before accepting it as fact. Since this does not seem to come naturally, one hopes such a general procedure can be taught more successfully in the future than it has been in the past.

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Computer-Age Art

Science and Technology in Art Today. JONATHAN BENTHALL. Praeger, New York, 1972. 180 pp., illus. Cloth, $8.95; paper, $4.95. Praeger World of Art Series.

During the last five or six years nearly a dozen books have appeared about the growing enthusiasm of artists for scientific and technological phenomena. Some are historical résumés, others tend to be overenthusiastic apologetics for future-oriented art. Because of its author's breadth of perspective and consistently fair critical sense, this book is in many ways the best of the lot.

Benthall possessed a sound technical background when he began to write a monthly column on "art and technology" for *Studio International* four years ago. Two lecture series which he planned for the Institute of Contemporary Arts in London remain the most provocative of recent attempts to span the gap between human mythic systems and scientific rationalism. Among the topics covered by his book are: the significance of "media studies" (studies of techniques of communication) to the fine arts, photography as an art medium, the esthetics of computer systems and laser holography, recent evaluations of kinetic art, art and the ecological trend, the analysis of art through linguistic models, and finally a summation of the cultural attitudes—and illusions—that tend to distinguish the goals of art and science.

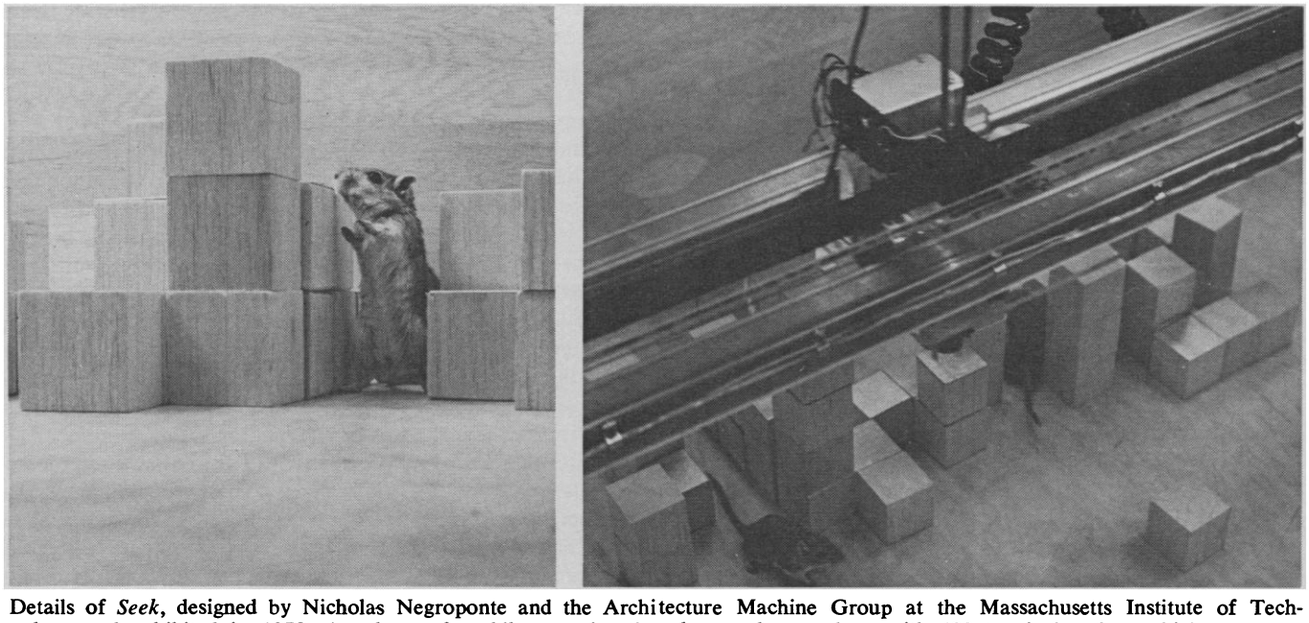
Most recent attempts to fuse sophisticated technology with art have met with bitter hostility within the art world itself. Benthall is very much aware of this, and his own cautious, hardheaded criticism of much recent "Teck-Art" is the best response to the emotionalism generated elsewhere, both pro and con. For instance, his clarification of the question of creativity within "computer graphics" is helpful. He writes in part,

> The term 'computer art' is itself a provocation (even more than 'artificial intelligence') because the very terms in which we often characterize art—'humanity', 'warmth', 'spontaneity', 'sincerity', 'originality' and so forth—are laden with implicit prejudice against the values of which the machine is a symbol.

To an art critic who dismisses an example of the ecologically oriented art of Alan Sonfist—one in which crystals vaporize and condense in a container—as a "high-school physics project," Benthall replies,

> Looked at in this way, all of Sonfist's work would be quite meaningless. . . . One cannot really argue with those who refuse to respond to such work as legitimate forms of art. But one can insist that a painting by, say, Rothko is not meant to be taken as an experiment in the drying properties of paints, nor did Duchamp exhibit his famous urinal to measure the viscosity of urine. Conversely, the technical sophistication or novelty of a work of art is no guarantee of its *artistic* interest.

Benthall does not bog down in elaborate technical detail, nor does he take sides. His book differs in two other respects from its predecessors. He devotes a good deal of space to various research projects which neither by intention nor by popular definition qualify as art but which either have strong esthetic appeal or parallel research conducted by artists. In dealing with Joel Weizenbaum's conversational computer programs or Nicholas Negroponte's computer-controlled gerbil environment, Benthall is dealing with questions raised by artists and esthetic-ians—rightly seeing that if the art-



Details of *Seek*, designed by Nicholas Negroponte and the Architecture Machine Group at the Massachusetts Institute of Technology and exhibited in 1970. A colony of gerbils occupies the glass enclosure along with 480 two-inch cubes, which a computer transports, stacks, and aligns by means of an overhead electromagnet. The computer "configures the original assemblage of blocks by using a random number generator which has been programmed to have tendencies to provide enclosures . . . nooks, crannies, and mazes in which gerbils can play." The gerbils' movements continually disrupt the constructions, and the computer continually realigns displaced blocks or, where the dislocation is of sufficient magnitude to be interpreted as "a gerbil-desired move," attempts a new arrangement. A spectator who perceives the display as a metaphor for life in the Machine Age may identify "now with the freedom of the gerbils to consume and excrete, scurry, court and squabble, now with the responsibilities of a lumbering bureaucracy to keep the environment orderly." [From *Science and Technology in Art Today*]

technology symbiosis has any significance, it is in conceptually dissolving the old boundaries.

The author's remarks on the structural relations that may exist between art and natural language are perhaps his most provocative. At one point he writes, "For instance, computers cannot handle natural language, and this fact is held by some (rightly in my view) to be very relevant to a provisional definition of human creativity." In his chapter "The implications of linguistics," Benthall makes some far-reaching speculations on the systems approach to ecology and the applicability of the same principles to other language and sign systems. One wishes that he would push these a bit further. Probably the average art-lover will find little of comfort in Benthall's book. But for the serious reader who has lost patience with the antics of avant-garde art, this introduction into one realm of it will prove a clarifying experience.

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Coming to Grips with Time

Time in Science and Philosophy. An International Study of Some Current Problems. JIŘÍ ZEMAN, Ed. Elsevier, New York, 1971. 306 pp., illus. $17.75.

The Study of Time. Proceedings of a conference, Oberwolfach, West Germany, Aug. 1969. J. T. FRASER, F. C. HAVER, and and G. H. MÜLLER, Eds. Springer-Verlag, New York, 1972. 550 pp., illus. $20.30.

Temporality is so pervasive that a thorough understanding of it would seem to be a prerequisite for success in any philosophical or scientific investigation whatsoever. Yet, like all such pervasive and general features of experience and of the world, it resists direct characterization in general terms and is involved in so many diverse disciplines that a complete and unified analysis based on these is all but impossible. By bringing together writers from diverse disciplines to deal with problems in which time plays a central role the two volumes here reviewed attempt to overcome the difficulties which the lone investigator would encounter in attempting such an analysis.

Failure to achieve the rather ambitious goal of a complete and unified analysis of time would by no means render these books unworthy of note. Each of them will be found useful, if not indispensable, for many purposes, some of which are pointed out below. Certainly no major university library or special collection dealing with the philosophy of science, philosophical problems of physics, or philosophical problems pertaining to time can afford to be without either volume.

A crucial question in examining these works is whether these heterogeneous writers succeed in speaking the same language to a sufficient degree to communicate with each other or with a common audience. Only to the degree that this goal is realized will it be possible to progress toward a deeper, more encompassing, and more unified understanding of time.

Ironically, of the two books, it is the one which deals primarily with a narrower range of topics, *Time in Science and Philosophy*, that is the less successful in this. It seems that the "philosophy" followed by the editor has been to include selections from as many viewpoints and approaches as possible, and the contents of the book are grouped under the headings Astronomy and Physics; Geology, Biology, and Psychology; Philosophy; and Time Measurement. Yet the bulk of the material is devoted to philosophical issues related to the physical sciences and such allied fields as information theory and probability theory. Some of the articles, including the opening one, are so technical that potential readers are limited to those knowledgeable in these fields. If the book has a common audience it would thus have to be a subclass of those persons knowledgeable in the physical sciences. Yet, very few such readers—indeed very few readers at all—are likely to profit from an exposure to the barrage of highly specialized technical jargon encountered in one of the psychologically oriented articles. Still less likely is it that a reader with a scientific background will gain new insight into the nature of time by being told, in another article, that in positing the notorious thermodynamic or "heat" death of the universe modern science has unwittingly stumbled upon a fragment of the wisdom of the ancient Vedic sages, who, through special powers of intuition and cosmic insight which modern man lacks, came to know of the great World Cycles, the largest of which lasts 3.1104×10^{12} years and begins and ends with an undifferentiated formless state of pure consciousness or energy. Some of the other selections pose similar problems. Thus, neither the problem of specialized technical vocabularies nor that of incommensurable methodological and epistemological commitments seems to have been dealt with satisfactorily.

In contrast, in *The Study of Time*, although the problem of technicality persists in discussions in which the concepts and findings of physics play an important role, a more consistent effort seems to have been exerted to make the gist of arguments and issues clear to the reader who lacks the technical background to follow the details. In the life sciences and humanities surprisingly uniform success is achieved in dealing with the problem of technical jargon. Since *The Study of Time* contains large sections devoted to the life sciences (primarily biology and psychology), philosophy, sociology, cultural and intellectual history, drama and art criticism, as well as a special section on flight dysrhythmia, this achievement is all the more remarkable. Incommensurable epistemological and methodological commitments are also much less of a problem, largely because the basic viewpoints taken by the authors are all Western and empirical. Conceptions of time from other philosophies and cultures are discussed, but from a Western, empirical viewpoint. Within these limits epistemological and methodological diversity is present, however, and can be expected to surface in any sustained probing of the philosophical issues involved in the problems presented. In some cases basic philosophical commitments and their consequences are very much in evidence, as is the case, for example, with the surprisingly virulent—for the 1970's—logical positivism of David Park in "The myth of the passage of time."

Taken as a whole, however, *The Study of Time* seems to succeed in providing the necessary conditions for the development of a deeper and more unified conception of time. Thus it might serve very well as a text for an interdisciplinary course on time, provided the instructor is prepared to provide appropriate supplementary material from the physical sciences for those whose background in them is inadequate. All factors considered, however, both volumes here reviewed are likely to see the most service as resource and research references. Each