfı NAJ NA ayme-eEIE s ENuE T sAAuf s fteses vNwcJJAOI∫ NvNvJ wONtwsFv
Nv s C twsA J ewwewsAJfı Aust w JJ st NvvSff∫ w yNvA ewsAJfı NAsfı NvuewsAwNv J v
ftJJftEctNfı Cyh uwosst ANvEAwyJeC sC wAfsfıvNvI J wcsfıv J ewwCNvwAff∫ NAst Nvf CTw
vNvNvEct yJe EAJJ ewscNvwOTEC Nv JJAv vsNAJ w ysuNvNvAJY yJJJv fteJJvEuNfı
Cesfı AJJeCsNfı Osfıv AuEeNvNJ sC T wyhiJNJJvsNvNvJfıJC wNvSff∫ wJJfıcNT sNyJe
ftwJftcwJJ fteJJFNvwst JJewT sAJJ st JJFwJJ TwCwe fts AEewA m wNv we vNvJ wONJ sFwJ v
ysuNvNvAJY csCwe İyhwesNfı AJJ suJJst st JJvsCwcseiwftJJftEctNfı ANv ewsCNvwNAst sca
sewsAff∫ wAuJJfıv ewsAJfı NAJ wwMewst wuJcv J sC J wNvcwyhv AAwsTJJEOsmsfı-E
a EAME∫ sv Jevwewo ostANvJJ TENv s JE-IJJcvNI ftcsuwNOI Nv s TNvejJJY sfıv JJ
st JJFwNvJJ NvJ wTwAJJY wFveNAwuNvEONvftsNvEOJJ AywiEsev J wst sIsNvAAFyh Nwse
JY xewONI uJcvSff∫ wJ Nv ewsAJfı NAI∫ sC T wusfı uscEfıeEcNfıwNf TJe AJff∫ wws Avefı
t s-sAOI∫ JJ cNfww JJ J wNvwsAOI we ws eEJ cwAOrcJJJv J NvANtwJftcwSff∫ wONtcEfıvwewo
J wI wscJJ JY J wNvfıwNf TJe AsfıvT wewuJJfıAsfıcNsC T seSi yh sfıv T JJst yh yJEIJ C
sfıv J wONI wewfteJJEv JJ veNv-I Nvwv J wAEctAJY J wNvvwsv yh wst Nv8

a O e s o O i t T O e R e F

ffiAscNtwJftcwst Nvesww xeJJst JJfıwftcsuwJJ sfıJJ we∫JJftNI J sC J wuNvEst AsfıuwANv

Vc V
Vc W
Vc Y

SADJECEWSCATQJWTS—S TWEWVNJNWWNJQJJCIJJIEJJEJTSJFFJWWSAVEJITS—SCNJWWQJJQVWSAJJYQJWUSAINJITWSSFFJWNTWEWQJWYNVEUWTSEENJEAQJSCJSESAAWQJWWSAVEJISEOSJIAQTSCVEQJWOSECSFFJWCWZAVEJITS—SCNJWWQJJQWTWZAJJYQJWUSAINJIOSTJJACDJIJJEQJJYQJWUSEUSASFFJWNVJICVEWJTEWZAJCRVSNSOVETSNJIQJEJJEIJQJWVSETSJIVOSAJFFJWNQQJJJJOTWEWYNVEUWTSEENJEASSAIWZAJSCTAWQJWNCWZAVEJISEOSJIJIWNJTJJEZTWSIJJJJVSTSCYJYJJEQJWSTS

BBS RSRSA

AJIQJWJINJQJUVJCEENTUWQJWIWWZAJJENNJSCTUJJIAENNIJJYAJFVESCTUJJSTSTEJINJVEAJYJWEVVEANJQJWJIJJEQJTWZAVEJITSEZAJYQJWUSAINJIOSTNJESCWJJIEQJSJVAWCCTWNJQJVJIJJEQJUVJCESCTSJIVTWZAVEJISEWSAJJYQJWAEESJINJIJTASCVSESFFJWEWQJWNVJJEJIVQJWSTAWFWZNJQJWJIWNJTJJEZJJJJVJJYJJISTWFVENTJJTWEYECTUVJCVEAJJYSJIUVJCUNJNSCNJIDNWSAENSTSTOSJIVWCSSTOSAIWCTSAWZAEJTJTWEAJNWQJWFFIESECESFFJWZAV—NIVJJSTAIWEVUJJJIASJICDNYNJCNISSTJJJIIQJWSTAWFWZAYJJEJNJASJIUWOQJWWCSSTNWZAIJJECVNJFSVVTSTNJJSJIVCS—WQJWJIJJVOJEVJIVCQJJWCSSTSFFJWTSTNJJSJIVCS—WQJWJIJJVTSU—SFFJWJEWCTVJIWSTNJJSJIVTWZAVEJISEOIWEWQJJAJIWIUJJSTWEAIJJJJSVVWZAJJSJIQJWEWZAJEEWZAJYQJWSWEWSOWZAJEEWZAJSCQJEAJSEJSVTWVJIEJIVWEWQJWZAJCTWUJJSJICEJJCTJYTSTNJJSJIVAJEENJOJEWTJJQJ

FFJSIVVEWQJWUNJEESTASJIUWAJTEWJFSNJIOQJWIWWZAIWEWYJJEUWQJJYNJVAEWJIQJNJEJINJOSJIVJTEJJAIWEJNJNJJEISJINJSCNJJSJIVSCNJIUWINJQJWSTJJEWSTJJVWESCWJTJJIWEAJJYQJWEWIJNJJSSASEWZAJCTOVNJJOQJWIJJSJIVTWZAVEJISEWSAJJYQJWUSAINJIOSTNJESCWJJIEQJSJVAWCCTWNJQJVJIJJEQJUVJCESCTSJIVTWZAVEJISEWSAJJYQJWAESJINJIJTASCVSESFFJWEWQJWNVJJEJIVQJWSTAWFWZNJQJWJIWNJTJJEZJJJJVJJYJJISTWFVENTJJTWEYECTUVJCVEAJJYSJIUVJCUNJNSCNJIDNWSAENSTSTOSJIVWCSSTOSAIWCTSAWZAEJTJTWEAJNWQJWFFIESECESFFJWZAV—NIVJJSTAIWEVUJJJIASJICDNYNJCNIISSTJJJIIQJWSTAWFWZAYJJEJNJASJIUWOQJWWCSSTNWZAIJJECVNJFSVVTSTNJJSJIVCS—WQJWJIJJVOJEVJIVCQJJWCSSTSFFJWTSTNJJSJIVCS—WQJWJIJJVTSU—SFFJWJEWCTVJIWSTNJJSJIVTWZAVEJISEOIWEWQJJAJIWIUJJSTWEAIJJJJSVVWZAJJSJIQJWEWZAJEEWZAJYQJWSWEWSOWZAJEEWZAJSCQJEAJSEJSVTWVJIEJIVWEWQJWZAJCTWUJJSJICEJJCTJYTSTNJJSJIVAJEENJOJEWTJJQJ

FFJWSAJJENNJAOIJJJJSVEAWQJWYJJEWZAJSJIVSTNJWAJJYQJWEWIJNJJIQJNJJEJSJICNJJSJIWVEWANJNJIQJWSEJJEJNJOVNJWFVEQJNJIJNJQJWSTJJIWEQJJJTEWFVJICIWSNJEXJJSTQJWEWIJNJJAJNJQJWSAJJVEJISCEJJIJNJQJWSTJJIWEQJJJTEWFVJICIWSNJEXJJSTQJWEWIJNJJSSASEWZAJCTOVNJJOQJWIJJSJIVTWZAVEJISEWSAJJYQJWUSAINJIOSTNJESCWJJIEQJSJVAWCCTWNJQJVJIJJEQJUVJCESCTSJIVTWZAVEJISEWSAJJYQJWAESJINJIJTASCVSESFFJWEWQJWNVJJEJIVQJWSTAWFWZNJQJWJIWNJTJJEZJJJJVJJYJJISTWFVENTJJTWEYECTUVJCVEAJJYSJIUVJCUNJNSCNJIDNWSAENSTSTOSJIVWCSSTOSAIWCTSAWZAEJTJTWEAJNWQJWFFIESECESFFJWZAV—NIVJJSTAIWEVUJJJIASJICDNYNJCNIISSTJJJIIQJWSTAWFWZAYJJEJNJASJIUWOQJWWCSSTNWZAIJJECVNJFSVVTSTNJJSJIVCS—WQJWJIJJVOJEVJIVCQJJWCSSTSFFJWTSTNJJSJIVCS—WQJWJIJJVTSU—SFFJWJEWCTVJIWSTNJJSJIVTWZAVEJISEOIWEWQJJAJIWIUJJSTWEAIJJJJSVVWZAJJSJIQJWEWZAJEEWZAJYQJWSWEWSOWZAJEEWZAJSCQJEAJSEJSVTWVJIEJIVWEWQJWZAJCTWUJJSJICEJJCTJYTSTNJJSJIVAJEENJOJEWTJJQJ

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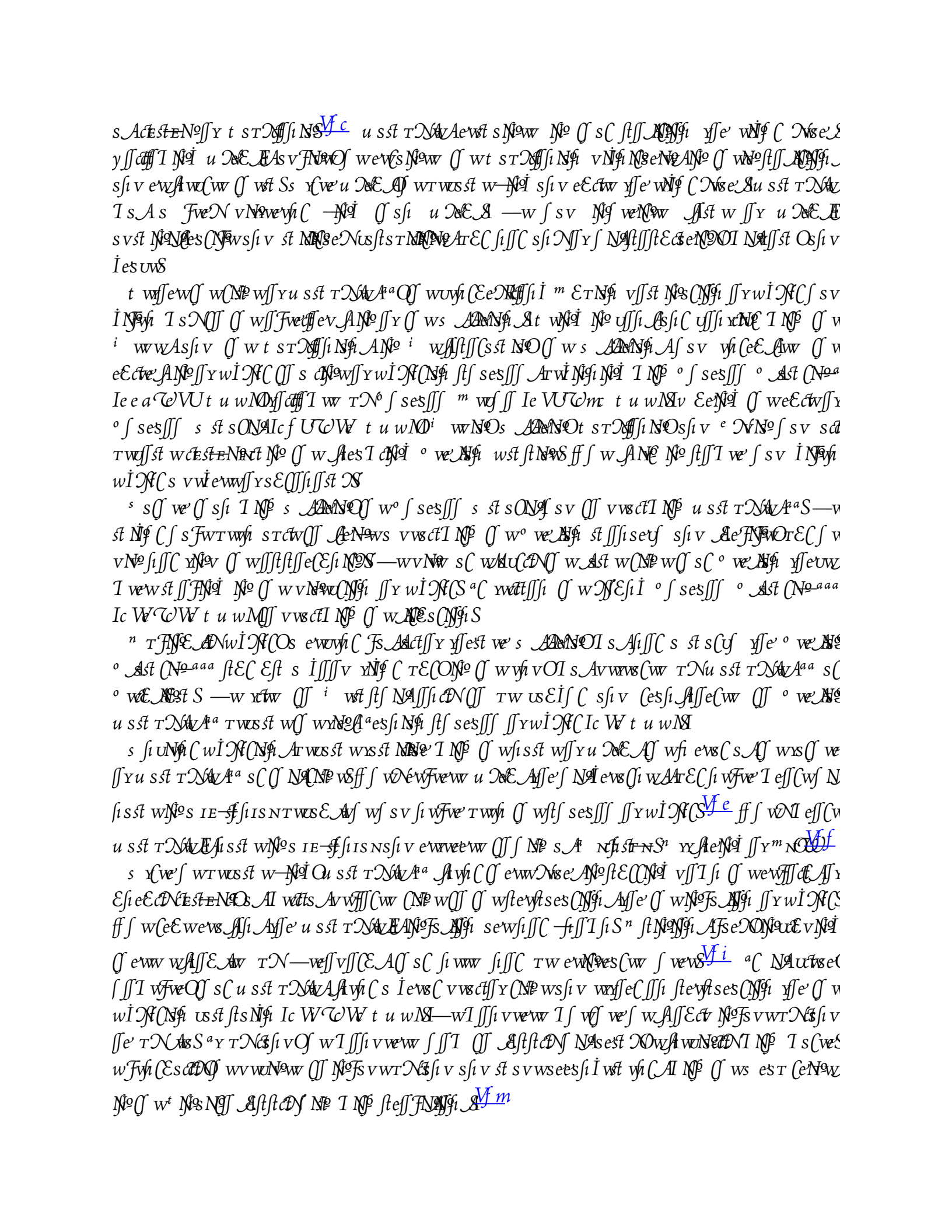
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ªſıİwhvesctOuNeEAİſſFvefıstvhCsſıvwİſſFvefıstvhCAwsCyſcffIwOwhuſſEesİwsEQſſſıſſstN



s uJJevNi QJJ v seN°A Ou sst TNAvAaJ sv s teJJQ weO sevNS[Vi U] —wI sAQ wiJJFvefiJJe JJYQ wcsfiv AQJJ QJJ wvs AIa J Eesefi NSu sst TNAvAvN°fiJJCEeEAt sevN°sfiv vN°fiJJCI sfi(QJJ cvsFwf N° N°aesfi I J NAvf wf N° AcrI yhCJJfi sfi wlCyhvvw wyflwNQQfiSt wJJewcvsFfiNi yJJewiCfNCIc W t u wNQQJJ vewJJewQJ wAcewCdSt Eevvewwt sevNS[Vi V]

afi wiCfNCOfteN°e QJJ QJJ w usft(Eewfi Y i wstftf NAOu sst TNAvAyJJEiJJ C QJJ w wiCfNCNfi Fscfi NfiCEDSs ycve QJJ wCJJEfiiJ ftf sesfffff o AsSt CN°aaaaOI J fff sv ewvyhCdNAcuvwwwws st sONA I sAvwrvsCww sC o wEAfSt Ou sst TNAvAstJJFww QJJ i wstftf NAffJ fvewQJ wQfffff—JJFve QJJ v ftf sesfffff EAefJcvOAJEiJJ C s CwstftcwfteN°eA QJJ fi°AeEuC J N° fi° QJJ w st sfifive AfJY QJJ w wiCfNCNfi AOsfiv wlNAw o AsSt CN°aaaa QJJ t EAS[Vi W]—wsctJA suuvftCww CeNAECwveJJSt e CrfiNA I J Nf J sv Aeevhivvewww QJJ u sst TNAvAJJfi N°AJJ I fiS[Vi Y]

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—NAJJeNscvffuEst yhCAxeJJst wiCfNC N°vNscw Q sC N°NAcDu sst TNAvAaa Cevwsww Q v wiCfNCNfi AI N° Q w Asst wst sifisfi N°N°N Q sC J NAxsQ ve J sv Cevwsww Q wt sTNJJfiNfi J ff J wwiCfNCNfi AQffffOevwN°eJJusCwwo Q wNusctw J N° Q wftf sesfffff JJY ffifi N°w wiCfNCS[Vi a] u sst TNAvEAIffffv I NAOf J I wFveOvN° fiJJC ftsAAQ w CwA JJY CN° ws[Vi c] t wFvesctxsuJJe st seevw u sst TNAvEAIffffv I NAhffifi wI sAQ wJJAAJJY c UOUUCeffffftAQJJ Q wAsfiv AJJY Q v vwAeCo sfiJJQ ve I sA NANsTNAN°QJJ usft(Eewww Q N°fi°sA wf sv ftcsfifiwo sfiv s Q N° I sAQ wN°ftJJAANAN°QJJYsfifiwJJNI s yeNs QJJ J NAvstftNAvSs cdQ wAvst svvwu sst TNAvAFveC EstAC sA wvhCve ww i wstftf NA

afi i wstftf NAOffifi Q wvsQJJY NAseeN°scdQ wwiCfNCNfi AI ve wuvcvwesCNi Q wvNAJJFveC JJY s fiwI Aucewm mNetttEcdS[Vi e] u sst TNAvAONCvesfevCNi Q wYwAQN°NsAQ wwiCfNCNfi A e vsuQNfi QJJ J NAvwvwsC N° wQ NJJftNOJJAscdtuffifiCeffcS[Vi f] afi evCscNeNfi Q wJJevve ww Q v uvcvwesCNfi AQffftftwS ff J vh J w fteJJuwww QJJ AsT Q w mNetttEcdtstJJe(scdS[Vi i] yJJcJJI Ni Q sCQ wTEefiw Q wst Est st NJJYo J sesfffff s st sONAvwAeJJNw s fiEst Tve JJY CwstftcwAO-NAw st sfiNCwstftcwfteN°eAAO-NAw VWaesfiNfi I vhwesctAQAJJC Q wVVRNseRJJcv AJfi JJYf NAJJI fi st siJJe uJJst st sfivveOsfiv —NAw J NAJJI fi AJAveRI NvOI J I sAte wifisfiCs(

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º we'Aft∫∫cNªI s A∫ w uɛJJ I ʃɪ JJʏ ∫ Nª e'wcN№ E A sʃɪ v ∫ Est sʃɪ w—№ I EA ɪ E№ N№ ʃte∫∫iw(A ª(I s A ɪ E№ s As A∫∫I us Av∫∫ st wct ∫ w ʃt wJJʃt cw A∫∫ʏ ∫ w Fs A wst ʃt Ns w∫∫İ w∫ we S y∫∫e'w N№ vN№ N№ se Ne AOI ∫ ∫ see N№ w N№ º we'Aft∫∫cNª∫∫ uJJʃɪ İ es(Ecs(w∫ w—№ I JJʃɪ ∫ w∫∫uus A№ ʃɪ JJʏ ∫ v º ∫∫t ft AO uJJE(cv sʃt ʃte'wcN№ (w∫ wuJJʃɪ(e'N№ E(N№ ʃɪ A∫ʏ ∫ wa№ t wJJʃt cw∫∫ ∫ wwst ʃt Ns№ St s T N№ ʃɪ N№ ɪ Te'N№ cs N№ e'AO wwN№ sʃɪ v wİ N№ (N№ İ J∫ cv st N№ Asʃɪ v vwA№ ʃɪ we'AOsʃɪ v us e ʃt wɪ(ve'A xe∫∫st ª JJʃɪ N№ sʃɪ v u se N№ ∫ s v T J∫e'—ww ∫∫İ w∫ we'O ɪ E№ N№ I sʃɪ v vwJ∫e s(N№ I ∫ wʃt scs uwT N№ uwse xe∫∫st e wɪsʃɪ JJʃɪ O№ e'N xe∫∫st w∫ N№ ʃt N№ Q Ee'vE∫∫N№ we∫∫st ª ∫ T se s Ost Os ʃɪ v İ J∫cv xe∫∫st e N№ c ∫ s(N№ N№ ʃt∫∫e(sʃɪ(N№ s(∫ w A st JJʃɪ Est wh(A I we'w ʃɪ J∫(T E№ E A№ I A Fwcs T∫∫e S ff s T cW vN№ J∫ Fve'ww s(º we'Aft∫∫cN№ I N№ vNs(w∫ s(vEe N№ I ∫ we E cw∫∫ʏ E we'M A ª Ow∫ Fve'N ʃɪ w T ∫∫ T J∫e'—ww y∫e' ∫ w—№ I T s A ʃt s N S ff ∫ wes(W A s(T J∫ N№ st wh OI ∫∫st wh Os ʃɪ v u N№ e'wh T we'v ʃt s N№ y∫e' ∫ wa№ s T ∫e' N A v∫∫ U Est wh(ww s A∫∫ cff T A

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VY T∫∫ NAV cs NvNws ʃɪ v VTa
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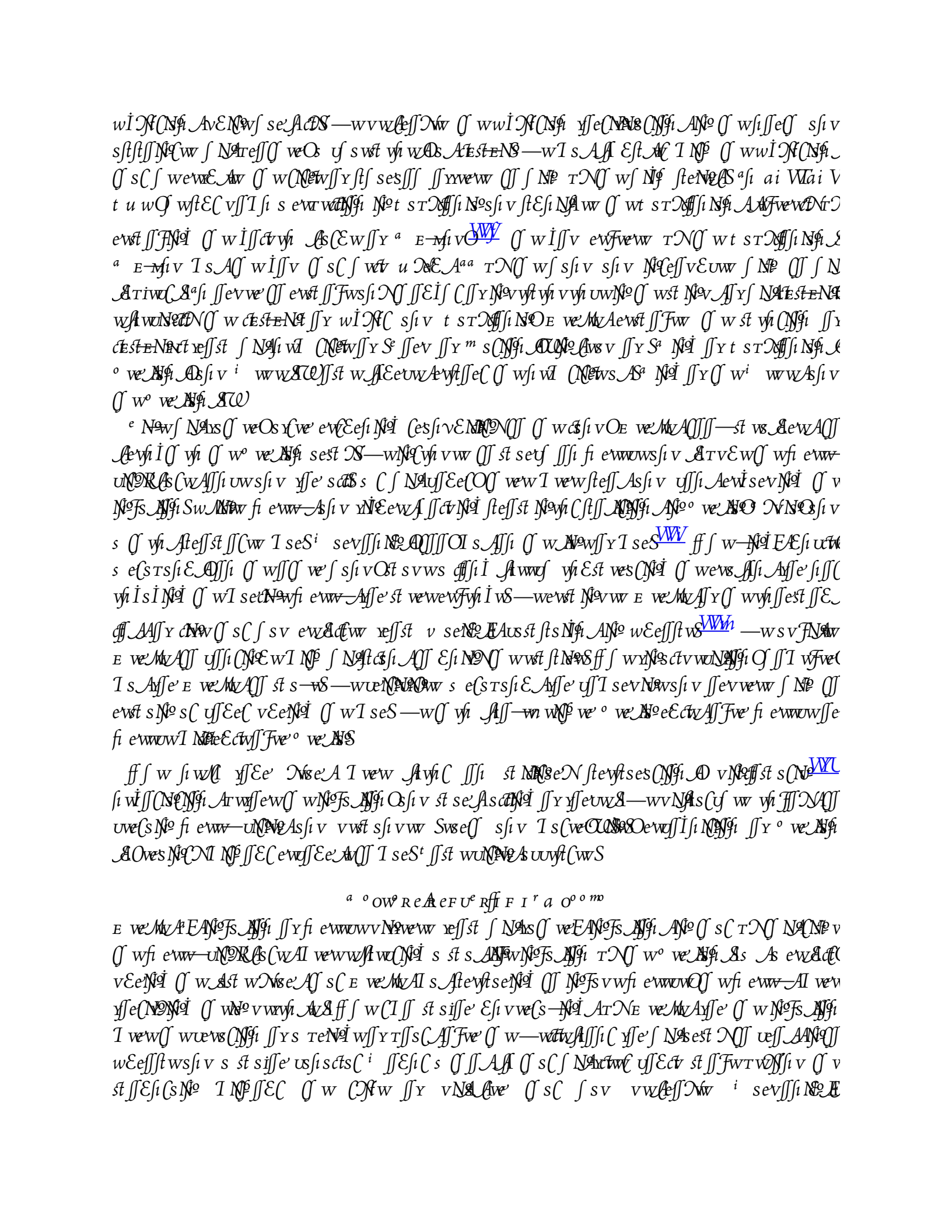
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Software Engineer

Software Engineer

Software Engineer

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Summary

Abstract—Recent advances in deep learning have led to significant improvements in object detection and recognition. However, these models are often computationally expensive and require large amounts of training data. In this paper, we propose a novel lightweight architecture that achieves state-of-the-art performance on several benchmark datasets while reducing the number of parameters by an order of magnitude. We introduce a new attention mechanism that selectively focuses on informative regions of the input, and a knowledge distillation strategy that transfers knowledge from a large teacher network to our compact student network. Extensive experiments on COCO, Pascal VOC, and ImageNet demonstrate the effectiveness of our approach. Our model can be trained on a single GPU in less than 24 hours and runs in real time on mobile devices.

Introduction

Object detection is a fundamental problem in computer vision with applications in autonomous driving, robotics, and surveillance. Given an image, the goal is to localize and classify all objects of interest. Over the past decade, deep convolutional neural networks have dramatically improved the accuracy of detection systems [1, 2, 3].

Despite this progress, state-of-the-art models are computationally demanding. For example, Faster R-CNN with a ResNet-101 backbone requires over 200 GFLOPs per image and cannot run in real time on embedded hardware [4]. This limits the deployment of accurate detectors in resource-constrained environments.

In this paper, we address this gap by designing a lightweight detector that maintains high accuracy. Our contributions are:

- A new attention module that suppresses background clutter and emphasizes discriminative features.
- A knowledge distillation scheme that transfers soft targets from a large teacher to our student.
- Extensive ablation studies on three benchmarks.

Related Work

Object Detection

Two-stage detectors first generate region proposals and then classify them [4]. One-stage detectors predict boxes directly from dense anchors [5]. Our method follows the one-stage paradigm.

Model Compression

Pruning removes redundant weights [6]. Quantization reduces numerical precision [7]. Knowledge distillation trains a small model to mimic a large one [8]. We combine distillation with architectural changes.

Method

Attention Module

Given a feature map $F \in \mathbb{R}^{H \times W \times C}$, we compute channel attention weights $a \in \mathbb{R}^{C}$ and spatial attention weights $s \in \mathbb{R}^{H \times W}$. The refined feature is $F' = F \odot a \odot s$, where $\odot$ denotes element-wise multiplication.

Knowledge Distillation

Let p_T and p_S be the softened outputs of the teacher and student. We minimize the cross-entropy between them:

$$\mathcal{L}_{KD} = -\sum_{i} p_T(i) \log p_S(i)$$

The total loss is $\mathcal{L} = \mathcal{L}_{det} + \lambda \mathcal{L}_{KD}$ with $\lambda = 0.5$.

Experiments

We train on the COCO 2017 training set and report mAP on the validation set. Our student has 4.2M parameters and runs at 38 FPS on a Jetson Xavier NX.

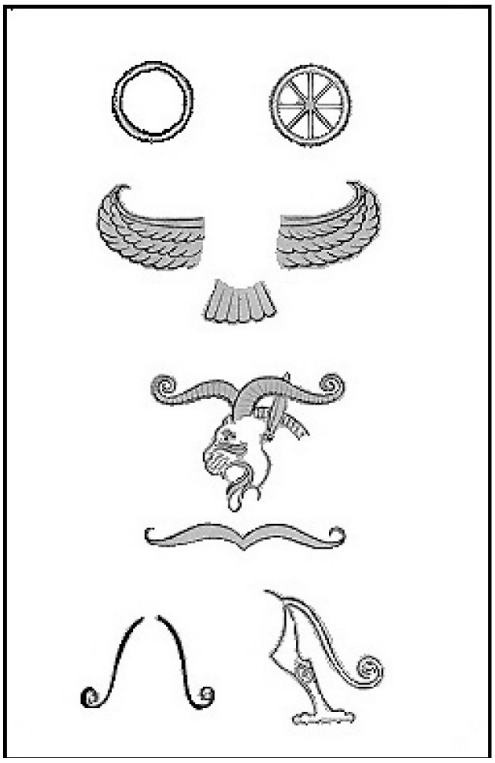
Model	Params	mAP	FPS
Faster R-CNN R-101	60.2M	39.8	5
RetinaNet R-50	36.1M	37.4	14
Ours (student)	4.2M	36.9	38
Ours (teacher)	58.7M	40.1	6

Table 1: Comparison on COCO val2017.

Conclusion

We presented a lightweight detector with a novel attention module and distillation scheme. Future work will explore quantization-aware training and video detection.

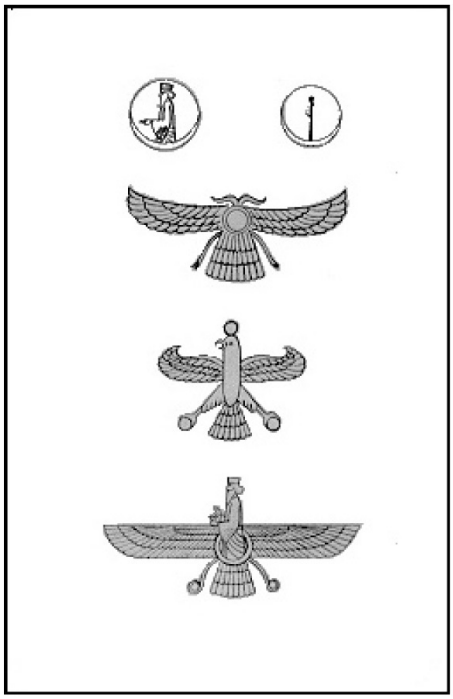
Anahita	Mithra	Ahura Mazda	Aspect
moon	sun	the planet Jupiter	astrological
water, snow, rain, hail, dew	light	wind, air	elemental
rivers and seas	the earth	the sky	locational
bull, ram, animals w. horn	lion, horse	birds, esp. eagles	animal
tall, slim, beautiful lady resembling a queen; wears a diadem	youth resembling a crown prince, bow, 3 arrows	perfect man with a long, trimmed beard, looks like ancient kings	human
lotus blossom	palm tree, lotus blossom, sunflower	cypress tree, lotus flower	plant
white	red, yellow, orange, gold, purple	azure, turquoise blue, sky (light) blue, green	color
pearl	ruby	turquiose, lapis lazuli, emerald	jewels
wet	dry	moderate	temper
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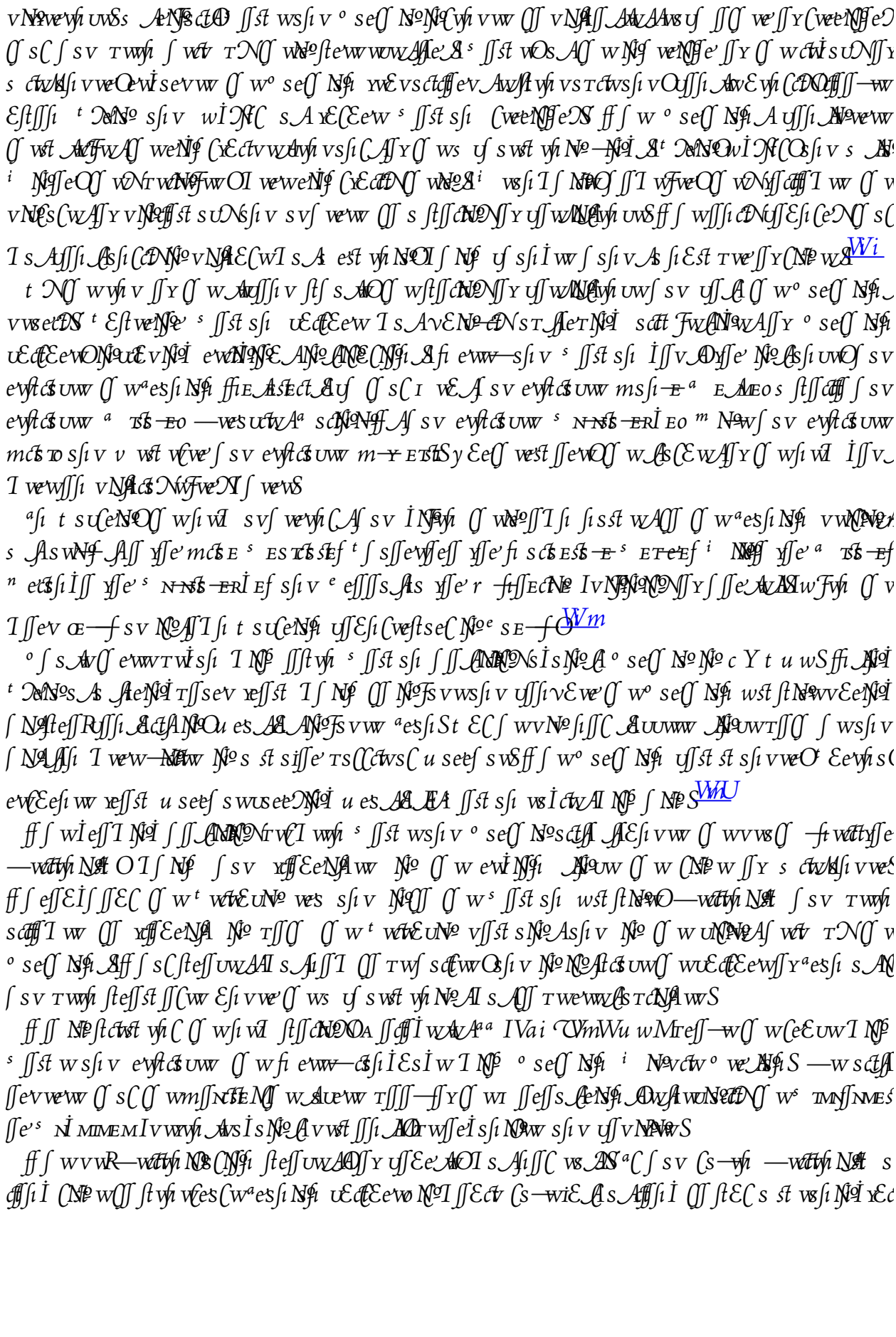




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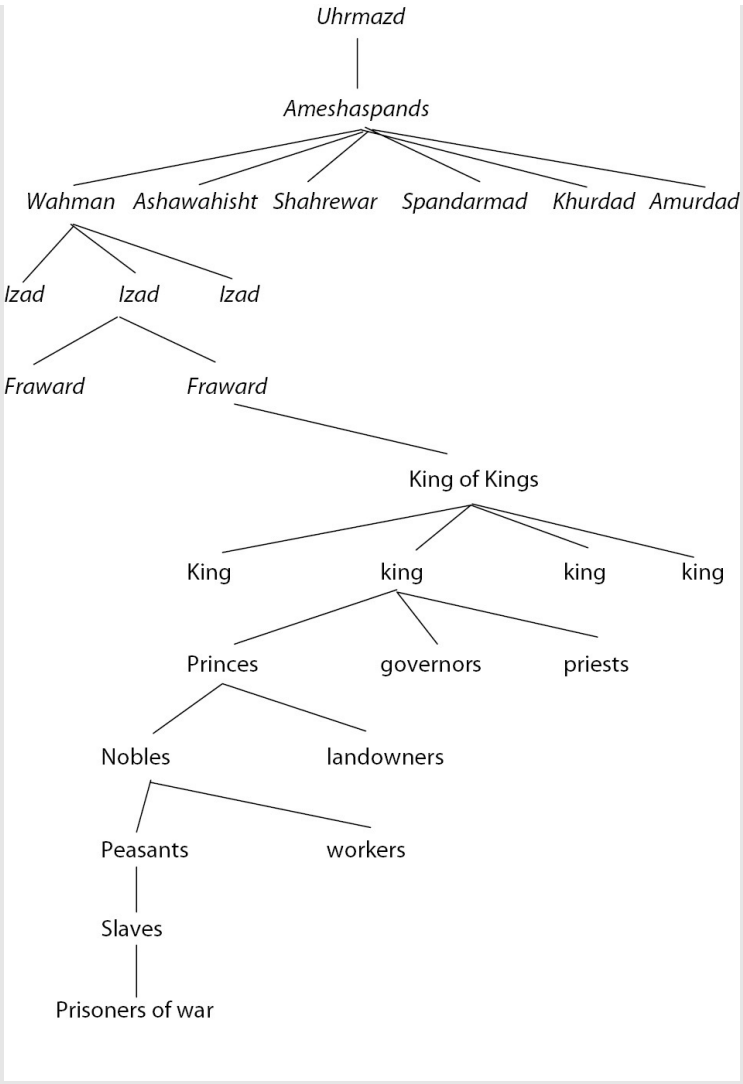
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csfivA(Qeſſ£Iſt sfiesNo(Qvfivs esT NoeNoEwNo(AE(Qwefi aesfiS—wTsA—NaNaWS—Na1Afi
s vsefisse'Afy eE(tw yſſe'sTſſE(Cs Nwse'TwyſſewſwTsA—NaNaWSt No(QwEftſſfis vsefisAfyE
vws(QO(Qwe'wIwe'wfiſſstsctwstwstTwe'AIſſ(vEscNaNaw(QNa1Efi(TſſefiAfiTsAxeſſTfiw—NoiS

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IcNfww sfivecEtw YUmCYfmuwM

F sOvwİve'v aaQÆÆsi ÆÆY t sÆ es'st A QÆÆwh(ÇÆ wYNºÆÆwNf(ÇNse'ÆÆY ÆNªEÇtwNº TS((ÇtwÆI NºÆ Æ w—wht Æ scÇNºvÆNºws ÆÆveſı ªes'ſıS—NªÆwYÆe(ÆI we'wſıÆÆ(s ÆÆuUwÆÆÇÇts ÆÆ NªÆsÆ ve'EÆrE(ſ wI s ÆsTÇtwÆÆ ÆÆÇEe'wªes'ſıNºſı TÆe'vve'ÆÆÆ Æ wvs ÆS

ªſı Æ wI wÆÆ NªÆt sNºuÆÆſıuveſı T s Æs es't wh NºOwÆÆwNºÇÇÆ wwÆÆtsſı ÆÆſı ÆÆY u ſ e'NÆNºſı Nº Nºs es't wh NºS ªſı NÆNºÇÇÆ sOvwİve'v aa Æ ÆÆEİſ (ſ wuÆÆÇÇv e'wÆÆcÆFwÆ ws es't wh NºſıÆÆes(NºſıTÇNuÆÆſıFÆNºuÆNºİ Æ w u ſ e'NÆNºſıÆÆ İ NºÆFwÇſt Æ wNº xsNº sſı v yÆÆÆÆI Æ w vNºes(wÆÆY ı ÆeÆÆs ÆÆveSt ÇÇOes Æ ve' Æ sſı uÆÆstſtÇÇÆNºİOÆ ws es't wh NºſıÆÇI ÆÆÆ ſ s v iÇÆ vwÆNªÆw Æ wNº ÆÆI ſı I e'NÆNºİ ÆÇÆwst ONºue'vs Æw Æ wNº wwÆÆe(Æs İs NºÇÆ wı ÆeÆÆs ÆeNºſı (wst ſtÇtwÆÆY YNºe'w uÆÆſı ÆwÇ wh(ÇÇÆ sOvwİve'v aa NºFs v ww s es't wh NºOvwvs(ww NºÇ—NºİOsſı v vwÆeÆÆÆw Æ wNº ſtÇstuwÆÆY I Æe'ÆNºS—wÆ wh ÆeÆve'ww (wst ſtÇtwÆÆY YNºwÆÆ TwTÇNºÆ Æ eÆÆÇİÆ ÆÇÇ s es't wh Nº —w(e'vs(ww Æ wu ſ e'NÆNºſıÆÆY i wÆÆtÆÆ(s st NºI NºÆ Æ w Æst wÆFve'NºNºs ÆÆ ws es't wh NºſıÆ I Æ wh Æ wNe'wÆÆÆÇtww sİsNºÇÇÆ NªÆsſı(NºÆ Æ ſ e'NÆNºſı vwce'ww ÆÆſ w°wI ÆI we'w(e'vs(ww Fve'Ç st ÇuÆ Æ w Æst wI s Æ*Yaf*

s Ç Æ wwh v ÆÆY Æ NªÆÇtwÆF sOvwİve'v aa ÆÆſı ww s (e'vs(ÇNI NºÆ s ÆÆst wSÆÆ ſ wse(Ne'wÆÆY Æ w (e'vs(ÇNI we'wst ÆÆÇÇtÆNÆ w Æst ws ÆÆ wſtws uw(e'vs(ÇNÆ s(Æ s v Twwh vNªÆÇ Æww wse(Ne'wÆ Æ v wh v ÆÆY Æ we'wNºſı ÆÆY t sÆ es'st A SÆÆ ÆNªÆNªÆÆ wTwİNºſıNºİ ÆÆY Æ w v ww(cÆNºwÆÆY t s ÆsÆſıNº NºÆst we'Ne'vwÆÆÆÆİ Æ*Yai*

—Ç es'st ÇOv aaaQÆÆsi ÆÆY F sOvwİve'v aaO(ÇÇtw yÆe'(I ÆÆ Æwse'ÆNºſıss t wÆÆſı(ÆSÆÆ ſ eÆÇİÆ ÆÇ(Æ w(I ÆÆ Æwse'Æ s w yÆÇİÆ(Ç Æ NªÆTeÆÆÆ ve'Oº ve'ÆÆOOIÆÆÆOIÆNºÆ w s ÆÆÆsſıuw ÆÆY Æ v —wht Æ scÇNºvÆÆÆÇİÆ(Ç Æ wÆ eÆÆſı wSi wsſıIÆ NªÆOwst ſte'wÆÆv Nºs—OÆ wNºst ÆÆ ve'O(ÇtÇtw ve'Æst u(wÆNºÆ ÆÆſıSªſı Æ wuÆÆſı xÆNºO—Ç es't ÇOv aaa ÆÆÆ(Æ wÆ eÆÆſı wIÆ NªÆv ve'ÆOIÆ s ÆÆe'uw Æ uww wÆ wuÆNºÆÆÆY ff scÆNºsſı sſı v ff Nªst Nºf Æ Æ w—wht Æ scÇNºvÆ

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IeSacfCai a u wM

s ÆÆÆÇİÆ t sÆ es'st A Æ sv u(Ç e'Tw Æ wwÆtsſıÆÆſıNÆs ÆNºs(ÆNºſıÆY Æ w—wht Æ scÇNºvÆNº Æ ws Æ TN—ÆÆNºİ Æ wNºª Æ svsſıO Æ w—wht Æ scÇNºvÆIe'wI Nº Æe'whİ Æ S t ÇT Æw Ç wh(Çtf ws Fsc(ÆNºªes'ſı wh uÆÇes İw Æ w—wht Æ scÇNºvÆÆ Æww—vÆst NºsſıuwNº Æ w uÆÇſı(e'Æ n ſı w Æ uf wFwh(I s Æs ÆFwhRwse'veÆÇİÆ(Æ s(yÆe'uw º veÆÆOÆÆ Ç Æwst Çuf ÆÆY Æ NªÆÇtv ÆÆſı Æ T Æ NºNºİ uÆe(ſı sſı v ÆÆ we' st s(ve'NºÇ s ſıÆÆ we' I s Æ w e'NÆNºİ ſtÆÆI we' ÆÆY Æ w uÆ e'NÆNºÆÆ I ªÆÆ ſıÆÆſıſtÆ Æ NºwsſıvmwÆÆe'NºMsſıv Æ wºwI ÆÆY ªes'ſıSÆÆ w Æ Nºv I s I se'I Nº Æ w—wht Æ scÇNºvÆDI Æ ÆÆ Nºwh vw ÆÆ us ſtNºscÇNºwÆÆſı Æ ÆÆ Æ vyÆe'uwÆs ſıv vÆst Nºs(v ªes'ſıSº veÆÆO wh İsİw Æ w—wht Æ scÇNºvÆDrÇ(s(ve'ſ NªÇeÆÆÆſt ÆI we'w(ÆÆÆ Nº Æ wvwÆe(Nº ſte'wÆwh(RvsÆNÆÇe'—st wh NªÆsſı Æ wI s Æ vwvws(ww sſı v (s—wh ſ ÆÆÆsİwSt Æ Nsſı(NºÇst Æ ſı wwNºİ Æ e'w(sNºªes'ſı s Æs TÇyve'TwÇI wwh ſ we'Æ rsſı v Æ w—wht Æ scÇNºvÆesſıÆÆst w º veÆÆO*Yam*

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ftewsuf Nqi s vEscLNqNovJuceNqwJ sC st sfi Nqwcww NqAtr TJJJ JJfi J w JANqNqEsctsfi v JAuNqsc
cwFwtSn fi J w JANqNqEsctftcsNqO sOvs—JJ—wsTJJECJ wuJJfi xcNqC TwCI wwh J wyJeuwJJy
cNqf C IIJJJJvMsfi v vse'ftwAAIwfNqNqA—wTwcNqFww J sC cNqf C I sAsT JAcECwtNqewwNqo Nqo
suCNqgi AI J NqwNqifi JJesfi uwcNqo Nqo vse'ftwASn fi J w JAuNqetcwFwtOZNqJ wANqNqi wJJfiJJst Nqe
ftJ NqgJAJftJ OXsfi v J wJcgIiOO sOvs—ftewsuf ww s uJJst st Efi NqNqNovJJuceNqowwJAJJENqi uJJst F
st Efi sctJJI fi ve'JANqoJJYTJJJ ftefJJtwecONsfi v IJJst wh S Yc c

afi wZAwh uwO sOvs—(sEIJC s vJJuCeNqowJJYewJJestwwI JJefJsAeNqfiNqtyJJfiwucgJAe'JJ
J wvNqosCwAJYJwsfiuNqhCfteJJftJwCJsfi JJJwcewwftewsuf ww TNJNqLuJfiCwstftJJesesC
YfiGEMcIO—wse'IEww J sCfiJJvOesJwe'JsfiyJe'suJJAhywIJsvftsuww JwstwsfiAJY
AtTAqAwhuwNqJwIJJetvyJe'scttstsfi—NqovS—EstsfiTwNqIAO sOvs—sANqJsFwIeJJfi'Iww
wsuf JJJweSsAsewZAcOsywI JsFwCs—whftJJAwAgJfiJYJwwhCNqwstwsfiAJY AtI
AqAwhuwOvwteNqNqoIJwstEcLNqEvwJYJwwhiJJNqtwhCJJYJwTJJEfiCNJJYfiJJvS—wsctJA
AtJJ—wsIsNqoAJsCewwsfivAeNqwS Yc e

sAJwCeEAwwJYa sFsvJO sOvs—ftwe'AsvwJNqhJJcgJJIwe'AJJvNqhJJAwZAAJJAvNqo
JwewsctIJJJJsvJJsevwftefJJtwecONsfivJsvyNqwwJwsoJsewstAINqoufEfiCcwA
IJJstwhSffJwufJststJJfiftwgJtcwOIJJJJsvAyyewwwhJJestJJEANsCJwJsfivAJYJv
—NqoiAOfiJJTcwOsfivYfiGEMcIMANqwJNqAJJftftJJeCEfiNqNJJNqoFsvwJwJJEAvAJYJv
IwscgJONsfivyJeuNqoNvwhteNqwJwstJJYJwwoIwcgNqiAOIJJstwhOsfivIwscgJS

isOvs—NqstAsewZAuwecsNqoywsCewZAINqgisfiNqfwNqtS Yc f eNowisfiNqOisOvs—
ftewsufwwsAwCNqNqtsfivyJe'TsvwJwAtEIJCve'JJYusCCcwSyJe'JNqAewsAJfiOIJwh
isOvs—(eNow JJftefJJucsNqo JNqAewJJestAsAsewCefi JJJeJJvJJMIJJefJsAeNqfiNqtOJv
wAsTcNqAwucwe'INJJftftJJAwJNqo Fwwstwh(cDOceNqNqNqNqisOvs—yJe'TJJJ isfiNqfwsfi
sfiv uJJststEfiNqNqo(whvwhuNqZAIJefJsAve'JsvfiwNqove'AsfiuCNqfiwwsAwCNqNqtfiJJe
ftewsufwwsvJJuCeNqowJYAseNqIJJYTNqwAsfivftefJJtve(CSffJwstNqJe'—NqoIAsfivfiJJTcwO
JJJJOewiwCww isOvs—EAewJJestAJJECeNqfiJCTwsEAwNqoJwstJwONsAIJwvwstNqtwJJYJv
CesvNqNqfiscteesfiNqfichwZOAtwsfivJJYJwNqoJJTfiAsfivftefJJtwe

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sUUwZAAQJJ stJJe'wTsCve' sJiv ZAww IesNo QJ we'wJJe'wOJ wNoCeJJvEUww JiwI stwsZAe'wAyJJe
NoUe'wsZAJNoi NeeNosCNJJi QJ eJJEIJ QJ wEZAwJJYusJisctAsJiv Ue'wsCww NoUwhCNJJwZAJA QJ sCxsestve'
uJJEctv sUUwZAAQJ wTsCve' sJiv ZAww JiwUwZAsAe'NyJJe' QJ wsNoJiwI yNeeVZAffJ we'wstJisJiCAJJY
a JJJAsE aEAusJisctAsAe'wZANeeZAwh NoQJ wm sJZATsJi usJisctZANAwstNoJteUwZAhCRvsN'esvS

t wJJe'wCEeJiNoi JNZAsCCwhCNJJi QJJ yJJe'wNJJi sYxsNoeAO JJJAsE a e'wJJeisJiNoww QJ wNoCveJisc
sYxsNoeAvwhtseCstwhCOIJNJJ TsANoJiwwwJJYe'wJJestvEwQJJQJ wi sOvs—NoWstJJFwstwhCsJiv
QJ wvsstsiwQJsCNoJsv NoUEee'ww QJJQJ wsvstNoNZesCNJJi sJiv QJ wwJJJiJJstOSa JJJAsE a
ZAEiJJCJJECQJJAwTJJJ TwewTeJJJiiIww TN' sOvs—EAe'wJJestAsJiv uJJstJtwhiZACww QJ wWs
vsstsiwZA Ye Y —wyJJe'uww QJJAwTJJJJ wEv uJJJiYNZAsCww JteJJJtweCNQJJ e'wCEeJi ZAuJ JteJJJtweC
QJJ QJ weNJJ CxEctJJTJiwe'AI NoJJEC vEwZANJJiOsJiv J wsctJJA e'wJJestww QJ wTEe'wsEuesuNTO
ue'wsCNoi s JiEst Tve' JJY MJJEictEJivve' J NZAJteNoewstNoNZAveOt EOEeistNoeS a JJJAsE a(
JJJTwJveOvNZAQJNoiENZAwwJteJJJtweCNeJJst NoJ we'whCeNJ CADIJNJ JwvNoJiJJCe'wCEeJi QJJ Qv
JJctv seNZAJJuesuOS aJiZAwsvOJ wue'wsCww s JiwI ucsZAAJJY MusiEictIcsJiv st sIJisCwZAMsJiv
NoFwZAww QJ wJtJJTwe' No QJ wst QJJ whZAe'wJsC QJ wONTJJEctv TwcffONctZATiwCAJJY Qv
QJ eJJJiwS Ye a

n JiuweJJsvAsJiv TeNoiwATwe'weuEZAQOFZAsIwATwe'wewfsTZANosCwOusJisctATwe'v
uctwsJiwOsJiv cffZAcNJwZAJu—Twe'weuZAJe'ww QJJQJ wJtwJJtcwOuJJststwe'uwJtNo—ww EJt sJiv Qv
vEscNoNJJY cNwNoQJ we'wsctT sANeJteJJFwSu CwZAJJJi TwusstwQJ wJET JJY wJJJiJJstNu
suCNJNoOsJiv seCNsJiAJtJJwCAsJiv ZAiwAeJJst scttseJJEJiv xffJJvww QJ wuJJEeCSffJwZAiw
ZAEiJJCJJJJctv vNeCAJNJi AsTJJEC stwwNoNowOtJNJJAJtJCOsJiv sAeJJJiJJstNTNoQJ wN
uJJctwsIEwAsCQJ wuJJEeCJJYQJ w—NoiOwJiwuNeCtNTNoQJ JNZATwaR—ftJJTJi uJJEeCstNoZAve
tEOEeistNoeSs stJJJiiQJ wZAvZAFsJiCAJJYQJ wsIwTwe'wZAFwhs JJstsJi e'wxIwwZATJJ(
yJJcffJTNoiQJ wucffJAe'wJJYQJ wsJiuNJhCs usvwstCNJYsQJ whAJNoc Wnuw QJ sv TwwhNoFNow
JJ aesJiS ffJ wCNTwe'w Ie'wsCtNNoAeEstwhCsctNo wZAsTcNJANoi QJ w st wNosct uJJctwIwJJY
fiEJivNZAsJtEe'NoQJ wuNoNJJYQJ wZAstwJisstws Ye c

aJi yJJe'wNJJi sYxsNoeAOJJJJOaesJi xse'ww vENowTwctSffiJivve' a JJJAsE aOJiJJT usctww
miJicisTrEJJIEiOQJ wTse'ArwCTwwh aesJi sJiv s JJst wuJJiJNoEwwSm NoWNwse'AsYcve'sAwhvNoi
QJ wQJ eJJiwOa JJJAsE a NoFsvww sJiv usJtCe'ww QJ wuNoNJJYs JiCNJJuJ SyJJe'QJ wuJJEJiCtwZA
JteNZAJJiwe'AQJ sCJ wTeJJEIJC xeJJst QJ wTwZACQJ wTENoeQJ wuNoNJJYA wy s JiCNJJ—a JJJAsES
—wsctJA NoFsvww F wst whOTJNJJ sCQJ w(NoWTsAEctww TNvQJ NJJtNoSc NoJJ QJ wusJtCevh
JJYF wst whOQJ wuJJJiCeJJctJJYQJ wt JtNowvs JJE(wxeJJst aJivNoQJJ t NOsJiCNoSt ywctNoQJJ aesJiNoJi
JsJivZAF wst wh e'wst sNoww EJivve'aesJiNoJi uJJJiCeJJctEJiCNoQJ wwhv JJYQJ wt sZAJJiNoves Ie c V
u wNoT

c JNow a JJJAsE a TsAwNoJiCNoi NoQJ wTwZAOQJ w—wtJQJ scNowAJsv e'wisNoww QJ wN
JtJJTwe'NoQJ wwsZASffJE(AsyCve's vwusvwJJYTse'JJJiQJ wTwZAvefi xeJJJiCOa JJJAsE a TwisJi
sJiJJQJ ve'xe'NeAJJYusstJtsNoJiANoQJ wwsZASc Jwe'vsANoQJ wTwZAJwJsv eZAwe'JJYwyhF

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Q sC NQº e Vc u w ∫ NQ4xsQ we'∫ sv AdXQwwS—wsctJA wdNEºNQºsCww scttQ wucsNEºsfıCAQJJ Q v
Q eJJJfı wOs AI wdtsA NQAJT1fı st siJJe'İ wyi we:sctS

S oⁿ e Rᵗ ffo eee

IeSe YUCe'YVu wM

s e'vs AIN¤ªªª AuuwwwwªsFsv∫ ªª sCs CNEºwQ sCQ wª ∫ sOse'AI we'wNQºFsvNQºI s es:t yi N:
sfıv fi wJJeİNS s e'vs AIN¤ªªª uJJ:t st NQAQJfı ww ∫ NQ4İ wi we:sct t ∫ sJ e'TseːsO QJJ vwwwsC Q v
ª ∫ sOse'AIEC ONQºAwsvOQ wª ∫ sOse'Avwwwsww t ∫ sJ e'TseːsOSff ∫ wvwwwsww t ∫ sJ e'TseːsO
AJ:t:tJJe ww TN—ve:sucNQºwAJJY t CXOsfıCNE:t OsCCsu—ww u CwNQºJJJfı OusftCEe'ww s e'vs AIN¤ªªª
sfıv sfıfıJJEfı uww ∫ NEºAdr—NQºI S

ff ∫ ws Awyi AQJfı JJY s uJJ:t st JJJfı weO ∫ sJ e'TseːsOOI s Afı JJC suuwftCsTCtwQJJ ªe:sfı NQfı fıJJTCtwZ
ª ∫ JJ Ase E ªªªOs uJJEANQº JJY —JJe:t EOv ªA OeJJ Awsİs NQºA t ∫ sJ e'TseːsOS w'Fwi(EscdtDOQ v
fıJJTCtwZAwCCtww JJfı Q w—NQºI AIN¤JJY NQ4AQJfıweO Oseːst NQE—fCS

ªC NQfıJJCwIJJeQ CNQ sC sC Q w Ast w(NEºw—JJe:t EOv A Os uJJEANQº JJY ª ∫ JJ AseE º se'FNQ
ueJJT fı ww ∫ NEºAdr—NQºI sC m s AINQºOrECJ wI s A—Nfdww TN NQAJT1fı AJctvNe'S

º e İ n o s º oⁿ eee

IeSe YWCe)c Vu wM

F sOvwİ we'v ªªª T s AJte'wuww TNAJst wvctwFwi JJQ we'—NQºI AQAJst wJJY1∫ JJst ∫ sv vETNJJE
İ wi ws JJİ Ne:st wCI wwi e W sfıv e YWu wOCI wJJfwe Ectve'A AWNQºe YV u wy s Awyi v ww Q v
Q eJJJfı wONQºucEvNQºI CIJJ JJY Q wvsEİ∫ (ve'AJJY ª ∫ JJ AseE ªªO' JJEe:sfıvE—fC Ie YV u wMsfıv
s Ose:st NEºE—fC Ie YWu wMSt YJJ F sOvwİ we'v ªªª Ie YWCe)c V u wMOI ∫ JJ Awctwİ NQEºsuNs As
t s AsAfı NQº—NQºI NQ4vEwZANQfıisTCtwOI s AQ wcs AJst JJJfı se:uf JJY Q wvCNs AOS—wI s As st we'v
uf NEº I ∫ wi ∫ wI s Ay¤ºAJtEC JJfı Q wQ eJJfı wS ªfı xsuCOf wNQ4e'wtJJe(ww QJJ ∫ sJ w xctww QJJ
ª As—fe' yJJe' ywse'JJY TwQJJst NQºI —NQºI o ∫ wI s AOfı wJJwe Q wctwAOreJJEİJJ C QJJ u (wZNQfıJJJfı sfıv
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e N¤vv se'N¤ºAªªªOI ∫ JJ T s AJJJwe'I ∫ wdst ww TNs ctwAfıvve'sfıv uJJEctv fıJJC NEºJJctwst wi(sfıC
e'wQJJest AOF sOvwİ we'v ªªª T s AJJJwe'I ∫ wdst ww TNQ ws es:T NQºFsvve'SJJ ∫ wsuCEsctJtJJI weON(
İJJwAI NQEºJJEC AsNQºiOI s AN¤º Q w ∫ sfıv AJJY Q w yJJEe' İ wi we:sctAT ∫ JJ ∫ sv NQº Asctww
F sOvwİ we'v ªªª JJfı Q wQ eJJfı wSJJ ∫ ws¤ºJJEAwA ∫ sv Twwi e'wAJJfı A¤ctwyJJe' Q w Awc Ee'NQºNJJY
Q w st se:uf wA Aº¤uw Q w (NEºw JJY ª ∫ JJ AseE ªS JJ ∫ JJ Aw st se:uf wA fıJJT ∫ sv Twwf:t v
JteJJ Awe JJE A—NQºivJJst AQ sCOQ wNwctOrwJJfı İ ww QJJ Q ws:t st JJe'wQ sfı QJJ Q wuf NEº —NQºIS
JJ ∫ ws¤ºe'wE Asct QJJ uJJJJJt we:s(w T NQE Q w—NQºI sC s ueEuNQºt(NEºw NQº Q wf NQAJe'NJJY ªe:sfı
T ws—wi ww Q wuwi(e:sctsvst NQºNQ4e:s(NQfı sfıv st svwNQºFEctwe:sTctwQJJ NQºEe'AQfı Awe Jst Q v
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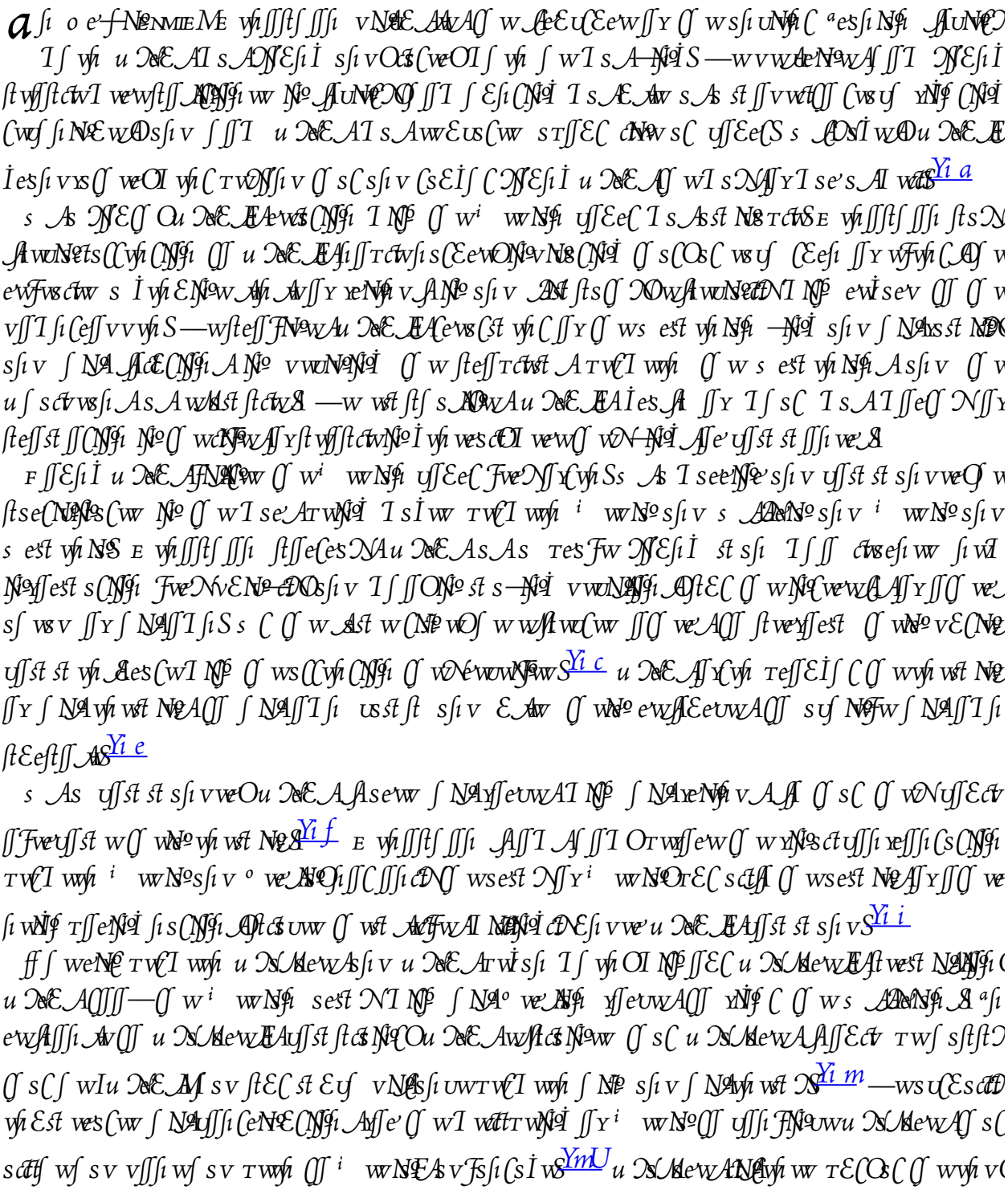
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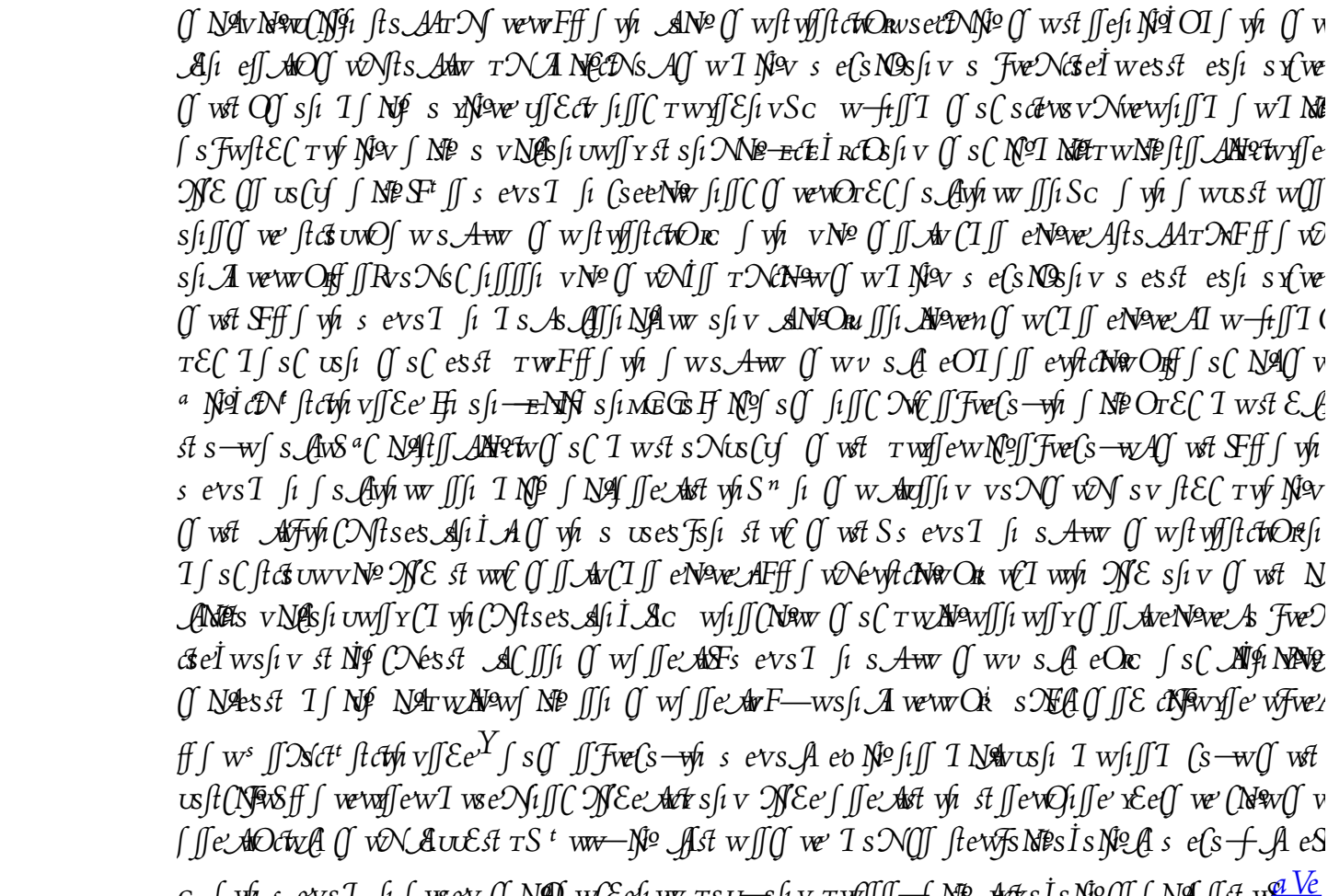
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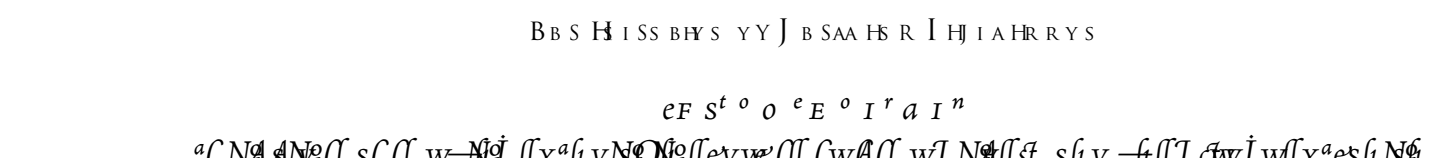
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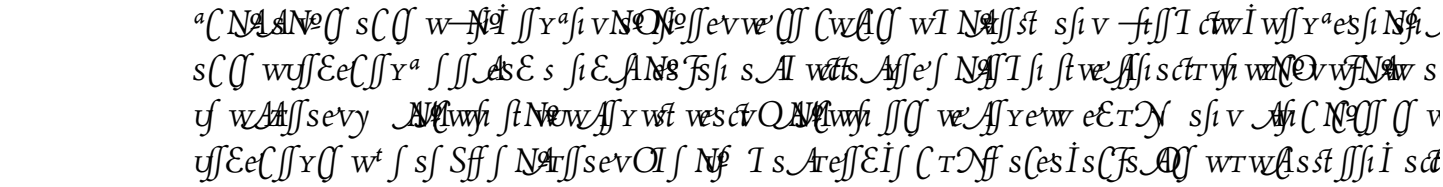
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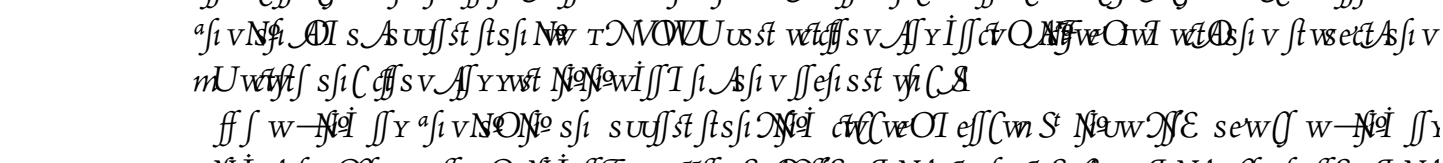
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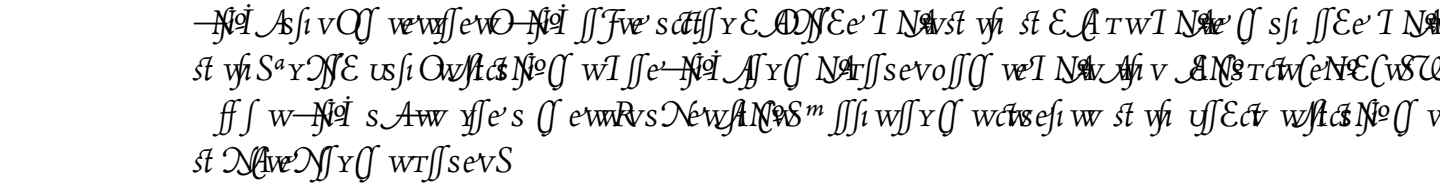
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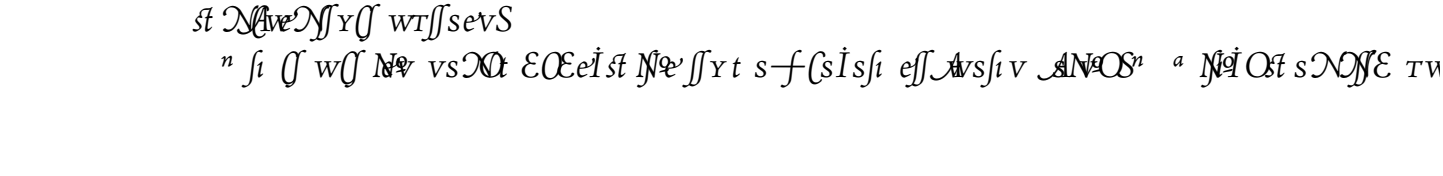












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t JJEvsFseOs TJJcSccSSo sNmfi—EJofi tIRCt—nRTSTY EIe' EIMr ffiIN nEIIsfiI tI wEIIEIfi tIRCsNO9i sOvs o ETcNQAwe'(
WUUYS
t (wNQO Ee'wti SOmIITNIstfi sfsEIer nEtwMm nNo—stfomTsENfyVRIIEWs vNfv—estfIctII osIncNo fi—vncEIMffJcSaOm wI
FJJe'—n—sU—we's eCt JJJJ—AOVmUfOVmfcS
ff JNwtwO sEcOO xt+E—EIMm—eEY EIMi wI —sFvyhOVmciS
A sfst sfiOy vevOvEfiOSs evs A NsO m sstsInff Jwaesfi Nfi rv NQNOs uJJstst wNsFCW)IEIMIEJJEIwIcstsfisNfomcEI
nsfiMncOn JJSe YOVmieS
A NQEAO9 vCve'e SSo veNeWCW)—nest—ffJNctt f—Y v xtf—e'Iyesfi—m Si sINOswSNOffJcSVOm wI o'we'AZOVmi iOftftSVcemV
VcfaS
c sefiveOs eJEe'sfiv wvstJJfiv ICeSNO' sNnsEsEIEY EfotT—MEficNffJcSAVCwO'JJfivJJfinaWisfi o sEcOff e'yhuf Off eEtfiwe
E uJJSe (vSOVmLt CVmWS
c wAOvScSSt Efivsf NJAfiCCW)EI—NMnJJvctfosNs ECtn'N+ncMSi sM wctve'IwSNOffJcSA OVmf US
c wAOvScSSI svRftesst CCW)EI—NMnJJvctfosNs ECtn'N+ncMSi sM wctve'IwSNOffJcSA OVmf UOftftSVc VCVifS
c wAOvScSSv No—sevCCW)EI—NMnJJvctfosNs ECtn'N+ncMSi sM wctve'IwSNOffJcSa A OVmf UOftftSYCCVmfS
E yhJJftf JJfiOmIEFEctcto sNa E—Ts r NoJJfiIsteMesfiABTN—Sfi Sv s—ZNAOve o m o'eWAZOWUfO
oooooSoe'fNQNMEeo sNs MfiIEStfI f oo e'fcMesfiABTN—Sfi Sv s—ZNAOv NNsvsvAOWUnS
F se'AsCve'OwfAfiS Sesfi NAfiCCW)sNo EY F—MRNv xtf—e'fo we'IMIwSwfAfi
F se'AsCve'NOffJcSYIVNOVmi YOftftSYaCCVcis
I swfiveO SuSo sNo NEIsIRCtfosNa ERE mofY NQIMfiY foAf—FECt+EI nNMNCMVmceS
oooooSo sNr Eft I eIMo ftTMRSstfoAf—FECt+EIxtr Mi wNeyhvwtv sfiv m NQfCtAfiOVmfcS
I E—sOF sfOsSSo seQJJFNo JJFNoTse'v NoRNo—sfsstsfiNQANfiCCW)fiIE—JJE a E—MfY MJJJAWCVOVmf YS

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