Between chance and choice: interdisciplinary perspectives on determinism
Harald Atmanspacher and Robert Bishop, (Eds.), Imprint Academic, Exeter, New York, 2002, 528pp., US $48, ISBN 0907845215

This volume on chance and choice, with the subtitle *Interdisciplinary Perspectives on Determinism*, represents 22 papers given at a workshop on determinism near Munich in June 2001. The speakers came from many disciplines: mathematics, physics, cognitive science, social science, and philosophy. There are too many papers for the reviewer to attempt comments on each. However, the volume has a principal subdivision: the first part is devoted to the relation between determinism and chance, and this is the focus of the first 13 articles. The remaining nine concentrate on determinism and free will.

But this subdivision is not strict and separating. Instead, this volume is a cornucopia of ideas, big and small, deep and superficial. Almost any topic one can think of bearing on the title can be found mentioned at least once and, often, many times. In any case, in the first subdivision I would give pride of place to the long, wide-ranging article of Gustafson, perhaps mainly because he has a lot to say about many themes close to my heart. For example, he remarks on time, from its role as a continuous parameter in mathematical physics to the problems raised by ever better measurements of it. The only thing I missed was a more extensive discussion of the consequences of discrete, rather than continuous, time being the fundamental physical concept, a move that is thought by some to spell the end for determinism, once and for all, which I doubt, but more later on a different burial for determinism.

Several articles in this first subdivision are substantial and interesting, full mainly of remarks rather than developed ideas of the many ways to think about chance and determinism in contemporary physics. This limitation is natural in a volume like this, meant to build an intellectual bridge between many disciplines. Given the highly technical nature of much modern work in stochastic processes and mathematical physics, all but the most initiated will find many passages and paragraphs tough going. But all the same, those footloose and fancy free enough to wander over unknown territory will find many interesting things.

I am thinking here especially of the articles by Atmanspacher, Primas, Misra and Dieks. Atmanspacher's article is notable for carrying through the standard philosophical distinction between ontological and epistemic claims to the detailed structure of different physical theories. The distinction often made in these terms in the properties of quantum mechanical systems is carried over to the chaotic and stochastic classical systems, especially those whose study was initiated by Kolmogorov and Sinai. Primas emphasizes the important relations between determinism, probability, and time's arrow. He draws attention especially to something that is made obvious by the detailed examination of complex classical mechanical systems but is not well recognized by some philosophers: determinism does not imply predictability. Primas also has a useful analysis of Hadamard's well-known conditions for a problem to be well posed in relation to determinism.

He includes a levelheaded negative analysis of why quantum mechanics cannot explain freedom.

Misra's article begins with a brief survey of beliefs about determinism and chance in ancient Buddhist thought, and also in the ancient Vedic literature, about both of which I know little. He says, "The Shewtashwatara Upanishad begins with the question: What is the ultimate principle? Is it niyati (necessity, determinism) or yadriccha (chance)?" (p. 149) I would like to be able to compare this doctrine with Aristotle's limited role for tyche (chance), but I would need assistance to do so. Misra does recognize the need for a complicated view in his positive reference to the Epicurean's introduction of swerving in the motion of atoms through the void. But the focus of Misra's article is to give a survey of the ways in which one can obtain probabilistic Markov processes from deterministic dynamical evolution without appealing to a subjective or "ignorance" interpretation of probability and coarse-graining. His analysis, in terms of modern dynamical-systems theory, is too technical to summarize here. But from a variety of sources, we now know that there are classical deterministic systems that are so unstable that, apart from any ignorance of their exact initial and boundary conditions, they behave randomly. My own favorite example, not mentioned in this volume, is the restricted case of the three-body problem in classical mechanics studied by Sitnikov (1960), Alekseev (1969a, b), and Moser (1973).

Dieks' article provides a useful and detailed analysis of the degree to which the distinction between determinism and indeterminism in current theoretical physics can be used to show that indeterminism supports free will and, consequently, unexpected novelty in human behavior. His skeptical attitude is that phenomena which exhibit indeterminism, chance and probability will not, just because of these characteristics, necessarily leave room for originality, novelty and an open future. One of the main thrusts of his argument is that there is no direct way to use results in physics to support familiar concepts of ordinary language that do support the kind of openness just mentioned. I like his argument that begins by replacing the vague notion of novelty with the technical concept of complexity, and then goes on to argue that there is no general argument linking complexity to indeterminism rather than determinism.

My one serious point of disagreement is his assertion that "spontaneity is a concept from the sphere of human actions and intentions" (p. 221). This is certainly counter to the austere sense of spontaneity introduced in Kant's Third Antinomy in the *Critique of Pure Reason.* More generally, before the nineteenth century, the view was widespread that living beings of all sorts, e.g., insects and other animals far from human beings, could be spontaneously generated out of decaying matter. Moreover, Theophrastus often mentioned the spontaneous generation of plants. The swerving of atoms, famous in the writings of Epicurus and Lucretius, is another case for spontaneity that should at least be considered.

The second subdivision of the book consists of nine articles on determinism and free will. Somewhat unfortunately, most of what is said in this part is not deeply engaged with the many physical theories and analyses of determinism and indeterminism to be found in the first subdivision. An example is the first article

by Dowe, who, as a philosopher, has written clearly and usefully about free will, and in many ways, does so here. But what he has to say about scientific determinism is said too quickly and without any important distinctions. He asserts, "scientific concepts based on functions, laws, or predictability are all probably symmetric in time" (p. 311).

There is a fundamental distinction about scientific analysis of processes that is missing from this view. The laws governing many processes are weakly reversible, in the sense that a time reversal will carry a physical or other natural process into another one satisfying the law, but under time reversal the two processes are not necessarily observationally equivalent, so that if you saw a movie of the original process and the transformed one, you could tell them apart. The stronger sense of reversibility is that you cannot tell the processes apart. Put in a vivid way, it is impossible to judge whether a movie of the process is being run forward or backward. The classic one-dimensional harmonic oscillator is a good example of such a deterministic process, although most deterministic processes, especially dissipative ones, do not have this strong symmetric time invariance. (See Suppes, 2002, Chapter 7, Section 3 for a detailed discussion of these two senses of reversibility, often thought of as the weak and strong concepts.)

There are many useful arguments and distinctions drawn, mainly by philosophers and psychologists, in the remaining eight articles. I restrict my detailed comments to two. Guignon poses the starkest opposition to the view that physics and its conception of scientific laws has much to do with free will. Many humanists are highly sympathetic to this outlook, which draws much of its vitality from Heidegger and some later phenomenologists. The other article is by Kane, a philosopher who has written carefully and extensively about the modern literature on free will. His strategy is one of engagement, rather than withdrawal from the debates about the relevance of physical determinism to the problem of free will. (Dorato is another philosopher writing in a way that is sympathetic to much of what Kane has to say, but differing in the end on fundamentals: Dorato is a compatibilist, Kane is not.)

Much of what Guignon has to say about human agency and action seems correct, and it represents a humanistic vision that should be taken into account by those of us who believe in a naturalistic vision that is more congenial to modern science. I shall not try to survey our points of agreement, but, in the short space available, try to focus on what seem to me to be salient criticisms of the vision Guignon develops. First, he attacks "the conception of reality dictated by what I have described as the perspective of modern science" (p. 359) from several different angles. This conception is derived, so he claims, from the mechanistic physics of the 17th and 18th centuries, and "in its standard form, has very little relevance to making real-life situations intelligible" (p. 359). I find this claim of irrelevance incredible. Let me just take two examples. Why have most educated families in most parts of the world stopped consulting a soothsayer, astrologist, or someone of like ilk in fixing important family dates, such as that of a wedding or even a trip? Not because Guignon's or Heidegger's brand of phenomenology has made clear the "real-life" unintelligibility of such a move. No, not at all. They have been abandoned for a scientific worldview that is derived from the oldest serious science, namely,

astronomy, and that took a long time to develop, and an even longer time for the true nature of astrology and divination to be uncovered by the incontrovertible scientific evidence that the world is not that kind of place. A second example is the practical one of the increasingly sophisticated basis of modern medicine with its many lifesaving discoveries and inventions. What my examples are meant to show is that the humanists, like Cartesians of old, want to have too pure a vision of what being human is like. Science must be part of any realistic conception of humanism and a place must be made for that which all but the bewitched know is supported by a great preponderance of evidence. Surely, Guignon would not propose that application of Heidegger's concept of changing meanings as the proper ground for evaluating the human worth of a new medicine. Guignon summarizes an argument of Heidegger's that he thinks makes a thoroughgoing determinism about human agency untenable. "First, humans have the ability to reflect on what has come before, redefining the past by endowing it with a different meaning. Since there are no facts about the past independent of these meanings, there is no way to specify the causal antecedent of an action in a way that satisfies the requirement of generality of causal statements" (p. 333). Statements that such unrestricted revisions of the past are possible make little sense to someone trained in the literalness of modern science. I will not even bother to give examples. The real point is that certainly there are aspects of our understanding of the past that are properly subject to new interpretations and revisions. Just about everybody recognizes this feature of the past, so much has been written about it in the past half century by historians rather than philosophers. The real philosophical problem is to make distinctions about what can and what cannot be radically reinterpreted. It is this hard work that is missing from the passionate prose of the humanists' concern for meaning.

Kane's sober and judicious article on the philosophical literature about free will provides an in-depth survey of current discussions. Perhaps the most important feature is his insistence on making a number of distinctions about different kinds of actions that we would like to think of as free, some of which are compatible with determinism and some of which are not. In his sophisticated defense of causal indeterminism, which also leaves room for agent causation, Kane admits to being something of an Aristotelian in his basic outlook, a philosophical viewpoint that I consider much sounder than the Heideggerian one advocated by Guignon. Kane goes about as far as one can go into details, without entering the scientific arena in a full-blooded way, in his discussion of physical determinism and various aspects of neuroscience. To resolve the many different conflicting views advocated in this volume, it will, I think, be necessary to get into that arena, but just as essential, those writing from a scientific standpoint need to be more deeply familiar with the long philosophical tradition that has nurtured the conflicts about free will for centuries.

From my own stance on the problem of free will, what I missed most from this volume was something hinted at in several of the articles by scientists, but not developed in detail. This is the idea that comes from recent work in ergodic theory, exemplified best by the long article by Ornstein and Weiss (1991). What is proved there for certain kinds of ergodic phenomena, such as that of a billiard ball on a table with a convex obstacle in the middle, is this. No matter how many observations are

made of the motion of such an idealized ball, it is not possible to distinguish between a Markov stochastic process (indeterminism personified) and a Newtonian classical model of the motion, with bounded accuracy of measurement of position and velocity. What is the philosophical implication of this? Clearly, it is that, for important special cases that can be thoroughly analyzed, there is no choosing between determinism and indeterminism. I cannot say more here, but I cannot refrain from referencing two philosophical articles in which I try to spell out the significance of this result (Suppes, 1993, 1994).

References

Alekseev, V. M. (1968–1969a). Quasirandom dynamical systems I, II, III. *Mathematics of the USSR-Sbornik, 5,6,7*, 505–560 and 1–43.

Alekseev, V. M. (1969b). Quasirandom dynamical systems. *Matematicheskie Zametki*, *6*(4), 489–498 (in Russian) (English translation in *Mathematics Notes, 6* (1969), 749–753.).

Moser, J. (1973). *Stable and random motions in dynamical systems with special emphasis on celestial mechanics*. Princeton, NJ: Princeton University Press.

Ornstein, D. S., & Weiss, B. (1991). Statistical properties of chaotic systems. *Bulletin of the American Mathematics Society* (New Series), *24*, 11–116.

Sitnikov, K. (1960). Existence of oscillating motions for the three-body problem. *Doklady Akedemii Nauk, USSR*, *133*(2), 303–306.

Suppes, P. (1993). The transcendental character of determinism. In: P. A. French, T. E. Uehling, & H. K. Wettstein (Eds.), *Midwest studies in philosophy*, Vol. XVIII (pp. 242–257). Notre Dame, IN: University of Notre Dame Press.

Suppes, P. (1994). Voluntary motion, biological computation, and free will. In P. A. French, T. E. Uehling Jr., & H. K. Wettstein (Eds.), *Midwest studies in philosophy, Vol. XIX, Philosophical naturalism* (pp. 452–467). Notre Dame, IN: University of Notre Dame Press.

Suppes, P. (2002). *Representation and invariance of scientific structures*. Stanford, CA: CSLI Publications.

P. Suppes
CSLI, Stanford University, Stanford, CA, 94305-4115, USA
Email address: psuppes@stanford.edu

doi:10.1016/j.shpsb.2003.09.003

Quantum mechanics and its emergent macrophysics
Geoffrey Sewell, Princeton University Press, Princeton, NJ, 2002, xi + 292pp., price US $65, ISBN 0-691-05832-6

As Dr. Sewell has written an earlier book (1986) under a somewhat similar title, it is necessary to lay to rest a few immediate questions concerning their relationship. (1) The purposes of the two works are significantly different, (2) a knowledge of the