Language of Vision: The Nuts and Bolts

CHARLES EAMES

Charles Eames was born in St. Louis in 1907, began architectural practice in 1930, and in 1936, at the invitation of Eliel Saarinen, accepted a fellowship at the Cranbrook Academy of Art. There, he and Eero Saarinen collaborated on designs for furniture which earned the two first prizes in the Museum of Modern Art's "Organic Furniture Competition" of 1940.

In 1941, Eames and his wife, Ray, moved to California where, in addition to architectural projects including their own house in Santa Monica (1949), they developed low-cost techniques of wood lamination, bonding, and molding which made production of the first plywood chairs feasible. Later Eames furniture has included an upholstered lounge chair, aluminum frame chairs and airport seating, and the ubiquitous fiberglass stacking chair.

Since 1950, films and multiple-image shows, many of them winners of international awards, have become an important aspect of Eames' work; the Eames office is currently preparing an international exhibition on "The Age of Franklin and Jefferson" for the American Bicentennial.

The following communication was delivered by Mr. Eames at a Stated Meeting held last spring under the auspices of the Western Center of the American Academy. The lecture was illustrated with several of his films and slide shows which are described in brief italicized notes; since the presentation consisted of more pictures than talk, it follows that the printed word provides only a partial record of the meeting.

In 1953, George Nelson, Alexander Girard, my wife, Ray, and I produced "A Rough Sketch for a Sample Lesson for a Hypothetical Course"; the project was sponsored by the Engineering School of UCLA, then headed by that remarkable man, Dean L. M. K. Boelter. Designed to make the most efficient use of classroom time, the "Rough Sketch" was an attempt to determine how much information *could* be given to a class in sixty minutes. We used a multi-media approach with three concurrent images: a live narrator, a long board of printed visual information, and complementary smells which Sandro Girard piped into a chemistry lecture theatre through a powerful ventilation system. All of the special effects were used not to produce a "far-out" experience but to support the fundamental concepts being presented.

We introduced as much substance as possible into the "Rough Sketch," and it later became the film, "A Communications Primer," aimed essentially at an audience of architects. This primer was the outcome of a feeling that processes based on information theory must be an essential component of city planning. One cannot anticipate a strategy that will meet an increase in population or social changes unless one has a way of handling enormous amounts of technical information.

The original "Rough Sketch" was intended to demonstrate the importance of using the language of vision in the university. It was presented through the engineering department of UCLA – an appropriate forum because it is part of the working center of the university. Unfortunately, universities today are becoming discontinuity headquarters, with each department avoiding communication with the others and with the rest of the world. Used as it could be, the language of vision is a real threat to this discontinuity, and so it is avoided at all costs. The film department is usually located in the drama or in the art department and caters for the most part to people's creative idiosyncrasies rather than to the development of basic, current, working ideas of science and the humanities.

The danger is that film will be prematurely contaminated by a virus of self-expression. When a scientist, engineer, or mathematician collides with a painter or sculptor, he often catches the bug to which the painter or sculptor has already developed an immunity. Instead, the scientist should recognize aesthetics as an extension of his own discipline. For instance, if a mathematician is writing a paper on mathematics, he would not particularly improve his work by hiring an essayist to do the job. On the other hand, if the mathematician were part essayist, he could make his point more accessible to his colleagues, his students, and perhaps an even wider audience. The film department can support the university's charter for promoting intellectual inquiry only if it is able to serve all departments from a central position within the school.

I believe that universities should establish a visual service unit open to every department to assist the faculty in learning to use the language of vision effectively. Some time ago, we made a proposal, as part of a program at MIT, whereby a person knowledgeable about the nuts and bolts of the language of vision (the making and use of film records, tapes, etc.) would be assigned to each class, whether it be history, biochemistry, small particle physics, or chemistry. In the future, intellectual, political and technical people are going to need ways of communicating complex ideas; MIT seemed a very good place to test the possibilities of the language of vision.

In a film which we made about Copernicus we tried to communicate an overview of his life, the time in which he lived, and the development of his ideas. The film is the record of an exhibition, honoring the five hundredth anniversary of Copernicus. Because exhibitions are usually dismantled and never seen again, we made this film as a history of the event.

The film shows landscapes, artifacts, buildings, and astronomical imagery of Copernicus' time, as well as original manuscripts of his work. A narrator describes Copernicus' work and quotes from his writings and those of his peers. We hear Copernicus' description of his early thoughts on the place of the sun in the universe: "I began to be annoyed that the philosophers had discovered *no sure scheme for the movements of the machinery of the world; therefore I also began to meditate on the mobility of the earth." Complementary to this quote, we see his own simple drawing of "Sol" as a small circle with a larger concentric circle indicating the course of the earth about it. As far as possible, Copernicus and his world speak for themselves. The accompanying music, put together by Elmer Bernstein, captures the spirit of the sixteenth century. The imagery and the narrative are chosen to decrease the distance between a modern audience and the world of the past.*

A film of ours comes into being because it is either a logical extension of an immediate problem we are working on or it is something we have been wanting to do for a long time and cannot put off any longer. The film "House of Science," which was made as an introduction to the United States science exhibit at the Seattle World's Fair, seeks to provide a rough, but real feeling of how science came to be the way it is. The first section is, in effect, a time-model that has a scale: every 2½ seconds is equal to a decade. The various disciplines of science are represented as buildings. The growth of the buildings is an architectural allegory approximating the number of people in each field at any given time.

In the opening of the film, the "House of Science" is shown as a small building which then begins to change and grow. For example, it soon adds the "House of Anatomy"; the "Science of Alchemy" appears temporarily as a tent and is then subsumed under the "Science of Chemistry." Near the end of the sequence, branches of science appear very rapidly spreading over six screens, and finally the entire screen area is filled with all of the sciences which have developed by 1962.

For the body of the "House of Science" film, of which this clip is just the introduction, and also for a presentation called "Glimpses of the U.S.A.," prepared for the United States exhibit at Moscow in 1959, we used a multiscreen technique. This was not a capricious method but rather a way of establishing credibility and avoiding superlatives. At the time of the Cold War, when this exhibit was prepared and shown, the citizens of the Soviet Union had heard much about the United States but had little concrete imagery on which to base a belief in what they heard. We wanted to present not an editorial statement but a comprehensive, *fair* picture of this diverse country. With seven screens we were able to show simultaneously a whole range of examples of various subjects – say, families eating. In the same way, in "House of Science," we showed simultaneously many different examples of the category "microscope." The audience recognizes an open set and this somehow raises the level of truthfulness.

Some of the same technique is again used in our "Circus" slide show. The circus is a nomadic society which is very rich and colorful but which shows apparent license on the surface. Parents tend to take their children to the circus as a kind of ritual, a kind of initiation into a world which is just not allowed and which cannot be. Everything in the circus is pushing the possible beyond the limit – bears do not really ride on bicycles, people do not really execute three and a half turn somersaults in the air from a board to a ball, and until recently no one dressed the way fliers do.

Yet, within this apparent freewheeling license, we find a discipline which is almost unbelievable. There is a strict hierarchy of events, and an elimination of choice under stress, so that one event can automatically follow another. The lay-out of the circus under canvas is more like the plan of the Acropolis than anything else; it is a beautiful organic arrangement established by the boss canvas man and the lot boss. Upon arrival at a circus site, the lot boss used to drive a horse-drawn cart around the entire lot to make his preliminary investigation. Then he began again and, by counting the horse's hoofbeats, marked out the appropriate spots for the boss canvas man to place the quarter-poles. In this activity, and others of the circus people, one can see the precise arrangements of people in relation to one another. The lot boss knows exactly what his relationship is to the boss canvas man because the mutual objective and the method of accomplishing it are clear to both.

In the actions of circus people waiting or rehearsing or preparing to perform, there is a quality of beauty which comes from appropriateness to a given situation. There is a recognized mission for everyone involved. In a crisis there can be no question as to what needs to be done. The circus may look like the epitome of pleasure, but the person flying on a high wire, or executing a balancing act, or being shot from a cannon must take his pleasure very, very seriously. In the same vein, the scientist, in his laboratory, is pushing the possible beyond the current limit and he too must take his pleasure very seriously.

The concept of "appropriateness," this "how-it-should-be-ness," has equal value in the circus, in the making of a work of art, and in science. It often turns out, however, that scientists, engineers, or mathematicians abandon their own disciplined approach to problems when they face questions which concern pleasure. They tend to think of the aesthetic level and the scientific level as discontinuous, whereas both actually involve this quality of appropriateness and exhaustive definition of the problem. They fail to take pleasure seriously.

I was raised in a nineteenth-century mode, where my first experiences with science involved minor physics experiments done almost as parlor tricks, mathematics through magic squares and electricity by way of a "shocking machine" which was reputed to have some therapeutic value. All this had an aura of magic about it; by the time I became an architect I was not at all surprised that our understanding of electricity grew out of toying around with pith balls, or that pneumatics and hydraulics were first used to impress the populace by magically opening doors and raising fountains. Joseph Needham says in his book, *Science and Civilization of China:*

> Perhaps the passage of jugglers and acrobats to and fro merits more attention in the history of science than it has yet received, particularly when we remember how much of the early mechanics of such men as Nero of Alexandria and also of their Chinese counterparts were occupied with mechanical toys for palace entertainments — devices of illusion, stage play machinery and the like. . . . For ancient and medieval people, there was not much difference between jugglers, alchemists, mechanicians, star clerks and all dealers in magic and glamour.

In the "Circus" show, three slides at a time are projected on the screen with typical circus music and the sound of an audience in the background. Many of the images are closeups of the operation of the circus – performers waiting in the wings; carefully placed equipment, such as the pulleys used for the high wire acts and the locks on cages; and well-worn shoes of various types, including ballet slippers frayed at the toes and large clown shoes down at the heels. We also see the working faces of the circus people beneath their make-up, and in general the great orderliness and strictness necessary to give the audience pleasure in the performances. As the camera moves back, the film audience sees again the finished product, the entertainment presented to the circus audience, but by the end of the show the discipline necessary to the performance has been underscored.

Cable television, as a means of promoting the language of vision, offers a special opportunity for improving communication between groups, but its potential has not been fully realized. I think that cable television could be of great benefit to a small university or college. Once a school purchases a franchise, it faces the problem of reducing the contents of the college into a form that can be transmitted on several channels and made available to the public.

It has been said that some of our films deal with the "found object," the thing as it is seen in a fresh way. The universities would do well to offer a "found education" through the language of vision. I do not think that anyone realizes, or could have predicted, the kind of education that currently takes place through television, with the programming as poor as it is. There are people who hear their own language spoken on television who, to all intents and purposes, never hear it spoken in the street or at work. And every time a child sees, for example, a table being set on television, he's watching the performance of a recognizable ceremony. Think what the universities could do if they were to take their own best offering and transmit it on a "found education" basis. Of course, it is important for the university to have good projection facilities so that the viewer can gain a feeling for the quality of projected images. The sloppy use of images can erode the sensibilities in a way which many of the people who tout sensibility fail to recognize. Universities – and everyone who purports to carry on the sacred flame – have a responsibility to the details of communication.

Another part of our proposal to MIT, which I mentioned earlier, was the suggestion that individual students could improve their understanding of concepts and their communication skills by devoting six months to teaching in elementary schools. The student should *not* teach an elementary lesson; he should be asked to communicate, in effect, the essence of a subject in his own specialty. He would be faced with the problem of having to whittle a substantial idea down to a size that is meaningful at the elementary level. One of the best ways of doing this is to put it on film because through this medium the central idea can be supported by images which give substance and liveliness to it. This reduction of one idea to its essence, using the support of visual images, is the core of several films we made on mathematical topics. One of these dealt with the concept of symmetry, which was illustrated by some footage of a young man putting on his clown face for the circus.

In "Clown Face," the young man is seated casually in cut-off Levi's; he applies his make-up around his mouth, eyes and nose, and then sharpens the clown face with dark outlining, each stroke unhesitating and each line almost a perfect curve, though not quite. The line to the left of his mouth is just slightly wider than what should be its mirror image on the right, but at the end of the session the audience is impressed with the increased appearance of the symmetry of a human face.

Another film directly addressed itself to the definition of "symmetry." It was done with animated drawings.

The narrator says, "When we think of symmetry we usually think of a design balanced around a center line. . . . We think of man being symmetrical. . . . There are many kinds of symmetry and some things can be shown to be more symmetrical than others. One test for this is to count the number of positions that an object can take in a box that fits it perfectly." At this point in the film, cartoons of a man sitting in a chair and a dog beside him are suddenly encased in boxes and their asymmetry is quickly apparent. The narrator says, "A man can fit in a man box only one way, but a card can fit in a card box four ways — front upside down, back up, back upside down, as well as face up." This sort of explanation continues as the film progresses through objects *which are increasingly more symmetrical until it shows a sphere which fits in its box an infinite number of ways. Although the narrator mentions that a mathematician determines symmetry with "a form of algebra called group structure," the main purpose of the film is to communicate a direct understanding of and feeling for the basic concept of symmetry.*

We have made a small series of vignettes like this – exercises in taking an idea and trying to reduce its exposition to two minutes from a standing start. Another film that we have used to illustrate "symmetry" takes its name from a sea animal about three-eighths of an inch wide, "Polyorchis Haplus."

Because the film is shot in close-up, the Hydromedusa appears to be a monster and the sand grains look like rocks. The close view of this very strangely shaped animal shows clearly its two, eight-sided transparent layers of flesh. At the base of these umbrella-like layers are long and short tentacles spaced evenly about the body. The animal moves by slightly inflating or deflating its transparent body, and, as it swims elegantly through the water, the audience can see the effect of its shape on its movement.

Since I have been urging scientists and mathematicians to use the language of vision in their work, I would like to point to an able exponent of this effort, Raymond Redheffer, a distinguished mathematician at UCLA who has acted as a consultant to us in many of our exhibitions and films. Redheffer takes his pleasure seriously; after collaborating with us for some time, he decided that he wanted to be in more direct touch with film. We set up a camera for him and, using direct animation, he created a film of his own dealing with equations. His art was rigorous enough so that he was able to make jokes on film which were not peripheral to his topic but actually furthered understanding of his concepts. As we said in the "House of Science," "Science is essentially an artistic or philosophical enterprise carried on for its own sake. In this it is more akin to play than to work. But it is quite sophisticated play, in which the scientist views nature as a system of interlocking puzzles." In Redheffer's film, we see a mathematician involved in very serious, sophisticated play.

One area in which we are sorely in need of some serious play is the planning for the 1976 Bicentennial of the United States. In this instance, we have begun to confuse celebration with synthetic gaiety or the building of bandstands. During the Depression, the W.P.A. was faced with a disastrous situation, but everyone pulled together and the result was a genuine national celebration. I think our professional societies, including the American Academy of Arts and Sciences, have a responsibility for developing celebrations in the spirit of something real but exceptional – something that is needed but can only be realized within the context of a special occasion.

Our office is working on an exhibit for the Bicentennial – I don't know if it qualifies as something we really need, but it's interesting to us, and only the Bicentennial could provide the chance to do it. The subject is "The Age of Franklin and Jefferson"; it opens in Paris in January 1975 and continues on to Warsaw and London before coming to the United States in 1976. We have, on film, a kind of prospectus of the exhibition as we originally envisaged it. The purpose of the film was to provide the people with whom we were discussing the exhibit with some foretaste of what it would be like; to simulate the experience of the exhibit, so that we could obtain advance opinions before we actually started building the show. We did get feedback, and now the exhibit has moved away from its initial prospectus in various ways.

"Powers of Ten" is my final example of a film that uses various effects not to promote "self-expression" or to experiment with a new, idiosyncratic technique but rather to give the audience a direct sense of exponential change. It was conceived in a way that conveys meaning to a distinguished scientist as well as to a small child.

First we see a close-up of a man sleeping on a golf course; and then, accelerating at a rate of $10^{t/10}$ *meters per second, the camera continuously zooms away; the man is seen as a speck on the grass; then the park itself disappears and we see the earth loom and quickly diminish. We move out through the solar system, still looking backwards at the same spot; we leave the Milky Way galaxy, and eventually view our whole local group of galaxies as a point of light among many objects. The camera then returns and continues past the dimension level of our everyday world to the microscopic level. We see the skin cells of the man's wrist, the atoms and finally the atomic particles. At the left of the screen a dashboard shows the total distance traveled, the corresponding power of ten, the traveler's time, the earth time, and the percentage of the speed of light. A dispassionate female voice describes every stage of the journey in full, rapid detail, also supplying occasional extra information. "We have now reached the point where we can see the distance light travels in one second," she says, and a short line of light, one second long, passes before our eyes. In addition there is a strange, quiet score supplied by Elmer Bernstein on a miniature Japanese organ.*

The choice of a title for this evening – "Language of Vision: The Nuts and Bolts" – was intended primarily as a warning. We have sometimes found ourselves presented under a title such as "bridging the two cultures." To me this is a non-issue and a counterproductive one. If the media people truly had the confidence of their craft, they would be ready to assume the task of conveying those ideas that individuals have a need to convey with a minimum of added art. And if the scientists and engineers had not somehow browbeaten themselves, they would recognize that they have no need for extra aesthetics. What is required to bring these two groups together is nothing exalted – just the nuts and bolts of the subject.

TITLES OF FILMS AND SLIDE SHOWS

Copernicus (9 mins. 30 secs.)

House of Science (introductory sequence)

House of Science (another sequence showing laboratories)

Circus (slide show, 11 mins. 30 secs.)

Clown Face (3 mins. 30 secs.)

Polyorchis Haplus, a Small Hydromedusan (2 mins. 35 secs.)

Exponents (by Raymond Redheffer, 3 mins. 6 secs.)

Franklin and Jefferson (13 mins.)

Symmetry (2 mins.)

Powers of Ten (8 mins.)