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Martin Zwick
Portland State University, zwick@pdx.edu

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Towards an Ontology of Problems

MARTIN ZWICK

Systems Science Ph.D. Program, Portland State University, U.S.A.

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Systems theory offers a language in which one might formulate a metaphysics – or more specifically an ontology – of problems. This proposal is based upon a conception of systems theory shared by von Bertalanffy, Wiener, Boulding, Rapoport, Ashby, Klir, and others, and expressed succinctly by Bunge, who considered game theory, information theory, feedback control theory, and the like to be attempts to construct an "exact and scientific metaphysics."

Our prevailing conceptions of "problems" are concretized yet also fragmented and in fact dissolved by the standard reductionist model of science, which cannot provide a general framework for analysis. The idea of a "systems theory," however, suggests the possibility of an abstract and coherent account of the origin and essence of problems. Such an account would constitute a secular theodicy.

This claim is illustrated by examples from game theory, information processing, nonlinear dynamics, optimization, and other areas. It is not that systems theory requires as a matter of deductive necessity that problems exist, but it does reveal the universal and lawful character of many problems which do arise.

1. Overview

The proposition advanced here is that systems theory offers the possibility of constructing an ontology of problems. Section 2 begins by defining what systems theory is. Section 3 discusses difficulties inherent in trying to formulate a general conception of problems. Section 4 then shows how systems theory might contribute to such a conception. Section 5 concludes by noting some virtues and deficiencies of this approach.

This is only a sketch of a argument which needs to be made in more detail; a comprehensive treatment is currently in progress.

2. Systems Theory

In the view of Mario Bunge (1973), systems theory reflects an attempt to construct an "exact and scientific metaphysics." "Metaphysics" here means a system of abstract propositions of general interest and applicability; an "exact" metaphysics is one which is expressed mathematically or is at least a candidate for mathematical formalization; a "scientific" metaphysics is one which bears upon - draws from and/or contributes to - one or more scientific disciplines. Bunge's conception is close to views of von Bertalanffy (1968), Wiener (1950), Boulding (1956), Rapoport (1986), Ashby (1956), Klir (1991) and many others.

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Bunge applied this characterization specifically to game theory, automata theory, and other long-established systems and cybernetic theories, but it applies equally well to the more recent theories of nonlinear dynamics (Gleick 1987), nonequilibrium thermodynamics (Nicolis and Prigogine 1989) and "complex adaptive systems" (Santa Fe Institute 1987-1991). Strictly speaking, there exists no singular systems theory as such, i.e., in the sense that information theory and game theory are formalized theories. "Systems theory" is actually a label for the ensemble of theories, ideas, models, etc., which exemplify the research program described by Bunge. This program crystallized and had its "classical period" after World War II; it is now undergoing a "Renaissance" (with Santa Fe as Florence) in the "new sciences" of chaos and complexity. Although as a coherent intellectual structure, systems theory is an aspiration and not a reality, many components for an exact and scientific metaphysics now exist, and new components are continually being developed.

The systems program proposes, in effect, that existing scientific knowledge be organized around such archetypal themes as order, distinction, part and whole, system and environment, structure and function, continuity and discontinuity, constancy and change, and other basic issues. To state the matter simply, borrowing an expression from contemporary physics: systems theory is the attempt to construct a "general theory of everything," but in a manner completely different from the way this goal is understood in particle physics. Rather than seeking a unity of the sciences through reduction, and the floor of reduction in elemental units of materiality, systems theory seeks a unity of the sciences through similarities of form and pattern, independent of the specific nature and composition of the entities involved.

For example, information theory is about organization or communication in general, without regard to what is organized or to the entity which sends or receives messages. Game theory is about cooperation and competition in general, whether cooperating or competing units are organisms, persons, organizations, or social systems. Chaos theory is about order and disorder in deterministic dynamics in general, and is not restricted to any particular type of nonlinear system. Evolutionary theory can be used to model adaptation in general, without regard to the entities which are adapting or the environment in which they are situated.

Systems theories are typically but not invariably mathematical, but they are not simply part of mathematics. There is, for example, an extensive systems literature in the social sciences which is strictly verbal, with no mathematics at all (e.g., Luhmann 1982). Even where systems theory is mathematical, its applications emphasis and orientation towards phenomena is central. This makes it less abstract than mathematics, though more abstract than the scientific theories to which it is linked (Boulding 1956). It is concerned not with forms which might logically exist (the domain of mathematics), but with forms which do actually exist, and especially those which are ubiquitous.

3. Problems

From a certain perspective, a problem is a gap between what is actual and what is ideal, but such a definition focuses exclusively on human perception and valuation and does not touch the question of ontology. It does not explain what problems *are* in the sense of what objective conditions in the world correspond to these gaps, and how these conditions arise. It especially does not suggest the possibility that an integrated conception of problems might be both desirable and attainable.

It is hard, however, to imagine such a conception within the framework of modern science. The standard notion of explanation within science is reductionist, and within a reductionist metaphysics a coherent view of problems is impossible. Problems are divided into unconnected (or only locally overlapping) domains: organic disease and death are assigned to biology and medicine; mental distress and dysfunction to psychology and psychiatry; economic and political injustice to the various social sciences; environmental dangers to chemistry and ecology, etc. Since, in the standard view, phenomena at each level can in principle be reduced to those of a lower level, problems are only epi-phenomena, whose ontological solidity is dissolved in reduction.

The successive reduction of scientific description from level to level cannot reassemble phenomena at different levels into an integrated conception. It fragments and, at the level of elementary particles, dismisses the subject. Natural systems are (nearly) "vertically decomposable" (Simon 1981) and, though the jaguar may ultimately be constituted by the quark, reality at the level of the quark is fundamentally irrelevant to human concern. There is, admittedly, a pristine elegance to this reductionist view, and perhaps also solace for those who can internalize this cosmic vision, but the conception of the world it offers is impoverished. It does not save the phenomena in which we are most interested, and as an account of the origin and nature of problems it begs the question.

If an ontology of problems is to preserve and not dissolve these phenomena, perhaps it should derive strictly from the behavioral and social sciences. However, such an ontology would fail to cohere. There is no unity among the social sciences, or within any of them. Further: such an approach would suggest that problems are not only defined by human perception and valuation, but are also engendered only by human action. Such a view would be too limited. We share, to some degree, our perceptions of harm - certainly our actual vulnerability - with other forms of life. Though the very notion of "problem" is necessarily anthropocentric in motivation, as theory it cannot be cast exclusively in human terms, but must encompass the general difficulties faced by all living beings. The biological order is embedded in the natural physical order, so a concern with a broader domain of science is also unavoidable. Most critically: even where problems clearly result from human behavior, it is not obvious that pointing to the human origins of such phenomena exhausts - or even clarifies - their essence.

It is natural enough to hold a conception of precariousness and adversity which focuses exclusively upon human action or the human psyche. It has the endorsement of old and new religions, e.g., in such doctrines as "original sin" or of desire as the root of suffering, or in psychodynamic or economic reductionisms. It is a reflection of the human wish to be at the center of things, a wish which survives the Copernican and Darwinian revolutions. We want to be able to solve our problems, so we insist upon being their sufficient cause. But there has always been an alternative view in which human suffering is seen as incomprehensible in strictly human terms, which insists upon a general, i.e., "cosmological," explanation, but "cosmological" in quite a different sense from the use of this word in physics, a sense which preserves the phenomena in question, although in abstract form.

Systems theory aims at such a cosmology. It offers the possibility of a precise, scientific, and general account of the origins and nature of evil, "evil" here being understood not narrowly as an epithet for wrongful human action, but broadly, to include imperfection, suffering, decay, and death. Such an account might be called a "secular theodicy." Traditionally, theodicy is the reconciling of divine justice and power with the reality of evil, and strictly speaking, of course, a secular theodicy is a contradiction in terms. However, if one conceives of such an undertaking in the spirit of Spinoza's metaphysics of immanence, one will not reject such a possibility as an oxymoron. There is no intent here to speak of, no less defend, divinity. "Theodicy" here refers to the philosophical attempt to understand the origins and nature of evil in the deepest and broadest terms available. If we no longer see a theological contradiction in the existence of evil and thus a need for rational legitimation of the cosmic order, there is still a need for explanation and for consolation, which are also the functions of theodicy. For explanation to be satisfactory, it must be systematic and compatible with - ideally, cast in terms of - modern scientific ideas. Yet, the standard view within science is reductionist, and within a reductionist metaphysics a theodicy is impossible and unnecessary. By contrast, there is an underlying affinity between systems theory and the concerns of theodicy, and it is not surprising that prominent systems theorists have occasionally employed or addressed religious concepts (see, e.g., Deutsch 1966, Churchman 1979).

Though thoroughly secular, a systems theodicy would have theological overtones. Order and distinction, rather than creation *ex nihilo*, are the themes of the opening lines of Genesis (Levenson 1987). On these subjects modern science has much to say, and in fact order and distinction are the primary notions which organize and motivate systems theory. A systems theodicy would echo the views of the the Gnostics (Jonas 1958) and Kabbalists (Scholem 1991) who held that the origins of suffering and evil were obscure but fundamental; that they were to be found in the very fabric of existence and to require a comprehensive explanation, in which the human dimension of evil, however important, was only a special case. It is this view of suffering and evil - of problems, to use a more subdued term - to which systems theory can give modern scientific expression.

4. A Systems View of Problems

Systems ideas can contribute to a coherent understanding of problems and perhaps even to their amelioration. The more worldly side of the systems movement ("systems analysis" and the like) has explicitly concerned itself with problem-solving methodologies and with providing specific solutions, where possible, to well-defined technical problems. It may well be, however, that it is the more academic side of the systems movement (classically, "general systems theory" and "cybernetics," contemporaneously, nonlinear dynamics and "complex adaptive systems," collectively referred to here simply as systems theory), the side which aims at metaphysics rather than at problem-solving, which has the deeper contribution to make. A framework for understanding problems in general terms is more critical than any repertoire of problem solving techniques. Nevertheless, it is systems analysis, which at its best is motivated by moral considerations, which brings the need for such a general understanding into sharp focus.

Systems theory can help clarify the universal character of difficulties which afflict systems and which compel our personal and societal concern. It unveils the abstract essence of these difficulties, the general principles of which these problems are specific instances. By seeking the universal archetypes which underly these difficulties, it accepts the reality of these phenomena instead of trying to undermine this reality through a cascade of promised reductions.

To briefly mention just a few specific systems concepts which might be useful for such purposes, consider the following ideas from game theory, information processing, nonlinear dynamics, and optimization:

* The prisoner's dilemma is a formal mathematical structure within game theory which

captures the essence of a wide variety of situations in the biological and social worlds wherein cooperation is advantageous but difficult to achieve because competition is optimal for each individual actor; in these cases, it is the structure of the situation which is flawed and which condemns the individual entities to self-defeating action. This and other game-theoretic structures underlie many intractable dilemmas of collective action in social, economic, and political systems.

* Beyond a certain degree of complexity, systems tend to exhibit the separation of the functions of coordination and control from fundamental processes of production and maintenance; that is, there tends to emerge a domain of information from amidst the domain of matter-energy. While this hierarchical distillation has the natural function of promoting unity and efficiency, the very existence of an informational order distinct from the substratum it oversees opens up the possibility of conflict, subversion, and parasitism. This possibility is one source of the inevitable vulnerability of organisms, organizations, and economic systems to exploitation and dysfunction.

* In the phenomenon of chaos, we see that deterministic temporal constraints do not guarantee order. For certain environmental conditions (parameter values), systems exhibit the possibility of shifting from highly ordered to highly disordered behavior. Many aspects of such shifts are unpredictable. This is the rule for dynamic systems, not the exception: most systems are nonlinear and most nonlinear systems are chaotic. It is therefore reasonable to expect that biological, economic, and political order may exhibit unpredictable fragility, the longevity of such order providing no assurance of its ultimate stability.

* There is no universal method to optimize simultaneously multiple objectives; to identify global, as opposed to local, optima; to contain the combinatorial explosion which afflicts many problems of discrete optimization; to satisfactorily aggregate a set of ordinal preferences. To the degree that the solution of human problems requires rational decision making and optimization, the possibility of such solutions is severely limited, even theoretically.

Within the systems literature there are many other ideas which clarify the abstract essence of problems: notions about tensions between variety and constraint, unity and multiplicity, openness and closedness, autonomy and interdependence, part and whole; about instabilities of cybernetic control; about the counter-intuitive behavior of complex systems and the impossibility, in any intervention, of doing just one thing; about the ubiquity of hierachical order and its inherent pathologies; about the gap in all models between image and reality, etc. From a systems perspective, the problems which we face - and our human incapacity to eliminate them - have their "cosmological" source in difficulties such as these. It is cosmology in *this* sense, and not in the sense of the big bang and what might have "preceded" it, which illuminates human experience.

Hazard and impermanence are universal and not anomalous; their appearance in the human domain can to a degree be avoided or ameliorated but not eliminated. There is a risk of overstating the case. It is not that system theory requires as a matter of deductive necessity that problems exist, but it does help explain why they are ubiquitous, and it does lay bare the fundamental character of many problems which do arise. This view is a very different from the perspective on systems theory which considers it to proclaim a natural harmony. There may be such a deeper harmony (and systems theory may offer one language in which it might be expressed), but one cannot start with this position, and the right to proclaim it is not so easily earned.

Finally it must be remarked that understanding the "lawfulness" of problems does not provide for their solution. It may well be that problems are universal, i.e., instantiations of abstract principles, but solutions – at least to difficult problems – are unique, i.e., contingent upon concrete detail and context. Nonetheless, the solution of such problems is likely to be aided by grasping their "metaphysical" essence.

5. Summary

There is not the occasion to be explicit about how specific problems exemplify general difficulties. The precise role these notions can play in the understanding or amelioration of any specific problem should not be exaggerated; abstract ideas can inspire and provide an analytical framework but must inevitably be augmented with subject-specific details. But the efficacy of abstraction should also not be underestimated, as the scope and depth and evocative power of both music and mathematics clearly demonstrate.

At the price of an uncompromising abstraction, systems theory offers a viewpoint which can unite both anthropocentric and cosmological perspectives. By giving priority to patterns prevalent in the domain of living systems (or, even more specifically, in the human sphere), the systems conceptualization can be "centered" in this domain; it can thus be more accessible and relevant than the standard scientific model which gives precedence to the very small and the very large. At the same time, a systems-theoretic view can be broader in scope and more integrated than any social science-based "anthropodicy" (Becker 1968), and can thus link the human sphere to its universal context.

The ideas within systems theory are formally developed to differing degrees, ranging from full-scale mathematical theories to extended metaphors. These ideas are interconnected (Zwick 1984); taken collectively, they constitute a world view complementary to that of the standard scientific model. In these ideas, there are the beginnings of an exact and scientific metaphysics and the components for an ontology of problems.

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