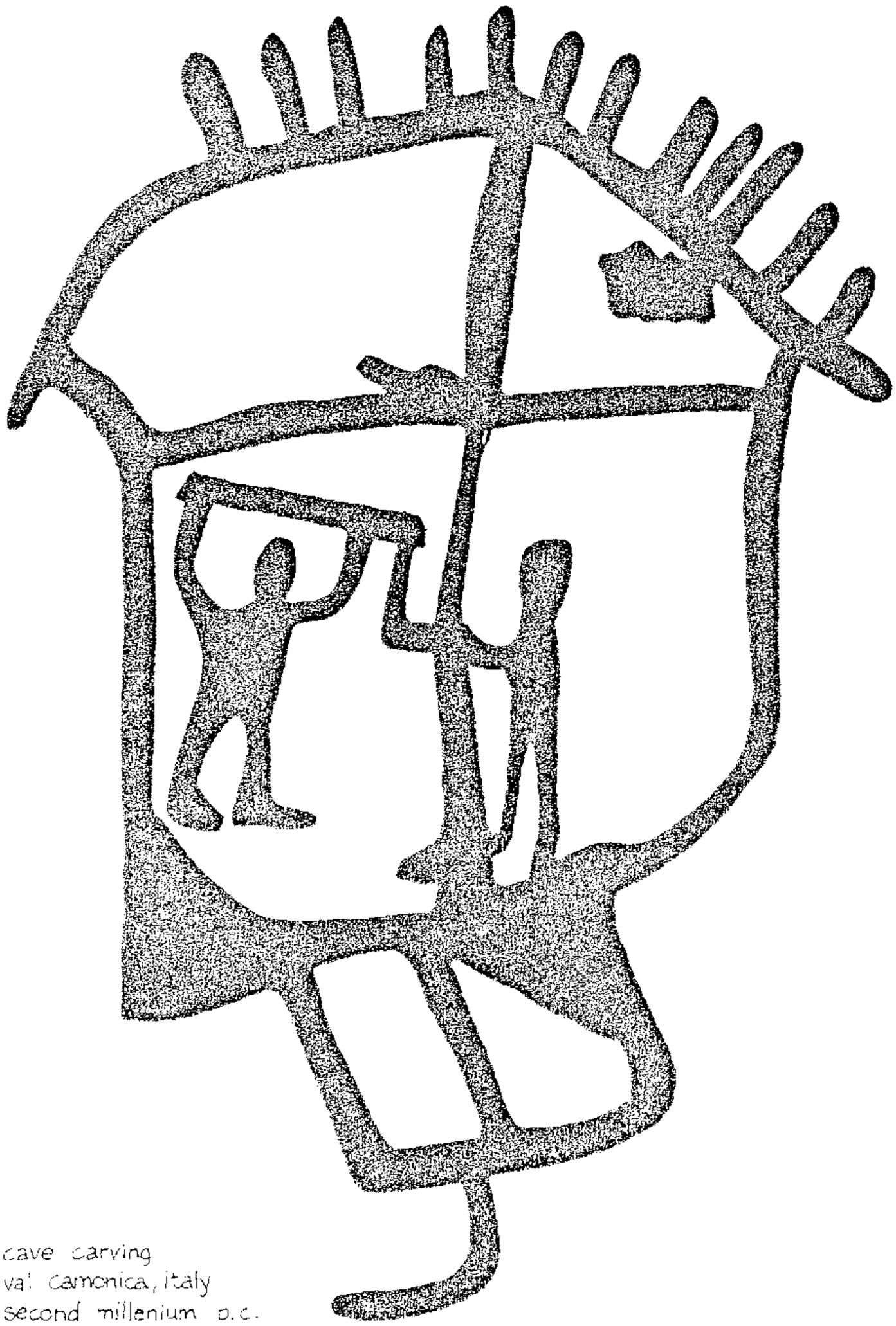
The Responsive House



cave carving
val camonica, italy
second millenium b.c.

The Responsive House

Selected papers and discussions from
The Shirt-Sleeve Session in Responsive Housebuilding Technologies,
held at the Department of Architecture,
Massachusetts Institute of Technology,
Cambridge, Massachusetts,
May 3-5, 1972.

Edited by Edward Allen

The MIT Press
Cambridge, Massachusetts, and London, England

Strategies for Evolutionary Environments

Wolf Hilbertz

"Not form, but forming, not form as a final appearance, but form in the process of becoming, as genesis."
Paul Klee

1. INTRODUCTION

If we ever will be able to discuss what has been called interactive, self-organizing, adaptive, intelligent, responsive, cybernetic, or even evolutionary environments in a sense other than utopian, large scale integration of the arts, architecture, engineering, and the hard and soft sciences has to occur. In order to promote the forming of the necessary substrate of integrated knowledge and creativity, unusual hypotheses will have to be set forth and fresh questions will have to be posed. The approach is heuristic.

The development of environments within the previously mentioned framework is in its embryonic state. Notions like flexibility, changeability, design participation, fit, increased choice and decision making, accomodation of continuous change, man/environment interaction, etc., are abundant, but the meaning is not clear. Goals are not stated and the underlying philosophy is obscure.

On the other hand we have to guard against a scientoid reductionism which certainly would prove to be detrimental to this emerging field. Only holistic approaches promise to successfully cope with the problems of increased complexity that we encounter.

2. BACKGROUND

In 1966 we began defining the potential role of cybernetics and evolution in a genuinely progressive architecture. Since then, principal research interests center around:

1. Evolutionary, self-organizing environmental open systems capable of forming higher orders of organization; dynamic morphological and psychological manifestations in transactional symbiotic response to continually changing interior and exterior forces.

2. Man-animal-plant-technology-nature symbiosis including the interpretation and effectuation of behavioral, social, and other information from animate and inanimate sources for environmental solution generation and processes.

3. The environment as an evolutionary code and the interfacing of information and morphogenetic systems.

Wolf Hilbertz teaches in the School of Architecture at the University of Texas, Austin, Texas, and is the Head of the Symbiotic Processes Laboratory.

4. Exploration of man's inner and outer self in a rapidly evolving synergistic setting with the prospect of enhancing and complementing organic and socio-cultural evolution, both being the result of organism-environment interaction.

5. The development of morphogenetic (material distribution, manipulation, and reclamation) systems on land, in air and water, under the earth, on polar icecaps, and in extraterrestrial space.

6. Energy requirements, energy-harnessing developments and energy conservation.

7. The socio-political and biological implications of proposed complex symbiotic environmental systems.

3. RESPONSIVE ENVIRONMENTS

To chart the historical development of building technology it is useful to compare the flexibility of use with the degree of industrialization. (Figure 1). Beginning with existing and modified cave volumes such a progression eventually leads to the evolution of a cybernetic technology which leads to responsive environmental systems. This implies that the user becomes the stimulus to which the environment responds.

Conceptually, such systems eliminate interpretive linear skills of the building profession which have so successfully adapted architecture to past circumstances, while placing the user on Procrustes' bed and ignoring him thereafter.

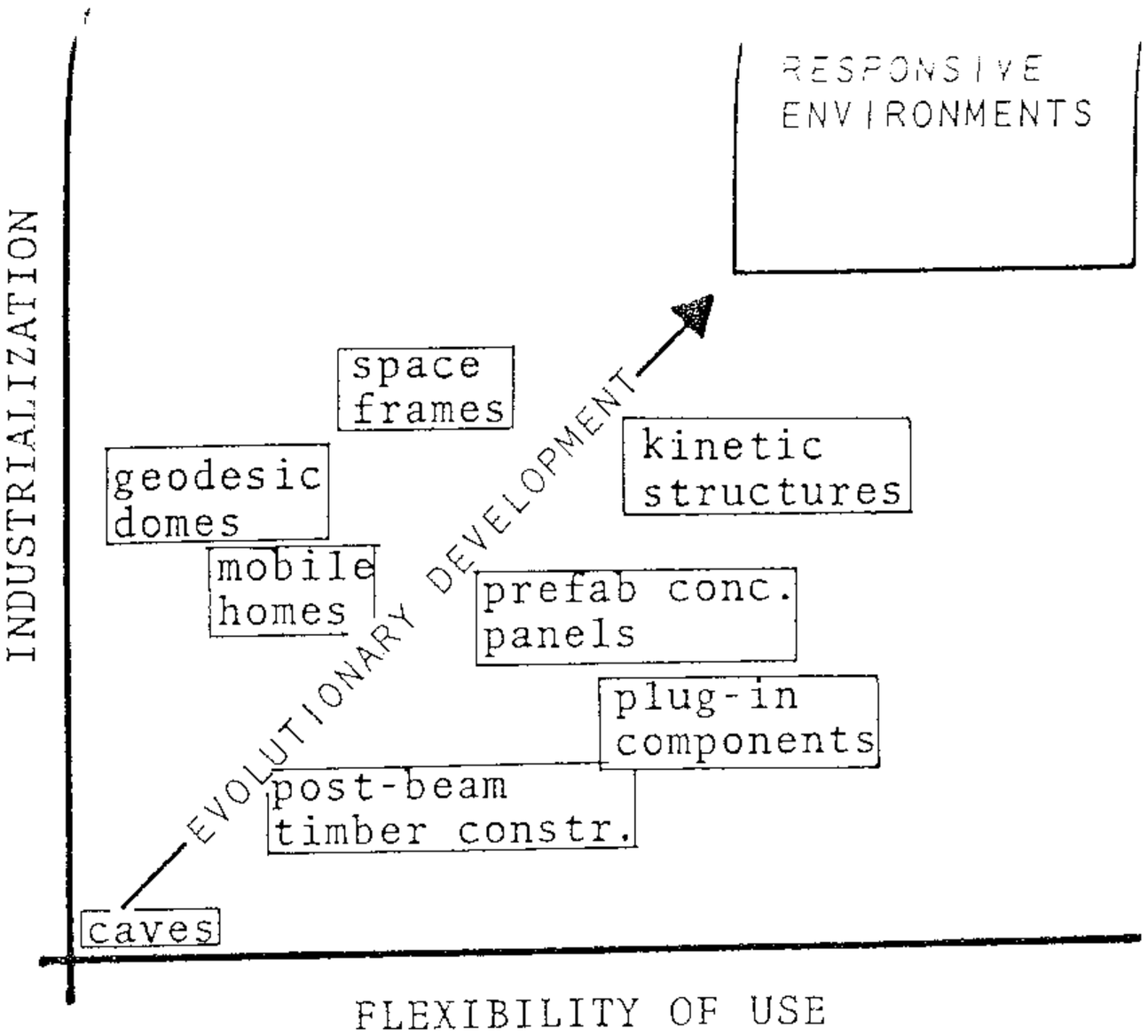
The potential implications of responsive environments are far reaching. First, the development of diverse life-styles within varying social contexts would accelerate rapidly.

Second, the dynamics of such environmental systems would serve to weaken considerably outdated beliefs and petrified institutions; and would ultimately generate previously unpredictable solutions based on the currency of the moment. Conceptual activity occurring in this and related fields seems to have already laid the groundwork for these changes.

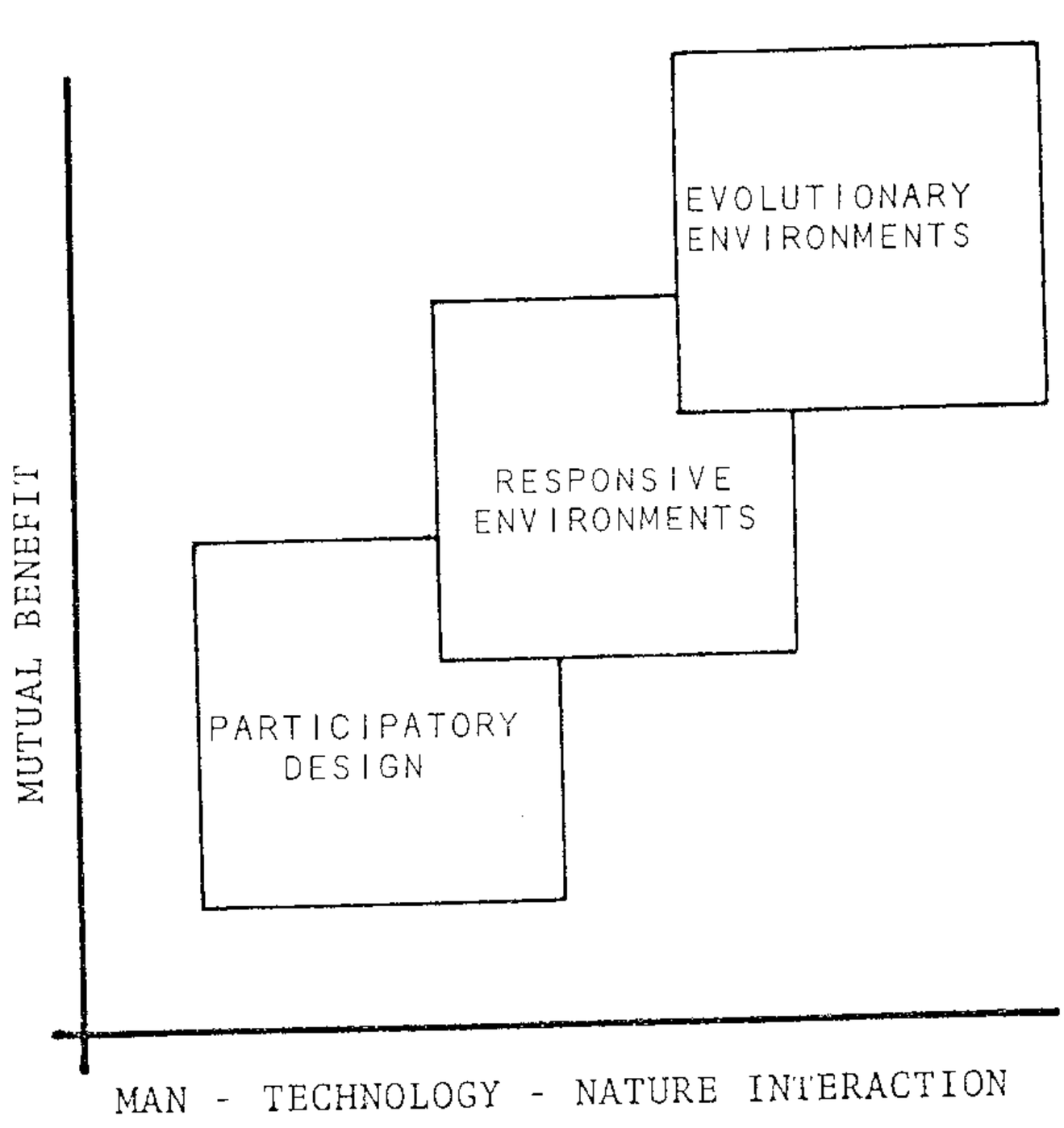
Third, the development of cybernetic environments requires new "yardsticks" by which to gauge and reflect changing goal structures. The use of measures of flexibility and industrialization would no longer be adequate.

Fourth, the development of these environments appears to be merely a requisite stepping stone on the way to achieving what I refer to as evolutionary environments. (Figure 2).

Since, in this context, the morphism of the environment to meet changing needs and stimulate further development demands increased plasticity, the traditional separation of morphogenetic capability and material has to be abandoned. Thereby the morphostatic component is weakened. A detailed description of proposed morphogenetic hardware and reversible materials with sensing properties is given elsewhere (Hilbertz, 1967-72).


RESPONSIVE ENVIRONMENTS
space frames
kinetic structures
geodesic domes
mobile homes
prefab conc. panels
plug-in components
post-beam timber constr.
caves
EVOLUTIONARY DEVELOPMENT
INDUSTRIALIZATION
FLEXIBILITY OF USE

G. 1


EVOLUTIONARY ENVIRONMENTS
RESPONSIVE ENVIRONMENTS
PARTICIPATORY DESIGN
MUTUAL BENEFIT
MAN - TECHNOLOGY - NATURE INTERACTION

IG. 2

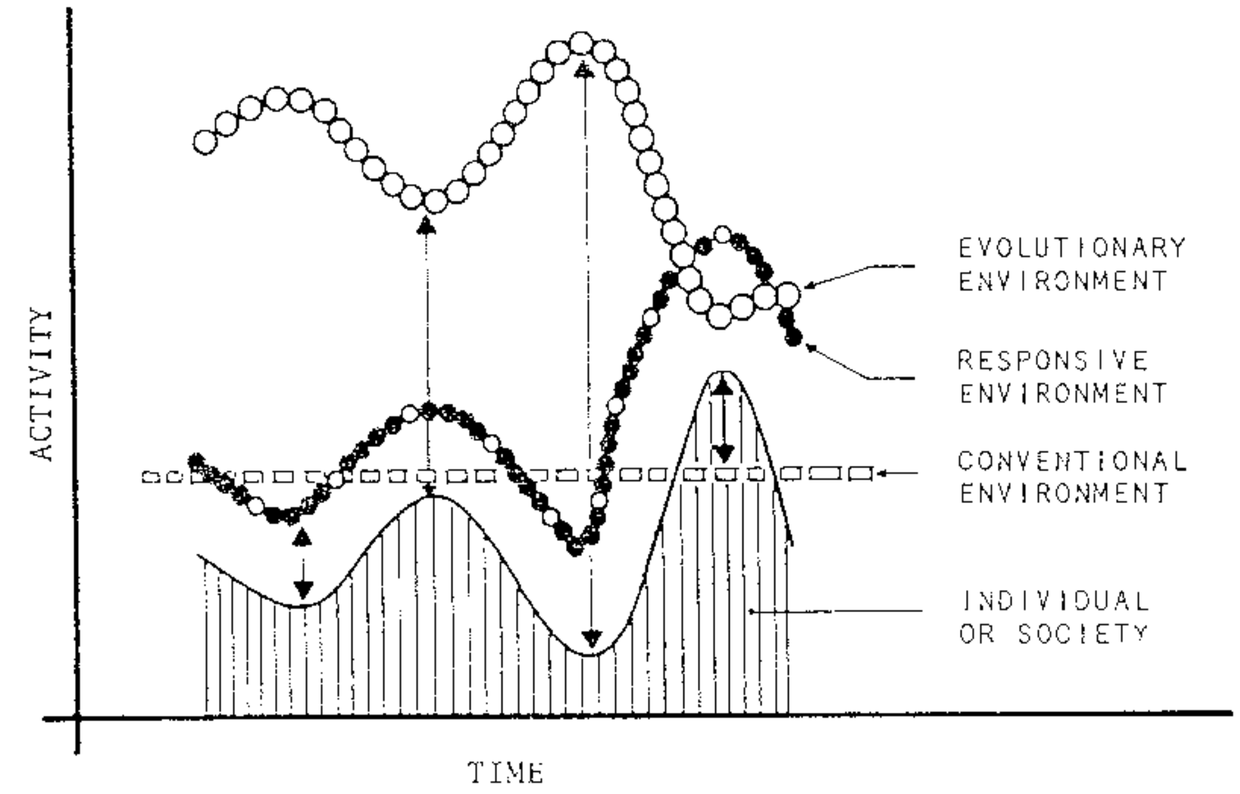

ACTIVITY
EVOLUTIONARY ENVIRONMENT
RESPONSIVE ENVIRONMENT
CONVENTIONAL ENVIRONMENT
INDIVIDUAL OR SOCIETY
TIME

FIG. 3

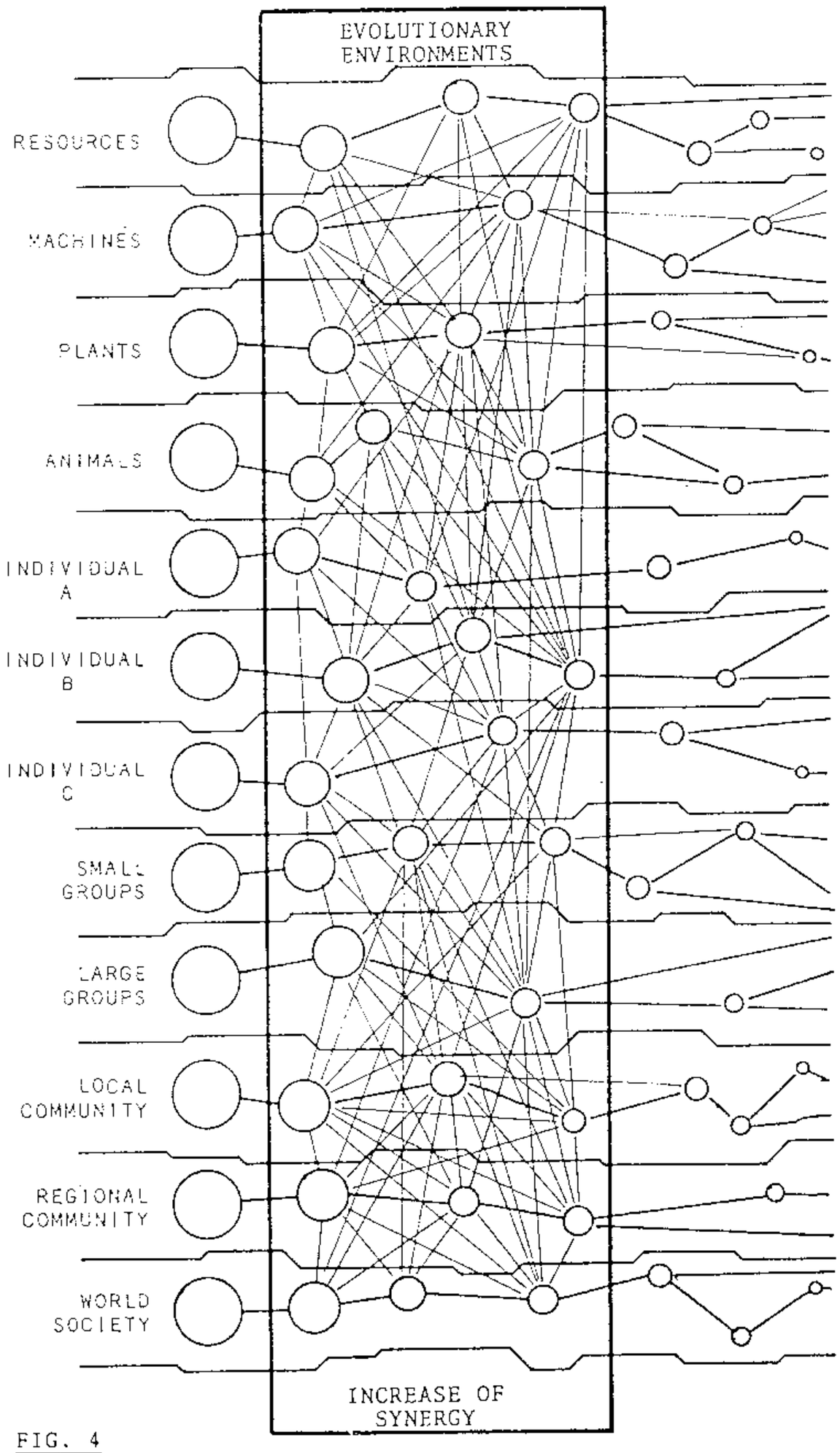

EVOLUTIONARY ENVIRONMENTS
RESOURCES
MACHINES
PLANTS
ANIMALS
INDIVIDUAL A
INDIVIDUAL B
INDIVIDUAL C
SMALL GROUPS
LARGE GROUPS
LOCAL COMMUNITY
REGIONAL COMMUNITY
WORLD SOCIETY
INCREASE OF SYNERGY

FIG. 4

4. EVOLUTIONARY ENVIRONMENTS

The differences between traditional, responsive and evolutionary systems are obvious. (Figure 3). The conceptual separation of the user (stimulus) and the physical environment (response) in the responsive system implies that at best only one-sided evolution or a superficial fit between the two can be achieved. In an evolutionary environment, however, this cause-and-effect dualism is replaced by dynamic interrelationships. (Figure 4). The richness of connections between components determines the system's performance. Whereas the responsive system produces a "mindless fit," the evolutionary system accelerates both socio-cultural and biological evolution through purposeful stimulation. The evolutionary system is comprised of man, his extensions and nature; being simultaneously beginning and end, originator and result, producer and user. (Figure 5).

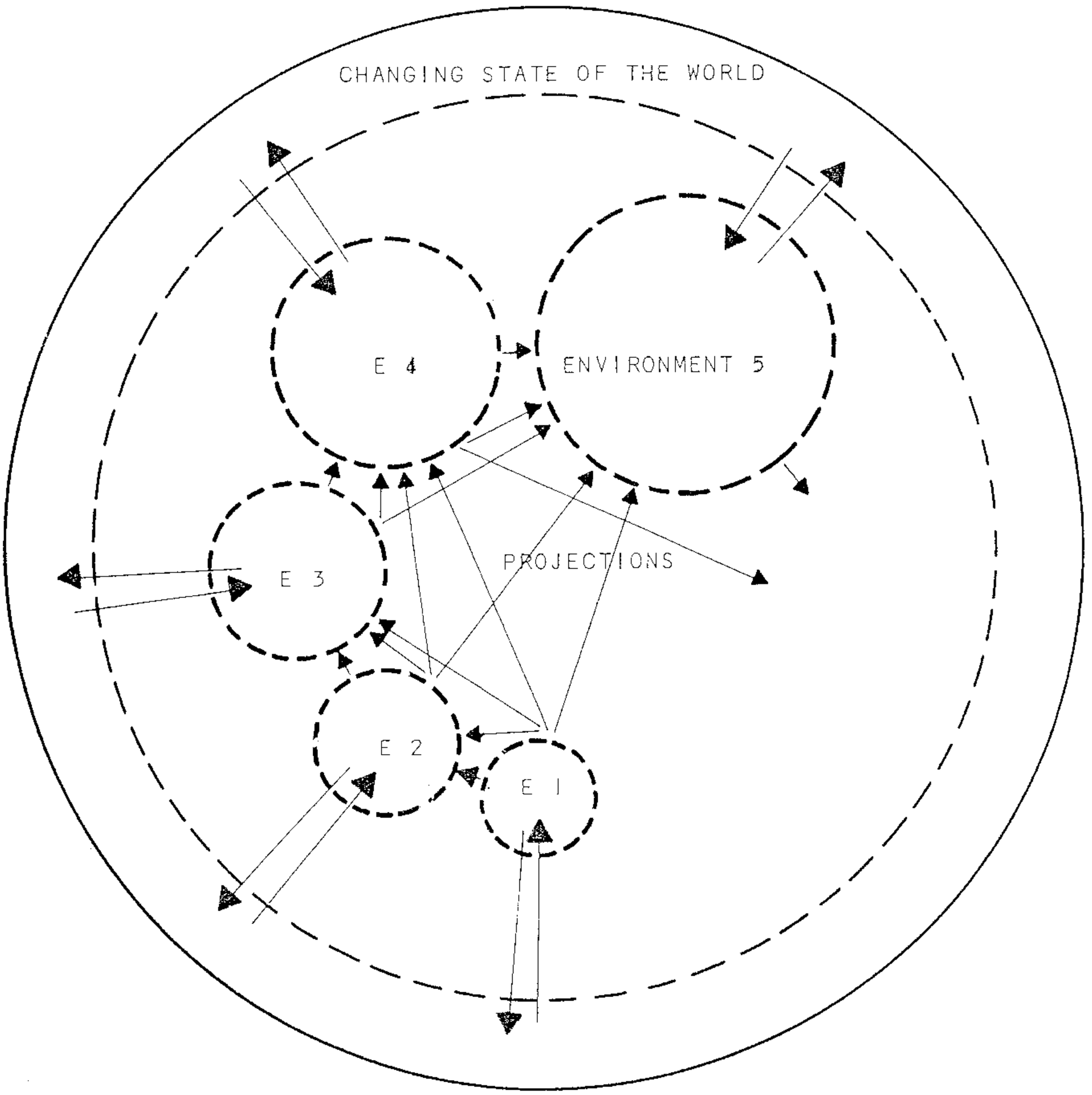


FIG. 5

Since the early Greeks (Aristotle, Herodot, Hippocrates) the influence of the environment on man has been studied. During the 18th century, Montesquieu developed a 'theory of the milieu,' and around the turn of the century the scientific exploration of this field began (Malacarne). Although it was generally assumed that brain changes as a result of organism - environment interaction would occur, only recently scientific proof of this hypothesis was given.

Animals were placed in impoverished and enriched physical environments. After varying exposure times their brains were examined. It was shown that both environments caused distinct and measurable changes in brain anatomy and chemistry. Animals with enriched experience had a greater weight and thickness of the cerebral cortex and greater activity of certain enzymes. They developed larger nerve cells and nuclei, more basal dendrites and larger synaptic junctions. (Bennett, Diamond, Krech, Rosenzweig, 1964; Rosenzweig, Bennett, Diamond, 1972).

Walter (1969) contends that by adapting the environment to our models rather than ourselves to the environment, we oppose organic evolution, i.e., that evolutionary mechanisms no longer apply to ourselves but to our habitat. This is perhaps the earliest most general description of a responsive environment.

But evolutionary environments will be structured in a way as to insure further and faster organic, sociocultural, and environmental evolution. Organism - environment processes and consequences are mutually dependent systems and cannot be separated.

5. GOALS OF EVOLUTIONARY ENVIRONMENTS

1. Abolishment of the exploitative dominance of man over man.

2. Abolishment of the exploitative dominance of man over nature.

3. Directed potential development of all animate and inanimate forms. (Entelechy, Evolution).

4. Conciliation of all animate and inanimate forms. A new kind of nature.

Figure 6 describes some characteristics of proposed evolutionary systems.

6. SOME RADICAL PROPOSALS

There exists an incompatibility between our limbic system (the animal brain) and the neocortex (the seat of reason and conceptual thought), the latest addition to our brain (Ardrey, 1970; Esser, 1972). The neocortex cannot successfully correct the animal drive functions of the old brain; both parts speak different languages. Considering human history and the chance of meaningful development, evolutionary environments can assume the mediating role between the two parts, and thus insure a healthy mix of reason, emotions, foresight and instincts governing our affairs. Evolutionary, prosthetic environments also possess the potential for inducing the further building-up of neural connections between the neocortex and the limbic system at increasing rates of speed. (Figure 7).

The environment can provide the code to facilitate and enhance human interaction (De Long, 1972).

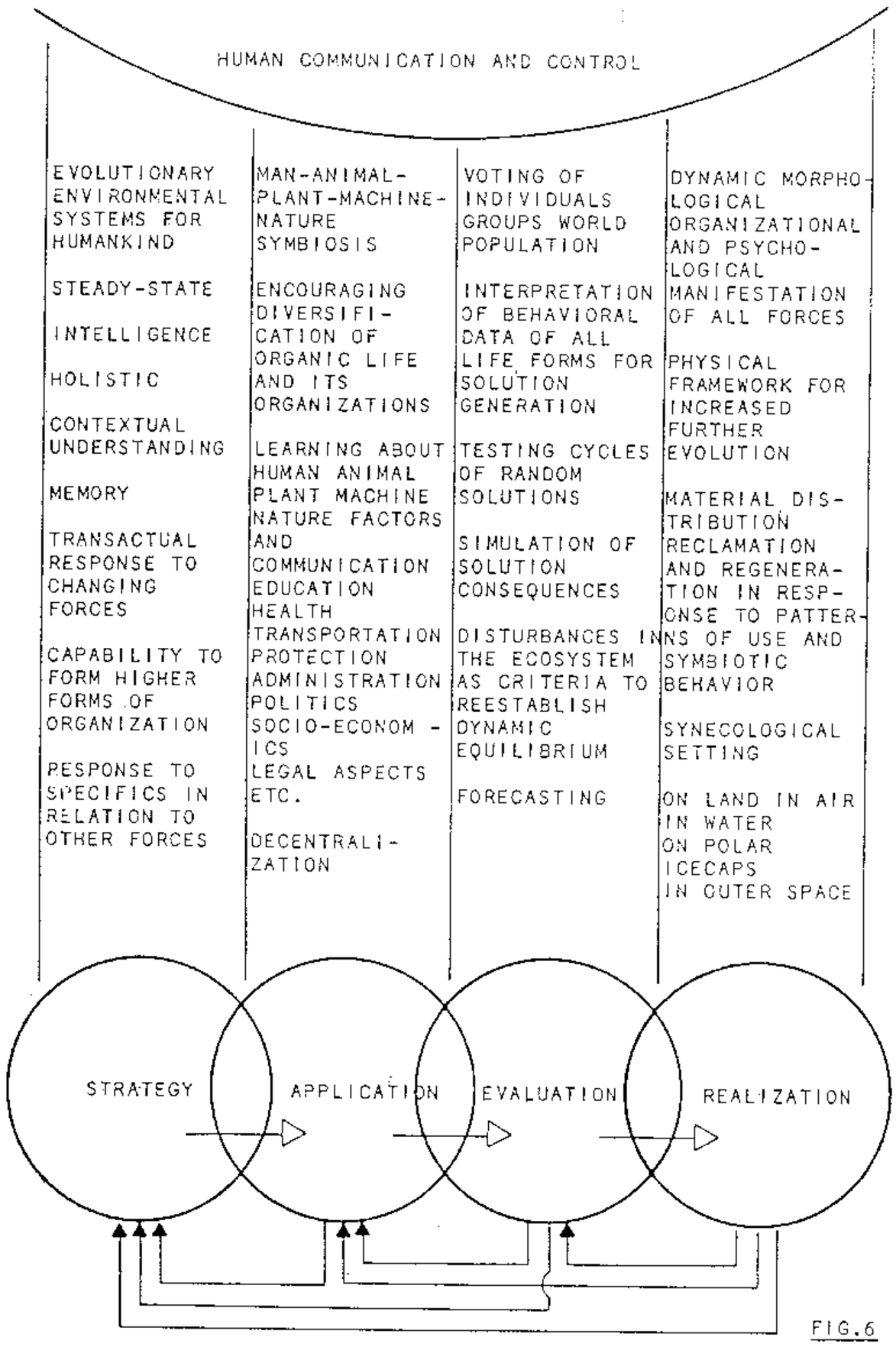

HUMAN COMMUNICATION AND CONTROL
EVOLUTIONARY ENVIRONMENTAL SYSTEMS FOR HUMANKIND
STEADY-STATE
INTELLIGENCE
HOLISTIC
CONTEXTUAL UNDERSTANDING
MEMORY
TRANSACTUAL RESPONSE TO CHANGING FORCES
CAPABILITY TO FORM HIGHER FORMS OF ORGANIZATION
RESPONSE TO SPECIFICS IN RELATION TO OTHER FORCES
MAN-ANIMAL-PLANT-MACHINE-NATURE SYMBIOSIS
ENCOURAGING DIVERSIFICATION OF ORGANIC LIFE AND ITS ORGANIZATIONS
LEARNING ABOUT HUMAN ANIMAL PLANT MACHINE NATURE FACTORS AND COMMUNICATION EDUCATION HEALTH TRANSPORTATION PROTECTION ADMINISTRATION POLITICS SOCIO-ECONOMICS LEGAL ASPECTS ETC.
DECENTRALIZATION
VOTING OF INDIVIDUALS GROUPS WORLD POPULATION
INTERPRETATION OF BEHAVIORAL DATA OF ALL LIFE FORMS FOR SOLUTION GENERATION
TESTING CYCLES OF RANDOM SOLUTIONS
SIMULATION OF SOLUTION CONSEQUENCES
DISTURBANCES IN THE ECOSYSTEM AS CRITERIA TO REESTABLISH DYNAMIC EQUILIBRIUM
FORECASTING
DYNAMIC MORPHOLOGICAL ORGANIZATIONAL AND PSYCHOLOGICAL MANIFESTATION OF ALL FORCES
PHYSICAL FRAMEWORK FOR INCREASED FURTHER EVOLUTION
MATERIAL DISTRIBUTION RECLAMATION AND REGENERATION IN RESPONSE TO PATTERNS OF USE AND SYMBIOTIC BEHAVIOR
SYNECOLOGICAL SETTING
ON LAND IN AIR IN WATER ON POLAR ICECAPS IN OUTER SPACE
STRATEGY
APPLICATION
EVALUATION
REALIZATION

FIG.6

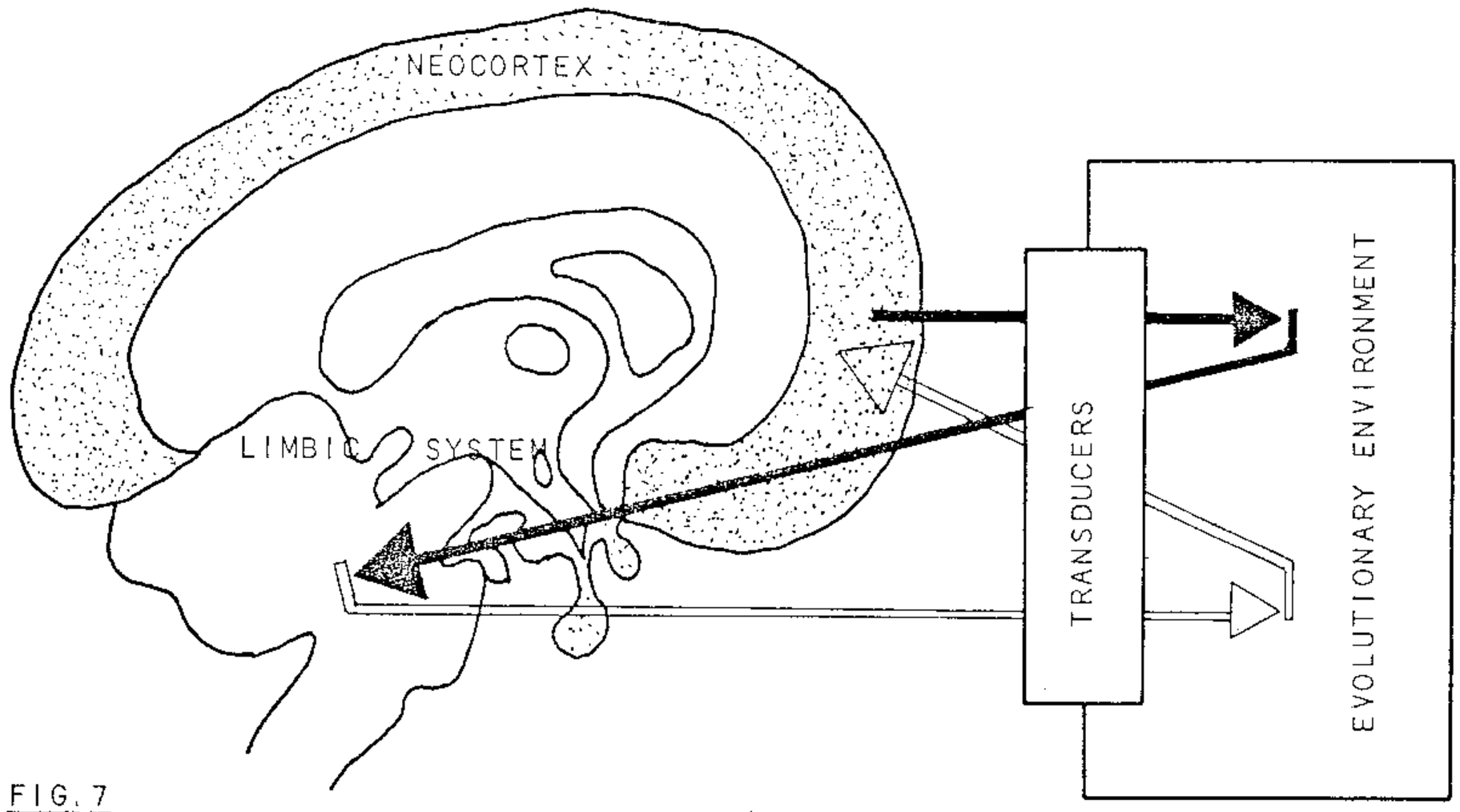
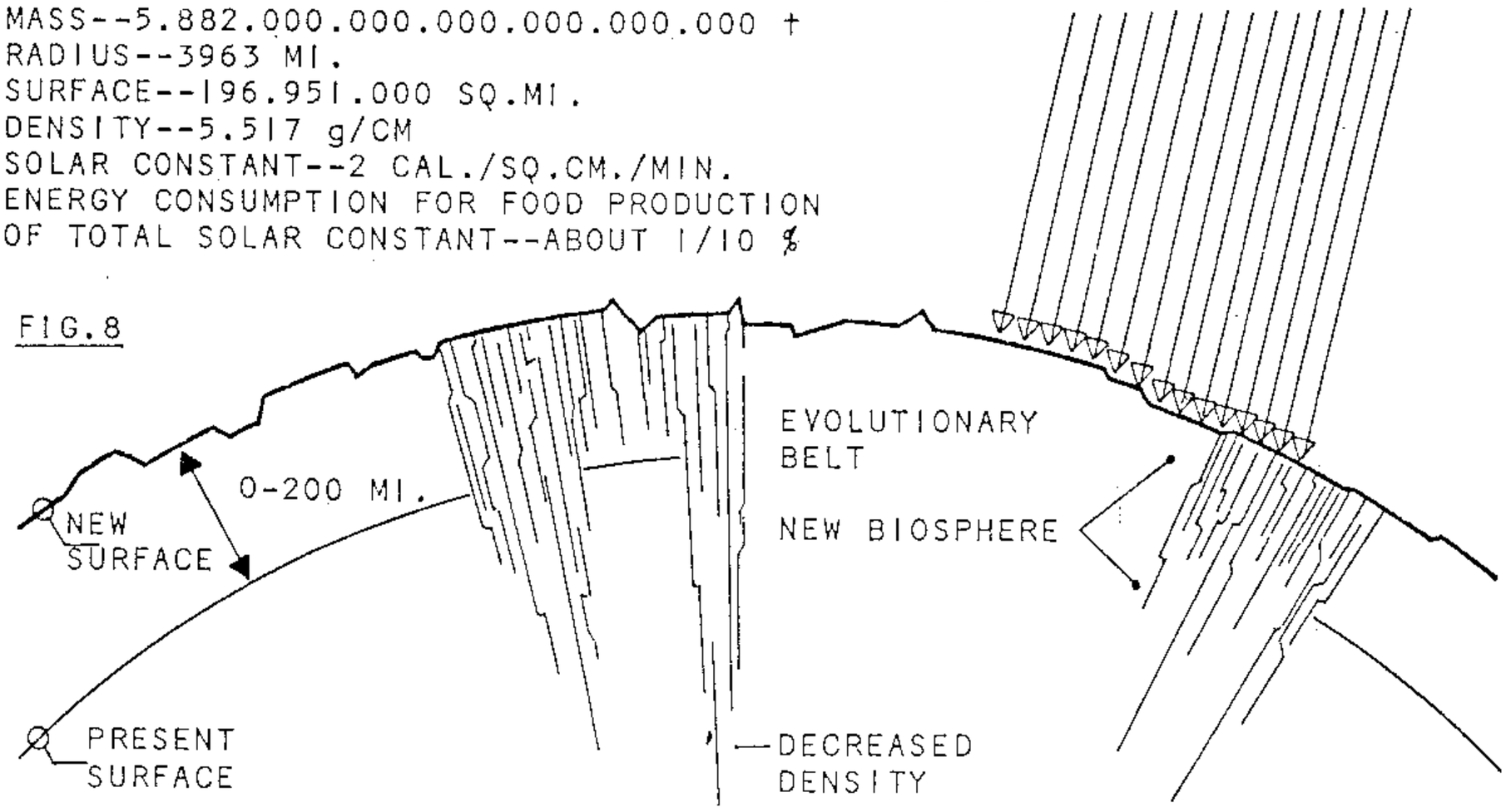

NEOCORTEX
LIMBIC SYSTEM
TRANSDUCERS
EVOLUTIONARY ENVIRONMENT

FIG.7

EARTH AS EXISTING:

MASS--5.882.000.000.000.000.000 +
RADIUS--3963 MI.
SURFACE--196.951.000 SQ.MI.
DENSITY--5.517 g/CM
SOLAR CONSTANT--2 CAL./SQ.CM./MIN.
ENERGY CONSUMPTION FOR FOOD PRODUCTION
OF TOTAL SOLAR CONSTANT--ABOUT 1/10 %

FIG.8



To trust blind and capricious organic evolution would not only be hazardous but outright deadly. History and the daily news prove this point.

Today, the human species is self-evolving (Dobzhansky, 1962; Hall, 1966). According to J. B. Calhoun (1971) we will have to evolve ourselves toward the "Compassionate Revolution", a notion consistent with those of several others (e.g. Maslow, 1964).

Man is an integral part of nature, and like all other living systems, he has to draw negative entropy from his environment to stay alive. But in the process he increases positive entropy in his surroundings. Man's prosthetic extensions conform to the same law. Within the present context of shortsighted, man-centered technology we live at the ever-increasing expense of the rest of nature. We, thereby, not only endanger our own existence but refuse to accept responsibility for the conservation and further evolution of all other compatible forms of life.

A radical shift of our beliefs and attitudes is needed. First of all, our self-deceiving anthropocentric dream must be abandoned.

In its beginnings the earth was badly suited for life. Primitive organisms brought about the conditions under which more complex organisms eventually would develop. Man is increasingly in a position now to restructure the earth and even other planets, and there is no reason why he should not proceed if he understands himself as a tool of evolution. (Figure 8). Ultimately the sun-earth-moon system will be an evolutionary system beneficial to all of its components and symbionts. It will be powered by solar, geothermal and nuclear energy.

A beginning, then, is to develop systems which can continually transform living and nonliving matter into ever higher levels of organization within a fully synergistic setting. All-encompassing systems, in a constant state of <u>becoming</u>...

7. REFERENCES

Allan, J., Hilbertz, W.H., De Long, A. J., "The Symbiotic Processes Laboratory," Man-Environment Systems, S 60, September, 1971.

Ardrey, R., The Social Contract. New York: Delta, 1970.

Bennett, E. L., Diamond, M. C., Krech, D., Rosenzweig, M. R., "Chemical and Anatomical Plasticity of Brain," Science, Vol. 146, No. 3644, PP. 610-619, October 30, 1964.

Calhoun, J. B., "Space and the Strategy of Life," in: A. H. Esser (ed.) Behavior and environment. New York: Plenum Press, PP. 329-387, 1971.

De Long, A.J., "Environment as code," AAAS Meetings, Washington, D.C.: December, 1972.

Dobzhansky, T. Mankind evolving. New Haven: Yale University Press, 1962.

Esser, A. H., "Evolving neurologic substrates of essential forms." General systems, XVII, PP. 33-41, 1972.

Hall, E. T. The hidden dimension. Garden City, N. Y.: Doubleday & Co., 1966.

Hilbertz, W. H. "Cybertecture, an evolutionary environmental system," Working paper , The University of Michigan, Ann Arbor: February, 1967.

Hilbertz, W. H. "Toward Cybertecture," Progressive Architecture, PP. 98-103, May, 1970.

Hilbertz, W. H. "Cybernetic Architecture, a teleological process" in: Michael Kennedy (ed.) Proceedings of the Kentucky Workshop on computer applications to environmental design. University of Kentucky, PP. 95-99, 1971.

Maldonado, T. Unwelt and Revolte . Hamburg: Rowohlt: 1972.

Maslow, A. H., "Synergy in the society and the individual," Journal of individual Psychology, 20, PP. 153-164, 1964.

Rosenzweig, M. R., Bennett, E. L. Diamond, M. C., "Brain changes in response to experience," Scientific American, Vol. 226, No. 2, February, PP. 22-29, 1972.

Urbanitat 2002, Modern American Architecture. Traveling exhibit in Europe (Fuller, Hilbertz, Knowles, Safdie, Soleri, Vivrett), May 1972 - May 1973.

Walker, W. G., Observations on man, his frame, his duty and his expectations. Cambridge (G.B.): Cambridge University Press, PP. 37-38, 1969.