THE STUDENT PUBLICATION OF THE SCHOOL OF DESIGN VOLUME 18

During the past 20 years, the architectural profession has undergone significant change in response to the change in environmental needs of society resulting from growth of population, increased urbanization and improved technology. In the past, architecture was concerned with producing individual "works of art" on individual sites. The method of design solution was intuitive and relied heavily on the experience, judgment and "talent" of the individual designer. Although this approach to architecture has resulted in some of the most enduring and noteworthy achievements of previous generations, the profession today faces severe challenges which threaten its traditional role.

The challenges presented by the environmental needs of a society attempting to deal with the problems resulting from population growth, technological advances, and increasing urbanization have created a critical need for architects capable of dealing effectively with complex and dynamic environmental design problems. The enormity and complexity of many of today's architectural projects have forced the architect to abandon the attitudes and methods of the past. Although this does not eliminate the architect's primary problem of giving meaningful form to man's physical environment, it does demand that the architect also develop an integrated total design approach based on performance, developing insights into human behavior, advanced technology construction systems, and rational design methodology.

In order to generate a design approach which responds to the complexities of the total environment it is necessary to develop a body of knowledge which will enable the architect to deal rationally with the numerous factors which must be considered in the design solution. The articles in this publication have been selected because each deals with an area of investigation essential to the development of such a body of knowledge.

Basically, a new body of knowledge for environmental design will allow the designer to predict the consequences of physical form on behavior; it will require a fuller understanding of the cultural origins and perceptual significance of image and symbol as communicated by physical form; it will allow designers to produce solutions compatible with the values of their users; and it will employ a method of problem solving which is capable of handling and communicating more information.

Among those authors who are chiefly concerned with the effects of physical form on behavior, Kenneth Craik deals specifically with aspects of perception and response to landscape form and the roles assumed by those touring and viewing the natural environment. David Stea discusses responsiveness to the artificial environment of the city with respect to conceptual image-making as a means of maintaining orientation in the urban environment. Henry Sanoff is concerned with the relative effect of visual attributes of form. He attempts to derive a set of dominant positive and negative visual attributes of the built environment through the use of sampling techniques and computer analysis. David Bonsteel investigates the potential of the televised image of a model interior as a simulation technique, a possible means of predicting the effect of proposed interior environment upon behavior.

Amos Rapoport discusses the importance of the effect of the cultural origins and perceptual significance of image and symbol as communicated by physical form in the organization of urban space, and uses numerous examples from his readings and travels to support his arguments.

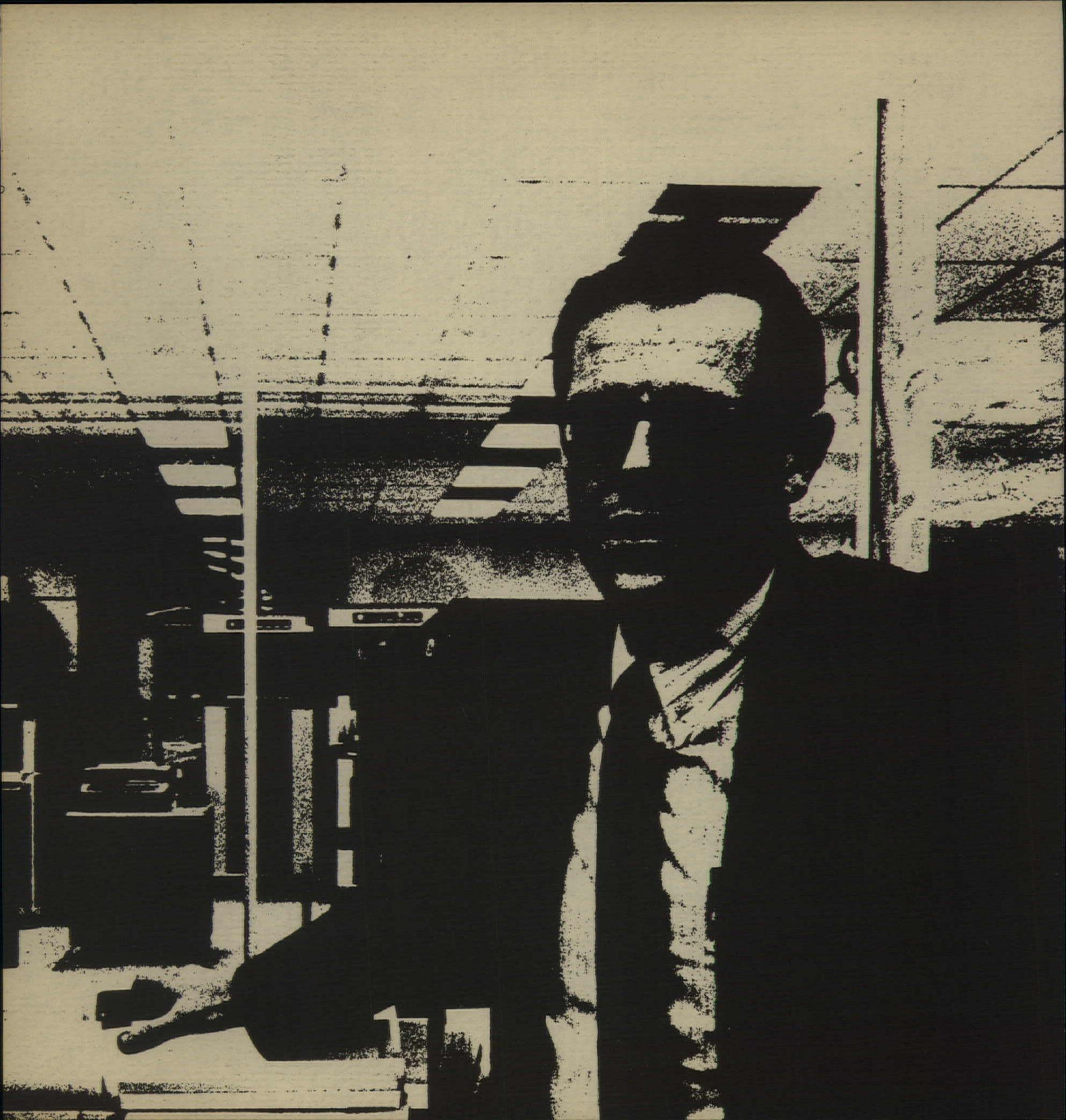
As well as being concerned with the effects of physical form on behavior, Craik and Sanoff are also involved in producing solutions compatible with the values of their users. Craik's concern with the roles assumed by the observer in the landscape, as well as Sanoff's relative valuation of visual attributes work toward this end. Also, Sidney Cohn recognizes the environmental values of the community dweller by his concern with architectural control as a means toward an enriched, yet harmonious urban fabric. Specifically, he employs the technique of gaming to simulate the real world transactions of architectural control in a teaching situation.

Toward the goal of producing a method of problem solving which is capable of handling and communicating greater amounts of information, Raymond Studer presents a design methodology which attempts to generate solutions based upon behavioral needs. If the design process is to deal comprehensively with many variables, it will be necessary to develop a common vocabulary. Charles Burnette presents one such solution employing computer techniques.

Because the emergence of a new theory of environmental design will require contributions from several disciplines, it is hoped that this issue will serve as a vehicle of inter-disciplinary communication. We hope as well that this publication will help expose students and laymen, in addition to professionals and researchers, to changing roles in the fields of environmental design.

Gary J. Coates and Kenneth M. Moffett, Co-Editors

RESPONSE TO ENVIRONMENT



MURRAY A. MILNE, with an educational background in mechanical engineering,
industrial engineering, and architecture,
is well equipped for a career dealing with the interface between design
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After several productive years with General Motors' Research Studio
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His interests center on computer-aided design,
decision making,
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This, plus an ability to see the broad picture as well as the specific situation,
makes Mr. Milne well qualified to consider the

State of the Art:
The Imminent Revolution in Architectural Theory.

We architects are odd animals. We claim to be problem solvers, but we seem to believe that just about every problem can be solved with a non-prototypical physical form that in some way resembles a building. We always insist on trying to invent "new" solutions. Even when we know that a valid solution already exists, we will not recommend it. Imagine how ridiculous it would be if a physician tried to think up a brand new cure for every one of his patients.

Clearly, some types of environmental design problems are as ubiquitous as the common cold, yet architects operate on each one as if it were rare and uniquely different from all others. I have never known an architect to advise his client to go out and purchase a tract house, or rent a trailer, or hire a contractor to build one of the stock plans from *Better Homes and Gardens*, although it seems to me that for some problems these would be excellent solutions.

And yet, if every solution is supposed to be different, why do they all turn out to be the same? To me they all look exactly like buildings. It seems that architects almost inevitably exclude the possibility that a problem might require some type of non-physical-form solution, such as a transportation system, a communication system, or even a political, legal, educational, or propaganda solution. Clearly many problems we deal with could have non-form solutions. For example, I expect that some day many of the buildings which presently house such things as market places and stock exchanges will vanish, being replaced by a communication system, a simple computer, and a transportation system. If a business man came to an architect and said, "Look, our company lunchroom is overcrowded, what should I do?" the architect will inevitably propose a newer, larger lunchroom, but the administrator would suggest that lunch breaks be scheduled nonconcurrently. Many architects feel that they could solve the problems of the ghetto, that great monument to American democracy, by completely rebuilding it from the ground up; but clearly the most lasting solution to this problem lies in the domain of education, propaganda, economic opportunities, and, if necessary, legalistic constraints.

Oh, it's true that architects are pretty good at solving problems which have the kind of solutions that they know best—the so-called "building types". Traditionally, architectural practice is a process of refining these existing prototypical buildings. Prototypes are defined in terms of the way buildings function rather than the way they look. The visual quality—the "newness"—of these building types may appear to change radically from one project to the next, but in fact, the way they are used by their occupants evolves very slowly. But every once in a while a new building prototype appears. Inevitably it is in response to newly created needs or newly developed technological means of meeting old needs. Rarely does a new building type emerge because some lucky architect was blessed with a flash of creative insight. For example, motels, shopping centers, drive-ins (restaurants or movies or banks), automatic auto washes, supermarkets, computer centers, California garden apartments and Florida trailer parks, all reflect in physical form recent changes in the social, cultural, technological, or economic structure of the society for which they are intended. I can find little evidence to indicate that the architectural profession was associated with the design and construction of the first exemplar of most of these prototypes, and for some strange reason, this list also contains many projects which established architects feel are undesirable commissions.

Fortunately, once a viable new building prototype has emerged, most architects can grasp its essential characteristics and can begin to clarify and refine it with each succeeding project. So in this sense at least, we do stand on the shoulders of those who have gone before.

Although it is evident that the refinement of existing building prototypes falls to the practicing architect, it is not at all clear where or how new prototypical buildings are created. In the past, investors and developers, sensing economic potential, generated many of the new commercial prototypes. When an environmental design problem appears which demands a truly innovative solution, industry, government, and the purchasing public turn most often to engineers, systems analysts, behavioral scientists, politicians, the space industry or its "think tank" offshoots, or even the police. For some reason, the architectural profession is not consulted unless everyone knows before hand that a prototypical building is the best solution. I am told that one of the reasons our profession exists is to provide shelter for all of society's activities, and yet every year a smaller percentage of the buildings built in this country are designed by architects. If this situation continues, architecture will soon be relegated to a role in society similar to that of fashion designers or interior decorators.

The reason that architects are so embarrassingly impotent in the face of these demanding problems is that our profession is unable to assimilate new information within its existing conceptual framework. Today we are deluged with information, and it seems we would rather drown in the stuff than drink a drop. Too much new information is ignored, or is used once and forgotten, or is used as some kind of artistic rationalization or as a cartoon or a symbolic gesture. The complexity of our world is increasing faster than our ability to deal with it.

The root cause of this worsening state of affairs is the belief that *Architecture is an Art*. Our veneration of this paradigm is all pervasive and unwavering. It perpetuates itself through long years of apprenticeship in schools of architecture, in design juries which talk and talk of little else, and on page after page of the architectural fashion magazines. At the 1963 A. I. A. Convention Paul Rudolph said: "The artist ignores certain problems, addressing himself to a selected few. He proceeds to solve these so eloquently that everyone understands the statement and its truly glorious solution.... It is axiomatic that certain problems be ignored if a great work of art is to be created, and in the hands of an artist this is justifiable, indeed necessary." This is an honest admission by one of the better-known practitioners of his inability to solve certain parts of the problem that is considered central to his profession.

The paradox is that within the profession, everything is subordinate to *Art*, but by and large no one else gives a damn. I've heard many clients complain about the functional or environmental inadequacies of a new building an architect has designed, but I have never heard a client complain that his building was ugly (even if it was). On the other hand, I have yet to see *Progressive Architecture* or the American

Institute of Architects give an award to a building for reasons other than its artistic merit. We live in two different worlds.

But, you say, aside from *Art* there is really no other criterion we could use to objectively evaluate a building. If this is true today, it only serves to prove the point that if there are now no explicit criteria for evaluation, then previously there could have been no explicit criteria for design.

Obviously a fantastic amount of information exists today which is relevant and essential to the solution of environmental design problems. Why can't architects apply it? The reason of course is that our profession is so helplessly bound by its *sacred* paradigm—and beyond this there is no conceptual framework, no theory which can assimilate this information.

It is really amazing to realize that there is no theory of architecture. At a time when two thirds of the twentieth century is already history, there is no textbook dealing with the central issues of our profession. True, we have many books on design philosophies, but they tend to be anecdotal, inspirational, and very subjective. It is also true that architecture has borrowed some fairly sophisticated information from other professions—particularly civil and mechanical engineering—but this, too, obviously fails to qualify as a theory of architecture. Incredibly, a Professor of Architecture today only needs to come in from his practice and supervise a classroom full of students—his atelier. He does not have to prepare himself by reading any particular literature. He does not have to organize and present any new information to the class. He does not have to do anything that could qualify as research. He does not have to produce any scholarly additions to his profession. Any place else in Academia this would never be tolerated. I have an uneasy feeling that if University Chancellors and Presidents ever find out about this they'll boot us all out and devote the space and resources to more productive activities.

What would a theory of architecture look like if one appeared tomorrow? It probably will not look like an equation or a flow chart. More likely it will be a kind of scenario or conceptual model for structuring information in a way that will allow architects to see their world in a very different light. As Thomas Kuhn points out in his book *The Structure of Scientific Revolutions*, "After Copernicus, astronomers lived in a different world." Other professions have gone through a great many of these revolutionary changes. In physics, which is the best example, consider the way man saw his world after the discoveries made by Aristotle, then by Galileo, then by Newton, then by Einstein.

This new perception of the world, this expansion of consciousness, will allow architects to see relationships between factors which previously were ignored or were handled as if they were unrelated to one another. We will be able to articulate and operate with not only the technological but also the social, cultural, and behavioral determinates of environmental design problems. We will also be able to deal competently with solutions which have implications well beyond our present constrained little area of interest: buildings. By understanding and using this new relational structure, architects will be able to predict and test a great range of new solution alternatives. We will all see our environment in a very different way. For us it will be a new world.

Clearly a new theory will not receive immediate acceptance. This is especially true in architecture where recourse to rational and logical debate is not one of our strong points. Ask yourself whether you would accept such a theory. And what about the guy at the next drafting board? Kuhn says, "A new theory, however special its range of application, is seldom or never just an increment to what is already known. Its assimilation requires the reconstruction of prior theory and the re-evaluation of prior fact, an intrinsically revolutionary process that is seldom completed by a single man and never overnight."

I believe that today we are on the threshold of a new theory of architecture. Already we are in the midst of what Kuhn calls the Pre-Scientific Phase of the Revolution. This means that a lot of people around the country are engaged in strange activities such as collecting and classifying interesting but seemingly irrelevant facts. The first step is to develop a taxonomy. If we are to communicate with one another, we must share a common and precise vocabulary that is not constrained by past preconceptions or paradigms.

This taxonomy will not spring into full bloom from the tip of one man's pen. Instead it will probably be a natural composite of the work of many people, all of whom are trying to develop a new conceptual structuring—a new way of looking at a little part of their world. What binds them together is a common concern for the design of the man-made environment, an explicit discontent with the tools that are presently available to attack this problem, and a willingness to try almost anything. Most of these people are new to this field, and more often than not, they bring with them a considerable amount of experience and expertise from some other discipline or profession. Therefore, it is not surprising that they all are attacking the problem from a little different point of view. No one knows, of course, who is on the right track. The names of some of these people, if such information is important, can be found in publications like the *Directory of the Design Methods Group* (1) and the *1967 Directory of Behavior and Environmental Design.* (2)

As this vocabulary becomes more fully developed, the introduction of abstract constructs in the form of theories will be necessary in order to relate various parts of the taxonomy. Soon, others will attempt to disprove these hypotheses or to validate these theories by testing their predictive power. Kuhn believes that when this happens it will indicate that the second or Scientific Phase of the Revolution has begun.

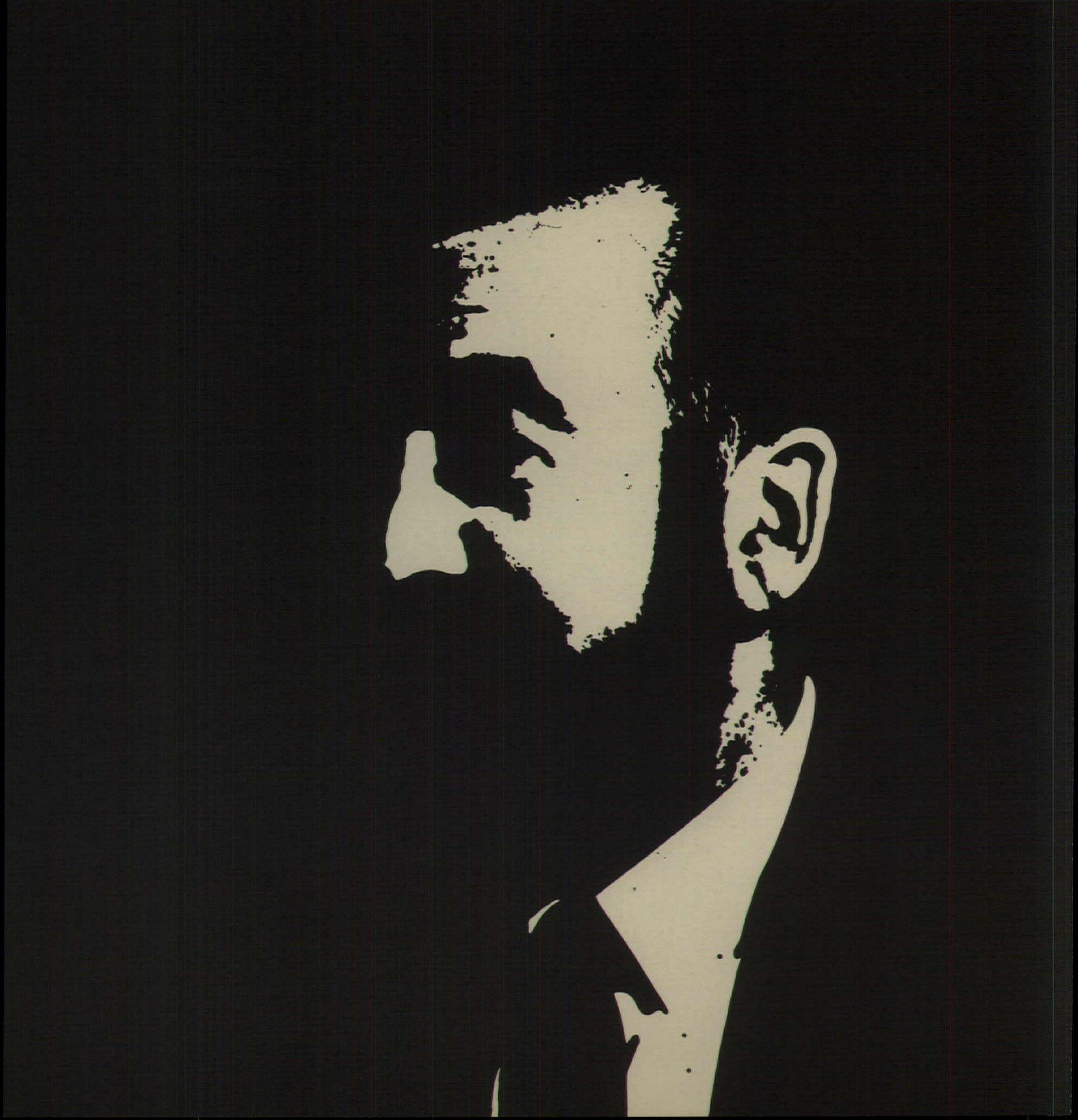
Among the things which I hope this new theory will do, when it finally appears, is allow me to predict the effect physical form will have on human behavior. Further, I would hope that it would allow me to understand and deal explicitly with the way inanimate physical form communicates to humans, this is its so-called symbolic or image quality. I would also hope that it will allow me to generate solutions which are compatible with the value systems of the group I am designing for rather than forcing me to impose my own social, ethical, and moral values on them. But perhaps most important, I think it is imperative that this new theory employ a method of problem solving which will handle more information more efficiently than the old intuitive Beaux Arts design method which we all use today. I am sure that other people would wish to suggest other goals for such a theory.

There are many casualties in every revolution; I do not believe that can be avoided. It is also proper that one of the functions of an established institution is to protect itself from destruction by revolutionary change. Therefore, it is possible that the architectural profession will assume a defensive and somewhat conservative attitude in response to this challenge. This will be a most exciting and stimulating period for us all. If the profession survives, and I believe it can, architects will play a far stronger and far more competent role in society. Therefore, I would hope that when new theories of architecture eventually appear, they will be attacked rationally and challenged vigorously, and if they are not found wanting, they will then be welcomed warmly.

It's inevitable, so we might just as well enjoy it.

(1) Published at the Department of Architecture, University of California, Berkeley, California.

(2) Published by the Research and Design Institute, Providence, Rhode Island.



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Receiving his Ph.D. in city planning at the University of North Carolina, his career has included teaching and research experience, consulting services, and professional practice.
Dr. Cohn is presently engaged in teaching and research at the Department of City and Regional Planning, the University of North Carolina.

Much of his research since 1960 has focused on the problems of inventorying and measuring visual characteristics of the environment for the purposes of establishing design criteria.
Specifically, an interest in the establishment of more effective controls over these visual characteristics has led Dr. Cohn to his present investigations on

Simulating the Architectural Control Process.

INTRODUCTION

The twentieth century has witnessed a continued increase of public concern for the quality of community appearance in the United States. This concern intensified a public demand for action by local authorities to insure a more pleasing urban visual environment. As a result the courts modified their traditional reluctance to permit the use of the police power to regulate esthetics and in the 1930's a new public regulatory device emerged. Referred to as architectural control, this device was similar in concept and administration to zoning and general building regulation but had for a specific purpose the regulation of the external appearance of the man-made physical elements which make up the urban environment in order to improve community appearance.

By 1937 approximately thirty American cities employed a limited form of architectural control. Today more than 550 cities of over 10,000 population do so but for the most part in a manner less than ideal, at least as prescribed by the advocates of the tool. The ordinances tend to be piecemeal in their territorial scope, limited in their substantive application and have achieved limited success.

However, the actual usefulness and desirability of architectural control, even in an ideal context, continues to be challenged and criticized by architects, planners, and even non-professionals on the grounds that it cannot achieve its goals for both substantive and administrative reasons. (1) Perhaps because the device is relatively new or because the examples in this country are less than ideal, there has been no systematic attempt to analyze architectural control administration and to establish its effectiveness. In spite of the criticisms and the limited application of the device to date,

(1) For a detailed review of the controversy in the U.S. see: ASPO, Reports No. 6 and 96; Fagin and Weinberg, pp. 14-24; Weese; Cheney; Fifth Annual Conference of Cornell Planners; Joint Committee of the New York AIA and AIP; *Progressive Architecture,* November 1958, July 1952, and October 1962. For a review of the controversy in Great Britain, see: Cohn, 1967.

trends in judicial opinion, the public concern for community appearance, and the application of architectural control suggest that this device will continue to become increasingly common in the United States. (2) Thus growth of the device continues, perhaps based on faith or perhaps on desperation, but interested communities have little substantial evidence on which to rationally determine the desirability of adopting architectural control or the most effective form of administration to employ.

AN ANALYSIS OF ARCHITECTURAL CONTROL EFFECTIVENESS (3)

Although examples in the United States do not provide as yet a suitable source of data, several European countries appear to do so. Holland, Great Britain, Germany, Sweden, and Denmark have exercised esthetic control since the middle ages and for the last century have done so in a manner which would be considered as ideal by the proponents in the United States. A comparative analysis of these organizations should provide significant insights into the potential effectiveness of architectural control administration and the functional and structural factors which contribute to effectiveness.

METHODOLOGY

The evaluation of organizational effectiveness normally focuses on their productivity or the degree to which the organizations achieve their goal, in this case a beautiful urban environment. But the measurement of the production of beauty on a comparative basis is an unviable task. Therefore a systems-model, deduced from formal organization theory, was developed as a conceptual framework for the analysis.

(2) For a survey of controls, in the U.S., see: Fagin and Weinberg; Fagin; and ASPO, Reports No. 6 and 96. For a survey of the evolution of judicial opinion, see: Dukemeiner, Kucera, Rodda, and Hamilton.

(3) For a full report see Cohn, 1968.

A systems-model is a conceptual model of organizational variables and the relationships between them which must exist if the organization is to be capable of operating successfully (Etzioni, 1961, pp. 77-80; Georgopoulos and Tannenbaum, pp.534-535). Since the most significant aspects of goal achievement are embodied in an organization's ability to make sound decisions and in its capability of implementing these decisions, systems-models of the decision-structure and the power relationships necessary to implement these decisions were developed. The decision structure model describes the characteristics and areas of competency of the decision makers and the relationships between them. The compliance model describes the forms of power embodied in the organizational ranks, the effective relationships between these members, and the effective power relationships between the organizational members and the building applicants based upon the latter's emotional orientation and their involvement in architectural control. Since these models are normative in nature, the relative effectiveness of the European examples can be assessed by comparing the congruency of their decision and power structure to the models.

Because ineffective decisions and dysfunctional power manifest themselves in undue participant strain, overt manifestations of strain were viewed as a third indicator of effectiveness. (Georgopolous and Tannenbaum, pp. 534-5; Caplow, Chapter 1.) For strain to be meaningful as an index, however, it is necessary to explain its existence or absence in terms of the constraints of the political culture of the nation, i.e. the participants" . . . attitudes towards the political system and its various parts, and attitudes towards the role of the self in the system," (Almond and Verba, p. 12) and the structural conduciveness of the existing appeal systems as a vehicle for ameliorating strain. Since congruency of an organization with the model is correlated with potential effectiveness, comparison of the organizations to the model provides an index of their relative effectiveness and the manifestations of strain serves as control on these theoretical conclusions.

ANALYSIS

Analysis of the data indicated that in the cities of Holland and in Dusseldorf, Germany, where high congruency between organizational structure and the model existed, there was little strain and considerable satisfaction with architectural control. In Sweden and Denmark, where moderate incongruence was exhibited, commensurate strain was found and this strain was directly related to the deviations of the organizations' structures from the systems-model. The inability of these organizations to achieve congruency could be explained by their political structures and the lack of structural conduciveness of their appeal procedures.

The analysis indicated that in communities lacking a high level of pervasively employed design ability and without a high level of public esthetic sophistication, architectural control could be an effective device for improving community appearance. This conclusion was limited, however. Architectural control is at best a satisficing device, while it can be expected to improve community appearance, it cannot achieve a beautiful city. It is not a substitute for good design. Further, the effectiveness and ultimate desirability of the device is highly dependent upon the decision-making and power characteristics of the organizational members, their appropriate allocation, and the existence of a clear definition goals, objectives and values throughout the organization. It was equally clear that an extensive period of operation was required to achieve these characteristics; i.e., a period of maturing was required.

DEVELOPING AN OPERATIONAL SIMULATE: A TECHNIQUE FOR TRANSFERENCE GAMING AS A TEACHING DEVICE.

A device which has powerful implications for teaching the implications of this research is simulation. Simulation, in the general sense, refers to the replication of the essence of reality without reality. It is model-building based on systems-analysis, i.e. the analysis of the real world system into its constituent parts. It is concerned with the interactions among the elements within the systems as they contribute toward the working of the whole toward its objectives. It links the elements and represents the system or process as a sequence of decisions. These are arranged into a model whose organized structure produces a product which reflects the entire real world system. The goal is to reproduce the behavior of the system in every important aspect; not too complex for understanding but not losing anything significant.

The term simulation, as currently used, refers to a set of techniques which, though similar in concept, vary in their degree of abstraction medium, and application characteristics, as well as the rigidity of the structure.

In terms of their degree of abstraction from the real world and rigidity, the various techniques form a continuum indicated below:

Math-Simulation	**Computer-Simulation**	**Game-Simulation**	**Gaming**	**Real World**

Gaming is the least abstract of the simulation forms and likewise it is the least explicit and expensive. Through the device of role playing, gaming offers the opportunity for players to experience the decision process and to a degree, the implications of their decisions. Actors represent the real world decision-makers in a structured relationship. But it is particularly applicable to simulating unstructured human-decision systems. Unlike the other forms, it does not require a complete understanding of the components of the system, that the system be represented either in computer or mathematical language, or that the system be a closed one. Neither must the system be pre-optimized or must the decisions be predetermined. The lack of these is specifically the characteristics which makes esthetic decision-making the problem and makes gaming particularly applicable, particularly as a heuristic device. It allows for unpredictable human behavior as well as the opportunity to explore the implications of various strategies.

As Scott indicates, gaming is particularly relevant to political decision making:

Gaming, he states . . . is a tool that will allow policy-makers to try out different developmental strategies and analyze their results before committing themselves to one strategy or another. Policy-makers need to have a way of generating synthetic experience to take the place of actual experience . . . Gaming . . . holds promise of meeting that need. It permits the experimenter to trace out the implications of complex strategies, to enjoy vicarious "experience" to try out alternative strategies, and to do it quickly. (Scott, p. 15)

Of even greater significance is the fact that gaming provides for a condensation of time and an acceleration, thereby, of the learning process. Further, it serves to articulate and emphasize the factors and relationships which cannot be objectified and which need to be understood by the decision-makers. The needed maturation of the "committee" can be achieved in the process. As Meier states:

The most significant advantage is that gaming-simulation (sic) rapidly enhances the sophistication of the players regarding the factors at work and the relationships between the key roles in the real world. Players come to the games with imperfect concepts of community, and they leave it with shattered myths. Usually, they achieve a sense of what kind of action, when coordinated, yields what kind of outcomes. A well-constructed game and its environment should yield more realistic mental impressions about how a large system . . . works. It offers a low cost substitute for experience in the most responsible decision making roles. (Meier, in Duke, p. iii)

In summary, gaming appears to provide a vehicle, which, if properly designed, can perform the following valuable functions and as a result make possible the creation of sound-functioning architectural control organizations: (1) articulate and clarify the decision variables, their inter-relationships, and the decision-making steps involved; (2) enable the actors to appreciate the consequences of their decisions within a short period of time; (3) force each actor to view the decisions from the perspective of all of the actors; (4) allow the introduction of alternative decision strategies, decision-assisting tools and decision-makers; (5) force the players to establish their goals, criteria, values, etc.; and (6) all of the above, quickly and without creating diseconomies in the real world. In short, a "game" would enable the local policy-makers to create more sophisticated and pertinent local legislation and the decision-makers to gain experience and expertise in the use of this new power.

Of a somewhat different tact, the gaming process offers an additional unique opportunity which is significant in this peculiar form of decision making. The creation of the architectural control committee as a quasi-legislative body involves the delegation of authority to an "expert" committee involved in making subjective decisions. It is difficult for the local policy-makers to provide any adequate criteria of policy whereby the effectuation of their policies can be guaranteed. The only assurance that public values will be manifested in the decisions of the committee is through the proper selection of the committee members. Thus, the selection of the member is in itself a direct exercise of public policy. Criteria for the selection of committee members are themselves highly subjective and a game will allow policy-makers to observe the potential decision-maker "in action" and to better determine the latter's expertise as well as his esthetic value.

Hence, the simulate of the process was constructed, designed to demonstrate the superiority of the concepts embodied in the decision and power structure models. The rationale underlying the design of the simulate assumed that by controlled manipulation of decision-making and power relationships and the structured introduction of issues, participants would be able to perceive the more effective administrative components. The more effective forms would yield perceptibly better results, more effective decisions, and provide greater symbolic satisfactions to the participants with less participant strain. Further it assumed that forcing the participants to resolve issues involving a wide range of both esthetic and non-esthetic values would provide them the opportunity to rank their values and thereby establish a community value set. Lastly, it assumed that making such decisions would resolve conflicts between the actors prior to instituting regulation and would yield many minor unprogrammed operational benefits.

The Components of and Structure of the Simulate. The architectural control process consists basically of a group of participants interacting with respect to proposed building projects. Each participant attempts to achieve certain rewards from the interaction. His activities are constrained by his relationship with the other actors as well as by a pattern of behavior outlined in the legislation and enforced by the judiciary. Although not directly involved in the behavioral network, the general public exerts influence on these behavioral patterns.

The simulate is composed of four major components which together replicate the significant aspects of the architectural control process. These elements are: the participants; the building project and its environment; the legislation; and a set of instructions, stimuli, and schedules referred to as props.

The actual process involves five types of participants: (1) building applicants; (2) review bodies, i.e., the administrators; (3) a legislative body; (4) a general public; and (5) a judiciary. The first three are direct participants in the process and are replicated by participants in the simulate. The general public and the judiciary, whose participation is sporadic and often indirect, is replicated indirectly thru props.

There are three types of applicants: architects, entrepreneurs, and laymen. There are four types of administrative roles: (1) a lay committee; (2) a bureaucrat trained in design; (3) an expert advisory committee; and (4) a combination of 2 and 3. Each of the administrative roles provides a basic administrative model and is the major variable in the operation of the simulate.

In order to overcome the problem of role conformance to real life values and behavior patterns, the roles are played by persons who fulfill these functions in the real world. The legislative body roles are played by three local councilmen; the applicants are played by local architects, realtors, entrepreneurs, and interested laymen. Members of the various administrative roles are similarly chosen. As a result, there is little need to specify roles in detail and there is little danger that the participants will fail to conform to the role characteristics.

The rules for operating the simulate are embodied in a mock architectural control ordinance, variations of which define the procedures and standards to be followed for each administrative model. They describe the goals of the program, the roles and legal power of the actors, and articulate the community values implied in the program. The ordinance is made up of a basic body for each administrative model and a series of alternate paragraphs which are substituted or added to the basic ordinance. These alternate paragraphs are specifically designed to implement the objectives of the games by introducing variations in community goals and values, standards of acceptance and judgment, decision-making criteria, forms of power, application presentation quality, etc. By systematically varying these in each administrative model, it is possible to manipulate the potential effectiveness of each model and to articulate the relative merits of each of these dimensions.

Of central interest to all the participants are the proposed building projects. They are simulated by two sets of props, one set related to the proposed buildings per se and the other to their environments. (4)

Each building project prop consists of a set of architectural drawings and an applicant information sheet. The drawings have been procured from architects, engineers and builders and represent actual projects; they are similar to that which a review board would encounter. For the most part they have been stripped of data not relevant to architectural control decision-making. The proposed buildings vary in a number of dimensions. Substantively, they include a wide variety of land use types and building sizes, e.g. single family and multi-family residences, institutions, stores, factories, and office towers. They include new construction as well as store front remodelings. The projects vary in their esthetic quality including national AIA award winning projects, contractor's speculative houses and several offensive designs. (5)

(4) At present the simulate has 24 projects which can be reviewed. By the interchanging of projects and environments, however, it is possible to develop with ease more than 100 projects.

(5) Since the buildings are never used on their original site, even the national AIA award winning buildings, which may be beautiful per se, in some cases lack harmony with their surroundings.

They vary in the quality of presentation from highly professional drawings to extremely crude sketches as might be done by a layman or carpenter. Lastly, the drawings themselves, as simulates of reality, vary in their degree of abstraction; some are extremely abstract and brief construction drawings and others include detailed, rendered perspectives.

In addition to providing a realistic experience for the participants, these variations have been selected to stimulate specific conflicts and achieve the objectives of the simulate. The variety in esthetic quality stimulates esthetic issues. Differences in land use induce non-esthetic conflicts such as disparities between zoning plan and the esthetic objectives, and between economic and esthetic goals. Differences in graphic quality and the degree of abstraction of the drawings serve to articulate the difficulty in conceptualizing reality from graphic symbols and the quality of experts required to effectively make such judgments.

The application information sheet (See Fig. 1) supplements the drawings by providing necessary information to the applicant. It provides a description of the building use and its materials. In some cases it also provides data on the budget, temporal constraints on construction completion, and other factors which could influence the applicant's response to a threat of rejection by the administration. Lastly, it suggests a number of issues which may emerge with the review board and supplies the applicant with a series of strategies he can employ to overcome the criticisms and objections of the reviewers. These strategies add reality to the process by enhancing role proficiency and by stimulating desired conflicts, thus helping to achieve some of the desired objectives.

Each project is related to a specific site and neighborhood whose characteristics are described by a set of environmental props. Each combination is chosen to create specific esthetic problems as well as conflicts between esthetic and non-esthetic objectives. These props consist of maps, photos, and description of the site and general area. The map of the area (Fig. 2) indicates the proposed site, existing building, streets, and other pertinent land use data. The photos (Fig. 3) provide a visual orientation to the condition and character of the area.

FIGURE 1

APPLICATION INFORMATION SHEET

Project No. P-5 On Site No. S-10

PROJECT TITLE: Fire Station

Applicant: Architect (Type) ; (Name)

Influencing Characteristics:

Predominantly downtown residential area with some apartment conversion and development. Area is entering a phase of transition.

Building and Site Description:

1. Wall material: brick
2. Fascia: metal
3. Trim: metal
4. Roof: flat
5. Site: setting back building; preserve the existing trees and maintain open character

Applicant Strategies:

1. Two houses formerly occupying the site were destroyed by fire—area needs a fire station.
2. Need for small local fire stations in the city for better service.
3. Construction will provide lower fire insurance rates in area.
4. Plan maintains open character of the area.
5. Located at intersection of major residential collector streets.
6. Use of materials will set standard for improvements in the area.

Issues:

1. Out of character with surrounding buildings
2. Noise of trucks and bells
3. Danger of trucks

FIGURE 2

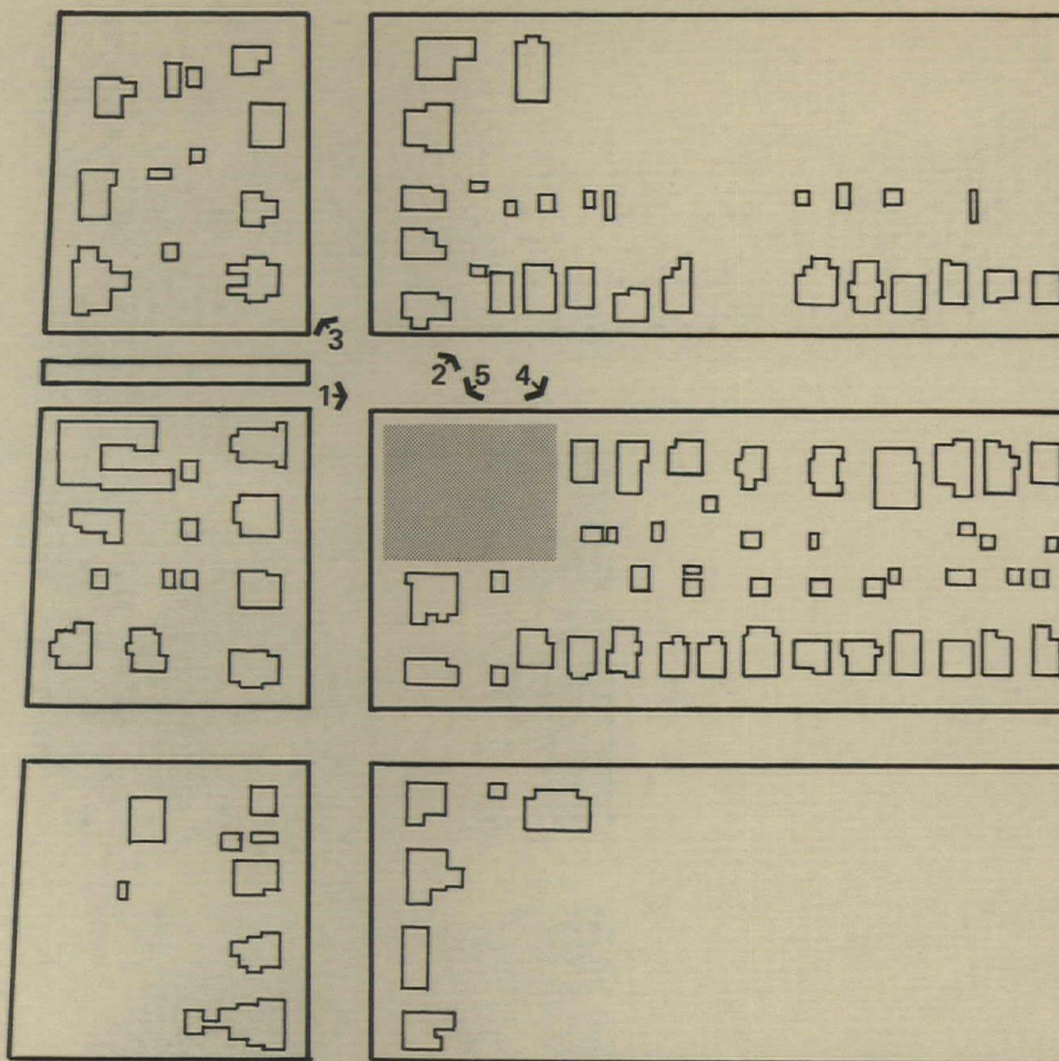

FIGURE 3.

1

2

3

4

5

The description (Fig. 4) includes data on the visual and functional characteristics of the area as well as its physical condition, both as it exists and as to directions of change. In some cases, objectives of the local planning or urban renewal agency are stipulated which deal with the stabilization of existing conditions, the induction of change, the achievement of a specific esthetic goal etc.

To simulate the influence of interest groups in the architectural control process, a series of props are employed. Their purpose is to evoke the wide range of esthetic and non-esthetic value conflicts which emerge in architectural control and to permit the opinions of such interest groups to influence the system. These props take the form of newspaper editorials, letters to the editor, and letters to the city administration from garden clubs, labor unions, business organizations and the like (See example, Fig. 5). In addition, memoranda and directives from other municipal departments are simulated to induce conflicts between the objectives of the various departments and to provide information which can be of value to the applicant.

FIGURE 4

S-10: SITE DESCRIPTION

The site is in a residential area on the fringe of the central business district. The houses are now largely low middle income multi-family dwellings. There are few, if any, vacancies.

The design style of the neighborhood is early twentieth century eclectic with a touch of identifiable Victorian. The buildings are just beginning to show need of maintenance and repairs both inside and out.

While much of the area is residential and will probably stay that way in the near future, the commercial and warehouse uses of the central business district have taken over certain areas of the neighborhood.

The site is on a corner which was formerly two separate residential parcels. A major collector road for the area, leading to the nearby industrial area, runs in front of the lot (photos 1, 4).

FIGURE 5

PI-12

MEMORANDUM

TO: The Chairman and Members of the City Council

FROM: The Association of Community Realtors

SUBJECT: Architectural Controls and the pending appeal of project P-13

The executive Committee of this association with the support of the member realtors of this community wishes to make known its position on architectural controls generally and on the specific project proposal under appeal.

The design quality of a housing unit is closely associated with its marketable value. Further, basic design can have substantial effects on the values of surrounding properties. We generally favor architectural control as such so long as it acts to facilitate the operation of the real estate market in this community and maintains the overall high quality of the product offered.

With regard to your consideration of the specifically named project, it is felt by us that an action on your part rejecting this project would tend to insure the quality of the adjacent neighborhood and the market value of the immediately surrounding properties.

Failure to reject this project would possibly lower the marketable value of the adjacent properties by $1000 to $2000 immediately. The loss would be further compounded with the passage of time.

Procedure for Operating the Simulate. The major variable in the operation of the simulate is the administrative structure of which there are four models: (1) the lay board; (2) the expert committee; (3) the bureaucrat; and (4) the bureaucrat and expert committee. Each model is best viewed as a chain of decision alternatives and opportunities as represented in Figures 6 and 7. Within each of the administrative models, variations in other components (e.g., projects, environments, public interest props, etc.) are relatively consistent. This arrangement permits comparison of the various administrative models and comparison of variations in the other components, e.g., decision criteria and esthetic issues, within each administrative model.

The actual procedure and synthesis of the various components is structured in a program for each model (See example, Fig. 8.). The program specifies the sequence with which the projects and their respective environments are reviewed and the order of introduction of the public interest props, the esthetic decision instructions, and the ordinance variations. It also specifies the type of applicant role, i.e. architect, entrepreneur or lay person, for each project. The sequencing and phasing of all of the elements is designed to achieve the simulate's objectives.

A description of the lay review committee model in operation will illustrate the procedure and activity involved in a typical session. Following a description of the simulate, the game operator summons the first project applicant who in the interim has been briefed on his project. The applicant enters the room, bringing with him the drawings and information on his project (e.g., Project 10, Site 18–See Fig. 8.). The operator introduces the applicant and his project and instructs the esthetic review committee and the community council to refer to the appropriate site in the environment description book and brief themselves on the site conditions. The applicant places the project plans before the review committee and states the nature and description of the project. This is followed by a review and discussion of the plans and environment by the esthetic review board. The esthetic review group may ask questions of the applicant and discuss the project with him.

The game operator maintains a record of the esthetic review committee discussion as well as a record of the decisions. These serve to inform the council as to review committee judgments and as a basis for post gaming evaluation.

When the chairman of the esthetic review board believes that a decision is appropriate, he calls for a vote. If the project is approved, it is passed on to the council for its review. If the project is rejected or approved with modifications, the applicant is informed that he may appeal to the council. If this occurs, the project is presented to the council and the operator presents an overview of the review committee discussion and findings. The applicant then states the nature and reasons for his appeal. The procedure for the council is similar to that of the esthetic review unit.

Regardless of the nature of the decision, the project is reviewed by the community council. Substantively, this serves to keep the council aware of all decisions by the review committee in order that the council can better evaluate the committee's performance. Operationally, it serves to prevent boredom; it maintains the council's interest and involvement.

While committee review is taking place, the next applicant is being briefed. Upon completion of a project review by the esthetic review board and its subsequent referral to the council, the next application and project is introduced along with any modifications called for in the program and the process iterates.

This then is the general procedure to be followed for each model regardless of which administrative model is operating. The major difference in the playing sessions is the variation of the administrative model. The professional board-public official combination requires several minor modifications, and in addition, there are slight deviations for the introduction of public interest props to the community council during the course of an appeal or when the basic ordinance is changed.

FIGURE 6.

Decision Model One:
Lay Board,
Expert Committee,
or Bureaucrat

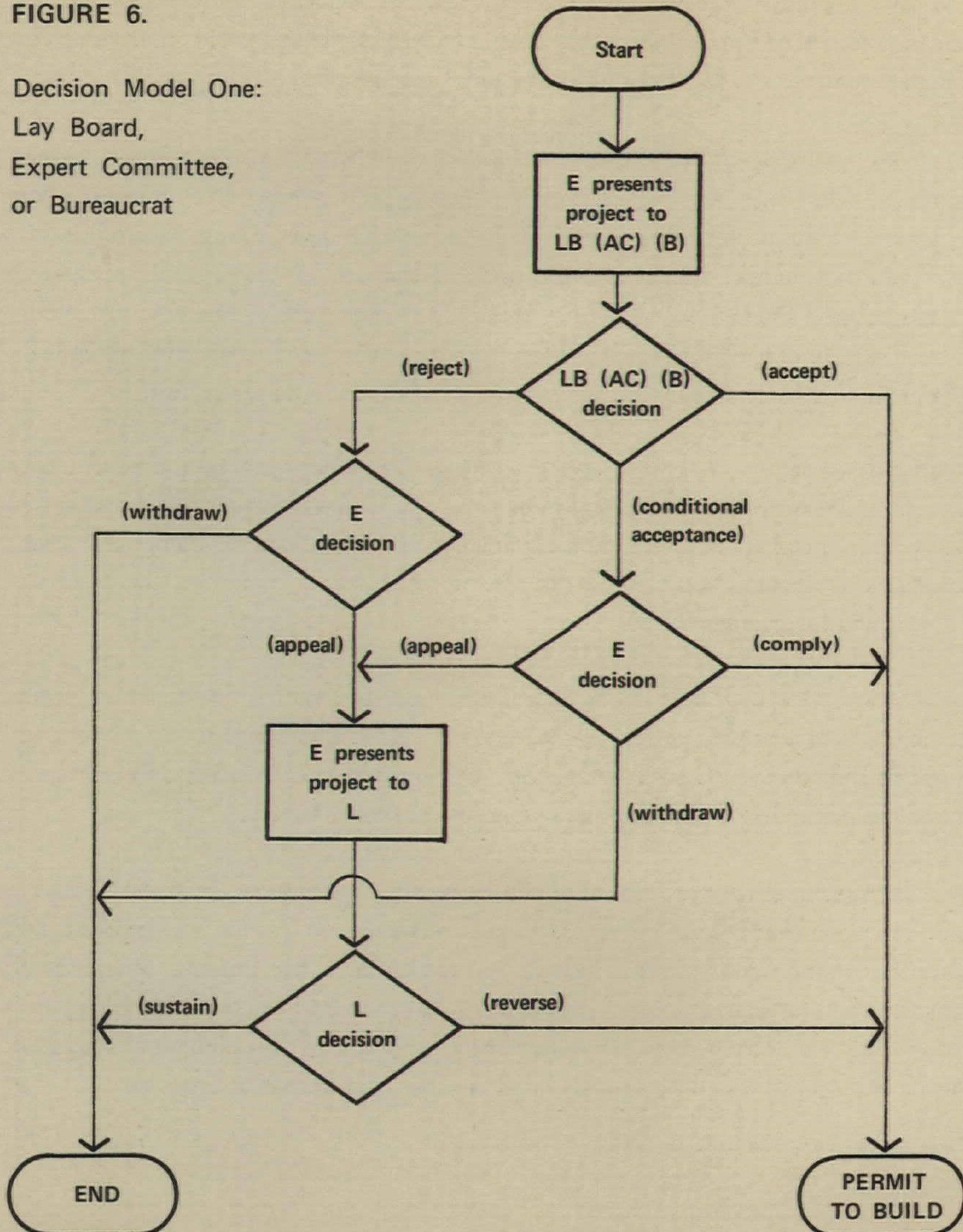

FIGURE 7.

Decision Model Two:
Bureaucrat
and Expert Committee

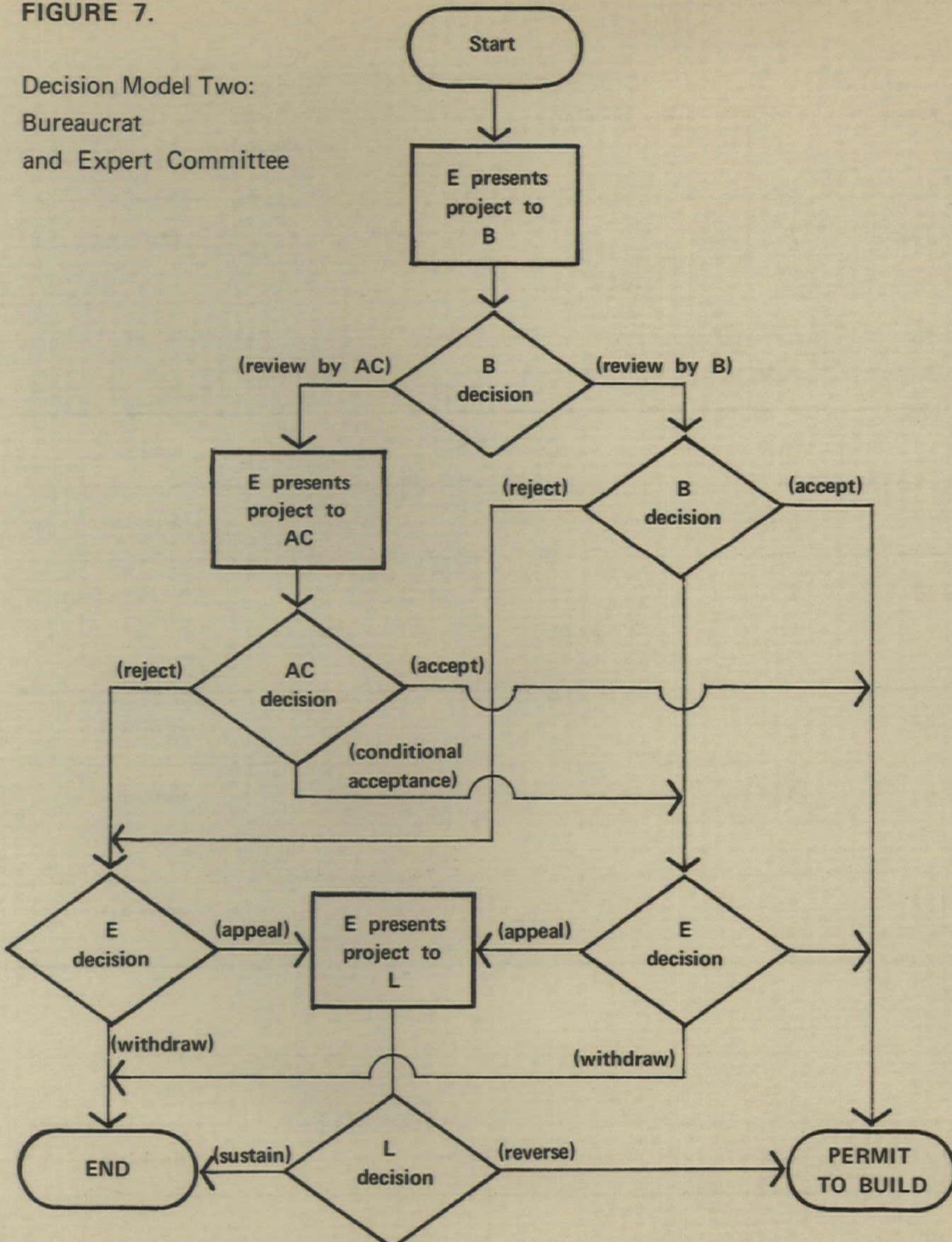

FIGURE 8 Partial Example of Program

Project No.	Design Environment No.	Ordinance Sections	Public Interest Props Used	Esthetic Decision Instructions	Applicant Types
P-10	S-18	Sub: Title II Art. 3 Var. 2	PI-8, 9, 10, 11		Architect
If project rejected on basis of appropriateness to area				No. 2	
P-11	S-18		PI-6, 7		Layman
P-5	S-10				Architect
P-12	S-1	Sub: Title III var. 2 for var. 1			Entrepreneur
P-17	S-11				Architect
P-6	S-12B	Add: Title II Art. 4.1	PI-16, 17, 18, 19		Entrepreneur
P-22 Parcel A	S-21		PI-20		Architect
P-1	S-2		PI-1, 2, 3, 24		Entrepreneur
P-14	S-3				Architect
P-23	S-11		PI-21		Architect

Each decision model may be operated independently, in a sequence, i.e. first, lay committee model; second, bureaucrat model, etc. In order to further condense time, to increase the involvement of the council member, and to increase the number of participants, two or all four administrative models can be operated simultaneously. In addition to the above benefits, we hypothesize that the simultaneous operation of all models will heighten the contrast between the models for the legislative body and improve the effectiveness of the simulate as a teaching device. Basically this involves employing one council, the four administrative esthetic review units, and a larger set of applicants. In this procedure, all review units operate simultaneously and each processes all projects but in a staggered sequence. All projects are reviewed by the single council, made possible by the fact that council requires considerably less time than does that of the esthetic committee.

EVALUATION

To date the simulate has not been operated in its entirety and evaluation of its effectiveness as a teaching device is premature. We are not certain, for example, if all of the major objectives will be effected nor have all the projects been tested and fully developed. The initial responses from the participants, however, is encouraging. We are amazed at the rapidity with which some of the major objectives become clear to the participants and in addition, the number of non-programmed minor insights into architectural control which are gained. Although the participants are aware of their "game-playing" they easily loose themselves into their roles and participate with considerable enthusiasm and realism.

There appears to be no question as to the participant's ability to impute from the simulate to reality. The realism of the props, upon which the participants frequently comment, and the easy adaption to the roles certainly enhance this. An unanticipated spin-off has been the ability of some participants to impute their experience to other forms of administration, particularly zoning.

While the simulate was created as a teaching device, there are indications that it may have value in studying organizational behavior. Although this is not usually the case with gaming-simulates, the use of participants who fulfill these roles in the real world provides a dimension of role control not normally attained. This suggests that the analysis of participant behavior under these controlled conditions would yield satisfactory data, a belief that is borne out in the predictability of participant behavior to date.

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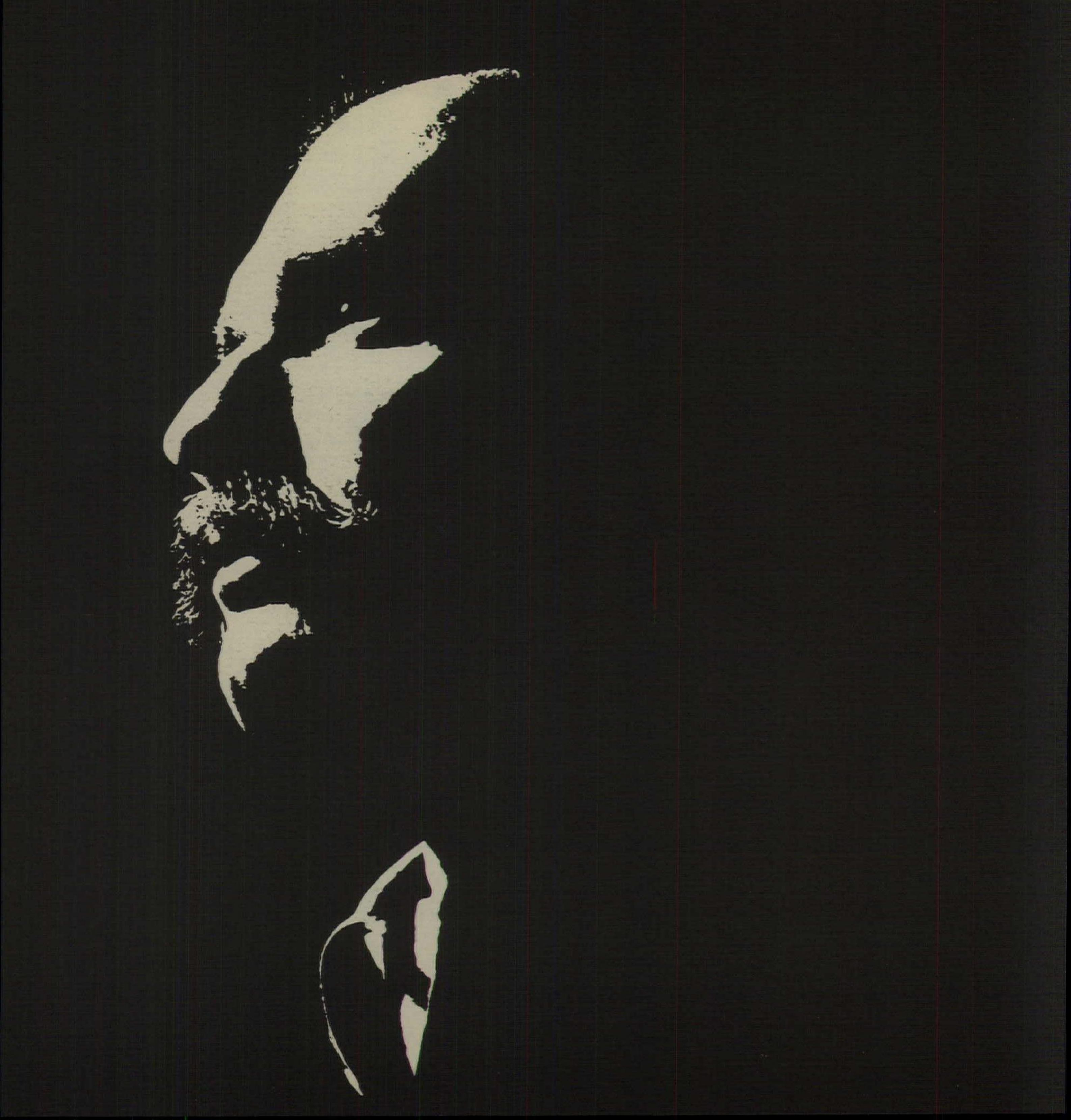

It is generally accepted that man's behavior is influenced by the environment in which he lives. The environment is multi-dimensional and includes both a social and physical component. Within the latter are the perceptual and spatial attributes of the environment which contribute to the shaping of the individual's style of life.

There is evidence to indicate that individuals have a requirement for sensory intake of appreciably varied perceptions while an extreme lack of external stimulation can have deleterious consequences.

Our vernacular past is rich with visually satisfying communities whose development was based on a leisurely sequence of growth. Today's development is rapid and changes come swiftly. Urban environments alter their character within a few years. The population increase and mania for speed outweighs consideration of quality, and environments are created with very little forethought. With this increasing urban development, there appears to be a loss of aesthetic quality where the environment becomes monotonous, impersonal and standardized.

Today people experience very little more than paving, sidewalks, building walls and advertising signs. Rarely is visual satisfaction experienced and, as a result, individual's aesthetic sensitivity remains unawakened. Man perceives the visual world and responds to it through the areas of his potentialities that have been made functional by environmental stimulation. The life experiences determine what part of the genetic endowment are converted with functional attributes. Only recently has the concern for the quality in the environment been emerging. There is a greater awareness today that some form of conscious influence over visual appearance of the physical environment is necessary. It is increasingly being accepted that some sort of public regulation is required to preserve inherited environments and avoid extreme incongruity, particularly if visually satisfying new communities are to be achieved in the future.

There is, however, little precise agreement on what the appropriate methods of aesthetic regulation should be. Many approaches have been tried to date. (1)

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Low Income Housing Demonstration, 1963-65, and
Evaluation of three Case Study Dwellings, 1965-66,
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Mr. Sanoff has served as Housing Consultant to the office of Economic Opportunity
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His varied research interests include
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and predictive and evaluative techniques for the measurement of performance.
Out of a concern for the perception of the physical environment,
Mr. Sanoff presents his investigation of

Visual Attributes of the Physical Environment.

1. **"Look-alike" regulations, seeking to enforce uniformity in a neighborhood, seem to foster monotony.**

2. **"No-look-alike" regulations, intended to compel variety and produce chaos.**

3. **Regulations to maintain public open spaces, vistas and views.**

4. **Architectural design review boards to which the designs of new structures are referred before building permits are issued.**

Indirect influences have also been exerted by other authorities as well as *ad hoc* public groups. Descriptions of what constitutes visual appeal by the Federal Housing Authority are related to the qualities of simplicity, harmony and refinement which are defined as follows: simplicity is freedom from complexity, intricacies and elaborateness. Harmony results when there is a pleasing arrangement of well proportioned elements and when there is such accord between the various parts of the composition that the effect of unity is produced. Refinement, sometimes termed "good taste," is characterized by freedom from ostentation and by restraint in design.

The underlying premises for these regulations tend to be restrictive, while the aesthetic assumptions are based on prejudice.

Perceptual "goodness' is largely haphazard rather than intentional, since few attempts have been made toward developing a theoretical framework based on the visual impact of the environment. Designers of man's environment have little more to rely upon as a basis for their decisions than their own intuition and their own response to the environment. Though the designer today may be dissatisfied with the appropriateness of his solution, he is still unable to predict the consequences of his decisions with any degree of accuracy. The rationale for the design of visual impact of the environment has not been based on a systematic analysis of the user's perceptions, but on a group of aesthetically inclined individuals who have formalized their intuitions into heuristics.

The freedom from imitating eclectic and ineffective forms was initiated by 20th century aesthetic philosophies. However, there are at present no viable control mechanisms to prevent visual disorder or monotony despite the growing awareness of its needs, nor does there appear to be a concensus of the appropriate design prescriptions for overcoming dissatisfaction with the environment. As the patterns of the urban fabric becomes more monotonous or chaotic by design and public regulation, the possible rewards of stimulation diminish. To alleviate the visual poverty in urban areas, a body of knowledge about perceptual phenomena is necessary to increase the sensitivity of the interrelation between behavior and the physical environment.

As A. E. Parr (2) succinctly states, "the variety inherent in the natural environment has been succeeded by a smaller selection of much more vigorously repetitive forms. A loss of diversity, particularly in the visually perceived environment, is one universal, and still continuing trend in the transition from country to city streets."

DuBos (3) indicates that "we must shun uniformity of environment," and further goes on to state that the present "creeping monotony" can be overcome by "creating as many diverse environments as possible." Though his concept of environment is holistic in nature, the observations appear to be appropriate at many environmental contexts. Diversity in the designed environment can give rise to sensory stimulation while a more homogeneously uniform environment may discourage any sensory arousal. Therefore, judgments of satisfaction about the physical environment are a manifestation of arousing visual stimuli which sustains the interest of the perceiver.

The knowledge of man's visual comprehension of his physical environment is primarily the responsibility for environmental psychology, which may be defined as "the psychological study of behavior as it relates to the everyday physical environment." (4) How people perceive their everyday physical world, their distinctions about it and the significant factors affecting comprehension are all questions which are of great importance to architects and urban designers and require immediate attention.

It seems evident that knowledge of the perceptual responses elicited by visual stimuli can be gained through the use of psychological theory and testing techniques. Many laboratory studies have been conducted by experimental psychologists with controlled visual stimuli and their corresponding responses.

Berlyne's (5) experiments in complexity and novelty conclude that more complex stimuli elicit the investigatory reflex more strongly than others. He also states (6) that diversity, complexity, novelty and ambiguity in a composition are conditions which lead to "arousal" and "attention." Order, organization, symmetry and repetition keep arousal in moderate and tolerable bounds. An aesthetic product has to accomplish two things; it has to gain (and maintain) the attention of an audience and it has to keep arousal in limits.

Hebb (7) describes the stimulus field as "requiring some familiarity, yet some novelty to sustain the interest of the perceiver. When novelty is lacking, a loss of interest is felt." Pfaffmann (8) states that sensory stimulation plays a significant role in the motivation as well as guidance of behavior—euphemistically he states, "in controlling behavior for the pleasure of sensation."

According to much of the literature of experimental psychology, the primary conditions for human sensory stimulation associated with visual environments are that they be continual, varied and patterned. (9) There also exists a body of experimental literature to justify that non-fulfillment of any of these conditions is stress producing and ultimately intolerable. Studies dealing with various forms of sensory deprivation demonstrate conclusively the needs for continuity and novelty. (10) They indicate that exploratory behavior regarding novelty seeking, fantasy and the preference for moderately non-redundant figures to highly redundant ones, begin when there is not enough information available.

The above findings and observations relate directly to the principles of good design as well as the concept of "good gestalt" as a proper end for the process of design.

(11) A good gestalt requires a high degree of internal redundancy, that is, predictability or syntactical coherence. Good gestalt also is the absence of deviation from a predicted pattern. The less information needed to define a given organization, the better it qualifies as a good gestalt. But the many experiments that deal with complexity and novelty disqualify good gestalt as a theory of design because it tends towards states of diminishing novelty in the environment.

Valuable as these studies are, their focus is extremely limited; however, they suggest possible avenues of approach.

The awareness for greater perceptual interest in the physical world has recently been expressed by D. Stea, (12) F. Vigier, (13) A. Rapoport and R. Kantor, (14) and many others. Thus, the approach herein presented is predicated on the notion that physical forms are no longer ends in themselves, but means employed to bring the designed environment into equilibrium with human systems.

Comparative studies of environmental perception involve four groups of variables: observers, modes of observation, environments and attributes of environments.

The specific aims of the experiments are: (A) to assess the relation between visual satisfaction and complexity, ambiguity and novelty (15) (B) to develop a model which can be utilized by designers to describe the desired attributes.

Before any assertions can be made, a common vocabulary among designers must be constructed, particularly if these terms are to be used for guiding designers in achieving these attributes of the physical environment.

In order to make diagnostic predictions of useful accuracy, a fund of systematic empirical knowledge concerning stable relationships between descriptive characteristics of environmental displays and evaluative criterion indices has to become available.

There are generally two ways in which we can examine the structure of the physical world; that is, two fundamental operations for sorting out meaningful relations among words; contrast and grouping. (16) Attributes can be isolated so that the physical world can be ordered with respect to this attribute or is irrelevant to the attribute. Or, alternatively, descriptions can be made in terms of collections or similarities of attributes. This experiment focused of the ordering of attributes, though it is well recognized that other associative techniques would be developed in future experiments.

Assessment techniques can be utilized to permit expressions of varied and subtle reactions to environmental phenomena. Environmental assessments can reveal adjectival descriptions of the images they evoke. These evaluations can be made using linguistic concepts to describe meaningful associations. The encoding instrument to be used for eliciting descriptive judgments is based on a technique utilizing a bipolar scale of attributes in the form of a semantic differential. (17)

In order to identify these attributes for study, an *ad hoc* list was drawn from the terms most frequently used by designers in their judgments and descriptions of the environment.

The properties selected for analysis incorporate a concensus of opinions about visual attributes; however, the list is by no means exhaustive or comprehensive. The list undoubtedly reflects a professional bias, since the properties were identified by professional designers. The words involve a considerable range of meaning varying with time, place and context of perception and with the background and experience of the respondent.

Figure I indicates the polar nouns and polar adjectives used on this form of the semantic differential. Terwilliger demonstrates in *Free Association and Semantic Differential,* (18) that the accuracy of the rating scale is dependent upon the degree of ambiguity of the descriptor and as the number of definitions of a word increases its ambiguity increases. It is therefore assumed that the selection of less ambiguous words will be an important factor in determining the subject's reaction to the word. Thus the selection was based on previous findings as well as probabilistic assumptions.

Several of the terms used to denote properties are value laden. Thus to many *symmetry* has a negative and asymmetry a positive connotation. *Novel* may be viewed more favorably than common; *static* and *dynamic* seem to be bad and good respectively. An attempt, however, was made to include "objective" words, though they too have values depending on the attitudes of the respondents and their image of visual satisfaction.

In spite of the emotional significance of the words selected, any replacement would invalidate comparative analysis in future experiments and alter an unknown portion of responses. This technique can elicit a large number of specific judgments to a complex aesthetic stimuli by a forced-choice protocol. Responses along the scale between each pair of terms indicates the direction and intensity of each judgment while permitting a wide discrimination of choice. Through controlled associations, connotative and denotative judgments of the visual world can be made. The relative strength of these attributes as they effect judgments of satisfaction then becomes of prime interest.

Descriptions of the attributes of an "ideal" environment were elicited from thirty experts in research and design, utilizing bipolar attributes (Figure 1) on a 7-point continuum. Results from the thirty respondents show an unusual degree of neutrality on the scales referring to an "ideal" (Figure II). The same group of experts show polarization when presented with specific examples of architectural form (ED a, b, c, d).

FIGURE I

Noun and adjective pairs used in semantic differential

simplicity-complexity
stimulating-sedate
harmony-discord
roughness-smoothness
ambiguity-clarity
formal-informal
symmetry-asymmetry
boldness-unobtrusiveness
interest-boredom
hardness-softness
individual-universal
unity-variety
austere-sensuous
novel-common
satisfaction-frustration
paradoxicality-comprehensibility
exhilarted-depressed
high-low
peaceful-disruptive
static-dynamic
ordered-disordered
uniform-divergent
tense-relaxed
calm-violent
intimate-distant
like-dislike

FIGURE II

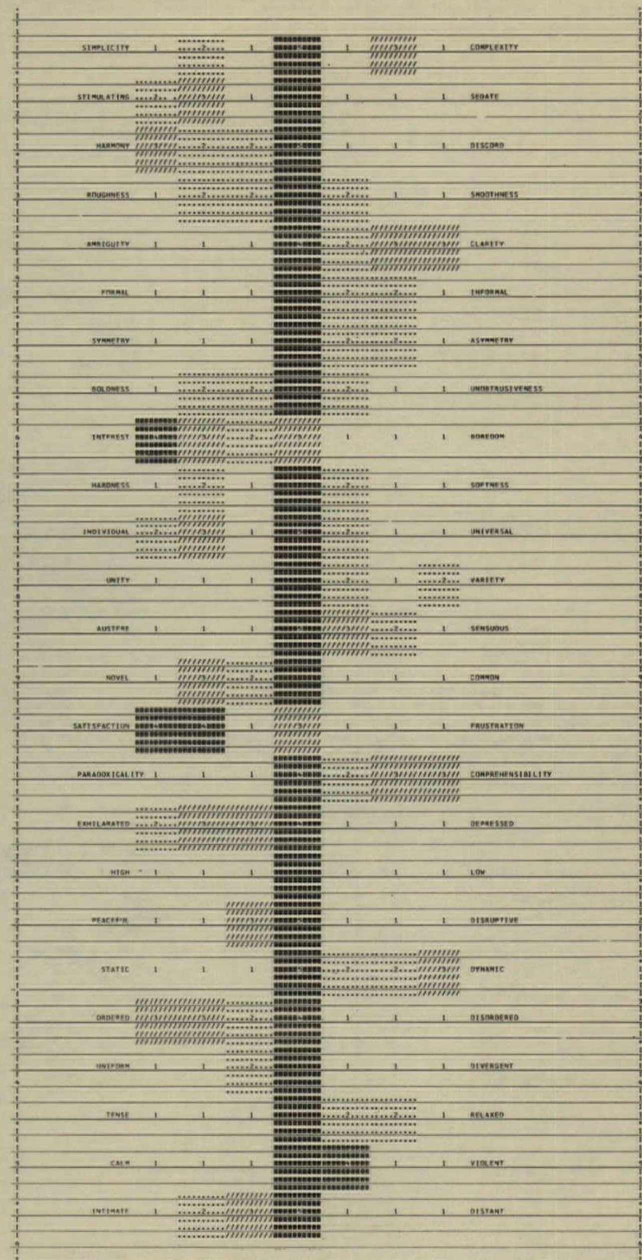
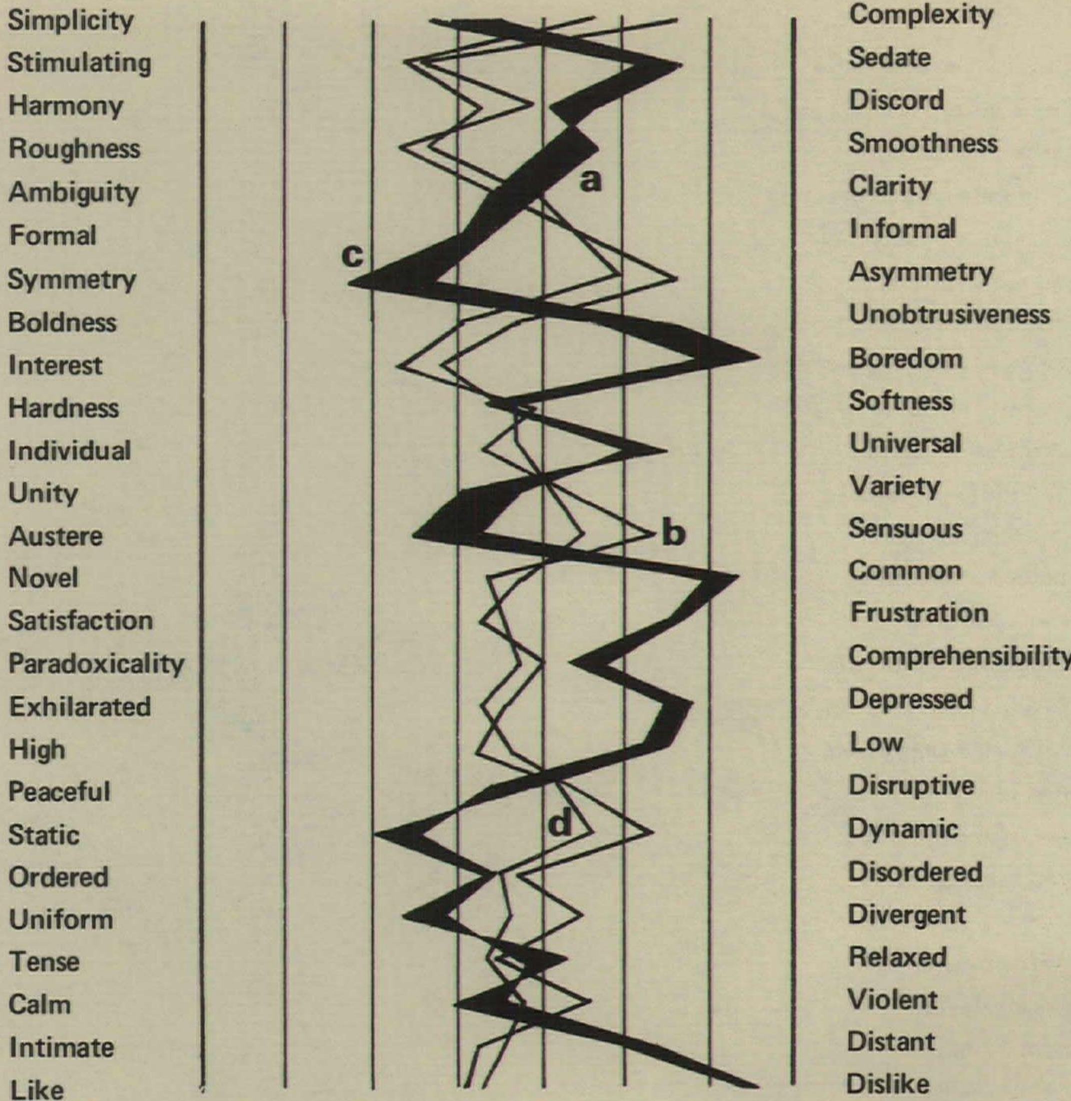


FIGURE III

Statistical Mean Distribution for Environmental Displays a,b,c,d



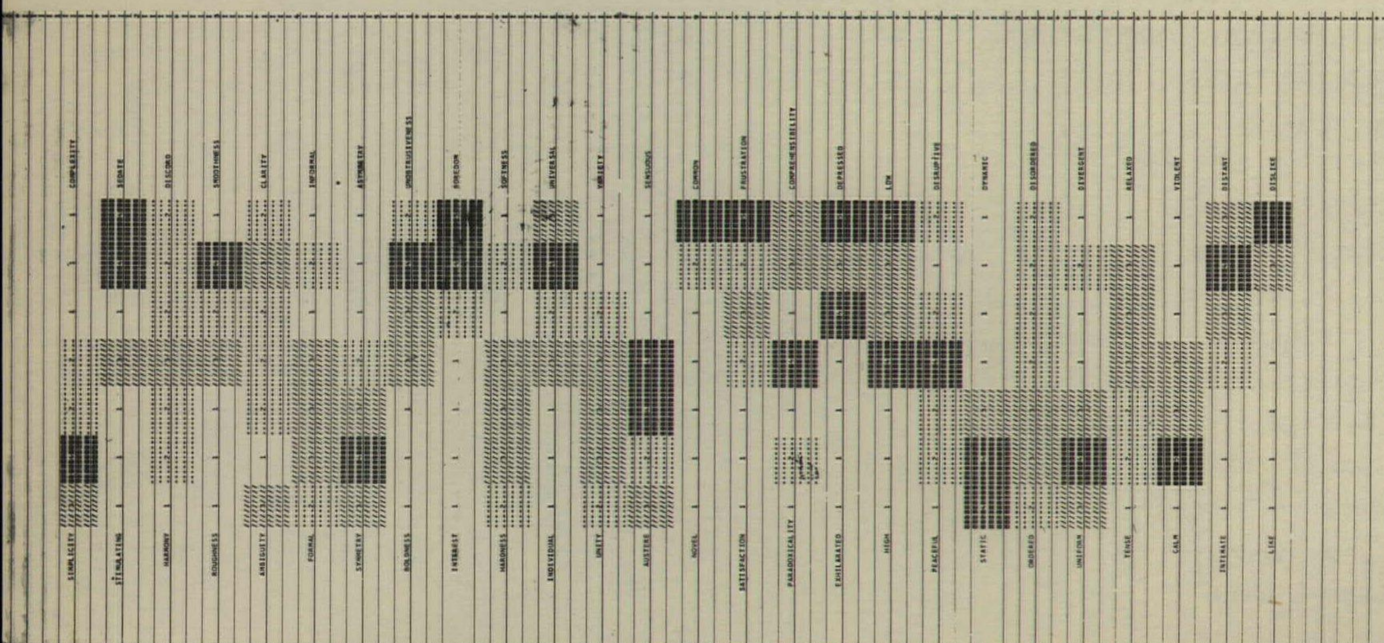
Analysis of Variance

Each of the 30 individual responses to each of the ED's was analyzed to discover which of the attributes appear to distinguish between ED's. Figure IV represents the level of significance of the attributes which separate the ED's. It can be concluded from Figure IV that the instrument is not sufficiently sensitive nor was the sample size large enough to discriminate between Environmental Displays that may possess attribute characteristics that are similar, however, not identical.

FIGURE IV

Attributes	a–b	b–c	a–d	b–c	b–d	c–d
Simplicity–Complexity	.01		.01	.01		.01
Stimulating–Sedate	.01		.01	.01		.01
Roughness–Smoothness	.01	.05	.01	.01		.01
Formal–Informal	.01			.01		
Symmetry–Asymmetry	.01		.01	.01		.01
Boldness–Unobtrusiveness	.01		.01	.01		.01
Interest–Boredom	.01		.01	.01		.01
Individual–Universal	.01		.01	.01		.01
Austere–Sensuous	.01		.01	.01		.01
Novel–Common	.01		.01	.01		.01
Satisfaction–Frustration	.01		.01	.01		.01
Paradoxicality–Comprehensibility	.01		.01			
Exhilarated–Depressed	.01		.01	.01		.01
High–Low	.01		.01	.01		.01
Static–Dynamic	.01		.01	.01		.01
Uniform–Divergent				.10		
Tense–Relaxed			.05			
Calm–Violent	.05					
Intimate–Distant	.01		.01	.01		.01
Like–Dislike	.01		.01	.01		.01

ED a



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DISCORD
HARMONY
SMOOTHNESS
ROUGHNESS
CLARITY
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FORMAL
ASYMMETRY
SYMMETRY
UNOBTRUSIVENESS
BOLDNESS
BOREDOM
INTEREST
SOFTNESS
HARDNESS
UNIVERSAL
INDIVIDUAL
VARIETY
UNITY
SENSUOUS
AUSTERE
COMMON
NOVEL
FRUSTRATION
SATISFACTION
COMPREHENSIBILITY
PARADOXICALITY
DEPRESSED
EXHILARATED
LOW
HIGH
DISRUPTIVE
PEACEFUL
DYNAMIC
STATIC
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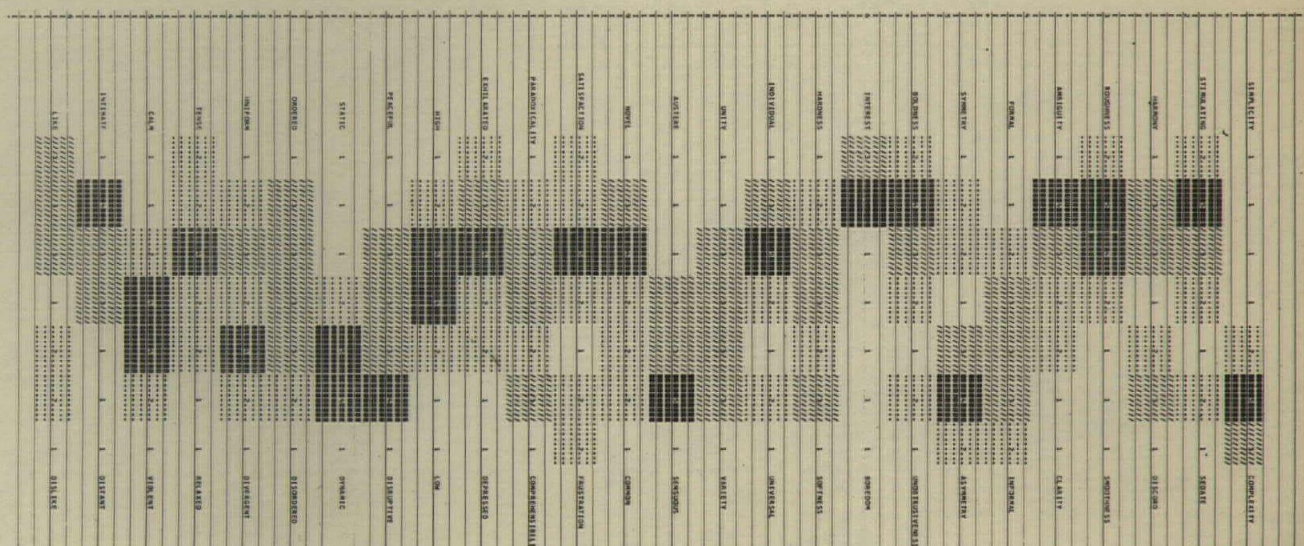
ED b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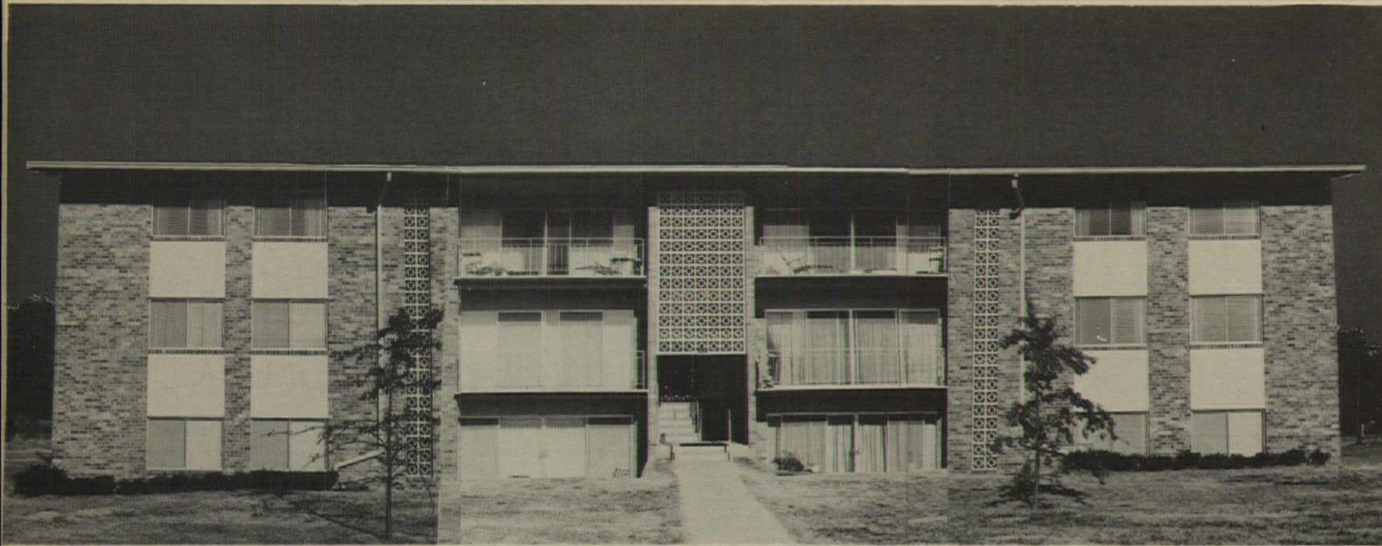
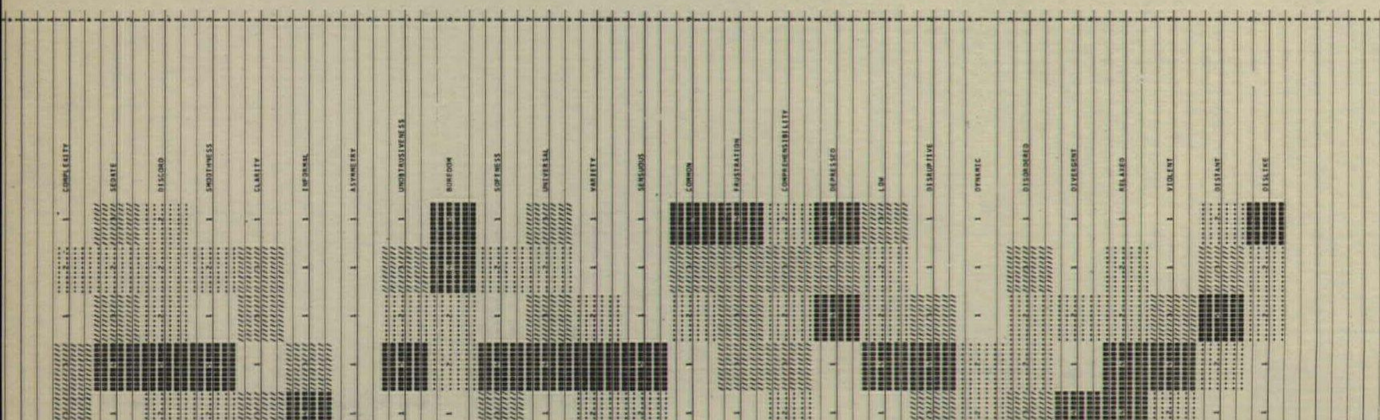


ED c


COMPLEXITY
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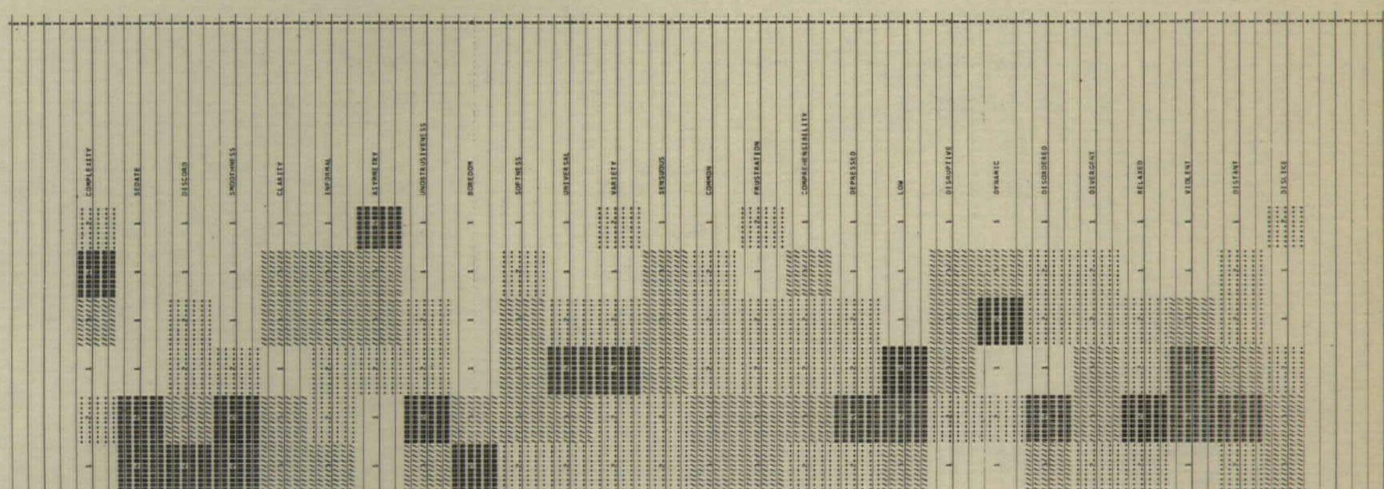
INTIMATE
LIKE

ED d


SIMPLICITY
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STATIC
DYNAMIC
ORDERED
DISORDERED
UNIFORM
DIVERGENT
TENSE
RELAXED
CALM
VIOLENT
INTIMATE
DISTANT
LIKE
DISLIKE

The attributes which appear to polarize in distinguishing between the ED's are indicated in **FIGURE V.**

EDa	EDb	EDc	EDd
Simplicity	Complexity	Simplicity	Complexity
Sedate	Stimulating	Sedate	Stimulating
			Harmony
	Roughness		Roughness
Formal		Formal	
Symmetry	Asymmetry	Symmetry	Asymmetry
Unobtrusiveness	Boldness	Unobtrusiveness	Boldness
Boredom	Interest	Boredom	Interest
Universal	Individual	Universal	
Austere	Sensuous	Austere	
Common		Common	
Frustration		Frustration	
Depressed	Exhilarated	Depressed	Exhilarated
	High	Low	High
	Disruptive		
Static	Dynamic	Static	Dynamic
Uniform		Uniform	
	Tense		Tense
Distant	Intimate	Distant	Intimate
Dislike	Like	Dislike	Like

Based on the intensity of responses, EDa and EDc which were extremely disliked, polarized to more extremes than EDb and EDc which were slightly liked. The descriptors which are associated with like and dislike are indicated in **FIGURE VI.**

Dislike (EDa & c)	Like (EDb & d)
Simplicity	Complexity
Sedate	Stimulating
Symmetry	Roughness
Unobtrusiveness	Asymmetry
Boredom	Interest
Universal	Sensuous
Austere	Dynamic
Common	
Frustration	
Depressed	
Static	
Uniform	
Distant	

It appears that there is a more positive concensus in describing the characteristics of what is disliked than what is liked.

Factor Analysis

The data was analyzed by pooling responses to EDa, b, c, and d, in order to arrive at the verbal associations for this class of environmental display, rather than a stimulus response for each display. In a stimulus response analysis, the associations between principal factor components vary between each environmental display with a wide range of attribute loading.

There are three factors with eigen values greater than 1, and together they account for 65% of the total matrix variance.

Factor 1 describes the associated components of a preferred environment, sensuous and unique. Factor 2 describes environments that are perceptually anonymous and compelling little attention from an observer, whereas Factor 3 represents the physical characteristics of a highly redundant environment with very little positive impact on the observer.

ATTRIBUTE FACTOR LOADINGS

ATTRIBUTE	FACTOR		
	1	2	3
simplicity—complexity	0.40	−0.45	−0.42
stimulating—sedate	−0.81	0.22	0.13
harmony—discord	−0.59	−0.35	−0.39
roughness—smoothness	−0.48	0.42	0.25
ambiguity—clarity	0.07	0.48	0.55
formal—informal	0.29	0.11	−0.69
symmetry—asymmetry	0.67	−0.01	−0.43
boldness—unobtrusiveness	−0.68	0.44	0.03
interest—boredom	−0.92	0.12	0.10
hardness—softness	0.26	0.63	−0.21
individual—universal	−0.61	0.38	0.19
unity—variety	0.18	−0.12	−0.75
austere—sensuous	0.75	0.01	−0.32
novel—common	−0.84	0.19	0.16
satisfaction—frustration	−0.84	−0.17	−0.03
paradoxicality—comprehensibility	−0.12	0.60	0.43
exhilarated—depressed	−0.90	−0.03	0.06
high—low	−0.79	−0.02	0.06
peaceful—disruptive	0.01	−0.48	−0.53
static—dynamic	0.83	−0.29	−0.19
ordered—disordered	−0.29	−0.46	−0.60
uniform—divergent	0.28	−0.20	−0.79
tense—relaxed	−0.09	0.75	0.21
calm—violent	0.31	−0.73	−0.16
intimate—distant	−0.74	−0.22	0.20
like—dislike	−0.89	0.07	−0.02

PRINCIPAL FACTOR COMPONENTS

FACTOR 1

Attribute	Factor Loading
INTEREST–Boredom	–0.92
EXHILARATED–Depressed	–0.90
LIKE–dislike	–0.89
SATISFACTION–frustration	–0.84
NOVEL–common	–0.84
static–DYNAMIC	0.83
STIMULATING–sedate	–0.81
HIGH–low	–0.79
austere–SENSUOUS	0.75
INTIMATE–distant	–0.74
BOLDNESS–unobtrusiveness	–0.68
symmetry–ASYMMETRY	0.67
INDIVIDUAL–universal	–0.61
HARMONY–discord	–0.59
ROUGHNESS–smoothness	–0.48
simplicity–COMPLEXITY	0.40
calm–VIOLENT	0.31

FACTOR 2

tense–RELAXED	0.75
CALM–violent	–0.73
hardness–SOFTNESS	0.63
paradoxicality–COMPREHENSIBILITY	0.60
ambiguity–CLARITY	0.48
PEACEFUL–disruptive	–0.48
ORDERED–disordered	–0.46
SIMPLICITY–complexity	–0.45
boldness–UNOBTRUSIVENESS	0.44
roughness–SMOOTHNESS	0.42
individual–UNIVERSAL	0.38
HARMONY–discord	–0.35

FACTOR 3

UNIFORM–divergent	–0.79
UNITY–variety	–0.75
FORMAL–informal	–0.69
ORDERED–disordered	–0.60
ambiguity–CLARITY	0.55
PEACEFUL–disruptive	–0.53
paradoxicality–COMPREHENSIBILITY	0.43
SYMMETRY–asymmetry	–0.43
SIMPLICITY–complexity	–0.42
HARMONY–discord	–0.39
AUSTERE–sensuous	–0.32

Generally response information has been response-defined due to the nature of the task, and not stimulus-defined. For a more comprehensive understanding of aesthetic responses, experimentation is needed in the area of transitional response states and the probable impact of any one specific response state. (20)

Additional techniques need to be explored, partially to test the efficacy of the semantic differential as well as generate further insights into response patterns to visual fields. Multi-dimensional scaling techniques incorporating the tools of graphy theory in the analysis of proximity matrices (21) appear to be the direction towards which this work shall proceed.

The major portion of this research lies in its heuristic possibilities. Clearly, environmental descriptions are amenable to scientific investigation. It is possible to reduce the terminology of environmental descriptions to a parsimonious few factors. The future uses of descriptors will be to study the interaction between behavior occurring in an environment and the physical properties of the environment as well as its predictive and evaluative implications. Results from empirical studies in environmental perception can be of significant influence in effecting a greater visual impact of designed environments.

FOOTNOTES

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15. Complexity is defined "an intricate combination of physical elements." Ambiguity would be alternative reactions to the visual environment or associated with variability in environmental descriptions. Ambiguity, thus, tends to result in complexity.

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19. The visual mapping of the frequency distribution was accomplished by the adaptation of the SYMAP graphic program which represents data as points in space. (ED, a, b, c, d) The graphic distribution of value into ranges from white to black are represented by black corresponding to 50% or more of the total responses, while white represents 10% of the response. The figure in each cell represents the percentile value from 1 to 5.

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His research interests have included
the psychology of environmental design;
behavioral problems of urban design;
human and animal perceptual and conceptual learning;
social and organizational behavior;
and general systems.

His most recent work has centered principally on the effects of designed environments upon behavior, particularly as to the measurement and description of their mental representations. Dr. Stea develops some of his findings in this area as he writes of

Environmental Perception and Cognition: Toward a Model for "Mental Maps."

The subject matter of and the issues within what is usually called "the psychology of perception" are among the oldest within the field of scientific psychology. In most of the traditional work in perception within psychology, the subject is told what to perceive—or at least, he is told where to look for what he is supposed to see. A majority of the studies in perception using human subjects have been done in the visual-sense modality. This is reasonable, since most of our intelligence concerning the outside world comes through this modality; in other words, to abuse a reasonably common cliche, "we are visual animals." Such experiments present subjects with stimuli which can be perceived instantaneously, or over a very short interval of time.

Experiments dealing only with this form of perception treat intervals of time much smaller than the intervals usually involved in gaining "useful" information, such as learning how to get around in a city, or even learning, or "appreciating," a single building. However, in this era of interdisciplinary endeavour, some architects have become enamored of the word "perception" and what it connotes. They are often convinced that what they have been trying to do in the past is, through manipulation of certain hypothesized visual characteristics of architectural products, to "tell" people what to perceive. Sometimes they have been successful, many times for reasons they do not know; more often they have failed. Urban designers have also tried, with somewhat less success.

The suggestion here, and it is by no means a new one, is that the majority of our actions, thoughts, etc., *vis-a-vis* the physical environment, are by no means based upon a "perception" in the strict sense in which the term is used by experimental psychologists, nor upon any simple combination of such perceptions, memories and leanred modes of organizing these. Except in very simple, but not always trivial cases, we know very little about these modes of organization, complex combinations which could be and have been called "images," "cognitive maps," "mental maps," "conceptual spaces," "schemata," etc.—the name often depends upon the discipline to which one subscribes. Before the First World War, the then-dean of psychology, John B. Watson, had dismissed the "image" from psychology. (1) The concept briefly reappeared again in the work of Sir Frederick Bartlett and Kurt Lewin in the 1930's and 1940's, but remained relatively dormant until George Miller, Eugene Galanter, and Karl Pribram revived it in their now nearly-classic little book, *Plans and the Structure of Behavior.* Perhaps it will again become respectable.

To clairfy the distinction between a "perception" and an "image" or "mental map." We can get around the Watsonian objection, which was largely that there exists no direct way for the scientist to "see" this image, by stating very simply that what we are interested in is not necessarily the map itself, but its manifestations. That is, we shall define the image "operationally" in terms of resulting behavior. Or, in other words, "images" may not exist at all, but some representation of certain real-world characteristics, no matter how far divorced from veridicality, must exist. It might be no more than an unordered list of place names. But once we have gotten some idea of what *is* there (and to do so we shall have to construct a theoretical framework and formulate hypotheses), we can put together a model—with all the shortcomings that models usually have—which may tell us something about the ways in which people orient themselves in, and form conceptions of their surroundings.

First, we are speaking only about spaces so large that they cannot be perceived at once, not of those perceivable in a brief series of glances; problems of the latter kind already have been treated adequately. Larger spaces, which must be cognitively organized, we hypothesize to have the following "conceptual" characteristics (in terms of the possibly fictitious "mental representation" of which we have spoken earlier):

(1) Prior to this time, interest in imagery had centered about the relative "clarity" of images—such issues as identifying characteristics of "eidetic imagers" were then central. The distortions which occurred in imagery, particularly in successive reproductions, later occupied the interest of some. The emphasis here is upon what might be called the "metric characteristics" of specifically spatial or geographical imagery, a subject heretofore largely neglected.

1. The space consists of a series of "points" (not points in the mathematical sense, because our points may have dimension) arranged in some one-, two-, or three-dimensional way.

2. There may be several possible hierarchical arrangements among these: in terms of size, importance, etc. In fact, several hierarchical arrangements may co-exist, or may exist at different times within the life of an individual. In a child's drawing of a visit to a zoo, the largest animal drawn is usually the most important to him—often a monkey; similarly, in drawing his home, mother is often drawn much larger than father.

3. The space is somehow "bounded." The boundaries may be clear or indistinct; they may be in the form of lines or other imaged areas. A neighborhood may be bounded by a street or another neighborhood, for example. Further, there may be boundaries within the boundaries; as an individual "images" a city, he may image neighborhoods within the city as bounded entities.

4. If it is possible to get from one given point in the imaged space to another by *any* means of transportation, we say that they are "connected." If it is possible to get from one point to another by *some* means of transportation, they are "semi-connected." In either case, there exists a "path" between the points. If the two points are semi-connected or non-connected, there exists a "barrier" between them. However, the converse is not necessarily true; the existence of a barrier does not necessarily imply that there exists some means of transporation by which it is impossible to get from one point to another. The barrier may simply make certain forms of transportation more difficult.

5. Barriers differ in their *permanence,* their *permeability,* and their *quality* ("natural" or "artificial"). A construction project in the middle of a superhighway decreases permeability and is impermanent, a flood, also impermanent, reduces permeability to zero. The frontier between Mexico and the United States is temporarily quite impermeable when rumors are received that a shipment of marijuana

is expected; all travellers attempting to cross the border then experience difficulty.

6. **Barriers may be symmetrical (the same when approached from one member of a pair of points as from the other) or non-symmetrical. The city of Providence, Rhode Island, for example, was for most travellers between Boston and New York prior to the completion of the turnpikes, a non-symmetrical barrier; that is, the north-south and south-north routes through the city were different and it was considerably more difficult to traverse the city in one direction than in the other.**

In summary, the space of which we are speaking is bounded; one-, two-, or three-dimensional; and consists in a probably finite (given the limitations of the human organism) collection of points [of anywhere from zero through three dimensions]; of paths between them; and of interposed barriers. We need be no more mathematically rigorous than this in our specification. Further, we need not postulate an entity which might arouse the wrath of the late Dr. Watson. The "mental maps" of which we are speaking need not necessarily be "geography in the head"; indeed they may be an utter fiction—that is, there may be no reportable imagery at all—without loss of heuristic value. It matters not a whit that we cannot observe a "mental map," that we cannot know for sure that it is actually "there"; if a subject behaves *as if* such a map existed, it is sufficient justification for the model.

What we are proposing is no more than that the large and complex real world must be handled by people with limited capacity for information storage, manipulation and retrieval. Hence, certain simplifications and distortions take place, in accordance with the needs and experience of the individual in the conceptualization of these large and complex spaces. These alterations are distortions only in the sense that they do not correspond with maps objectively prepared by objective geographers. The distortions may be expected to vary from individual to individual, but where certain kinds of distortions are consisent across a given class of persons, they are interesting in and of themselves. The measures to be used may be behavioral, in the sense that we observe the individual's actions vis-a-vis a real or artificially created environment and infer the "image" that yielded the observed behavior, or "introspectively descriptive" in that we ask him to describe an *imagined* interaction with the environment. (2)

We may also speak of "static" and "dynamic" maps. To form a "static" map, the subject need only imagine himself within a space, either standing or moving, and describe its "points," either in the form of free or directed recall, or by sketching a map from memory. We may then evaluate the verbal description in terms of the relative salience of various points when a number of subjects have been interviewed, or in terms of the physical placement of the points on a sketch map (both the relative positions of these points and their deviation from "reality"—what might otherwise be termed "accuracy" of memory"). (3)

The "dynamic" map differs from the static in that not only are the points of the map important, but the individual's *interaction* with these points—how he imagines himself to be moving among them. We hypothesize that it is imagined or actual movement that ties the elements of the image together—they may define the *nature,* if not the *details* of the image. They may also answer some questions regarding human orientation in a civilized world consisting largely of designed environments. Assuming that there may exist several modes of orientation, we may ask whether there is such a thing as a *generally* well-oriented person, what orientations are best for what kinds of urban areas, and what is the role of one's previous interactions with physical environments ("Where'd you grow up, sonny?"), etc.

We will not address ourselves here to the chicken-and-the-egg problem of the extent to which "cognitive maps" generate movements *vs.* the extent to which movements generate "cognitive maps." We may assume that both occur. As merely an outline of a viewpoint, this paper will concentrate upon certain easily definable interactions of an individual (in real or imagined motion) with an environment that he cannot immediately perceive in its entirety. From a highly simplified view, certain testable hypotheses will be generated. In all, we can present herein only a "theory in the rough" and, at that, only a portion of what really should be a much more complete theoretical development.

We begin by asking the most general question, "what does a person do?" First, he is or imagines himself in a location, that is, at a "point" (origin) in space. Second, he moves, or imagines movement to another "point" (goal), probably passing through intermediate "points" (which may be termed sub-goals) on the way. These various points bear a certain relation to each other, the weakest of which (in correspondence with the real world) is the preservation of order—which point comes first, which second, etc. in the direction of travel. Third, the origin and goal are separated—there exists some *distance* between them. Fourth, movement is initiated in a certain direction (bearing—which is presumably related to the imaged location of the goal *vis-a-vis* the origin. Fifth, this bearing is generally not maintained throughout the entire journey or "virtual trip;" changes in direction which we call *turns* periodically occur. Finally, the person usually operates on the basis of some system of coordinates.

Let us examine each of these and the experiments they suggest.

Topological Correspondence. It is hypothesized that when maps are drawn or descriptions given, the product is not an exact description of the "real world," but that under specifiable conditions, the order in which these objects appear, and such other ordinal characteristics as relative size, relative path length, etc. are conserved. The depiction of the "mental map" will thus be an *order—preserving transform* when the following conditions hold:

(2) We shall call this the "virtual trip."

(3) This is the nature of the work reported by Kevin Lynch in his book, *The Image of the City.*

1. The difference in magnitude between the length of two paths, the sizes of two subspaces, etc., is demonstrably recognized (demonstrable in the sense that we have some other, independent measure); and

2. The elements involved (paths, points, spaces, etc.) are equal in importance, cogency and valence (attractiveness of goal value), and are equally well known to the subject; or

3. Differences in importance, valence or cogency are in the direction of objective differences in magnitude.

It is further hypothesized that when "mirror reversals" occur in the order of things, from the subject's point of view, left-right reversals will be more common than front-back reversals. That is, it would seem to be easier to err across the body's line of symmetry than otherwise. People giving directions on the street in terms of their own position seem more likely to commit errors of left-right confusion than others. This problem will be further treated in the section on coordinate systems.

Distance. The conceptualization of what "distance" may be in spatial imagery may be aided by phrasing the issue in quasi-mathematical terms. The "real world" is, mathematically speaking, a metric space; that is, if we take any non-trivial portion of it and call it "X" ("X" may be a [non-mathematical] neighborhood, a region or a nation), we may consider a function defined on the non-empty set "X". This function will be called "d" (distance), and the pair (X,d) is then a metric space if the following three conditions are satisfied for any pair of points (a and b) in "X" [for d (a,b) read "the distance between "a" and "b"] :

1. $d(a,b) \geq 0$; $d(a,b) = 0$ if and only if $a = b$.

2. $d(a,b) = d(b,a)$.

3. $d(a,c) \leq d(a,b) + d(b,c)$; this is the familiar "triangle inequality".

Distance can be thought of loosely as a line of communication or transportation. It is obvious that the real world is metric in the above sense; the interesting question is whether the image world is too. There is at least some evidence from a recent study of "virtual trips" among cities in New England (4) (in which a person imagines that he is traveling by a specified means of transportation between two points known to him) that condition (2) does not necessarily hold in imagery; it makes a difference whether the question asked is: "What is the distance between Providence and Boston?" or "What is the distance between Boston and Providence?" That is, distance estimates are "non-commutative." When familiarity with the end points and the routes of such "virtual trips" are equated, a number of factors may account for the discrepancy in estimation; two potentially powerful ones are the desirability ("valence") of the goal relative to the origin, and the nature of the barriers between the two.

There is apparently no available evidence on (1) and (3). Failure of condition (1) to hold seems absurd; such failure would imply the statement, "I am not where I am." But if we shift the emphasis from simple distance estimation to communication, the statement is not so absurd at all. With the increase in size and number of "megalopoli," especially within the United States, it is becoming increasingly common for people to give the major population center nearest to their homes as their actual location. Thus, the statement, "I am from San Francisco," might imply, "I am from that area of which San Francisco is the center" (Palo Alto, for example). What is conveyed to the receiver of this message is equivocal; if the image generated is that of San Francisco itself, then for that pair of communicating individuals, "a" and "a" are not coincident.

Failure of (3) means simply that a less direct route may be conceptually shorter than a more direct one between two points. Students trained in geography classrooms in which the Mercator projection of the world was the major teaching aid are presently suffering difficulties in studying air routes, which seem, in terms of the maps with

(4) Buckman, Irene. Unpublished ms., Brown University, 1966.

which they are familiar, to be most indirect indeed (the "great circle route" problem). And, especially with reference to air travel, it must be noted that *distance* (yards and miles) is not the only measure of "distance." *Time* is for many people the most common, useful and meaningful measure. "It is five hours from San Francisco to New York," for example (but "longer" in the reverse direction).

Bearings. In addition to impressions of distance, the image must include the initial direction taken from the point of origin to the goal. The question of bearing cannot be divorced from the issue of orientation systems, of which there appear to be two basic classes:

1. **Body or "ego-centered" orientation—directions given in terms of the individual's position, i.e. left-right, back-front, etc.**

2. **"Objective" orientation, which can be further divided into**

   (a) "Universal" compass coordinates
   (b) "Local" compass coordinates.

These are especially interesting, since what is considered to be "North" often varies with locality. Indeed, each town in New England seems to have its own system. Orientation on the San Francisco peninsula is complicated by the fact that its inhabitants "consider" it to run North-South (in fact it is oriented Northwest-Southeast). Freeway signs in this area are based upon universal rather than local coordinates. The resulting confusion is prodigious.

Turns. A turn is simply a change in bearing and may be described with reference to a previous bearing or direction of travel (e.g. "turn right") or with regard to compass coordinates. But the most interesting characteristic of an "imaged" turn is its magnitude. With an infinity of possible variations, people tend to simplify these imaged turns, the most common simplification among dwellers in gridiron cities being a right angle. A psychologist once jokingly remarked, "There is no such thing as an obtuse angle—only a poor right angle." For dwellers in those cities in which a radial pattern is superimposed upon a grid (or vice-versa), as is the case with Washington, D.C., simplifications of 45° and of 90° may be made. The point to be made here is that turns may well be remembered as other than what they are, and that the nature of the simplification is likely to be a result of one's accustomed interaction with the environment. Thus, we hypothesize that people whose experience has been largely with "irregular" lines of communication—cities such as Guanajuato in the Republic of Mexico—are likely to have received the last reinforcement for "simplifying assumptions" and, while they may experience some difficulty in adjusting to gridiron urban environments, will probably experience much less difficulty than others when lines of communication depart slightly from rectilinearity (as is the case in Mexico City, which is a complex radial pattern superimposed upon a complex grid). The experimental question here is: for a given individual, how large does a departure from strict rectangularity have to be before it is perceived (treated as) a departure?

In this connection, a consideration of what has come to be called "The Boston Common Problem" may be instructive. The Boston Common is an irregular five-sided figure. The cues surrounding it are well-known to Bostonians (although partly occluded by foliage in the spring and summer), but are generally not known to the stranger walking around the Common, who tends to rely upon the turns for his cues. Since the figure is five-sided, these turns are not right angles, but they may be "perceived as" or "simplified to" right angles, leaving the befuddled traveller 90° out of phase with the environment when he has traversed the five sides. We would hypothesize that this problem would be greatest among recent arrivals from highly regular Midwestern cities, and least among those Americans whose home, while not necessarily Boston, has always been some "irregular" New England town. (5)

(5) It would be ideal if we had some form of control over the previous environments of our human subjects. Such, of course, is impossible; we cannot dictate where they shall live (or shall have lived); even if we could, the period of environmental learning is much too long to yield an experiment which could be realized within any reasonable period of time. What we can do, however, is to *simulate* the experiences of humans developing in environments of various forms by using animal subjects whose period of maturation is much shorter—hooded rats, for example (an organism with which the author has had considerable ex-

Bearings and turns combined—the formulation of orienting schemata. Finding one's way about a city is essentially a problem in the utilization of paths, junctions and cues (the paths and junctions themselves providing some of the cues). In the present terminology a person continues along a certain bearing, then changes bearing by making a turn, and so on. This constitutes a *route* from an origin to a goal; a complex of such routes for a given area constitutes a *schema.* We contend that two fundamentally different types of *schemata* may be formed, that they depend upon the coordinate system and mode of imagery utilized, and that the two are not equally well suited to all areas. The distinction should be clear to anyone who has ever taken directions (or given them) over the telephone. One way to give directions is to specify an origin, an initial direction (street name or number), a "cue" at which one turns "right" or "left," a succeeding cue at which one does something else, etc., to the goal. This can be mapped or "imaged" but it can just as well simply be listed; not even the vaguest graphic image is really necessary. The second way of giving directions is to minimize the emphasis upon specific cues and to give information in terms of compass coordinates and general characteristics, generating what the psychologist E. C. Tolman referred to figuratively, and what we shall refer to literally, as a "cognitive map." Image-wise, it allows for alternative routes within a general framework; the former method does not, in the sense that "if you miss a cue (choice-point), you're lost." On the other hand, where the channels of communication and transportation are exceedingly irregular, the former system may be easier to learn and may "work better." If images in their most generic sense are built up, however, those based upon one of the above systems of "route-following" will be very different from the other. One will be a conglomeration of independent routes, the other a "cognitive map."

perience). One colony of rats could be raised in an environment in which all changes of direction were constrained to right angles (very much like the mazes presently used in many studies in psychology); another colony could be raised in an essentially "circular" environment where corners simply did not exist. These, of course, represent the extremes. At maturation these animals could then be tested in mazes with "variable-angle" turns; the degree of "confusion" experienced by these animals, defined in terms of difficulty experienced in solving the problem posed by this "variable" maze, would then be the datum of interest.

A TENTATIVE CONCLUSION

We have assumed that people "operate" (make plans and execute them) in accordance with their *representations* of the "real world;" hence, it would appear important for geographers and planners (and even, perhaps, for political scientists) to know and to understand these representations, and the nature and magnitude of their distortions. Such things as the relative attractiveness of cities and the barriers restricting communication among (and even within) them are of interest to planners and urban geographers. Research on non-commutativity of distance estimates may yield some information on this. Similarly, it may be supposed that "getting lost" is often a matter of making a wrong assumption about the nature of a turn which must be made.

There are possibilities for supplementing the body of knowledge within the psychology of perception too, if interest in this heretofore uninvestigated form of "imagery" is revived. It might be possible to develop a crude "psychophysics" of conceptual spaces—for example, what are just noticeable deviations from rectangularity perceived through other than the visual mode, how do these vary depending upon how they are experienced, etc. If results from early studies support our initial hypotheses, we might "probe" the cognitive map—insert unreal or misleading "cues" to see how much additional distortion can be introduced. Alternatively, assuming that the "virtual trip" represents the most impoverished stimulus field, we might "en rich" the field by inserting features which are progressively more veridical (or simply inserting more features) to see how much additional information is required to get genuinely veridical estimates. (6)

The possibilities are myriad. It remains only to revive interest in an area of research long neglected, but of undeniable interest to researchers in many fields.

(6) Borrowing the "sequential notation" devised by the architect Philip Thiel or utilizing slide sequences described by Gary Winkel and Serge Bouterline, which simulated visitor experiences at the Seattle World's Fair.

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Some Aspects of the Man-Designed Environment Interface.

Increasingly complex, technologically sophisticated cultures cannot long survive complacency and gross ignorance regarding effects of the man-made environment upon human affairs. The vicarious attributes of designer experience, conventional wisdom and intuitive guessing all have a role in the design process; but alone they are not good enough. The move toward a more refined understanding of man-environment relations as they impinge on the design process is as irreversible as it is necessary. Scores of competent researchers from a variety of disciplines are joining those in the design community in an examination of the interface between humans and the designed environment. (1) Frustrating and elusive as this particular inquiry can be, progress toward a more integrated understanding is and will continue to be made. For the present we must operate with a great deal less information than will ultimately be required. The following comments attempt to outline some of the issues concerning the man-environment interface from the viewpoint of the environmental designer. At this juncture it appears that the designer and the behavioral scientist may not be looking at this interface in exactly the same way. If this be true, it could account in part for the obvious confusion encountered when these two disciplines attempt to interact.

Designers are primarily interested in the effects of the designed environment upon the outcome of human events. Psychologists have long dealt with such questions, and we have quite naturally turned to the resources which have grown out of their inquiries. If we but understood precise environmental effects, would we not be in a position to make the correct decisions? So it would appear, but when one attempts to make application of these psychological findings, the results are usually disappointing. While no one acknowledges the existence of a comprehensive integrated and functional science of human affairs, there exists an enormous body of information and generalized principles—some approaching the status of psychological laws. Designers, on the other hand, invent and construct environments which more often than not fail to properly accommodate the human systems they are intended to support. I

(1) The "designed environment" is herein defined simply as that set of (physical) elements in the environment which is under the control of the environmental designer.

cannot begin to fully delineate the many difficulties involved in applying psychological findings to environmental decisions, much less resolve them. These comments merely outline some of the issues as these have emerged from a modest attempt to identify a relevant approach to physical design. As a rule, the behavioral scientist asks: How does the environment affect human systems? Few researchers have asked the more pertinent question from the standpoint of environmental design: How do human systems affect the environment? The following is a brief exploration of this second question.

Man faces a somewhat paradoxical realization in his understanding of human affairs. His destiny was once in the hands of the gods, beyond the pale of mortal understanding. He then came to understand that he was an integral part of, and under the control of a system of natural forces, forces yet to be fully revealed or explicated. It was assumed that if the "natural state" of human systems were understood, we would know precisely what decisions to make. Descriptive human sciences emerged and launched massive empirical investigations of historical and extant human cultures in an effort to grasp the underlying "forces." As we now know, few functional tools for the conduct of human affairs emerged. Finally comes the realization that we are products of a human and non-human environment which is but a product of ourselves. To search for the "true nature of man" is to seek a myth. A distinction between man-made and "natural" environments becomes increasingly obscure, and no longer can we relax in the soft velvet image of man carrying out his role in a giant unalterable teleology. Demise of the "system" demands not only a psychological adjustment as ordinary citizens of the world, but a new epistemology of environment design—physical and otherwise. The proposition that we have the choice to control or be controlled by the environment is no longer a live issue. Environmental designers, for example, cannot in the face of scientific evidence, abdicate their role in shaping the outcome of human events. The question is not *whether* they control, but whether this control will be exerted via accidental contingencies or via scientific findings of environmental effect. If the designed environment does exert significant control over the outcome of human events, what are the issues and what are the consequences for the design disciplines?

The nature of the designer's task and responsibilities has been partially obscured and misdirected by his declaration that his objective was not to control other humans, but to meet their (biological and extra-biological) needs. As an alternative to routine analysis, however, presents difficult problems. Needs, and environmental effects upon them, can be assessed only in terms of their external manifestations—upon the resultant behavior. What people do is the ultimate and final reality. Problems of environmental accommodation must be defined in the same dimensions.

What the environmental design disciplines critically need is a research consensus. We must seek a level of agreement within the community of researchers in this area on what the relevant and researchable issues actually are. The behavior-contingent paradigm (Studer, 1967) is an attempt to identify a general framework which assumes only that behavior is the class of independent variables for the design of human environments. Viewing behavior as the class of fundamental units reveals the methodological objectives more clearly. The environmental designer's mission is, in short, the delineation of human behaviors which must be accommodated, and realization of a system of energy and matter which supports these.

THE BEHAVIOR-CONTINGENT PARADIGM

If human environmental requirements can ultimately be assessed and accommodated only in terms of behavior effect, the following concerns necessarily emerge. The issues which must be dealt with in a behavior-contingent approach grow out of an analysis of those operations required to:

1. **Delineate the system of behaviors required in a particular human organization;**

2. **Specify the precise characteristics of the physical system required to realize the behavior system delineated;**

3. **Realize the physical system specified;**

4. **Verify the resultant environment-behavior ensemble;**

5. **Maintain the environment-behavior ensemble.**

The objective of behavior-contingent physical design is a well-fitting relationship between human behavior systems and the designed environment in such an approach, conventional problem space definitions, e.g. "house," "office building," "city," "school," "room," etc. are quite meaningless (Studer, 1966). Rather, physical problems are assumed to be detected, isolated, structured and resolved through an analysis of human behavior systems. What this means is that the behaviors to be accommodated must be appropriately described. It is perhaps tempting to assume that such a system could be determined empirically. This is unfortunately not the case. If the human organization in question does not yet exist, there are no behaviors to observe. If the problem is to re-accommodate an existing human setting, all that can be observed is a malfunctioning environment-behavior ensemble. If this system were not in a state of malfunction, there would simply be no problem to solve. The task of identifying a viable system of behaviors (R_2) (3) for environmental design purposes is *normative.* It is essentially a problem of (behavioral) design directed toward the conceptualization of a behavioral network, which is but an operational description or extension of a human organization's purposes and goals. (4) These goals are in turn constrained by physiological, psychological and cultural givens. There appears to be no more fundamental principle of behavior specification than this.

The human participants must communicate their goals, but beyond this the problem is one of designating the behaviors whereby these can be realized. This can be a formidable undertaking embodying fairly technical implications. Whether or not environmental designers are equipped, or ought to be equipped, to handle the design of such behavioral networks is another kind of issue—a pedagodical one, perhaps. For-

(2) For a more detailed explication see Studer, 1966, 1967.

(3) Denotations refer to diagram.

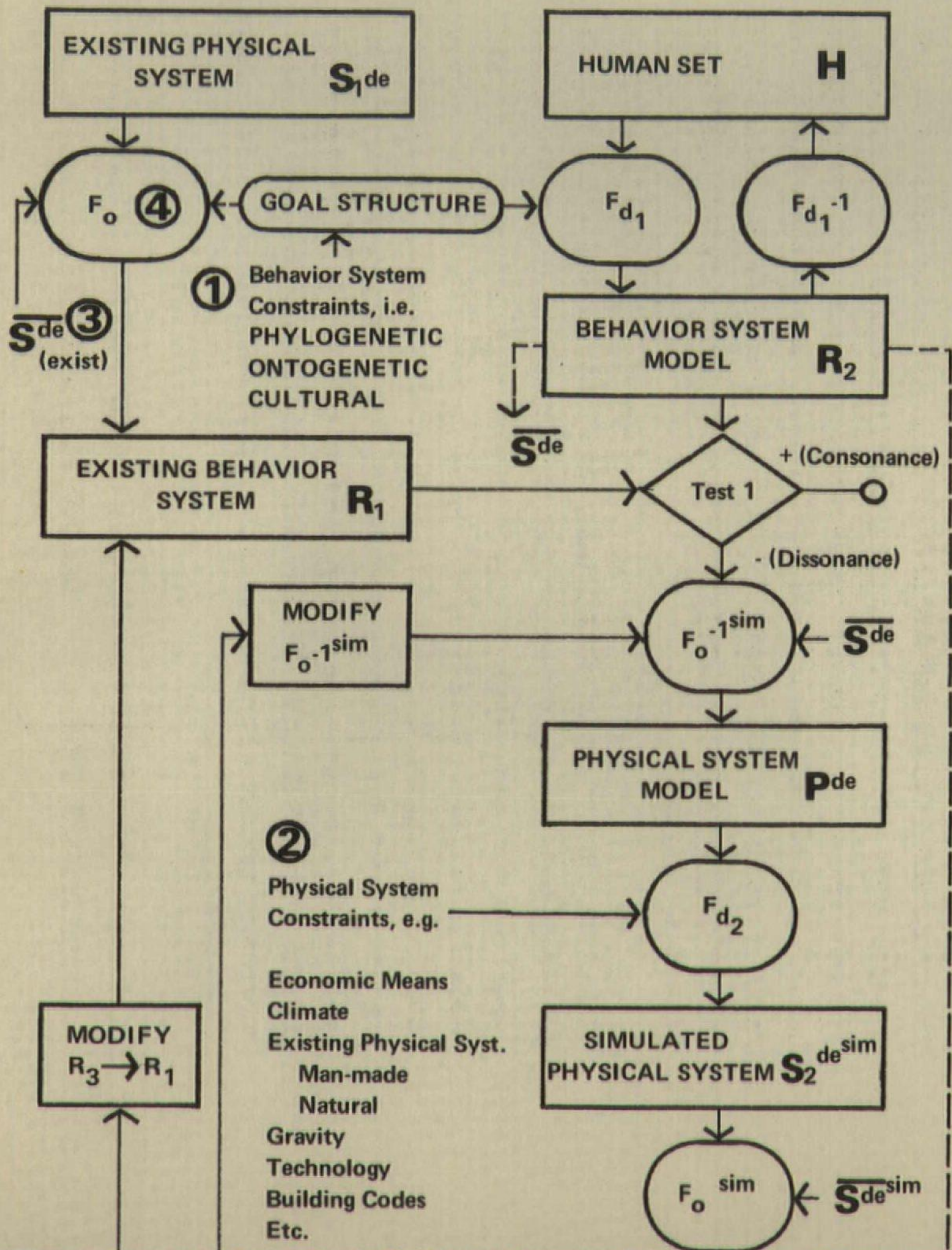
(4) See Miller, J. G., 1965.

tunately, a number of tools are developing in other disciplines which are directly applicable to such a problem. Designers, it seems, must either become technically equipped to handle such operations, or find a means of working integrally with other disciplines which can. Perhaps the latter is more feasible at this time.

Once a viable behavior system has been identified, i.e. modeled, it becomes the generating criteria for all subsequent operations. It should be noted, for example, that until an adequate behavioral system model has been identified, it is not even possible to determine the existence of a physical problem (see Test 1). That is, a problem exists, if, and only if, there is disparity between what the system *is* and what it *ought* to be (see R_1 and R_2).

If, in comparing extant and required behavioral configurations, it is found that an environmental problem exists, i.e. disparities between is and ought states are due to physical variables, an alternative physical order must be specified. Which is to say that a physical problem must be stated before it can be solved. To specify a physical system (P^{de}) for a particular human setting is in essence to model a specific environment-behavior interface. In order to describe the quantities, qualities and relations in the spatial environment, a precise mapping between these and the antecedent behavior system model (R^2) is required. Such mappings are very difficult to come by. A handy tool would be a comprehensive, integrated and functional science of behavior. No such science exists, and the issue seems to be whether we are at all justified in attacking the problem with such an impoverished understandeng. On the other hand, even the tools and knowledge we have cannot be made effective until we arrive at some sort of consensus as to the general nature of the designed environment-behavior interface (F_o^{-1sim}). Some of the issues concerning this interface will be explored further, but first let us complete this outline of the paradigm.

Assuming that a physical system—one which precisely correlates with the requisite behaviors—has been specified (P^{de}), the physical designer's more traditional skills come into play. The problem of formal synthesis is that of arranging energy and matter in such a way that well defined behavioral goals can be realized. The physical



H —Set of all participating humans.

F_{d_1} —Set of operations to define a requisite behavior system for a given goal structure.

$F_{d_1}^{-1}$ —Set of operations required to specify a requisite set of humans for a given behavior system.

$\overline{S^{de}}$ —Other related classes of environmental elements, e.g. social, economic.

Test 1 —1) Compare requisite behavior system (R_2) with existing behavior system; 2) identify dysfunctions due to S_1^{de}.

F_o —Set of organismic functions which produce particular system of behaviors given a particular environmental state.

$F_o^{-1^{sim}}$ —Simulated set of inverse organismic functions (F_o).

P^{de} —Specification of the physical system required to produce R_2.

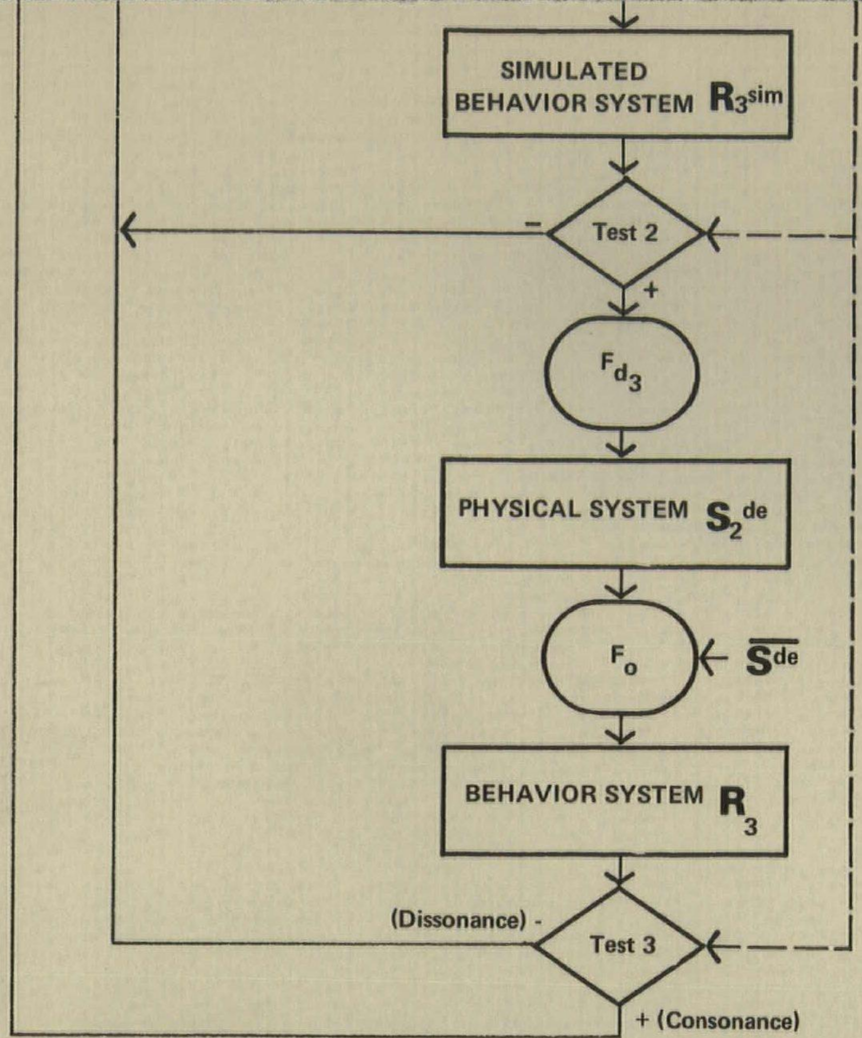
F_{d_2} —Set of operations to simulate a real physical system (S_2^{de}).

system model describes the configuration which accommodates these behavior goals, but the task of actually realizing the system modeled is made extremely difficult by ambivalent forces in the external environment (see Physical System Constraints). The macro-environment, e.g. gravity, climate, building codes, imposes constraints on the physical system which must be satisfied in order to realize the requirements described in the physical system model. Such external physical constraints are exerted by virtue of location in a particular space-time context.

Both the normative and behavioral aspects of problem-solving are receiving considerable attention both within and outside the design community. These studies reveal that the process is intrinsically iterative. The solution is apparently arrived at through a series of hypotheses, each moving from an abstract description of the problem space (P^{de}) via some simulation mode toward the actual real-world state (S_2^{de}). The behavior-contingent approach requires that a correct simulation of the real system should be evaluated in terms of the behavior system it will produce. This resultant simulated behavior system (R_3^{sim}) must be tested and retested against the behavior system model (R_2) for fit before the real physical system (S_2^{de}) is produced in the real world.

Finally, the behavior system which actually results from the real environment must be tested against the requisite system for final confirmation that a human problem has actually been solved. Until verification becomes an integral aspect of the design process, we can never move beyond folk wisdom in design. The behavior-contingent approach offers substantive criteria for evaluating design solutions. If the input units are well defined and empirically assessible, there is a basis for verification. Tests (see Test 3) again involve the comparison of the proposed (R_2) with the resultant behavior system (R_3) for fit. If a test of the real-world system reveals a dissonant environment-behavior ensemble, an embarrassing situation emerges within existing modes of thinking.

In view of our ignorance of the environment-behavior interface, and the crudeness of our design methods, perhaps finite-state objectives implicit in this and similar phys-



S_2 —Simulated physical system which accommodates the states specified in P^{de} within the impinging physical constraints.

F_o^{sim} —Simulated set of organismic funtions (F_o).

R_3^{sim} —Simulated resultant behavior system.

Test 2 —1) Compare R_3^{sim} with R_2; 2) identify dysfunctions due to elements in $S_2 de^{sim}$.

F_{d_3} —Set of operations to realize the physical system analogue ($S_2 de^{sim}$).

S_2^{de} —Resultant physical system.

F_o —(See above.)

R_3 —Resultant behavior system.

Test 3 —1) Compare elements of R_3 with elements of R_2; 2) identify dysfunctions due to S_2^{de}.

1 2 3 4 —Sources of dissonance

ical design frameworks require serious re-examination. Indeed our ignorance of these matters is not the only source of difficulty in realizing finite-state ensembles. If there is one obvious and unchanging characteristic of human systems, it is that they exhibit constant change.

Dissonance in the environment-behavior interface can come about as a result of:

1. **Changes in the human organization's *goal structure.* All human systems, e.g. industrial, governmental and even families.**

2. **Changes in *other environments* in the human setting, e.g. social, economic. These change state in response to external and internal events.**

3. **Changes in external *physical constraints,* e.g. man-made and natural physical impingements, building codes, economic means, produce new environmental states.**

4. **Changes in the participating *human organisms* come about as a result of deprivation states, adaptation, and learning. These produce entirely new response probabilities in a particular setting.**

Each of these classes of inevitable variability can and does produce dissonance in the designed environment-behavior interface. These sources of dissonance—together with our sheer ignorance of human behavioral processes generally and our impoverished methodological tools—produce a problem solving environment of enormous uncertainty for the designer. In the light of these uncertainties it becomes clear that a physical solution is not a solution at all but an *hypothesis,* which can only be verified in the real world. Furthermore, even a verified hypothesis must be reformulated when constraints vary. To put the issue squarely, any human problem situation changes before a solution to it can be realized! In light of the realities of man-environment systems, I have come to the conclusion that we should simply reject solution-oriented design objectives in favor of realizing experimental contexts. The design community's mission is not to realize "timeless" artifacts, or even "optimal" solutions to man's needs. The real challenge is realization of the technical and conceptual means to maintain equilibrium between behavioral goals and the supporting environment on a *continuing* basis. In other words, the "experiment" *is* the solution. The physical implications of such a proposition are challenging to say the very least.

This all too brief outline hopefully reveals some of the basic problems and possibilities for a behavior-contingent approach to design. Each of the issues raised, and several which were deleted, would seem to point to major areas of research requiring expanded and interrelated attention—hopefully under some sort of unifying interdisciplinary framework. The major questions raised involve the tools and knowledge required to: 1) identify and order behavioral inputs, 2) specify a particular environment-behavior interface, 3) realize specified physical configurations, 4) verify environment-behavior systems, and 5) maintain them.

COMMENTS ON THE NATURE OF THE INTERFACE

In the search for a means of realizing well-fitting physical systems, few if any issues are as controversial and complex as those encountered in comprehending the designed environment-behavior interface. Before we can develop the kind of interface description required, we must obviously have a more complete understanding of the relationship between man and the designed environment. Consider the following taxonomies: (5).

(5) Adapted from Fitch, 1965.

❬ ENVIRONMENTAL DESIGN

ENVIRONMENTAL SYSTEMS	ORGANISMIC SYSTEMS	BEHAVIOR SYSTEMS
Thermal	Metabolic	R_1
Atmospheric	Perceptual	
		$r_{1.1}$
Temperature	Visual	
		$r_{1.2}$
Humidity	Auditory	
Movement	Tactile	.
Composition	Temperature	.
Chemical	Wet-dry	$r_{1.n}$
Physical	Texture	R_2
Pressure	Pressure	
		$r_{2.1}$
Aqueous	Shape	
		$r_{2.2}$
Gaseous	Olfactory	
		.
Fluid	Gustatory	
		.
Solid	Proprioceptive	
		$r_{2.n}$
Nutritive	Skeletal-musculature	
Luminous		.
Sonic		.
Spatio-gravitational		R_n
Objects		
		$r_{n.1}$
Human		
		$r_{n.2}$
Animal		
		.
Vegetable		
		.
Mineral		
		$R_{n.n}$

ENVIRONMENTAL ANALYSIS ❭

The behavior-contingent paradigm tends to bring vague notions of man-environment relations into somewhat sharper focus, at least for design purposes. The designer is primarily interested in the fact, beyond any theory which explains it, that a particular ordering of physical elements will produce specific behavioral topographies. His interest in a refined description of internal organismic functions would seem to be limited, provided that the behavioral manifestations are understood. Two interrelated classes of problems are associated with an understanding of this interface. First, we obviously need more comprehensive and refined empirical data. Dependencies between behavioral and designed environmental elements are simply not well understood. Secondly, we need a more appropriate language for expressing these dependencies so as to specify a proper physical order.

The principle difficulty designers have experienced in attempting to apply resources in the behavioral sciences lies, of course, in the general lack of empirical findings regarding environmental effect. But this alone does not entirely explain the quandary. Resources, i.e. theories and findings, in the behavioral sciences are both disparate and incomplete. As mentioned above, nothing like a complete science of behavior exists. Beyond this, the behavioral scientist's mission is quite unlike the designer's. Grand overall systems have given way to more modest and realizable goals. The behavioral scientist, for the most part, selects very small environment-behavior samples, asks limited questions and answers these thoroughly—taking care not to move beyond the facts. He isolates only those aspects he wishes to examine, and he characteristically deals with analysis. The general result is a fragmented and disparate collection of possible resources. One senses that each is in some way relevant, but they seem to exhibit surprisingly few integrated principles which can be directly applied to the design of complex human settings. The designer, as contrasted with the behavioral scientist, must come to terms with human behavioral phenomena as they come. Indeed, he deals with a level of behavioral complexity which has never been even approached by an experimental analysis. His seeming inability to deal incisively with human complexity is no doubt related to his nurturement outside the scientific community. Failure in this regard is, however, equally attributable to involvement in problem situations requiring a synthesis—the realization of behavioral phenomena—of the most complex sort. The kinds of resources in the behavioral and related sciences which are brought to bear understandably depend upon how one views the nature of physical design problems. The designed environment has been variously viewed as:

1. A work of art;

2. A communication system;

3. A source of sensory nourishment (mental health);

4. A system to minimize physiological and extra-physiological stress (physical and mental health);

5. A system to maximize man's pleasure and well-being;

6. Etc.

These are possible ways of viewing the designed environment. Perhaps it is to some extent all of these. There is great research interest involving questions related to man's perception and comprehension of the design environment, which is also a relevant aspect. But none of these alone gives a valid and unifying direction to the design task per se.

The behavior-contingent paradigm offers no panacea regarding the inherent difficulties in understanding and accommodating man-environment relations. It does tend to reveal the *nature* of the relationship as regards the arrangement of physical elements. The nature of the environmental designer's problem is this: A behavioral system has been specified (within the constraints imposed by the particular human participants and by the goals of the organization of which they are members). The participants are not presently emitting the specified behaviors, otherwise there would be *no problem.* It is necessary that they do emit the specified behaviors if the goals of the organization are to be attained. The problem then is to bring about the acquisition or modification of behaviors toward the specified states (without in any way jeopardizing their general well-being in the process). Such a change in state is called *learning.* Designed environments then, are basically *learning systems* arranged to bring about and maintain specified behavioral states.

ELEMENTS OF A BEHAVIORAL ANALYSIS

Fortunately, human learning is a phenomenon which has been most extensively and successfully studied. "Most psychologists, especially those of an experimental bent, regard learning as the fundamental process in the understanding of human behavior" (Berelson and Steiner, 1964). Extensive and rigorous laboratory experiments have demonstrated that temporal and spatial events in the environment can be arranged so as to bring about entirely new and predictable forms of behavior. These techniques of behavior acquisition and modification refined in the laboratory have also been successfully extrapolated to more complex real-world human settings, e.g. in the form of programmed instruction and related technologies. If the environmental designer's basic task is as indicated, i.e. one whereby new specified topographies are sought, these techniques of behavior acquisition and modification are of obvious and direct relevance. The following outlines some of the basic concepts of a branch of psychology which constitutes an important and untapped resource in programming and realizing designed environments.

The behavioral effects of *respondent conditioning* come about when stimuli are paired with processes necessary to maintain the internal economy and well-being of the human body, e.g. eating, drinking, sex, defending one's anatomy. The designed environment includes many stimuli which affect respondent behavior, i.e. the conditioned and unconditioned reflex, but the simple stimulus-response relationships involved in the reflex are inadequate to explain the causes of most human behavior. *Operant behavior,* i.e. "voluntary" behavior which operates on the environment, involves other processes and must be analyzed in another way. The methods for bringing behavior under the control of certain elements of the environment is called operant conditioning. Research in operant behavior concentrates primarily on an experimental analysis of the temporal relations between behavior and its *consequences,* i.e., the effects on an individual of what occurs after a particular behavioral event has occurred. Skinner (1953) argues convincingly that behavior systems are, in fact, maintained by such consequences.

The consequences of behavioral events can have a positive or negative valence, and they can be attributed to unconditioned or conditioned states. Tense consequences can be said to *reinforce* the antecedent behavioral event. *Positive* reinforcers are a class consisting of unconditioned items such as food, water, and shelter; and conditioned items such as social approval and praise. The effectiveness of a positive reinforcer is obviously dependent upon the state of deprivation. The reinforcing strength of food increases with deprivation time; conversely satiation weakens food's reinforcing properties. *Negative* reinforcers are an aversive class consisting of unconditioned items such as physical pain, intense heat or noise; and conditioned items such as social disapproval or ostracism.

Operant conditioning is facilitated by positive and negative reinforcement. Positive reinforcement occurs when a positive reinforcer is mede contingent upon a particular class of responses. Negative reinforcement occurs when the removal of an aversive situation is made contingent upon a particular class of responses.

Once a behavior pattern has been established, it has been found that intermittent reinforcement is *more* powerful than when it is continuous, i.e. reinforcement after each response. Rate of response and characteristics of extinction (removal of certain responses from the repertory) have been systematically controlled through the use of various *schedules of reinforcement.*

When behavior occurs but is not reinforced, it will be *extinguished.* New forms of behavior can develop through a procedure called *shaping.* This process occurs when aspects of behavior are selectively reinforced while others are allowed to extinguish. Under the influence of such a process, a person can be seen to speak, write, or even problem-solve better when only those effective aspects of a behavioral repertory are selectively reinforced. When a child produces the more correct sounds of words, for example, we invariably exhibit greater approval than when he utters those that are less so.

If a particular response configuration is reinforced in the presence of particular stimuli, an interesting thing happens. When these (or similar) stimuli are present in the future, there is a higher probability that this calss of responses will occur. Response to these similar stimuli indicate that they have come to exert *stimulus control.* Having been reinforced in the presence of particular stimuli, one comes to discriminate these. The most important aspects of human behavior are under the control of the *discriminative stimuli.* All human communication, for example, involves discrimination learning. Successful behavior in designed environments depends heavily upon the building up of a system of discriminations. As these discriminations are learned, many topographic features of the designed environment come to elicit appropriate response, e.g. signel lights, signs, even specific formal patterns.

Aversive events maintain a great portion of a person's behavior. *Escape* behavior occurs in an attempt to terminate an already present aversive situation. *Avoidance* behavior occurs to prevent or delay the onset of an aversive situation. Leaving a portion of the environment which is hostile is escape behavior. Not entering such an environment in anticipation of its aversive qualitit
environment in anticipation of its aversive qualities is avoidance behavior. Aversive *conditioned* stimuli are those which are present when other aversive stimuli are present. Future presentations will have aversive effects. For example, if a person is socially humiliated or threatened in a spatial setting, the setting itself can have a similar

effect as the original events. If such incidents are paired with the spatial setting several times, no amount of architectural ingenuity will overcome the effects of these aversive conditioned stimuli. It should be noted that aversive behavioral control, while highly effective, can produce many harmful side effects including critical forms of physiological malfunction and emotional disorders. In spite of the deleterious effects, however, a great protion of our behavior is maintained by them.

These are but the most basic elements of a highly complex behavioral analysis based upon the contingencies of (environmental) reinforcement. (6) To sum up the principles outlined, extensive and highly controlled laboratory experiments have isolated three aspects of the environment which are relevant: 1) the situation, or *stimuli,* 2) the behavior, or *response,* and 3) the consequence, or *reinforcer.* Behavior control comes about when reinforcing events are *contingent* on a particular behavior in a particular situation, i.e. a reinforcer is contingent on a response in the presence of a given stimulus configuration. A behavior becomes more probable in the presence of the stimuli that were present when the behavior was reinforced, i.e. stimulus control. When these contingencies of reinforcement can be temporarily and spatially arranged in the environment, behavior comes under the control of them.

SOME IMPLICATIONS FOR ENVIRONMENTAL DESIGN

Many psychologists insist that an operant analysis is too simplistic to account for all aspects of human behavior. A science of psychology, they contend, must deal not merely with behavioral manifestations of environmental effects, but with intervening processes as well. The proponent of operant behavior agrees, and points out that some of the "most significant research in physiological psychology is being carried out by means of behavioral techniques that were developed by Skinner and related workers" (Sidman, 1960). What he objects to are speculations which move beyond

(6) For more detailed explications see Ulrich, Stachnik and Mabry, 1966, and Honig, W., 1966.

the evidence. The antagonist then counters that experimentation without an hypothesis is useless if not impossible—and so it goes. These are controversies which must ultimately be worked out within the behavioral science community. There is one thing which cannot be denied, however, and that is the effectiveness of these techniques in bringing about controlled behavioral changes. Operant conditioning is a fact. If, as has been argued earlier, the problem of environmental design is to bring about and maintain new behavioral topographies, then the need to understand the principles of operant behavior as a fundamental aspect of the designed environment-behavior interface, is essential. The techniques and findings outlined were developed in laboratory settings using apparatus—environmental manipulations—quite unlike those available to designers of human physical environments. Clearly a program of research in larger human settings is in order. There are obvious complications and possible side effects which may emerge on a larger scale. It should be noted, however, that where properly introduced, they have been effective.

Using the basic concepts introduced, how might our conceptualization of the interface be enriched? An operant analysis suggests, among other things, that events which have traditionally been regarded as the *ends* in the design process, e.g. pleasant exciting, stimulating, "comfortable," should be reclassified. They are not ends at all, but valuable *means* which should be used with discrimination to direct a more appropriate overall behavioral texture. They are members of a class of contingencies of (designed environmental) reinforcement. These aspects must be identified before behavioral effects of the designed environment can be fully understood. Stimulus control via elements in this system is an obvious design objective. Successful behavior in complex man-made environments depends heavily upon the building up of important stimulus discriminations, i.e., the situation whereby a particular stimulus configuration increases the probability of a particular behavior.

A central problem in behavioral accommodation, then, is in identifying elements which are likely to have reinforcing potential. Any organism will attempt to stay in contact with, move toward, a positively reinforcing state; conversely, they will avoid or attempt to escape from, aversive consequences. (7) Negatively reinforcing states, i.e. aversive stimuli, can be produced by particular designed environmental states, (8) e.g.:

Invasion of territory
Invasion of personal space
Excessive or inadequate social distance
Sensory overload, underload, non-patterning
Noise (all sense modalities)
Excessive homeostatic (physiological) disruption (e.g., thirst, hunger, pain, exposure)
Etc.

Negative reinforcement, as mentioned earlier, gets immediate and highly effective behavior results (which is undoubtedly why these are so commonly used to regulate the culture, e.g. fines, punishment, disgrace), but not without dangerous side-effects. Using aversive controls in designed environments is certainly not a tenable strategy. Indeed, it is generally agreed that the designed environment is intended to interpose between humans and ambivalent forces in the macro-environment to minimize these and similar aversive stimuli. Ostensibly the removal of these is positively reinforcing to a human under the influence of them. Unfortunately, designers have not always been successful in removing aversive stimuli (Fitch, 1965).

The physical designer obviously controls several classes of unconditioned reinforcers, e.g. food, water, shelter. These are common to all human participants and can obviously be manipulated effectively. The difficult problem is that of identifying the more pervasive conditioned reinforcers. In most cases the participants are unknown except as a general class, and known or unknown each has a unique ontogenetic his-

(7) The problem in real-world situations is that many conflicting reinforcers are operating simultaneously. The manifest behavior is obviously a summation of the many vector forces of attraction and repulsion.

(8) See also Carson, D. and B. Driver, 1968.

tory. Moreover, conditioned stimuli which are reinforcing to designers, a special subculture, are often ineffective with regard to the participants. Elements of a designed environment can, of course, themselves come to acquire appropriate or desired reinforcing qualities. The process is one whereby particular unconditioned stimuli are systematically linked with an unconditioned (biological reinforcer or another conditioned reinforcer. In any event, knowledge of the participants' reinforcement potential can be highly instrumental in realizing a well-fitting relationship. It is therefore an area of concern worth pursuing a bit further.

The etiology of behavior is generally considered to involve three interdependent classes: 1) genetic endowment, 2) history of environmental interaction, and 3) the impinging environment. The designed environment obviously affects only the third, and the above resources deal exclusively with this aspect of behavioral control. Genetic alteration can also exert a tremendous effect, but such variables are certainly not in the hands of the designer. The second class of behavioral causes, i.e. ontological history, does embody important information regarding response probabilities. Manifested in a human's history of interaction with the environment is a configuration of conditioned reinforcers. These in essence constrain probable responses to elements in the designed environment. At this point a (somewhat tenuous) tie can be made with another kind of psychological analysis. Some behavioral scientists contend that humans do not simply respond moment to moment to environmental events as they are presented, but anticipate future events (Miller, Galanter and Pribram, 1960). This planning behavior is described as a structuring of hypotheses concerning future environmental-behavioral states. These hypotheses are constantly reformulated in response to events as they occur in the real world. This anticipatory behavior has been depicted as one whereby a person constructs a model of the environment, runs the model faster than the environment, and predicts that the environment will behave as the model (Galanter and Gerstenhaber, 1956). This "environmental model" then represents a human participant's expectations (based upon a conditioning history) concerning the environment, its future states and how they will respond to it. If humans do, in fact, carry such representations and expectations—an environmental model—contained therein is an indication of a set of conditioned reinforcers (positive and negative). Before such information is at all useful, or even verified as existing, it must of course be *externalized.* If it can be, such information is of obvious value to the designers of well-fitting environments.

In this very superficial glimpse of the man-designed environment interface, an earlier point has been reinforced. General uncertainty and the time-dependent character of man-designed environment systems demand new kinds of physical conceptualizations and realizations. Viewing designed environments as experimental settings which are monitored and manipulated to upgrade and maintain equilibrium in the interface appears to be a viable objective. We must therefore find the means to marshal the resources of existing or soon to be developed technology, ile. both hardware and software systems to produce appropriately responsive physical settings capable of assuming many states. Seeing effective human behavior as the fundamental objective of design invention, reveals both the problems and enormous possibilities for environmenmental designer as a positive and integral force in human affairs.

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His work in design linguistics, underway since 1963, has been concerned with language, media, and methods of practical communication in the converging area uniting architecture, the building industry, and computer science, and with the synthesis of a comprehensive theory relating these areas. Mr. Burnette expands upon his ideas concerning one means of effecting and structuring this communication as he discusses

A Linguistic Structure for Architectonic Communication.

INTRODUCTION

Architectural problem solving is not now broadly appreciated as a form of constructive communication, nor are construction activities or works of architecture conceived to be complex messages manifesting the communications which organized them. Least of all is there a theoretical appreciation of the information handling and structuring problems which such conceptions uncover. Yet clearly, the making of architecture involves more than one person from more than one discipline in a co-operative effort over time to resolve a complex problem. In order to synthesize the message generated by each discipline, an effective basis and appropriate means for organizing communication must be found. Until such organization exists, the tremendous potential of the computer for expediting the making of architecture, for assisting the planning of our cities, and for coordinating the efforts of the building industry will be only incidentally realized.

This article briefly presents concepts, information and proposals which are intended to clarify the nature of constructive communication, and provide it with a linguistic organization suited to the computer-aided mediation of the interdisciplinary decision-making which should define architecture. Being theoretically comprehensive and normative, the work anticipates the problems which methodological empiricists such as Christopher Alexander at the Center for Environmental Structure will face when they must give a linguistic facility to their collections of "patterns" and "methods". (1) The approach taken in arriving at the ideas to be presented has been to attend to the psychological problems in apprehending and using classification systems, to the structure of problem solving and verbal communication, and to list-processing principles in order to construct a formal yet mediating bridge linking human communication and thought with computer implemented information handling systems. The scheme presented is intended as a pragmatically acceptable, heuristically helpful, computationally effective organization with the capacity to structure and handle the diverse information of the building industry during its application to the solution of problems by all those involved. As such, it is thought capable of application at the national level to structure the collection, storage and classification of information or at the individual level as an aid to thought. It is also applicable to formal contracts or conversational communication, to descriptive synthesis or analysis and to graphic as well as verbal data. It is a beginning of the organizational work that may ultimately enable architecture itself to become a dynamically varying message reflecting the changing character of the life it houses at a qualitatively more significant level than can be managed today.

PROBLEM SOLVING AND COMMUNICATION

We have noted that architectural problem solving is not now broadly appreciated as a form of constructive communication. Architectural problem solving, especially design, is more typically thought of as the personal, often intuitively informed, working of the individual's intellect regarding some problem which he recognizes and responds to. Yet even as he thinks, the individual designer does so conversationally, setting up a mental image and then qualifying it by what he knows or learns, evaluated against the criteria of his purpose. Often this internal dialogue is too complex to maintain in the head. The questions, qualifications, tentative solutions and their dynamic control overload the mind and must be objectified and arrayed for ready reference, typically as drawings or written notes. Unfortunately, most individual thinkers, not least the architect, have more or less taken it for granted that their thoughts "on the board", to use Jerome Bruner's words in a *Study of Thinking*, (2) are still literally their thoughts, forgetting that on paper or in another medium they are perceived by their authors and by others entirely in a new context. They have an objective reality they did not have before and play a different role in the mediating of subsequent thought.

With this in mind, let us define *communication* as the *interaction between an interpreter and a message.* This has an advantage over the traditional definition of communication as "the process of imparting, interchanging or transmitting information, thoughts or opinions (between people)" in that it embraces an interchange with oneself and acknowledges the objective reality of the message even as it implies that the message has some origin, originator or originators.

SOME PROBLEMS OF ARCHITECTURAL COMMUNICATION

When one recognizes, as many architects appear loath to do, that the entire process of realizing architecture is one in which many media and many individual thinkers interact even as the media convey messages between thinkers of varied educations, habits of mind and dispositions, one must appreciate the complexity of the communications problem, the amount of message distortion likely during the course of realizing a work of architecture. Beyond this, information often originates in answer to queries and proposals generated during problem solving in response to the discovery of unforeseen needs or conflicts in prior decisions and proposals. Coming from so many sources under such circumstances, the information that is made available to architectural decision-makers is naturally extremely varied in character. It is almost always inadequate, somewhat inappropriate and awkward to use.

Although liberally and artistically educated, the architect has assumed the tasks of coordinating, organizing, editing, conveying and evaluating the information defining buildings. He undertakes these complex tasks of message organization without benefit of theory, formal methodology, sophisticated media, effective feedback, experiment or analysis. Architects have traditionally coped with this complex information-handling problem which confronts them and the cognitive overload which their habits foster by cognitive and descriptive over-simplification (typically regarding the program and information used), by redundancy (typically in drawings and specifications), by permitting only their own interpretation to govern the definition of meaning (typically by governing choice of verbal and visual description), by refusing to accommodate dynamic interactive communications (typically by favoring the sequential production and consideration of messages, i.e. first program, then preliminary drawings, working drawings, bids, change orders, etc.) and by a failure to introduce empirical evaluations (typically of past experience). In addition he does not have a way of communicating the important knowledge of spacio-temporal experience which he specializes in, nor does he possess the explanatory means necessary to preserve these understood effects against the uncomprehending yet technically expedient arguments during practical communication. Clearly, one mental channel, that of the architect, is inadequate to mediate the complex communications required to resolve the architecture of today. The adage that two minds are better than one must today be recognized as more valid than the cherished conceit that great art can only come from a single creative mind. Great art, the significant realization and communication of expressive intent, can be the outcome of great collaboration, the joint realization of expressive intent. Civilization is no less an art form than the sculpture or painting of an individual. The problem is to realize this great collaboration, to design the mediating instrument necessary to enable it to happen.

ARCHITECTONIC COMMUNICATION

With these polemics out of the way, it is appropriate to define architectonic communication for our purposes.

The concept of architectonic communication may be thought of as communication which has the goal of resolving the content, structure, and effect of some complex message out of partial qualifying messages which contribute to its meaning. It is communication aimed at constructive synthesis as distinct from only analysis or merely the conveying of descriptive information between communicants. Diplomacy, law and architectural problem solving exemplify this appreciation of terms. In the largest sense, any communication is architectonic that builds up or defines an overall intention recognized by all involved, one that has a unifying thread of concern and embodies a problem of expression to be solved rather than literal decomposition or use of previously established messages. With this appreciation of terms, the making of significant art is surely coterminous with the result of significant architectonic communication.

DESIGN METHOD AND DESIGN LINGUISTICS

The concept of architectonic communication may be usefully related to the notion of design method. The latter is primarily concerned with the normative structuring of the design process in terms of particular methodology appropriate to component problems encountered during the process. Architectonic communication, as has been noted, is concerned with the dynamic mediation of messages and meaning during design. Methodology may be the object of this mediation as can any other referent data.

Design methodology is thus part of the content rather than the form of architectonic communication. Another concept, that of design linguistics, is needed to denote the form or structure of this communication.

Design is not a language but focussed behavior, architectonic communication, leading to the realization of some physically dimensioned entity. It involves not merely verbal and visual expression but goal identification, data collection, organization, implementation, sensate experience and evaluation at many levels. Linguistics also is not language but rather the study of language, its operative and descriptive structure and use. Design linguistics, then, is concerned with developing a coherent formal structuring for the organization. Interpretation and conduct of architectonic communication, a structure which provides syntax to control the functional relationship of message elements, regulates semantics by providing the control for the terms and labels involved and guides both the expressive and interpretive behavior of those various interests which communicate regarding architecture. It is the questions of design linguistics which must be resolved before the interdisciplinary architectonic communication is possible. It is linguistic structure for design in its extended interpretation of architectural communication with which the remainder of this paper will be concerned.

DEVELOPING LINGUISTIC STRUCTURE

There are essentially two ways to approach the development of linguistic structure, one theoretical and the other empirical. Theory attempts to synthetically abstract an integrating organization from manifested experience in general, while an empirical approach would bring out of a particular experience with active communication that structure which most explains it. In the general field of linguistics, these two viewpoints are reflected in Chomsky's theory ot transformational grammar, (3) on the one hand, and the more traditional structuralist-behaviorist school on the other. (4) The present effort takes the theoretical approach and allies itself in spirit, if not in fact, to transformational linguistics.

The principal reason for adopting a theoretical approach is that an empirical approach cannot, by its very nature, be comprehensive whereas a theory may; and capacity is fundamental to an effective language. The problem then becomes to find a theory which generates a comprehensive linguistic system. Once broadly adopted, a system need not depend on theory. Said otherwise, the approach to creating a linguistic structure may be entirely one of innovating a structure that is pragmatically acceptable rather than explaining structurally what people presently do. Once accepted, such a structure would function as a convention mediating what people do. To be acceptable to broadly varying users in differing circumstances, however, a structure must possess considerable recognizability and fit into present habits of thought and expression. If it is difficult to assimilate, remember or use by anyone in the language community for which it is intended it will prove pragmatically unacceptable as a matter of course. Such problems of acceptance are basically people problems and are difficult to overcome. Architects as a group are not outwardly receptive to conventions (though we readily refer to graphic standards and accept various symbolisms in the production of working drawings). We are particularly unwilling to accept any communal organization requiring behavioral conformity. In manifesting this bias, we generally forget that we conform to the conventions of the English language without undue hardship and that, if we did not, the practice of architecture in an English speaking culture would be immeasureably more difficult.

What then could be the theoretical basis for a linguistically conceived organization to facilitate architectonic communication?

We know that the normal human mind readily recognizes and remembers 7 ± 2 distinctions without having to resort to strategies of remembering such as grouping, association, etc. (5) As humans we also learn to recognize structural qualities of a closed grammatical expression like the English sentence. We recognize roles within the sentence such as nominal, verbal, adverbal, etc., and we also recognize referential connections from one sentence to another.

With these considerations rather than a complete theory in mind, let us attempt to create a similar linguistic instrument for architectonic communication. Let us posit an organization that has only seven distinctions and which is closed like a sentence. Let us say that each of the seven distinctions is like a category and may embrace a variable amount of information identified with that category. These categorically meaningful blocks of information may be strung out sequentially like a sentence or stacked vertically as a list.

0	1	2	3	4	5	6	7

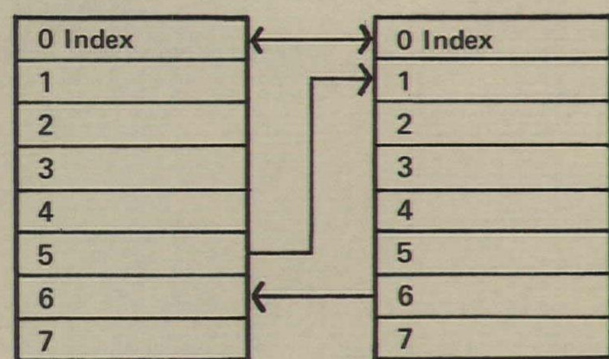
0
1
2
3
4
5
6
7

If each list is an integral unit of description like a sentence, elaborating seven aspects or view points regarding only one referent subject, however general or particular, then we may also treat it as a unit record, a fileable item which may have its own indexing labels and file addresses.

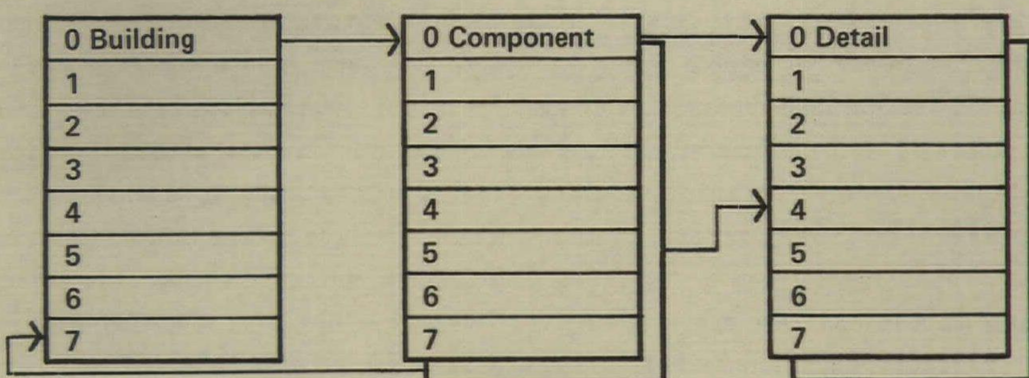
0 index labels

From a computational point of view, we may treat each such bundle of information packages as stored in a contiguous series of addresses in computer memory, the first address being the address of the entire list. These addresses facilitate the retrieval of the entire list or any component portion of it. That is, to obtain, establish or operate on the information in any addressable location, one cites the address of the information involved along with the instructions guiding the operation on it.

Although the seven addresses in each particular list are contiguous, different lists may be in various, not necessarily contiguous, locations in computer memory and one list may be cross referenced to another by coding links from any address within one list to any address within another.



By the use of such links, complex messages may be built up, structured by the directions of the links, to build trees, lattices or other meaningful patterns of interdependence. For example, if I establish a very general description of a building in a list early in the design process, I may later wish to hierarchically elaborate my description in more detail, perhaps by specifying building components, construction details or tasks.



I may, on the other hand, wish to consider one description in comparison to another, to translate or to measure one description in terms of another or to coordinate two descriptions of equal importance—for example, the description of a pre-manufactured door and that of the masonry opening in which it is to fit. This may be done by specifying bi-directional links.

In interdisciplinary communication, however, one would particularly like to know the meaning behind the allocation of message elements to each component location in a list by its originator, for it is on this meaningful relationship that the more complex data structures depend for substantive meaning.

That is, we must structure the semantic, syntactic and pragmatic use of this list or statement format, its linguistic use as distinct from its formal organization. We have seen that questions of generality and specificity are resolved by the way the data structure, the linkage between lists, is constructed. We may also make syntactical use of the sequential locations within each list if we can establish useful conventions which relate the content of these locations.

In order to apprehend how people use words, linguists classify recognizable verbal experience and relate it to behavior. With this in mind but still adhering to our theoretical approach, let us note that, if we wish to aid interdisciplinary problem-solving communication, it is reasonable to classify problem-solving experience and ask each member of our language community to learn the conventionalized classes, be able to recognize them in his experience, and attempt pragmatically to distinguish and express information according to its relationship to these classes. Since all persons solve problems, there is a universal basis for such a normative scheme—i.e., people may learn to recognize its distinctions in terms of their own experience. Similarly, if all communicants attempted pragmatically to structure their information according to the same classes and ordering, then any subsequent interpreter of such a list who knew the common reference classes and order could readily know from place location alone how the originator interpreted his information in the context of his specified subject and dependent qualifications. The interpreter may still fail to appreciate the distinctions in the same way as the originator, but there is at least a common reference framework.

PARTITIONING THE PROBLEM SOLVING PROCESS

There are many ways that the problem-solving process may be partitioned. Which way is the most useful? We have already specified upper limits, no more than seven distinctions. We would also like our distinctions to be as exclusive as possible. Most particularly, we are interested in the benefit of categorization as it relates to the problem-solving process.

What are the benefits of categorizing? In *A Study of Thinking*, Jerome Bruner and his associates have listed these benefits. (6)

1. **"Categorization is the means by which the objects of the world about us are identified."**
   In problem solving it is necessary to identify component elements of the problem to establish what entities are to be considered in arriving at a solution.

2. **"By categorizing as equivalent descriminably different events the organism reduces the complexity of his environment."**
   The complexity of a problem is reduced by conceptual organization delimiting the funtional relationships between elements.

3. **"Categories permit the ordering and relating of classes of events into super-ordinate systems."**
   Super-ordinate systems in problem solving are those formal representations of potential solutions, models or plans which transcend identified elements and organizations to manifest the essence of the problem.

4. **"Categories provide direction for instrumental activity in advance of it."**

Instrumental activity in problem solving is the carrying out or execution of a plan, how something is done.

5. **"The establishment of categories based on a set of defining attributes reduces the necessity of constant learning."**
   In problem solving the record of an experience or a result reduces the necessity of constant learning by establishing data for future use.

We have in the above the distinctions necessary and sufficient to outline an operative definition as scientists commonly accept it. However, if we are to be complete in our description within a list format, we must also specify our purpose or concern and we must also acknowledge our evaluation after dealing with the information contained in the unit list.

With these considerations to lend validity to our choice, let us adopt the following partition of the problem-solving experience:

0. **Problem identification**
1. **Preliminary directive and instructive statements of purpose.**
2. **Collecting and descriminating individual data to be considered.**
3. **Conceptualization, organization and the relationship and grouping of elements.**
4. **Formal mediating representation of the problem or its solution.**
5. **Implementation, instrumentation and the execution of a plan.**
6. **Experiencing and recording the results of carrying out the plan.**
7. **Retrospective evaluation and analysis.**

The problem-solving process is revealed by reading down the list. Some label or number is selected to identify the problem. A purposeful apprehension of need, number 1 above, is followed by the recognition of elements to be considered, number 2. Once these constituent descriptions are established they must be structured in the abstract, i.e., organized. The several possible organizations under the circumstances and purposes of the problem must then yield to a selected strategy, plan or model of the solution, 4. The implementation and execution of this plan, 5, brings about some results, 6, which constitute the experience gained from the pursuit of that particular strategy. Retrospective evaluation, 7, of this experience leads to the consideration of any or all of the other stages generating new problem statements or other elaborations.

One may easily see that distinctions one through four are primarily formulative in the abstract while four through six are relatively operational in that they are concerned with carrying out the implications of the formulations.

Although the sequence of considering these stages may vary in practice with input and circumstances, each depends on the existence of information of the type appropriate to and generated by the stage before. These types of information may be apprehended as follows: (7)

0. **Nominal— That which identifies, names or locates**
1. **Directive— That which suggests, orients, or interprets**
2. **Designative— That which descriptively enumerates and individuates**
3. **Conceptual— That which relates, groups or links defined entities**
4. **Representational— That which formalizes, notates or conveys concepts**
5. **Procedural— That which implements, channels or instructs action**
6. **Empirical— That which portrays experience and the results of action**
7. **Evaluative— That which measures, accounts and reformulates experience**

It may be noted that these categories are merely an interpretive transformation of the categories of problem solving. They need not be learned separately. Descrimination of information according to type does, however, depend on the specification of purpose. Only relative to some purpose is the division a helpful one. It follows that in every list there must exist some form of directive information, statement of purpose or interpretive instruction to provide a frame of reference for interpreting the remaining distinctions.

The use of these distinctions may be readily tested by attempting to categorize any problem on hand. For instance, an architect may characterize the architectural process as a problem:

0. Architectural process	
1. Client contact	**Directive**
2. Program elements	**Designative**
3. Preliminary design	**Conceptual**
4. Presentation	**Mediatory**
5. Working drawings	**Implementation**
6. Construction supervision	**Empirical**
7. Follow through	**Evaluative**

Most architects will recognize that the primary type of information he deals with in each of these spheres above corresponds to the types of information as noted.

Given the ability to make pragmatic distributions of various purpose-related information in terms of a partition of problem solving or of information types, and given the ability to order this information meaningfully in a sentential format and in data structures, what can we do with this facility that represents aid to architectonic communications?

Let us take as an example the description of a particular space by an architect and a structural engineer. The architect may establish his description according to the categories on the left while the structural engineer might do so according to those on the right.

0. Space or mass designation	**0. Space or mass designation**
1. Interpretive directives	**1. Interpretive directives**
2. Architectural elements	**2. Structural elements**
3. Architectural organization	**3. Structural principles**
4. Building form	**4. Structural patterns**

5. Building technique	**5. Erecting technique**
6. Functional use	**6. Behavior under load**
7. Consequent evaluation	**7. Analysis**

Clearly, both lists of categories reflect the concerns of the particular discipline identified with them. Both may be independently elaborated and reflect any degree of completion. Yet both may be meaningfully correlated across all descriptive categories (categories 2 through 6 are descriptive, 1 and 7 interpretive and evaluative). This correlation can facilitate the comparison of data, focussed reinforcement of description and the resolution of conflicts on a category-by-category basis. Elements may be easily itemized and totaled for cost estimating or ordering, organizing concepts may be compared for philosophical consistency, forms and patterns may be checked dimensionally, techniques of constructions coordinated and behavior and use related. As each outline would be independently and progressively specified by their generating discipline their joint recall from computer memory would present a picture of the progress of the given project at any moment in time. Since each revision simply adds information to a category the latest revisions may be assessed without loss of the record of earlier decisions. A history of the communication between persons is readily available; and should future decisions cause reconsideration of earlier decisions, the background of the decision can be traced.

There are many other benefits to architectonic communication which stem from the proposed linguistic structure and its pragmatic use. Due to the syntactic structure within a list, categorical identification does not depend on an identity of vocabulary between communicants, yet word use and habits of expression may be analysed against normative conventions. Each statement list also provides a slice of the comprehensive range of descriptions. This facilitates search and communication by limiting the scope of a given list by making incomplete descriptions easy to spot, and by encouraging a balanced description of each referent. The statement structure can also provide a low-level coding basis for machine programming and a kind of short hand for interpreting data structures which is consistent with the learned meaning of categories, thereby encouraging direct programming and interpretation of machine coding by all users.

THE MEDIA FOR INTERDISCIPLINARY ARCHITECTONIC COMMUNICATION

An on-line, time-sharing computer system with remote consoles having graphic capability in the hands of individual professionals has been assumed as the media for the implementation of the linguistic system outlined above. The various individuals are thought of as communicating through this media system using the list format for query, response, programming, data processing and interpretive assistance. Since computer memories are always precisely defined and the rules which manipulate them are unambiguously applied, they may function as dynamic contracts between communicants. In this regard rules by which access, modification or substitutions may be made may be in the form of executive programming; yet display in answer to query, or for administrative use, may be unlimited; and print-out may be specialized in response to particular query yet be unlimited in quantity and disposable. Difficulties in handling paper records can be largely overcome. Data processing (sortations, quantity take-offs, cost summaries) the organization and editing of specifications, network scheduling and even the manipulation of building form are an integral capability of the media and have been formulated in terms of the proposed scheme. (8) With this comprehensive media system and the linguistic organization of its use, appropriate and approved monitoring of communication within or between disciplines can also be developed to generate and provide industry-wide statistics, to detect information need, to disseminate research findings and to translate information into useful forms.

Perhaps more than anything, such a linguistic media system can foster the coordination of the building industry and provide it with the means to deal with the problems of complexity and need which now confront it. A structure for interdisciplinary architectonic communication is a means to many ends—among them a new depth to the art and science of architecture.

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and urban design being emotionally and symbolically satisfying environments,
and can be relevant to environmental design today,
particularly when combined with the findings of
psychology, anthropology, and cultural geography.
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Professor Rapoport now brings together some of his ideas and findings
on cultural aspects of urban form, and discusses

Some Aspects of the Organization of Urban Space.

The recent interest in the study of the relation of man and environment is due, at least in part, to the need for more and more generalized norms as a result of the ever greater scale of the problems and the increasing separation of teh designer from the user. In primitive situations, the designer, user and builder were one person or family; in the context of pre-industrial vernacular, the designer and builder were one and shared a common knowledge and value system with the user; the traditional designer worked for a specific client who was often the user and they still shared a common value system. Today the designer, client and builder are different people, and frequently are teams or committees rather than individuals; the client and user are rarely the same and the value systems of the various participants are very different. One result has been the need for some generalized norms, one way of deriving these being a more rigorous study of the relation between man and his environment.

While this marks an advance over the arbitrary assumptions of the recent past, much of such work has been rather simple-minded. In both architecture and planning, the stress has been on the "physical" form determinants. Socio-cultural, psychological and perceptual aspects have received much less attention, and where they have been considered, the emphasis has been on studying the stimulus properties of the environment and the more or less immediate responses to them—problems of *why* people organize space the way they do, how they react to what is built, and how they react to environmental stimuli over long periods of time, which involves the question of how they perceive such stimuli. These problems are problems which have long been neglected. Variations between individuals and groups, particularly as revealed by the study of periods and cultures distant from our own, as well as the study of vern—acular examples have also been neglected. There have also been other weaknesses which provide the starting point for my discussion of the primary, although not *exclusive,* role of socio-cultural determinants in the organization of space.

It is becoming increasingly clear, form work in a number of disciplines, that the man-environment relation needs to be studied. This can most profitably be done by relating the stimulus properties of the environment to their symbolic manifestations, which are a function of culture as well as of individual development, and by examining the effects of the symbolic environments which men create. This has been pointed out by geographers such as R. W. Kates, and psychologists such as David Stea and Rene Dubos. The latter, writing about physiology, comments on the fact that man has a tendency to symbolize everything that happens to him and then to react to the symbols as though they were the environmental stimuli. He suggests that, as a result, the actual effects which the environment has on man, bear little if any resemblance to the direct effects to be expected from the physical nature of the stimulus. The body reacts not only to the stimulus itself, but to all the symbols associated with the experience of the past and expectations of the future—symbols which are converted into effective stimuli.

One reason why symbols may be so important in this connection is suggested by Abraham Moles in his discussion of the implications of information theory for perception. Symbols are used to structure information from the environment which otherwise would become unmanageable due to its fantastically rich sensory bombardment. Symbols do this by increasing the redundancy or predictability by increasing the number of connections between elements and groups of elements, and by reducing the number of elements through selection. Selection involves *choice* and hence value judgments which are based on *images* and *schemata.* Suzanne Langer has also drawn attention to the role of symbols in giving significance to various aspects of the environment.

The complexity of the relation of man and environment is becoming clear even from recent ergonomic studies (for example Chapanis) and from work on temperature, light, sound, color and other relatively "simple" physical variables which show the gap between physical stimuli and subjective responses. One reason is that the environment is not something "out there" acting on man but that it and man form a complex, interacting systme involving man's perception of that environment. It is becoming increasingly clear that the relation of man and his physical environment is complex, multifacited, and multilayered; that the linking of single variables or stimuli with specific responses will hardly work. The gap between the design disciplines and the behavioral and environmental sciences is due, at least in part, to the lack of studies on the symbolic rather than the stimulus properties of the environment.

The result is that we cannot consider the man-enviornment relation as a simple stimulus-response mode, since man persists in putting symbolic meanings to the environment. These intervene in the organization of space and the way in which man responds to it. The images which an organism has of itself and the universe have a major effect on behavior; the relation between stimulus and response is mediated by the organized representation of the environment through symbols and schemas as Miller, Galanter, and Pribram have shown in *Plans and the Structure of Behavior.* Gombrich, in *Art and Illusion,* shows the effects of schemata on the perception of reality as shown in drawings of the same buildings and landscapes at different periods. In these, the concept "castle," "cathedral," and the like had specific images associated with them which affected the way they were seen on the spot. Terence Lee in Britain has shown the effect of socio-cultural schemata on the meaning of "neighborhood" in the city. While some reviews of Blake's and Nairn's books on the American landscape are of interest in this connection, showing, as they do, the difference between visual and non-visual approaches to the landscape. A given environment may then be seen as good or bad, depending on the point of view—whether the yardstick is visual quality or economic productivity.

This is one of the reasons why built form and space organization may not have immediate effects on overt behavior. Rather they may affect people by changing their images through the effect of moods or feelings, irritational, non-logical, unconscious and subconscious reactions. Since the image is resistant to change, there may be considerable time lags involved between the stimulus and the response. Changes in the image, resulting in new symbolic interpretations, may result in unforseen, and hence unnoticed, changes in behavior. It is therefore necessary to consider the images, schemata and symbols which affect the ways people organize space.

It has long been accepted that these affect the design of certain building types, for example, the Renaissance church reflecting the neo-platonic universe, the Byzantine church as Ikon, the gothic cathedral as a reflection of scholastic philosophy, the

Mosque as an image of paradise and so on. The point is, however, that this applies to the organization of space and built form of all kinds and at all scales. I would suggest that the design of the physical environment can best be understood as the organization of space, and that this organization is a continuum at different scales—from the region through the city, the building, and the room. Since the organization of space is an act of some importance, it is necessary to know why people organize space and hence what needs to be done to organize space in any given situation and at any given scale. My suggestion is that socio-cultural schemata are the primary determinants of built form and space organization and that they must be seriously considered since they affect the images and symbols which mediate the perceptions of, and reactions to the environment. Many anthropologists, as well as the French cultural geographers, have pointed out that each culture makes a selection from the possibilities open to it—as each individual makes a choice from those open to him within the culture. In fact, one can suggest that the physical factors themselves are much affected by culture as we have already seen, for physiological and other stimuli.

The reason that images and symbols can act with such strength is that in terms of its physical constraints architecture and urban design are of low criticality. This concept can most easily be understood by analogy. A freeway has higher criticality than a pedestrian path which can take on many more configurations, i.e., it has more degrees of freedom. An aeroplane of the 1920's had more degrees of freedom, and hence, more different forms than the jet of today while a rocket or nose-cone has higher criticality. Although even in that case there are a number of equally valid configurations. In design, we have tended to assume that physical criticality, and hence the need for tight fit, is higher than it actually is and that the symbolic and perceptual criticality is lower than it actually is.

Culture, as we have seen in our discussion of schemata, affects the perception of space and objects, although there is also evidence for perceptual constancy, and both probably play a role. Segall and others bring experimental and other evidence for the influence of culture on perception. Whorf showed how culture, as expressed in language, structures the universe and the perception of buildings and spaces; Hall, de

Lauwe and others have shown the way culture affects the way space is structured and organized. A good example, which also shows the importance of using cross-cultural comparisons, is the way space is organized in the Western and Japanese city. In the Western tradition, urban space is organized around streets. This is so typical that Colin Cherry, in *On Human Communications,* uses it as an example of the way one seeks out a person by first locating the country, then the city, the street, the number and so on. In Japan, the system is very different and space is organized in a series of *areas* of decreasing size; within the smallest of these, the houses are numbered in the order in which the houses were built rather than in a serial order. The search process is very different, yet the street system of organization had been imported to Japan very early (from China) and used in Kyoto. It was rejected both then and after World War II when the Americans tried to name and number at least some streets because it did not suit the way space was structured conceptually.

Another aspect of the impact of culture and symbols on the perception and choice of the environment has been discussed by Sonnenfeld and others. He suggests that a landscape (and, I would add, a building or urban landscape) can have a number of meanings, both positive and negative. These meanings can be:

Concrete Meaning (the actual objects)
Use Meaning (the use to which they can be put)
Value or Emotional Meaning (sublime, pleasing, ugly, depressing)
Symbolic Meaning (With regard to the city, consider the medieval German proverb: "City air makes men free.")

From the previous discussion, it is clear that while all of these meanings are affected by culture and its symbols and images, the last two show the effect of these particularly clearly. While it has usually been assumed that the first two affect the choice of environments, Sonnenfeld concluded that culture is the main determinant of spatial and landscape preferences. These cultural choices, based on symbolic interpretations of the environment, lead to the search for an ideal environment. If the environment is symbolized, then the organization of space may be seen as the making visible of some ideal environments. It is the making visible of Suzanne Langer's *Ethnic Domain*, or Mircea Eliade's *Imago Mundi*. In this process, socio-cultural aspects become dominant and aspects such as climate, technology, topography, economics, communications and the like become secondary or modifying factors.

Historically we find cultures seeking plains or mountains, lakes or rivers as representing an ideal type of envieonment and certain types of sites never used; occasionally, the same culture, for example, the Moslem civilization, may regard coastal or inland sites as desirable at different times. Even in the present day United States, as a number of geographers have shown, and as David Stea described in the Autumn 1967 issue of *Landscape*, the choice of environment, leading to internal migrations, is based more on symbolic and ideal values than on "real" or rational ones. Stea discusses the concept of the "Invisible Landscape"—a perceptual and conceptual schema which helps explain many of man's locational preferences.

In the past, religion has been the primary way in which this ideal environment has expressed itself, and the geography of religion has given many examples of the way whole landscapes have reflected ideal cosmic images. In the case of the Dogon of the West Sudan fields, villages and other features of the landscape are laid out to reflect the cosmic order. Eliade, Deffontaines, and others bring many examples from numerous cultures and periods, while in a more architectural context, there is the relation of the Greek landscape to the character of the gods—discussed by Scully and my own work on the house forms of many cultures. In the case of the Chinese garden, we see the impact of Confucian and Taoist images of the world on the landscape, while the effect of images and symbols on urban form will form the topic of the next section.

Some geographers of religion, Erich Isaac, for example, have suggested that while in the past this symbolic mode of perceiving and structuring space may have been prevalent, it has now been replaced by an "abstract" mode. But it becomes clear from his further discussion that there is an ideology and an ethos reflected in this new mode which finds its reflection in the modern landscape—i.e., there is still a form of symbolic attitude. One can, in fact, say that the modern view of the land as something to be exploited for man's material good is as much an image as the religious view of man as caretaker of the land. In other cases, symbols such as health, recreation, view, "humanism" and the like become the new ideals and serve as the organizing principles of spatial orders. What one may suggest is that there seems to be a universal existence of values related to ideal space conceptions—orders of space organization and landscapes—but that these values take on different expressions. There is no one city form or landscape which would always be accepted as ideal—and this is precisely what one would expect if such choices were made on the basis of cultural values expressed through styles of life and their symbols.

SYMBOLS, IMAGES, AND THE ORGANIZATION OF URBAN SPACE

To show the primacy of socio-cultural factors and the mediation of images and symbols at a number of scales, I will discuss several examples of their effects on landscapes and pre-urban settlements before turning to a consideration of the city. J. B. Jackson has well documented the impact of the division of South America into two zones of influence—Portugese and Spanish—as an arbitrary political act, and the different ideals underlying the settlement of New England and the Virginias on the respective landscapes. His analysis of the totally different landscapes on either side of the United States-Mexican border, in an area of similar topography and climate, is also most convincing, as are his analyses of the changes in the American landscape due to changes in attitudes and images of the good life. Similarly convincing analyses have been done for most areas having different perceptions of the landscape. Mountains, for example, were only seen as exciting, and hence desirable, with the rise of the Romantic movement, and these changing perceptions have led to different siting of towns and buildings in many areas and cultures. One example of this is the Portugese tradition of siting towns on hilltops and the Spanish preference for plateaus. In Britain, Hugh Prince has discussed the impact of antiquarianism on the landscape while others have commented on the differences in attitudes to the city and rural areas as influencing the total environmental quality of Britain and France.

Most pre-urban settlements show the impact of an ideal spatial order. These are usually related to cosmic imagery such as the strict solar symbolism of the Baltic Solskift villages, (the relation of Pueblo and Maya settlements to cosmogony, and others). Levistrauss describes the Bororo village and its close relation to the image of the Universe as well as its critical relation to the life of the people which the missionaries understood. By destroying the village form, they were able to destroy the basis of Bororo culture and make conversion much easier. Eliade suggests that the whole basis of space organization among primitive people is the delimitation of sacred space from the vast, undifferentiated expanse of profane space; only this act can make space liveable.

In much recent discussion of the origins of cities, the primacy of sacred, rather than economic or defensive forces is stressed. There is evidence to suggest that city walls were meant for religious delimitation before they were used for defense—an aspect of Lewis Mumford's argument that man was a symbol-making animal before he was a tool-making animal, for which there seems much evidence. Any city of the pre-industrial era can be understood as a reflection of a cosmic order, (*Imago Mundi*). This is the case of the Indian city whose form is laid sown in sacred texts—the Roman, Cretan, Mayan or any other city. The Chinese city reflects cosmological ideas, and the system of Feng Shuei not only relates the settlement to these, but also tries to use it to capture the magical forces inherent in the Universe.

The fact that from Plato through Botero and the Utopians to our own day, the city has been discussed as an ideal and has frequently been used as a vehicle for the expression of symbolism suggests that it is more than an economic or political unit. At least, people think or *feel* that it is. The transplanting of urban forms by colonial powers—Saigon, Djakarta (Batavia), the Moslem cities of Yugoslavia, etc,. is one instance. A very striking instance is given by comparing the forms of the Arabic and French parts of Fez and Marrakech or the English and Indian parts of Indian cities, for example, New and Old Delhi. It is clear that these differences are not due to either site and climate and can hardly be due just to different technology.

Other examples are the Spanish towns transplanted to Mexico, which Stanislawski has studied. These are structured quite differently from the Indian towns in the same area, in that locations around the plaza for "Noble" activities are preferred, gradually becoming less so as one goes outward, whereas, the Indian towns have no such structure. In Spain itself, Moslem cities reflecting different philosophies of life and hence different concepts of space organization. The Moslem city had religion as the rationale for its social organization and separated the home realm from the market and mosque. The house turned inwards and almost reversed the Christian (which is also the West European) house-street relationship where the street comes first and houses conform to it, turning their best faces to it. In contradistinction to the Western extroverted city, the Moslem city is introverted with a clear separation of domains.

It is also the close relation of the city to some implicit ideal which makes it possible to tell easily, often at a glance, where a place is; why, there are cues which tell us almost instantaneously that a place is here rather than there. There thus, seems to be a relation between national character and urban form—different cultures organize, use and structure space differently. The very dense and tight city of ancient Crete cannot be attributed to defense or other material forces. It is rather, attributable to the love of gregariousness which can still be seen in Greece today, and can be contrasted with the English attitude. This image of how one should live and how the city should be used affects settlement patterns in many areas of similar climate, topography, degree of military danger and economy. The choice among possible forms depends on the style of life and images.

One consequence, to which I have already referred, is the need to look at different cultures before generalizing. We need to look at more than one moment in time and at more than one way of doing things: at history and cross-cultural studies. This will show that many aspects we accept as basic vary from culture to culture depending on values. By looking at pre-industrial societies, we include more extreme variations than by merely using industrial societies, and the same applies to the consideration of non-Western examples. It has been one of the axioms of urban sociology that cities have been the centres of intellectual ferment, change and the seat of radicalism. In China, as Murphey has shown, the role of the city was fundamentally different; it had no independence; rather than being a centre of change and radicalism, the Chinese city played the opposite role—it was the administrative centre which suppressed the radicalism of the countryside. Thus, despite the similarity of their economic functions in Western Europe and China, the cities played totally different roles and any generalizations based on Western European examples, as most are, only apply to Western Europe and not to the city as an institution.

The civic pride so typical of the Western city, and which has had such striking spatial effects on it, is absent in the traditional Japanese city. Meyerson has discussed the distinction between the public and private realms in the Japanese city. This affects not only behavior which is highly controlled and polite in the private realm and uncontrolled and rude in the public, but also affects design. There is a contrast between the messy, uncared-for public realm and the superbly arranged, designed and cared-for private realm—"private beauty is surrounded by public squalor." The spatial structure of the Japanese city also reflects the split; traditionally, these cities have no public spaces corresponding to the plazas, avenues and parks of the Western city and this has led to the development of shopping and amusement areas as public space—a striking feature of the Japanese city.

Urban hierarchies offer one clear example of differing images of the city. A number of American writers have commented on the fact that cities such as Los Angeles, Houston and Phoenix have structures and hierarchies, but that they are of a new and unfamiliar kind. Whether this is indeed the case seems of less interest for my purposes here, than the fact that many European writers disagree. They are particularly struck by the lack of any comprehensible hierarchy and hence structure of the city. They cannot accept these conglomerations as cities because they lack the traditional hierarchies which could fit the image of what a city should be. The traditional hierarchies are clear and can be expressed by the people (as in the studies by de Lauwe) whatever the elements—Town Hall, Royal Palace, Plaza, Sanctuary, Cathedral, Opera, Stock exchange, Market or what have you—both their form and hierarchic order is clear. It is interesting that in the new towns of Nazi Germany there was a clear reflection of the national hierarchy explicitly designed—from the main party buildings in the centre in a descending cone a clear visual statement of the leader's absolute control was expressed—not such a major step from the structure of Peking or many other cities.

The work of Glowczewske and his team at Aswan offer an instructive example of the hierarchy of importance attached to certain facts and images. After a design had been produced, the Governor's image of what the city should be intervened. This image attached great importance to the grand waterfront avenue which is typical of the great cities of the Mediterranean—Alexandria, Nice, Cannes, etc. The leaders identified their city with this grandeur and saw it as essential, taking precedence over other goals which the planners set for themselves, such as easy recreational access to the river and traffic exclusion. This example also shows a conflict between the values of the planners—access to the river and rational traffic flows—and those of the political decision makers, which also reflected those of the public. This is an aspect of the more general conflict between the values of the planners and architects and the public, which cannot be discussed in detail in this paper. Many aspects of the city critisized by planners and designers are valued by the public—often for their symbolic meaning. This becomes clear from a comparison of the popular professional press. One finds totally different sets of problems and concerns—totally different universes of discourse and different languages. Planners often plan for other planners rather than the public; like architects, they are working for their peers. Planners and architects can be seen as subcultures whose members have very special characteristics and possess ideologies. In France, for example, there has been a conflict between planners who have urged high rise, "communal" buildings and actually speak of destroying individualism and creating a new "communal personality" in a country of extreme individualism and a mystical attachment to the values of the small house.

At the same time, the values, goals, and ideologies of the planners themselves change very rapidly. Judging by the *AIP Journal,* they have changed from a concern with physical planning fifteen years ago, to a concern with very abstract model building now. This leads us to consider the images of planners and the effects these have on what they do. Much of the planning in the English speaking world of the past fifty years can be understood, in part, as an expression of an anti-urban bias, a strongly held view about the bad effects of the city and the desire to destroy it. Certain physical characteristics are identified with the city—they become symbols of the city and they are progressively eliminated. I would argue that the spatial expression of contemporary urban design, and the modern city as a whold, may be better understood in terms of new images than in terms of the needs of traffic, parking, sunlight, and the like. David Crane has spoken of the aesthetic bias of zoning in favor of free-standing buildings. This is merely one aspect of the destruction of the street and of space enclosed by buildings which is anti-urban; (enclosed spaces and streets are urban symbols, and grass, trees, and open expanses of space are the reverse. It also indicates a desire to have buildings as isolated pieces of sculpture to be seen, admired and *photographed* in isolation from all sides.

An examination of planners' images and values in different cultures also shows striking differences. It is instructive to compare the city as seen by American planners with that seen by French planners. The former, typified by Melvin Webber and Richard Meier, see the city as an information transfer system liberated from the need for place and almost free from the need for physical form. These are abstractions where there is hardly place for the irrational, emotional and constant in man as expressed by symbols, the "erotic" element in the city (von Eckhardt's term), joy, pride, excitement and the like—a refusal to even consider the visual aspects of the city (A similar turning away from visual concerns occurred in the nineteenth century). An example of the French attitude may be found in *Urbanisme No. 93,* (1966), which we may consider as typical of much work. That issue, devoted to urban sociology, adopts the premise that the city starts as a symbolic place—whether the symbol is church, temple, Agora, Forum or great square—and that the urbanite lives in a world which "speaks to him." There is much discussion of symbolism, the feelings of the inhabitants and of the need for a city to express a civilization in physical terms, to be an "irreplaceable theatre for life." Neither economic constraints nor the need to move traffic must be allowed to interfere with these other functions. Shopping is discussed not in terms of "efficiency," (whatever that may be) but as a social occasion and emotional experience zoning. Traffic and the like are discussed in similar terms. Urban form is seen as extremely important and as the "projection" on an entire so- emotional experience zoning. Traffic and the like are discussed in similar terms. Urban form is seen as extremely important and as the "projection of an entire society on the ground." Whether these views are successfully put into practice, or find expression in current plans, seems less important than the totally different ways of seeing the city and stating the problems. Eventually, these attitudes will be reflected in the plans Because different cities are seen, different cities will be built.

As an example of the totally different images of the city in France itself, producing totally different visions of the city, and hence, also inevitably resulting in different designs, it is instructive to compare Michel Ragon with P. H. Chombart de Lauwe. Ragon is concerned with technology, materials, forms and the like, but never people and their culture and wants. His approach is extremely abstract with a romantic stress on machines, rockets, computers—a romanticism not unlike that of the futurists or some of the founders of the modern movement in architecture. Taking technology as his utopia, Ragon sums up the possible future spatial trends of the city as being glacial abstraction or naturalism, both of which represent extremely abstract ideals and non-human images. De Lauwe, on the other hand, is interested in the socio-cultural aspects of the city. Rather than discussing "immateriality" and abstract space as Ragon does, he sees the city as a series of overlapping realms of space resulting from the perception of people. Such realms comprise social space, biological space, anthropological space, time space, topographical space, economic space, total geographic space and cultural space. His stress is on human use, heterogeneity, the social role of various physical components of the city, thr relation of the style of life to physical features such as shops and transportation. He relates the visual quality of the city to the way people use it and perceive it, attaching much importance to designing the city in terms of the value system of the inhabitants as expressed through symbols. Even without getting involved in details of the two points of view, one can clearly see the significance of the difference in these perspectives, and it seems crucial.

The discussion of planners' images has tried to show that while cosmological, religious and magical aspects have disappeared in the organization of urban space, as in the organization of the environment in general, there is still a predominant impact of values, images and the symbols attached to various aspects of the environment. Mobility, recreation, immateriality or something else may become the new value. New mythologies take over, but the symbolic essence remains. Even in the American context today, many images and symbols are still acting. It is interesting to consider the importance of the individual house as a symbol rather than its undoubted utility. Steinbeck has well described how Americans get tears in their eyes over the concept "home" and points out that builders build homes, not houses. The dream home is conceived as a detached house, surrounded by trees and grass in either country or suburb and it must be *owned.* Even though people rarely stay in it more than a few years, it represents a symbolic rather than a "real" need. A French study has confirmed the symbolic aspect of the small house and what it stands for. It becomes clear that ownership may be explained as part of the territorial drive. Territoriality itself, the constant aspect, takes on different cultural expressions, one clear example being the presence or absence of fences (comparing Britain and the United States, for example and other similar devices which show different ways of defining territory and boundaries of privacy.

Other cultures also see "home" differently. A study in Vienna found that a flat in the centre of town was much more highly prized than a detached house, confirming that forms seem to reflect ideal concepts as does the way dwellings are arranged, i.e., in which urban space is organized. As an example, consider the matter of *density.* In Anglo-Saxon planning, density has largely been used in a negative sense although in itself it is not a word with negative connotations. In France, planners have regarded high densities as a positive value, but in the English literature, density is referred to as an evil, implicitly if not explicitly. Density standards can, therefore, be seen as a cultural value quite independent of the merits or otherwise of given densities or any consideration of their consequences. The destruction of the city has been prevalent for a long time, both in England and the United States, and it has been well documented, no doubt affecting densities and the nature of designs. It forms part of the anti-urban bias of which I have already spoken and the destruction of all symbols of the city—of which density had alswys been one of the most apparent. In book after book, low density is equated with desirable goals and is used as a yardstick for amenity and liveability as, for example, in the Public Health Association planning handbooks. Absolute density standards have been set as though they were self evident on human grounds, yet they vary from culture to culture.

Hall and others have pointed out that density requirements vary with the degree of sensory involvement, and examples from many cultures could be given to show that acceptable, and, indeed, desirable densities are culturally defined and related to images and goals,—to the way the city is used. One of the crucial distinctions seems to be whether the city is seen as forming part of the total living space or whether the house is seen as the total setting for life. This basic difference as shown for example, by the American and the Italian city is clear to any visitor and is possibly the major factor in shaping the character of the two types of city. Victor Gruen quotes an Italian immigrant who, when asked how he liked Boston, answered that he enjoyed the home comforts—kitchen, bath, and the like. He added, however, that, whereas in Italy, once he left his rather less comfortable dwelling, he had the whole city to live in, to meet people in, to sit, talk, drink and enjoy himself, in Boston, even though he is able to bathe and dress much more comfortably and quickly, he had nowhere to go. He would like both. Since a city of this gregarious sort can only exist at a certain level of density, a desire for it must affect the organization of urban space.

There are other aspects of the American city where the effect of images and symbols can be seen. The success of developments such as Rossmoor can be related to the symbolism of its walled character and the guards which is the major difference from other developments. These are at least as much symbolic and status matters as ones of real security. People respond to the symbol of security and prestige (as *Progressive Architecture* pointed out in describing these developments). The whole matter of prestige ("the wrong side of the tracks") becomes an important aspect of urban space organization in the American city, as it does in many others—and is related to the "invisible landscape." In fact, the whole form of the American city, every aspect which gives it its character, can be understood in similarly symbolic and cultural terms. The tall buildings in the centre were originally as much, if not more, a mark of achievement and an expression of American values of grandness, greatness and success than they were a matter of economic necessity. The chaos of the roadside strips can be seen as expressing the concept of personal freedom and initiative, the right of contending forces to hammer out a result and is also related to the division between public and private realms. Both Galbraith and Victor Gruen, in different ways, have commented on the high standard of the individual environment and the low standard of the public environment in the United States, a situation reminiscent of the Japanese city which I discussed before. The freeways and cars are at least as much a matter of symbolic values as they are of the real mobility which they give. The Boston Redevelopment Study found that people coming to downtown by car walked much longer distances than they would from stations or subways. It may be the symbol of door-todoor as much as real convenience—after all, in shopping centres, the distance walked is often considerable but is considered as door-to-door. The difficulties of planning in the American city are related to mores and values reflected in politics: the many governmental subdivisions, the system of checks and balances—which seems obvious but is rarely made explicit. Even racial segregation is due much more to social and cultural factors than to poverty.

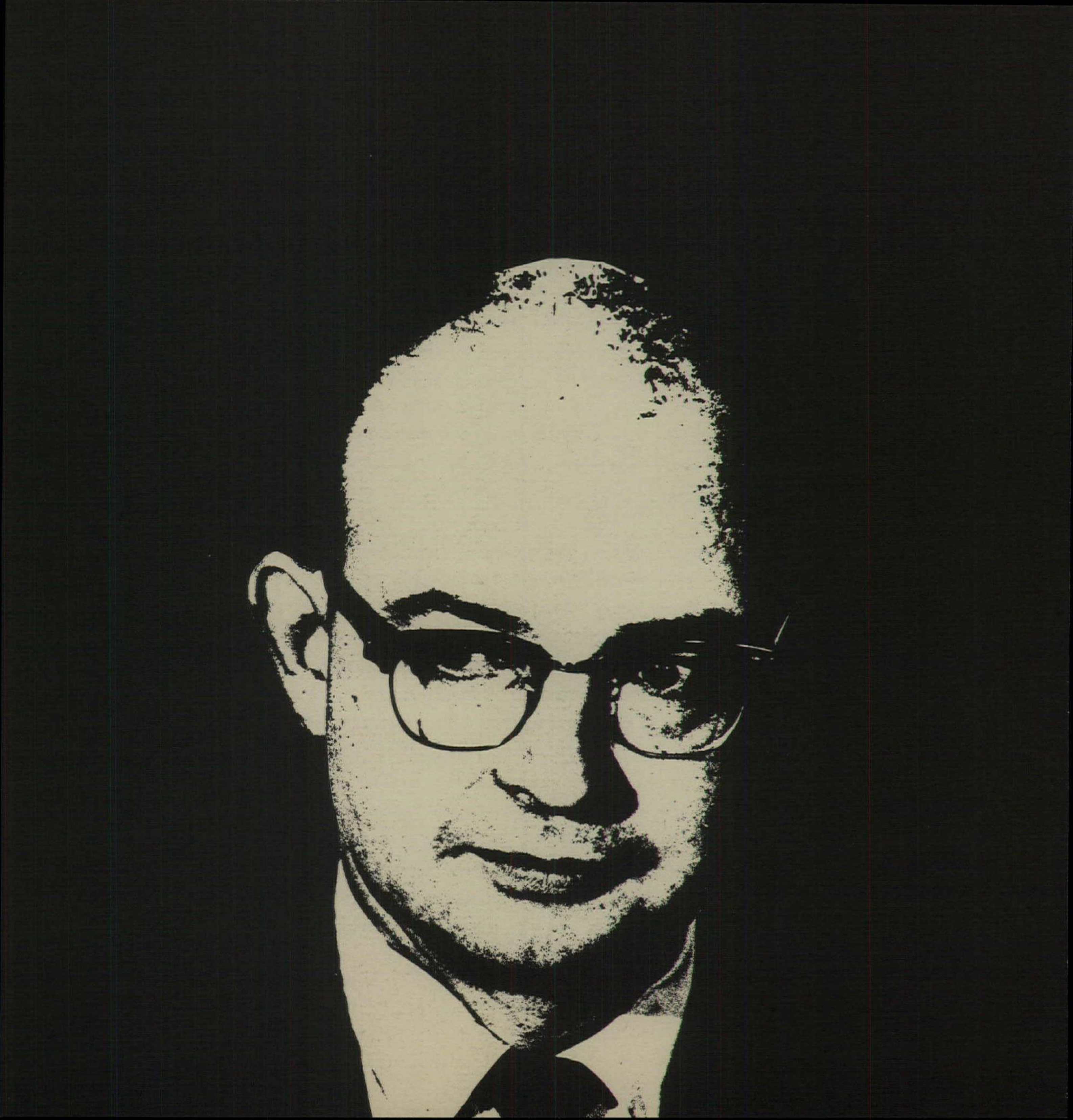
Following this argument, the growth of developments built around different forms of recreation—swimming, horse riding, sailing, and the like are also of great interest. This development is related to Stea's discussion of "invisible landscape" which is much concerned with leisure time which is related to ideals of leisure, depending on the way of life and the image of the good life. The whole concept of towns built around work is a clear example of the impact of socio-cultural values. Another, related example of the impact of socio-cultural values. Another related example, is the number of developments being built around water, especially around artificial lakes (for example, the series being built by Perine at Gary Indiana, Cleveland, Chicago, Kansas City, San Francisco, and Virginia near Washington D. C.). People are reportedly prepared to drive an hour or more extra a jay just to live in these places and the leisure use of the water may be much more symbolic than real—possibly as a symbol of affluence and "having made it." It may also be related to J. B. Jackson's suggestion that in the United States, historically, one of the principal motivations in the organization of urban and natural landscape has been the image of the healthy life. Others have similarly suggested that sun, sport and health become a "new religion" determining the orientation and layout of houses and towns in ways analogous to the cosmicorientations of the past.

There is an important point to be made at this juncture—even if it cannot be developed at length. This is that while I have been stressing cultural relativism and change, the discussion also brings out the presence of constant aspects. Not only is there evidence that symbols have shown remarkable constancy over long periods of time, and my discussion of the constancy of the motivations if not the forms. There is also evidence for both constancy and change at the level of man as a living organism, at the level of perception, and at the level of behavior. There is also the fact, which most of us have experienced, that artifacts—whether art, buildings, or cities, retain their validity long after the original cultural setting has disappeared, probably due to their low criticality. I personally have lived in very old buildings and cities belonging to different cultures and often found them more satisfying—perceptually and in other ways, than my own, a not uncommon experience. It is, of course, true that this latter type of constancy is more relevant at some scales than at others. There is little doubt that the metropolis or megalopolis is a new form of human settlement—a rare event in human history—possibly the first in 5,000 years, according to Blumenfeld. However, within the metropolis are smaller scale areas: streets, spaces for people to use, shopping precincts, residential areas; within those areas, there has been very much less change and constancy may be much more relevant than many people suspect. At that scale we find that, as Mumford has pointed out, the city has changed little since 2,000 B.C. when all its physical organs were already present. There are striking similarities in the forms of urban space organization many thousands of years and miles apart. There are also constancies in behavioral patterns; for example, the tendency for groups of common background to settle in contiguous areas seems to occur in cities throughout history. This is of great importance in many developing countries today and forms an important part of Richard Meier's plan for future Indian Megalopolis.

Since new problems and new ways of doing things undoubtedly occur, what does all this wide-ranging exploration tell us about planning and design? If nothing else, it gives us a much richer view of what the built environment is, how people see it, create it, and use it. In addition to being the organization of space design, it is also prediction. Each design is a prediction of some relation between the environment and man. George Kelly in his Personal Construct Theory has suggested that man generally acts as a predictive organism using constructs for this purpose. If both designers and the users of the environment act in a predictive manner, then we need to test our predictions. To do this, we need to know not only the explicit objectives of our designs but also the constructs of the users. This is the topic which I have been discussing. In evaluation, the success of any design, we need to know what a "good environment" is for the given situation, the types of spaces and their relation to the images and schemata, the culturally accepted devices for achieving the transitions, barriers and definitions of realms, the degree of complexity for different people and types of movement and the like.

This suggests the approach which I think planners and designers need to take. They need to ask why and in what way space is organized at different scales to obtain insights into what needs to be done. An approach such as this may often explain patterns and desires which seem to make little sense otherwise and may help to clarify the relation between images, symbols needs, social organization, constancy and change—and the physical forms of the environment. Only at that point can we proceed to develop strategies for achieving the desired forms of organization.

At the moment this approach is not, as yet operational. It is useful as an analytical tool and as a source of insight. How to use it in practice is a problem which has not been resolved. There is even a danger that one may become so aware of the complexity of interactions and wealth of problems that design becomes impossible. One cannot make a decision. Yet the potential rewards are correspondingly great; unless we ask the right questions—and I believe the ones I have been discussing to be the right ones— we shall never have the right answers.



DAVID BONSTEEL is presently Assistant Professor of Architecture and a member of the Graduate Faculty at the University of Washington, Seattle. Educated as an architect, Mr. Bonsteel has had a varied career of professional and academic activities. His teaching activities center around program analysis, computer uses, and graduate studies involved with perception or computer applications to the design process.

His research investigations have dealt with environmental perception and programming, and with physical simulation studies, particularly concerning sequential experience. Mr. Bonsteel presents the details and findings of his recent research in the area of simulation, in his

Investigation of a Televised Image in Simulation of Architectural Space.

This study was carried out at the University of Washington, College of Architecture and Urban Planning, by Assistant Professors David L. Bonsteel and Robert Sasanoff under a grant by the Agnes H. Anderson Fund and was published as *Architecture/ Development Series Number 6*, April 1967, with the aid of funds from the United States Steel Institute. The developmental project had as a goal the identification of the elements in a closed-circuit television system for the simulation of architectural space, the experimental development of such a system, and the testing of the system in a laboratory simulation study of movement in architectural space.

INTRODUCTION

The design professions have long lacked a means for objective analysis and prediction of behavior in architectural space. The traditional tool for architectural analysis continues to be the intuitive design concept based on individual experience. Even though the design process itself is a simulation of reality and the completed design a prediction of the result of patterns of use, few attempts have been made to evaluate the "real world" result in terms of the conceptual simulation or to accumulate data on behavior in the real world. With increasing environmental complexity and ever more rapid change the design professions are faced on the one hand with more complex variations of existing problems that require ever more rapid solution, and on the other hand with new problems without previous experience for prediction. In addition, designers are somewhat precluded from intentional experimentation with human behavior in a designed environment, and the length of time necessary to observe behavior in the created environment is such as to preclude the feedback of evaluated data in day-to-day practice. There is also a difficulty in knowing just what variables are present in the real environment. This study is another step in a continuing series of related searches to provide a laboratory tool for the experimental study of behavior in environmental spaces.

The ultimate goal is the development of a means for simulating an environment and predicting user behavior. That is, a logical or analytical system of simulation such as might be based on probabilistic analysis of behavioral patterns. For this type of analysis it will be necessary to create a laboratory situation in which the principal variables of the environment are controllable by the researcher so as to simulate a comparative reality. The assumption to be tested is that the subject-observer will behave in the simulated reality as he would in the real world. Therefore two decisions must be made: what constitutes an abstraction of reality; what aspects of behavior are to be observed. Other studies, and this investigation, have sought only to characterize gross physical movement in space; and this study sought to abstract the real situation, the main gallery in the Museum of History and Industry in Seattle, Washington, in terms of the model form suitable to the media of black and white television.

The intention of a previous study had been "to simulate the real world by means of projection of photographs on screens within a 'simulation booth'. With a suitable 'vocabulary' of photographs of the real world the attempt was made to recreate this real world in the laboratory, in terms of the user behavior of interest."(1) In this way the simulation "vocabulary" was the real world, a naturalistic observation by camera of a specific environment. The abstracted reality of simulation was the presentation of a real world viewed only in slide form, an optical device for recreating the architectural space; and the behavior of interest was the choice of path (views chosen) by the subject as he "moved" through the space.

Photographs had been useful in the simulation but did not provide the flexibility necessary for making and evaluating changes in that any single change in the model environment would have necessitated the retaking of a major portion of the slides. Another prerequisite for successful simulation appeared to be the ability to make a smooth transition from one scene of the environment to the succeeding scene as soon as the subject desired to move. Technical difficulties inherent to slide projection suggested the use of a televised image as the next step. This choice of closed circuit television for investigation, while it would provide greater flexibility for movement and for changes in the environment, represented a step backward in other ways. In that with the available equipment the image itself would be only black and white, and the image projected would be restricted to the field of a wide-angle lens, a 45^{o} cone, as opposed to the previous 135^{o} angle of three simultaneously projected slides. Even so the ultimate objective of flexibility in making environmental changes was thought to be the over-riding consideration, particularly as the authors had knowledge of image systems with color capability, normal field or view, and large screen projection that would all be useful but were not available without special funds and some prior background in the use of the media.

When the simulation system had been developed to the point that it was as close a match with the real environment as time and equipment permitted the system was tested using subject-observers and revised in the light of their experience. This step and the final phase, that of obtaining experimental data by use of student observers as subjects, were simulation samples, but only the last series of tracks represented a simulation sample using the system as developed. The small size of this sample does not allow it to be a valid simulation study as such. This project had the limited scope of developing the elements of the simulation system and establishing desirable characteristics of equipment—not the use of such a system per se.

PREVIOUS SIMULATION STUDY

The real world system that had been selected for the previous study was the Museum of History and Industry in Seattle, Washington. "This setting was chosen because the occasional changes of exhibits would allow even regular visitors to find themselves in the position of a 'tourist' rather than that of an 'habitue' thus increasing the tendency of their behavior to reflect the influence of the perceived environment rather than that of habit. Movement through the museum was selected as the user-behavior of interest because it was possible to obtain reliable estimates of movement patterns; because movement was one variable which appeared to be more easily amenable to study in a simulation setting; because movement is one variable which may be influenced by the form and content of any kind of space; and because movement in the museum situation represents an exceedingly crucial aspect of user-behavior operating to define a complete 'museum experience'."(2)

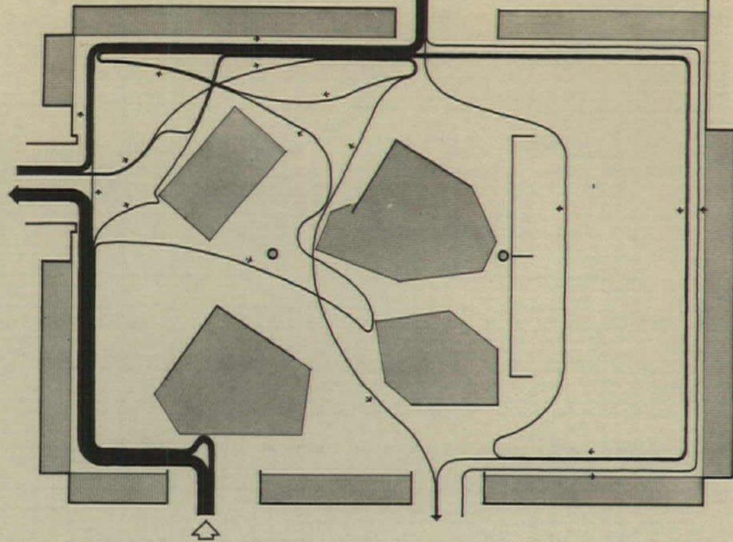
To record physical movement a plan of the Museum gallery had been furnished to each investigator. Proceeding without the visitor's prior knowledge, the investigator would track and record each subject's movement and activity in the space by drawing a line of movement and making comments as to time at exhibits, number in party, actions in viewing, etc. After the subject left the main gallery at one of the two exits to the other museum floor the investigator interviewed him briefly to obtain information on his museum visit pattern and significant exhibits remembered. The individual record of physical movement, the dependent variable of interest, was assembled as a composite map representing path behavior of the particular sample. (Figure 1). A factor analysis correlating movement and the variables of interest (exhibits visited, sequence of exhibits over path, age, group characteristics, etc.) was performed to discover significant relationships that could account for variations in patterns of user-behavior.

THE SIMULATION SYSTEM USED IN THIS STUDY

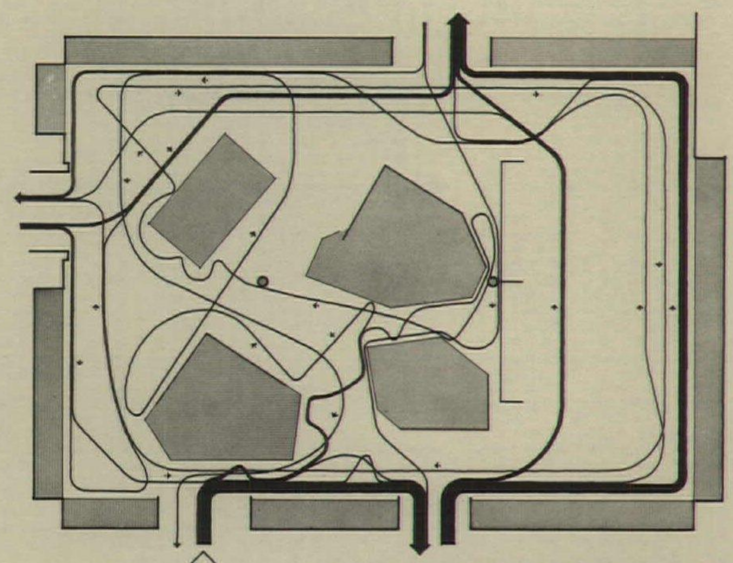
To a large extent this study depended on the availability of existing equipment to investigate modeling of a simulated world. Much of the initial work consisted of identification of sources of equipment and proposals for matching elements so as to assemble a system for experiment. The next task was to isolate the necessary relationships between elements. The original proposal suggested two elements: the model environment and the television system itself. Further work indicated that for better definition such a system might be said to consist of four elements.

For this study the determining factor was the optical system. Choice of this element dictated, in conjunction with the mode of movement, the size and scale of the model environment, and established the criteria for the element of lighting.

Photographs of the developed system are shown in Figure 2. A simulation system involves the linkage of elements—the view of a model world through an optical

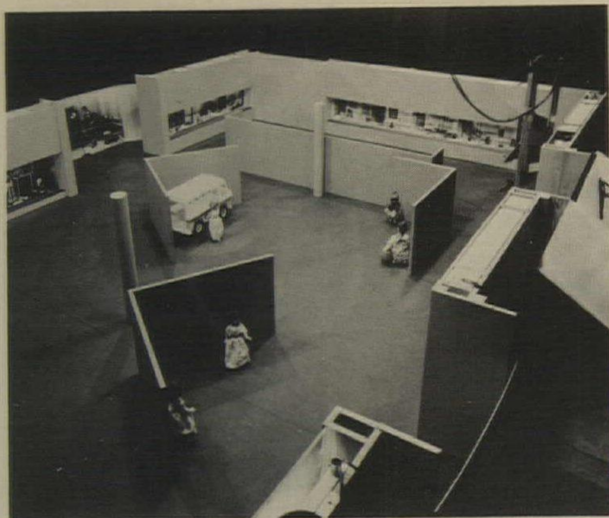


Sunday visitors, left turners

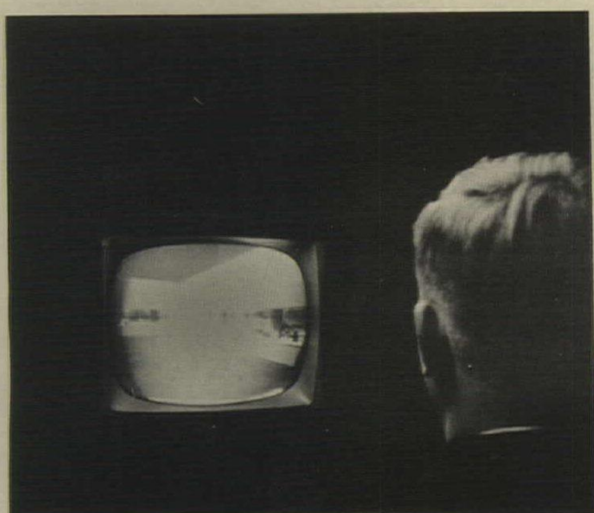


Sunday visitors, right turners

FIGURE 1. Maps of left and right turners in real world tracking study



Camera dolly position (upper right) for televised view below



Monitor view from this point

FIGURE 2. Televised image for a point in the model

system as seen by the subject. Control of the environment should rest with the researchers; physical control of the experiencing element of the system might best be vested in the subject to avoid researcher misunderstanding of subject intention.

The Model

An exhibit plan of the actual main gallery of the Museum is shown in Figure 3. The Museum entry hall opens to this gallery; the principal exit, the ramp to exhibit floor below, opens from the opposite wall. Two Wings, Animal and Maritime, open from this main space and they each have a secondary exit: to the outside, and to the floor below respectively. Within the main gallery the only fixed objects are two supporting columns and the area is undivided except for movable eight-foot high panels arranged especially for each exhibit. The room is lined with wall cases with their own interior lighting, and those exhibits in the northeast corner or along the north and west walls are historical in nature and seldom changed. As this was the space in which tracking for simulation studies had been done previously, this was the space to be modeled. Since a person "exiting" via the ramp area or main entry hall was said to have left the gallery it was not necessary to model these spaces, but some modeling of the Animal and Maritime Wings was necessary as persons entering and viewing these spaces could re-enter the main space.

Two physical limitations determined the size of the model: television camera size and size of the space in which the study was done. The camera should be able to maneuver in the same manner as a person "visiting" the Museum, and this might include moving through or turning around at a given point. After consideration of available cameras and dolly design, it was decided that by mounting the camera vertically the narrowest passage to each side of the free-standing exhibit at the entry hall could be negotiated if the model scale were 1½" = 1'0". The main space could then be modeled to scale with the real space if desirable. However, the size of the research study space precluded modeling of the Animal and Maritime Wings in a like manner, and dictated experimentation with some means as heightened-perspective modeling to create a sense of "size" of space in the limited area available. A plan of the completed model is shown in Figure 4.

The Museum space itself is merely the container within which exhibits are housed. Movement through is patterned by those exhibits seen or unseen as the visitor moves and examines. Thus the modeling of exhibits was a critical item for consideration. With greater time and funds it might have been possible to create, item by item, the contents of exhibit cases and then experiment with degrees of abstractness and detail so as to determine the necessary "reality" for things *of* an environment. As this could not be done it was necessary to use photographs of case contents for those exhibits, and to seek already manufactured objects and mannequins so as to duplicate free-standing island exhibits. Color slides had been taken five feet on center for the entire exhibit perimeter in the previous study. These were reduced to black and white negatives, enlarged in print form, and then pieced together to duplicate the exhibit format. The free-standing exhibits were another matter. At the model scale chosen it proved impossible to find readily available marketed objects and mannequins for use. Final choice of items narrowed to toy trucks and costumed dolls that were neither the correct scale nor "life-like" in appearance. The "reality" of photographs was surprising as most subjects did not perceive these pieced together prints as unreal in any sense, but the unreality of toy exhibits proved to be a tip-off to the "set" nature of the simulated space.

As the model had to be lit from above to supply necessary light for camera operation, and, as a camera cable linking it to the monitor was necessary, there could be no ceiling on the model itself. The real space had a relatively dark ceiling with only scattered down lights as spots for displays so that the ceiling was not obtrusive in the visual field. It was found that a percepted ceiling could be established by no ceiling at all—that the side walls of the research study space, painted black, reflected sufficient light of the overhead model lighting system so as to seem a ceiling. Thus the wall sections and columns were cut off at the scaled height of the real walls, and the vertical plane (research space walls) appeared, as seen by the camera, a horizontal plane (model space ceiling). For what range of ceiling light values this relationship

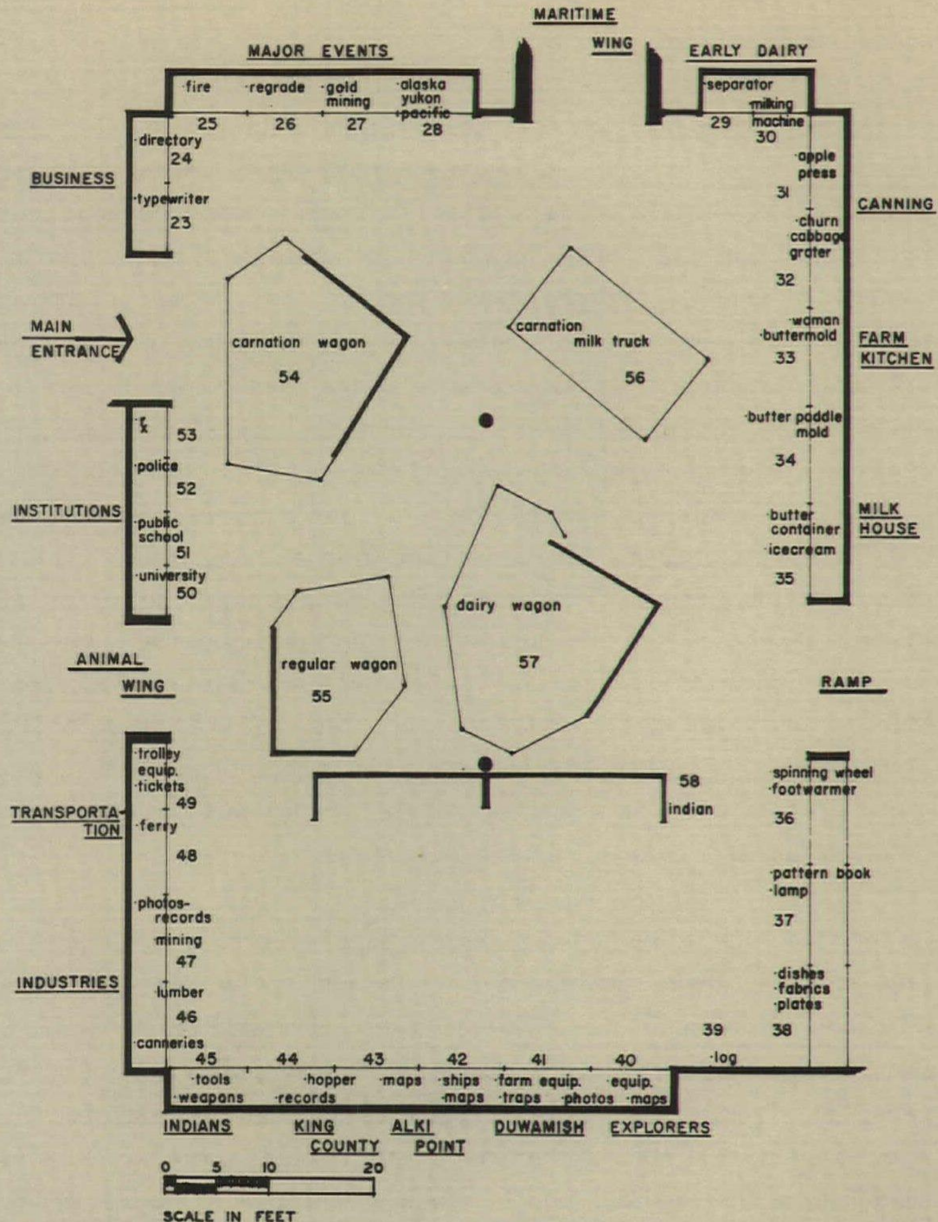


FIGURE 3. Plan of main gallery of museum

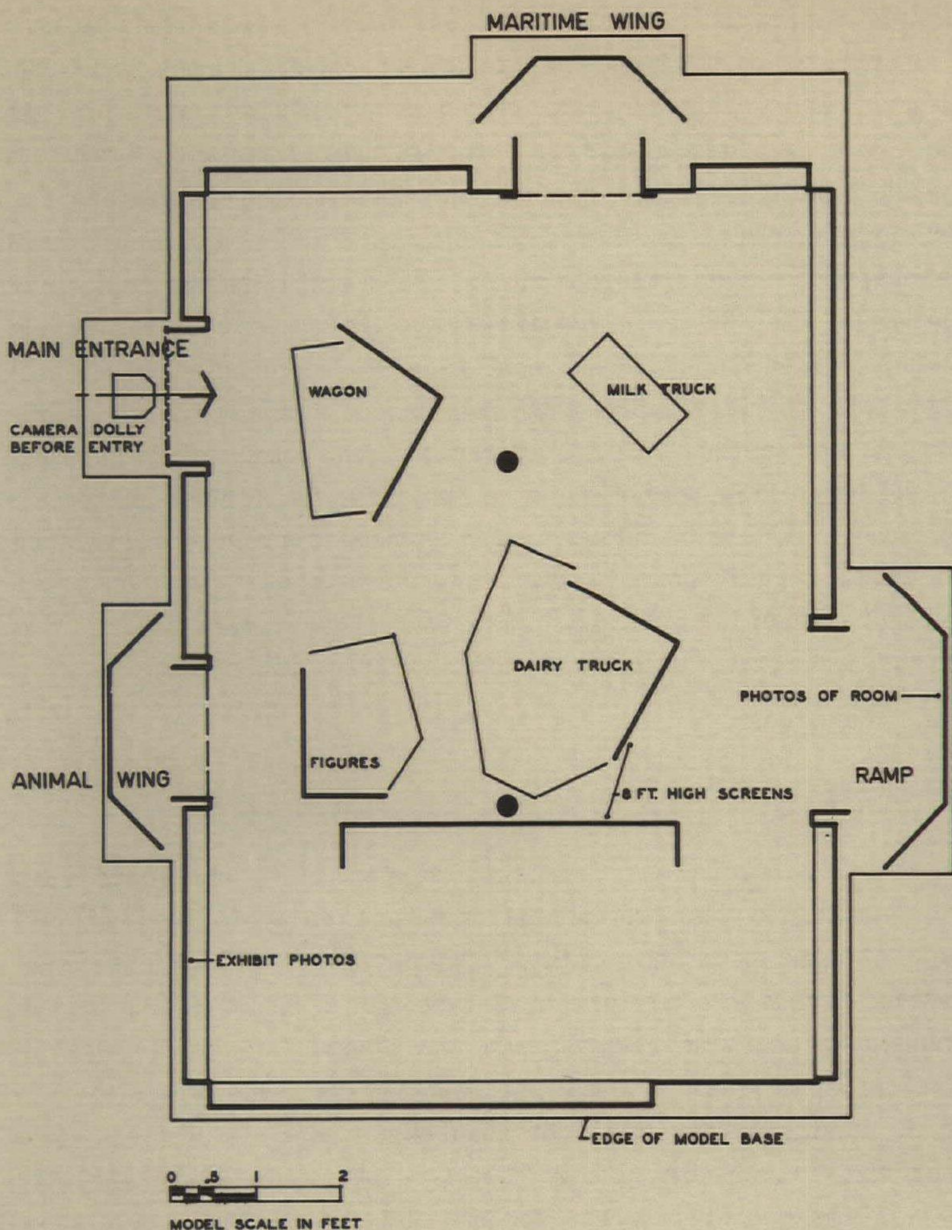


FIGURE 4. Plan of model of museum gallery

would be true was not determined. In the case of the two adjacent galleries, each having a luminous ceiling, it was necessary to form a ceiling of tracing paper to replicate the lighting and to heighten the percepted sense of the separation from the main space. Translucent tracing paper transmitted sufficient light from the overhead lighting and this created the sense of luminous ceiling. The chief determinant of spatial definition for black and white television appeared to be the value (grayness) of the defining surface. Without shadows to model the form, differences in depth of up to 4 inches (in scale) for parallel planes meeting at an edge were not perceived in the television monitor if of the same light value. In determining light value of surfaces this study sought to replicate the relationships of the real space. A SEI-light meter was used to read direct and reflected gray scale values in Foot-Lamberts for floor, wall, and exhibit cases of the actual space. The proportional relationship of ceiling-to-wall-to-floor-to-exhibit cases was maintained in the model environment by mixing and applying the proper gray tone of paint with the overhead lighting in place. The light value of the wall exhibit cases was the base value for comparison in determining the proper ratio for real-to-model translation.

Overhead Lighting

The Museum gallery model was lit from above using eight PH/2 photoflood bulbs mounted in reflectors 6′–8″ above the model floor in two rows, with end of rows at eight-point of model space. The quantity of light was determined by the television camera selected in that each type of camera, vidicon or orthicon, requires a particular minimum lighting level. Each reflector was clipped, but not permanently fastened, to one of two fixed wooden rails extending the length of the model in order that the number and spacing of lights could be studied. By varying the camera lens opening or the number and spacing of lights it was possible to determine the combination of light quantity and lens opening that would apparently result in the most "real" monitor view. Problems encountered in the use of this lighting included excessive heat in the enclosed space, shadows more defined than in the real space, and light reflections picked up by the diagonally fixed mirror of the camera dolly.

Reflections appeared as a moving spot of light in the monitor, and no way could be found of eliminating them completely though the constrast control of the monitor provided some capability in alleviating spot brightness.

OPTICAL SYSTEM

The best available optical system for this simulation study consisted of a Sylvania "800" vidicon camera having a separable body and lens and feeding a Conrac 21-inch table model monitor. The lens unit, approximately 3 inches by 4 inches by 8 inches, was mounted to the camera dolly and connected by overhead cable to the camera body unit in the simulation booth itself. The optical lens could be focused by remote control at the camera body. This separable feature proved most useful in that one investigator, stationed with the subject in the simulation booth, could manipulate the lens focus and appear to bring "up" or "focus on" a particular object the subject wished to see. In addition, by adroit use of the focusing mechanism, the investigator could adjust the view seen to level out discrepancies in lighting, degree of detail, or other inconsistencies in the monitor view. The camera body was connected by separate cable to the monitor, thus providing a degree of flexibility of placement of system elements. The Conrac 21" monitor contained its own contrast and brightness control, but these could be manipulated only between subject tracks and not during a particular track. With the camera lens mounted for a mirror image it was necessary to have internal circuits of the camera body revised so as to transmit a corrected view to the monitor.

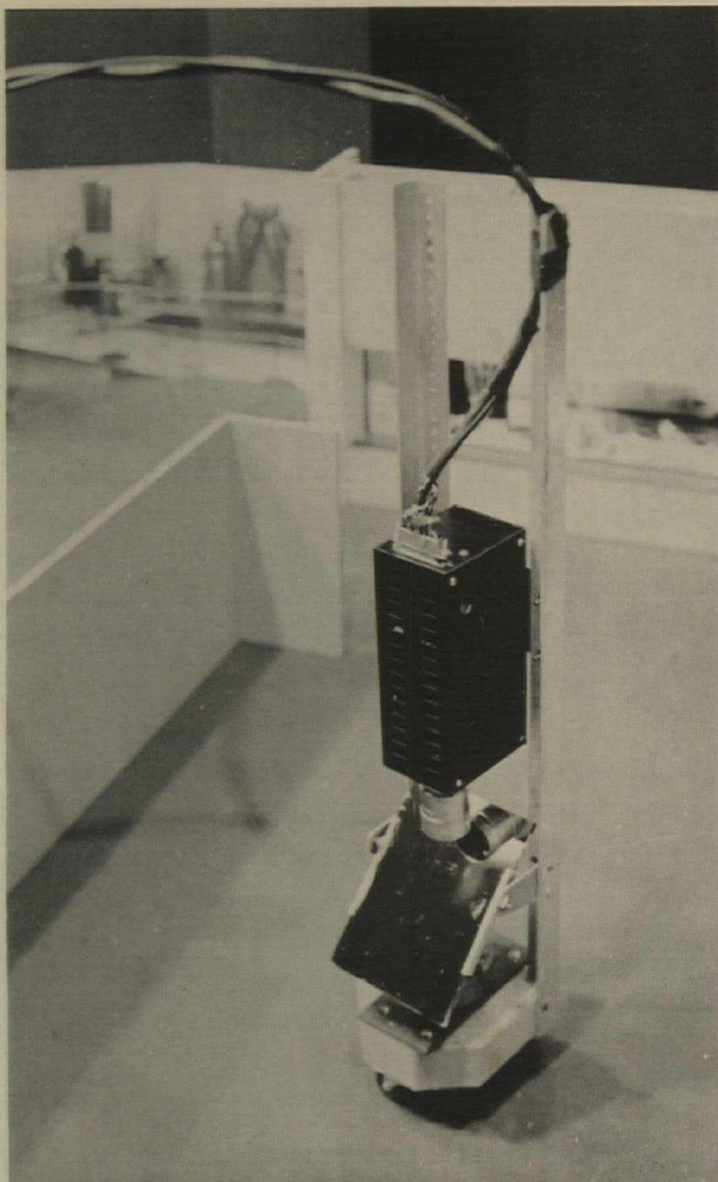
Mode of Movement

For this study the subject was not free to move within the model environment under his own control. Perception of movement was restricted to the televised image of the lens as directed by the subject, and as performed by the camera dolly controlled by one of the investigators. Movement was after the fact—the percepted path chosen and indicated after viewing but not that chosen during the process of viewing. Having made the initial choice of physical movement as the behavior of interest, two factors determined the actual device by which the subject "moved" within the environment. The most important factor was a limitation on physical size and camera support in that both the supporting unit and the camera must move *within* the model environment. Second, the camera would have to move on the model floor itself. There was no means, for this study, of rigging an overhead suspension system.

With camera selection the determinant of model size, the camera dolly was designed to occupy little more space than the camera itself, and to provide flexibility for experiment in determining "eye level" and for trying varying camera lenses. (Figure 5). The camera was fixed vertically on the dolly frame and aimed at the pivot of a five by seven inch front surface mirror. Several "eye heights" and attitudes were tried during the study, then the mirror was fixed at 5'6" high for eye height with line of sight horizontally ahead. The 10mm lens used was fixed in height above the mirror to provide approximately a 45^{o} angle field of vision when viewed in the 4½" effective field width of the mirror. A continuing problem was the mirrored reflection of overhead lights, and placement of masks over the peripheral mirror area did not solve this problem.

THE SIMULATION BOOTH

The research study space consisted of a series of rooms the largest of which was approximately 12 feet by 27 feet. In this space two separable areas were devised so that there would be an area for the model of the environment under study and an area, the simulation booth, where subject-observers could view the televised image. Simulation booth facilities consisted of the Conrac 21" monitor before which the subject was seated, but with the camera body controls located behind the subject's position so that one investigator could both observe subject behavior and manipulate image quality control of the televised view. Video recording equipment and tape unit were also located where accessible to the investigator, but not so as to be



Lens unit shown is connected by cable to remote camera body, with focusing controls, in simulation booth.

FIGURE 5. The camera dolly

obvious to subject. Ceiling high panels separated this area from the adjacent model area with the model, lighting system, camera, and the other investigator who would control camera movement. The entire space, ceilings and walls, was painted a dead black in order to concentrate attention on the monitor and cut down on unwanted reflections of light.

The simulation booth was so established that the subjects would be as completely unaware as possible of the presence of a model, or person, in an adjoining area. During a particular tracking sequence equipment hum and other building noises tended to mask noise from the adjoining model area. The areas were placed in proximity so that the instructions given to the subject-observer to the investigator in the simulation booth could be overheard by the camera operator and translated as quickly as possible into simulated movement. Thus the subject was not to be aware of the adjacent existence of the environment to be viewed but merely to accept its existence as being somewhere. One reason for doing this was to see if subjects did in fact see a model world or a "real" world as this would be a test of the reality of simulation.

The television monitor was positioned so that the center of the screen was approximately at eye height for a person seated in a straightbacked classroom chair. The subject was seated in a chair positioned so as to provide a viewing distance of 3'6" from screen. This, though closer than normal for a 21" screen (actual mask size was 19" wide), did establish approximately the same cone of vision in viewing as provided by the camera lens used to televise the view. The television camera, rated by manufacturer as 800 lines, combined with the monitor in use did provide good resolution (approximately 650 lines) and image quality at this distance.

After the subject had been seated before the monitor each was asked his name, age, intended University major, place of residence, and visit patterns at the Museum of Science and Industry. The subject was then instructed:
"We would like to have you experience a particular space of the Museum through the media of television. You will be free to move, once you've entered the space,

any direction you may choose. Just indicate for me if you wish to: go left or right, stop or continue, straight ahead or turn around, go slow or fast, look (examine the exhibits), or any instructions at all. I want you to walk through this space as if you were actually there. You can look as long as you like, and leave at any time you wish."

During this time the image had been defocused, but now the investigator, located behind the subject at the camera controls, began to focus the camera while saying, "Let me get a little better focus." At this cue, the camera operator began to move the camera slightly forward so as to enter the main gallery itself while the investigator in the booth with the subject explained that:
"You are now entering this space; you can see we are coming through the entrance. Just indicate from now on what you would like to do."
From this point on the subject-observer told the investigator where he wished to go and what he wished to see. These directions could be overheard by the camera operator, and the camera dolly was moved so as to carry out the instructions. In the absence of a specific indication the camera continued to move in the direction previously indicated, or, if stopped, to await further instruction. The speed of movement and maneuvers such as turning completely around or scanning were carried out in a "normal" manner based on previously developed techniques unless the subject otherwise indicated. During the time the subject was in the simulation booth the investigator marked the course of the "visit" on a map of the museum gallery. Figure 2 shows the televised image as seen by the subject-observer for that particular camera dolly location in the model.

Doorways to the Animal and Maritime Wings of the museum model were not ceiling height, therefore, the camera dolly could only "stand" at the entrance and scan the space. If a subject came to these spaces and indicated a desire to enter he was then told that **"you now can enter this wing to view the exhibits and then you have a choice of re-entering the space you have left or continuing (from the Maritime Wing only) to another area of exhibits. Which do you choose to do?"** If the subject, after scanning the Wing, indicated a desire to return to the main gallery, this was done. At the end of the museum "visit," that is, at the point the observer-subject indicated he wished to leave the main gallery, the subject was given a blank map of the main gallery and asked to mark his path within the gallery. In addition he was asked: to describe noticed aspects of the space he had visited in physical terms—the size and characteristics of floors, walls, ceilings; to adjudge whether the televised image was that of a real space, or of a stage set, or that of a model; and to comment on cues perceived as to the character of the space or "disturbing" elements noticed. These questions were of particular concern in determining what cues were used by the subject to "know" an environment, and what elements of the simulation were "unreal." See section on Comments.

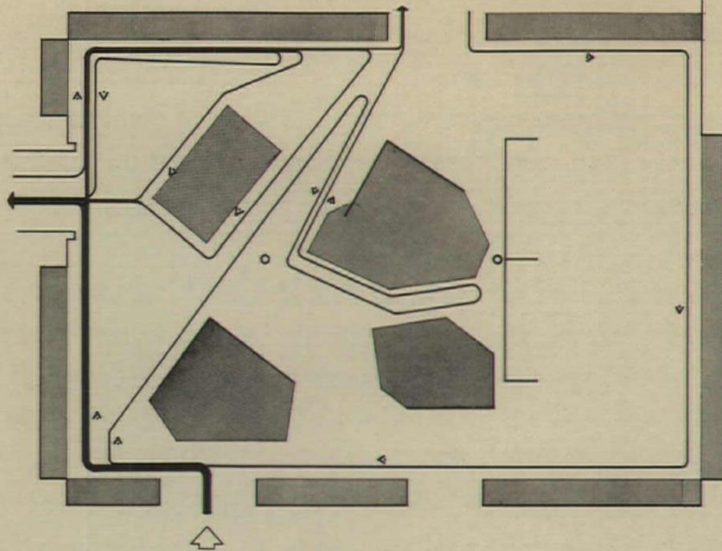
DISCUSSION OF RESULTS OF SIMULATION STUDY

The subjects for this study were University students of an architectural appreciation class who voluntarily participated. Their intended major ranged from architecture (one) to zoology (one) of the thirteen departmental interests listed. There were ten females and six males in the test sample with one person 45 years old participating, but with the rest being between 17–21 years of age. Twelve others participated in developmental phases, but their responses were not accurately recorded. The actual time spent in the booth while viewing the gallery divided itself into two time spans: those who spent 4 minutes approximately and a nearly equal number who spent between 13 and 20 minutes. Group composition was such that approximately half resided in Seattle and of the total group, 13 had been to the museum previously.

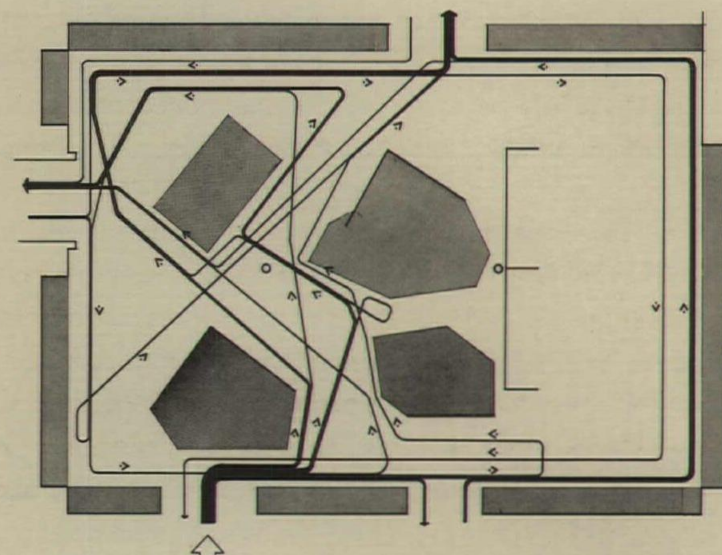
In this developmental study it was not intended that any thorough simulation study be carried out. Rather, the aim was to develop elements of the system and the degree of abstractness necessary to model construction, and then to test the system with a small subject-observer sample. The investigators saw obvious flaws that made it unlikely that elements of the devised system would lead to comparative behavior with the real world. The greatest apparent limitation was thought to be the field of view that would be "seen" by the subject, and this narrow view (in comparison with the previous study) proved, though not disturbing, insufficient to provide orientation in the environment. This was indicated by the comments of subjects afterward in that they were largely unable to describe physical space, and when handed a map on which to mark theii remembered trip, did not fully equate the experience with movement in the space itself.

It was possible, however, to obtain a track of movement in the simulation booth. Maps of direction of movement for the real world study previously done are shown in Figure 1. Comparative composite maps of left and right turners for this study are shown in Figure 6. The maps do not represent any single state of the environment in that changes in lighting of the Maritime Wing were made during the sample study. Maps are included to indicate the ability to achieve behavioral patterns in this simulation, and to indicate, by the amount of backtracking, the influence on behavior of the narrow field of vision used in the study. The amount of backtracking is an obvious difference between "real" and "simulated" behavior patterns, but the very nature of the paths chosen indicates the freedom with which subjects were able to move in this study. Also of note is a tendency to stick close to the walls—probably as the most interesting exhibits in the model were photos of the real world cases while island exhibits were for the most part toys without the detail of wall cases.

A vital aspect of this study was the simulation in *real time*—that is, the ability to change or continue movement within the space at nearly the same time as viewing the scene. In the previous study a ten second pause was necessary to change each set of slides for a particular view, and this slowed progression within the space. No estimate had been made in the previous study of the time necessary for each subject's "trip" through the gallery as the pauses between views were an integral part of the experience. In this study, using a televised image, one group of subjects "spent" only four minutes in the main gallery while an almost equal group spent 13–20 minutes, the average time spent for this simulation study being ten minutes. In the real world of the Museum the time spent until exiting from this same gallery was some twelve minutes with a few people tracked spending as long as 20 minutes. Figures are not statistically comparable as simulation sample is too limited, and real world times



Student sample, left turners



Student sample, right turners

FIGURE 6. Maps of left and right turners in this simulation study

include time spent in detailed reading of exhibit material not easily possible in this study.

In addition to the real time aspects of the simulation, the opportunity to make changes in the environment was an advantage. Perhaps even more than in the real world, within the modeled world as viewed by television what is "real" is that which appears at the moment. Thus it was possible to make changes in the environment between tracking of each subject, or to make changes during a particular track so long as the changed item was not appearing or had not appeared in the monitor view. Experiments were made with lighting, particularly of the Maritime Wing "ceiling", and with free-standing exhibits of trucks to see what effect a physical change might have on the behavior of the subject-observer. The change in Maritime Wing lighting materially changed the number of "left turners", apparently as the light-spill was visible from the starting position at the Main Gallery Entry as each subject was asked to make a choice of direction.

Cues and clues as to the form of environmental simulation were apparently remembered as the exhibit case mannequins and free-standing exhibit "dolls." Some of the "unreality" of the case mannequins established a model world even though they were, in the study, photographs of the real world cases. In several subjects' opinions they (the photographed mannequins) were unreal even though the same subjects remembered "real" objects (also photographs) beside the mannequins. Toy dolls were much more a cue and the toy trucks puzzled some of the sample. Because of their scale, they were slightly undersize and an eye level view passed over the roof line. Some subjects therefore noted them as "models" but others accepted them on the basis of being "compacts" or "foreign." Other comments suggested an interested participation by the subject in the experience of visiting the Museum, even in the primitive form possible in this study.

CONCLUSIONS AND SUGGESTIONS FOR FURTHER DEVELOPMENT

This study had as its goal the identification of elements in a system for simulation, experimental development of such a system, and experimental testing of the system for simulation. Two criteria were defined for such a system:

1. **A degree of abstraction from reality more in the control of the researcher than in the previous study.**

2. **A device that would permit a more real experience within the simulation booth than possible in the previous study.**

Although neither was met in entirety during this study, development of the system does suggest that beyond the abstraction of a televised image itself, there is the possibility of abstracting the variables of the real world in a manner very much in the control of the researcher. And that at least certain gross aspects of behavior as physical movement can be changed by a controlled change in the environmental simulation. The second characteristic, that of a more real experience in the visual sense, was achieved within the initial limitations of the available lens and monitor of the optical system. This needs to be and can be improved, but the results of this study indicate that subjects can "move" in nearly real time by the use of such a system. This provides yet another laboratory check on behavior in the real world.

A second limitation, already often noted, was the narrowed field of view. Third, and as important, was the lack of control the subject had over his own movement. It is *his* experience that is being recorded, but the verbal link between view (monitor) and eyes (camera lens on dolly) is such as to preclude an easy experiencing of an architectural space. This linkage is even more important as the image transition speed approaches real time, for the subject must think about doing while doing (seeing). With further practice it would have been possible for the camera operator to more nearly have become the subject's "feet" in movement, but the operator should never attempt to pre-judge and thus predetermine the subject response. Other than those largely mechanical defects of the system, the development of the simulation system initiated in this study does suggest a capability for laboratory simulation of movement patterns in architectural spaces.

Conclusions reached by the authors of the report suggest that further development is both necessary and desirable. Limitations of the present system and increased knowledge resulting from its use indicate possible directions for further study. Two factors are seen to govern the assembly of any such future simulation system:

1. The mechanics of assembling compatible elements, each of which would possess the characteristics necessary for a successful simulation.

2. The appropriate uses to which this tool might be put.

The appropriate future use of such a system is of paramount importance in that it determines in large measure the necessary characteristics of the elements in the system. From the inception of these studies in simulation it has been suggested that a laboratory tool for developing means of studying behavior is the goal. The ultimate goal is prediction of behavior itself as influenced by the variables of the physical environment. For these studies it is not necessary to model a whole world if a vocabulary of the environmental parameters would suffice. That is, it is not necessary to model a city block if you know the environmental parameters that define and identify that block. For the immediate future the process of identifying variables will be a necessary part of the simulation study itself. Therefore, any future system must accept varied environmental models.

An even more appropriate use for any system that is part of a university campus might be as a teaching device. Architects and planners know, by experience, the predictable result of some of their designed concepts; students may not. It is therefore fitting that a simulation system be used as a means of giving students the immediate benefit of their own design experience. This would also allow the student to study the development of a vocabulary of environmental parameters to define form and thus provide a more basic approach to the design process. Thus two things are required: first, that the system must accept varied environmental models and second, that it be a laboratory tool capable of successful simulation of behavior for research study.

COMMENTS ON SIMULATION EXPERIENCE BY SUBJECTS

Transcribed below are some of the subject comments in response to specific questions about the simulation experience once the Museum "visit" had been completed. The comments were recorded by a tape unit for the purpose of ascertaining what views persons *did* use (and remember) in this environment, and to identify limitations and defects of the simulation system elements. The questions used are followed by a grouping of comments pertaining to particular aspects of the model environment. Some of the preconceptions subjects expressed are as interesting as their perceptions.

"When did you realize that what you were looking at was a model or a stage set?"

"You mean that wasn't a museum? Well, it didn't occur to me that it was a stage set or anything. I just didn't think of it."

"I thought it might have been a model because particular pieces on display didn't look like anything....."

"The truck and the large dummy or doll standing out in the floor: you could see that it wasn't part of the display."

"The people in there or what appear to be mannequins were obviously dolls; the truck is obviously not a truck, your wire ropes and things are models, good ones, but undoubtedly models. Your furnishings are a little.....and your floors aren't quite right. They just don't look like floors. The general lighting—if you were in an actual room, you could tell there would be light coming in through the windows, you could see the patterns of..... [there are no windows in "real" museum space]. How individual fixtures have individual shadows. Your photographs on the wall are—I don't know—maybe that's why I couldn't see quite the detail. Don't get a change of perspective as you walk."

"How soon? When I first saw it I didn't, then I saw the writing 'Carnation Company'. [The model replication was of an actual exhibit that had included commercial vehicles from horse-drawn wagon to modern milk truck] .....No, the walls [talking of eight-foot high free-standing panels] didn't come all the way up to the ceiling. I didn't feel they did."

"It was a real room, flat, looked like artificial dividers, but I don't think we were seeing the whole room, just a section of it....."

"It looked molded. From the side everything looked polished, not like real. Everything inside the truck looked perfectly molded and shiny flat." [Subject could see into toy truck and no attempt had been made to replicate contents.]

"Was there anything about the surfaces in the room that stand out in your mind: floors, walls, ceiling? Can you describe the space—just the space itself, what it was like?"

"It didn't seem square."

"Plain. I don't remember noticing the ceiling. I wasn't looking at it."

"It seemed sort of non-cluttered, to the point that it was just one large area with sides. It wasn't that interesting—inside area wasn't good. The walls were white, I suppose."

"I think the floor was cement. The walls looked kind of like plywood. [**Ceiling?**] I don't know; I guess I figure the ceiling was real high, sort of like the kind of ceiling that....."

"Of course, you can't tell about the color, the color might have been such that it would have drawn your attention one way or the other. But here, you see, you can't tell."

"Low [**walls**] about belt-high; don't remember looking at the top of the wall, might not have been visible."

"Was there anything special that you would remember from the room itself?"

"The ship models to me. The diagrams of ten ships, telescope, depending on the type of boat they were looking at and what date it was. But I have never seen the Maritime history. As far as the clothing and those things go, I have seen them before. I have been in lots of museums, I remember some of them and forget most of them. But as far as the details of them?"

"The only thing I remember is the farm kitchen. It was on that mural. I don't remember very much about it though; I saw the sign 'Farm Kitchen'."

"Yes, it looked like the history of Seattle. It started out from the early history and went through the institutions, different men who founded the area—Alki, King County and different items that looked like they showed the Seattle fire. You could get a good history of Seattle from this area."

"The clothes the women wore, and had, to do general chores, would be particularly hard to keep up and looking nice; and the fact that they saved things, that there were things saved in the Seattle area from before the fire, and that people look at them now and evaluate what life was like then. I think that's important—that they were saved and people can look at them."

"Did anything look out of scale?"

"I don't know if it was just too far away from it in the picture or not, but when you came down that first wall it looked like a store window. I think that truck looked small to me, but I don't know much about trucks, whether it was just one of those compact things."

"They looked small, geared to a child. [**Which ones?**] The ones in the roped off areas with the truck were geared to maybe a child's size. I thought the dolls were about half your height. The truck, about one-third of actual size. The exhibits along the wall look about normal size."

"Would you please indicate on this map (a map of the Museum space) your path through this space?"

".....doesn't seem like this size."

"Are these displays along here? I'm completely lost."

"I went this way, didn't I? This was equipment and things of that sort, that's wrong though, I think it went over here because I know this is the Maritime Wing where I went in. Was all that first exhibit right here? And then the women were along here? But then I said, let's see what's over here—well, this confused me, otherwise I would have thought this is the way I went. Because we backed up there and looked at the truck this way, I went this way, out of here, we didn't go around the truck, we went this way, that's right.....I think this is where the women were. I think this is where the fire hats, and, no, that's not right. The fire hat was here, the scale with the beans was here, with the gold ring stuff, so the women must have been here, you sure forget where you were, don't you? I have forgotten what this one did, but all along this here is where the separator was, the ice cream churn. Oh, the apple press was in here—I remember looking at the truck back this way and seeing it over here. In other words, it is a full size truck, from this size drawing? And there was no truck over there: didn't even notice that."

(1) Winkel, Gary and Sasanoff, Robert. *Approaches to an Objective Analysis of Behavior in Architectural Space.* University of Washington, Architecture/Development Series, No. 5, August, 1966, p. 13

(2) Winkel and Sasanoff, *op. cit.*, p. 13

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His varied research interests include: socio-psychological factors in environmental transformation; techniques for the description and assessment of environmental scenes and entities; and personality dimensions and cognitive processes related to the non-human environment and to environmental design. Dr. Craik deals specifically with some aspects of the influence of the natural environment on behavior, as he investigates

Human Responsiveness to Landscape: An Environmental Psychological Perspective.

An outsider is compelled to admire the impressive efforts of the design disciplines to live up to their contemporary ideal of designing with systematic regard for the 'total environment.' Regional landscape design, as a case in point, extends the analysis of scenery and the visual qualities of the physical environment to a regional scale, and also recognizes that 'scenery' exists in the interaction between material reality and human observers (Twiss, 1965; Twiss & Litton, 1966). Thus, in addition to design notions, regional landscape analysis is based in part upon geography and natural resources management, considering the impact of landform and land use upon scenery, and in part upon the new fields of environmental behavioral research, studying relevant characteristics of the observing public, for whom scenery has become a resource in its own right.

The recent advent of behavioral research on human responsiveness to landscape reflects a more general trend toward study of how man comprehends the everyday physical environment, how he shapes it, and how he is shaped by it (Archea, 1967; Beckman & Studer, 1967; Craik, 1967; 1968b; Esser, 1968; Kates & Wohlwill, 1966; Parr, 1964-5; Searles, 1962; Taylor, Bailey & Branch, 1967). The sciences and disciplines dealing directly with landscape, such as landscape architecture, geography, forestry, and natural resources management, have not only encouraged such research in principle (Darby, 1962; Kirk, 1951; 1963; Lowenthal, 1961; 1962; Lucas, 1966; Twiss & Litton, 1966; White, 1961; 1966; Wright, 1966); they have contributed to it (e.g., Lucas, 1963; Burton & Kates, 1964; Saarinen, 1966; Sonnenfeld, 1967).

Environmental psychology deals with at least three somewhat distinct questions: What does the everyday physical environment do to people, that is, what are its consequences for human behavior? What do people do to the everyday physical environment, that is, what are the behavioral antecedents of environmental transformations? And, how do people comprehend the everyday physical environment? The first question is concerned with the degree to which human behavior is influenced and controlled by the physical environment; the second question is concerned with the human behavior of persons who manipulate, design, and plan the physical environment. The last question, concerning the ways people comprehend the physical environment, is central to research on the other two topics, for the influence of physical environment upon behavior and the influence persons attempt to exert upon the physical environment are both mediated by the manner in which the human organism comprehends it.

First, an over-view of the problems entailed in seeking to study the comprehension of the physical environment, especially landscape, will be reviewed. Second, a theoretical framework will be presented which provides guidelines for research and practice. (1)

I. COMPREHENSION OF LANDSCAPE: A RESEARCH PARADIGM

How do people comprehend landscape? In what terms and categories do they talk and think about it? What qualities and dimensions of it do they distinguish and attend to? What preconceptions and expectations do they bring to it? How do people vary in their attitudes, values, and other environmental dispositions toward landscape? Any investigation of human responsiveness to landscape entails decisions regarding four elements to the problem (Craik, 1968a). How are the landscape scenes and settings, which might be termed *landscape displays*, to be presented to the observers (Media of Presentation)? What are the characteristics of the landscape displays themselves (Environmental Dimensions)? What kinds of responses to landscape displays are to be elicited from the observers (Response Formats)? And, whose landscape comprehensions are to be studied (Observers)?

Media of Presentation

Landscape displays can be presented to observers directly, through site visits, tours, and even long-term residence, or indirectly, through such media as sketches, paintings, maps, models, photographs, films, and television. Direct presentation of landscape displays claims epistemological priority, but poses questions of expense, logistics, and individual differences among observers in exploratory behavior. The use of various representational media is an attractive alternative, offering less expensive, more convenient, and more standard means of presenting landscape displays. However, unless research is specifically directed to the study of responsiveness to *representations of landscape*, evidence of the success of simulation of landscape by indirect media must be obtained. Furthermore, simulation must be appraised in terms of *behavioral equivalence,* i.e., responsiveness to indirectly presented landscape displays must be comparable to responsiveness to directly presented displays (Craik, 1968a). Evaluation of simulation techniques on the basis of behavioral equivalence is just getting underway (Winkel & Sasanoff, 1966).

Environmental Dimensionality

Consider several landscape settings and the dimensions along which they differ. The multi-dimensional nature of landscape becomes immediately evident. In studying environmental preferences, Sonnenfeld (1967) used landscape displays rated on the dimensions of: greater or lesser relief, richer or poorer vegetation, more or less water, and warmer or cooler temperature. Shafer and his associates were able to score twenty-four campgrounds in the Adirondack State Park of New York on forty environmental characteristics, such as distance to the lake shoreline, density of over-story, and percentage of grass cover. When the forty scores were intercorrelated and factor analyzed, nine environmental dimensions emerged (Shafer, Thompson, Discenza, & Hamilton, 1966). These nine dimensions, along which the twenty-four campgrounds varied, were related to the intensity of use of each campground, as a means of identifying environmental characteristics associated with frequent and infrequent campground use.

A taxonomy of landscape dimensions which are susceptible to reliable, quantitative appraisal is the goal of a research project currently in progress. (2) Based upon a scheme for the visual analysis of landscape developed by Litton (1968), a set of rating forms will assess landscape displays in terms of such dimensions as: extent of view, nature of foreground-middleground-background discontinuities, direction and quality of lighting, degree of enclosure, and presence of isolated forms, surface shapes, and ephemeral features. The purpose of this project is to provide a set of rating forms yielding adequate levels of inter-rater agreement. An extensive collection of photographic slides of landscape scenes quantitatively, reliably and independently rated along the entire set of landscape dimensions will be a by-product of the study and will constitute a useful experimental apparatus for further research. At a later point, the rating forms will be evaluated for their usefulness in the descriptive assessment of landscape displays presented directly, i.e. through field trips by observers. (See Figure 1).

Individuals trained in the fields of forest management, landscape architecture, conservation, and outdoor recreation, as well as persons from the general community, will serve as raters in the project. One might expect to find differences among such groups in their environmental attitudes, preferences, values, and policy orientations, but in this study, of course, the search is for agreement and the hope is that these dimensions will provide a common language for communication at the descriptive level, at least. The project has value for environmental design because of its immediate implications for improved methods of conducting landscape inventories and evaluating landscape resources. These tasks are gaining the attention of landscape architects, foresters, and other planners bearing an often elusive responsibility for environmental quality. The project has value for environmental psychology because it is a step toward establishing a system of reliable environmental dimensions. The lack of a system of metrics for describing and systematically varying complex environmental displays is one reason for the neglect of the everyday physical environment in psychological research. Psychologists have readily made use of physical variables provided by physicists, such as temperature, luminance, hue, and amplitude, but have not made use of complementary environmental variables which geographers and environmental designers might be able to contribute to the common effort.

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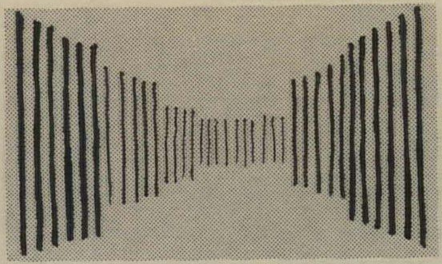

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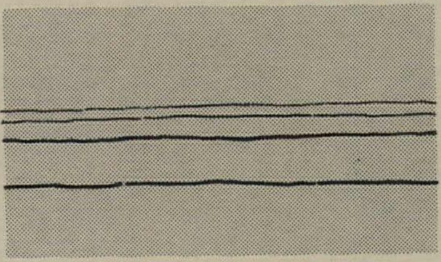

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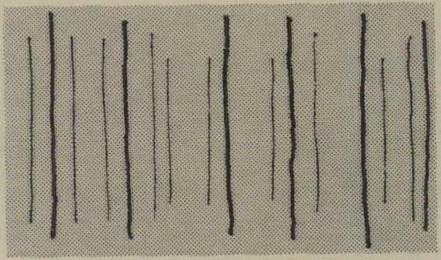

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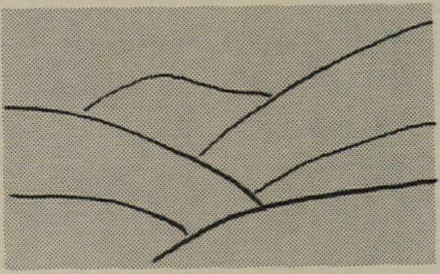

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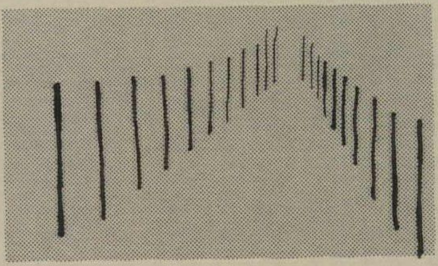

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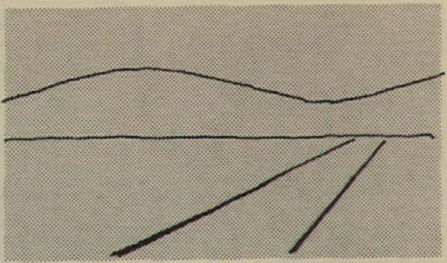

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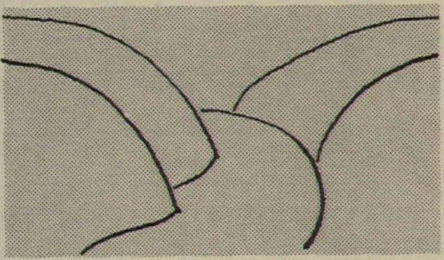

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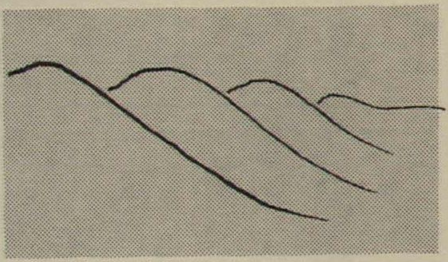

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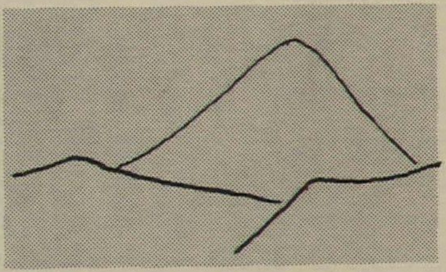

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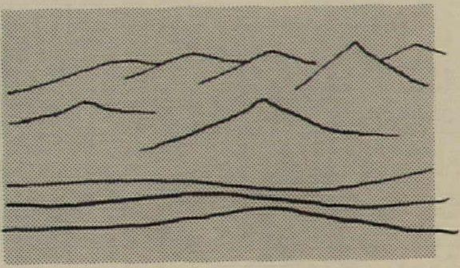

FIGURE 1: In the study of landscape dimensions, raters first assign each landscape scene to one of the ten types of landscape configurations graphically depicted. Raters then proceed to describe each landscape scene along a series of dimensions, selectively illustrated below.

1. The observer is

a) looking down upon the scene.
b) looking straight on at the scene.
c) looking up toward the scene.

2. Extent of view: the distance to the most remote elements in the scene is

a) less than ¼ mile.
b) ¼ mile to 3 miles.
c) greater than 3 miles.

3. Does the scene contain an isolated form, composed of a single element or a group of elements, seen in profile or silhouette against the sky or against a distant background?

a) Definitely present.
b) Somewhat present.
c) Definitely absent.

4. Does the scene contain a surface shape, seen as an outline embedded in the landscape itself?

a) Definitely present.
b) Somewhat present.
c) Definitely absent.

The upper display in Figure 2 is typical of the landscape scenes being studied.

Varieties of Responsiveness to Landscape

Human responsiveness to landscape, like landscape itself, is multi-dimensional. Several levels of responsiveness will be illustrated; techniques for assessing them have been reviewed elsewhere (Craik, 1968a).

1. Environmental Description. Placing minimal constraint upon spontaneous response, free descriptions of landscape displays made by observers in spoken or written form are characteristic and revealing. They approximate the typical way the observer describes landscape to himself; they provide insights into the scope of his environmental vocabulary and into the patterns of learning, and of taste, which have influenced its acquisition. However, the very fact of individual variation in terminology and extensiveness of response creates the need for standard descriptive formats, such as adjective check lists and rating scales, which provide comparable and quantifiable means of recording impressions of landscape scenes (Craik, 1968a). The development of techniques for the study of environmental description is receiving attention from several researchers (Collins, 1968; Kasmar & Vidulich, 1968; Lowenthal, 1967).

2. Environmental Beliefs and Concepts. Observers vary not only in their direct descriptions of specific landscape displays but also in the conceptual and inferential schemes which guide their understanding of them. Among users of the Boundary Waters Canoe Area, Lucas (1966) found that paddling canoeists had a more restrictive and delimited notion of what constituted the "wilderness" portion of that national forest domain than did motorboaters and other users. In a study presently underway, the inferences observers make about features of the forest landscape are being investigated. (3) Observers are presented with specific forest landscape displays, through the medium of photographic slides, and systematic probes are made of their inferences concerning: 1) the nature and origin of prominent features of the scene, 2) any human activities evident in the scene, and their larger context, 3) the character of the surrounding countryside, e.g., within a five mile radius, 4) the sorts of persons likely to be found in the location, 5) the consequences, both environmental and social, of certain hypothetical changes in the scenes, and 6) the likely appearance of the scene ten years hence (See Figure 2). An attempt is being made to achieve representative coverage of features of the forest landscape related to natural resources management, settlement, recreational use, and transportation systems, as well as those related to ecological processes.

3. Environmental Values and Preferences. The nature and relative intensity of values is often assessed by having the observer indicate his preference among alternatives. Environmental preferences regarding landscape (Sonnenfeld, 1967), camping facilities (Shafer & Burke, 1965) and neighborhoods (Michelson, 1966; Peterson, 1967; Wilson, 1962) have been studied in this manner, through photographic presentations. Observers are requested to choose between paired alternatives, rank displays in order of preference, or rate them on degree of preference. In a thorough analysis of environmental preferences, investigators identify the qualities of environmental displays which are the effective basis of the obtained pattern of preferences and the ways in which those qualities are comprehended by observers when reaching their preferential decisions. Thus landscape displays with independently established environmental dimensions and modal environmental descriptions must be employed, if our goal is to specify not only which landscapes are preferred or not preferred, but also what descriptive responses mediate the preferences and what environmental features are associated with the preferences.

Selection of Observers

How do the several hundred million persons in the United States vary in their responsiveness to landscape? What order exists in this variation and how is it to be understood? Candidates for study come readily to mind: natural resource managers, conservationists, and preservationists; urbanites, suburbanites, villagers, and farmers; natives and newcomers; backpackers and Sunday drivers. These sets of candidates pose the minimal hypothesis of the existence of consistent differences in landscape responsiveness. The first task is to demonstrate the generality of such variation. But

FIGURE 2: In the study of environmental inferences, observers respond to specially constructed booklets, with one question per page.

1. List 5 noteworthy features of the scene.
2. List all signs of human activity in the scene, specifying the nature of the activity indicated.
3. Identify, as completely as you can, the types of vegetation in the scene and the species of wildlife likely to be found in this setting.
4. Explain briefly the nature, origin, and significance of the following feature of the scene: the central clearing.
   What is the feature?
   What forces or circumstances produced it?
   What is its significance?
5. Suggest 4 ways in which this scene might be improved.

1. List 5 noteworthy features of the scene.
2. Identify the social groups, organizations, and institutions likely to be directly or indirectly related to this setting.
3. List 10 likely characteristics of the area within a 10 mile radius of the scene.
4. Explain briefly the nature, origin, and significance of the following feature of the scene: the clearing in the upper left.
   What is the feature?
   What forces or circumstances produced it?
   What is its significance?
5. Describe briefly the likely appearance of the scene 10 years hence.

in addition, they reflect certain implicit hypotheses about the development and functional role within the personality of responsiveness to landscape. The systematic formulation and test of developmental and functional hypotheses promises to be a rewarding enterprise.

II. THE PSYCHODYNAMICS OF THE SCENIC TOUR

Kenneth Clark credits Petrach with two scenic firsts in recorded history: climbing a mountain to take in the view and expressing the sentiment underlying the popularity of landscape painting: "The desire to escape from the turmoil of the cities into the peace of the countryside." (Clark, 1961, p. 7). From Petrach to the wilderness user of today (Wildland Research Center, 1962), a typical encounter with 'scenery' is represented by an urbanite on tour. Taking the context of the scenic tour seriously offers one functional approach to the study of human responsiveness to landscape.

The everyday physical environment is experienced with the observer in motion. We are seldom, if ever, perfectly still and still alive. Yet the experience of gross movement through the environment, as along a highway or pedestrian pathway, has characteristics peculiar to itself. Standard descriptive systems are being developed, akin to choreographic notational systems, which permit trained observers to note the sequence of principal elements as one moves through either urban areas or countryside (Appleyard, Lynch & Meyer, 1964; Casey, 1966; Halprin, 1965; Rose, undated; Thiel, 1961). In addition to obtaining expert description of the view from the road, complementary research is identifying what features of the landscape an observer attends to as he moves through it and what features he recalls at a later time (Carr & Kurilko, 1964).

Mention of memory brings to mind psychological work initiated by Sigmund Freud and Kurt Lewin on the dynamic nature of that cognitive process. What is remembered by a particular scenic observer and, for that matter, what is attended to is influenced by the person's ongoing motives, conflicts, incentives, anticipations, and their place within the functioning of personality as a whole (Erickson, 1962; MacKinnon

& Dukes, 1962; Sanford, 1963). Thus, the scenic journey is a psycho-sociological event with a temporal course. What components of the observer's motivation for undertaking the journey are scenic and which are extra-scenic? If the observer is traveling with others, what is the inter-personal significance of the journey? What are the salient themes of the journey itself and to what extent have extra-scenic concerns and preoccupations swamped the impact of scenery? If the journey is predominantly scenic in intent, what are the travelers' scenic goals and what strategy do they adopt to attain them? Since the impact of an experience may not cease with its own termination (Hilgard, 1962; Klein, 1956), what are the after-effects of the journey? They may be social. The individual has new narrative material for presenting himself to others. They may be personal, in shoring up his sense of himself as a person close to nature. Or, they may be psychological, re-charging his imagery of natural landscape. The intense experiences at vista points may be quickly, though temporarily, lost in the hustle and bustle of the journey back home, but may pay off later in revivified daydreams over the lathe at the workshop. Not only poets may heed advice such as Bishop Berkeley's admonition to Alexander Pope to travel more, in order "to store his mind with strong images of nature" (quoted in Hussey, 1927, p. 88).

III. THE SCENIC OBSERVER ON TOUR: NOTES TOWARD A ROLE THEORETICAL ANALYSIS

From the vantage point of social psychology's role theory (Sarbin, 1954; Sarbin & Allen, 1968), responsiveness to landscape is structured by the particular role of scenic observer which the individual enacts when touring the countryside. Although it requires reliance upon historical materials, analysis of the case of *the observer of picturesque landscape* is instructive, because the definition of that scenic role was clear and distinct. Historical sources include a remarkable collection of volumes of tours, excursions and guides to the District of the Lakes of northwestern England, which were published and widely read between 1770 and 1820, a period coinciding with the height of the picturesque movement in England (Hussey, 1927; Manwaring, 1925; Merchant, 1951). In particular, the writings and conduct of one Rev. William Gilpin provide a formulation and model for the role of observer of picturesque landscape (Gilpin, 1792).

First, what were the *role expectations*, that is, what conduct was deemed appropriate to the role? While touring the countryside, the observer was to scan the landscape for "that kind of beauty which would look well in a picture." He was to locate prospects and viewpoints from which landscape met the criteria of good composition employed in pictorial art. Indeed, the rise in popularity of landscape painting in the urban centers of northern Europe, especially the landscape paintings of Claude Lorrain and Salvator Rosa, may well have been the impetus which sent scenic observers off to the countryside (Clark, 1961; Gombrich, 1966; Manwaring, 1925; Ogden & Ogden, 1955). The observer was to sketch and also to acquire the terminology of landscape painting, in order to describe scenes to himself, and to others, for the scenic observer was expected to have his own tour book in progress or, at least, to maintain an extensive correspondence.

Special devices aided the observer in his search for the picturesque. Claude-glasses, consisting of small, rectangular sheets of colored glass, served both to frame a landscape scene and to endow it with the mellow hues of that master's landscape paintings (Hussey, 1927, p. 107; Manwaring, 1925, p. 182; Merchant, 1951, p. 17). Small mirrors were also used in role enactment. Rev. Gilpin often toured the District of the Lakes in a carriage, with his head turned away from the landscape but toward its reflection framed in his mirror, all the while marveling at the prices which paintings of nature's well composed scenes would fetch in the city (Manwaring, 1925, p. 186). Such was the peculiar conduct appropriate to this scenic role.

The proportion of tourists of the District of the Lakes who actually enacted the picturesque scenic role cannot be determined, but the means of *role acquisition* were readily available and widely sought in the form of tour books and guidebooks to the region. Many of these volumes, by William Hutchinson, Arthur Young, Thomas Pennant, Rev. Gilpin, Thomas Gray and Richard West, and even William Wordsworth's famous guide to the District of the Lakes, instructed the reader on the picturesque scenic role, acquainting him with the proper principles of pictorial composition and descriptive terminology. The most popular, Richard West's *Guide to the Lakes,* which went through ten editions between 1778 and 1812, gave the novice meticulous directions to 'Stations' throughout the region, from which authenticated picturesque scenes might be viewed. In addition to the means of acquiring a repertory of roles, the notion of role enactment implies the existence of an *audience.* Persons accompanying the observer of scenery and persons to whom he expects to narrate an account of his scenic tour constitute the obvious audiences. In addition, the observer himself may serve as an audience for his own role performance and the authors of the tour books he has read may function as an imagined audience.

Finally, note may be taken of the character, Edward, in Jane Austin's *Sense and Sensibility,* who satirically disclaims one facet of appropriate *role skill,* namely, the ability to label and describe properly what he has seen in a walk through the countryside:

"You must not inquire too far, Marianne—remember, I have no knowledge in the picturesque, and I shall offend you by my ignorance and want of taste, if we come to particulars. I shall call hills steep which ought to be bold; surfaces strange and uncouth, which ought to be irregular and rugged; and distant objects out of sight, which ought only to be indistinct through the soft medium of a hazy atmosphere." (Quoted in Merchant, 1951, p. 9).

The acquisition of a suitable environmental vocabulary is only one component of role skill; others may even implicate motoric behavior, as in knowing how to look at landscape and how to explore it.

A *taxonomy of scenic roles* would also have to include the role of *observer of romantic landscape,* which placed less emphasis upon composition and the pictorial aspects of landscape and more upon the impact of scenery on the emotions and imagination (Hussey, 1927; Nicolson, 1959). The romantic scenic observer was ever alert to the terrible joy and delightful horror, the sense of the sublime, the intimation of mystery and unattainability afforded by cascades, crags, pools, caves, and deep forests. Role enactment demanded somewhat more adventurous touring into wilder, less pastoral regions. Another scenic role is the *observer of ecological-wilderness landscape* (Lucas, 1966), whose role expectations contain ingredients of informed analysis, originating in the science of ecology (Evans, 1956), of spiritual appreciation of holistic patterning (Bews, 1935, 1937; Glacken, 1967), and of moral imperative and guardian vigilance (McHarg, 1963; Patterson, 1967). This is not to say the observer of picturesque scenery is an anachronism—note the ubiquitous camera. What is clearly needed is systematic study of the contemporary taxonomy of scenic roles.

The urbanite, in order to enact any of the roles of scenic observer, must travel to the countryside, which necessity permits illustration of another concept of role theory, namely, *role conflict.* Role conflict exists when the enactment of two roles poses contradictory requirements. Clark has suggested that fine landscape painting requires simple-heartedness, calm, and personal tranquility on the part of the artist (1961, p. 90) and, further, that a rise in popularity of landscape painting in a society is a symptom of quietism (1961, p. 30). In a similar vein, enactment of the role of scenic observer can be presumed to require a peaceful, relaxed, and contemplative demeanor. In contrast, the role of traveler entails active concern about personal safety and comfortable accommodations. If the conditions of travel are sufficiently dangerous and uncertain, the excitement, distress, and turbulence experienced by the tourist in enacting the role of traveler, or more technically stated, his *degree of organismic involvement* in the role, may preclude successful enactment of the role of scenic observer.

Again, historical sources may be cited. Hussey notes that Alpine scenery, so greatly appreciated in the eighteenth century and thereafter, was seldom remarked upon in the seventeenth century, when routes were truly dangerous. Only Italy beyond them made the Alps endurable (1927, p. 87). Turning to the craze for touring the District of the Lakes, Hussey counts the improvements of roads in Westmorland and Cumberland as an important cause of the sudden discovery of the district's delights. Indeed, he asserts that appreciation of 'scenery' in England increased in direct ratio to the number of Turnpike Acts.

"Where the roads were evil or non-existent, either travellers went not, or were too engrossed in their discomforts to give more than a disparaging glance at the prospect. Whatever the shortcomings of the turnpike system it did at least revolutionize poetry" (Hussey, 1927, p. 101).

Wordsworth's own guide to the region devoted considerable attention to the condition of local roads, the adequacy of lodgings, and in general to diminishing the saliency of the role of traveler and to co-ordinating it with the role of scenic observer.

In keeping with the dramaturgical imagery of role theory, the relationship of *environmental props* (Altman & Letts, 1967) to enactment of scenic roles may be considered. Just as the staging of *A Midsummer Night's Dream* and the staging of *Waiting for Godot* require different sets of props, enactments of scenic roles require specific environmental props. Thus, the three scenic roles already briefly described can be thought to place different demands upon landscape, in ways which have design and management implications. The demands placed upon landscape by the role of observer of picturesque scenery are limited largely to visual configurations. The observer of romantic landscape makes demands across more sensory modalities, including sight, sound and smell, and requires somewhat more dramatic physiognomic landscape forms. The requirements for enacting the role of wilderness landscape observer are especially stringent, involving demands for intact ecological niches and genuine isolation. Thus, landscape features can serve as environmental props essential to the full enactment of scenic roles. In addition, such environmental props function as cues which locate the person in a scenic role, rather than in one of the many other roles concurrently available to him. Other environmental props, such as billboards, may serve to locate the observer in competing, non-scenic roles, such as role of consumer, role of voter, or role of traveler. As increased understanding of the effects of environmental props upon *role location* is attained, the design and management of regional landscape may eventually include systematic consideration of the sequence and mix of environmental props which foster and sustain the enactment of specified roles or combinations of roles.

Role theoretical analysis is destined to make important contributions to study of the functional aspects of responsiveness to landscape. The preliminary application reviewed here has dealt with the role of tourist, which has special environmental relevance (Thiel, 1964). Everyone knows that as one moves from newcomer to resident of a place, focal alertness to the physical environment perceptively decreases. However, certain roles available to the resident, such as guide to visitors, can restore keen, direct responsiveness to landscape, if the role is not enacted too frequently. In contrast to the emphasis upon visual appreciation, sensory delight, and moral significance, which characterize scenic roles, other environmentally relevant roles are more active and operational in nature, such as the roles of active recreationist, farmer, or other resource managers. In his study of flood plain inhabitants, Kates (1962) found that urban resource managers displayed a somewhat different, and more adaptive, comprehension of flood conditions than did other residents. In the study of inferences about the forest landscape mentioned earlier, preliminary results suggest striking differences between persons in professional environmental roles, such as landscape architect and forest management expert, and those in non-professional roles, such as university students.

Fortunately, efforts to achieve an empirical analysis of contemporary environmental roles will have available the network of concepts which constitute role theory, including the notions of role expectation, role acquisition, role skill, role location, and role conflict. As the structure of the existing taxonomy of environmental roles becomes identified, research can proceed to relate dimensions of environmental role enactment to personal characteristics of individuals, their significant reference groups, their education and socio-economic status, and so forth.

In the case of residents who seldom enact environmentally relevant roles, research might focus upon *latent affectional responsiveness,* such as indicated by the impact of relocation (Fried, 1963) and by strong attachment to native landscape (Jonassen, 1961; Sonnenfeld, 1966, 1967). Opportunity to study affectional responsiveness to landscape occurs at times of migration, and during environmental change, as anyone who has heard the protests and pleas of local residents at public planning commission hearings can testify. Supplementing affectional responsiveness, *cognitive adaptation* also brings a vested interest in environmental stability. Research on the acquisition and quality of environmental images which provide spatial orientation (Appleyard, 1967; Friedman & Rochmes, 1968; Lynch, 1962) will increase our understanding of cognitive adaptation to the physical environment. Migration of East Coast residents to California offers another illustration of cognitive adaptation. For a year or so, the migrants lack suitable terminology for describing to themselves and others the day-to-day and seasonal variations in weather conditions. Until they acquire the appropriate labeling system, they often resort to analogy: a day in January in Berkeley is "just like an April day in Providence." Descriptive study of the course of acquisition of the meteorological terminology of ordinary language by migrants from various regions to a given location would be a worthwhile undertaking.

IV. SUMMARY AND CONCLUSIONS

Throughout all levels of environmental design, management, and policy formation there is embedded a structure of assumptions about the interplay between human behavior and the everyday physical environment (Gutman, 1965-66; Langdon, 1966; Lucas, 1966; Studer, 1966; Studer & Stea, 1966; White, 1966). These environmental-behavioral assumptions, usually functioning implicitly in the design and decision-making processes, are seldom grounded in systematic empirical knowledge. Yet, when, for example, a social commitment is made to give more earnest heed to the impact of regional landscape design and management upon the observing public, a practical and professional interest in human behavior as it relates to landscape becomes inevitable.

Behavioral research on human responsiveness to landscape is in an early stage of development. A paradigm treating major research issues from an environmental psychological perspective has been reviewed. Preliminary theoretical analysis of the functional aspects of human responsiveness to landscape has been offered.

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