Problem-Solving and Problem-Worrying

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[N.B. This is the unedited text as read on the above occasions.]

Hearing Imre Lakatos last night, I was prompted to recognize that my paper could easily be viewed with reference to his division of epistemology into the logic of justification and the logic of discovery. The "problem-worrying" of my title, which I shall try to support in the latter part of my paper, represents a dynamic involvement in the problem situation. I think my example from architecture will not be wholly foreign to Lakatos' demonstration of the logic of discovery in mathematics.

In the first part of my paper, I shall suggest that the notion of problem-solving, especially as architects have thus far encountered it, is bound up with a desire for justification. In the stronger instances, there has probably been a belief that problem-solving routines would lead to justifiable results; in the weaker instances there may have been the belief that one could justify one's activity merely through using powerful, if misappropriated, techniques.

It is imperative that we do not warp human well-being just for the sake of exploiting a technique — especially when the technique is a powerful one. As I shall soon explain in more detail, the ideas of problem-solving which have recently interested architects are involved with either problems of achieving definite goals or else with problems of synthesizing from a body of established facts. Because of these characteristics of either definite goal orientation or inductivism, these notions of problem-solving are neither descriptive of the traditional behavior of the best architects nor applicable to the current problem situation of architecture. In contrast to these attitudes of solving the problem, I wish to present another attitude toward problems — "problem-worrying." If I were to attempt to characterize the notion of "problem-worrying" explicitly and with words of a more positive connotation, I would suggest that architecture is

concerned with structuring man's environment so as to facilitate the achievement of human purposes, where the purposes are incompletely known at the outset and cannot be extrapolated from known purposes. Rather, the human purposes are altered by the very environment that was created to facilitate them. The structuring of the environment must be accomplished, then, through the exercise of tentative foresight and the critical examination of that foresight and the actions to which it has led. According to this description, neither the human purposes nor the architect's methods are definitely determined in advance. Consequently, if this interpretation of the architectural problem situation is correct, any problem-solving technique that relies on explicit problem definition or distinct goal-orientation will distort the human purposes involved.

Though I confess that I have no explicit model of "problem-worrying" to compare with certain problem-solving models, I have a rudimentary idea of it which I shall try to exhibit with the aid of an example. The example is that of a building which in its realization led to the reformulation of the problem which it set out to solve, the original problem having been how best to develop visual awareness in a population that had been described as visual illiterates.

Finally, it must be acknowledged that there are important problem-solving models which incorporate much of what I have called "problem-worrying," namely, when a problem-solving model incorporates a highly sensitive feedback mechanism and is operating in an appropriate domain. However much more closely this may align problem-solving routines and architectural design, it may still be argued that there is a significant incongruence between these activities. It is doubtful, then, that problem-solving models are preferable to problem-worrying in problem situations with extraordinarily complex feedback such as architecture, as I have described it, is.

So much for the summary. To begin all over again, then, I have assumed that architecture is concerned with the well-being of man. We are inquiring as to the appropriateness of problem-solving techniques for architecture.

We may now take a more detailed look at the relation between architecture and

problem-solving. Although perhaps not the approach to problem-solving that has most interested architects, the strongest claims for the close relation of creativity and problem-solving stem from those theories which are based on definite goal orientation. Men such as Allen Newell, J.C. Shaw, and Herbert A. Simon have concentrated on automizing the problem-solving situations of games, of symbolic logic, and of certain limited and very clearly stated "real-life problems." In these situations it is possible to describe the initial state and the state to be achieved in the same symbolic language. The problem is a matter of achieving the goal, the already described final state. Achieving such a goal is not automatic even in, say, many games with limited elements and precise rules. It is still necessary to develop a sense of good play. Invention, ingenuity and other similar traits enter into the development of such a sense of good play, and this leads Simon and his colleagues to consider creativity as a special class of problem-solving.

There is no reason to deny the use of the word "creative" for achievement of the sort just described, but one should resist seeing this kind of situation as adequate description of quite different problem situations and their appropriate creative responses.

When Simon and his colleagues extend their understanding of problem-solving and creativity into the design of physical objects (as they do by reference to work on automatized design of electric motors), it turns out that they are establishing a hierarchy of design operations. The "design engineer" whom they are automatizing is a rather clerical decision-maker working within a game with well structured elements and rules. The establishment of fundamental policy, the creative design of the whole family of motors takes place outside and prior to the automatization. They are seeking to automatize the play of chess, not the creation of the game itself. This is a limited and reasonable approach which no doubt has useful applications where certain decision-making routines must be repeated again and again; but we cannot generalize from this to problem situations where words such as "design" and "creativity" are used to refer to activities which do not have such

objective criteria of merit.

An engineer whose design activity is more comprehensive than the design activity of the engineer who was automatized in the motor factory, and architects too, would view the problem of designing the motor as including the need, the manufacturer's policy-making, detail design, testing, production, and the use of the motor. This partial rendition of the factors complicating a desire for comprehensive design, suggests why the results of the design process are so often found wanting. And this in turn leads to the imperatives for laying bare the bones of the design process.

In architecture, the demand for systematic design arises from a situation which is quite generally recognized. Increasingly, it seems, the works of even our most renowned architects are open to serious criticism; and regardless of the severity of the criticism, architects have proved themselves incapable of justifying what they do. Systems oriented architects appear to interpret this situation in the following way: If our building were to fit its problem perfectly, then there could be no criticism and we could justify both our method and our product. Such a perfect fit, they continue, can only be achieved if we have a well-structured, detailed description of the problem and then generate the solution from the problem statement. It is fortunate that we have several new sciences and new tools that can aid the systematic designer in this program of satisfactorily complete definition of the problem and synthesis of the solution.

As you will all know, there have been steps in the direction of realizing the systematic design program. However, it may be of interest to you to learn of certain recent developments in the United states which treat architecture as systematic problem-solving. There are now signs that the exploratory studies in the adaptation of electronic communication and data processing, of systems analysis, and other new techniques are about to receive generalized, semiofficial support from the architectural establishment.

To document this advent of semi-official support for a new problem-oriented, systematic approach to architectural design, I shall mention only one of several recent events. The American Institute of Architects and Princeton University recently entered into

an agreement to study the key problems of the architectural profession and of the professional education of the architect. The principal intention is that the study will result in educational reform. Included in the first document from Princeton was "A List of Key Problems in Architecture." The list began with a problem stated as question and answer, as follows: "1.) How can we improve competence in environmental programming? a.) develop more effective techniques of problem-stating and problem-solving." Top priority is given to the role of the program in architecture, to problem-stating, and this leads one on to the satisfaction of the program, problem-solving.

I do not want to go too far in pre-judging the A.I.A. Princeton project, which is only getting underway. However, I think their proposals do bring out the second justificational approach to problem-solving, and the approach that is more common among architects. Rather than seeking a clearly defined goal (the first justificational approach), this second justificational approach is inductive, seeking to define the problem carefully in order to have a fixed standard against which to judge any proposed problem solution. The static quality of this understanding of the design process is well brought out in the most recent document of the Princeton project. The first three stages of their breakdown of architectural design activity are as follows:

I) Identify: goals, needs, resources and priorities of client, user, community.

2) Formulate: alternative policies, strategies, procedures for form, content and process.

3) Predict: likely consequences of each alternative, using analytical tools.

So much could be interpreted variously, but where the complete lack of any sense of dynamics is revealed is in the fourth step:

4.) Select: the alternative with best match to no.1, that is, to the problem-statement.

Because one wants to justify one's actions on the basis of their conformity with the original program statement, there can be no consideration of the fact that any concerted set of design proposals and evaluations will alter the architect's understanding of the problem.

There can also be no exploration of the fact that any proposal will entail originally unintended consequences. To whatever degree these can be foreseen, the problem should be reconsidered in the light of these consequences.

Thus, this whole approach can be criticized in at least two serious ways: 1) the usual problem of inductivist theories that they can never be sure that they have adequate data from which to synthesize or even adequate data to check against, if one is seeking justification; and 2) that the process of creative design is artificially simplified in order that it may be viewed more systematically and in order that its results may be justified by their consistency with an initial statement. This, even though the original statement may be a curious artifact that bears only slight resemblance to the new problem situation.

Now, systematic problem-solving design is not the only possible alternative to the current easily criticizable situation of architectural design. If systematic design is not the only alternative and is itself open to serious criticism, then why should the adoption of these techniques seem to be so imperative?

Our society certainly encourages an enthusiasm for new techniques, but such a compulsion is especially deeply rooted — explicitly and implicitly — in the thinking of architects. This compulsion stems from the acceptance of the nineteenth century doctrine that architecture is the physical expression, and perhaps the fullest expression, of the spirit of the time. Once this notion is accepted for past times, and once it is realized that we live in a different time, the necessity arises for discovering the spirit of our time and discovering those forms that will express our spirit. Such a search for spirits and expressions can lead to various situations, but one compelling interpretation is that which claims that the architect must express the spirit of his times through the use of the newest materials and techniques. The poignancy of the topic we are discussing is this: the search for a spirit of the times is a kind of historical phrenology that distracts one from actual problem situations. Yet in our instance the spirit-expressing technique is one of problem-solving.

It appears, then, that in the 1960's there is a double imperative for the use of problem-solving techniques; first, because we have problems, and then because their use will contribute to the expression of our times. This combination of inductivist and historicist ideas, open to criticism in so many ways, also encourages the pursuit of problem-solving techniques as an end in itself. If the problem-solving routines should be inadequate to handle the complexity of the problem and therefore generate an environment that distorts man, one can interpret the distorted man as being expressive of his time. Even the inadequacy of the technique could be seen as a, perhaps unfortunate, fact of the time; this fact must be embraced and solace found in knowing that another appropriate step of destiny has been fulfilled.

That is, under the historicist prejudice of modern architectural thought, what results from the use of a new technique is less important than that the use of these means is demanded historically. In such an inflation of means, there is the danger that a humanly important activity, providing physical environment that will facilitate the achievement of human purposes, will be artificially and detrimentally simplified in order that it fit the available techniques.

My argument may now be reformulated to say: There is no imperative that we must use any given technique. There is an imperative that we attempt to better understand the activity of the architect, the problem situation within which he works, and the reasons for his often rather bad performance. At any rate, it is only through such an understanding of the architect's relation to his problems that we could come to know when and where to use which new techniques.

To achieve such an understanding of the architect's problem situation and of the response of the best architects to such problem situations will be anything but easy. Tonight I shall attempt nothing more than an example and what appear to be some of its implications. [Insert next] That which immediately concerns me is that an important human activity should not be artificially and detrimentally simplified in order to fit an extant mechanical routine. The danger of such an over-simplification stems

both from the enthusiasm for mechanization and from the impoverished understanding of architecture fostered by modern architectural theory.

The meaning which the architect attaches to design can be illustrated in the earlier example of the motor. Even in the instance of inductive problem-solving we have included the manufacturer's policy-making, the work of the problem solving engineer, the production of the motor, and the motor in use. But if we now pursue all the reciprocities of these factors, we then have an idea of the extraordinarily complex activity that the architect often calls design. He sees that any solution, any form, has implications beyond those that were intended, including implications for the reformulation of the original problem or need. Consequently, he is as interested in the form as in the problem; he sees this dynamic interrelation of form and problem as of the first importance. And it is this reciprocity of form and problem that is not sufficiently recognized by the problem-solving designer.

This idea might be made more clear by paraphrasing M.C. Beardsley's description of creativity: "... as the artist moves from stage to stage, it is not that he is looking to see whether he is saying what he already meant, but that he is looking to see whether he wants to mean what he is saying."[1] We can test the adequacy of architecture conceived as problem-solving and the universality of such conceptions as the frictionless fit of form and context by the examination of such a building as Le Corbusier's Carpenter Center for the Visual Arts at Harvard University. The Carpenter Center has been roundly criticized for being anything but effortless in its relations with people, with its neighboring neo-Georgian buildings, or with the Cambridge street pattern. One cannot deny that there is reason for people to discover that the Visual Arts Center is assertive and does not make frictionless contact with its context. However, it is important not to look for a well-oiled solution here, but rather to the way in which a problem has been developed and left open to continuing development.

Harvard University had discovered that, in their own words, "colleges graduate

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[1] JAAC, XXIII, 1965, p. 299.

visual illiterates."[2] It was therefore decided that Harvard should have a teaching program that called for active participation in the visual arts. Such a teaching program required a building; and since the involvement was with the visual arts, the site should be near the Fogg Museum.

The teaching at the Visual Arts Center has the opportunity to be the most important factor in Harvard's program of education in the arts. But as a complement to that didactic program, Le Corbusier and his building have brilliantly reformulated the original problem. Any teaching program would reach only a small part of the Harvard community, and very few people outside that community. If universities are concerned with general artistic illiteracy, then they must offer instruction to the whole community. The building itself must reach out and engage every person in such a way that even people who will never be formally enrolled at the Visual Arts Center will have the opportunity to achieve new realizations about the potential of architectural form as a shaper of life. I had the memorable and most happy experience of seeing such a realization take place. Without any prior instruction, we brought some of our M.I.T. freshmen to visit the Carpenter Center. A girl from a small town in Illinois, completely untutored in architecture, explored the Corbusier building. After she had moved through the building for some time, we asked what her reaction had been. She was at first a bit timid about answering, but then she told us that when she had come to the top of the ramp, she felt that she was all over the building at once. I think one could at least begin to analyze what objective qualities of the building contributed to her reaction. But for now, the important thing is that she had come to realize a potential in architecture which she had not even suspected. The fact that she had made her discovery by means of actual movement through the building is one of many indications that Corbusier reshaped the original problem in at least two ways. First, he had made the building itself an active participant in the problem situation rather than a retiring, effortless framework. Secondly, the visitor and Harvard are forced to recognize

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[2]A.D. Trottenberg, "College Graduate Visual Illiterates, Saturday Review (Feb. 19, 1966), 73 ff.

that the illiteracy about art is not a matter of vision only. In this building art is not a spectator sport; all of one's senses, the whole of one's perception and thought is engaged. In some ways, one is tempted to feel that the Carpenter Center for the Visual Art is a world, a context, a problem, and we have the happy opportunity to form ourselves against it. That is, Corbusier's building may be seen as a complete inversion of the idea of frictionless, efficient design. It also stands in sharp contrast to any simple notion of problem-solving. Harvard still has not defined the original problem, nor solved it; but they have entered into the problem situation more fruitfully than anyone with a hard definition.

A similar argument for growth through "problem-worrying" could be made for the way in which Le Corbusier, at the VAC, continued to transform one of his own architectural problems which had been set out in the Maison Domino in 1914.

Of course it could be argued that the buildings where we would value such assertion from architectural form are unusual. As a matter of degree, this might be so; here I have only wanted to demonstrate that we cannot accept problem-solving and effortless fit as universal concepts in architectural design. Elsewhere I have tried to suggest that a resistance of efficient design can also be important in something so prosaic as housing for married students.

In contrast to the problem-solving design approach, then, I would see the architect's approach as a sequence of activities encompassing at least the following stages: generalized understanding of the problem; various formal proposals; study of the implications of the proposals; successive reformulations of the problem and proposals; and the final selection of a form for its appropriateness to the reformulated problem. In this case, one must judge not only the fit, but also how the problem has changed. And one must judge the fit not in terms of frictionlessness, but in terms of whether the friction is suited to the new problem formulation. Does the whole — reformulated problem and form — resist criticism?

[INSERT HERE — The following material was not read in London]

But now it might be objected that I have described the architect as he already

exists. Furthermore, in claiming that we have no clear statements of architectural problems, no axiomatic system for design, no specification of elements, no specifiable identification of a solution, and that the problem shifts with the form adopted, am I not forced to the awkward position that everything is relative and the admission that the architect can justify nothing(or anything) that he does?

However, I think the understanding of the work of the architect toward which my paper points not only conflicts with the notion of architecture as problem-solving, but also structures traditional architectural activities somewhat differently.

We return to the generally recognized situation that I mentioned earlier in my paper. That is, much of recent architecture is open to serious criticism, and architects have no way of justifying their actions. The systems-oriented architects have adopted new techniques and sought to analyze the problem into a rationally unassailable assembly of bits which could then be synthesized into an unassailable solution. My contention is that in most cases man, his activities, and the environment itself change over time the time of the day as well as a more epochal sense of time. Consequently the analysis of any problem involving more than artificially limited aspects of man cannot be complete, nor can it be free of ambiguities and tensions. In analyzing the problem, we cannot know all of the bits, nor can we be sure of the unassailability of the bits or our analytical structure. Neither can we be sure of our heuristics of synthesis. If we take the problem-solving approach, we certainly cannot do this haphazardly, but if we go through that process conscientiously we will never succeed in even stating the problem, let alone solving it. But since the environment will still have to be manipulated, certain aspects of the problem-solving system will be irrationally slurred over in the interest of achieving some result. Not only does this reintroduce irrationality, but the method is then built on a very curious assembly of some carefully researched data, loose assumptions, personal hypotheses and particulars developed in relation to other hypotheses. [END OF INSERT]

Here I would like just to insert one observation which will require much more consideration than I have been able to give it. The reciprocal relation of problem and

form that I have been discussing is indeed quite different from the concepts of problem-solving that I have discussed. In defense of the problem-solving approach, however, one must acknowledge that the continuing development of feedback systems appears to be providing models that more closely simulate the activity of architectural design. I would only wish to express some reservation as to whether even a very refined feedback mechanism can compete with the human mind in such an improbable, controversial domain as that of environmental design for the facilitation of human purposes. I do not express this doubt on my authority, but on the authority of Norbert Wiener's fears of the modern sorcery of gadgeteering engineers.

In contrast to the description offered by the notion of problem-solving, can we imagine a more rational and more consistent way of structuring the activity of an architect?[3] One of the accusations is that the architect cannot justify his large-scale decisions; and therefore can justify anything. However, there is nothing peculiar about the architectIs inability to justify his actions. Even the most rational man, dealing with the most rational issue can finally be pushed back to nothing stronger than his personal faith or commitment in rationality. W.W. Bartley has proposed that we change our demand. Rather than asking the rational man to rationally justify everything he holds, which leads to infinite regress, we ask only that the rational man not justify what he does hold irrationally. Applying this argument to our situation, we drop any demand that the architect justify himself rationally, but we do demand that he be open to criticism and that he not blunt the criticism by irrational justification.The removal of the demand for justification admits the desirable pluralism of approach; rational criticism keeps that pluralism in bounds.

We can ask the architect to be as clear as possible about his assumptions and his methods, but there is no demand that he justify these a priori. We may also expect that the architect's work will be under self-criticism and open to the criticism of others. In this

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[3]The formulation of this section of my paper is clearly reliant on the studies of William W. Bartley, III, especially in his The Retreat to Commitment, New York, 1962.

way, we may begin to discover the connections between inadequate architectural form and certain formulations or assumptions made by the architect. At a certain point, we may be able to say, it is irrational to continue to make this assumption; or, in this problem-space it is unreasonable to adopt this formulation. In this way, we do not ask the impossible of an architect— a rational justification of a position which involves many qualitative as well as factual judgments. But we also do not clip his wings and tell him to make no such judgments. Rationality rests in the willingness to examine one's hypotheses and one's judgments and to abandon these when they prove to be false or detrimental.

But what would count as criticism? There would be the criticism of logic. Unless a logical contradiction is being used for "friction" in a beneficial way, we may expect that the system adopted (adopted without prior justification) will be consistent. If the system leads itself into irresolvable self-contradiction, this must be accepted as a criticism of the system.

There would be the criticism of empirical test. This would include such mundane but decisive failures as collapse of the building, spaces with uncontrollable temperature, glazed areas that are deemed a risk of life under adverse but recurrent weather conditions, orientation that creates external spaces that exaggerate adverse weather conditions, and the like.

Especially when one is dealing with proposals rather than with finished buildings, there would be the criticism of scientific theory. Once the work is built, any relevant scientific theory must either be corroborated or refuted by the building; but before it is built, we may wish to use scientific theory to criticize the proposal. If structural theory tells us the building will collapse, we will at least want to build and test a model. If sociological theory tells us the proposed environment will warp the psychic life of its inhabitants, we will at least want to examine the plausibility of the theory on which that judgment is based.

There would also be the criticism of competing architectural proposals. Multiple

proposals suggest both new opportunities and new criticisms. They also have the psychological advantage of breaking down personal identification with a particular proposal.

Finally, there is the check of the problem. I have been emphasizing the development of the problem, the transformation of the problem into something which subsumes the original problem statement; but the original problem has to have been dealt with in some way. I have suggested that Corbusier translated the problem of alerting a community to the significance of the visual arts into a more comprehensive problem concerning the relation of man to a formed environment. But to suggest a negative test case, if one desired an environment that would encourage the spontaneous confrontation of scholars from different disciplines, we may inquire whether this has been achieved. Whether the architect interpreted this problem to involve a greater physical proximity, a new communication system, a symbolically identifiable place, or whatever else, it should be possible to discover whether the approach adopted enhanced or decreased such contact among the relevant population.

I believe these suggestions incorporate types of criticism of a strength that should instruct us in ways to improve our architectural hypotheses and heuristics. Of course, an individual can always construct ad hoc arguments to ward off any and all criticism. He can simply refuse to be rational. But this becomes a matter of professional education and ethics. If we unburden the architect of the demand to justify his position a priori, we must ask him, help him, instruct him to be self-critical and to value and carefully weigh the criticism of others.

In conclusion, I have been arguing that we certainly cannot demand, probably cannot expect or desire a rigorous system for architectural design. This, however, does not deny the possibility or desirability of man-machine communications where the machine becomes a further tool of the designer.

We also cannot synthesize the human environment from hard and conveniently

deterministic atomic facts.

The strongest and most flexible rational system available is to give the creative person free reign subject only to responsible, reasonable and sensitive self-criticism and the public tests of performance and criticism.

The call is not for artificially precise problems, rigorous systems, friction-less solutions, or justification of one's actions.

Growth of architectural learning and practice calls for a relentless rational and sensible criticism that "worries" the problem, striving for a better problem — especially a better problem — and then also for a relation of problem and form that is resistant to criticism.

It is common to hear that architecture is at sea.

- We have no clear general theories or goals.
- We have no reliable particulars or facts.

The typical reactions to this have been:

- To agree, despair and lapse into complete relativism
- To accept the formulation of the crisis and therefore I) to formulate ideals, theories and goals which are put forward on a take it or leave it basis
  2) to collect and display reliable facts.

The claim of my paper is that:

- As bad as the situation of architecture may be, it is not as bad or as unusual as it may appear.
- All of science, mathematics, and art - human knowledge is a matter of growth, not solid foundations.
- We have the conditions for growth.
- We need the understanding to cultivate our growth.

How do we cultivate our growth?

- Not, I have argued, by a systematic methodology that returns to the old dogmatic false problem of foundations.

- Not by treating all new systems and techniques as mere tools since this does not face the issue of what problems, or the influence of the tool on the problem.
- Not by treating all new systems and techniques as absolute media both because the techniques are rich and flexible and problems are also generated outside the media.

We are in a pluralistic situation and this pluralism can be turned to account.

Along with our complex problems we have complex techniques and many people with naive conjectures. We should be more systematic in recognizing these factors in setting up the conjectures, in criticizing them, and thereby learning and growing. But such an approach is not systematic in the sense of imposing a manageable structure; rather it seeks to discover the structure through an interesting situation of multiple conjectures and criticism.

Since we don't know what the situation is till we get involved in the process, it's no use later asking if we are saying what we meant. We learn through the process and therefore want to ask "Do I mean what I am saying?"

I ask that question of myself and I'm sure I'll learn much from all of you this week. Thank you.

NOTES

Footnote 1(top page 12): JAAC, XXIII, 1965, p. 299.

Footnote 2 (bottom page 12): A.D. Trottenberg, "College Graduate Visual Illiterates, Saturday Review (Feb. 19, 1966), 73 ff.

Footnote 3 (page 16): The formulation of this section of my paper is clearly reliant on the studies of William W. Bartley, III, especially in his The Retreat to Commitment, New York, 1962.