

# The First Information Technology: Writing Systems



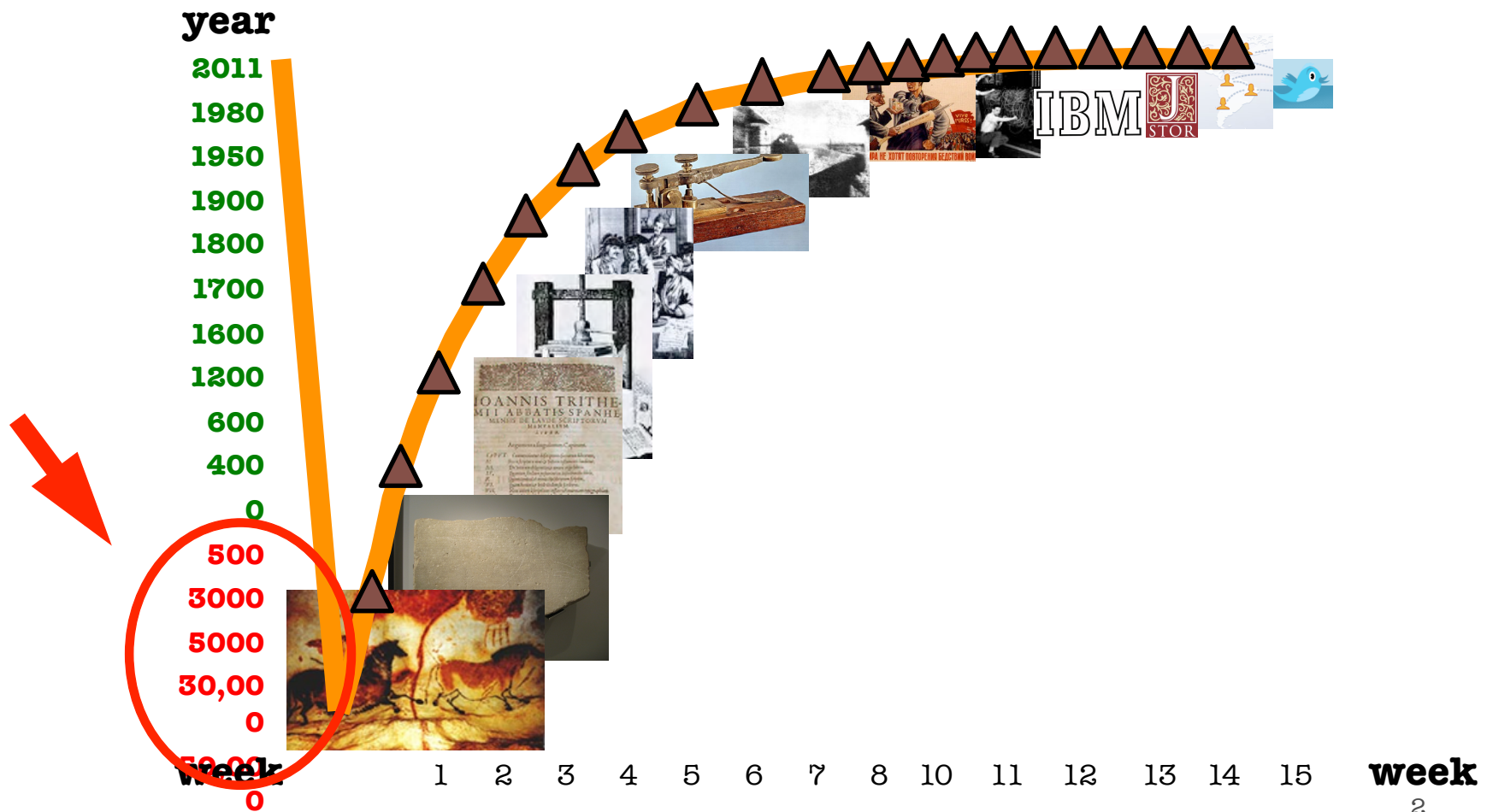
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**School of Information, UC Berkeley**

**IS 103**  
**History of Information**

**Jan. 27, 2011**

# The first 50,000 years...





## Itinerary, 1/28

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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"

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... 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



# The Scope of "Information"

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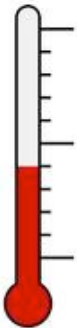
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... it's always there when we look for it, available wherever we bother to direct our attention. We can glean it from the pages of a book or the morning newspaper and from the glowing phosphors of a video screen. ~~Scientists find it stored in our 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.

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)

"Man's first affirmation of himself" Maurice Blanchot





# 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."





# The Varieties of Signs

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

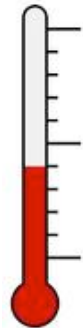


**Icon:** relation of resemblance (more-or-less) to signified.

E.g,

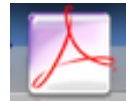


**Index:** stands in causal/spatial relation to the signified (blaze on tree to act of marking, thermometer to temperature)



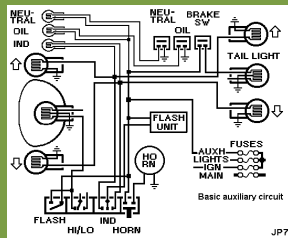
**Symbol:** arbitrary relation between sign and signified.

E.g., written word *cat*, spoken word /kæt/.





# The Varieties of Signs

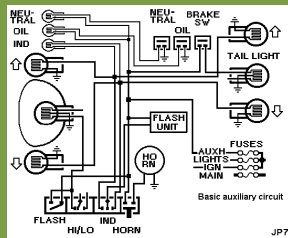


**Icon:** sign stands in relation of resemblance or similarity to signified (often only roughly).





# The Varieties of Signs



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





# The Varieties of Signs





# 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, genealogy, 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

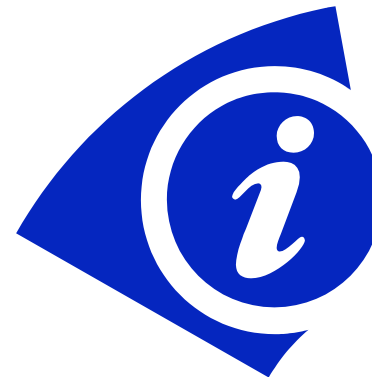


Notched bone, Congo, ca. 25,000 BC -- may. represent lunar calendar



# The Varieties of Signs: Symbols

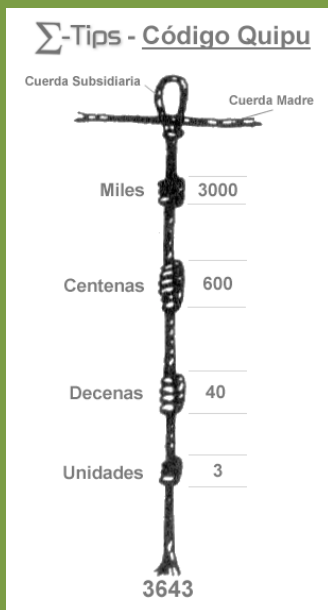
Arbitrary (or effectively arbitrary) relation between sign and thing signified



***tree***



# Elaborated Indexical System: The Inca *quipu*



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 interpretation



# Pictographic (Iconic) Communication Systems

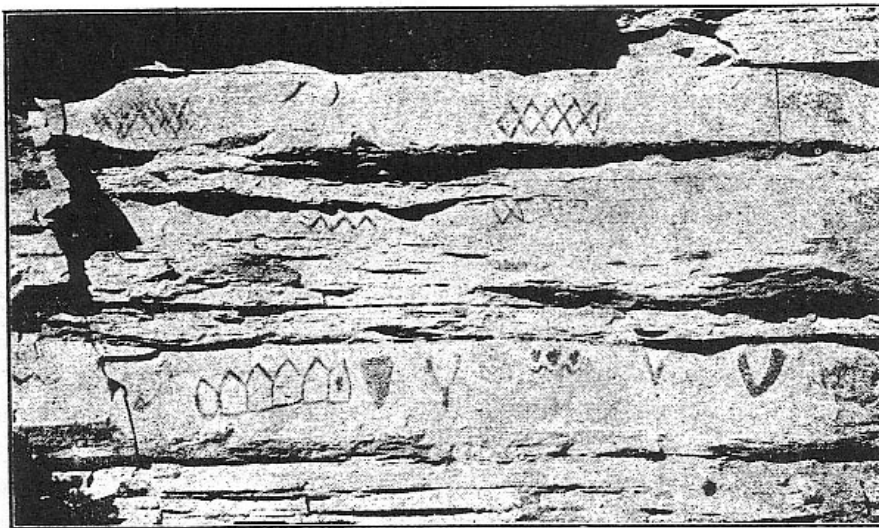
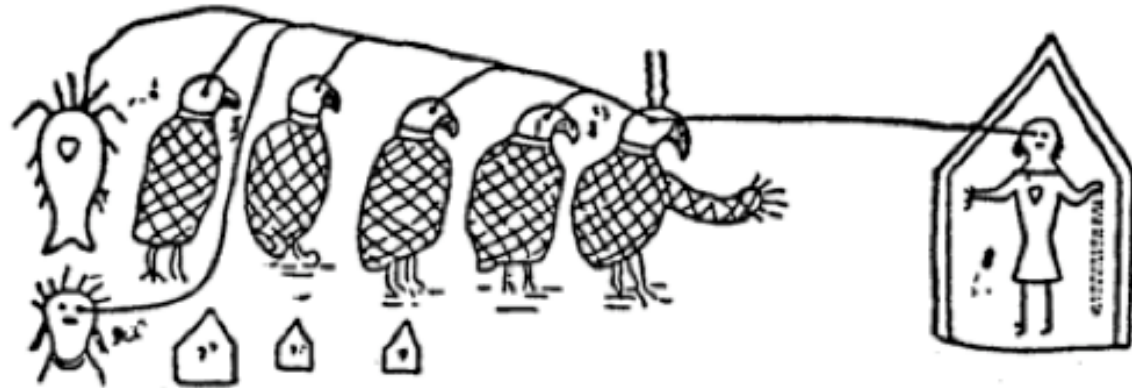


Fig. 4.—Geometrical forms. (From a photograph of rocks).





# Pictographic (Iconic) Communication Systems



Kiowa message to the US President



# Pictographic (Iconic) Communication Systems

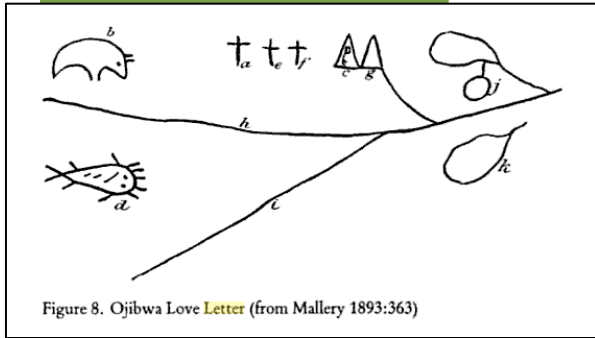
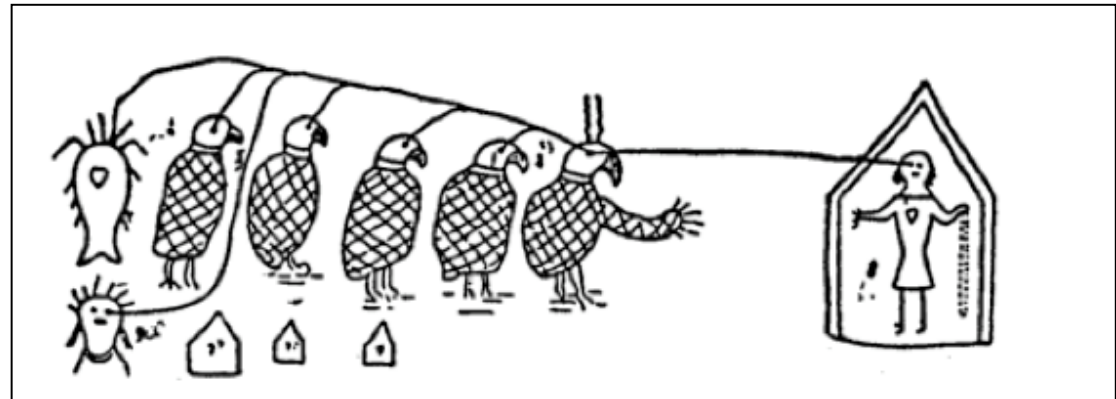


Figure 8. Ojibwa Love Letter (from Mallery 1893:363)



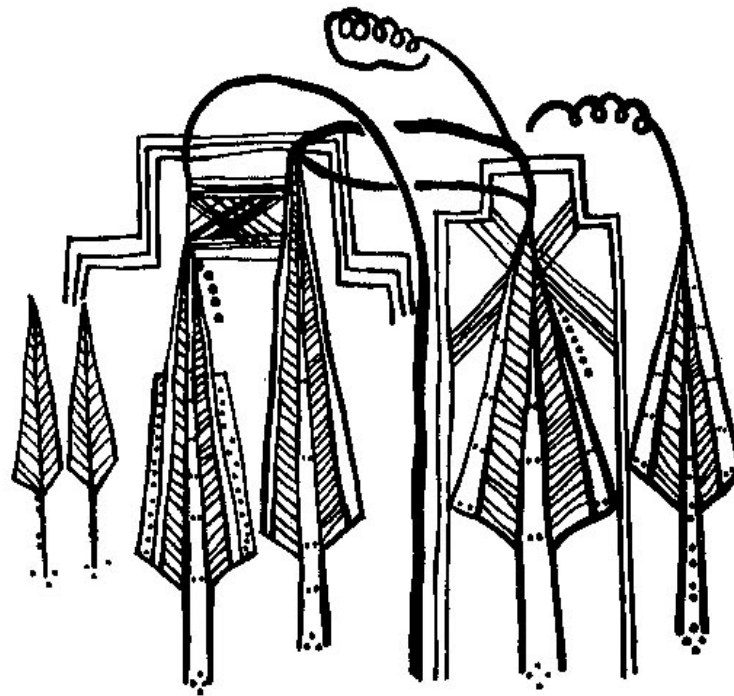
"Letter of credence" presented by Chippewa delegation to Washington, 1849

"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

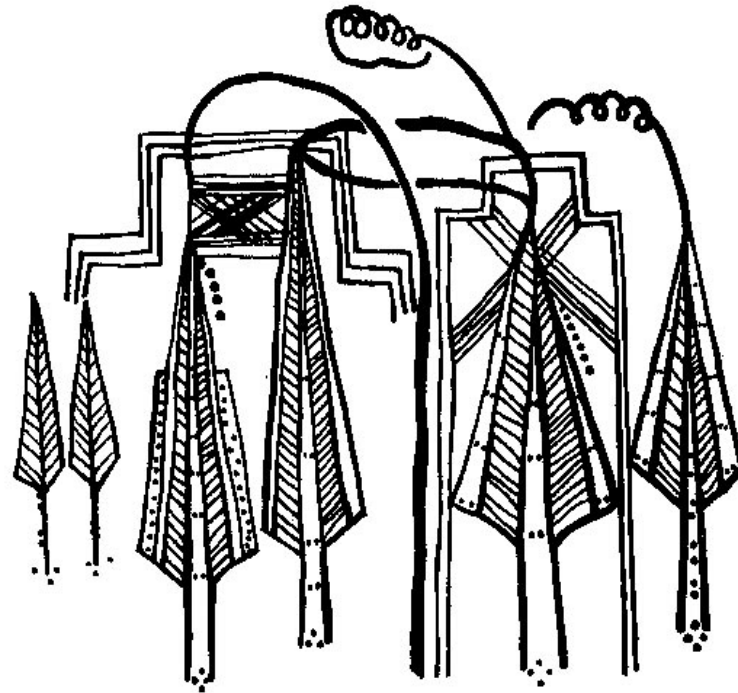
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Yukaghir (Siberia) “love letter,” late 19th c.



## "Pictographic" Systems

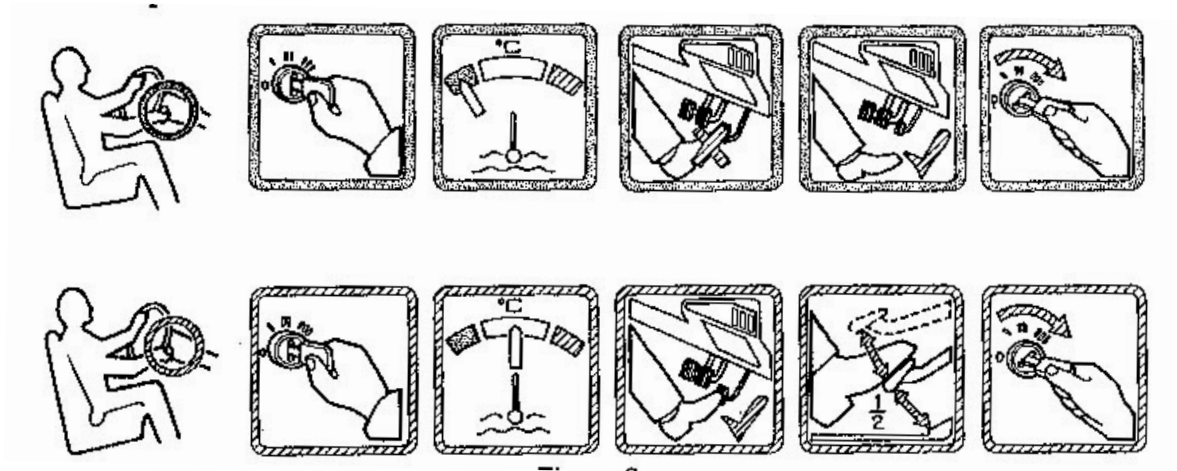


"I know you're fighting with that Russian girl you broke up with me over. I'm unhappy in my house as I think of you, but you should know there's another guy hitting on me, so get a move on before I get married and have children."





# 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.



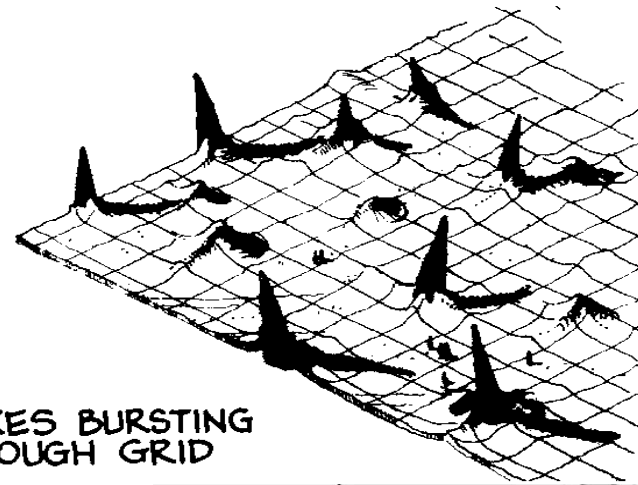
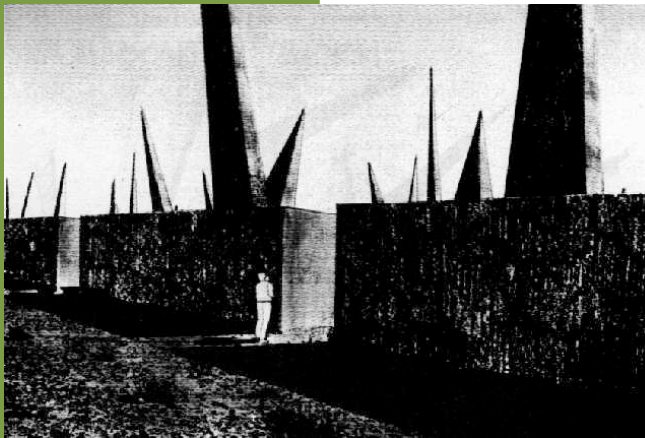
**DANGER**

POISONOUS RADIOACTIVE  WASTE BURIED HERE  
DO NOT DIG OR DRILL HERE BEFORE A.D. 12,000





# The 10,000-year warning



SPIKES BURSTING  
THROUGH GRID





# 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.

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.

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

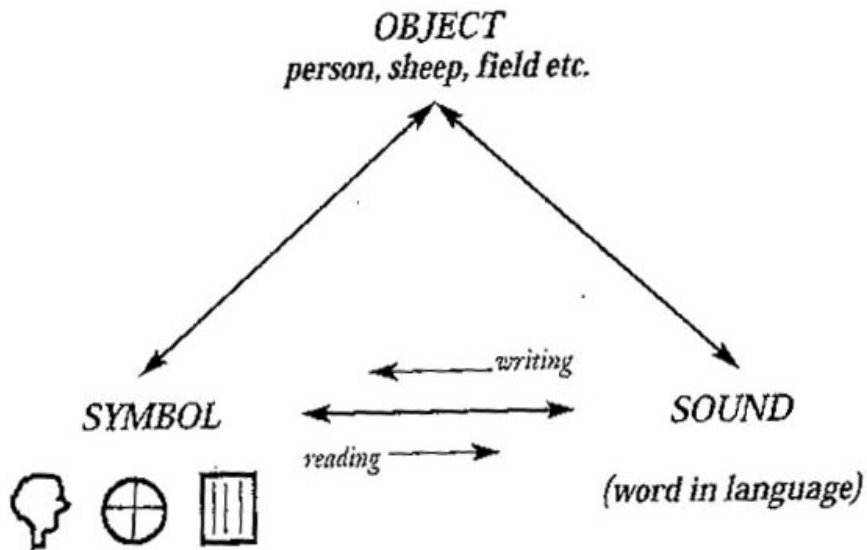
"For all x, if F of x then G of x"/"Everything that is F is G," "If something is an X it's a G" etc.

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, wũ, etc.

"\$" vs "dollars," etc.



# Origins of Writing in Sumer

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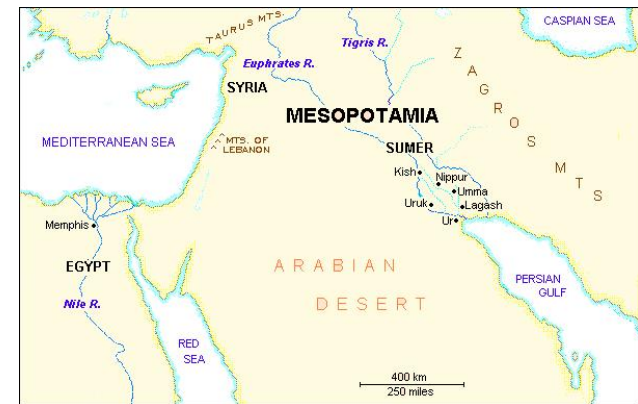


# Origins of Writing in Sumer

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

4,000 BC -- earliest clay bullae

3500-3300 BC -- earliest clay tablets from Uruk.



Bullae and tokens

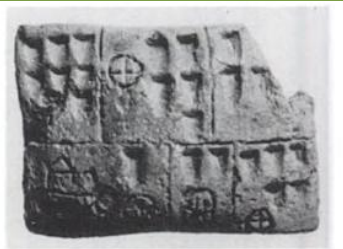


Early cunieform





# 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.

Evolution from Token to Cuneiform Writing

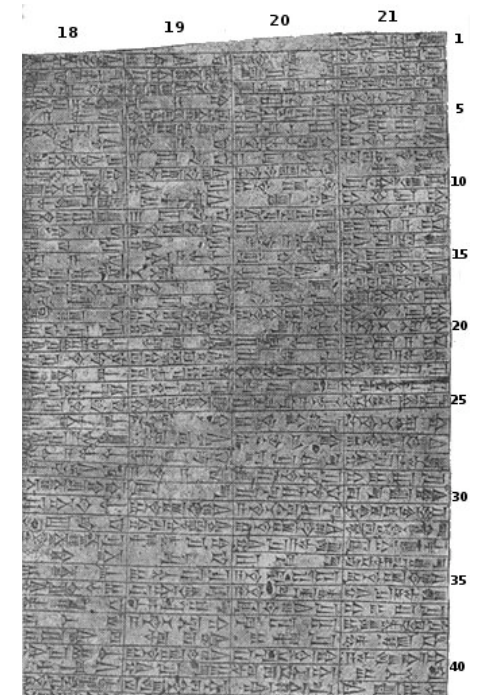
Token	Pictograph	Neo-Sumerian/ Old Babylonian	Neo-Assyrian	Neo-Babylonian	English
					Sheep
					Cattle
					Dog
					Metal
					Oil
					Garment
					Bracelet
					Perfume



# Origins of Writing in Sumer



2500 BC -- cuneiform “true” writing  
2400 BC script used for Akkadian  
2000 BC script used for Babylonian & Assyrian..  
1750 BC Code of Hammurabi





# Functions of Early Writing

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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 (7<sup>th</sup> 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

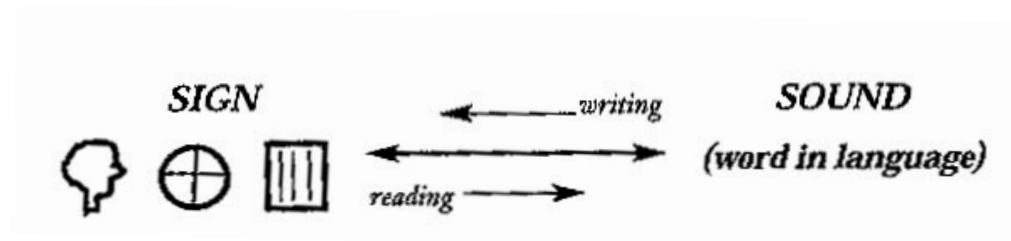
Proto-cuneiform c.3000 BC	Early cuneiform c.2400 BC	Late (Neo-Assyrian) cuneiform c.700 BC	Transcription and meaning
			sag "head"
			ka "mouth"
			du/gin/gub "go/walk/stand"
			gud "ox"
			udu "sheep"
			ku "fish"
			dug "pot"
			gi "reed, to render"

Figure 2.2 The development from proto-cuneiform, through early Sumerian cuneiform, to later Akkadian cuneiform. Proto-cuneiform signs are often pictographic, though not always, as the sign for "sheep" shows.



# 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/ → “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

Logographs ultimately perceived as having purely phonetic value.

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# Origins of Alphabetic Writing

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

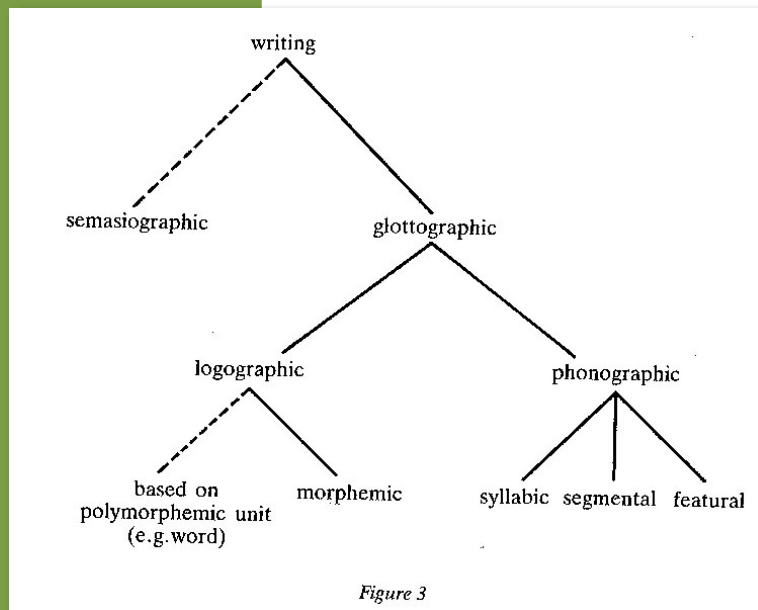


Figure 3

Logographic: mod. Chinese, Japanese (mixed)

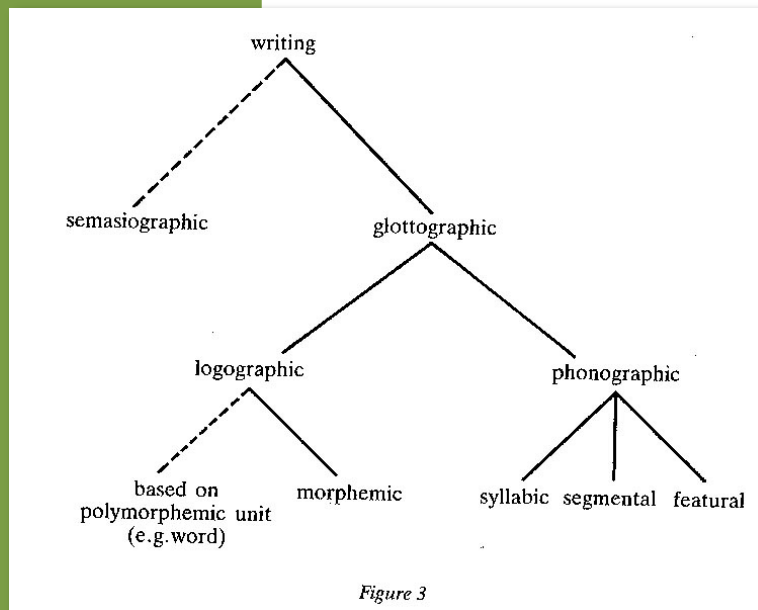
Syllabic: Linear B, Cherokee, Korean Hanguk (featural)

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



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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,

Problem with completely phonetic alphabetic systems: ambiguity.

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



# Development of Written Symbols



Iconic



# Development of Written Symbols

Simplification of sign →



Iconic

Semasiographic/  
ideographic

*Proto-writing*



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Simplification of sign →



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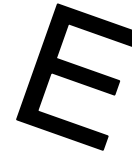
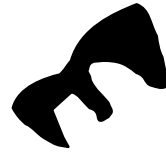
Rebus  
extension

*Proto-writing*





# Development of Written Symbols



Simplification of sign →

Iconic

Semasiographic/  
ideographic

Rebus  
extension

[ɛlvls]

logographic

"True" (glottographic) Writing

*Proto-writing*



# Development of Written Symbols

Simplification of sign



E

E



[ɛlvɪs]

/ɛl/

Iconic

Semasigraphic/  
ideographic

Rebus  
extension

logographic

syllabic

"True" (glottographic) Writing

Proto-writing



# Development of Written Symbols

Simplification of sign →



[ɛlvɪs]

/ɛl/

/ɛ/

Iconic

Semasiographic/  
ideographic

Rebus  
extension

logographic

syllabic

alphabetic

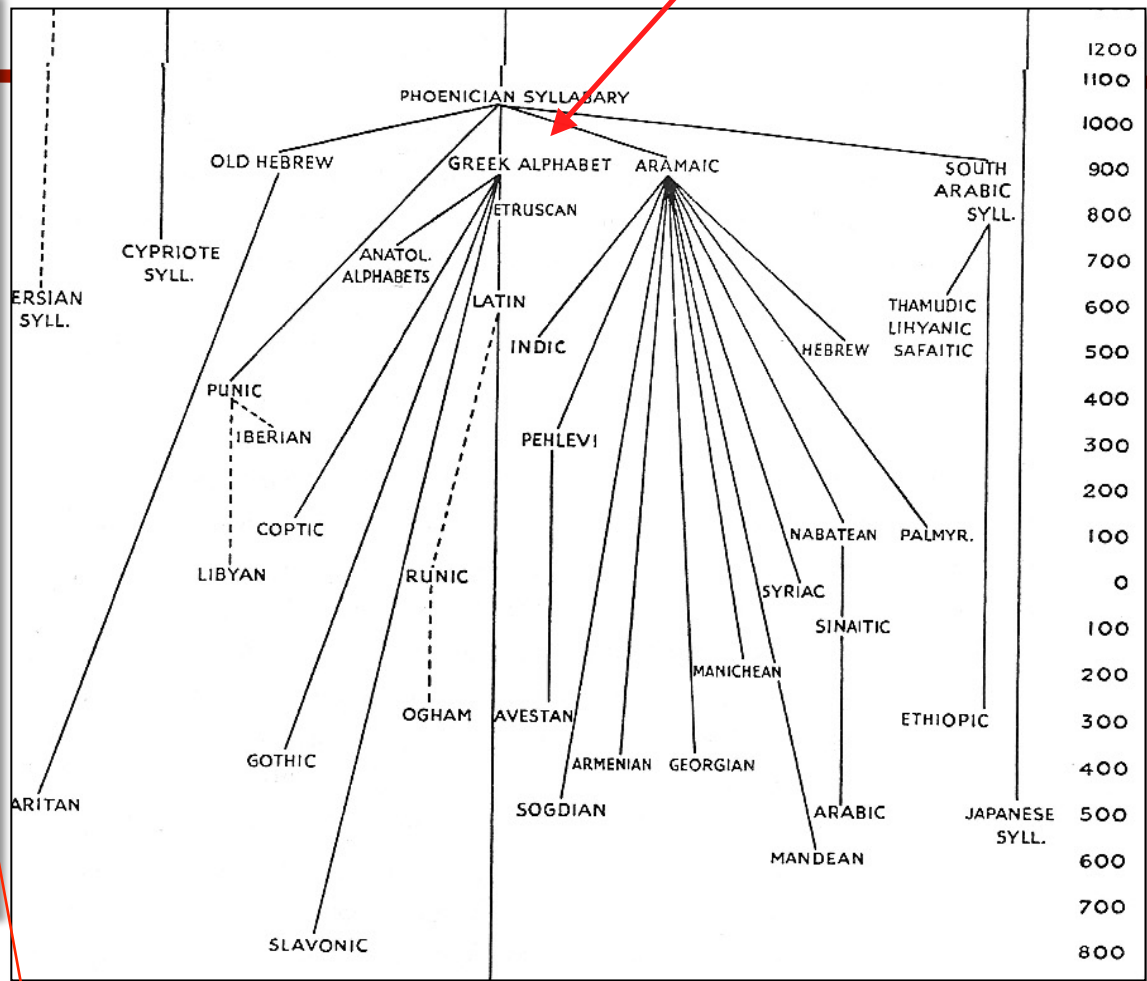
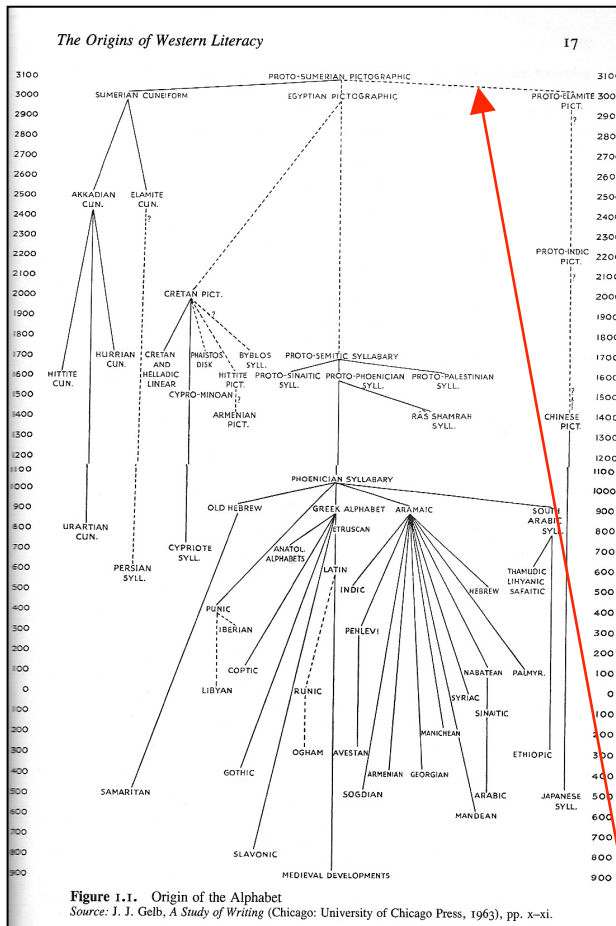
"True" (glottographic) Writing

Proto-writing



# Geneology of Writing Systems

Invention of the alphabet



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



# **Independent Invention of Writing Systems**

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# Independent writing systems: The Cherokee Syllabary



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

a	e	i	o	u	v [ǎ]
<b>D</b> a	<b>R</b> e	<b>T</b> i	<b>Ꭰ</b> o	<b>Ꭱ</b> u	<b>Ꭲ</b> v
<b>Ꭳ</b> ga <b>Ꭴ</b> ka	<b>Ꭶ</b> ge	<b>Ꭷ</b> gi	<b>Ꭸ</b> go	<b>Ꭹ</b> gu	<b>Ꭺ</b> gv
<b>Ꭼ</b> ha	<b>Ꭽ</b> he	<b>Ꭾ</b> hi	<b>Ꭿ</b> ho	<b>Ꮀ</b> hu	<b>Ꮁ</b> hv
<b>Ꮂ</b> la	<b>Ꮃ</b> le	<b>Ꮄ</b> li	<b>Ꮅ</b> lo	<b>Ꮆ</b> lu	<b>Ꮇ</b> lv
<b>Ꮉ</b> ma	<b>Ꮊ</b> me	<b>Ꮋ</b> mi	<b>Ꮌ</b> mo	<b>Ꮍ</b> mu	
<b>Ꮎ</b> na <b>Ꮏ</b> hna <b>Ꮐ</b> nah	<b>Ꮑ</b> ne	<b>Ꮒ</b> ni	<b>Ꮓ</b> no	<b>Ꮔ</b> nu	<b>Ꮕ</b> nv
<b>Ꮖ</b> qua	<b>Ꮗ</b> que	<b>Ꮘ</b> qui	<b>Ꮙ</b> quo	<b>Ꮚ</b> quu	<b>Ꮛ</b> quv
<b>Ꮜ</b> s <b>Ꮝ</b> sa	<b>Ꮞ</b> se	<b>Ꮟ</b> si	<b>Ꮠ</b> so	<b>Ꮡ</b> su	<b>Ꮢ</b> sv
<b>Ꮤ</b> da <b>Ꮥ</b> ta	<b>Ꮦ</b> de <b>Ꮧ</b> te	<b>Ꮨ</b> di <b>Ꮩ</b> ti	<b>Ꮪ</b> do	<b>Ꮫ</b> du	<b>Ꮬ</b> dv
<b>Ꮮ</b> dla <b>Ꮯ</b> tla	<b>Ꮰ</b> tle	<b>Ꮱ</b> tli	<b>Ꮲ</b> tlo	<b>Ꮳ</b> tlu	<b>Ꮴ</b> tiv
<b>Ꮷ</b> tsa	<b>Ꮸ</b> tse	<b>Ꮹ</b> tsi	<b>Ꮺ</b> tso	<b>Ꮻ</b> tsu	<b>Ꮼ</b> tsv
<b>Ꮾ</b> wa	<b>Ꮿ</b> we	<b>Ᏸ</b> wi	<b>Ᏹ</b> wo	<b>Ᏺ</b> wu	<b>Ᏻ</b> wv
<b>Ᏼ</b> ya	<b>Ᏽ</b> ye	<b>᏶</b> yi	<b>᏷</b> yo	<b>ᏸ</b> yu	<b>ᏹ</b> yv



# Independently invented writing systems: The Cherokee Syllabary



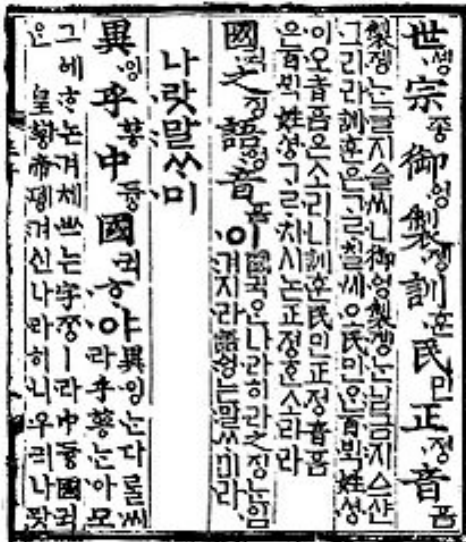
Cherokee Phoenix: First American Indian newspaper (1828)

# Independently invented writing systems: Korean Hangul



Writing system invented in mid-15<sup>th</sup> 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,





## Later Developments

ΦΑΝΟΔΙΚΟ  
ΚΟΜΨΟΤΙΜΕ  
ΡΑΤΕΟΣΤΟ  
ΗΝΙΟΚΟΠ  
ΣΙΟΚΡΗΤΗΡ  
ΚΟΠΥΙΑΔΕ  
ΡΗΤΗΡΙΟΝ  
ΠΣΕΙΟΜΘΗ  
ΡΥΤΑΝΗΙΟΝ  
ΕΥΚΕΝΣΕ  
ΕΥΣΙΝ

boustrophedon

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

it is of far more henceforth free that I am to write the history of 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: a death is 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



## Later Developments

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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

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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

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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?