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Author(s): Martin Krampen
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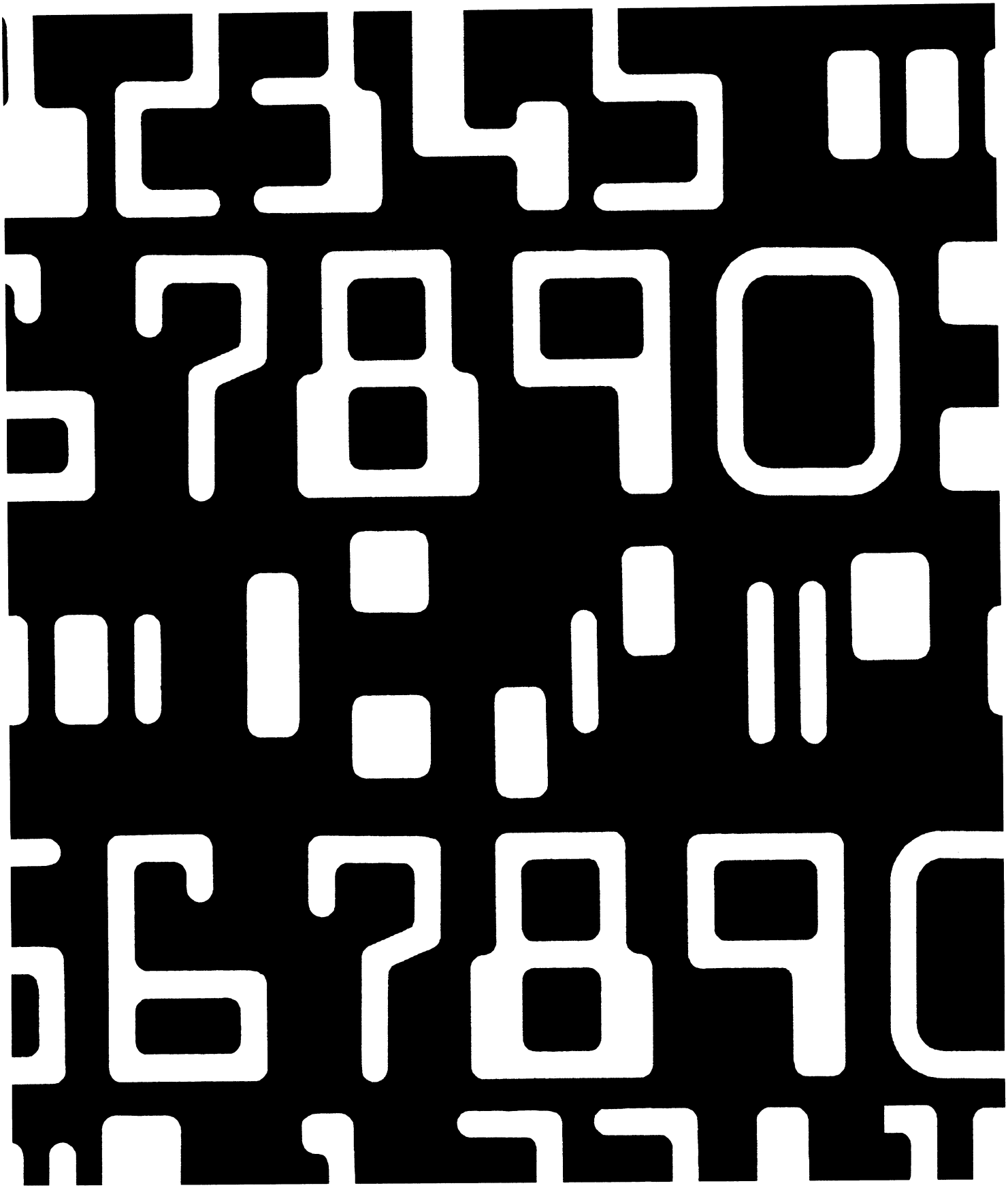
Design Quarterly 62

SIGNS AND SYMBOLS IN GRAPHIC COMMUNICATION

Walker Art Center Minneapolis, Minnesota



Signs and Symbols in Graphic Communication

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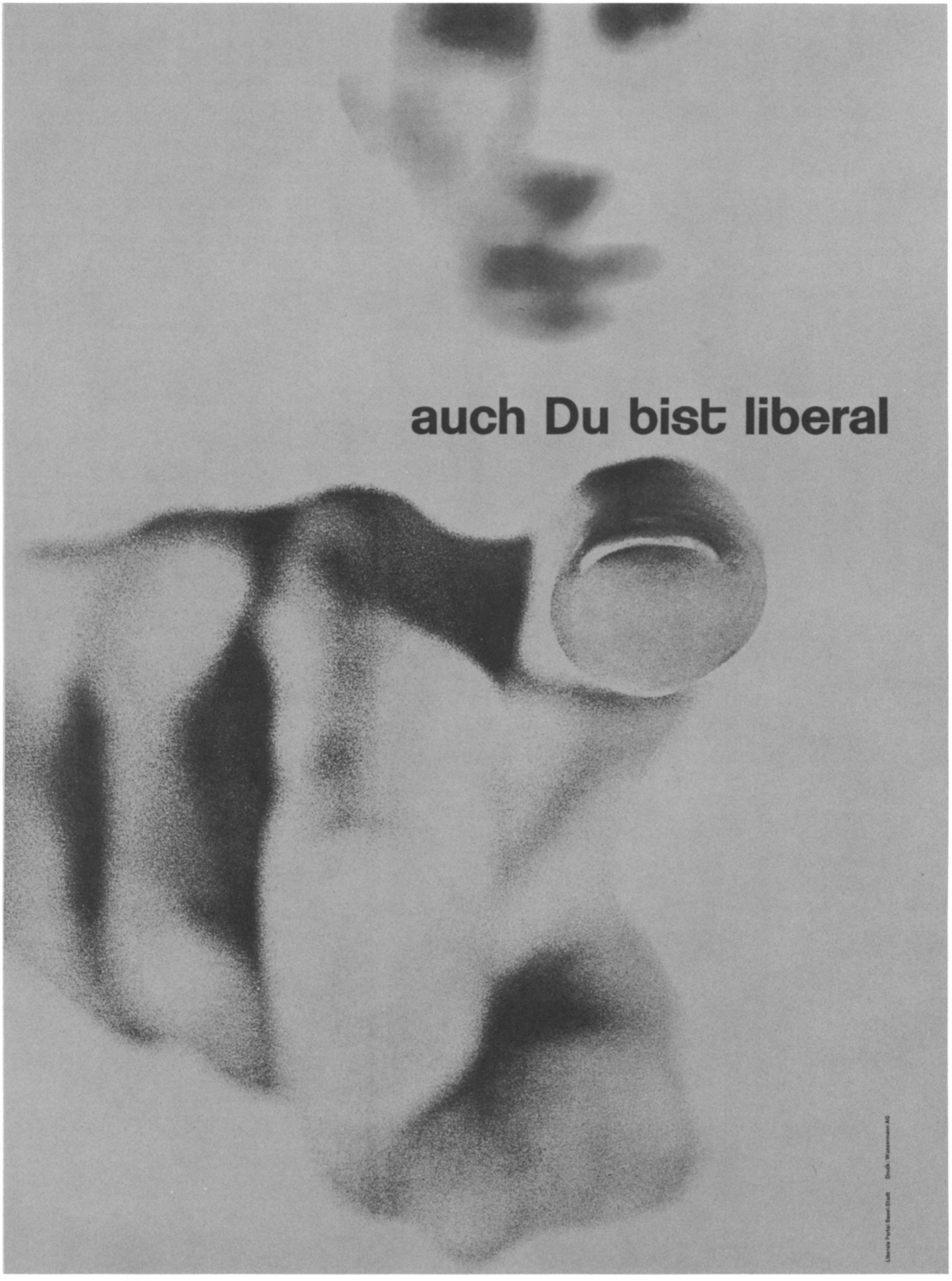
We strongly depend on a complex of symbols in the conduct of daily life. In our midst are the visual cues of traffic signs, advertising, film and television — the insignia and media of visual communication. We trust signs and follow the arrow unhesitatingly. But if these signs and symbols are to guide and inform, they must be clear and unequivocal for all.

Effective graphic communication should leave no room for different interpretations. Its function is to communicate a message in the most effective, direct way. Thus in graphic communication, the application of signs and symbols has become increasingly important. For example, universally understood symbols have been developed for such purposes as traffic regulations. For the recent Tokyo Olympics a pictographic vocabulary was designed to indicate events and services.

Such graphic communication which transcends traditional language barriers has an important place in education and technology. Graphic designers, conversant with the principles of Gestalt psychology and the theory of perception, can develop signs and sign systems for application in many areas. For instance, data processing machines demand the redesign of our whole numerical and alphabetical system; complicated technical instruments exported to foreign countries need elaborate sign systems which can be easily learned by any operator, regardless of his language.

In this issue of Design Quarterly Dr. Martin Krampen, designer and psychologist, University of Waterloo, Canada, presents an illustrated account of theoretical and experimental work in graphic communication in recent years. Considering the scope and sociological potential of graphic design, it is surprising that the theoretical study of visual communication is not very advanced and that graphic communication is not yet a cohesive field of study. Graphic communication techniques and methods are largely empirical; no available textbooks indicate principles or methods of approaching difficult problems. While experiments have been made on the relative legibility of typefaces and the viewer's comprehension of graphs and tables, we know virtually nothing about the effectiveness of a layout. No terminology presently exists to describe and relate all the elements and factors in graphic communication.

This issue of Design Quarterly, indeed, cannot present an absolutely complete theory of graphic and visual communication. Perhaps, however, it will be useful in establishing a workable terminology, and that it will clarify the uses and advantages of pictorial signs and symbols for the designer and his interested public. P.S.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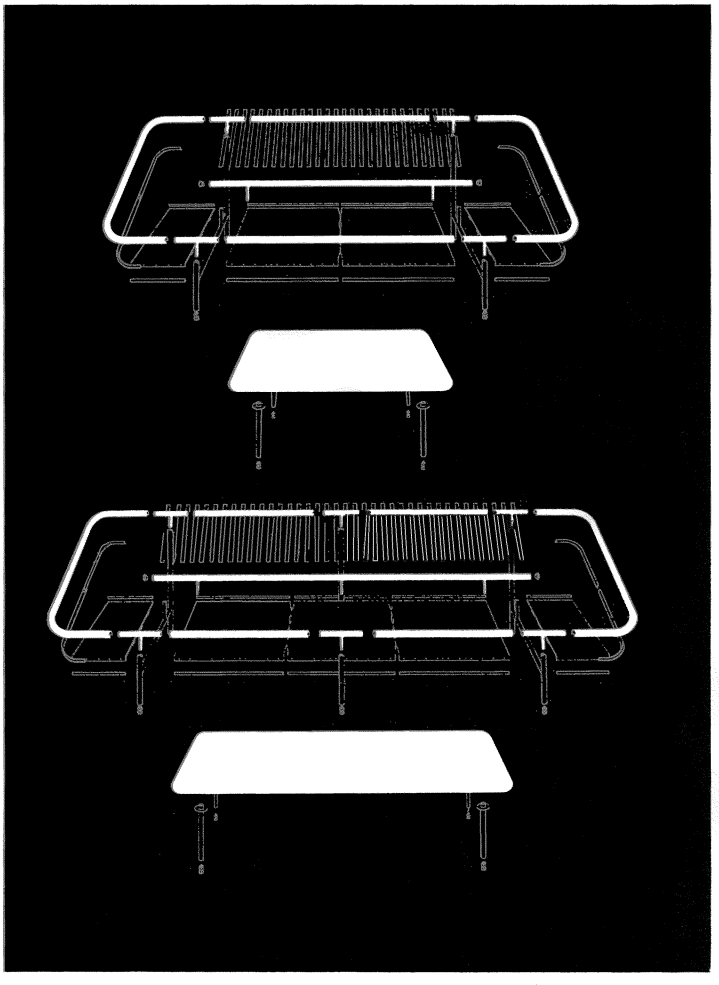
Visual communication is more widespread than ever. Pictorial signs are used, for example, to teach language to children, to communicate helpful information across language barriers to people in underdeveloped countries, and to persuade the sophisticated urbanite to choose brand X rather than brand Y. The basic question for the graphic designer is always when and how to use pictures in preference to words. As we shall see, the old saying that one picture is worth a thousand words is often completely untrue. Moreover, once a decision has been reached to use pictorial signs or symbols, the design itself becomes a problem. How much detail should a pictograph contain? What graphic technique should be used for a new symbol? Is the symbol "strong" enough to communicate in the presence of distracting "visual noise?" The answers to these questions can help the graphic designer improve visual communication.

Information and Persuasion by Graphic Communication

In the following pages an attempt will be made to summarize some of the theoretical and experimental work in visual and graphic communication that has been done within the last decade. Any such discussion must begin by acknowledging the basic function of graphic communication, which is the same as that of all human communication, i. e., the desire of the "source" (or sender) to influence a "receiver." This attempt to influence or change the state of the receiver takes two broad forms. The communicator attempts to change either the receiver's cognition (by increasing his knowledge, vocabulary, skills, etc.) or the receiver's attitudes (by increasing his preference for, or by decreasing his prejudices against some object, person, or group). Often both functions come into play together, as when a person's attitude toward some subject must be changed before his knowledge in this area can be increased.

The process in which the source attempts to shape (or increase) the *state of knowledge* of a receiver we may call *information.* The process in which the source attempts to shape or change the *attitudinal state* of the receiver may be called *persuasion.*

To relate these terms to the field of design a designer communicates *information* when he visualizes how an object is assembled or how components of that object can be identified. But when the designer attempts to change people's minds, for example about political ideas, he engages in *persuasion.*



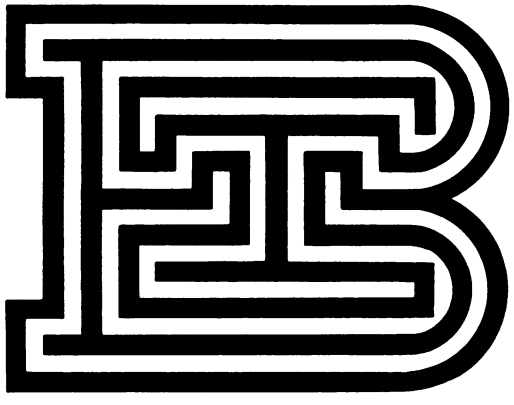
Informative communication: Exploded drawing of sling sofa designed by George Nelson and Co., Inc. (Manufactured by Herman Miller, Inc.)

Left:
Persuasive communication: Election poster designed by Karl Gerstner, Basel

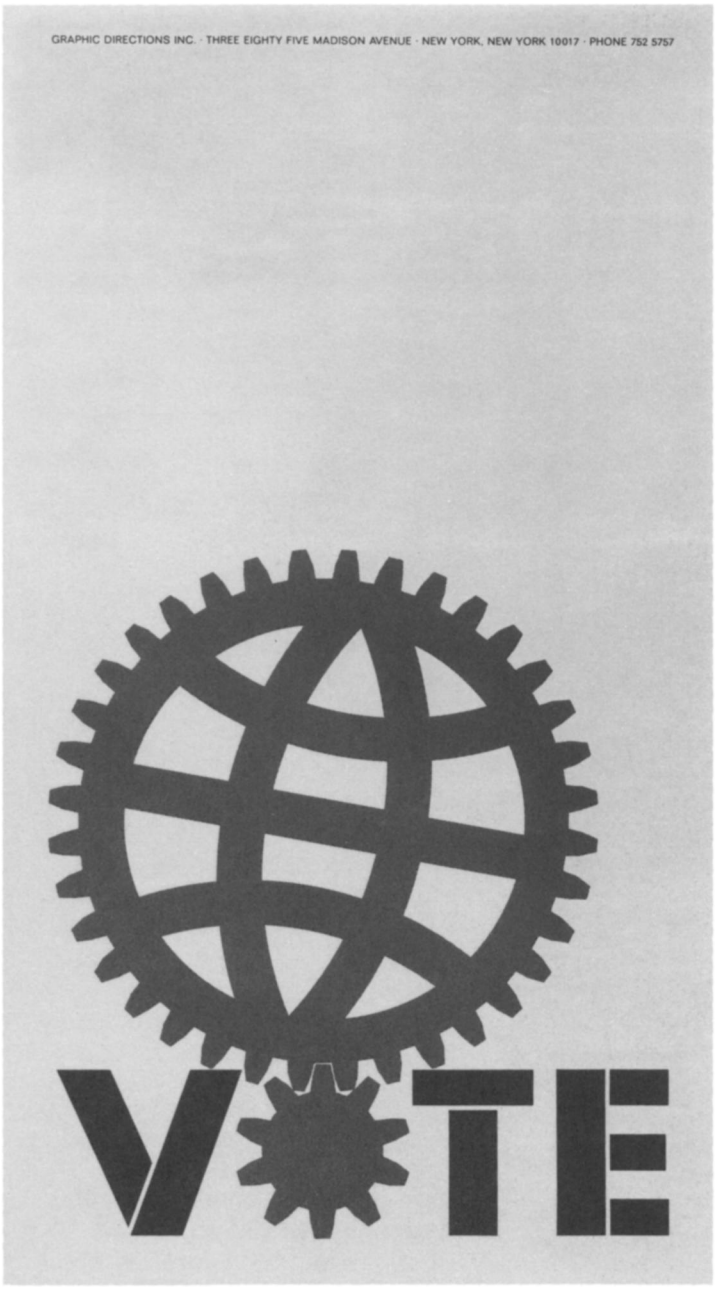
weniger Lärm

Visual Communication, then, can be seen as an attempt to inform or persuade, aimed primarily at the eye of the receiver. Graphic communication is one kind of visual communication which can be classified in terms of the following techniques:

1) Photographics = Photography: the use of light sensitive surfaces, optical systems, and reflected light.
2) Hand-graphics = Painting, drawing, drafting, etc.
3) Typographics = Printing, typography.



Center:
Typographic technique: Symbol for Bank (BT) designed by Norman Ives

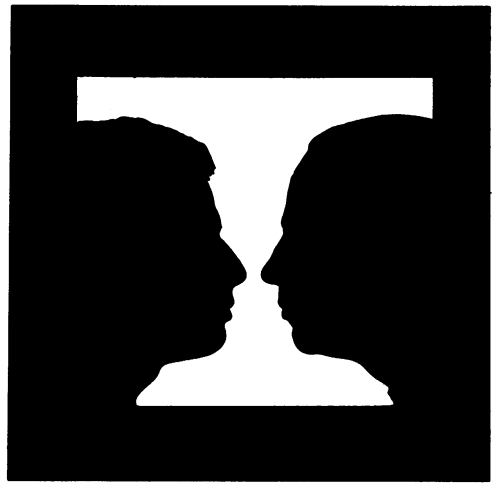


Left:
Photographic technique: Poster designed by J. Müller-Brockmann, Zürich. "Less Noise"

Hand-graphic technique: "VOTE" Self-advertisement by Roger Cook for Graphic Direction, Inc., N.Y.

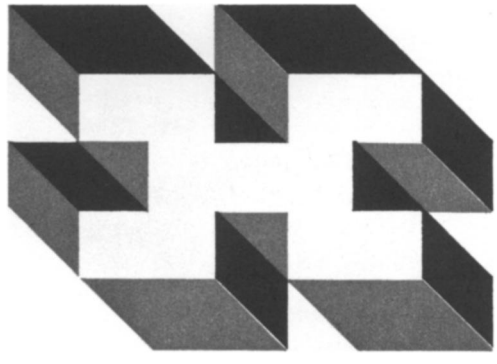
The Theoretical Study of Graphic Communication

If communications, and especially graphic communications, are ever to be grounded in scientific principles, they must draw their knowledge from other areas. Contributions to a more systematic understanding of graphic communication have come, in fact, from such different disciplines as aesthetics, philosophy, linguistics and psychology. On the whole, we will focus our attention mostly on empirical findings in these various disciplines in order to help the designer analyze his task and make predictions about audience reaction on the basis of sound assumptions. Many decisions in graphic communication have to be made on the basis of informal experience or "educated guessing." Even in those cases, essentially the designer is always making predictions about changes in his audience and applying them in his analysis. To improve these predictions, he must know something of the theory underlying perception and communication.

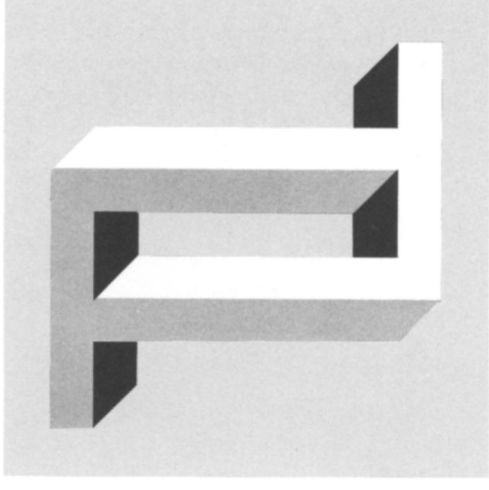


Graphic Communication and Perception

Perceptual psychology helps us lay the theoretical groundwork by telling us what causes the perceiver to see the graphic forms as a recognizable figure, distinct from its background. Thus we learn that the boundary or contour of the figure is of paramount importance. Such boundaries or edges of both objects in space and silhouettes or outlines on paper have one important feature in common: at these edges, a more or less abrupt change in luminosity takes place. That is, each time our eyes are confronted with a sufficiently sharp break in luminosity, we tend to see the edge or boundary of a surface. This mechanism of perception is the reason that silhouettes and outline drawings can function as substitutes for three-dimensional arrangements.



Most edges that function as object boundaries refer only to one surface in one direction at a time. An exception is the so-called "reversible figure" in which figure and ground appear to alternate as one inspects the picture. Two edges moving in opposite directions in a sign will form contradictory perceptions, as in the so-called "impossible objects."



Top:
Reversible figure: Trademark for Gottschalk & Krampen, Design Studio

Center:
Impossible objects: Trademark H designed by Norman Ives

Right:
Impossible objects: Trademark for Conference on Planning and Design, designed by M. Krampen

In visual communication, knowingly or unknowingly, the designer is constantly predicting what edge will be perceived as belonging to what surface. This is not always a matter of knowing which shape is the more familiar; for in the reversible figure, the viewer is familiar with the shape of a vase as well as with the shape of faces. It is rather the entire configuration or organization of the picture (the "Gestalt") that determines what will be perceived as figure and what as ground.

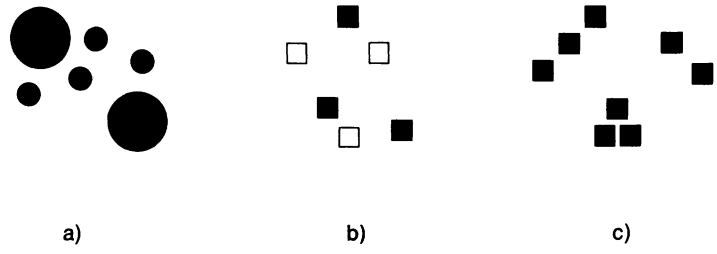
The Gestalt theory of perception suggested in its laws of grouping a set of rules for visual communication. For instance, forms that show *similarity* of shape, proximity, or color will be seen as grouped. Another Gestalt principle is the law of *simplicity:* where more than one organization can be perceived, the simplest alternative will be seen. Besides the law of similarity of shape, proximity, and color there are of course the laws of continuity, closure, and Prägnanz (balance or organization) of form. Recent attempts to link the Gestalt conception with the concept of "redundancy" in information theory have suggested that the good Gestalt requires relatively little information to predict or define.

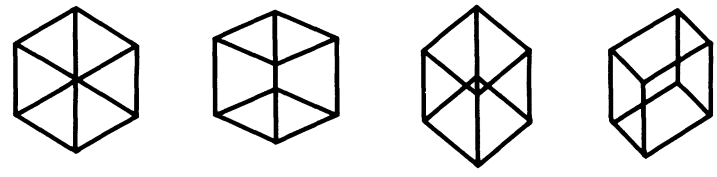
Another relevant question on which we have some answers is: Why are some two-dimensional figures (the so-called "ambiguous figures") perceived as solid or three-dimensional? The degree to which a pattern of lines on a paper is perceived in a solid rather than flat form is proportional to its asymmetry and complexity: The more different sizes of angle and different lengths of line a flat pattern contains, the more complex it becomes, and the more readily it will be perceived as a solid.

Progressing from outline drawings to more complex graphic material, we find that most pictures and virtually all photographs function as substitutes for solid voluminous objects and real scenes. What optic features produced by scenes of solid objects can now be also produced by the dappled surface of a half-tone picture? Shading is clearly one of the most important depth-enhancing properties of real objects and their pictorial representations. Objects in the environment are always found in different positions with respect to natural or artificial sources of illumination. They will thus exhibit shading on their surfaces and will cast shadows.

Another depth cue available in half-tone reproduction is the texture gradient. For example, when we stand in front of a plowed field, we see the texture of earth

Illustrations of the Gestalt law of similarity: a) size, b) color, c) proximity





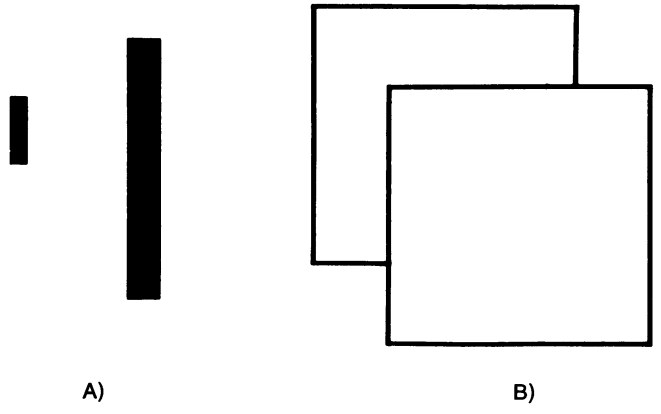
Ambiguous figures: As asymmetry and complexity increase (left to right), figures are more readily perceived as three-dimensional

clods – coarse in the foreground where the distance from the eye is short, and apparently becoming finer and finer as the distance increases. This gradient of texture density we interpret as "depth." Texture gradients characterize the spatial arrangement of all surfaces and provide us with information on what is far away (fine texture) and what is close (coarse texture) and therefore about the relative sizes of objects.

Additional important depth cues which can be artificially produced in surrogates include size (larger objects appear nearer), overlay, and linear perspective. Most of these cues were, in fact, used intuitively by artists long before the theory was spelled out by the artists themselves or by perceptual theorists.



Texture gradient – Larger objects appear to be close, smaller objects distant

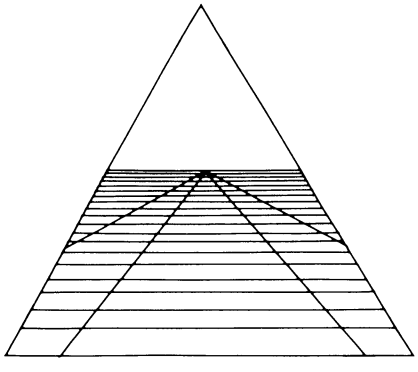


Spatial cue: A) Size: Discrimination of depth in physical space and of the relative distance of objects depends on the relative size of the objects. The larger object is generally perceived as the closer one.

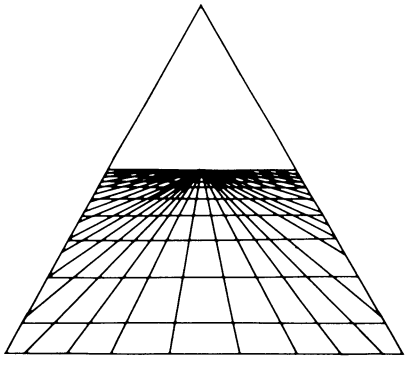
Spatial cue: B) Overlay: Discrimination of depth in physical space and of the relative distance of objects depends on which object overlaps. The overlapping object is perceived as closer than the overlapped one.

Only recently the texture gradient theory of space perception[1] has been applied to the design of aircraft display panels. Pilots were observed to be better at judging the attitude and altitude of their aircraft by means of a pictorial indicator than a numerical indicator; the so-called "contact analogue" indicator computes the position of an aircraft with respect to the ground surface and displays the results in terms of texture gradients similar to those a pilot would actually perceive if he looked out of his window. The advantage of contact analogues, especially in blind flight, seem obvious.[2]

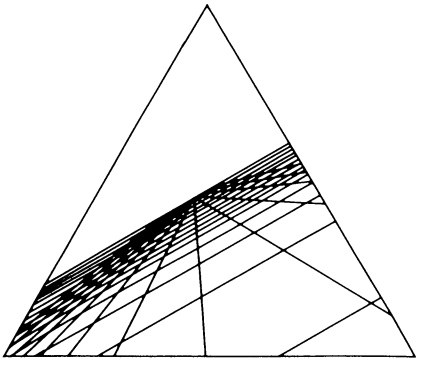
Below:
Representation of various aircraft attitudes and altitudes by means of the contact analogue. (From Aid and Suskind, 1. Reprinted from Electronic Industries, A Chilton Publication, July, 1958)



Low Altitude



High Altitude



Right Bank

Graphic Communication and Semantics

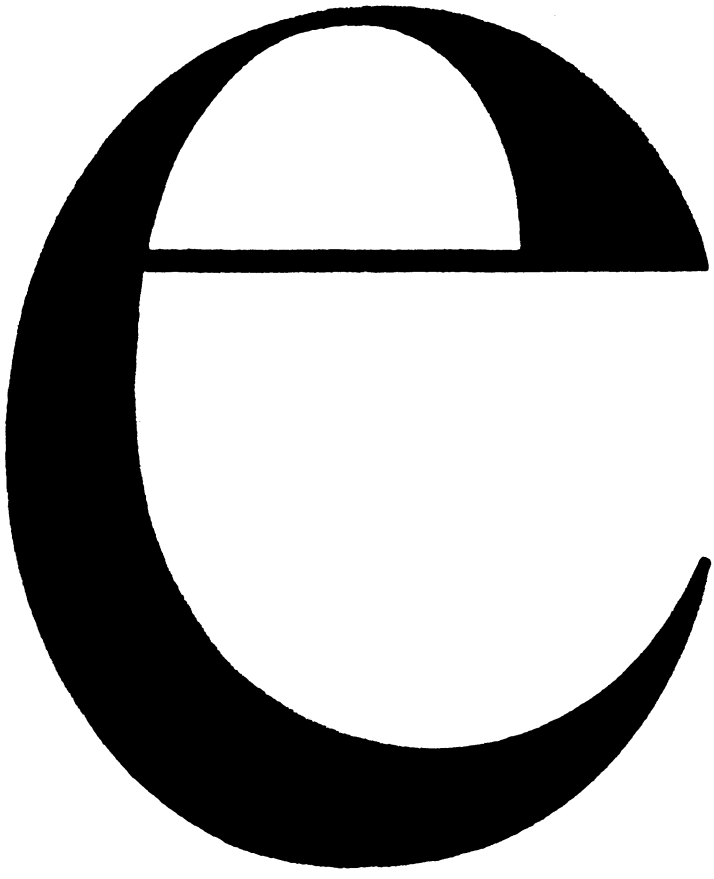
We turn from psychology to philosophy, which has contributed to graphic communications through its branch of semantics or semiotics, and particularly through analysis of the terminology applied to communication. Thus, for example, the philosopher C. W. Morris, in his *Signs, Language and Behaviour* (1946), has attempted to construct a vocabulary of meaning and communication. Such a common vocabulary is necessary in order for the various disciplines to discourse intelligently about graphic communication. Primary is the distinction Morris makes between *signs* and *symbols*.

Signs in graphic communication

When a street curve is depicted graphically on a traffic sign, the motorist's driving behavior is affected before he has actually reached the street curve: he slows down and gets ready to negotiate the curve efficiently. This example illuminates Morris's definition of a sign as a stimulus that stands for another stimulus not present at the moment. In this case the sign-stimulus (the highway sign) stands for the absent stimulus of the actual highway curve; the sign-stimulus affects the behavior (slowing down) of its interpreter (motorist) by virtue of its relation to the absent stimulus (anticipation of the danger related to highway curves).

How and to what extent a graphic sign affects the behavior of its perceiver has been subject of much controversy. Obviously the perceiver of a graphic representation of fire does not respond to the graphic sign as he would respond to the fire itself – i.e., by running away or attempting to douse the flame. But some component of his reaction to the sign may be similar to his reaction to the real thing. The difficulty in psychology so far has been to account in a single theory for the whole spectrum of reactions to graphic signs.

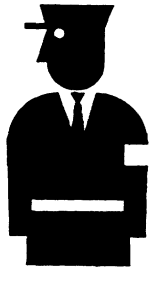
Consider the following three signs: the letter "e," the silhouette of a man, and a dollar sign. They are obviously different and we must be able to label them differently if we want to distinguish them. When we write an "e" or any other letter, we produce a particular kind of graphic sign called a "phonogram" which takes the dimension of speech-sound into account. On the other hand, the silhouette of the man and the dollar sign do not stand for speech sounds; they form a class of their own, called "logograms." Since logograms are independent of speech sounds, they have the important property of communicating across language

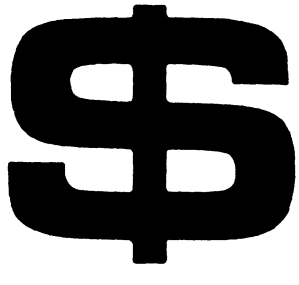


Top:
Phonogram: Roman "e," Caslon Old Style

Below left:
Pictograph for guard sign system for Tokyo Olympics

Below right:
Diagram: Dollar sign, arbitrary symbol

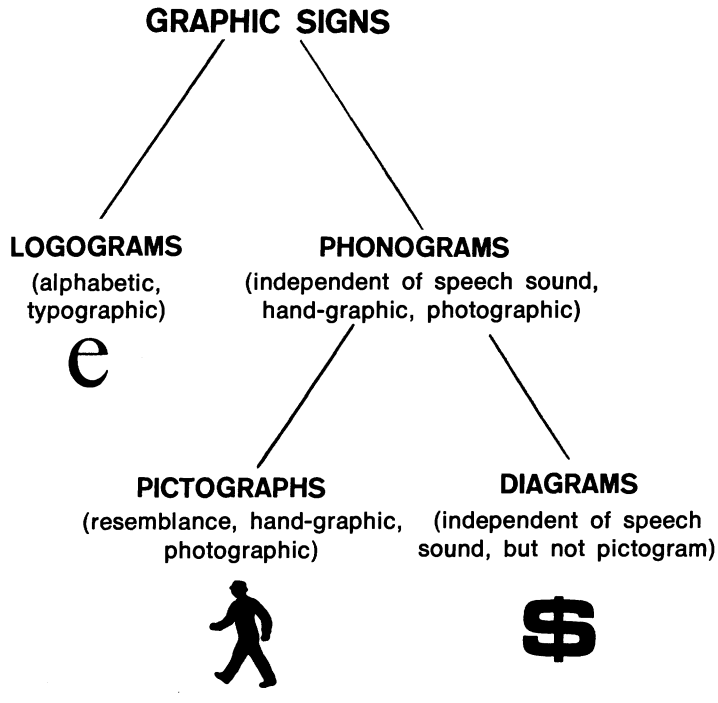




Indirect symbol: Royal Bank of Canada, Trademark design by Lippincott & Margulies, Inc.



barriers. There are, however, obvious differences between the silhouette of the man and the dollar sign. The silhouette of the man refers to the "real object" by *resemblance* and is called a "pictograph" while the dollar sign, also independent of speech-sound, but not iconic, belongs in the class of diagrams (see chart).

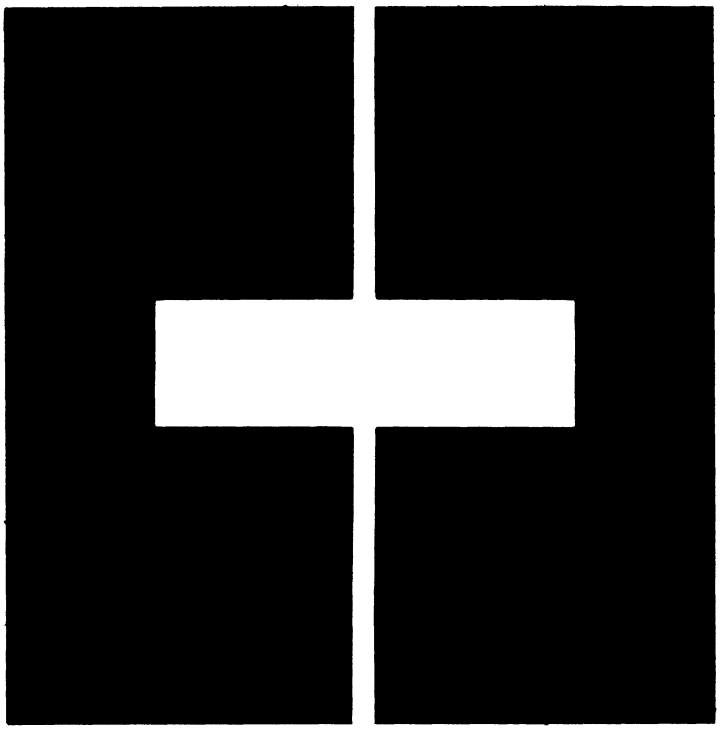




Direct symbol: One of the earliest pictographic suggestions for a traffic sign, 1923.

Symbols in graphic communication

There is a further crucial distinction between graphic signs. When a political cartoonist portrays the Republican party as an elephant, or the British Empire as a lion, he makes use of pictographs. But there is a difference here between the pictograph of a silhouette of a man and the pictographs of the elephant as used in our example. The pictograph of the elephant stands for an animal which in turn stands for a political party. (Similarly, the lion stands for an animal which stands for the British Empire.) Furthermore it can be classified more exactly as an "indirect symbol" – a sign that is substituted for an object (elephant) which in turn stands "indirectly" for another object (Republican party). There are also direct symbols: When we use the pictograph of a snail to symbolize "slowness," we refer directly to a property of the snail, and not



Pictograph by R. Modley

indirectly to another object. Such a graphic sign is a "direct symbol."

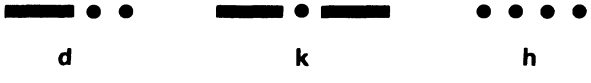
Everyone who has observed a snail knows that it is slow. But a snail is also defensive, slimy, etc. A pictograph of a snail would thus not necessarily suggest slowness to all receivers. When a symbolism is not collectively established, we talk about "quasi-symbols."

A true symbol is (unlike a quasi-symbol) well established within a given culture or society (e.g., the Republican elephant or British lion). When a symbol is universally understood within a culture, when it is so rigidly conventionalized as to be indistinguishable from the thing symbolized, we can refer to it as an "emblem." Thus most people in our culture are not even aware of the fact that there is a triple relationship between the pictogram cross, Roman instrument for death penalty, and Christianity. The cross has totally assumed the "meaning" of Christianity. Among quasi-symbols, symbols, and emblems, the latter are least likely to be misunderstood but are therefore "redundant," conveying very little new information.

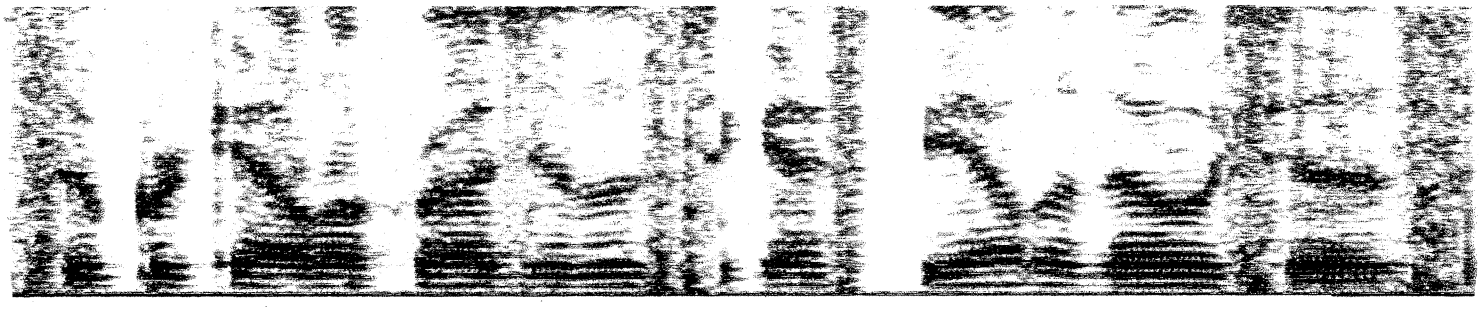
The designer should use indirect symbols only when he is sure that his audience is familiar with the indirect relationship depicted. Similarly, direct symbols are more effective when a universally known property of an object is universally symbolized by the object.

In ordinary speech, the term "signal" is often used interchangeably with "sign" or "symbol." But in the lexicon of graphic communication, "signal" has a very precise and technical meaning. It refers to an energy state transmitted from one physical system to another – as when the opening or closing of an electric circuit produces sound signals of varying durations. Signals can become "carriers" for signs, as the example of the telegraph or the sound spectrograph demonstrates.

Signals: Morse Code



Signals: Sound spectograph of human voice (courtesy University of Minnesota)

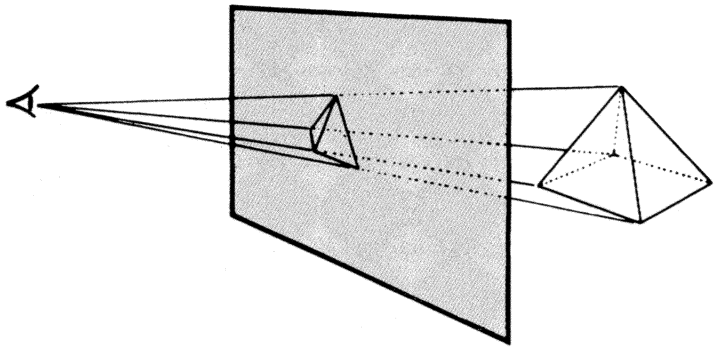


T R E E

Conventional surrogate for the object "Tree"



Mixed surrogate: Japanese picture writing: "Tree"



Non-conventional surrogate for an object by "projection" or resemblance

Surrogates in graphic communication

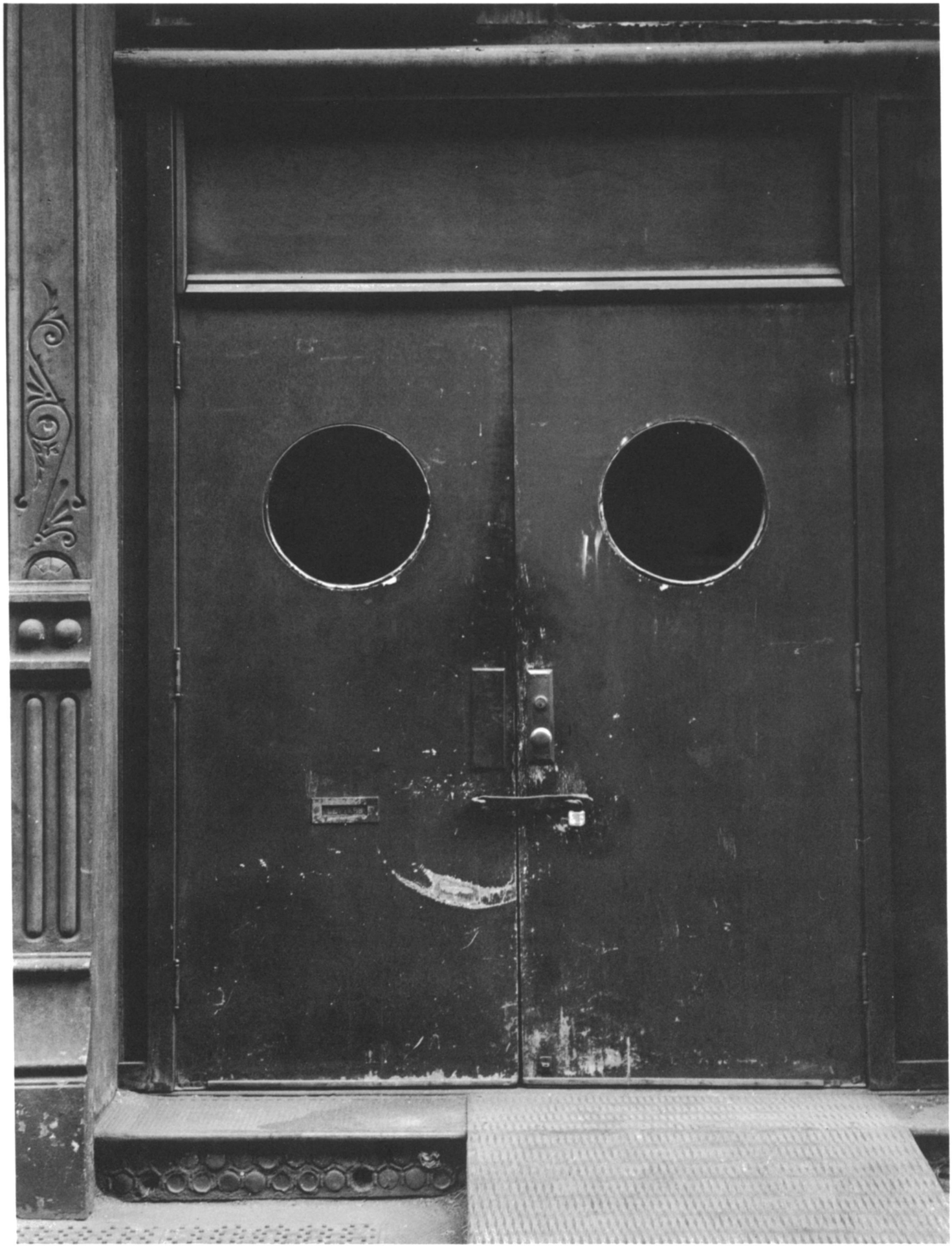
The terminology of Morris and the semiotic school has been criticized because the term "sign" is felt to be too broad to delineate the field of communication.[3] While pictorial communication is obviously different from verbal communication, they are alike in presenting us with substitutes for the communicator's direct experience. Thus, a writer uses words to make readers see, hear, and feel indirectly what he has experienced directly as feelings and sensations. Such a substitute or "surrogate" is defined as "a stimulus produced by another individual which is relatively specific to some object, place, or event not at present affecting the sense organs of the perceiving individual." The arbitrary linking of object and surrogate may become an accepted convention among a group of people. For example, the letters "T," "R," "E," "E" are for all users of English an acknowledged surrogate for the object tree. This type of surrogate is called "conventional." If a surrogate corresponds to an object by "projection," it then becomes a "non-conventional" or visual surrogate. For example: If a sheet of glass is placed in front of a tree, the outline of the tree can be traced on the glass and we may perceive it as a surrogate for the object tree. "Mixed" surrogates are specific to their referents partly by virtue of convention and partly by virtue of "resemblance." Japanese and Chinese picture writing are good examples of such mixed surrogates, depending both on convention and on pictographic fidelity.

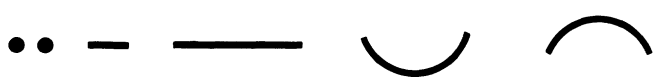
Graphic communication and pictic analysis

The discipline of linguistics defines and analyzes various levels of language structure. The basic differential unit in linguistics, the sound element of every language, is a "phoneme" (e.g., "p," "b"). Two or more phonemes may be combined to produce morphemes, the meaning elements of a language (e.g., pat, bat).

In the area of nonverbal communications, a terminology for body movements and gestures has been developed which parallels the various levels of linguistics.[4] More recently the same approach has been extended to graphic communication via so-called "pictic analysis."[5] The basic element of such analysis is the "pict," a dot, line or other visual units (cf. phonemes). Picts can be combined into "pictoforms," such as circles, rectangles, and triangles. A combination of picts and pictoforms can wake a denotative meaning response in the perceiver (a circular pictoform including two dot picts above a line pict may be labeled "a face").

Right:
Pictoforms in a photograph suggesting a human face





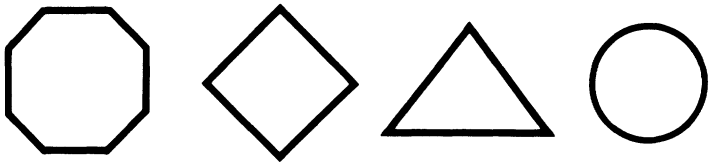
Picts: Dots and lines, the basic units of pictic analysis

Such a combination, called a "picto-morph" (cf. the linguistic morpheme) is capable of meaningfully representing an object.

These pictomorphs combine on a higher level into "picto-phrases," and on the next higher level, into "pictures." "Picture layouts" combine pictures in a spatial context (as, for instance, on a magazine page) and "picture sequences" combine pictures in a temporal context (as, for instance, in a film).

Up to the present, pictic analysis has been applied only to sketching the rudiments of a vocabulary and a grammar for the pictorial code of facial expressions. Since this type of analysis is very new, its possible consequences for a better understanding of graphic communications are difficult to estimate.

Pictoforms: Picts combined to make pictoforms



Special Problems Imposed by the Audience

Communication with Mass Audiences of Low Literacy

We proceed now from the theory to the practice, or technology, of pictorial communications, considering particularly the problems in informing and persuading people. Suppose one were to try to show a foreign rural population how to improve its health and farming practices, how would one proceed? To distribute printed literature would be useless. Unless a large staff trained in the language of the audience were available or unless the people could be exposed to mass media (such as radio and television), the only communication possible is through pictures.

The advantage of using pictorial signs in such a situation is self-evident, but what are its limitations? Some answers have been provided by research on the educational effectiveness of pictorial material used in South America in the 1950's.[6] These studies suggest that illustrations as such *have no educational value unless their content relates to the past experience of the intended audience.* When illustrations are used to communicate specific ideas, they will be more effective if the number of objects and actions that must be perceived is kept to a minimum. All objects and actions should be depicted realistically and should not allow secondary (symbolic) interpretation. Realistic color can add to illustrations as an attention-getter, and captions should be used to extend the meaning of the picture rather than to explain it. Thus, *simplicity* and *realism* seem to be the keys to effective pictorial communication with an audience of low literacy.



Pictomorphs: Pictoforms in a relationship suggesting the human face

Another study conducted in rural Brazil suggests why simplicity and realism are so important. The ability to interpret pictorial symbols was found to be a learned skill that has much in common with the ability to interpret verbal symbols. Age and education seemed to be the main variables affecting the ability to understand pictorial symbols. Younger people (with lack of "life experience") and illiterates were clearly inferior in picture comprehension.[7] More particularly, the selection of detail was most important in making pictorial symbols more comprehensible for younger people of limited schooling. Either extreme – inclusion of unnecessary detail or deletion of important detail – reduces comprehension. Imaginative treatment lessens picture comprehension because pictures are interpreted literally by people with limited education.* The comprehension of pictorial arrangements which have symbolic meaning demand greater capacity for abstraction. Similarly, processes or ideas requiring serial interpretation or pictures not directly related to the daily experience of the viewer are difficult to comprehend.

The study therefore recommends bold and clear designs containing only the necessary details and a minimum of artistic interpretation. Elements that are part of the past experience of an audience can be used by the designer as cues in introducing a new objects, since they enable the audience to relate the new object to experienced circumstances. Arbitrary symbols (diagrams such as the dollar sign) are to be avoided because they obviously depend on prior learning.

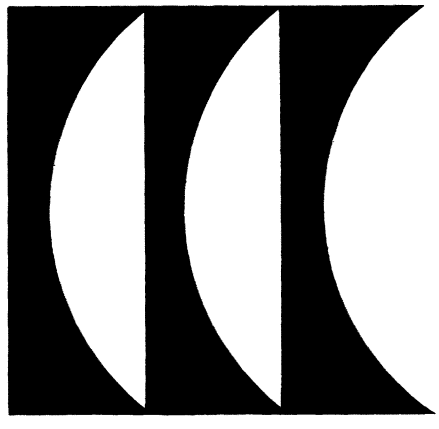
For the design of pictorial signs used in communication with such mass audiences of low literacy (including the design of trade-marks for products with vast distribution), the designer should follow the rule of "simplified realism." One might profitably start from silhouette photographs of objects, perhaps printed with strong contrasts, and then by subtraction (blanking out of unnecessary detail) obtain silhouette pictographs.

*One may ask, parenthetically, why certain preliterate groups should have difficulties recognizing photographs of family members or friends. Surely, they have had experience with these people. One answer appears to be that they have not had the necessary experience in dealing with the reduced scale presented by the photograph. As far as scale is concerned, a small photograph of a person is, in fact, a better "surrogate" for a realistic miniature figurine than for a full-size person.

Communication with Sophisticated Audiences: The Rhetoric of Visual Communication

It is obvious that the symbolic meaning of pictures is seldom understood cross-culturally or by audiences with low education. However, if the graphic designer has to persuade a sophisticated urban audience with high average education, he may have to use a more subtle approach than simplified realism. He is, in fact somewhat like the poet or the ancient expert in rhetoric, whose oratory was both a tool of persuasion and a source of aesthetic enjoyment for the audience. A complete study of the relationship between rhetoric and visual communication is still lacking, but there is growing evidence that graphic persuasion and rhetoric call on common underlying mediational processes.[8] Some of the traditional rheotorical "tricks" apply surprisingly well in graphic communication.

Substitution: Section of lens, symbol for a Camera Club, designed by Husaku Kamekura



Thus if a graphic designer represents a photographic organization in a trade-mark by a section through a set of lenses, he uses the classical rhetorical figure of *metonymy* (substitution of cause for effect, sign for thing signified, etc.). Examples of visual *metonymy* abound in advertising design. The effectiveness of metonymic symbolism will depend on the degree of popular understanding of the relation between the substitute and the object for which it stands. Similarly, to convey the idea of a chess game, the graphic designer need not represent the twice 16 pieces of which the game is made up. Audiences may, in fact, find it more challenging to fill in the missing figures mentally, when the designer uses the equivalent of the rhetorical figure of *synecdoche* (or use of a part for the whole) by supplying only the picture of the castle or the queen.

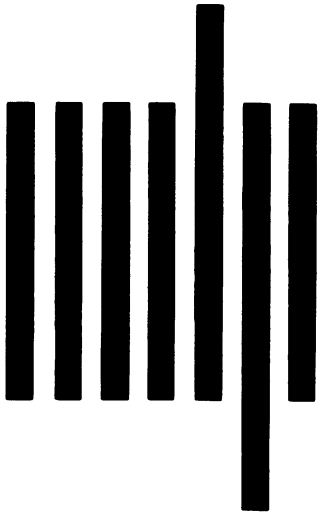
Caricatures are the visual equivalents of rhetorical *hyperbole* (exaggeration). The value of exaggeration in visual information and persuasion is that it highlights those features of an object or a situation that the communicator thinks are most important for a particular audience. For example, during the second World War, it was found that distortions exaggerating the unique or characteristic features of a given type of airplane improved its correct identification.



Hyperbole (exaggeration): Large sailboat made to fit into small Volkswagen Bus. Volkswagen advertisement by Doyle, Dane, Bernbach, Inc. (L. Sirowitz, B. Levenson, designers)

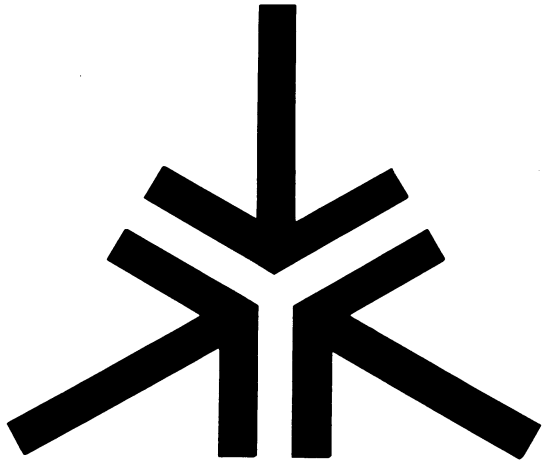
Another effective attention-getter is the yoking together of customarily unrelated material (the rhetorical device of *zeugma).* A picture of a dog's body with an elephant's head causes the perceiver to look at least twice. This visual use of *zeugma* has characterized both surrealist paintings and, more subtly, many advertising designs. A somewhat related technique, rhetorical

Fusion of object and letter forms: Trademark for Massachusetts Institute of Technology Press designed by Muriel Cooper.



fusion or amalgamation, is illustrated in trade-mark designs that combine object forms with letter forms.

Not all rhetorical devices can be translated into visual equivalents. Nevertheless, a careful study of classical rhetoric could lead to a catalogue of rhetorical devices that are capable of visual duplication. With all these devices the designer must remember that their effective use is confined to one particular culture, and perhaps even to a limited audience of high literacy within that culture.



Fusion of object and letter forms: Symbol for Yorkdale Shopping Center, designed by Page Graphics;

Communication with Many Language Groups Simultaneously: Conventionalized Picture Languages

Since the industrial revolution, the necessity to communicate across language barriers has constantly increased, new means of transportation have increased the frequency and ease of international travel. Organizations such as the United Nations, and international gatherings like the World's Fairs and Olympic Games pose special communications problems. Attempts to create international languages such as Esperanto, have so far proved unsuccessful. Pictorial signs would appear to be more effective vehicles, but they too require the conventionalizing of nonconventional surrogates. Conventionalization in such a case means literally that representatives of various societies or nations must meet and mutually agree on the form of a pictorial sign system which then becomes internationally adopted.

An illustrative case history: the international road sign code

The study of the development of international sign systems reveals that this conventionalization of sign systems seems generally to have followed a certain "rhythm":

a) Environmental problems arise, produced by technological or other developments.

b) Signs or symbols are created, often anonymously and tentatively, to communicate about these problems.

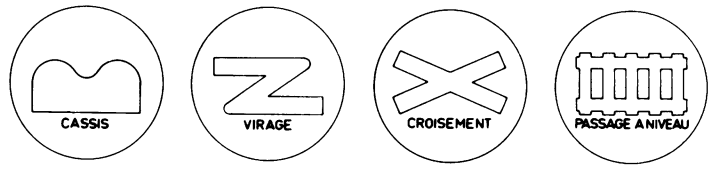
c) These signs or symbols are modified or corrected by collective experience.

d) The modified versions are finally conventionalized.

e) As new problems appear the sign code is further amplified, modified, corrected, and so on.

As we all know, the invention of the automobile had widespread consequences. It changed man's relationship to his environment. The old network of roads became quickly dangerous and obsolete. New highways had to be constructed, and gradually many of these highways, in turn, became dangerous and obsolete. Man had to communicate internationally about the dangers of his highways, about traffic regulations, and about directions and services.

The earliest road signs describing the dangerous traffic conditions of the time were installed by Automobile Clubs at the turn of the century. In Europe, as early as



The earliest danger signs, conventionalized in 1909

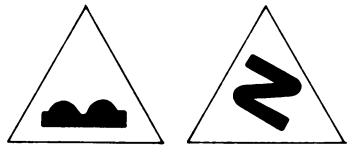
1909, four road signs, depicting typical road dangers of that time, were conventionalized at an international congress held in Paris. The convention was then ratified by most of Europe. Because these early road signs had been installed by private organizations with the help of commercial sponsors (such as automobile and tire manufacturers, etc.), the signs became increasingly cluttered with advertisements. Verbal signs, which could be read only by those who understood the national language, abounded. The second inter-

Fiat advertising incorporated in danger sign, installed by Touring Club Italiano

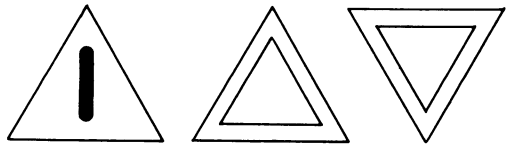


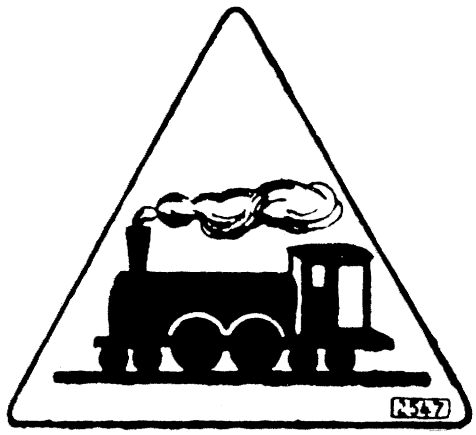
national convention on road signs held in Paris in 1926, recognizing the problem of verbal signs, introduced two pictorial symbols (one for *curve* and the other for *uneven pavement)* and adopted the triangular shape as a general danger sign for the international code.

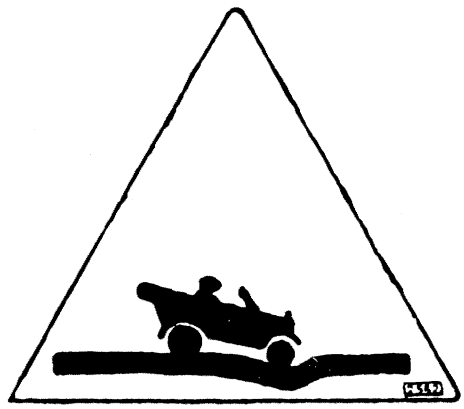
First two pictorial symbols, conventionalized 1926.

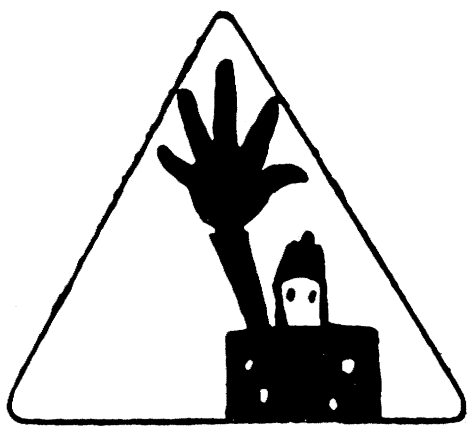


Triangular shape approved to signify all danger situations, 1926







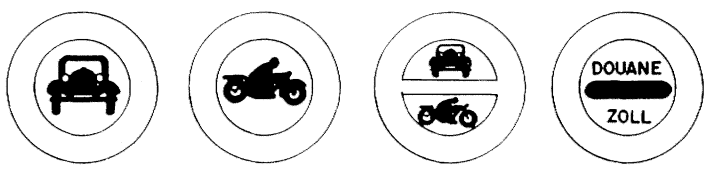




Meanwhile, traffic problems within cities required an additional group of regulatory signs. The Traffic Committee of the League of Nations proposed a set of such regulatory signs in 1928, and by 1931, a conference in Geneva had adopted a "Convention for the Unification of Road Signs," containing regulatory signs for city traffic. Since the Paris convention in 1926, the number of internationally recognized road signs had risen from six to twenty-six. Shortly before the second World War, in 1939, a committee of the League of Nations proposed a further amplification of the existing code. But it was not until after the second World War that the United Nations prepared a new "Protocol on Road Signs," which was finally adopted in 1949 in Geneva. The number of traffic signs since the 1931 convention had increased to more than fifty.
In 1950 the United Nations nominated a group of experts to prepare a draft convention for a worldwide roadsign system, taking account of the fact that three independent systems had already developed: the European, the Pan-American, and the African. (The Pan-American system[9] is largely based on verbal messages and the familiar diamond shape. The African system[10] is derived from the British system which split off from the continental tradition in the late twenties).

The expert group selected four typical danger signs of the same "meaning," using their respective version in each of the three systems including two color variations. The 24 experimental road signs were tested in various countries of various continents. The combination of black sign on yellow background was found to give superior visibility under most conditions. Angular shapes appeared to be more visible than round shapes. Pictograms and schematic signs were better perceived than verbal signs. On the basis of these tests and other deliberations in 1952, a draft convention for a worldwide road sign system was proposed.
It is essentially a combination of the European pictograms with the American yellow diamond shape.

Regulatory signs for city traffic, 1931

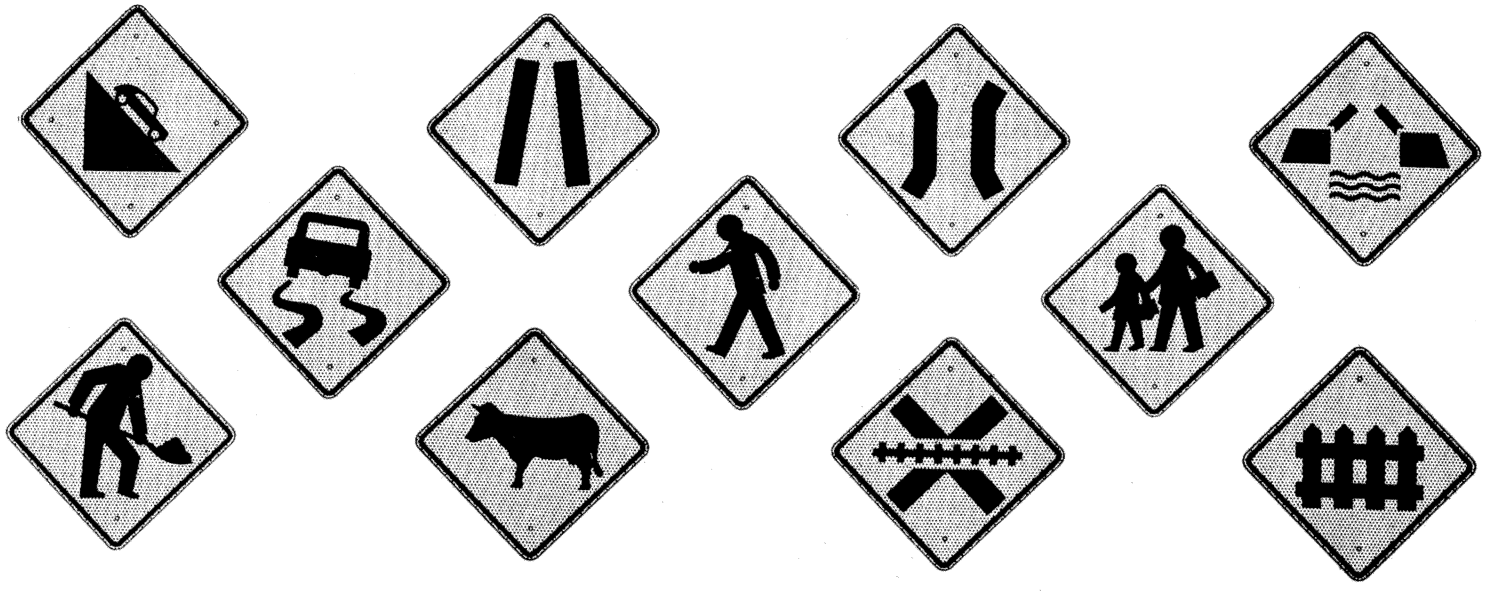


Left:
Early pictograms suggested by Swiss automobile magazine, 1923



Top left:
Part of the finally established set of danger signs, 1949.

Proposed world-wide road sign system: European pictograms combined with yellow diamond shape.

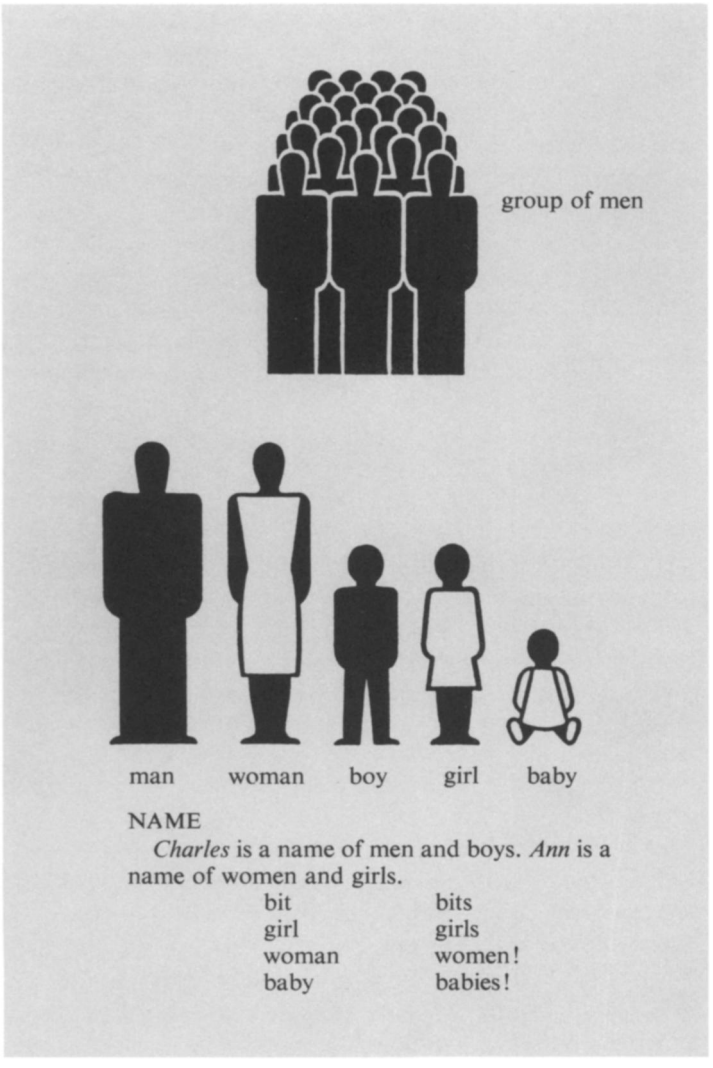


The international system of typographic picture education (ISOTYPE)

Another systematic attempt to design an international picture language was aimed at improving education and communicating across language barriers. This picture language, ISOTYPE (an abbreviation for "International System of Typographic Picture Education"), was designed by G. Arntz and E. Bernath in Austria. Otto Neurath, later the first editor of the International Encyclopedia of the Unified Science, had ISOTYPES prepared as early as 1925 in Vienna. They were used in public museum programs to convey statistical and other governmental information. Other ISOTYPES were developed by the International Foundation for the Promotion of Visual Education in The Hague and in London under Neurath's direction. In 1937, Neurath published *Basic by ISOTYPE,* an attempt to teach the 850 words of Basic English by means of ISOTYPE.

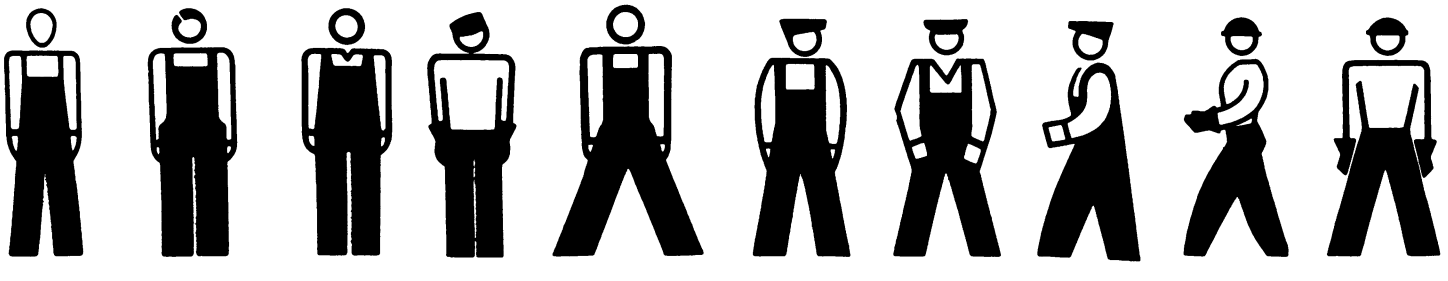
ISOTYPE was designed to make minimum use of verbal symbols. According to Arntz and Bernath, ISOTYPE's designers, one glance at an ISOTYPE should reveal the most important features of the object depicted; a second glance should disclose less important features; and a third glance should add mere details. No ISOTYPE should require more than three glances to yield all its information. As correlates of these principles, unnecessary details must be omitted, nonessential variations avoided, and the message restricted to the bare minimum necessary for the desired teaching effect.

From time to time attempts have been made to follow up the ISOTYPE tradition. For instance, the Pictograph Corporation in New York under Rudolf Modley issued a collection of 1000 pictographs for commercial and other uses. In an attempt to take stock of the number of graphic symbols in existence all over the world, the fund for the Advancement of Education (Ford Foundation) commissioned in 1959 a "Preparatory Survey on Communication Through Graphic Symbols."[11] Although its results are unfortunately not yet available, such a survey could lead to a dictionary of graphic signs and symbols.



Basic English as taught by means of ISOTYPE. Book by Otto Neurath

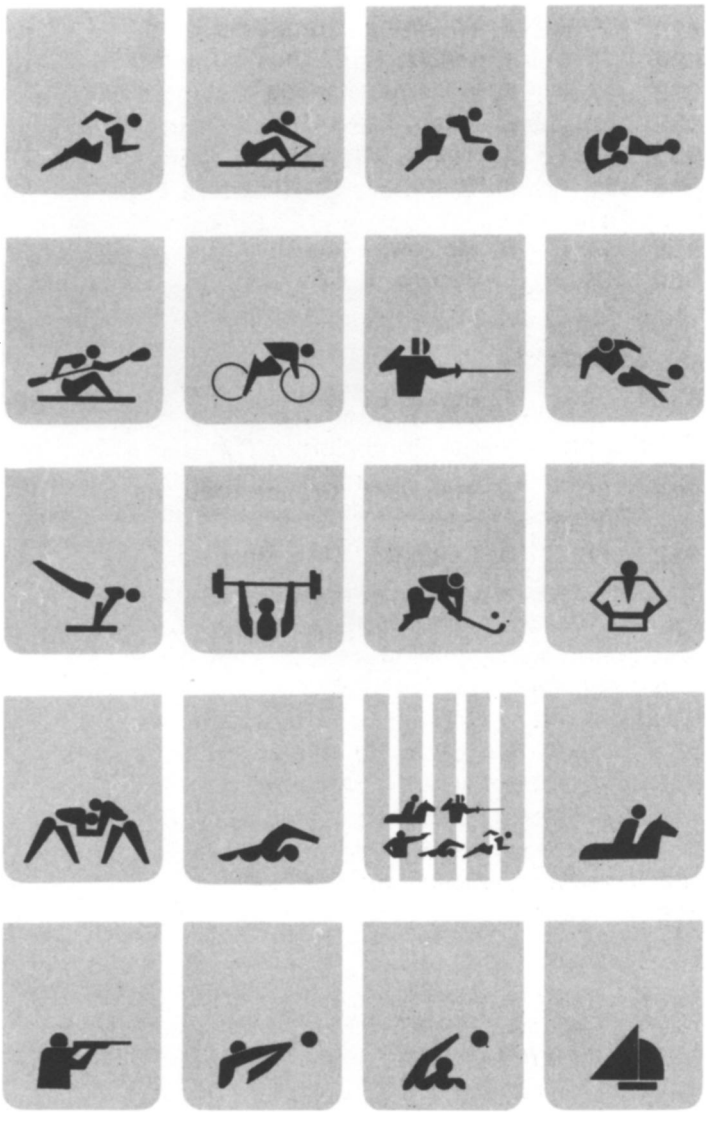
Below:
Pictographs by Rudolph Modley, Pictograph Corp., N.Y.



Other pictographic systems

International gatherings, such as Olympic Games and World's Fairs, attract members of many language communities. Because a large percentage of such an audience does not understand the language of the host country, pictographs are required for giving directions, identifying services, and clarifying regulations, warnings, and so forth. But all too often designers produce an entirely new picture language instead of helping to standardize already established pictographic systems (such as ISOTYPE). This fault was obvious in the most recent attempt to propose a picture language, during the 1964 Olympics in Tokyo. Many of these Japanese pictographs designating services and facilities are not at all self-explanatory. Also evident in the design is a lack of concern about whether or not the object depicted is part of the common experience of all visitors and whether there is too much or too little detail for optimal comprehensibility. In general, the pictographs departed from "simplified realism" in the direction of "oversimplified stylization."

The 1967 International World's Exhibition in Montreal will be faced with similar problems. While the projected percentage of visitors from other countries than Canada and the U.S. may be small, Montreal and the Province of Quebec have a linguistic problem to start with, since some of their natives speak only French or only English. This exposition will offer an occasion to weigh the usefulness of existing pictographic systems in international communication. ISOTYPE still seems to represent a basically sound starting-point. As an over-all principle, the ISOTYPES representing objects whose shape has changed (e.g., automobiles) should be modified,* and only those pictographs for objects not already represented in ISOTYPE should be designed anew.



Top:
Sign system for the Tokyo Olympics, 1964: Symbols identifying different sports, designed by K. Sugiura, I. Awatsu, I. Tomaka, M. Katsumi and numerous Japanese graphic designers.

* The shape of the "average automobile" of the twenties is different from today's. But if international pictographs were based on a mandatory principle for their production (e. g., the graphic simplification of an "average shape" derived by photographing the most representative samples of an object in a prescribed standardized position, the international picture language would be self-correcting without falling in the trap of obsolescence through "styling."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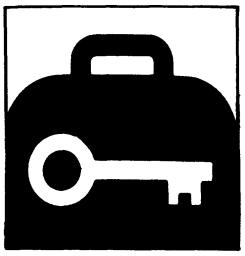
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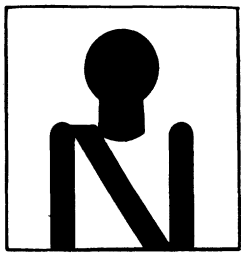
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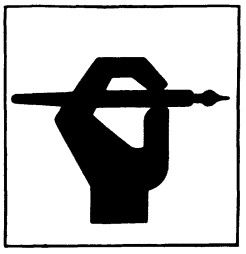
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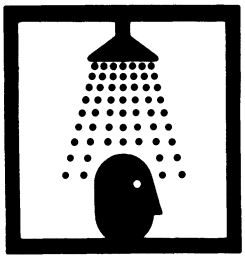
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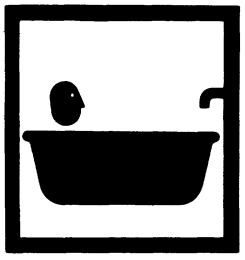
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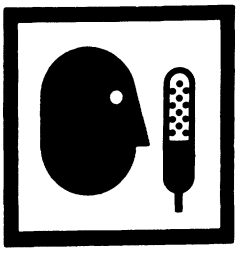
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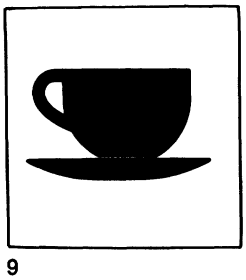
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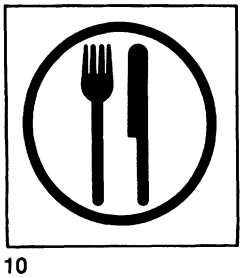
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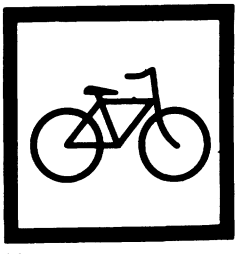
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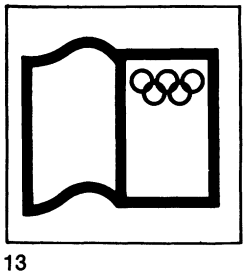
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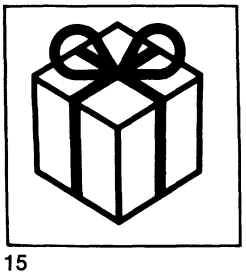
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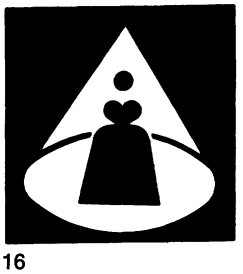
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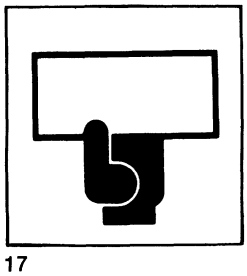
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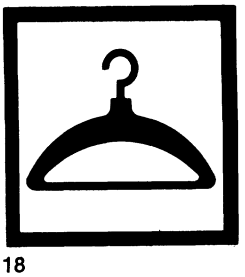
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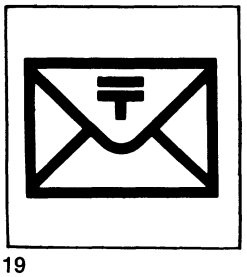
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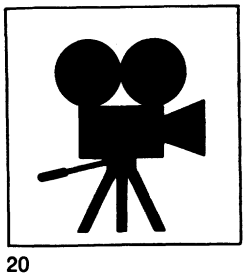
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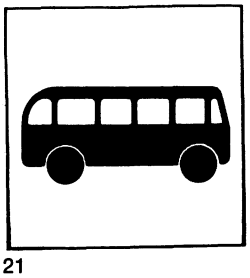
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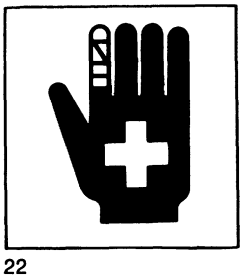
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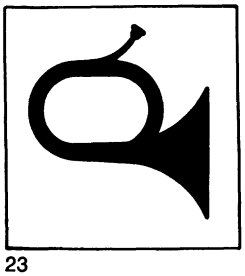
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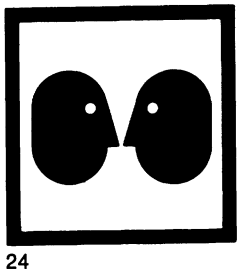

24

1) Athlete (woman)

2) Cloak room

3) Athlete (man)

4) Press

5) Shower

6) Bath

7) Sauna

8) Press interview room

9) Lunch room

10) Dining room

11) Lounge

12) Bicycle depot

13) Programs

14) Telephone

15) Shopping center

16) Theater

17) Ticket sale

18) Dressing room

19) Post office

20) Camera

21) Bus station

22) Dispensary

23) Band

24) Guest room

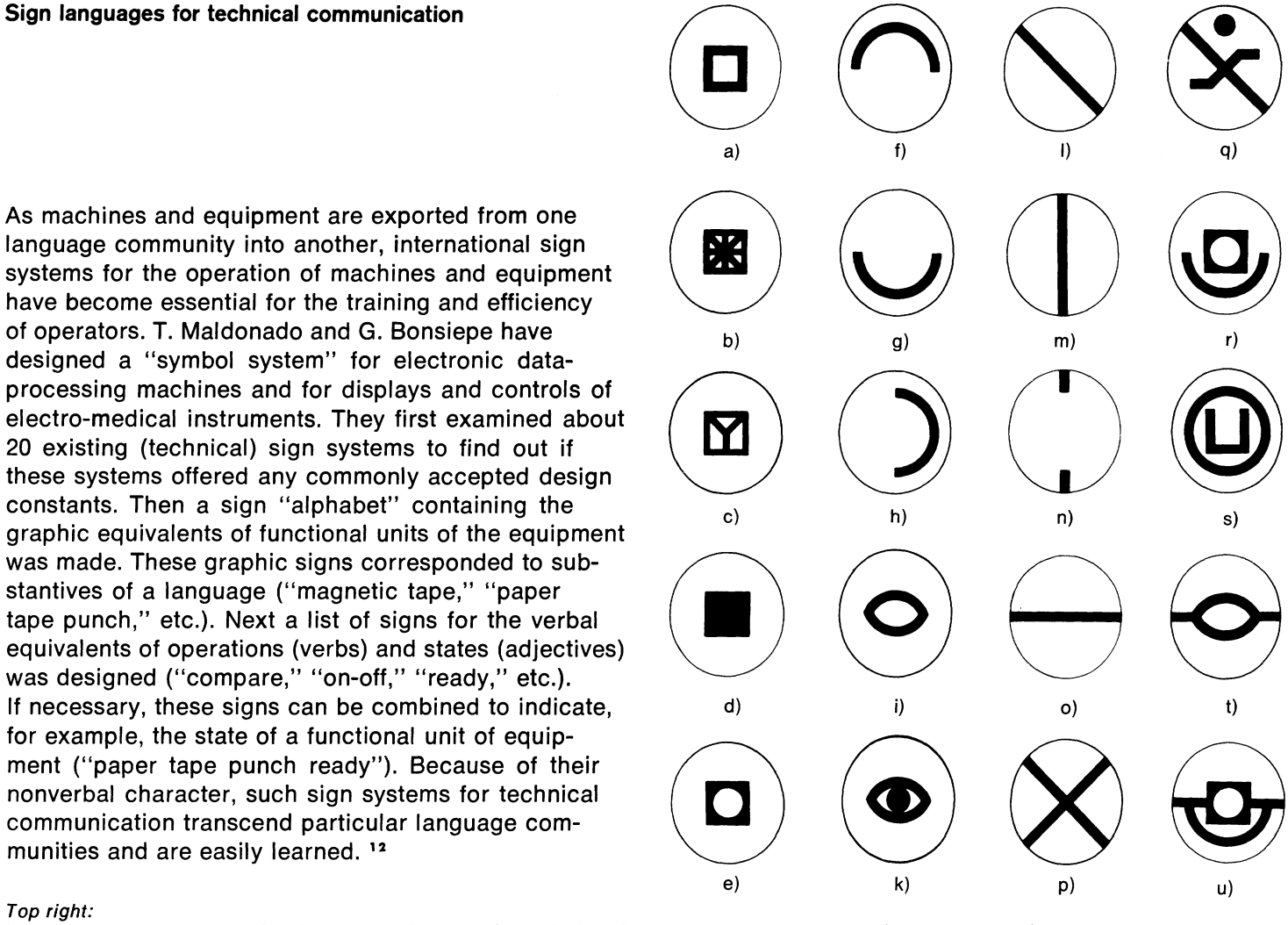
Sign languages for technical communication

As machines and equipment are exported from one language community into another, international sign systems for the operation of machines and equipment have become essential for the training and efficiency of operators. T. Maldonado and G. Bonsiepe have designed a "symbol system" for electronic data-processing machines and for displays and controls of electro-medical instruments. They first examined about 20 existing (technical) sign systems to find out if these systems offered any commonly accepted design constants. Then a sign "alphabet" containing the graphic equivalents of functional units of the equipment was made. These graphic signs corresponded to substantives of a language ("magnetic tape," "paper tape punch," etc.). Next a list of signs for the verbal equivalents of operations (verbs) and states (adjectives) was designed ("compare," "on-off," "ready," etc.). If necessary, these signs can be combined to indicate, for example, the state of a functional unit of equipment ("paper tape punch ready"). Because of their nonverbal character, such sign systems for technical communication transcend particular language communities and are easily learned. [12]

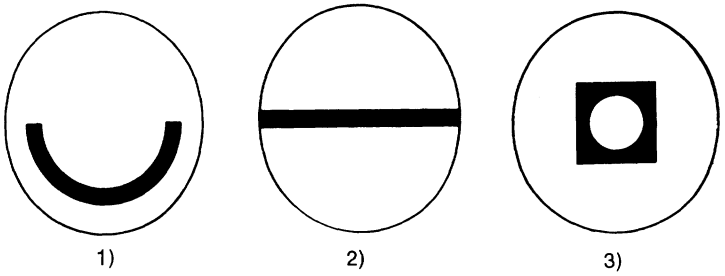
Top right:
Part of a new sign system for data-processing machines, designed for Olivetti by Tomas Maldonado and Gui Bonsiepe, Hochschule für Gestaltung, Ulm, Germany

Left:
Sign system for the Tokyo Olympics 1964: Pictographs identifying facilities, designed by K. Sugiura, I. Owatsu, I. Tomaka, M. Katsumi and numerous Japanese graphic designers.

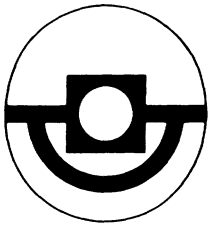
Below:
Sign system for data-processing machines by Tomas Maldonado and Gui Bonsiepe



a) functional unit
b) central unit
c) marginal unit
d) memory
e) magnetic tape
f) write
g) read
h) receive
i) trace
k) find
l) mistake
m) on
n) off
o) over
p) blocked
q) stop mistake due to jump
r) read magnetic tape
s) accumulator at work
t) trace finished
u) magnetic tape reading over



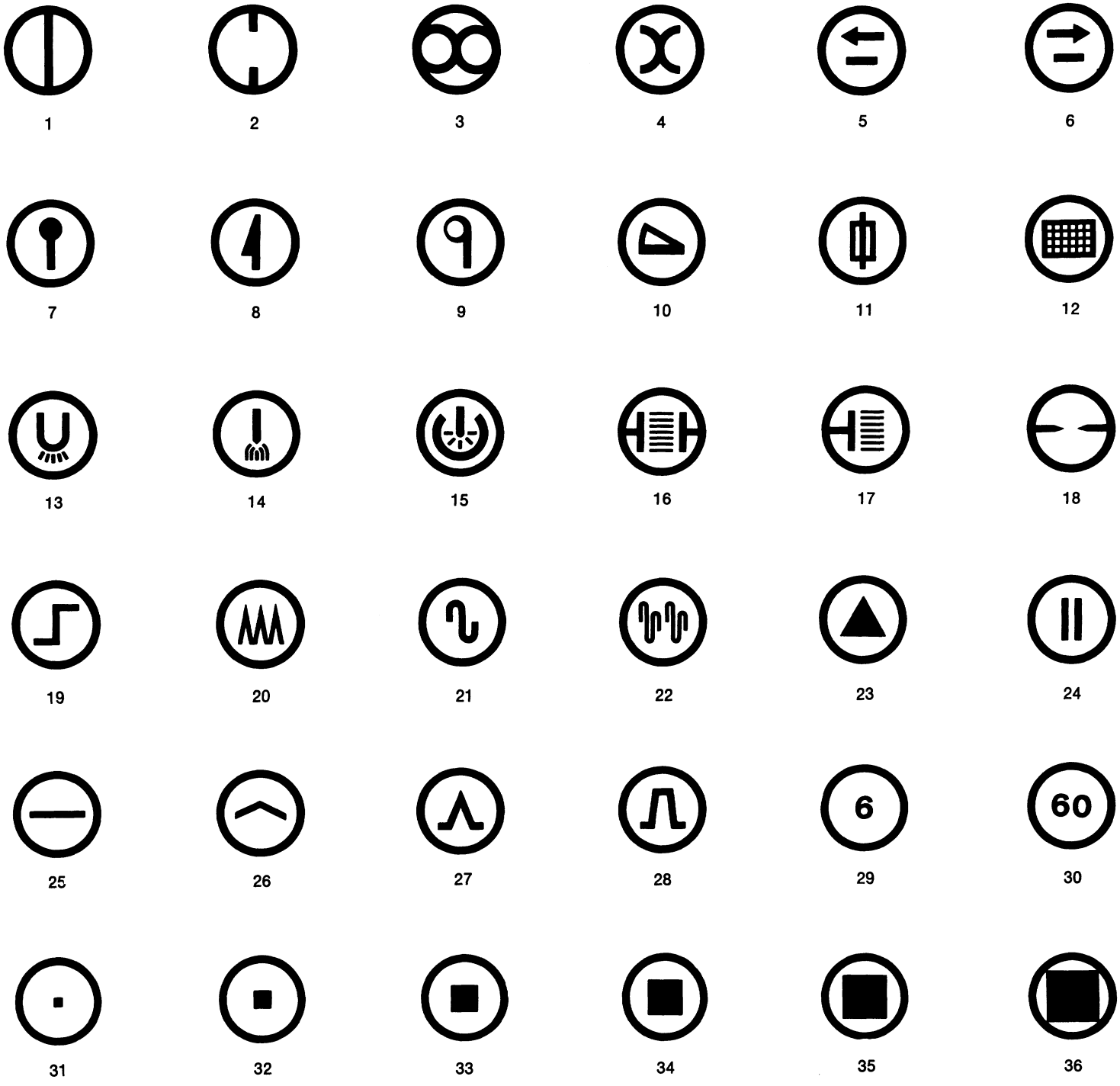
Left:
1) read
2) over
3) magnetic tape



Right:
magnetic tape reading over

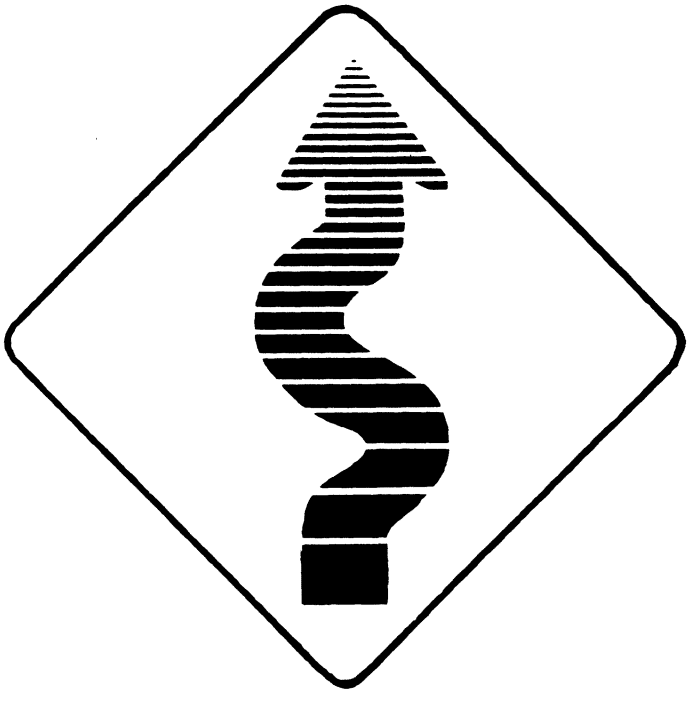
Below:
Sign system for electro medical instruments by Tomas Maldonado and Gui Bonsiepe

1) on 2) off 3) automatic 4) by hand 5) minus pole left 6) minus pole right 7) coagulation 8) cutting 9) resection 10) pedal switch 11) fuse element 12) neutral electrode 13) caustic 14) fulguration 15) endoscopy 16) two probes radiating 17) one probe radiating 18) spark gap regulation 19) galvanic current 20) faradic current 21) current from tube 22) current from spark gap 23) interference, danger 24) resonance 25) current, constant 26) current, increasing 27) triangle current 28) trapezoid current 29-30) 31-36) quantitative radiation measure



Applications of Theory: A Summary and Some Suggestions

A few examples can indicate how useful such theories as we have been describing can be for design. The applications of psychological theories of perception are still largely unexplored. For example, the application of texture gradient theory, as shown in the illustration of the aircraft display panel, could easily be extended to the design of road signs. Arrows on road signs are often used on a vertical surface to indicate a topographic situation which is horizontal in nature. For instance, arrows pointing up vertically indicate a direction ahead on a horizontal plane. Such arrows could be made more effective by applying a texture gradient in their design.



Texture gradient applied to traffic sign: suggested treatment for better comprehension of lateral change

Gestalt theory can also suggest important applications for the designer. Optical illusions, reversible figures, and "impossible objects" are effective visual attention-getters. But especially, Gestalt theoretic considerations may impose themselves as the designer informally tests new or old symbol designs by submitting them to all kinds of anticipated environmental "stress" or "visual competition." This applies to trade-mark design especially in that trade-marks are applied in very small sizes (on letterheads) as well as in very large sizes (on the walls of office buildings or factories). They must be perceived correctly when in motion (on trucks or vehicles) and under various angles of regard (lateral as well as frontal). The trade-mark must withstand the "noise" of other symbols surrounding it under various circumstances. Only those design alternatives that exhibit "good Gestalt" will perform under most of these conditions of stress. And "good Gestalt" means, first of all, simplicity.



Symbol proposed for the 1967 international world's exhibition (Man and his World) by Ernst Roch.



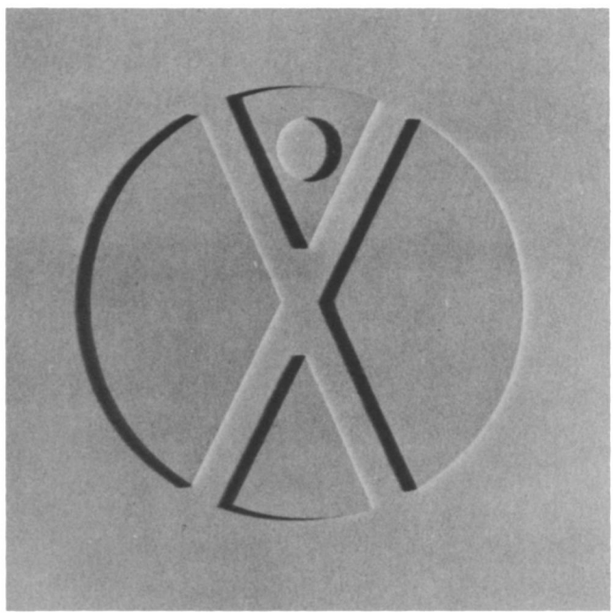
1)



2)



3)



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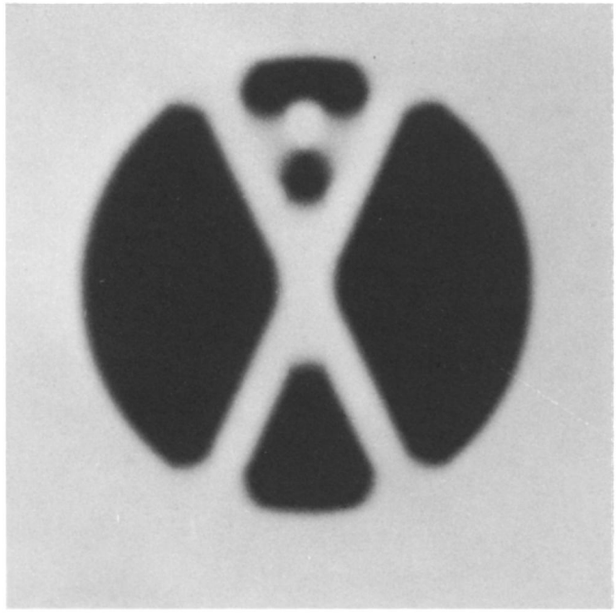

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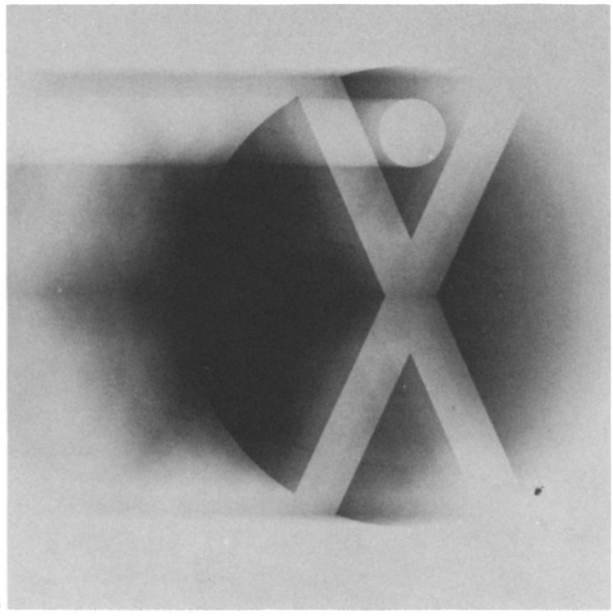


6)

Left:
Visual analysis by Ernst Roch:
Analysis of configural vitality:
1 — 2 Split image, perspective viewing condition.
Situational change:
3) Undulating surface
4) Three-dimensional relief emphasizing lines through light
5 — 6) Manipulation of focus and movement.

Right:
Symbol for Vocational Guidance Agency, designed by Kenneth Hiebert

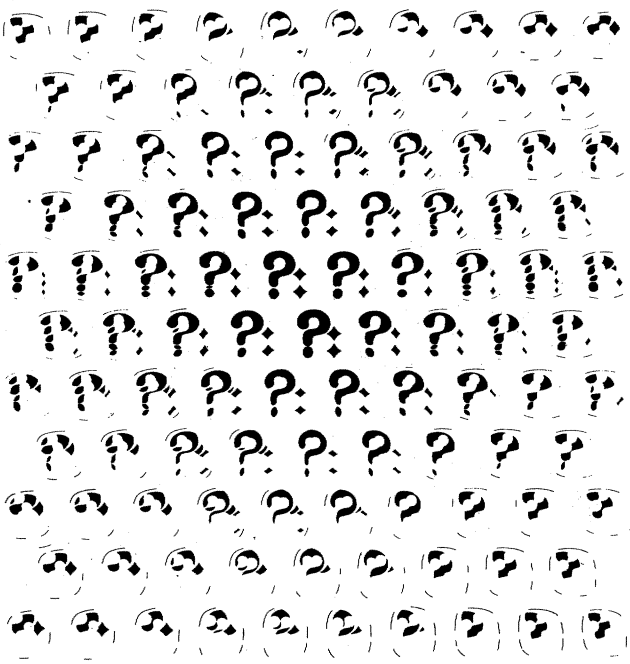


Below:
Visual analysis: Progression from regular configuration to final choice
1 — 4

1)



2)



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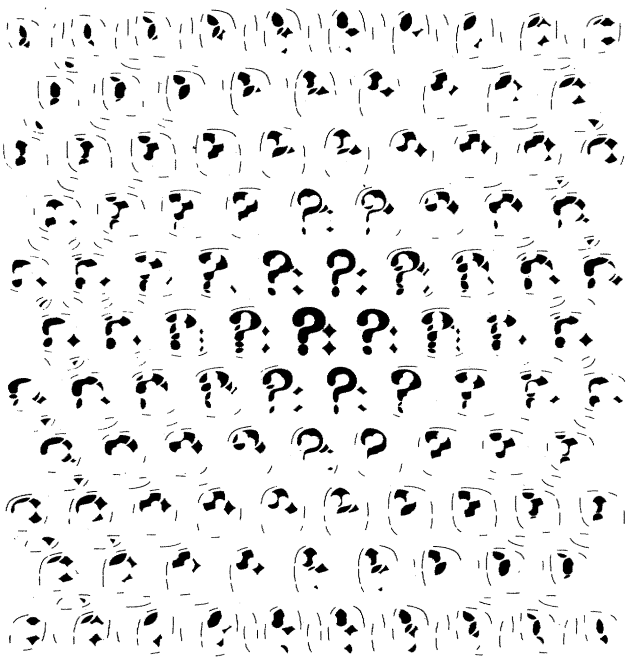
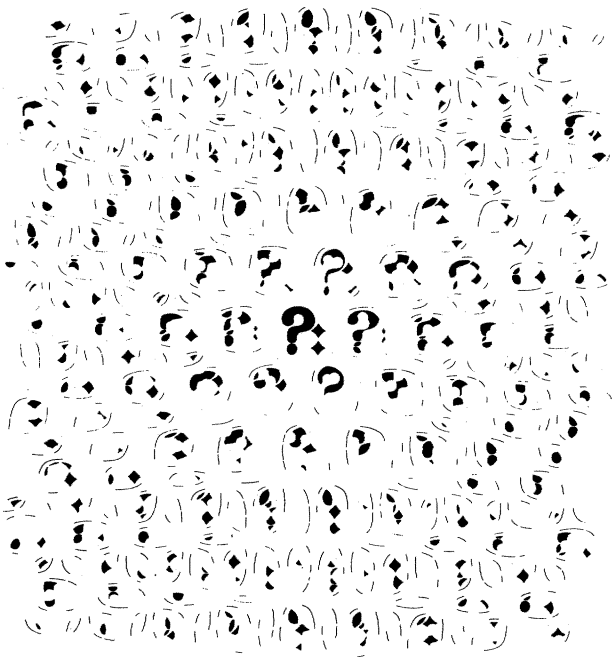


4)



Our summary of theoretical and experimental work related to the field of communication by signs and symbols has attempted to clarify for the designer the advantages and limits of information and persuasion by graphic techniques. Much of the discussion has centered around establishing a workable terminology. Semiotics, the theory of "surrogates" and "pictic analysis," are areas of study which can be useful in the analysis of existing symbols as well as in the gradual discovery of a vocabulary and syntax in graphic communication.

What does a graphic designer gain in practice if he is familiar with interdisciplinary knowledge about graphic communication? First of all, he may come to realize that signs, symbols, and pictures are not mysterious: their appeal is not ineffable, nor is one picture always worth a thousand words. We have seen that picture comprehension is a function of education (literacy) and age (experience). Both pictures and words have their advantages, and admittedly, within a given language community, words are usually more effective than pictures. The main advantage that outline drawings or other pictorial "surrogates" have over verbal signs is that, like the objects they stand for, they remain constant, while the verbal labels attached to them vary from verbal community to verbal community. Hence, they are most useful in communication across linguistic groups.

The crucial question in such cross-cultural communication is whether or not the object depicted occurs in the experience of the target audience or audiences. For instance, it will be equally hard to communicate with words *or* pictures about an elephant to Eskimos or about a polar bear to African tribesmen. The number of objects and processes the designer can expect his audiences to be familiar with depends primarily on their average education level and age. As we have stated, the designer is well advised not to count on the capacity to interpret "extended" or "symbolic" meaning, especially in audiences of another verbal community. In fact, if his audience is not very sophisticated, he may have difficulties with subtle "rhetorical" refinements even in his own culture. It is hoped that in the future, pictorial sign systems will be conventionalized internationally as the traffic signs system has been. In the design of signs and symbols, the designer should follow for pictographs the rule of simplified realism, and for other symbols, such as trademarks, the Gestalt principles of "good form" and simplicity. He should also attempt a certain flexibility in using all the techniques of graphic communication: there is no reason, for example, why he cannot use photography in the design of a trade-mark (see trade-mark on page 8) as well as the more common typographic techniques. He should welcome further investigation of and experimentation with visual perception, Gestalt theory, and other related disciplines, in the knowledge that it will establish a more systematic approach to graphic communication and thus help the designer to achieve his goals.

Glossary

1 This theory is proposed by J. J. Gibson in *The Perception of the Visual World* (Boston: Houghton Mifflin Co.), 1950.

2 Contact analogues are discussed in E. J. McCormick, *Human Factors Engineering* (New York, McGraw-Hill Co.), 149, 1964.

3 The theory of "surrogates" was developed by J. J. Gibson in his article "A Theory of Pictorial Perception," *Aud. Vis. Comm. Rev.,* II:1:3-23, 1954.

4 R. L. Birdwhistell calls the study of body movements and gestures "kinesics." His basic differential unit is a "kine." Kines combine on the next higher level into "kinemorphs," which correspond to elements of gestures. See "Kinesics and Communications" in Explorations, III:31-41, 1954.

5 The concept of "pictic analysis" and the following terminology was proposed by R. Harrison in an unpublished doctoral dissertation at Michigan State University, 1964.

6 In 1953 S. Spaulding tested the comprehension of illustrative material in a series of educational booklets in Costa Rica and Mexico. Some of the results are presented in his article, "An Investigation of Factors Influencing Communication Potential of Pictorial Illustration," *Aud. Vis. Comm. Rev.* IV:1, 1956.

7 Results of this study are quoted in "Comprehension of Pictorial Symbols: An Experiment in Rural Brazil," L. Fonseca and B. Kearl, *Bull. Dept. Agric. Journ. Univ. Wisconsin,* XXX:2, 1960.

8 G. Bonsiepe has prepared an interesting account of the problem in his article "Persuasive Communication: Toward a Visual Rhetoric," Uppercase 5, London, Whitefriars, 1962.

9 U.S. Manual on Uniform Traffic Control Devices for Streets and Highways, 2nd edition, 1948.

10 Introduced by the Central and Southern African Transport Conference, held in Cape Town in 1950.

11 This survey was directed by Mr. Rudolf Modley. As a result of the commission, two papers by M. Krampen were submitted to the sponsors: "An Approach to Classification of Graphic Symbols" and "Classification of Graphic Symbols and the Scientific Method" (New York, The Fund for the Advancement of Education, Ford Foundation, mimeographed, 1959).

12 An explanation of the design procedure can be found in the article by T. Maldonado and G. Bonsiepe "Sign System Design for Operative Communication" Uppercase 5, London 11-28, 1962.

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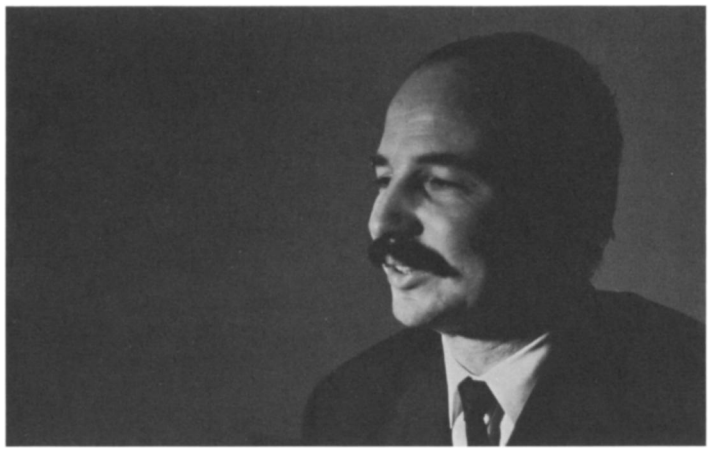

The Author

Martin Krampen was born in 1928, Germany. He studied psychology, philosophy, and theology at the Universities of Tuebingen and Heidelberg. He went in 1951 to Florence, where he studied painting and design at the Accademia delle Belle Arti. Having received his diploma at the Hochschule fuer Gestaltung, Ulm, Germany, he came to the U.S. in 1958 to work for his doctorate in Communication Arts at Michigan State University. After earning his Ph.D., he accepted an assistant professorship in the Department of Graphic Arts and Psychology at the Carnegie Institute of Technology. He is now Assistant Professor of Engineering (Design) and Psychology, University of Waterloo, Ontario, Canada.

Prof. Krampen has lectured widely in the U.S. and abroad, and has done extensive research and writing for professional journals on subjects including: world road sign systems, classification of graphic symbols (as part of a survey commissioned by the Ford Foundation), the perception of apparent movement, industrial design and industrial organization, and forgetting and retention of pictorial material.

As a graphic designer, he has worked in book design, magazines, and advertisements. His design projects have ranged from restyling the format of a newspaper (La Sera di Roma) to planning exhibitions and displays for USIS, Westinghouse, and the 1967 Montreal World's Exhibition. He has won several awards for typography and his graphic design is represented in the permanent collection of the Museum of Modern Art, New York.

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