Counting Sheep

A Brief History of Written Numbers

One way to write a number is to spell it out in alphabetic characters, just as one would write any other word: o-n-e. Other methods of numerical notation, however, include non-phonetic signs, which, unlike the alphabet, do not aim to reproduce the spoken word. This essay is about the relation between writing and numbers: to examine the history of numerical notation is to challenge a few basic assumptions about the nature of writing.

Many historians view phonetic scripts as the most advanced stage in the development of writing. The roman alphabet is an attempt to analyze the innumerable sounds of speech into a couple dozen signs, suited to being carved in stone or drawn on paper, and capable of indefinite preservation. Most definitions of writing take the physical permanence and phonetic fidelity of the alphabet as their model: a form of communication only qualifies as "writing" if it is a representation of speech, capable of being read back orally, as a series of words, one after the other. Writing is assumed to be *graphic,* consisting of lines drawn on a flat plane.

Techniques for visualizing numbers tend to appear in cultures long before efforts to reproduce the full spoken language. A look at several early forms of numerical notation reveals a fluid range of forms through which human cultures have attempted to depict the order—numerical and linguistic—of the world. Many of these visualizations employ concrete objects rather than graphic marks, including sticks, stones, beads, furniture, and the human body. Writing is commonly described as an inferior, secondary copy of the immediate, intuitive spoken word; some early representations of number, however, show that a culture's choice of symbols helps structure its verbal number sequence. In these cases, writing helps *give form* to the spoken language, rather than passively reproducing it.

Since the Renaissance, the infrastructure of Western civilization has consisted largely of paper. Modern Hindu-Arabic numerals appeared in India between the sixth and eighth centuries A.D., but they did not begin to compete with finger counting and the abacus in Europe until the fifteenth century: calculations on paper ultimately replaced calculations with objects. The fifteenth century also witnessed the introduction of movable type in Europe, and with it, the rise of the book and a growing dependency on paper. During the twentieth century, radio, television, and electronic media have shaken the supremacy of the book. We may find, in the multiple modes of representing numbers, an expanded definition of writing.

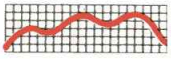
KEEPING SCORE

The English word *score* means "a cut or indentation;" it also refers to the number twenty. The word gets it double meaning from an object called a tally stick, a length of wood or bone marked with a series of scratches  . The twentieth cut on a tally stick is sometimes called a score. Tally sticks have appeared in literate and non-literate cultures from prehistory to the present; they keep time, count objects, and record credits and debts.

In the simplest form of tally, one notch is made for each item recorded: to count five sheep  , a shepherd might make five scratches on a stick  . This principle is called *ordering*: there is a one-to-one correspondence between the set of symbols and the set of objects counted. Ordering is also at work in modern dice, where  equals five, and in playing cards, where  is the five of diamonds.

The principle of *grouping* arranges an ordered collection of signs into smaller sets. Groups on a tally stick might be indicated with larger and smaller cuts  , or straight lines and diagonals  . In a tally convention familiar today,  represents five single strokes grouped in a bundle.

The ancient principles of ordering and grouping have no relation to spoken numbers, arising not from the will to record speech but from the need to keep track or "keep score" of objects or events. Whereas the Hindu-Arabic symbol 3 corresponds with the spoken number "three," a particular tick on a score pad, such as the third mark in the series  , is a graphic substitute for an event (the counting of a ). Linguists call this kind of mark *indexical*: there is a relationship of cause and effect between the sign and its referent,

as in foot prints  or a curve mapped on a graph  . The figure X, for example, is not only a phonetic letter but a sign it its own right, serving as a record or "index" of events: X stands for a signature  , or X signals an act of  selection or an act of deletion. X is also the roman numeral for ten.

Roman numerals were the dominant written numbers in Europe from the period of the Roman empire until the rise of the Hindu-Arabic system. Employing the principles of ordering and grouping, roman numerals consist of a graphic symbol for each power of ten (I, X, C, M), and for each subdivision of five (V, L, D). The numeral III represents three as one one one, and CCC represents three hundred as hundred hundred hundred.

The forms of the roman numerals coincide with the characters of the roman alphabet, but they may actually derive from tally markings. In tallies, a single vertical mark  commonly represents one, while two diagonal cuts, such as  or  , stand for five, and a crossed stroke, such as  or  , indicates ten. The roman numeral D is half of the symbol  , an ancient form of the sign for one thousand. The roman numerals may thus originate from a pre-alphabetic style of writing.

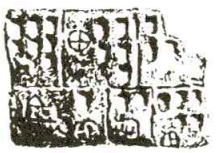
"After all the natural way to count is not that
one and one make two
but to go on counting by one and one....
One and one and one and one.
That is the natural way to go on counting."

GERTRUDE STEIN

CALCULUS

The English word *calculate* comes from the Latin *calculus*, meaning "small stone." Like tally sticks, stones are an ancient counting tool which, in their simplest application, require no verbal number sequence to operate: one stone is collected  for every object counted  . A counting technique used by the Sumerians beginning around 8000 B.C. involved small "tokens" manufactured out of clay  . Invented during the period when agriculture was supplanting an economy of hunting and gathering, tokens probably recorded business transactions between such parties as the temple government and a shepherd in charge of some  .

Groups of tokens dating from around 3200 B.C. have been found enclosed in sealed clay envelopes. The shapes of tokens were impressed into the clay container, one sign for each token. Thus the envelope could be read without being cracked open—the three-dimensional tokens inside offered a hidden guarantee for the graphic signs on the outside.



Soon, however, the marks impressed into the envelopes replaced the tokens altogether, and records were kept on small clay tablets instead. The production of tokens appears to have ceased around 3100 B.C., when a system for graphically recording the spoken language was emerging in Sumeria. The new script retained some symbols from the older token system, but a basic conceptual change took place.

"What is logic?

To me two and two equals twenty-two, not four."

MAN RAY

Each token had represented a quantity of a particular product: a clay disc marked  , for example, stood for  , and could not be used to count any other kind of object. The collection  signified  : number and object were fused together. The new writing system, however, paired a separate number symbol with a sign for the object, so that  meant five  . The number symbol , meaning five, might be paired with the sign for any object. Number was now independent from things: with the rise of written language came a move away from concrete thought and toward abstraction.

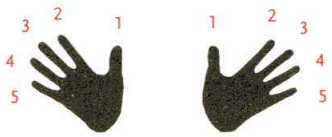
Modern English contains a few words that signify a plurality of particular objects: a flock of  , a herd of  , or a school of  . The English word *pair* names objects or groups of objects to which doubleness is a natural state: a pair of  , a pair of  , a pair of  . Modern Japanese has separate "number classes" for different objects; words called "counters" are inserted between the number word and the name of the object counted: for example, *dai* for vehicles, *hai* for glassfuls, *ma* for rooms, *mai* for thin, flat objects, *hon* for long, cylindrical objects, *go o-sya* for train car numbers, and so on. Linguists consider conventions such as these remnants of an older, less abstract stage of thought, which conceived of number as an integral characteristic of the objects being counted.

"The depicting of objects
is appropriate to a savage people;
signs of words to a barbaric people;
and the alphabet to a civilized people."

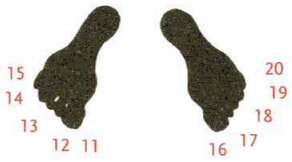
J.J. ROUSSEAU

DIGITS

Most verbal number sequences are organized into groups of ten; they are called "base ten." A number sequence can be devised with any other base, such as five or twelve; digital computers, for example, use base two numbers, which employ the most minimal set of symbols possible, zero and one, on and off. Yet no culture has been known to spontaneously generate binary numbers; most cultures use ten. Why would the human mind be almost universally compelled to generate number sequences with a base ten structure?



The answer lies not in the mind but in the body. Human hands, equipped with ten fingers, are convenient devices for counting and calculating. Numerous cultures use the hands and feet, fingers and toes, as the basis of number systems. Aztec numeration is base twenty; thus thirty is expressed verbally as "twenty plus one," and forty is "two times twenty." The modern French word



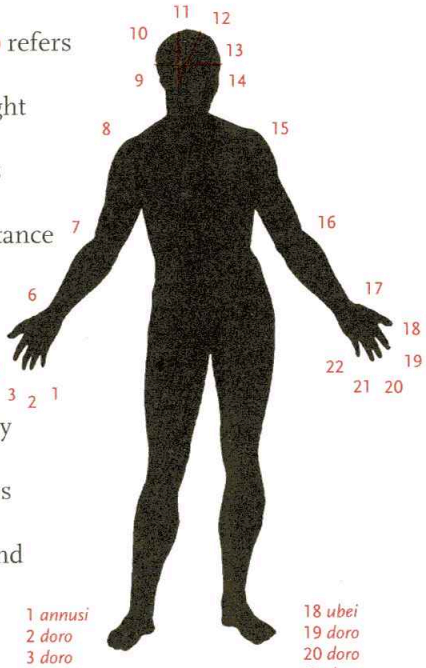
quatre-vignt, which means "four twenties," is equivalent to the English eighty. The human body readily suggests counting in fives, tens, and twenties: our word *digit* comes from the Latin *digitus*, meaning "finger or toe."

Europeans initially distrusted the zero.
A fifteenth-century French writer complained,

"Just as the rag doll wanted to be an eagle,
the donkey a lion,
and the monkey a queen,
the *cifra* [zero] put on airs and pretended to be
a digit."

The whole body can become a set of symbols for representing numbers. A technique used by the Papuan natives of the Torres Strait assigns numerical values to positions on the body. The verbal words identifying the numbers are each names for body parts, and some of the words appear more than once.

For example, the word *doro* refers to fingers from both the right and left hands, and thus its numerical value in any instance would be made evident only if the "speaker" were also pointing to a body part. Thus the verbal names have a nonverbal source, and cannot function alone.



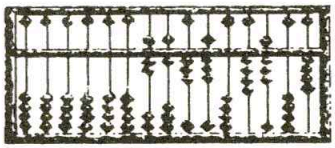
1 *annusi*
2 *doro*
3 *doro*
4 *doro*
5 *ubei*

18 *ubei*
19 *doro*
20 *doro*
21 *doro*
22 *anusi*

In its simplest form, finger counting relies on the principle of ordering: seven fingers for seven sheep. In the body system at left, each body part stands for a unique step in a sequence; it represents a *position* in a series rather than a concrete object. In Europe, hand counting systems capable of representing numbers in the thousands and tens of thousands were widely used until the ascendence of Hindu-Arabic numerals; the body provided a numerical vocabulary "spoken" by hand in both the monastery and the marketplace. Writing is generally defined as a method for depicting *speech*, yet the recurrence of the base ten sequence suggests that when representing numbers, speech followed an example offered by non-verbal expression.

ABACUS

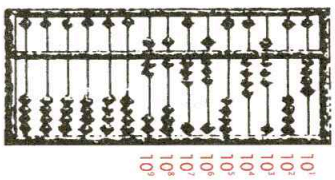
The *abacus*, used for counting and computing in ancient Greece and Rome, remained powerful until the rise of Hindu-Arabic numerals during the Renaissance. The abacus has had a longer life in China and Japan, where it is still used alongside the electronic calculator.



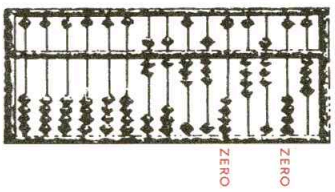
7 6 3, 8 0 4, 8 0 4

On an abacus, each string of beads represents a power of ten, and each bead is a unit. The horizontal division indicates groups of five, allowing a number to be represented with fewer beads. Adding and subtracting with an abacus involves manipulating physical objects rather than abstract signs—the concreteness of the abacus makes it useful for teaching children arithmetic.

The Latin word *abacus* also means "table": an abacus often consisted of a table that was cut with grooves or simply marked with chalk lines, on which discs called "counters" were moved about. Called "counting tables," such numerical furniture was used widely throughout Europe for both commercial and scholarly arithmetic. Like Hindu-Arabic numerals, an abacus indicates powers of ten by position. A major difference between the abacus and Hindu-Arabic numerals is how to represent the *absence* of digits in a power of ten. The abacus achieved this quite sensibly: an empty column. The Hindu-Arabic system could not use an empty column, however, because a gap in a row of digits would indicate two distinct numbers.



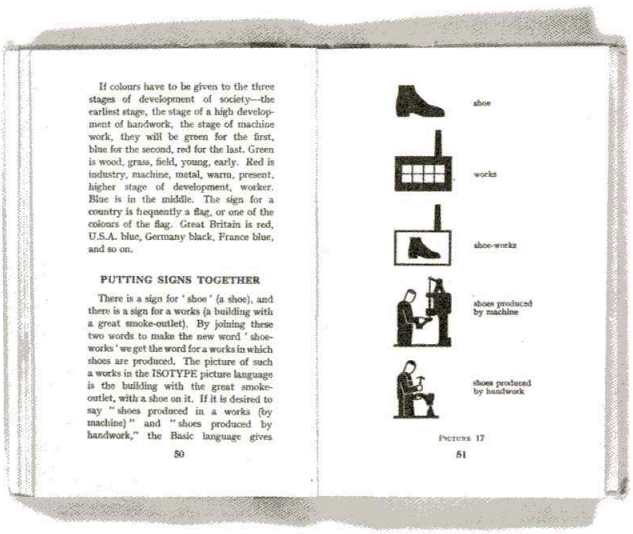
10^0 10^1 10^2 10^3 10^4 10^5 10^6 10^7 10^8 10^9



ZERO ZERO

Thus a symbol was invented to represent an empty set: the zero. The Hindu-Arabic system became the numerical equivalent of the alphabet: abstract, concise, graphic. With the rise of the new numerals, the tradition of "writing" with objects began to disappear.

SOURCES This essay relies on Georges Ifrah, *From One to Zero: A Universal History of Numbers* (New York: Viking Penguin, 1981, 1985), and Karl Menninger, *Number Words and Number Symbols: A Cultural History of Numbers* (Cambridge: MIT Pres, 1958, 1969). On Sumerian tokens, see Denise Schmandt-Besserat, "Tokens: Facts and Interpretations," *Visible Language*, Vol. XX, No. 3 (Summer 1986): 250-273.



If colours have to be given to the three stages of development of society—the earliest stage, the stage of a high development of handwork, the stage of machine work, they will be green for the first, blue for the second, red for the last. Green is wood, grass, field, young, early. Red is industry, machine, metal, warm, present, higher stage of development, worker. Blue is in the middle. The sign for a country is frequently a flag, or one of the colours of the flag. Great Britain is red, U.S.A. blue, Germany black, France blue, and so on.

PUTTING SIGNS TOGETHER

There is a sign for 'shoe' (a shoe), and there is a sign for a works (a building with a great smoke-outlet). By joining these two words to make the new word 'shoe-works' we get the word for a works in which shoes are produced. The picture of such a works in the ISOTYPE picture language is the building with the great smoke-outlet, with a shoe on it. If it is desired to say "shoes produced in a works (by machine)" and "shoes produced by handwork," the Basic language gives

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shoe

works

shoe-works

shoes produced by machine

shoes produced by handwork

PICTURE 17

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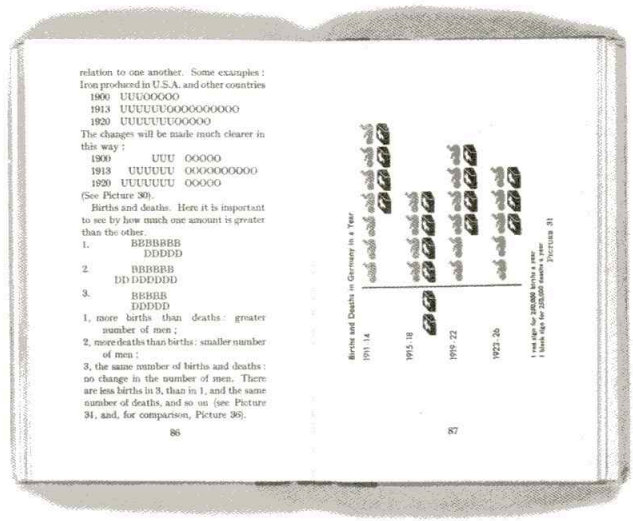

relation to one another. Some examples: Iron produced in U.S.A. and other countries

1900 UUUOOOOO
1913 UUUUUUUOOOOOOOOO
1920 UUUUUUUOOOOO

The changes will be made much clearer in this way:

1900 UUU OOOOO
1913 UUUUUU OOOOOOOOO
1920 UUUUUU OOOOO

(See Picture 30).

Births and deaths. Here it is important to see by how much one amount is greater than the other.

1. BBBBBBB
   DDDDD
2. BBBBBB
   DD DDDDDD
3. BBBBB
   DDDDD

1, more births than deaths: greater number of men;
2, more deaths than births: smaller number of men;
3, the same number of births and deaths: no change in the number of men. There are less births in 3, than in 1, and the same number of deaths, and so on (see Picture 34, and, for comparison, Picture 36).

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Births and Deaths in Germany in a Year

1911-14
1915-18
1919-22
1923-26

1 red sign for 200,000 births a year
1 black sign for 200,000 deaths a year

PICTURE 31

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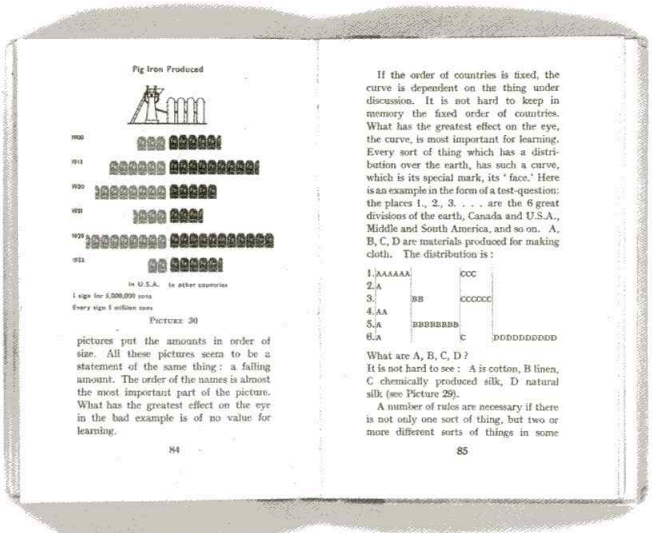

Pig Iron Produced

1900
1913
1920
1921
1929
1932

in U.S.A. in other countries

1 sign for 5,000,000 tons
Every sign 5 million tons

PICTURE 30

pictures put the amounts in order of size. All these pictures seem to be a statement of the same thing: a falling amount. The order of the names is almost the most important part of the picture. What has the greatest effect on the eye in the bad example is of no value for learning.

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If the order of countries is fixed, the curve is dependent on the thing under discussion. It is not hard to keep in memory the fixed order of countries. What has the greatest effect on the eye, the curve, is most important for learning. Every sort of thing which has a distribution over the earth, has such a curve, which is its special mark, its 'face.' Here is an example in the form of a test-question: the places 1., 2., 3. . . . are the 6 great divisions of the earth, Canada and U.S.A., Middle and South America, and so on. A, B, C, D are materials produced for making cloth. The distribution is:

1. AAAAAA CCC
2. A
3. BB CCCCCC
4. AA
5. A BBBBBBBB
6. A C DDDDDDDDDD

What are A, B, C, D?

It is not hard to see: A is cotton, B linen, C chemically produced silk, D natural silk (see Picture 29).

A number of rules are necessary if there is not only one sort of thing, but two or more different sorts of things in some

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Otto Neurath, *International Picture Language*, 1936. Modeling Isotype after language, Neurath showed how to build compound signs out of elementary units. Neurath's work extended beyond the design of symbols, however, to include the use of icons in statistical charts. His theory of information design included the search for ways to organize information that maximize their visual impact. Collection of Smithsonian Institution Libraries, Cooper-Hewitt, National Design Museum.

Modern Hieroglyphs

 and  are from the standard symbol set designed by Cook & Shanosky Associates in collaboration with the American Institute of Graphic Arts in 1974.  and  are endorsed by the U.S. Department of Transportation (D.O.T.). They belong to an international hieroglyphics of public infomation.* Their ancestors,  and  , were created by the Viennese philosopher and social scientist Otto Neurath in the 1920s. Neurath and his colleagues constructed a universe of people  ,  ,  ,  ,  places  , objects  ,  ,  , and actions  ,  ,  . He called his system Isotype  , the International System of TYpographic Picture Education.**

Although Neurath advocated the use of  in transportation signs, his primary interest was in presenting social statistics in textbooks, posters, and educational museums. In Neurath's charts, a given symbol, such as  , represented a quantity of people or things; a series () of symbols represented a larger number of objects. Thus a visual, perceptual Gestalt replaced abstract numerals in  charts. Anticipating Edward Tufte's later writings on the display of data, Neurath developed practical guides for representing #'s in a visually accessible way.

As a member of the Vienna Circle of philosophers in the 1920s, Otto Neurath was a founder of logical positivism, a theory that brought together two opposing modes of inquiry: *rationalism*, which studies reality through logic, geometry, and mathematics; and

empiricism (or positivism), which claims that observation is the key to knowledge.*** The  and its associated equipment—such as  and  —are the primary tools of empirical knowledge. The logical positivists attempted to analyze language into a minimal set of direct experiences, claiming that all languages can be reduced to a core of observations, such as big, small, up, down, red, or **black**. With  , Neurath translated a philosophical theory into a visual practice. The sign  is *positive* because as a picture, it is based in observation;  is *logical* because it concentrates the details of experience into a schematic mark. Neurath aimed to combine the mechanical empiricism of photography  with the rational structures of mathematics and geometry .

Although Neurath believed that pictures are objective and universal, the meanings of international signs are culturally specific. We understand, for example, that  and  represent *lavatory for men* and *lavatory for women*. Yet the reference to toilets is left unstated. A functional description, such as  and  , might denote the difference between these facilities more directly, but the signs' conventional meaning still would have to be learned.

We distinguish  as male because he is contrasted against the figure  , whose gender is marked by a stylized reference to a garment sometimes worn by Western women. In the D.O.T. system,  refers to "people" in general except where he is contrasted with  . Thus  does not mean *drinking fountain for men;* nor does  mean *elevator for men;* and nor does the sign  mean *waiting room for men*—  stands in for *man* generically. The only place  appears in the D.O.T. system besides on lavatory doors is in  , the sign for *ticket sales*. Here, where one person is offering a service to another, the designers deemed it appropriate to show  assisting  .

The stylistic principles of Neurath's  remain the basis of international pictograms today: *reduction* and *consistency*. Many Isotype signs are flat shapes with little or no interior detail, as in  ,  , and  . These flat silhouettes suggest a rationalized theater of shadows, in which signs appear to be the natural imprints of material objects—Plato's cave renovated into an empiricist  laboratory. When depth is expressed in  , isometric drawings  are used instead of traditional perspective. Parallel lines do not converge, and dimension is fixed from foreground  to background.

Consistency governs the stylistic uniformity of a symbol set. The D.O.T. system, for example, is a world of coordinated objects, including  ,  ,  ,  , and  . The sign system designed for the Munich Olympics in 1972 was the semiotic climax of international pictures: a geometric body alphabet  is deployed on a consistent grid:  ,  ,  ,  ,  ,  , and  .

The reduction and consistency of international pictures heighten their alphabetic quality. Neurath's  and  were a critique of writing that resembled writing, a utopian effort to transcend the limitations of letters by exploiting the visual characteristics of typography.**** Neurath's preferred typeface was **Futura**, designed by Paul Renner around 1926-27. Paralleling the machine aesthetic in architecture and industrial design, **Futura** is stripped of references to handicraft and calligraphy. Neurath conceived of  as clean, logical, free of redundancy: writing as a machine  for living in.

The current figure  might be called **Helvetica Man**, his style coordinating with the favorite typeface of post-war institutional design culture. A more inclusive pictographic land-

scape might be inhabited by variants of **Helvetica Man** that harmonize with other typefaces, such as Serif Man  , *Italic Man*  and *Cursive Man*  .

 and  are neither universal, self-evident, nor purely informational—like linguistic signs, they must be learned; like other styles of drawing, they are culturally specific. When we see  engraved over an airport door, we know she belongs to the language of public information, not the language of commerce. Thus we do not mistake  for, say, *brothel*, where  might purchase the services of  . The clean, geometric character of  and  is loaded with cultural associations—"public," "neutral," "modern."

An international picture functions as a memento, a token for memory, a souvenir for words.  is *restaurant* as  is *Paris*. The very American  is hardly the geometric essence of *drinking alcohol in airports*, but like  , a cocktail is a useful cliché for storing a range of experiences. Likewise,  ,  ,  ,  ,  and  , taken from different international picture sets, are helpful tags for remembering objects we tend to forget.

Otto Neurath believed that  could transcend national boundaries and unify global social life. By translating a philosophical theory into a popular medium, he fathered a new breed of **ABCs**, whose progeny have populated public spaces across the industrial world. Since the birth of Neurath's  and  , designers and critics have framed new questions about visual and verbal writing that acknowledge the cultural basis of images, symbols, and experience. As we rethink the boundaries between words and pictures, Otto Neurath could serve as a model for the graphic designer of the next millennium,  the language worker equipped to use design and theory as tools for unearthing new questions and  constructing new answers.*****

* This essay is based on research and writing initiated at The Cooper Union in 1986, with the exhibition *Global Signage: Semiotics and the Language of International Pictures*, curated by Ellen Lupton. The essay "Reading Isotype" was published in *Design Issues* 111/2 (1986): 47-58; and in *Design Discourse*, ed. Victor Margolin (Chicago: University of Chicago Press, 1989). The global iconography of pictograms and logotypes was further explored by Ellen Lupton and J. Abbott Miller in "Critical Wayfinding," *The Edge of the Millennium*, ed. Susan Yelavich (New York: Whitney Library of Design, 1993), 220-32.

The pictorial symbols endorsed by the D.O.T. are documented in *Symbol Signs* (New York: American Institute of Graphic Arts, 1974). International symbols became a major interest of modernist graphic designers during the 1960s and 70s. Martin Krampen surveyed the theory and practice of the movement in "Signs and Symbols in Graphic Communication," *Design Quarterly* 62 (1965). *Print* devoted a special issue to the subject, November/December, 1962. On signage for the Olympic games, see Heiner Jacob and Masaru Katzumie, "Sign Systems for International Events," *Print* (November/December 1969): 40. The industrial designer Henry Dreyfuss published the encyclopedic *Symbol Source Book: An Authoritative Guide to International Graphic Symbols* in 1972 (New York: McGraw-Hill); an archive of his research materials is housed at Cooper-Hewitt, National Design Museum.

** Otto Neurath's colleagues included his wife, Marie Neurath, the Dutch graphic designer Gerd Arntz, and the American graphic designer Rudolf Modley, who brought Isotype to the United States after working with Neurath in Vienna. The Otto and Marie Neurath Collection is housed at the Reading University Library, Reading, Great Britain. Neurath's writings on Isotype include *International Picture Language* (Reading: Reading University, 1980), facsimile of the 1936 edition; *Basic by Isotype* (London: Kegan Paul, 1937); and "From Vienna Method to Isotype," in *Empiricism and Sociology*, ed. Marie Neurath and Robert S. Cohen (Dordrecht, Holland: D. Reidel, 1973). Critical works on Neurath and Isotype include *Graphic Communication through Isotype*, ed. Michael Twyman (Reading: Reading University, 1975), 7-17; and Robin Kinross, "On the Influence of Isotype," *Information Design Journal* 11/2 (1981): 122-30. Works by Rudolf Modley include *How to Use Pictorial Statistics* (New York: Harper and Brothers, 1937); *A History of the War, In Maps, In Pictographs, In Words* (New York: Penguin, 1943); and *Handbook of Pictorial Symbols* (New York: Dover, 1976).

*** Neurath explained his philosophy in "Empirical Sociology: The Scientific Content of History and Political Economy," in *Empiricism and Sociology*, cited above. On logical positivism, see Peter Halfpenny, *Positivism and Sociology: Explaining Social Life* (London: George Allen and Unwin, 1982).
On Neurath and his context, see William M. Johnston, "The Eclipse of a Universal Man," in *The Austrian Mind: An Intellectual and Social History, 1848-1938* (Berkeley: University of California Press, 1972), 192-95.

**** Attempts to reform the alphabet into a more accurate reflection of speech were documented by Herbert Spencer in *The Visible Word* (New York: Hastings House, 1968). Herbert Bayer discussed his own writing reform efforts in "Basic Alphabet," *Print* (May/June 1964): 16-20. Charles Bliss proposed a new hieroglyphic script in which each character would "show the outline of the real thing, directly connected with meaning" in *Semantography (Blissymbolics)* (Coogee, Australia: Semantography Publications, 1949).

***** Whereas Otto Neurath saw pictorial communication as an antidote to writing, other writers and designers have addressed the overlaps between visual and verbal forms. On rhetoric and visual practices, see Roland Barthes, "The Rhetoric of the Image," in *Image/Music/Text*, trans. Stephen Heath (New York: Hill and Wang, 1977); Gui Bonsieppe, "Visual/Verbal Rhetoric," *Ulm* 14/16 (1965): 23-40; Hanno Ehses and Ellen Lupton, *Design Papers 5: Rhetorical Handbook* (Halifax: Nova Scotia College of Art and Design, 1988); and Katherine McCoy and David Frej, "Typography as Discourse," *I.D.* 35 (March/April 1988): 34-7.

Language of Dreams

According to Freud, dreams are organized or "written" according to the principle of the rebus, a form of expression employing both words and pictures. An image of a glove might stand for another object with a similar structure, such as a sock or an envelope, or it might stand for a memory associated with gloves, such as bad weather or polite manners. The dream-glove might stand also for a word whose sound or spelling resembles the name glove, such as love or grove. Freud argued that to decipher a dream one must exchange the direct, literal meaning of its images for indirect substitutions.

This principle, called the *rebus*, is a feature of numerous written languages, from Egyptian hieroglyphics to modern Japanese. According to many historians, writing naturally evolves from pictographs through various phonetic systems, climaxing in the alphabet, which analyzes the sounds of a spoken language into tiny repeatable elements. Discovery of the rebus principle enables a culture to invent a phonetic script.[1]

Japanese writing is built upon that of Chinese, a logographic system that has separate symbols for words and parts of words, resulting in over 40,000 signs. Chinese has numerous words that sound the same but have different meanings, called homophones. Thus Chinese writing, while it appears cumbersome to Westerners, is well-suited to the Chinese language, because even though many of its characters have similar or identical pronunciations, they are graphically distinct.

1 Comparative studies of writing include I.J. Gelb, *A Study of Writing* (Chicago: University of Chicago Press, 1952, 1963); Albertine Guar, *A History of Writing* (London: The British Library, 1984); and Roy Harris, *The Origin of Writing* (La Salle, IL: Open Court, 1986).

精神分析学の創始者シグモント・フロイトによると夢とは「リーブス」の法則(rebus = 判じ絵)、すなわち言語と絵とを使った表現の仕方によって、構成あるいは「書かれて」います。手袋(グローブ)のイメージが、例えばくつ下、封筒等他の構成がよく類似した物を意味しているかもしれません。又は、悪天候や上品なマナー等、手袋(グローブ)と関連した個人的な想い出に関係があるのかもしれません。夢の中の「手袋(glove)」は又、「言葉」の音と読みが似ている「愛(love)」や「小さい森(grove)」を意味するかもしれません。フロイトは夢を解読する為には直接的である夢のイメージの文学上の意味を間接的な代用物に交換することが必要だと論じています。

リーブスの法則はエジプトの象形文字から現代の日本語へと、色々な文語の特色となっています。数々の西洋の言語の歴史家によると、書法とは多くの異なった音声法を通した象形文字から自然に発展したものです。その頂点がアルファベットで、口語の音声を分析してこまかい繰り返し可能な要素となったものです。リーブスの法則の発見によって音声筆記体活字の発明が可能になりました。

日本語の書法は記号を語、又は語の一部に分類した語標法である中国語を基礎に出来た言語です。そしてこの結果として莫大な(4万個以上の)個々の記号になりました。中国語では「同音異義語」といって同じ音で異なる意味の単語が数多くあります。すなわち西洋人には見た目はわずらわしい中国語書法も中国語という言語面から見ると良く出来ているということになります。なぜなら、良く似たり同じ「発音」の言葉は多くても、図解的には見分けることが出来るからです。

The Chinese script already had been in use for around 2,000 years when Korean scholars introduced it to the Japanese court in the fourth and fifth centuries AD (Western time). The Japanese acquired deep respect for Chinese civilization, and some took on the ambitious task of learning its script. Initially, the Japanese used Chinese characters to read and write in Chinese, which became the official written language of Japan's imperial court. By the seventh century, however, more attempts were made to write the *Japanese* language with Chinese characters.[2]

This was no simple task. The Japanese and Chinese spoken languages are totally different in their grammar and phonology. While many Chinese characters could be exchanged directly for Japanese words, some features of Japanese are impossible to translate. For example, Japanese is heavily inflected, meaning that the basic form of a noun, verb, or modifier changes in different grammatical settings. Chinese, in contrast, has few inflections. In this sense, Japanese resembles Latin more than Chinese! The principle of the rebus arose to address such difficulties of translation: a Chinese character could be used to stand for a Japanese word or syllable unrelated in *meaning* but similar in *sound*.

中国書体は4、5 世紀に韓国の学者によって日本の皇室に紹介されるすでに2千年程前から存在していました。日本人は中国の文明に強い尊敬の念をいだいていました。そこで中国書体を習得しようという希望を持った人が何人か出てきたのです。初めに、日本の皇室公認の文語になった漢字は、日本人が中国語で読み書きするのに使われました。しかし7世紀に入ると、漢字を使って「日本語」を書くことが試みられました。

これは容易い作業ではありませんでした。日本語と中国語の話し言葉では、文法と音声学が全く違うのです。多くの漢字はそのまま日本語に置き代えられますが、日本語の特徴として漢字に置きかえることは不可能なものもあります。例をあげると、日本語は語尾の変化が激しい。つまり基本形の名詞、動詞、又は修飾語句が異なる文法の状況によって変化するということです。これに比べると中国語には語尾変化はほとんどありません。いわば日本語は中国語よりもラテン語に似ているということです。リーブスの法則はこれらの難しい訳に着手する為に発生したのです。すなわち意味的には関係がないのに「音」が似ているために、日本語一語や一音節を一つの漢字で表すことが出来るということです。

2 For discussions of the Japanese script, see Yaeko Sato Habein, *The History of the Japanese Written Language* (Tokyo: University of Tokyo Press, 1984); Wolfgang Hadminsky and Mark Spahn, *Kanji and Kana: A Handbook and Dictionary of the Japanese Writing System* (Rutland, VT and Tokyo: Charles E. Tuttle Company, 1981); and Roy Andrew Miller, *The Japanese Language* (Chicago: University of Chicago Press, 1967), Chapter 3, "Writing Systems," 91-140.

The chart at right is a thought game that invites the English reader to imagine designing a written form for English if the Latin alphabet did not exist. Imagine that a sophisticated neighboring civilization has a writing system, but that we have none. We will call this writing system Airport-*moji* (or Airportscript). We will pretend to invent an English writing system out of these hieroglyphs.

pictograph
象形文字

man and woman
女と男

knife and fork
フォークとナイフ

a man dreams of a question
質問を夢みる人

a car dreams of a key
鍵を夢みる車

We begin our task by trying to guess the meaning of Airport-*moji*. Some of the characters appear to be simple, direct depictions of objects (man and woman, or knife and fork). Others, however, are more obscure. Consider, for example, the character that shows a giant key floating above a car: if we interpreted this sign as a literal depiction of a scene, we might read "a car dreams of key." A figurative sign interpreted for its literal meaning is called a pictograph. A pictograph does not refer to a word in a particular language, but to a physical object in the real world.

While such fanciful scenarios as "a car dreaming of a key" have an appealing charm, we would find little use for such a specific sign in writing the English language.

「空港文字」の意味をあてることから作業を始めてみましょう。単純に物をそのまま表わした文字もありますが、意味がはっきりしないものもあります。例えば「大な鍵が車の上に浮かんでいる文字を考察してみると、その現場(鍵を夢みる車)をそのまま表わした様に解釈できます。そのまま事実に忠実な意味を解釈した形象的な記号を「象形文字」といいます。「鍵を夢みる車」の様な空想上のシナリオは、魅力的ですが、実際に英語の文語としてはほとんど使い道がありません。

ideograph
表意文字

toilets
トイレ

restaurant
レストラン

hotel information
ホテル インフォメーショ

car rental
レンタカー

Perhaps instead we should combine the individual meanings of the two pictures (car and key) to create a third meaning. The whole sign could mean car key, parking, or "Please lock your car," but upon consulting with native writers of Airport-*moji*, we discover that the real meaning of the sign is car rental. Such a sign is called an ideograph, because it stands for a concept or "idea" rather than a material object.

Chinese characters borrowed to write the Japanese language are called *kanji*. A *kun* reading of *kanji* employs the Chinese character for its Chinese meaning, but assigns it a Japanese pronunciation.

その代わりに2つの絵の個々の意味をまとめた文字から他の意味に訳してみるべきでしょう。その文字は「車の鍵」、「駐車場」又は「車の鍵をしめてください」という意味になります。しかし、この「空港文字」の筆者たちによりますと、この文字の本当の意味はレンタカーだということです。この様な文字は「表意文字」と呼ばれます。概念又は「アイディア」を表わしているからです。

日本語が借りた中国文字は「漢字」と呼ばれています。「漢字」の「訓読み」とは、その文字が中国語の意味を使い日本語読みをすることをいいます。

rebus
リーブス(判じ絵)


john
ジョン


knee
ニー(ひざ)


car
カー


son
サン(息子)

We soon run into difficulty, however, using Airport-*moji* to write English. Consider, for example, the familiar English proper name Johnny Carson. Rather than invent a new ideograph for it, we could use existing characters to stand for the sounds of the spoken name. (The rebus above relies on an English slang word for toilet — john.) The whole rebus reads "john-knee car-son."

In Japanese, some readings of *kanji* (called *on* readings) employ the Chinese rather than the Japanese pronunciation of the character. For example, the *on* reading of the *kanji* for "mountain" is *san*, a Chinese word, while the *kun* reading of the same character is *yama*, the Japanese word for "mountain."

「空港文字」を使い英語を書くのは困難だと間もなくわかるでしょう。「ジョニー カーソン」という英語で実在する名前を例にとって考察してください。新しい表意文字を発明する代わりにすでに存在する英語の名前の「音」を使用して「ジョニー カーソン」という言葉を表現することができます。(上記の判じ絵の「ジョン」とは英語の口語でトイレの男 (John-knee Car-son) 絵をつなぐと「ジョニー カーソン (John-knee Car-son)」と読めます。

日本語では漢字の読み方(音読み)がリーブスの法則にしたがうことがあります。音読みは漢字の発音をつかいます。例えば「音読み」の「山」は中国読みで「さん」、「訓読み」では日本読みで「やま」と読まれます。

syllabary
音節文字


car
カー


cup
カップ


cut
カット(切る)


cat
キャット(猫)

By employing the drawing of a car to stand for the English syllable *car*, we begin to create a syllabary, a set of symbols representing all the consonant-vowel pairs of a language.

Modern Japanese *katakana* and *hiragana* (together called *kana*) are indigenous phonetic sign systems used in addition to the Chinese *kanji*. Both *katakana* and *hiragana* are syllabaries.

In theory, *kana* could have replaced the unwieldy collection of *kanji*, but because of Japan's continued respect for Chinese culture and attachment to the subtle connotations and graphic variety enabled by its characters, *kanji* have remained a central element of Japanese writing.

もし英語の「車(car)」という「音節」を車のドローイングに毎回おきかえて使うとすると、「音節文字」、すなわちその言語のすべての音節を代表することのできる記号の一組みを作ることが可能です。

現代日本語の「片仮名」と「平仮名」(双方はまとめて仮名と呼ばれています)は中国の「漢字」に加えた日本国産の文字の集まりです。個々は音節文字で日本語の音節を表わしています。

理論上では仮名は、使用しにくい「漢字」の全てに代わって使うことができたはずですが、日本の中国文化に対する尊敬の念と、「漢字」によって微妙な語感と写実的、図解的変化に富む事が可能になったので「漢字」は日本の文語の中心として残ることになったのです。

alphabet
象形文字


A is for alcohol
アルコールのA


B is for boat
ボートのB


C is for car (and key)
カー(とキー)のC


C is for cigarette (and smoke)
シガレット(とスモーク)のC

An alphabet abstracts the sounds of a spoken language into even smaller units, assigning separate symbols to consonants and vowels. Western culture reveres its alphabet as the most rational of all writing systems, but in practice, the Latin alphabet is full of irregularities: The letter C, for example, can sound like the initial letters in either car and key or cigarette and smoke.

Attempts to reform such irregularities in English, like efforts to eliminate *kanji* from Japanese, have largely failed. It is unlikely that our spelling system will ever become more rational. The alphabet is not the perfect climax of writing's "natural" evolution, but it has seeped into the pores of our culture.

アルファベットとは口語の音をもっと小さな単位で抽象的に表わしたもので、子音と母音を別々の記号で割りあてたものです。西洋文化では全ての文語の中でアルファベットが一番合理的であると尊敬されていますが、実際問題としてラテンアルファベットには多くの変則があります。たとえばCは「車(カー)」と鍵(キー)」又は「たばこ(シガレット)」と「煙(スモーク)」のようによく似て聞こえます。

日本語から漢字を減らそうとした様に英語から変則を改正しようという試みは大きな失敗におわりました。我々のつづりの法則がもっと合理的になるということはないでしょう。それはアルファベットが文語の「自然」進化の完璧な最高頂のものであるからではなく、私たちの文化の底辺まで行き渡ったからです。