The First Information Technology: Writing Systems

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IS 103
History of Information
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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.

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

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

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

"Man's first affirmation of himself" Maurice Blanchot
"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/. 

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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

BEACH CONDITIONS

WARNING
DANGEROUS SHOREBREAK
Waves break in shallow water
IN DOUBT, DON'T GO OUT

WARNING
HIGH SURF
Can cause serious injuries or drowning
IN DOUBT, DON'T GO OUT

WARNING
STRONG CURRENT
May cause serious injury
IN DOUBT, DON'T GO OUT

WARNING
MAN-O-WAR
Stings are painful
STAY OUT OF WATER

WARNING
JELLYFISH
Stings are painful
STAY OUT OF WATER

WARNING
SLIPPERY ROCKS
You could fall and be injured
IN DOUBT, KEEP OFF

WARNING
SUDDEN DROP OFF
Bottom drops off abruptly
IN DOUBT, DON'T GO OUT

WARNING
SHARP CORAL
May cause serious injury
AVOID CONTACT

These conditions may exist at any time.
Early Iconicity

Petroglyphs, Bhimbetka, India, ca 9000 BC

Petroglyphs, Scandinavia, Bronze Age

Rock carving, Hong Kong (Kau Sai), 3000 BC
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
Arbitrary (or effectively arbitrary) relation between sign and thing signified
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
Fig. 4.—Geometrical forms. (From a photograph of rocks).
Kiowa message to the US President
"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."
Yukaghir (Siberia) “love letter,” late 19th c.
"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."
"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

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
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

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.

Bullae and tokens

Early cuneiform
## 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.

<table>
<thead>
<tr>
<th>Token</th>
<th>Pictograph</th>
<th>Non-Sumerian</th>
<th>Neo-Assyrian</th>
<th>Neo-Babylonian</th>
<th>English</th>
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<td><img src="image3" alt="Sheep" /></td>
<td><img src="image4" alt="Sheep" /></td>
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<td><img src="image7" alt="Cattle" /></td>
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<td><img src="image31" alt="Perfume" /></td>
<td><img src="image32" alt="Perfume" /></td>
<td>Perfume</td>
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</tbody>
</table>
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

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

<table>
<thead>
<tr>
<th>Proto-cuneiform c.3000 BC</th>
<th>Early cuneiform c.2400 BC</th>
<th>Late (Neo-Assyrian) cuneiform c.700 BC</th>
<th>Transcription and meaning</th>
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<tr>
<td><img src="image1" alt="Proto-cuneiform symbol" /></td>
<td><img src="image2" alt="Early cuneiform symbol" /></td>
<td><img src="image3" alt="Late cuneiform symbol" /></td>
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<tr>
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<td><img src="image5" alt="Early cuneiform symbol" /></td>
<td><img src="image6" alt="Late cuneiform symbol" /></td>
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</tr>
<tr>
<td><img src="image7" alt="Proto-cuneiform symbol" /></td>
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<td><img src="image9" alt="Late cuneiform symbol" /></td>
<td>du/gin/gub “go/walk/stand”</td>
</tr>
<tr>
<td><img src="image10" alt="Proto-cuneiform symbol" /></td>
<td><img src="image11" alt="Early cuneiform symbol" /></td>
<td><img src="image12" alt="Late cuneiform symbol" /></td>
<td>gud “ox”</td>
</tr>
<tr>
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<td><img src="image14" alt="Early cuneiform symbol" /></td>
<td><img src="image15" alt="Late cuneiform symbol" /></td>
<td>udu “sheep”</td>
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<tr>
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<td><img src="image17" alt="Early cuneiform symbol" /></td>
<td><img src="image18" alt="Late cuneiform symbol" /></td>
<td>ku “fish”</td>
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<tr>
<td><img src="image19" alt="Proto-cuneiform symbol" /></td>
<td><img src="image20" alt="Early cuneiform symbol" /></td>
<td><img src="image21" alt="Late cuneiform symbol" /></td>
<td>dug “pot”</td>
</tr>
<tr>
<td><img src="image22" alt="Proto-cuneiform symbol" /></td>
<td><img src="image23" alt="Early cuneiform symbol" /></td>
<td><img src="image24" alt="Late cuneiform symbol" /></td>
<td>gi “reed, to render”</td>
</tr>
</tbody>
</table>

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

“water” /a/ → “in” /a/

“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 /ereshe/ -- /u/ “plant” used to indicate “marsh plant” use of sign.
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.
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)

- 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
Development of Written Symbols

Simplification of sign

Proto-writing

Iconic

Semasiographic/ideographic

Rebus extension
Development of Written Symbols

Simplification of sign

Proto-writing

Proto-writing

"True" (glottographic) Writing
Development of Written Symbols

Simplification of sign

Iconic

Semasiographic/ideographic

Proto-writing

Rebus extension

[εlvIs] /εl/

logographic syllabic

"True" (glottographic) Writing
Development of Written Symbols

Simplification of sign

[εlvIs] /εl/ /ε/

Iconic

Semasiographic/ideographic

Proto-writing

Rebus extension

logographic syllabic alphabetic

"True" (glottographic) Writing
But evidence is slight for derivation of Chinese from proto-Sumerian
Independent Invention of Writing Systems
Sequoyah [George Gist] and the "talking leaves": 1819

<table>
<thead>
<tr>
<th>a</th>
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<td>ŋ ye</td>
<td>ŋ yi</td>
<td>ŋ yo</td>
<td>G yu</td>
<td>B yv</td>
<td>B yvv</td>
</tr>
</tbody>
</table>
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-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,
Later Developments

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

It is of far more worth that I am to write the history of her civil administration and the conduct of her war; she is annually elected magistrate; 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.

boustrophedon
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.
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?