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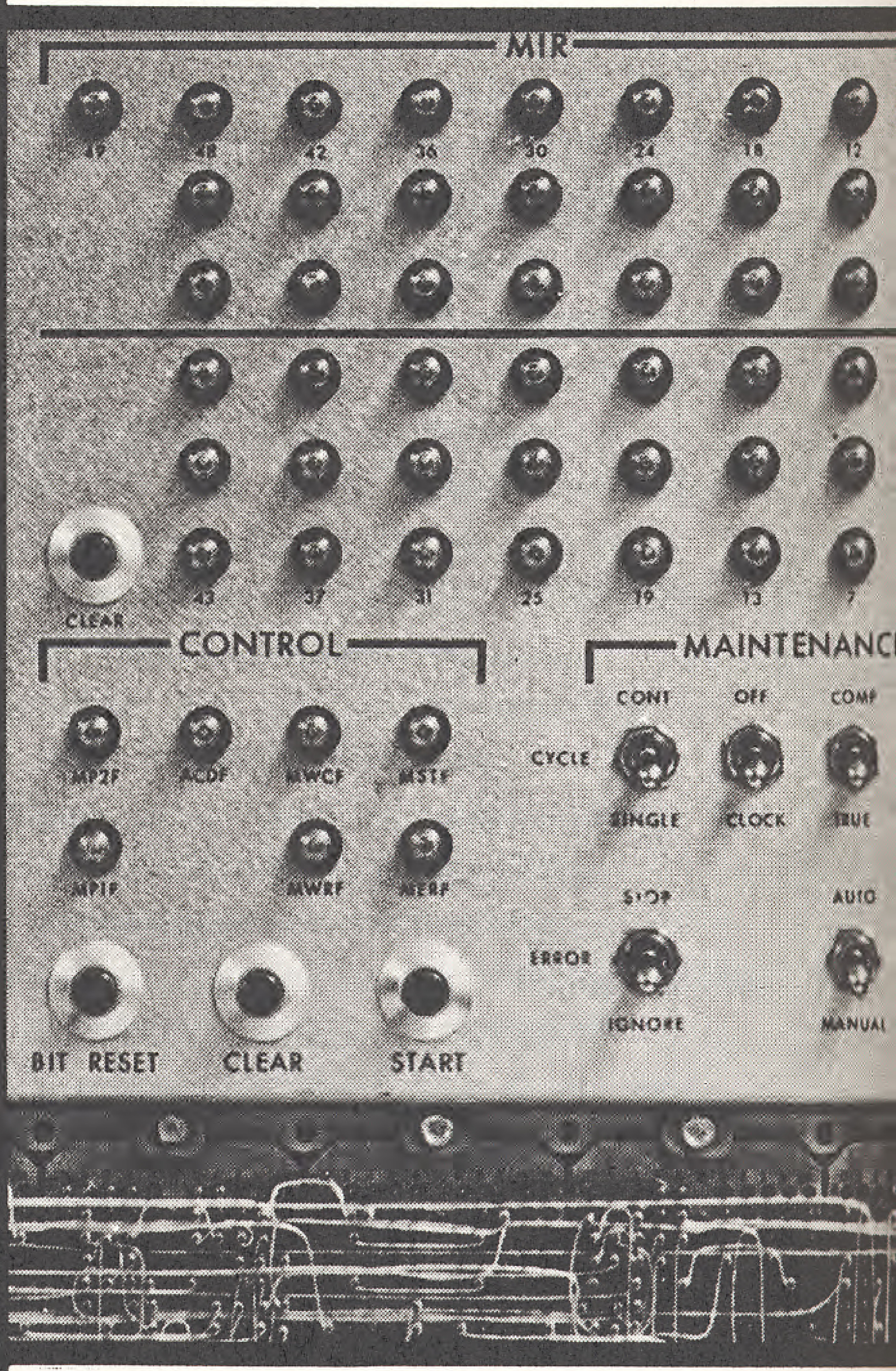

Systems and Art

By Jack Burnham

In trying to teach kinetic art to a group of students in 1962, I came to realize that most educational approaches to this medium degenerate into technique courses in basic electricity and mechanics, and that aesthetic development tends largely to be forgotten. The entire rationale of kinetic art as a successor to static art seems to be based on false premises. It is usually conceived of as being closely patterned on concepts of abstract art — but made to move (electrical and mechanical programming are simply the means to have this happen). The more fundamental relationship of man and the machine — or more broadly, between man, his natural environment, and the entire energy-information web which he calls technology — rarely comes to the foreground. I concluded that the essential task lies in defining the aesthetic implications of a technological world.

The need for this definition is not hard to justify. As every social critic from Ruskin to Galbraith has pointed out, our scientific-industrial culture is dominated by "rational" leaders, who are largely oblivious to the aesthetic and humanistic consequences of their decisions, and thus increasingly man finds himself unable to adapt to his inventions and discoveries. As the general environment becomes progressively more ugly and hostile to human use, the making of beautiful packages, sculptures, or buildings becomes absurd, or at best ineffectual. In a mechanistically functional world the making of art in the traditional sense appears to have little relation to cultural reality.

Surely we are in an age when kinetic art and electronic media could say much to man. But instead of using scientific motifs and patterns to produce fantasies that may charm the galleries, it appears more logical for artists to take up the challenge of the phenomenon of technology itself in its role as an extension of human facility.

The increasing complexity of modern life now makes it necessary for us to view nature and the man-made environment in a single conceptual framework. We have in this country since the 1950's gradually developed a technique for this kind of comprehensive analysis. In response to the vast planning and logistical problems faced by industry and the military in a growing America — man-machine relationships involving costs of billions of dollars — scientists have formulated a methodology which permits them to assemble vast numbers of components into coherent, functioning programs. This is the **systems analysis and design** approach to problem solving.

The systems concept has not had a

flattering press. It has been pictured as characterized by an icy Pentagon-esque logic which largely subverts human values in favor of such abstract expedients as cost-effectiveness, systems balance, and long-term usefulness. The systems approach however, has many uses and seems to be the one technique which can embrace an understanding of the span of present-day technology and its consequences. New models of society are being devised by sociologists with the aid of computer-supported systems techniques, and systems theory has also lately invaded the fields of conservation, pollution control, and human ecology. Even demographers have attacked the emotion-ridden dilemma of population expansion with this technique. It has become apparent that systems are not only interrelated but that some systems are stable and harmless to surrounding systems, while others are highly disruptive. In general, those systems relating technology and human growth have taken the latter course.

Until the present, rapport between art and technology in school has come about through the employment of the Bauhaus pedagogical methods, which are characterized by product design through the use of the abstract motifs. This idea of "making objects" — either for aesthetic purposes or for use as industrial prototypes — has too long dominated design thinking. A **systems** grasp of technology and its problems appears to be much more relevant to our contemporary classroom situation.

In the spring of 1965 a syllabus for an "Art and Systems" course was submitted to the deans of the Technological Institute of Northwestern University. This was accepted into the liberal arts program and made an elective for selected engineers in the following year. The intention was not to introduce engineers to art, or make art students more familiar with the facilities of the Institute, but to develop an aesthetic encompassing the most advanced engineering techniques for problem-solving while making this comprehensible to the undergraduate with no technical training.

The rationale was described as follows in the preface of the syllabus:

In viewing the formative trends of the last twenty-five years, the silhouette of the future must be determined by the following shifts: The understanding of biological life not as mechanical structure but as an electro-chemical control system, politics giving way to living priorities based on stable ecology, system analysis instead of machine design and plant layout in the former sense, books and files replaced by electron information storage and retrieval, and the concept of architecture challenged by atmospheric control.

While this list could be easily extended, in each case a palpable object is being substituted for the fluid consistency of a system — one more compact, versatile and adaptable than its static counterpart. This environmental transition will be accompanied by similar changes in our scale of values. Instead of our present "thing consciousness," more likely we shall become "systems conscious."

This course outline called for making "art systems" rather than art objects. These were intended to have only a given life duration; after their usefulness as pedagogical devices had ended they were to be destroyed. Only records of these "art systems" were kept. These took the form of reports, charts, films and slides.

By and large liberal arts students with some background in the arts or communication were recruited. Gustave Rath, a professor in the industrial engineering department and a systems analyst, selected the student engineers. Rath was instrumental in getting the first facilities for the systems class and he supplied much of the basic literature on systems analysis. Before the course commenced I attended some of his lectures in other classes, and I came to realize that if we were to treat systems as potential art works, the class would have to have rudimentary knowledge concerning the nature and behavior of systems.

Part of systems theory stems from cybernetics with its emphasis on elements of control in the relationships between animals and machines. Most systems have some means of control which determine the goals of the system. Control can be implicit in the structure of the system, or it can be a separate function with a hierarchical assembly such as the human brain and the nervous system. A different level of systems is concerned with organisms and their information and energy exchanges with the environment. Man-machine relationships presume such exchanges also, but are structured differently. It was the purpose of the course to change the student's perceptual sense so that he would be able to appreciate these frequently invisible interactions between interlocking and neighboring systems in higher and lower relationships.

The reason for applying a systems context to such an art synthesis may still be unclear. It is necessary to realize that the trend in research and industry to conceive of machines, information processing equipment, and personnel as a single totality has a distinct affinity with some of the more sophisticated happenings and art environments of the past few years. The best contemporary museums today are less storage space for art objects and more laboratories for mixed-media events.

The comprehensiveness of systems theory covers very dissimilar physical assemblies. Analysis includes changes in time or the "states" of a system. Such changes are defined by a system's transforming functions. Both the nature and duration of systems may vary radically. For instance, systems might include sports, means of communication, transportation terminals, plant life, star systems, motion picture making, waste disposal — all very dissimilar, but all classifiable within a systems context. Quite possibly some of these have similar characteristics in terms of their behavior and structure **as systems.** Such common characteristics provide the basis for analysis and can also establish revolutionary new criteria for aesthetic concerns.

For hundreds of years we have dwelled on those qualities which reveal the beauty of a painting or piece of pottery. Yet what makes one system aesthetically superior to another? Are our value judgements in this respect connected to our own self interests? For many, including the systems analyst, the answer would be yes: we do tend to judge systems in terms of their usefulness and compatability to ourselves. Yet for certain advantages humans tolerate destructive and ugly systems. Then how do we make adjoining and linked systems compatible? How does technology relate man-made to natural systems so that they maintain a healthy stability? Which man-made systems need to be abandoned or revised because of their harmful effects? Many of these appear to be solely practical, and at times utopian, considerations; actually they are aesthetic concerns of the highest priority.

A systems aesthetic presumes that the patterns of advanced technology should not be abandoned for simpler life patterns. Machines and information systems are not alien to human welfare, but appear to be compatible extensions of it. Within this context the place of the artist becomes less precisely defined. He is not so much an artisan forming hand-crafted artifacts in the traditional sense, but someone supremely sensitive to the evolving environment. While his role may still be to comment upon this environment in the aloof fashion of gallery art, he actually becomes responsible for forming that environment. Until the industrial revolution this task was traditionally the artist's and any future rapproachment between art and technology demands recognition of this fact.

During the winter of 1966 these and other concerns were projected in a series of papers written by engineering students. Dr. Rath, who guided these pilot studies, was mainly concerned with defining the objectives and methodology of an effective systems course whose major focus was the delineation of pertinent aesthetic criteria. The first "Art and Systems" course was offered in the spring of 1967. It was held in the Technological Institute because of needed facilities, despite the fact that deans of engineering are by inclination reluctant to make such concessions. (A later project in the course was that of designing the ideal systems classroom.) We discovered that an effective systems classroom should provide extensive working areas, a media storage area for keeping records of systems, and most importantly a portable "demonstration" facility which could be brought right into the classroom. In appearance this classroom should look like a theater-in-the-round with a movable bleacher stand. As yet most universities build for specific departmental demands, which in the more retarded disciplines, are usually projections of present curricula. The desire for large flexible working areas, equipped with sophisticated electrical and audio-visual facilities, can grow only as interdisciplinary courses prove their value.

To the outsider, a systems and art course, if it involves pure problem solving of a practical nature, becomes a kind of parody of engineering protocol — which is not bad in itself because this brings into question the routine practices of decision-making. As one student put it, often in technical classes teachers build "invisible electrical fences" around their subjects. These avoid questions about the objectives of various industries. The engineering student may learn the method of his field, but not the moral implications of his job. In some instances this has been changed, and a few universities now give courses in engineering ethics.

By and large most deans of engineering avoid mixing technical training with the philosophical bent of the humanities. While the student engineer may be obliged to devote several semesters to such liberal arts subjects as English literature and art appreciation, such teaching rarely impinges directly on his professional training. Some educators already feel that engineering training is inherently far broader in scope than equivalent exposure in the liberal arts. With some degree of justification, they point out that technical training is more in step with the realities of our society, and that the real educational deficiencies lie elsewhere. Thus it would seem that an art course introduced into a technological school might prove disruptive, or subversive in its impact on the young engineer's education. There is probably some truth to this.

Introductory lectures were begun with a philosophical approach to systems, its use in science and industry and effects on art up to the present. The latter dealt not only with kinetic and environmental art, but with protection and conservation systems in the museum. It should be noted that while the systems frame of reference is easy to grasp, it can also attain almost unlimited complexity. Also emphasized were the hierarchy of types of control for systems, input-output criteria, and the organization of systems. Simplified check lists were devised, defining problem-solving protocol and aesthetic concerns. While these were mostly intended for the non-technical student, they were not meant to be "rules" but rather more intuitive guidelines.

During the first week the chief task was to teach students to conceptualize projects in terms of systems thinking. For this simple problems were devised. One was a kind of charade where participants acted out complete systems in as abstract terms as possible. Work games were played wherein diverse systems with similar properties were listed. Also *haiku* were written. These contained three short lines, each of which represented a state in the history of a system.

Games are probably the natural and most human form of systems. We found these could be played before television cameras as a kind of mixed-media event. The audience had to learn the rules of the game by gradual participation. Tapes of these events were later played back to the audience, after a lecture was delivered on "human communication systems." It became apparent that many games contain subsystems which are subtle variations in human communication and response. The first year we used a single Sony closed-circuit T.V. unit. This proved flexible but limited in editing and picture quality. The year following, a training T.V. studio with monitor, director, and three cameras proved more adaptable to capturing the essential aspects of systems. The director was given editing power with the premise that activities were to be viewed not as dramatic events but as goal-oriented procedures. Rehearsal was rejected because it was felt that this defeated spontaneity. One game involved building a wooden structure with an aluminum foil covering around the outside entrance to a self-locking door; anyone going through the door would lock himself in the aluminum foil cage. Actually the "rules" for this game were developed during the building of the cage. The game had no other goal than to make the T.V. director angry through constant noise and interruptions, so as to cause him to stop building short of completion. In such a way the best systems usually provided some degree of environment invisibility.

We discovered that classwork was best facilitated by having technical and non-technical students working together. Groups were changed after each project. It was our experience that large groups working on the same project — unless given a specific task — were ineffectual in making decisions. As a technique the systems approach presupposes that problems will be approached step by step on a logical growth basis (this is best elucidated in Carl Gregory's *The Management of Intelligences: Scientific Problem Solving and Creativity,* McGraw-Hill, 1967). However, this in itself takes a good deal of indoctrination and training in systems thinking. Such autonomy in decision-making needs discipline which basic classes cannot be expected to have. Dr. Rath felt that ideally a systems class should be "self-organizing" in that it becomes capable of creating its own problems, which are a natural outgrowth of earlier efforts. Too often in past instruction, with the prime example being the Bauhaus Vorkurs or basic design course, techniques and problems have become codified to the point where they are stale. But we found that much class time is wasted unless the direction of the class is set towards concrete ends. As a method, the systems approach is eminently perspectivistic. Yet the teaching goal in such an atmosphere is to allow divergent ideas to build towards solutions rather than constant dissension.

Not only should systems be designed, but a major aspect of the course should be the analysis of man-made environments, stressing those features which might allow a system to be considered an underground work of art. Aesthetic merit does not necessarily rest on the visual level. "Nice looking" systems were rejected because frequently their assets were too obvious. Once a system was picked, students spent a good deal of time experiencing it and making detailed reports of their reactions. These reports were synthesized and the results made into a flow chart showing the system's structure. This was supported by slides and photographs where possible. A final stage consisted of abstracting the system into some form of analogue or model.

Such analysis can be made about almost any phenomena. Some of the more unusual in our classroom were the experience of "seeing a lighthouse," the destruction of a black ghetto apartment building, the operation of an automated food dispensing area (known by the students as the ro-"Bot Room"), daily activity on a subway between two stops, a sewage canal and its processing plants as a communal feature, and management strategy for discouraging the writing of graffiti in a men's room with counter-tactics.

This year a final problem centered on ritual, particularly its function in a society where meaningful relationship has been reduced to interaction between people and mechanical systems. Research was done on the function of ritual as it has traditionally circumscribed human need. As the anthropologist Claude Levi Straus has shown, games and rituals present a dichotomy of human attitudes — games separate people by establishing winners and losers, while rituals conjoin by diminishing differences. One might say that the purpose of our system approach was that of creating a ritual with contemporary meaning. This is far from simple since rituals evolve over long periods of time. They should have a sense of rightness about them that springs from existing custom, resources, climatic conditions, scientific knowledge level, and collective need.

Originally systems thinking grew from the necessity of breaking questions into discrete, concrete, quantitative problems which could be fed into a computer. If the systems approach is anything it is logical. And this very insistance on logic runs counter to the nature of art. Historically in art goals and the means for reaching them have been derived from intuition. Thus the goal of making a ritual was an arbitrary act. The process by which the format of the ritual was evolved was a systems problem. Here a series of alternative physical events within a given environment had to be discovered. As important as goals are to systems thinking they cannot be predetermined originally through such methodology.

At first the class as one group discussed the problem of designing a ritual. Gradually several parameters began to take shape in view of the goal. Chief among these was the decision to hold our ritual on the Lake Michigan shore in the early evening. At this point it became evident that our objective was only partially revealed. After two weeks of rather futile discussion the class one day sat silently on the beach together for a whole afternoon. Then without guidance they came to the conclusion that their ritual would be based on the lake's gradual pollution.

At this point a systems approach became feasible. Not facing a typically complex engineering problem they were able to employ a fairly simple check list to create the ritual. These are the traditional set of questions which the systems analyst asks himself periodically throughout the course of his investigations.

1. Define the objective or objectives of the system under consideration as precisely as possible.
   A. What criteria indicate achievement of the objectives?
   B. What resources and constraints exist?
      a. Talents and capabilities of the designers
      b. Sources of supply and assistance
      c. Time limits and tentative schedule
      d. Relevance of existing physical systems
      e. Societal sanctions
   C. Evaluate feasibility of objectives in terms of resources and constraints.
   D. Consider alternatives, if necessary, to present objectives. (recycle problem through above outline if necessary)
2. Designing the Art System
   A. For each system indicate its components or subsystems. Also consider the system as a subsystem embedded in a larger supersystem.
   B. What are the working boundaries between systems levels?
   C. Define the structure of the system. (Graphs and charts showing input-output, transfer functions, states, sequences, timing, etc. can be prepared as elaborately as needed. Techniques for getting at these are extensions of systems methodology. The point of such planning is to make as few assumptions as possible.)
   D. Transcribe subsystems to their physical equivalents in terms of function and selection.
   E. If necessary propose alternative components.
   F. Measure system chosen against ultimate objective.
3. Systems Assembly
   A. Allocate work tasks and target dates.
   B. Test assembled subsystems for performance and compatibility.
   C. Evaluate system as a totality.

The class as a group met to draw up a table of answers to the first section and to part "A" in the second section. Groups were formed to work on each of the subsystems plus several contingent needs such as scheduling, getting permits, generating publicity, and locating materials. Other groups worked on the ritual itself, some constructing the ritual, some designing musical instruments using water, and others designing and building a tall glass water still with the help of a chemistry department glass blower.

In a sense much of the protocol here resembles the typical divisions of labor as they occur for any stage production: scenery design, lighting, stage crew, director, actors, etc. From a systems viewpoint the important thing is to provide collaborative efforts with a frame of reference for their work task, especially when these involve new goals, new physical environments, and technical requirements. Once work tasks are assigned, implementing the system becomes a

The Age of Aquarius — A Problem Centered on Ritual

matter of routine. Group creation is probably one of the hardest activities to structure and the use of a systems checklist under such circumstances becomes a matter of intuition. Too much insistence on formalized procedure tends to dampen general enthusiasm. Some students work best alone and this has to be taken into account, as do inevitable antagonisms.

Two days before our purification rite, which was called "The Age of Aquarius," all systems were set up for a dry run on the beach. The still had been tested in one of the chemistry labs. A kind of dais was constructed by the four "masters of the ritual." At the edge of the beach, stones were removed from the sand for a fifty yard radius.

At 5:00 p.m., May 30th, 1968 we prepared for the ritual by raking the ring and setting forty truck flares at its outer edge — these last were to be lit at the beginning of the ceremony, just at sundown. The musicians set up their water tubs, glass rods, and drinking glasses. Somehow the purification rite became a self-organizing process. People instinctively sat down and were quiet. An Evanston police car which had been watching from the road, radioed back that we didn't look very dangerous and drove away. Somehow the fact that one hundred people were sitting on a beach, watching a charcoal fire under an assembly of flasks and tubing, began to take on a significance which none of us had expected in the planning stages.

Except for bits of music in the background the ritual was silent and symmetrical throughout. Reminiscent of a Japanese tea ceremony on a larger scale, it centered around the processing through the still of rather doubtful Lake Michigan water. As the water dripped into a large green flask, all participants were offered small glasses of the result. Some refused to drink, pouring their water into the sand. All of us contemplated the water we were drinking and except for the class no one had been told that they would have to drink it. While the pageantry was spectacularly beautiful, the pathos of the event was certainly not lost on the more sensitive.

Two years ago a student in engineering management, well versed in systems analysis, wrote a paper for the course. His theme was to define those aspects of systems which people enjoy. The substance of his conclusion was that people enjoy participation, and the more this involves the whole range of their senses and interests the better. Beyond this he speculated that too many of our "systems" (technologies, transportation means, media, education) do not involve people enough and seem to be constructed as if people were outsiders looking in. In this sense much of daily life has been made non-participatory, not only in socio-political ways, but in the most sensual ways. If systems thinking does nothing else, it makes us realize that we ourselves are on-going, self-organizing systems that need to resonate with the systems around us.

THE DUEL by Julian Stanczak — Courtesy Martha Jackson Gallery