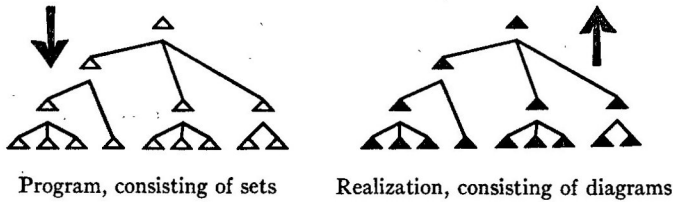


NOTES ON COMPUTER ARCHITECTURE

YI-FU TUAN



IN THE EPILOGUE, which is entirely italicized for emphasis, Christopher Alexander expresses the fear that what he tries to do will meet with resistance. And what is he trying to do? He is urging on designers the use of logical structures to represent design problems. This step brings with it an important consequence: the loss of innocence, of faith in design as a purely intuitive process. Modern functional problems are becoming more and more complex but the designer rarely admits his inability to solve them. Instead, as Alexander says, when a designer does not understand a problem clearly enough to find the order it really calls for he falls back on some arbitrarily chosen order. He learns to rely more and more on his position as an "artist," on intuition and the personal idiom, to relieve him of the burden of rational decision. The result is seldom happy.

The object of design is form. The problem of design is to fit the form with its context. Form is that part of the world over which we have control; context that part of the world which puts demands on this form. A good design is a good fit, one in which form and context are in frictionless coexistence. Such a design is further distinguished by the clarity of its articulation. In modern design, articulation is usually achieved only under the driving force of some simple concept. Le Corbusier, for instance, is able to achieve clarity of form in his Marseilles apartments by neglecting the demands of elementary comfort and convenience. In contrast, an average developer-built house is able to fit the context fairly well but only at the expense of macroscopic clarity.

According to Alexander, house forms which are clearly organized and also satisfactory in all the respects demanded by the context are almost unknown in our civilization. On the other hand, the combination of good fit and clarity is not hard to find among simple cultures. One may think the problem of the modern designer can perhaps be clarified by studying how the peoples of simple culture solve their problem of adapting form to context. But here is the rub. The Eskimos and the Africans of Cameroons have no problems of design to solve because their process of response to context is largely unselfconscious. The Eskimos do not have a special class of people called architects or designers whose job is to analyze the components of a problem in design, and then invent suitable forms. In unselfconscious cultures the goodness of fit between form and context is achieved over a long period of time. The adaptation is piecemeal and immediate, in direct response to a particular misfit. No individual is asked to assert his individuality by inventing form to meet with a total situation.

BUT IN WESTERN civilization, "to solve a problem" is a highly purposeful, selfconscious process. There does exist the individual called architect. He sits before his

drawing board, and in a few hours he has to design fitting forms which once took centuries of adaptation and development. The average designer is simply not up to the task. His chances of success are slight because the number of factors which must simultaneously fall into place is enormous.

In designing a kettle that would fit the context of its use, it is easy enough to list some twenty-odd specific requirements. When the design is of an urban dwelling the number of requirements that can adequately characterize the context is enormously greater. The designer cannot possibly keep them in mind at the same time and invent a form that will satisfy them all. An obvious device in simplifying the problem is to classify the requirements into categories such as economics, circulation, safety, acoustics. It then becomes possible to make diagrams, each of which expresses the demands of a particular category. But such categories will not help the designer in finding a well-adapted solution (form to fit the entire context) unless they happen to be independent of each other. And it is unlikely that these arbitrary ways of grouping are in fact independent. For instance, the diagram that satisfies the demands of economics is likely to conflict with that which satisfies the demands of safety. The designer finds that his separate schemes cannot be smoothly fused into a compound whole. In practice then the designer is likely to let the category which can be most clearly expressed carry the greatest weight. Whether the category is functionalism, economics or canons of beauty, it will be best reflected in the ultimate form. Others suffer and become the source of misfit.

Christopher Alexander suggests (in effect) that designers should do some hard thinking; that they should stop calling their unexamined preferences "intuition," with the veiled hint that the intuition is somehow inspired. The hard thinking consists in giving a logical structure to the multifarious requirements that constitute the context of design. The logical structure does not prescribe form; but it does express pattern, order and relations which can then be translated, through processes still largely intuitive, into an orderly complex of forms.

THE LOGICAL STRUCTURE is made up of mathematical entities called "sets." A set is a collection of elements. In design the elements are the individual requirements that must be met at the form-context boundary in order to prevent misfit. The elements may be as various as they need be; they may be quantifiable (e.g., noise level in decibels) or they may not (e.g., human warmth in a living room). This is unimportant to the mathematical program. What is important is that each element be clearly enough defined so that any design can be classified unambiguously as a fit or misfit. The elements may or may not be interconnected. The requirement for human warmth in the living room, for instance, is connected with the requirement for low noise level but not with proximity to market. Where two elements are related in some way they are said to be joined by a link. The problem of design can then be translated into a mathematical structure composed of two sets; one of elements and another of links. Any graph of this structure tends to pull the elements into natural clusters. Each cluster defines an independent component of the

total problem in design and can be solved independently. This mathematical decomposition of elements into components (subproblems) is unique. It is likely to be different from the one in the designer's head, which is based uncritically on verbal concepts like circulation, economics, acoustics. The solution to the problem consists in constructing a diagram for each of the components; a compound diagram can then be built from the simpler ones. Unlike diagrams based on arbitrary categories, diagrams based on mathematically derived clusters will not conflict, since each is (as far as possible) independent of the other.

Summarized in a paragraph, the method advocated by Alexander must raise many questions and perhaps objections in the mind of the reader. But it is impossible to do justice to his exposition in a short summary. Most of the difficulties that arose in my mind have been explicitly answered in one or other part of the short text; which, by the way, is lucid, concise and a pleasure to read. We are to bear in mind however that the use of a mathematical method does not by any means remove the element of choice and invention in design. Choice is necessary, for instance, in deciding on the list of requirements and on the interrelation between the elements. Invention is necessary in translating the diagrams into concrete form. What the mathematical method does is to minimize the *arbitrariness* of our decision in offering one design rather than another when confronted by a complex problem. It tends to do away with the "creation *ex nihilo*" pose of designers, a pose perhaps more easily maintained by the painter and sculptor than by the architect.

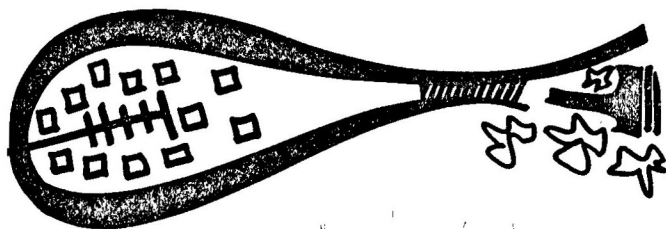
The second part of Alexander's book contains a worked example. The problem is to design a village for six hundred people which is to fit present and future conditions in rural India. It is in reading this second part that certain questions come to my mind that do not appear to be answered in Alexander's book. One is this: since the village is built to meet future as well as present needs, how can the present, precisely calculated layout meet with an appreciable increase in population? For instance, the design for housing calls for seven walled compounds, each of the shape shown in the second illustration hanging from a semicircle of communal buildings "like a cluster of grapes." Now the reason for the walled compound is that it satisfies a dozen requirements, including: (1) members of one caste like to be together and separate from others; (2) family solidarity and neighborliness and (3) security for women and children. Each compound will accommodate five to ten families. If the ten families in one compound were to continue to expand, the new families will have to move—perhaps to another compound which has not yet been filled. However, this move would inevitably produce "misfit," in that the next compound may be dominated by another caste. Family solidarity and neighborliness would also be adversely affected by the move. And what if all seven compounds are filled? There is no room within the semicircle of communal buildings for the construction of another compound; and of course to build one outside the grapelike cluster would simply destroy the meaning of the original plan.

ANOTHER QUESTION I have is this. Among the requirements (elements in the set) are those which we regard as traditional; for example, Harijans are ritually impure; castes are exclusive and like to live together. But other requirements are progressive as, for instance, the development of rural community spirit, radio communication and the destruction of isolationism. While Alexander's plan for the village does take both groups of requirements

into consideration, it does not provide for the likelihood that the progressive elements will in fact "progress." In other words, a bus station in the village and the establishment of radio communication may well destroy—in time—the notions of the impurity of the Harijans and of the exclusiveness of the castes. When such social changes occur, the walled-in compound of dwellings will seem anachronistic.

The academic reply to this objection is clear. Changes occur in response to misfits. We install light in a corner of the living room, for example, because, as a result of poor design, it is too dark even in daytime. Ideally, Alexander's plan has no misfits. The requirements of religion, social forces, agriculture, employment, material welfare, education and political development (in so far as they are included in Alexander's list of 141 items) are all taken care of in the structure of the design. We shall have in fact a village Utopia in which possible sources of irritation are excluded and no occasion for demanding change would arise. But I find myself not altogether convinced. There remains the suspicion that one cannot plan the ideal village as one can the ideal zoo. It is reasonable to admit the possibility of a perfect design for a zoo in which every known ecological requirement is taken into consideration, and all animals, boar to zebra, live in contentment. But the facts do not yet compel me to accept the idea of a design that will satisfy the needs—religious, material and social—of a modern human community, even one in rural India. Perhaps in some simple (unselfconscious) culture of the past a blissful equilibrium between men and environment was established. Romantic anthropologists are free to think so. The belief is certainly at odds with one root of selfconscious Western civilization: namely, Christianity, which insists that man is, and will remain, a misfit, a creature of profound discontent, in every conceivable social and natural setting on earth.

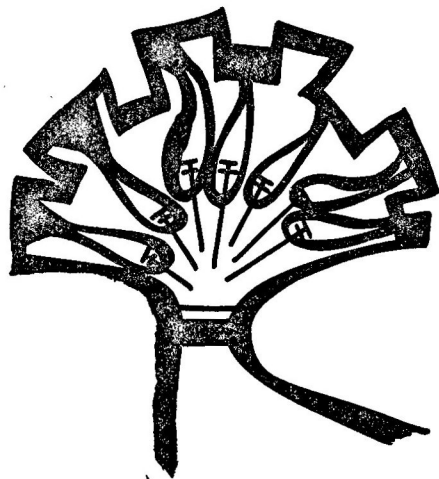
Another way of expressing the same difficulty is this. Early in his book Alexander says that every design problem begins with an effort to achieve fitness between two entities: the form and its context. "The form is part of the world over which we have control. . . . The context is that part of the world which puts demand on this form." The problem for the ambitious designer—and he is rightly called ambitious if he wants to design for an entire community—is that the context too is subject to our control. The context consists essentially of human attitudes toward community life, and these attitudes can be modified. Confronted by a flexible context, the designer is tempted to play the role of social philosopher. He does this when he assigns graduated value to human needs and attitudes. People like Le Corbusier and Frank Lloyd Wright, for instance, are not only architects but also, implicitly, social philosophers. If the Marseilles apartments are a little uncomfortable, well, (I can hear the Master say) the tenants will not die of it; in the meantime they will be taught to admire the



apartments' clarity of form. However, it doesn't seem to me that we can escape the charge of espousing a social philosophy by simply treating the context as given. For to accept the context as given is to accept the *status quo* of a social situation, and to design for that situation so that it may be preserved.

These remarks may appear to detract from my earlier appreciation of Alexander's method and thesis. I don't think so. One of my notions is that to design anything more complex than a kettle implies the espousal of an unexamined social philosophy in the designer. To justify a total plan for a community, we need to justify explicitly what we conceive of as the Good Life for that community. How many planners can do this? In the meantime cities are growing. Urban dwellings and community centers have to be built. Designers cannot just sit and debate philosophy. Here then lies the validity of Alexander's approach. The explicit mapping of the problem's structure, which Alexander advocates, is not just an isolated exercise in design; the structure, if successful, will *clarify* the life it accommodates. "A well-designed house not only fits its context well but also illuminates the problem of just what the context is." We are able to see the realities of modern life expressed, without undue arbitrariness, in concrete patterns. We may not like what we see. But first we must see.

Notes on the synthesis of form, Christopher Alexander. Harvard University Press, Cambridge, Massachusetts, 1964. \$6.75.



EVOLVING LANDSCAPES



USSR WITH A POPULATION of 8 million, Moscow now possesses approximately 200,000 acres of green space, including the forested Green Belt. This represents more than 30% of the total area. Each year more than 1600 acres is added. Immediately after the war, much of this land was used by citizens for small gardens, etc.; the present policy is to eliminate all small holdings and to impose an overall recreational use plan. The maintenance of local green areas is still left to the neighborhoods, the municipal authorities taking care of the parkways and central areas. The Moscow "Municipal Society for Greenery and Nature Protection," with a membership of 50,000, does much to encourage the proper use and maintenance of these areas, and, by means of its own flower market, helps finance many of the improvements.

DEUTSCHE GARTENARCHITEKTUR 1963/2.

ISRAEL THE INTERNATIONAL competition for a plan for the renovation of part of Tel Aviv-Jaffa attracted 152 entries. First prize was won by Branca and Angerer of Munich. All prize-winning entries emphasized the importance of relating the city as closely as possible to the sea—usually by means of an intervening lagoon, upon which faced the important public and cultural buildings. Since the competition was one of ideas rather than of concrete proposals it will serve primarily as an inspiration for other detailed plans.

ARCHITETTURA 100.

GERMANY A RECENT ARTICLE in a German motor magazine by a forester criticizing the "romanticism" of planting trees along highways has caused much discussion. The Bavarian highway authorities have ordered that hereafter, except in special cases, no trees or groups of trees are to be planted along highways in that state.

DER BAUMEISTER 1964/8.

EAST GERMANY THE CENTER OF BERLIN, almost completely destroyed in the war, is to be reconstructed over an area of more than two square miles. In line with the worldwide effort to revive downtown areas, the tentative plans call for five apartment houses of 24 stories each, grouped around a community service center, along the banks of the Spree River. Since the intention is to integrate this community into the business and cultural life of the nearby urban center, considerable thought is being given to the variety of social services needed in the complex and to the most appropriate apartment sizes. Hitherto, five-story apartment houses have been the norm in East Germany; the technological and social preliminaries for these unfamiliar building types will take some time.

DEUTSCHE ARCHITEKTUR 1964/6.

COLOMBIA THE COLOMBIAN INSTITUTE for Integral Planning has published a preliminary description of its program for the development of the eastern Antioquia. It calls not only for a detailed study of the area in question, but the formulation of standards for the "optimum-type man" which the area will be organized to produce.

ORBANISMO 1963/8.

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