

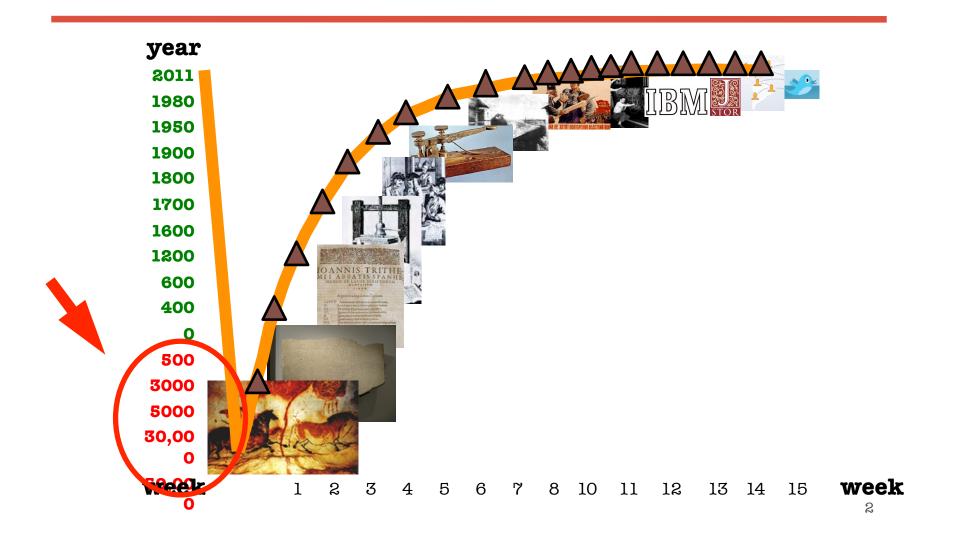
The First Information Technology: Writing Systems



Geoff Nunberg
School of Information, UC Berkeley

IS 103 History of Information Jan. 27, 2011

The first 50,000 years...





Itinerary, 1/28

The Origins of Language

The Emergence of Representation

The Variety of Signs

The Origins and Development of Writing Systems

Types of Writing Systems

Independent Inventions of Writing Systems



The scope of "information"

... it's always there when we look for it, available wherever we bother to direct our attention. We can glean it from the pages of a book or the morning newspaper and from the glowing phosphors of a video screen. Scientists find it stored in our genes and in the lush complexity of the rain forest. The Vatican Library has a bunch of it, and so does Madonna's latest CD. And it's always in the air where people come together, whether to work, play, or just gab.

What is it that can be so pervasive and yet so mysterious? Information, of course.

John Verity in *Business Week*, special number on the "Information Revolution," 1994

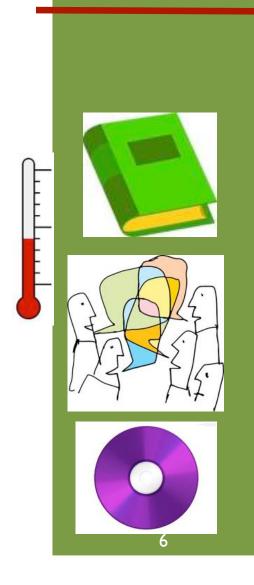


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Information (that has a history) always involves the creation, storage, transmission, or manipulation of representations of states of affairs.



The First "Information System": Language



James V of Scotland



FOXP2 gene

Early theories: "bow-wow," "uh-oh," "pooh-pooh," etc.

1886: Linguistic Society of Paris forbids "toute communication concernante l'origine du langage" [All papers dealing with the origin of language]

No direct evidence about origins of language

No existing "primitive" languages: all modern human populations speak languages of comparable complexity.

Was development of language gradual or sudden? Does language presuppose neural modification?

language might have emerged w. Homo erectus (1.5 m years)

Or with mod. Homo sapiens (ca 100-150k years)

Or with Upper paleolithic tool-making (ca. 40-45 k years)



The Beginnings of Representational Artifacts



"Venus of Tan-Tan," Morocco, possibly 250k years old, but may be a naturally occurring object.





Cave paintings, Lascaux, France: ca 15-13,000 BC (others perhaps to 30,000 BC)

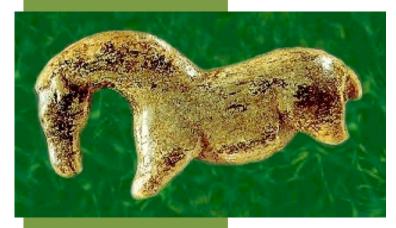






The Beginnings of Representational Artifacts

"Images and symbols... were markers of periodic and continuous cultural processes, of rites, and of repetitive myths and stories..." Alexander Marshack







The Beginnings of Representational Artifacts

"... whereas notations of whatever sort were apparently means of recording the passage of time in terms of culturally significant events."











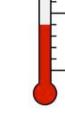
3 Types of signs (after Charles Peirce): icon, index, symbol

Icon: relation of resemblance (more-or-less) to signified.

E.g,



Index: stands in causal/spatial relation to the signified (blaze on tree to act of marking, thermometer to temperature)

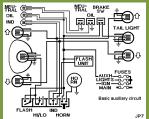


Symbol: arbitrary relation between sign and signified. E.g., written word *cat*, spoken word /kæt/.













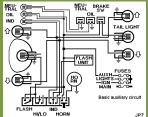


Icon: sign stands in relation of resemblance or similarity to signified (often only roughly).















Icon: sign stands in relation of resemblance or similarity to signified (though often only roughly).





Early Iconicity



Petroglyphs, Bhimbetka, India, ca 9000 BC



Rock carving, Hong Kong (Kau Sai), 3000 BC



Petroglyphs, Scandinavia, Bronze Age



The Varieties of Signs: Indexical



Index: stands in causal/spatial relation to the signified (pawprint to bear, blaze on tree to act of marking, thermometer to temperature)







Early Indexical Signs

Earliest signs are mnemonics for record-keeping, geneology, etc. (Tallying systems)

Knotted rope, notched stick or bone, etc. Become frequent in upper paleolithic



Notched Bone, England, upper paleolithic, 12,000 years old



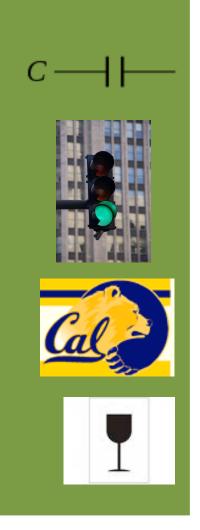
Notched Bone, Turkey, ca 3000 BC



Notched bone, Congo, ca. 25,000 BC -- may represent lunar calendar



The Varieties of Signs: Symbols



Arbitrary (or effectively arbitrary) relation between sign and thing signified



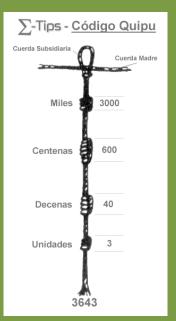


tree



Elaborated Indexical System: The Inca *qipu*







Knots of varying colors in llama or alpaca hair;

Sequences recorded population, taxes, geneology, astronomy (and possibly names) in base-10 positional system.

System maintained by knot-keepers (quipucamayoq).

Limits: can record only quantity and category; requires extensive convention for intepretation

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Pictographic (Iconic) Communication Systems

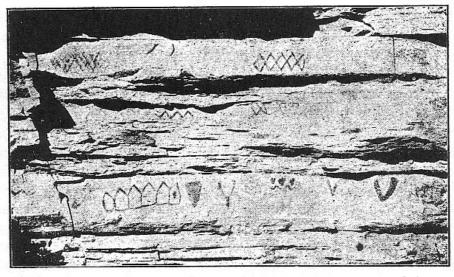
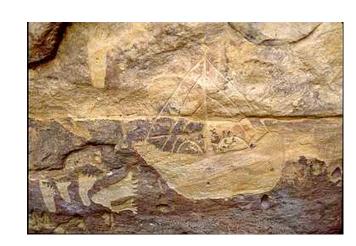
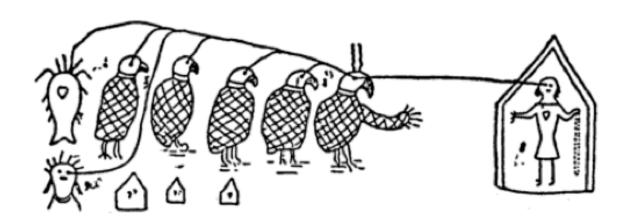


Fig. 4.—Geometrical forms. (From a photograph of rocks).





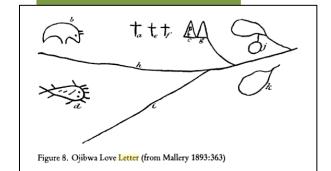
Pictographic (Iconic) Communication Systems

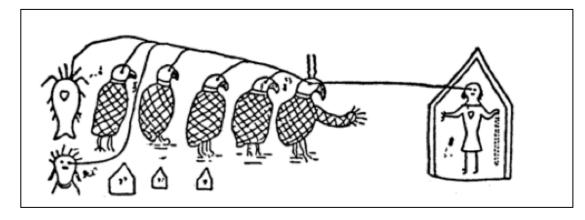


Kiowa message to the US President



Pictographic (Iconic) Communication Systems





"Letter of credence" presented by Chippewa delegation to Washington, 1849

"The chief salutes the president, and his warriors belonging to the eagle and catfish totems are in harmony with him and are willing to accept the white man's ways."



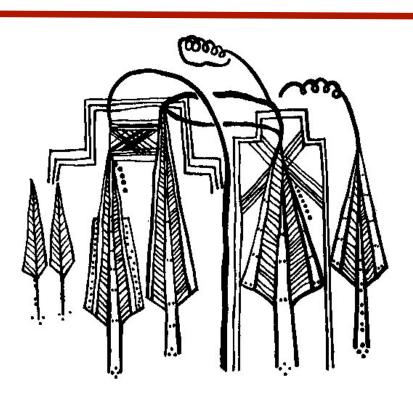
Pictographic Systems



Yukaghir (Siberia) "love letter," late 19th c.



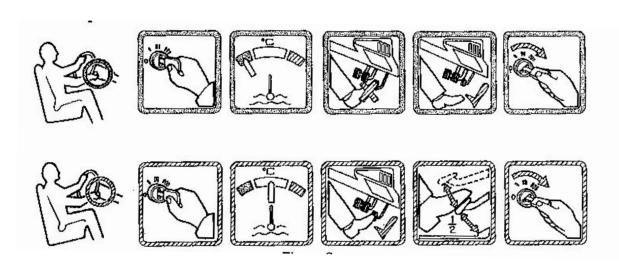
"Pictographic" Systems



"I know you're fighting with that Russian girl you broke up with me over. I'm unhappy in my house as I think of you, but you should know there's another guy hitting on me, so get a move on before I get married and have children."

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Ideographic (Semasiographic) Systems: the importance of context



"Turn the key. If the car is cold, don't step on the gas pedal; if it's warm, depress the gas pedal halfway as you turn the key."



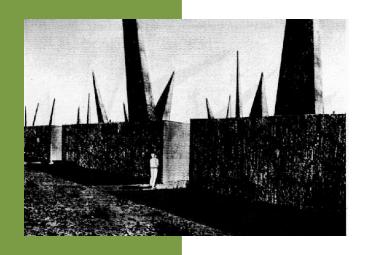
An Aside: The 10,000-year warning

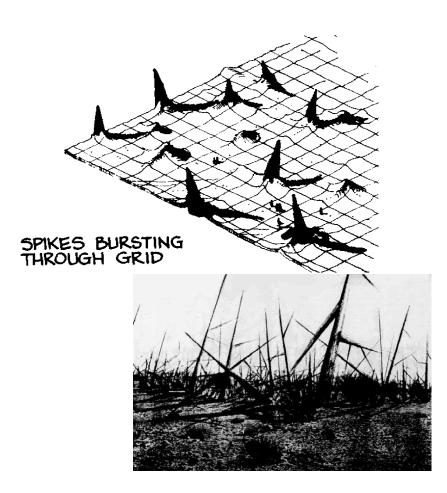
Sandia Labs: warning signs to last 10,000 years for radioactive waste dumps.





The 10,000-year warning







Abstraction in pictographic systems

Extending pictographic systems to deal with abstract or relational notions. E.g., "brother," "go," etc.

A step toward the development of "true" writing:

Form signs for abstract entities by extending or combining signs for concrete things (ca. 3300 BC)

```
foot = "go, come, walk, etc."

person + mountain = "foreigner"

eye + water = "weep" etc.
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Cf modern use of "metonymic" icons







The limits of ideographic/ semasiographic systems

Semasiographic system: symbols stand directly for ideas, not for words of a language,

In theory, semasiographic systems could communicate a full range of information without reference to spoken language. Cf mathematical notation:

$$10^9 = 1,000,000,000$$

"Ten to the ninth equals a billion."/ "Zehn hoch neun gleicht eine Milliarde," "Dieci alla nona potenza equivale a un miliardo," etc.

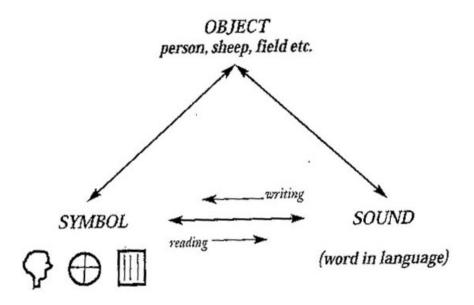
$$\forall x (Fx \rightarrow Gx)$$

"For all x, if F of x then G of x"/"Everything that is F is G," "If something is an X it's a G" etc.

But language-independent systems appear inadequate to express the full range of thoughts & information (as opposed, e.g., to artificial languages.)

The origins of true writing

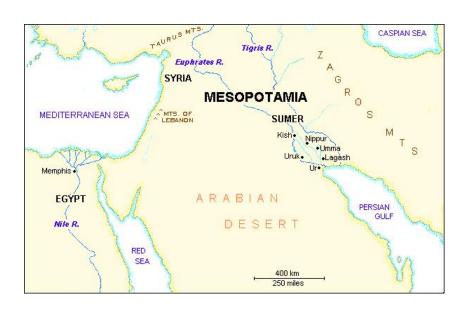
1.



Glottographic writing: rather than referring directly to reference/ideas, signs are associated with elements of the language (words, morphemes, syllables, phonemes).

Cf "5" vs five," cinque, wǔ, etc. "\$" vs "dollars," etc.

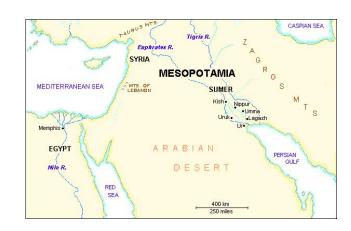
Origins of Writing in Sumer



Origins of Writing in Sumer

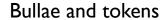
8-5000 BC -- earliest use of clay tokens.

4,000 BC -- earliest clay bullae 3500-3300 BC -- earliest clay tablets from Uruk.











Early cunieform



Tokens as origins of Sumerian writing?

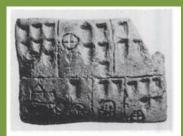
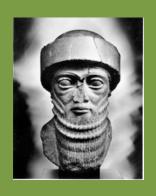


Figure 7 Pictographic tablet from Uruk, Iraq, late fourth millennium B.C. The account in the upper central case, for example, shows the sign for sheep and five wedges standing for the abstract numeral 5. Courtesy Vorderasiatisches Museum, Staatliche Museen zu Berlin, East Germany.

Token	Pictograph	Neo-Sumerian/ Old Babylonian	Neo-Assyrian	Neo-Babylonian	English
1	田田	凹	الطار	胀	Sheep
	66	<>	\$	12	Cattle
7	€\$	上田田		KI-III	Dog
			√ #	任	Metal
	\bigcirc	命	年	牵	Oil
		運		مآتد	Garmen
•		(受样	倒	Bracelet
a		鱼鱼	-HH	AFA	Perfume

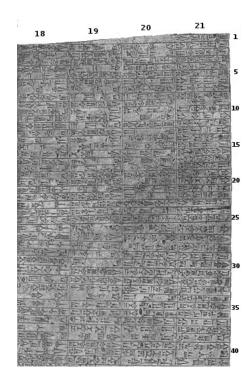


Origins of Writing in Sumer



2500 BC -- cuneiform "true" writing2400 BC script used for Akkadian2000 BC script used for Babylonian & Assyrian..

1750 BC Code of Hammurabi





Functions of Early Writing

Writing develops as memorial aid -- things that are hard to remember...

Commercial records

Calendars & dates

Or that have to be said just so:

Titles

Laws/proclamations

Liturgical texts

Poetry



Origins of Writing in Sumer

Epic of Gilgamesh (7th c. BC)

He who saw everything in the broad-boned earth, and knew what was to be known

Who had experienced what there was, and had become familiar with all things

He, to whom wisdom clung like cloak, and who dwelt together with Existence in Harmony

He knew the secret of things and laid them bare. And told of those times before the Flood

In his city, Uruk, he made the walls, which formed a rampart stretching on...



Epic from ca. 1500-1750 BC, existing tablets from 600 BC in Akkadian...



Increasing Abstraction of Written Form

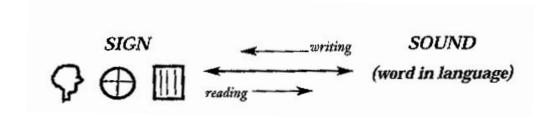
Proto-cuneiform c.3000 BC	Early cuneiform c.2400 BC	Late (Neo-Assyrian) cuneiform c.700 BC	Transcription and meaning				
()	Ê	当時	sag "head"				
		垣	ka "mouth"				
I	I	=	du/gin/gub "go/walk/stand"				
A	₩	Ħ	gud "ox"				
(1)	田	江 闰【	udu "sheep"				
	今	} }≺	ku "fish"				
7	P	11 5	dug "pot"				
\	F	না ৰু	gi "reed, to render"				

igure 2.2 The development from proto-cuneiform, through early umerian cuneiform, to later Akkadian cuneiform. Proto-cuneiform signs



The Origins of "complete" writing

"Complete" glottographic system: signs denote words/signs of the language



But how to signify "abstract" words? Creation, after, but, believe, faithful, if, etc.

Metaphoric extension (cf extended meanings of head, hand, foot, etc.)



The Rebus Principle













Rebus: Icons of things that stand in for their (phonetic) names



The Rebus Principle













Eye

saw

ewe

duck

deer

"I saw you duck, dear."

)

Rebus principle leads to logography

Rebus principle allows signs to be reutilized to signal abstract words, functional elements, etc.

"water" /a/ \rightarrow "in" /a/

T "oracle" /me/ → plural suffix /-me/

Accompanied by increasing conventionalization of signs... Creates need for "determinative" signs to indicate how other signs are being used.

Eg. "marsh plant" (/te/) sign also used for name of goddess assoc. w. marshes /eresh/ -- /u/ "plant" used to indicate "marsh plant" use of sign.



Logography to Syllabic System

Logographs ultimately perceived as having purely phonetic value.

Cf English logographs – @, &, £,

imagine the word h@b&

Where does this happen in everyday life?

•



Logography to Syllabic System

Logographs ultimately perceived as having purely phonetic value.

Cf English logographs -- imagine the word h@b&

Where does this happen in modern life?







Signs come to stand in for syllables

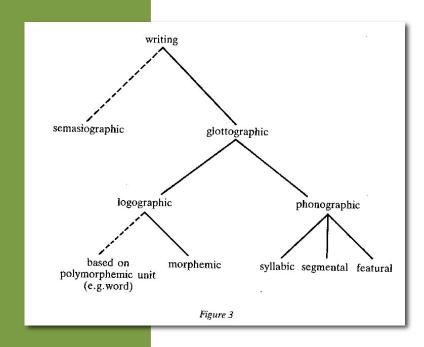
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Origins of Alphabetic Writing

Alphabetic system derived from application of syllabic system to different phonological structures.



Logographic: mod. Chinese, Japanese (mixed)

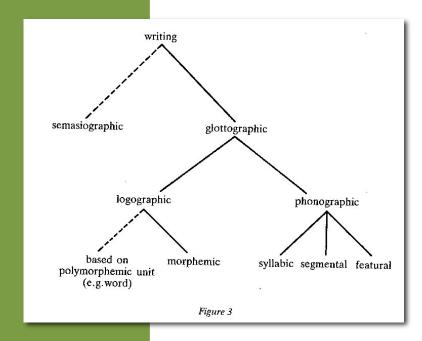
Syllabic: Linear B, Cherokee, Korean Hangul (featural)

Alphabetic: Roman, Cyrillic, Gk, Hebrew, etc,



Origins of Alphabetic Writing

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Logographic: mod. Chinese, Japanese (mixed)

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Alphabetic: Roman, Cyrillic, Gk, Hebrew, etc,

Problem with completely phonetic alphabetic systems: ambiguity.

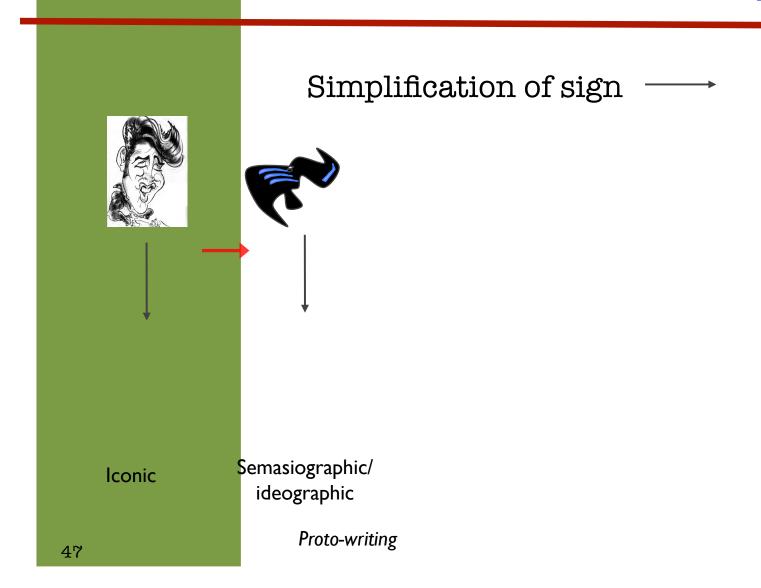
Cf French au, aux, ô, os, haut, hauts, eau, eaux, os, etc.



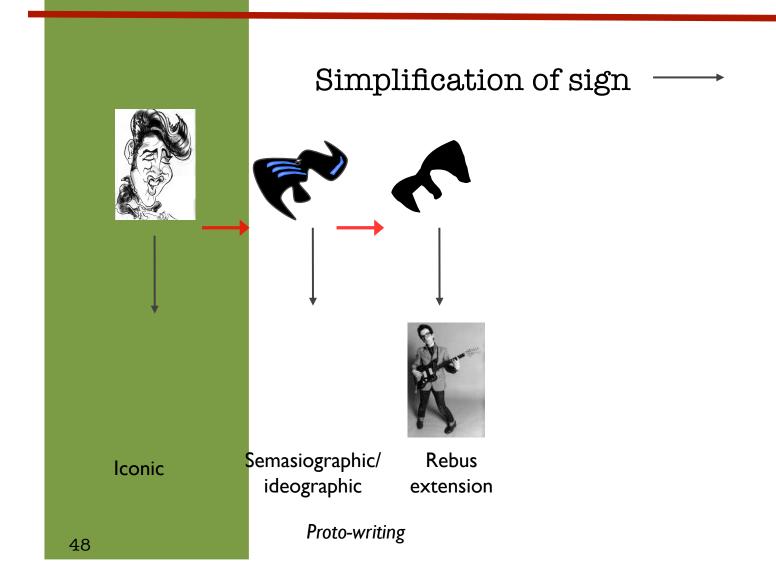


Iconic

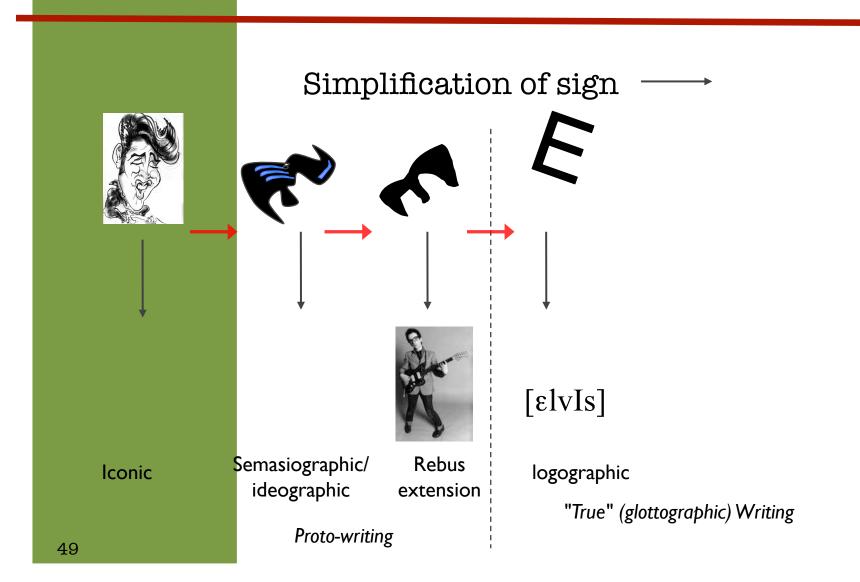




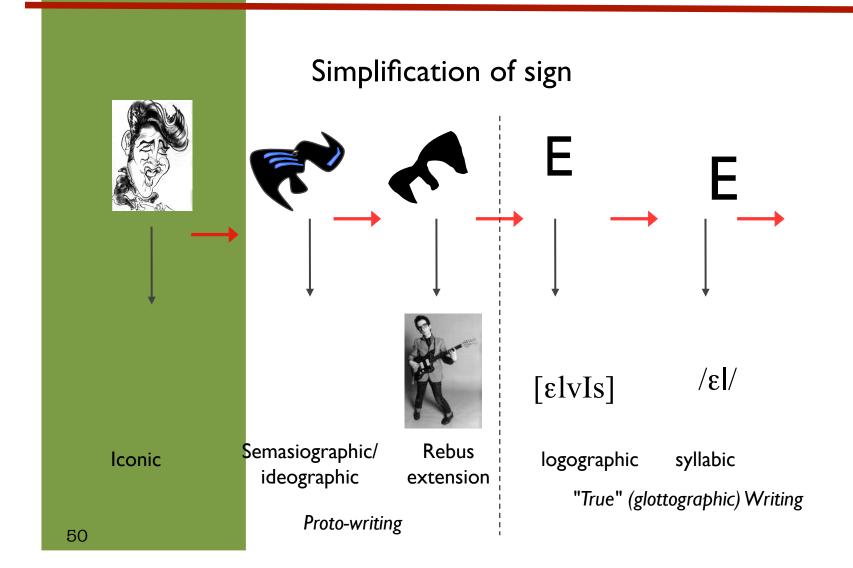




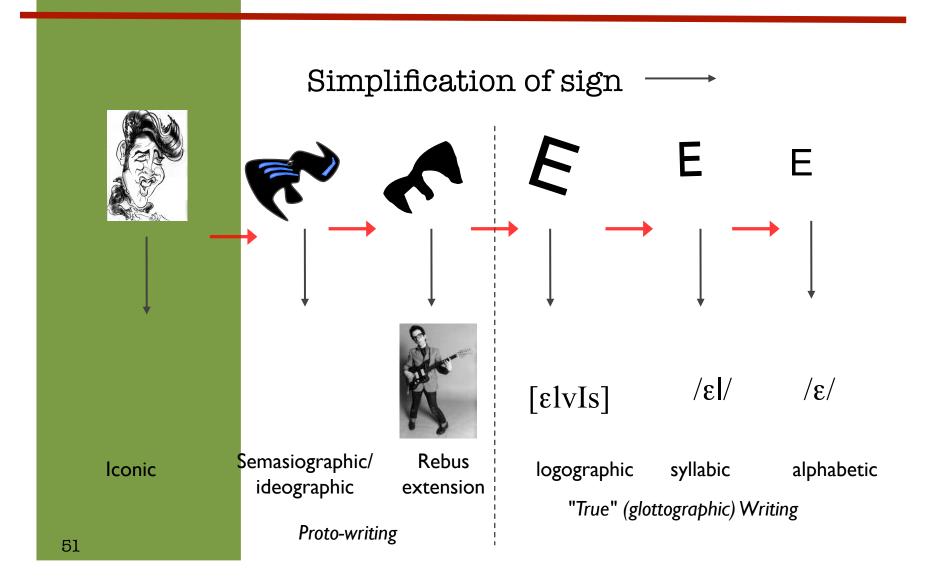






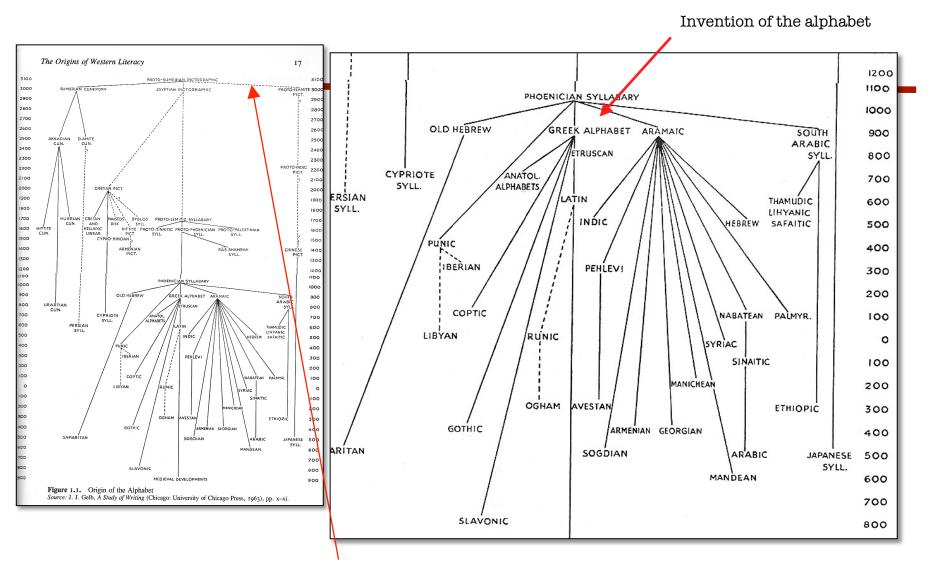






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Geneology of Writing Systems



But evidence is slight for derivation of Chinese from proto-Sumerian



Independent Invention of Writing Systems



Independent writing systems: The Cherokee Syllabary



Sequoyah [George Gist] and the "talking leaves": 1819

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Independently invented writing systems: The Cherokee Syllabary



VOL. I.

NEW ECHOTA, THURSDAY MARCH 6, 1828.

NO. 3.

EDITED BY ELIAS BOUDINGTT. PRINTED WEEKLY BY

ISAACH. HARRIS. FOR THE CHEROFEE NATION.

At 92 50 if paid in advance, \$3 in six months, or \$3 50 if paid at the end of the

To subscribers who can read only the Cherokee language the price will be \$2,00 in advance, or \$2,50 to be paid within the

Every subscription will be considered as continued unless subscribers give notice to the contrary before the commencement of a

The Phonix will be printed on a Super Royal sheet, with type entirely new procur-ed for the purpose. Any person procuring nix aubscribers, and becoming responsible for the payment, shall receive a seventh

Advertisements will be inserted at seven Atternsements with a last inser-tion, and thirty-seven and a half cents for each continuance; longer ones in propor-

All letters addressed to the Editor.

CWY ICAVOA AD BSJECGA POALERA TAAP UN INCRAA 1-484. BOAE JACKARY KTA DAP COURA PARI, TOX TEMOS DOJANTRAL TOZ PUP TOOA TE DEJORERA, KT Deg goldal 1-424. Deliger TE YW DOJARFAJ, C-YAT DSP C-OJEJ F-464. GWYZ O'GR JACHJAY, WENT DEG

COJEA PARA TRADE, TOX TERCOP DO-JASPAJ. KTAZ DSP YW 65 09JBA WIR DOLARDOLL.

LAKE OF ARDENT SPIRITS. Ms. Engrou-In recently turning over the pages of a Magazine printed in the year 1813, my attention was attracted by a calCONSTITUTION OF THE CHERO. KEE NATION,

Formed by a Convention of Delegates from the several Districts, at New Echota, July 1827.

ARTICLE VI.

Sec. 1. Whereas the ministers of the Gospel are, by their profession, dedicated to the service of God-and the care of souls, and ought not to be diverted from the or, owy read phonday gover great duty of their function, therefore, no minister of the Gospel, or public preacher, of any religious persuasion, whilst he continues in the exercises of his pastoral functions, shall be eligible to the office of Principal Chief, or a Seat in either house of the General Council.

Sec. 2. No person who denies the being of a God, or a future state of rewards & punishments, shall hold any office in the civildepartment of this Nation.

Sec. 3. The free exercise of religious worship, and serving God without distinct tion, shall forever be allowed within this Notion: Provided, That this liberty of conscience shall not be so construed as to excuse acts of licentiousness or justify practices inconsistent with the peace or safe-

Sec. 4. Whenever the General Counoll shall determine the expediency of ap-pointing delegates, or other public Agents, for the purpose of transacting business with the Government of the United States; the FARA, ORYZ OL DERGERALDER Principal Chief shall have power to recomniend, and by the advice and consent of the F48.1. GRYZ OLI ROSE DAS OL Committee, shall appoint and commission such delegates or Public Agents accordingly, and, on all matters of interest touching the rights of the citizens of this Nation.

JOOC PALL GIVY OUTS . [ovzaca]

1. ELF GALISTORELAS SON I DACHLEY, SAWL OVY PR SIF ABARAGE DEZ ASIM Chicalat hade sewal phonday be, if Whenca techpeal apart, De ora 25/01 EC05/V.La.1 45-48.L.

2. TOT VE SOW Y EA OCCUPE O TP-4-C. L. D.C T. JATE DI. TSP-3TP PA PET CALPRICA, IS DES DEAT 7.1 AP-4-LI, DEGWY SPAIL

S. AD GWY TOAL, ONLES AN TOUGHT, DORN COTTAIL DAME DOLO-DAE TOOPAL PARLISAW. RA JASOGFRA, IDAYAZO D KIN AY O'LANIES DE GWY AAS ER DIS belsy ecopataland appart

4. TOT AGAT OPO TOWE AN WOY JPSE DAPONGJ Obreca. De Chesca thata sier into SARY, OWYRYS DESCRIPTION D050-5-27, ABP 04" J0-AJ J/7. TEGOPALAJ PROBESCA COOK EAS BY, ORY OLEOGRA DE SLAT THA RESID OFFICE A JOLASWALL

shall so continue until altered or repealed [r-4-c.1 spayhzo- 120c.raz 19# Ly the legislature, except where they are temporary, in which case they shall expire at the times respectively limited for their duration; if not continued by act of the legis lature.

Sec. 13. The General Council may at my time propose such amendments to this Constitution as two thirds of each house shall deem expedient; and the Principal Chief shall issue a proclamation, directing all the civil officers of the several Districts to promulgate the same as extensivey as possible within their respective Districts, at least nine months previous to the next General election; and if at the first session of the General Council after such General election, two thirds of each house shall, by yeas and mays, ratify such proposed nmendments, they shall be valid to all intents and purposes, as parts of this Constitution; Provided, That such proposed amendments shall be read on three several what ore anway, we note: days, in each house, as well when the same are proposed, as when they are finally rat-

Done in Convention at New Echota, this twenty-sixth day of July. in the year of our | A.I P.46.I, SAGER DAPEREA, DE

ty seven; In testin each of us, hereur Delegates of C JNO. ROSS, I JOHN BALD

Delegates of GEORGE LO JNO. EROWN EDWARD GU

Delegates of JOHN 3 ARTIN. RE OGAL IS GUTSRA.

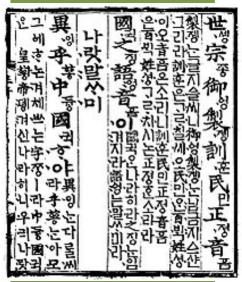
14. the pap oppose to z owy Tree is colleged de legels is ont ad Artad, th ore sewer dh WOY DEAGRAPAJ. TYPAYEZO OPHIC TARP GLASTINGS OF SAT 2.1 read, the ore saws: Jawe y sakat dapadag.

15. ore vive: .Ihwey, Tily SOUTH KT TIME WE ALLERI, 1919 JOHATAI SAGER DAPARAI, OF hATRA PARA GAP DOLOGART. DAY OFFICA OCCUPATION PART CAP Chart, Alfaral Part 10000 SY JOYELA Ship thereasily, DL PANY TROA OZIAL OBLIGAT JAPR JAWEY, OZYZ WPA CAW KT TAKES WE LEADED DUADON. Dhahalabal Tras liwey on SPAJ. KTAYDZO-JAUTPOBUK

Cherokee Phoenix: First American Indian newspaper (1828)



Independently invented writing systems: Korean Hangul



Writing system invented in mid-15th c. to replace hanja (Chinese writing system). Invention credited to King Sejong ("the Great"), who introduced it to increase mass literacy. Possibly influenced by central Asian scripts.

Sometimes described as only "featural" system: symbols representing sounds as features (i.e., "labial,' etc.) are clustered into a single "block" representing a syllable.



Later Developments



Subsequent development of further orthographic elements: word-spacing, punctuation, paragraphing, etc.

Not fixed till early age of print. Reduce ambiguity, make writing increasingly accessible to wider community or in absence of immediate context,

JESVSEVRGOANTCESEXATPESPASCS HACVENJITHE THEANTACOURAT FYERAOTIAZA-VUJMORIYUVJ TVEMMSVJCTYTAVITTYESVJFELCERVNT LAYICO.TICACNAPOTETCTOMARTHAHOINISTRKABATCBASARUSO VEROVNAVSEKATTE-ATSCOUPLENTATEVSCVJPOPARTALERGOZCE CEP TILKTERACTYN NGEN TIJ NARATPFIJIICI PRETIOVJICI VNEXITPE decienvactexterrificaypintsnsvispepacsentptetaombesim PLFITAESTEEXUNGEINTTOdaeRealxaltergovRhumexagtscipuhl TIGIVIXIVAAXGCARJORIIJAVITERATOULOIRAATTIVRVIATVARGLOCOVM LEN VIVONONXVENVITGRECEN PATSAENZARVJETAALT VOOESGTE GENTÉS? LIXINUTEMAGÉCNONQUITALECGAENTSPERRTINELEAT Adiviosed any publik likition chiosy capende can accontine pa MOTURPOTRA DETECTATION GOTES DUSTINEPILLA COUNTIXATECOS EPVIGTVKAEMSELESERVNETILLANAPAVPAERESENAIMSEMPGERBA beatisno bliis evafae avietano nse saperbavbens esos no VILLEROIZYKBAMVALIAEXTMVAACISTAVIATLOLICESTKETVENE ARVATNON UPROTEPRTES UMETANTOM OSERVILUZAR UMPUTAER CH-TANGURSOSCIAONITAMORRINISCHOGITANKERNNIAHVICOP RVTNCTPCJSSACCHCAOTVOVOTCTCAKARVOTNATCRFICTRENTY LVIAMYLVITPROPATCRILLXVM2 hThen TCXVeT-actsNeTcRCd ACED NINICIVO

JESV. OCAČLA . UVINERUO + SPES . LIVA. PORITENTIVO. PER. Magdalana . Lacrymas + Perata . Nostra . dilvas .



Later Developments

OXIΔONAΦ
ĒMITOPMOK
OTZOJTAĢ
ΠΡΟΚΟΝΝΗ
ЧΗΤΗΥΙΝΟΙΣ
ΑΔΕ:ΚΑΙΥΠΟΚ
ΑΙΗΘΜΟΝ:ΕΣΠ
ΠΟΙΗΝΑΤΥΡ
ΕΔΩΚΕΝ:ΣΥΚΕ
ΝΙΖΥΞ

boustrophedon

Subsequent development of further orthographic elements: word-spacing, punctuation, paragraphing, etc.

itisofaromehenceforthfreethatiamtowritethehistoryherciviladminist rationandtheconductofherwarsherannuallyelectedmagistratestheaut horityofherlawssupremeoverallhercitizensthetyrannyofthelastkingm adethislibertyallthemorewelcomeforsuchhadbeentheruleoftheforme rkingsthattheymightnotundeservedly becountedasfoundersofpartsatalleventsofthecity



Later Developments

Subsequent development of further orthographic elements: word-spacing, punctuation, paragraphing, etc.

It is of a Rome henceforth free that I am to write the history-her civil administration and the conduct of her wars, her annually elected magistrates, the authority of her laws supreme over all her citizens. The tyranny of the last king made this liberty all the more welcome, for such had been the rule of the former kings that they might not undeservedly be counted as founders of parts, at all events, of the city...



The Role of Punctuation

I spoke to the boys Sam and Tom.

The press secretary gave them the rules they were not allowed to speak to the committee directly.

To my parents Ayn Rand and God.

Assignment for 2/1

Havelock writes:

The invention of the Greek alphabet... constituted an event in the history of human culture, the importance of which has not as yet been fully grasped. Its appearance divides all pre-Greek civilizations from those that are post-Greek. ... On this facility were built the foundations of those twin forms of knowledge: literature in the post-Greek sense, and science, also in the post-Greek sense.

Consider just one aspect or element of this broad claim. On the basis of the specific evidence presented by Havelock and Gough, would you say it is largely true, largely false, or true in some respects?