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Ours is an age of reconstruction; to work in any field today is to rebuild. The age of anxiety is behind us, and we have learned its lessons well: the universe is meaningless only so long as you have nothing you mean to do in it. If, however, you intend to play a role in inventing the Twenty-first Century, then yours is the task of conceiving and testing the models upon which this future world will be constructed.

Such sweeping mandates are easily phrased; in actual practice, the job of attempting to design tomorrow's world becomes staggeringly complex. Part of the dilemma lies in the fact that the tools of human thinking are not yet really understood. The late physicist, P. W. Bridgman, always used to remind us that the hallmark of the educated man was his realization of the limitations of the human mind and therefore his consciousness of the necessity of formulating "laws of mental dynamics" analogous to the laws of thermodynamics in the physical universe.

One such law of mental dynamics might be stated thus: the mind can create order out of disorder only in terms of the freshness and novelty of its hypothetical models of reality. Or, the law might be otherwise phrased: man's power over his environment and thus over his future comes finally from his utmost abstractions. For it has become clear that man changes the future by inventing hypothetical models of possible worlds. The models he constructs serve as beacon lights by which he steers his way through the turbulent waters of social and technological change toward the horizon of the future he desires.

It is, of course, the mathematician who has made us most vividly aware of the way in which conceptual models steer the course of man's evolution. Mathematics, in Whitehead's classic definition, "is thought moving in the sphere of complete abstraction from any particular instance of what it is talking about." The very point of mathematics, Whitehead insisted, is always to get rid of the particular instance and attain the most complete abstraction possible. Thus, the man who in the dim morning of prehistory first arrived at the concept "seven" as opposed to concepts of seven sheep, seven apples, or seven days, marked a great breakthrough in the history of human thought. For he had broken his bondage to the immediate situation (of specific sheep, apples, and days) and was able now to achieve an interior distance from his surroundings and manipulate his environment with greater freedom. As man evolved, his mathematics became more and more abstract. He plunged deeper and deeper into the recesses of his mind, formulating abstractions that were even more remote from external "nature." Many of these formulations, such as the nineteenth century non-Euclidean geometries, even appeared to deny his sense impressions of "nature" altogether.

But the startling paradox has emerged that the more abstract and detached man's mathematical conceptions have become, the more relevant and useful they have been in building his basic science and technology. Strange as it sounds, our utmost abstractions have been our most valuable weapons in controlling and comprehending the world of concrete fact. The reason for this is that our abstractions embody the essence of literally hundreds of particular situations. And, clearly, any knowledge acquired about these abstractions is infinitely more powerful than knowledge acquired about any one particular situation--just as any fact applicable to all men is more powerful than a fact about John Jones.

How are these great abstractions arrived at? The scientist and mathematician answer with one word: intuition. Intuition in science means the ability to create a possible imaginary world, plus the ability to look then at the real world and see if there is any point of contact. The intuitive scientist makes a mathematical model. Then he examines it to see if it is beautiful, elegant, logically coherent, internally self-consistent. He is concerned at first only with building up this coherent, self-contained world; only after it is finished does he test it to see if it is relevant to the world in which people actually live. (The pure mathematician, of course, is never really concerned that his model be relevant. It is its own excuse for being. Of course, often a scientist comes along and finds an overwhelmingly relevant use for it, as Einstein did with Riemann's non-Euclidean geometry).

But the significant of all of this is that the creative scientist are making us aware that any man--not only a scientist--who wishes to transform his environment must operate as if he were, say, an intuitive physicist: that is, he must construct models of hypothetical world in the light of which he comprehends and controls his actual world. The man-on-the-street's models are not necessarily--or even probably--totally mathematical (as are the models of the astrophysicist), nor are they totally verbal (as are the models of society constructed by the realistic novelist). They may be a mixture of mathematics and words; or, more likely, they may live in his head as configurations of abstract patterns, geometrical figures, specific mental pictures of objects, of just vague suggestive shapes. The point is that these strange mental operations are now the controlling force among people who are concerned with shaping our evolution on this planet.

Just picture to yourself the vast spectrum of people who today are using models to transform the world we live in: the economist with his model of a society of abundance; the housewife with his model of a gracious evening of hospitality; the anthropologist with his model of the changing tribal patterns in an underdeveloped country; the civil rights worker with his model of the power structure in a rural community in the south; the city planner with his model of the racial situation in an urban ghetto; the P.T.A. president with his model of an experimental local grammar school. There are innumerable kinds of models in all shapes and sizes. But they all have two things in common: they all embody the abstract essence of the problem to which they apply; they are all constructed in a sequence of four basic steps:

1. First, a conceptual model of some kind of possible world is postulated.
2. Then, predictions are made, based on this model.
3. Next, these predictions are tested.
4. Finally, as a result of the tests, the model is either revised or discarded.

Let us imagine a specific example of model-building in a very practical situation. Suppose that you have been asked to lead an adult discussion group for ten weeks on the topic, "Renewing the Human City." You are going to be, in effect, a classroom teacher for this informal "course" of ten 2-hour sessions. Your first job is to construct for yourself a conceptual model of the course. Not just your model of the curriculum, but your image of the total learning situation: your decisions as to whether you meet in someone's living room or somewhere "on location" in the city itself, your judgement on how much lecturing you will do as opposed to how much group discussion you want, your choices of secondary teaching aids (tapes, films, prints, recordings, etc.). This model will not fall into your head out of the clear blue; it will be the result of days--maybe weeks--of brooding. But, after a period of deep concentration on what the course might be, your model may come to you in a flash--as many composers testify that the "shape" of a great theme in music comes to them.

Your next step is equally important. You make hypothetical predictions (to yourself) of how the material and learning situation are likely to work: will you be able to forestall more intellectual chit-chat? will your chosen emphases awaken concern regarding the city and the problems of its future? do you have material broad and diversified enough for ten meaningful sessions? if your course likely to lead to some kind of political or social action and are you ready to handle this eventuality?

Now you are ready to test your model at your first discussion group meeting. The first session is full of surprises. You discover that you have two architects in the group, and for their benefit, you will need to add much more weight to your curriculum in the area of urban aesthetics. You have three people who are already extremely well-read in the area of the evolution of the city in history; how should you make use of this unexpected resource? You feel that in the first session your lecture presentation was too visual; your need to involve more fully the total sensorium of your group. Finally, at the end of the session you had that indefinable feeling that something was very wrong. All the group members assured you that the evening had been "exciting" but you sensed that there was something deadly conventional behind their enthusiasm: the course had been merely what they had expected.

There had been no real discovery. You must re-coup your losses next time and really startle these people, or your course may turn into just one more exercise in dilettantism.

So, on the basis of this first "test" it is clear that your model needs major revision. The model looked good on paper, but in practice it lacked urgency, depth, and the power to really involve your group. How to revise it? Perhaps by conducting your discussion next time as if your group were a top-level board of city planners making decision involving millions of dollars. Or by using some other type of role-playing which would force them to create their own vision of what the city should be, compel them to make concrete decisions regarding its renewal. While you are revising your model, you read a tremendous new article on the city by the architect, Doxiadis - you must, you decide, include this somewhere in the next session. And so on and on. Always in your mind is your conviction that your main job as teacher is to challenge this group to mix themselves with the whole adventure of building the city of the space age. And you discover, as a teacher, that the old concept of "lesson plans" simply won't work for the electronic age. The members of your discussion group are not like the little picgures in a Dickensian classroom waiting eagerly to be filled with facts, facts, facts. They are whole people hungry for involvement in a chainging world, hungry for roles through which they can invest their energy in redesigning the earth. And your course can help them, only if it is shaped in the light of a model of the utmost novelty.

This, of course, is a very simple example. But is it not different in kind from the process of model-building needed to envision the future for a poverty-stricken area, for the role of woman, for the mission of the family, for a course of civic action, for a strategy for electing someone to a post in local government, for constructing the future of one's personal destiny. In all of these examples, the power over the immediate situation comes from an abstract model that grasps its essence, and enables the situation to be invisioned, revisioned, tested, redefined, and ultimately, changed.

One word of warning must accompany any look at the role of model-building in todays world. It is becoming clear that no conceptual model, however inventive and internally consistent, can guarantee relevance to the actual course of historical change. Just as no model in the sciences can guarantee its relevance to the flux of the natural world. There is nothing permanent or eternal about models. They must always be in the process of revision and must often (however reluctantly) be discarded. They give us no absolute certainty or security. But, even so, we must continue to use models because they offer the best means we have of freeing ourselves from the status quo and of envisioning the possibility of new world. It is now an inescapable fact that to live in this ever-chainging society today, man must have the courage of his constructs, the course of his never-static models-in process. And he must also have the courage to let his most cherished models go when they have outlived their relevance and be willing to face the painful process of changing his models and beginning anew. For man knows now--unquestinnably--that in changing his models, he changes his reality.