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Review of Joseph E. Early, Sr. (Ed.): Chemical Explanation: Characteristics, Development, Autonomy

Clark Glymour
Carnegie Mellon University

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Joseph E. Earley, Sr. (ed.), ***Chemical Explanation: Characteristics, Development, Autonomy,*** Annals of the New York Academy of Sciences, vol. 988. New York Academy of Sciences (2003), 370 pp., $130.00 (cloth).

I think no subject is better suited than chemistry for understanding how reasoning works in the natural sciences, and how and why scientific understanding develops and changes. Chemistry has an available, well studied history; it stands between two sciences, physics and biology, and has contributed to the advance of both; it is quantitative and qualitative, equational and diagrammatic, informal and intensely computational; and it is, for the most part, not esoteric. So I had hopes for *Chemical Explanation.* Containing more than 40 essays in the space of 370 pages, the book is an only faintly mitigated disaster; with exceptions to be noted, a volume on average so poor in original thought, clear theory, and insight that it has at least this use: it invites skeptical reflection on the very idea of a *philosophy of chemistry.* I can only hint at how much I dislike this volume with a little autobiographical story. In the fall of 1962, after the University of Montana had sent me packing,[1] I enrolled as a Philosophy major at the University of New Mexico, and went to hear an evening lecture by the late Archie Bahm, Professor of Philosophy, originator of the Directory of American Philosophers, and champion of the theory of "Organic Polarities," illustrated with depictions of circles of Consciousness and Being and such. I immediately became a Chemistry major, thinking I would escape all that. But maybe not. In *Chemical Explanation* you will find an illustration of the "Surface of Centration," and the "Surface of Reflection" and the "Noosphere." If you like this book, you'll love Archie.

Certain fragmentations in philosophy are natural; ethics has something to do with epistemology all right, but the kinds of judgments and inferences addressed are quite different; metaphysics has something do with both epistemology and ethics, but it is less a shared content then an interdependency of results. What about the philosophy of X, where X is

1. I did try to fill the Dean's office with Lime Jello, but that wasn't the reason. Reason was, I would not take ROTC, which was then compulsory for male students at the University of Montana.

some scientific discipline: chemistry, physics, anthropology, biology, psychology, statistics, etc? Each science has internal problems of an abstract character that can be addressed by anyone, philosopher or not, with a sound knowledge of the subject and sufficient acumen: the equivalence or non-equivalence of alternative theories; the reliabilities of methods of inference and argument common in the subject; equivocations that matter to content or inference; the relations among "little theories" within the domain; reasons for the survival of theories known to be false; characterization and botanizing of outstanding problems, and so on. Contributions to resolving these issues are contributions to the science. (For my money, the best work in "philosophy of physics" in the twentieth century was John Von Neumann's *Mathematical Foundations of Quantum Mechanics,* but there are many valuable contributions to physics of this kind, some of them by professional philosophers.) There is one piece like this in *Chemical Explanation,* James Mattingly's useful essay on gauge theory and chemical structure. But mostly not.

There is another side to philosophies of X. The histories of many sciences, chemistry among them, pose problems about representation, inference, content and explanation, solutions to which might apply much more generally: How can there be accurate and useful empirical laws involving quantities that no one knows how to measure (the law of Dulong and Petit; Cannizaro's determination of atomic weights)? Why do some empirically adequate theoretical frameworks suddenly die while others, equally longstanding, replace them (energetics versus atomism early in the 20th century)? Why do some radically false theories survive in scientific education and discussion (Lewis electron structures and molecular orbital theory)? Are some approximate theories introduced under a common theoretical framework closer to the truth—their entities, properties, and relations closer to something real—than others, and if so, why (resonance versus molecular orbital theory)? How is theorizing and representation limited and altered by computational tractability (electron density calculations) or by cognitive accessibility?

What makes scientific examples valuable in philosophical context is not the examples themselves, or the historical details of their genesis and influence, but a different level of abstraction the philosophical analyst can produce from them, a characterization of a pattern of argument, explanation, inference, depiction, rationales for preservation, or even a profound puzzle. There are no contributions of this kind in *Chemical Explanation;* there are a few essays that fairly vividly pose a question, but attempt no answer, for example Robin Hendry's nice discussion of leading practitioners' views of valence bond and molecular orbital approximations in quantum chemistry. Some contributors have elsewhere made excellent contributions to such questions (for example, Andrea

Woody's work on the reasons for the survival of Lewis structures and molecular orbital theory). But not here.

The philosophy of X affords two temptations, too seldom resisted. One is intellectual journalism, essentially reporting in technical detail, often mixed with philosophical jargon, on some scientific topic. The philosophy of physics is full of such pieces—they will tell you in great detail about gauge theory or quantum gravity or string theory or whatever, with no original contribution to the science itself and no philosophical point that warrants the esoterica. One can find the same kind of philosophical journalism, perhaps a little less esoterically, in many essays and some books on the philosophy of biology, cognitive science, anthropology, and, in the volume considered here, chemistry. The other temptation is the undergraduate lecture, which rehashes old philosophical doctrines in the context of the science of X. A great deal of *Chemical Explanation* is of this kind. In this volume, you can pretty much tell whether an author is a chemist or a philosopher by the philosophical literature brought to bear: chemists prefer the classics, Hume or Locke or Berkeley or even (I shudder to say it), Hegel. Philosophers prefer whatever they studied in graduate school: Husserl or Kuhn.

No one should suffer criticism by volume association, and I note some essays, besides Mattingly's and Hendry's, that I found useful and insightful, if usually not philosophical. Amid the several essays on reduction of chemistry to physics, an essay by G. Vemulapalli, a chemist, stands out for a simple and interesting point, nicely illustrated: additive calculations of molecular wave functions work because of the relative energy states of the system for which the calculation is done and that of its environment. Ilya Prigogine, famed for his work on irreversible processes, contributes a very short, very clear, invited note (apparently he did not participate in the summer symposium) on why non-integrable processes are essential to chemical kinetics, and a way to formalize them so relevant features might be computationally tractable. William Goodwin, a philosopher, contributes a perfectly sensible essay on the structure of explanations of reactions and their rates in organic chemistry. My complaints about intellectual journalism notwithstanding, R. Bruce King, a chemist, contributes a beautiful essay on the mathematical differences between chirality and handedness and the chemical significance of the distinction. Jody Roberts contributes an interesting if brief and quite incomplete history of Nuclear Magnetic Resonance Spectroscopy, unfortunately marred by a pseudo-philosophical post-modernist theme ("negotiated identities of chemical instrumentation"). In one of the few essays in this volume that considers—however briefly and without any philosophical observation—actual arguments from experiment to theory in chemistry, Joachim Schummer, a philosopher, argues that factions in

nineteenth century debates in the life sciences did not divide by chemists versus biologists.

The substantive (!) essays of this volume conclude with Eric Scerri's contribution on constructivism and relativism in chemical education. Without a lot of scholarly paraphernalia, Scerri observes that post-modernist relativism seems to have become the norm in the literature on education in chemistry. He thinks its silly, incoherent and damaging to science. The last contribution to this volume, written by Bruce Seely—at the time of writing the director of the NSF Science and Technology Studies Program—says this post-modernist stuff is "dynamic and exciting scholarship" (372). I agree that the scholarship Scerri criticizes is exciting—it excites my dismay at the state of the humanities. But even those who, with Professor Seely, find something of value in nouvelle philosohy of science will wish better of the philosophy of chemistry than this collection provides.

CLARK GLYMOUR, CARNEGIE MELLON UNIVERSITY

Bent Flyvbjerg, ***Making Social Science Matter: Why Social Inquiry Fails and How It Can Succeed Again.*** Cambridge: Cambridge University Press (2001), 204 pp., $55.00 (cloth), $20.00 (paper).

This books strives to provide a prescription for the popular diagnosis that the social sciences have fallen vastly short of their Enlightenment ambition to emulate the methodology (and success) of the natural sciences. That the social sciences have failed to achieve even a modicum of actual knowledge about the underlying causes of human behavior over the past 200 years, the author seems to take for granted. Given this alleged failure, he then offers a way out—that the social sciences should reformulate themselves on the basis of Aristotle's notion of "phronesis," as a practical guide to political and social debate, rather than as a self-conscious attempt to acquire "episteme," or scientific knowledge, about the causes of human behavior.

The book is divided into two parts: in part one the author seeks to establish that the "scientistic" model of social science is doomed to failure. In part two, he seeks to show that the "phronetic" model is a superior alternative. Flyvbjerg explains that phronesis is variously translated as prudence or practical wisdom. Aristotle defined it as a "true state, reasoned, and capable of action with regard to things that are good or bad for man." Flyvbjerg largely accepts this definition, and explains that "phronesis goes beyond both analytical, scientific knowledge (episteme) and technical knowledge or know-how (techne) and