

Reviews

Autopoiesis, Dissipative Structures, and Spontaneous Social Orders, AAAS Selected Symposium 55, edited by M. Zeleny, Boulder, Colorado, Westview Press, 1980, 149 pp. *

The Evolutionary Vision Towards a Unifying Paradigm of Physical, Biological, and Socio-cultural Evolution, AAAS Selected Symposium 61, edited by E. Jantsch, Boulder, Colorado, Westview Press, 1980, 200 pp.

A Systems View of Man, Ludwig von Bertalanffy, edited by Paul A. La Violette, Boulder, Colorado, Westview Press, 1981, 180 pp.

The first two books reviewed here are only a sample of the several edited volumes which report the results of symposia held at the AAAS National Annual Meeting in Houston, Texas, in January 1979. In many ways they are complementary because they deal with related topics which, of late, have become central to General Systems Theory. We quote from the Preface of the Zeleny volume:

Some of the most powerful and new paradigms for studying self-organizing and spontaneously generated phenomena in physical, biological, and social systems are identified and unified in these original articles. Autopoiesis, order by fluctuation, dissipative structures, nonequilibrium thermodynamics, hypercycles of catalytic synthesis, and spontaneous social orders are discussed.

One of the noteworthy features of these volumes is the short delay between the time these contributions were presented at the AAAS Meetings and their time of publication. As the publishers of the series explain, the series format "is designed to provide for rapid dissemination of information". They should be commended for their effort.

The foreword to the Zeleny volume was written by none other than K.E. Boulding, whose rich and witty prose provides a fitting introduction. He reinterprets

* See M. Kochen's review of this book within a different context in HSM (2 (3), pp. 231–232).

Adam Smith's 'invisible hand' in terms of the newly rediscovered concept of autopoiesis which describes certain systems whose functions are designed for self-renewal. These systems are characterized by relations, among their components and component-producing processes, which "through their interaction, recursively generate, maintain, and recover the same complex of processes which produced them." In short, the idea of autopoiesis is self-creation or self-production. Boulding postulates that the 'invisible hand' is endowed with autopoiesis. That is, it creates a "social order, in the form of an equilibrium price and output structure and a certain capacity for optimizing the satisfaction of wants, without any overall plan". Boulding conceives autopoiesis to be a special case of a much general principle — that of 'the creation of evolutionary potential'. It is interesting to note that we have not been able to detect the exact moment of creation of this evolutionary potentials — a consequence, we talk in Systems Theory about 'emerging' phenomena or events which can only be recognized by hindsight "after a good part of the potential has been realized". The probability of systems to move into extreme and unfamiliar positions seems also to be related to autopoiesis. As we all know, the role played by the actual occurrence of improbable events is of the utmost importance in systems management.

The first volume is a 'transdisciplinary' presentation of new approaches, new 'paradigms' which, with autopoiesis, are revolutionizing the study of self-organizing and spontaneously generated phenomena in physical, biological, and social systems. The authors of the first volume, M. Zeleny, P.M. Allen, W. Duechting, A. Gierer, E. Jantsch, H.R. Maturana, and M. Sanglier deal with:

—*order by fluctuation*, which underlies the appearance and evolution of *dissipative structures* under the conditions far from equilibrium (also described through so-called nonequilibrium thermodynamics),

—*autopoiesis*, mentioned earlier, expresses the primary of unity-maintaining self-renewal of living systems,

—theories of self-organizing and self-reproducing *hypercycles* of catalytic synthesis of complex nucleic

acids and proteins, —*spontaneous social orders* and the evolution of systems of the underlying rules of human conduct.

In the second volume reviewed here, E. Jantsch, H. Haken, P.M. Allen, I. Prigogine, H.H. Pattee, L. Löfgren, R.L. Abraham, K.E. Boulding, and H. Guenther use the same concepts found in the first volume to focus on *evolution* as an aspect of dissipative self-organization which underlies the generation of complexity and variety at many levels. They refer to “the emergence of a comprehensive self-organization paradigm” and postulate “the general laws governing evolutionary dynamics across all levels of evolution, including the evolution of humans and human systems. The resulting transdisciplinary view of reality emphasizes creativity over adaptation and survival, openness over determinism, and self-transcendence over security”.

The title of the second volume *The Evolutionary Vision* stems from a phrase coined by Boulding to describe a unified view of evolution that encompasses all levels of reality, from the cosmic or physical through the biological, ecological, and sociological to the socio-cultural. (From the Introduction.)

It is fitting that this volume was edited by the late Erich Jantsch. He, more than anyone else, has shown us the scientific and human implications of the emerging paradigm of evolution. (For E. Jantsch's obituary see HSM 2 (2) (1981) 118–120.)

The third volume reviewed here, serves as an admirable counterpart to the other two. It shows how von Bertalanffy deserves the name of a precursor to General Systems Theory and to all the present day approaches and paradigms discussed above.

As Zeleny pointedly states, these paradigms “are not so much new as they are newly being accorded an expanded attention and less hesitant consideration”. And indeed, this today's movement would not have been possible without the ground work of von Bertalanffy. La Violette, the editor of *A Systems View of Man*, clearly brings out von Bertalanffy's vision which has had such important implications for inter-disciplinary systems thinking. In this volume, von Bertalanffy's views on the historical development of symbolic language and how the breakdown of symbolic universes contributes to the feeling of meaninglessness so prevalent in modern society are presented. Also noted are his views on mankind's aggressive acts which he thought are not biologically based but arise within symbolic frameworks.

La Violette chose other important pieces for

this anthology. We can read how von Bertalanffy applied his general system perspective to attack the classical mind-body problem. He suggested “that we relate the fields of psychology (mind) and neurophysiology (body) by postulating an isomorphism between their constructs, and that we seek to unify these fields in theoretical principles that are generalized with respect to both”. (From the Introduction.) Indeed modern psychiatry owes a great debt to this approach. Other subjects treated in this rather short volume are new directions that should be taken to develop theoretical models in psychology and to avoid educational practices that threaten to stifle creativity. In a word,

if a holistic perspective of man, such as that which von Bertalanffy presented in the essays that compose this volume, were to be more fully adopted by our civilization, perhaps then the peaceful, humanistic world that we have long wished for could be realized sooner than we think. (From the Introduction.)

This anthology is a welcome addition to the works of von Bertalanffy and to the books published in his honor. (For a bibliography, see General Systems XVII (1972).)

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Seymour PAPERT

Mindstorms: Children, Computers and Powerful Ideas
Basic Books, New York, 1980, 230 pages

Far too many of us have at various times in our lives encountered alienating relationship with knowledge. The cultural climate that fostered such alienation in the learning process has all too often also denied us opportunities for building valuable relationships with fellow learners and teachers. We can hardly expect more human management of human systems under such conditions. Nor do the trends toward the use of computers in educating the next generation or in our own continuing education offer grounds for optimism. We are in danger of accepting as inevitable that information technologies constrain rather than free us, that our options are smaller rather than larger in number, and that computer-based systems control and program us, rather than vice versa.

Seymour Papert demonstrates persuasively that this need not be so. He presents a computer culture that is not yet widely adopted, and argues that it can

humanize learning. This computer culture helps us to learn. More importantly, it helps us to *learn about learning*. It furthers a more intimate relationship with knowledge by providing carriers of knowledge that connect with the learner's experience. It furthers deeper and better interpersonal relations as well as personal growth by offering opportunities for real intellectual collaboration.

The kind of computer subculture Papert refers to challenges the use of computers as means of helping teachers with such widely used methods as drill and practice. It challenges the acceptance of systems based on unquestioned assumptions or on design features that have no sound basis, e.g., the arrangement of keys on a typewriter, the use of BASIC as a language for learning to program. It substitutes LOGO, a computer language devised by the author at MIT. I have seen third-graders in the New York City schools use this language to instruct a computer to design pictures, for example.

A typical picture may be a stick-figure of a man, in which the trunk is a 2-cm long vertical line. This is accomplished by instructing a remotely controlled, moveable toy that can draw a line along the trace of its path — called a 'turtle' — to go FORWARD 20. The figure's left arm may be a line sloping down at 45 degrees to the left of its trunk. It could be produced in response, first to the command RIGHT 135, FORWARD 15. The program for an entire stick-figure constructed by writing one instruction after the other may reach 25 instructions and is likely not to result in what was wanted. Moreover it is hard to 'debug', to find and correct errors. This motivates rethinking in terms of a structured program: regarding the stick-figure as composed of a diamond-shaped head, a short line for the neck, an upside-down 'V' for the two arms, one for the two legs and the trunk connecting the 2 'V's'. Each part is programmed separately and the resulting programs are named and put together. This makes writing and debugging much easier. Moreover, it is natural to invent the idea of a variable, or name for, say, the length of the side of the diamond describing the head, which becomes part of the name for the head. In this concrete context, a learner is far better motivated to use variables and algebra than in a classroom situation requiring the determination of x such that $3 + x = 7$, which is divorced from all experience and reality. Equally important, the learner is not afraid to make mistakes. Indeed he comes to recognize the importance of producing an imperfect but correctable

product in order to learn at all.

Papert believes that such vehicles as the robot-turtles controlled by a LOGO-supplied computer can carry powerful mathematical ideas in mind-sized bites into almost any learner's head in much the way his own childhood fascination with gears did that for him. The computer is so much more versatile than gears that it can cater to thousands of individual tastes and inclinations.

A powerful idea is one which enables the learner to do or understand something he could not do without it: variables, structured programs, the theorem stating that, when a turtle gets back to where it started after going along the boundary of any area, the sum of all its turns is 360 degrees, are examples. What is important about an important theorem is that it is to be used, not memorized — that it is one of a few tools to think with over a lifetime, to be enjoyed and respected as a powerful idea.

It is all too frequent an occurrence that persons become obsessed with a rigid self-image such as "Mathematics never came easily to me, and that is why careers in science, engineering, business, etc., are not realistic for me". Such an image is often due to an exposure not only to 'mathematics' (or rather pseudo-mathematics), but to learning generally, that is sterile and divorced from reality or personal experience. This leads to an enormous waste of human potential. Papert makes a strong argument for a reversal of priorities in education from the present case that computers are used to 'program' children to children programming computers, thereby coming in contact with some of the powerful ideas from and about science, mathematics, even bodily skills such as juggling, interpersonal relations, and, perhaps most importantly, thinking itself.

This book is highly recommended to all readers of *HSM* for the hours of reading pleasure, insight and acquaintance with powerful ideas that it will bring. It needs hardly be mentioned that new vehicles that carry powerful ideas into the mind are of as much value for management as they are for education. Every thoughtful manager or management scientist will want to take a position on the issue of whether the present computer subculture or the one envisaged by Papert does more to further the cause of *human* systems management.

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Manfred KOCHEN and Karl W. DEUTSCH
Decentralization: Sketches Toward A Rational Theory
 Oelgeschlager, Gunn & Hain, Publishers, Cambridge, MA, 1980, 356 pages

Discussions about decentralization are often confused, vague, and ideologically motivated. It is the particular virtue of this book that its fundamental concept, touching upon many issues, is still fleshed out in sufficient detail so that particular features can be studied in greater depth. The main emphasis is on service organizations. The types of systems where the models are likely to apply are exemplified by computer facilities, postal services, medical services, libraries and municipal services. In all these cases a more or less clear range of services are offered to clients. How centralized should such services be? Is there an optimum? How can we find it? What are the likely effects in the future if loads and range expands? How will likely trends of costs and technology affect the future in terms of centralization? The authors aim to answer questions of this kind.

It should be noted that they are not studying decentralization of political systems or the degree of concentration of governmental power and authority. Their approach and results may be relevant to this important area in political science, but would require more elaboration.

The authors take a multifaceted approach and focus on eight aspects of decentralization, typically trying to quantify them, namely,

- (1) *pluralization*, number of stations or agents,
- (2) *dispersion*, spread over space,
- (3) *specialization*, number of functional specialties,
- (4) *feedback*, between server and client,
- (5) *flatness*, the reciprocal of the number of hierarchical levels,
- (6) *delegation*,
- (7) *participation in decision making*, fraction of people participating,
- (8) *participation in organizational design*, fraction of people participating.

Their aim, wherever possible is to construct quantitative models and to find conditions in each service system which will benefit society as a whole. Obviously, the concept of social benefit will raise many issues which are difficult to explore.

Three approaches are considered:

- (1) *Cost-benefit*, or cost-effectiveness, which

attempts to balance the cost and benefits of a degree of centralization, and to find an optimum;

- (2) *Descriptive and historical*, attempting to describe and perhaps explain changing patterns in decentralization due to political and other factors;

- (3) *Ideological*, to view decentralization as a central value, and to study what factors enhance it.

The authors opt for the normative cost-benefit approach. It is not possible to discuss the details of the wealth of models constructed and the insights they provide. The results of such analyses are "if-then" statements. Given certain values, usually expressed on a common scale of cost, what degree of centralization is optimum? Costs and benefits in social service systems may spread their effects differentially. To ask for an optimum is to seek a best balance or trade-off of different values and sometimes different groups. How should these trade-offs be decided?

In any case, the answer cannot be value neutral. As one example, consider the model for the optimal degree of pluralization. Among the costs considered are fixed maintenance cost, variable operating cost and the cost of a client's time. These costs are then combined and an optimal degree of pluralization, n , is found. The value of n depends on the assumed costs. In particular, it is affected by the costs of a client's time, which is often measured in terms of income. Consequently, as the authors point out, the result tends to pluralize, (decentralize in this respect) for the affluent, and centralize for the poor. Does this mean we ought to? Of course not, but the language of optimization seems, to the unaware, to have that imperative. Thus cost-benefit analysis can mask the trade-off of values. A useful presentation, sometimes employed by the authors, is to show graphically the dependence of the result on the assumed costs.

Two basically different activities are involved. First, calculating trade-offs, and secondly, judging the acceptability of a trade-off. One is objective, more or less, while the second is value laden and sometimes political.

For the authors, decentralization does not have a value in itself. Their stated key values are responsiveness, reliability, adequacy and quality of services. In their view, the efficiency of a service system should be measured in terms of these values per cost. Consequently, one can understand their distaste for what they call the 'extreme' decentralization of the kind preached by decentralists. This extreme, they claim, is impossible to achieve because the social

costs are 'prohibitive' and 'not worth' the benefits. However, decentralists generally do not seek decentralization for its own sake but rather because it tends to be in tune with their basic values of participation and human scale. They wonder whether responsiveness and quality of services, values they also desire, can be achieved without adequate participation and feedback. If indeed participation requires some sacrifice of service, who is to say that such a trade-off is irrational?

The political demand for decentralization is sometimes used to get service quality improved, or more importantly, to obtain services which otherwise might not be forthcoming. How much participation is desirable? Too little has social costs and too much may permit many poor decisions. These are difficult questions and relate to the proper use of competence and expertise. Of course, experts sometimes have their own agenda and training and can misconceive the real needs of clients – a factor which must have contributed to the increasing mistrust of experts.

An important use of the numerous models in this book is to raise the level of discussion and to study what the trade-offs actually are; how sensitive policies are to changes in service load and costs, and what future trends might be.

The authors have an interesting chapter on power and its relationship to decentralization. Traditionally, centralization is often seen simply as a means for holding or increasing power. They point out, however, that decentralization in itself will not always help the strong or the weak. Decentralization, without participation in organization design, can in fact be used to enhance control of the range and kinds of services offered. Providing efficient limited services, even with some participation in decision making, can dilute the demand for other, perhaps more costly services. The concept of political power, as used by the authors, is a variation on a common definition which sees it as the probability of prevailing in a conflict situation. Another point of view could expand on this idea and include cases of potential conflict where latent challenges are deflected. For example, the goals of power can often be realized by controlling or arranging the agenda so that potential conflict issues do not even arise. Another, more general definition would be to identify power in terms of whose interests prevail. A problematic extension would allow that the expressed wants of people may themselves be the product of a social condition which works against their real interest. This notion is

problematic since the idea of a real, but unexpressed interest, is controversial. As an approximation, a real interest might be what would be wanted if one could experience the results of a choice.

In the case of decentralization, potential services which might be desired are not offered, or services in the interests of clients are not even requested. Historically, groups have sometimes accepted arrangements as legitimate which were against their real interest. In fact, legitimation is often the most effective trouble-free method for maintaining power. A counterpart in individual psychology would exist if one person internalizes attitudes which further someone else's real interests even if they do not reflect his own. This notion of power would focus on whose real interests are served in any decentralization policy. It should be understood that this conception of power need not imply conscious will or deliberateness. If one's interest prevails over the interest of another, it makes a moral difference whether the state of affairs is deliberately arranged, but it does not make a practical difference in terms of benefits derived.

Technology clearly plays an important role in decentralization policies. The authors properly place importance on communication and feedback. Such considerations go back at least as far as Plato. In discussing the optimum size of a community he proposes 5040 citizens, (free adult males, excluding women, minors, foreigners and slaves), arguing that this is about the number that can conveniently be addressed by a single orator. Aristotle proposed a number between 10 000 and 20 000. The arguments about the optimal size of communities run through history from Plato, Aristotle, Rousseau, Montesquieu, and so on. The discussions of Hamilton and Madison in the Federalist Papers are also of great interest.

In Federalist Paper No. 10, Madison sets forth an ingenious argument for a large size by claiming that it would promote a variety of parties and interests thus safeguarding citizens' rights against the majority. This is sometimes formulated as the Plumber's Law. If there is approximately one plumber to every 1000 persons, then a community of 1000 is likely to have only one plumber. A town of 100 000 will have about 100 plumbers or so and very likely an organization of plumbers. The larger the size of a political system the greater the number of organized interests or interest groups.

The authors generally take technology *as given* or autonomous. While this may be useful for planning

or predictive purposes its validity is an open question. One should also study how technological choices affect decentralization and values. Should one necessarily take technology as autonomous, determining the level of centralization it entails? Alternatively, we could have a vision of man and society and promote technological and decentralization choices to further our values. This is not possible without studying the interaction of technology and decentralization policies. The authors provide numerous insights into this relationship.

Ultimately, as in so many other instances, many of

the questions raised involve goals and values. This book is indispensable for anyone wishing to study decentralization. It provides a framework in which to study the effects of different types and levels of decentralization on important values. This should increase our ability to plan, and to further our aims in a rational way, and to avoid discussion via slogans.

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