Reviews

Genesis. By MICHEL SERRES. Trans. GENEVIEVE JAMES and JAMES NIELSON. Ann Arbor: Univ. of Michigan Press, 1995. 142 pages. $32.50; $14.95 (paper).

A work entitled *Genesis*, even if it is a philosophy book, is bound to occasion thoughts of creation and, more specifically, of creation *ex nihilo*. "Genesis" suggests a doubly radical beginning, not only a fresh start but, more specifically, an originator that creates from nothing.

Such a two-pronged feat cannot be duplicated even by the profoundest metaphysicians. Modern philosophers however, did see themselves as little gods of sorts, striving to bring about radical beginnings. Creating *ex nihilo* was out of the question. But they sought a close approximation, leading their readers into pristine states of nature, unblemished *tabulae rasae*, and a *cogito* arrived at only after the accumulated debris of tradition had been cleared away.

Taking their cue from Descartes, modern philosophers thought of themselves if not as creators then as architects. They sought to isolate solid foundations and to construct systemic edifices on them. Architecture, quite literally "building on first principles," became a guiding, if sometimes unconscious, metaphor. Unity and rigidity were sought-after ideals. Kant's "architectonic of pure reason," which is a "system," that is, a "unity of the manifold modes of knowledge under one idea," represents a culmination of this philosopher-as-architect project.

Bergson helped bring modernity's hegemony to a close by openly questioning philosophy as architecture. He worried about the limitations of a philosophy whose metaphysics had been a metaphoric of the solid. Plato, prior to the dominance of the architectural metaphor, had, in *The Sophist*, avoided the temptation to erect a single principle as either the source behind multiplicity or its proper *telos*. He suggested, instead, five ultimate principles (existence, movement, rest, similarity, and difference) that were always present in some sort of mix or blending.

The contemporary discussion on this subject has just been enhanced by the translation of Michel Serres's *Genesis*. Serres is an important contemporary voice, maddeningly hard to follow for mainstream philosophers but worth the effort. *Genesis* is Serres's attempt to get beyond philosophy as architecture. Following Bergson, he wants us no longer to be afraid of the viscous. Like Plato, he wants philosophy to have the courage to embrace difference and multiplicity. "We were afraid of wind and waters, we are now afraid of disorder and the rarely predictable. In fact we are afraid of multiplicities. A Concept is a multiple reduced to the unitary" (p. 108). "The pure is in the impure, and the obscure is in the clear.

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We live and think within the mix. . . . We invent, we produce like the Demiurge, in and through the mix" (p. 132).

Whereas philosophers have prized a rationality built on a single solid foundation, Serres suggests a different tack for philosophy. "I'm trying to think the multiple as such, to let it waft along without arresting it through unity" (p. 6). "The multiple is the object of this book and history is its goal" (p. 7). "We must reintroduce into philosophy the concept of chaos, a mythical concept until this morning, and despised by rationality to the point of being used nowadays only for discourses on madness" (p. 98).

Reintroducing chaos will help rescue philosophers from the one-sided preoccupation with architectonics of various sorts. Philosophers must "protect to the utmost the possible." The task most to be cherished is presiding over parturition. Not architects but rather shepherds and gardeners present useful comparisons. "The philosopher is the shepherd who tends the mixed flock of possibles on the highlands. . . . The philosopher is the gardener, he crosses and multiplies varieties" (p. 23).

With *Genesis* Serres takes seriously the task of articulating a metaphysics that will do justice to the "flock of possibles." Here, perhaps, is where mainstream philosophers will find the text most difficult. The standard academic trope, situating oneself by contrast and comparison to other philosophers, is absent. Leibniz, Kant, Descartes, and Plato are mentioned. But Serres develops his formulation within a commentary on a painting that is not really a painting, *La belle noiseuse*, an artifact of Balzac in his story "The Unknown Masterpiece." Adding to this difficulty, Serres prefers to suggest his position via images rather than by means of standard philosophical concepts. "I imagine a hard nucleus surrounded by clouds of the upper air, I see an island, a mountain, I see an archipelago scattered in the midst of the clamorous sea, a jagged mass beneath the snow and in the clouds" (p. 127).

What results from this is a plea to embrace the multiple and a language for thinking it. Traditional philosophy, with its biases, formulated the multiple in negative terms as the *in*determinate, the *un*formed, *dis*order, the *in*definite, and the *a*peiron. Building on Balzac's story, Serres revitalizes an old French word, free of privative prefixes, *noise*. *Noise*, as the translators point out, signifies "ado, strife, contention" (p. 141). In English, we might reach for hyphenated words such as *hurry-scurry* or *pell-mell* to signal the tumultuous mixture that has not yet been limited and shaped.

A reformed, Serres-style metaphysics of chaos recognizes the fruitful, generative side of noise. It incorporates the noise as co-equal with the formed entities that emerge from it. To make room for such an incorporation, Serres rejects the architectural ideal that seeks to fix a privileged system once and for all. Instead, using liquid metaphors, he speaks of "turbulences," temporary, ongoing differentiations within a flowing stream. Being is turbulence, an enduring organization of the noise. It endures, but it is neither fixed nor eternal. "Turbulence is born of the noise, it is born unitary, to some extent, it takes shape. It takes shape, rises up, anadyomene, before breaking apart in the noise" (p. 121).

How does all of this bring us back to "genesis"? Serres never mentions it explicitly, but the entire work seems to be a gloss on the phrase "*tohu wabohu*" found in Genesis 1 and usually translated as "the void" out of which everything

has come. This *tohu wabohu*, in Serres's hands, becomes less a void or a *nihil* than a sort of encompassing, clamorous ocean, a vast womb of possibilities. Genesis, he appears to be saying, results not from nothing but from everything. Because the phrase *tohu wabohu* is constructed without a privative prefix or suffix, it, like *noise*, does not follow the more common pattern that prejudges the multiple as *un*formed or feature*less*. The source out of which everything comes is neither void nor unity. It is noise, or *tohu wabohu*, a constant background flow out of which temporary turbulences give form and structure to life.

This sort of gloss provides more than a new metaphysics. It suggests a new ethics as well. Emphases on unity and rigorous systematic structures lend themselves to exclusion. *Noise*, by contrast, invites inclusion. The highest ideal becomes not unitary, pared down purity but widespread mix and agglomeration. The "refinement of a civilization" depends upon "the degree of fury and noise . . . that a culture accepts, that it expresses, that it produces, that it accommodates, that a political system tolerates and lets alone" (p. 137).

Serres is not for everyone. His mix of imagery, single-sentence paragraphs, and seeming nonsequiturs is annoying and difficult to follow. His refusal to write a straightforward philosophical essay will alienate those who expect one sort of writing as *the* appropriate philosophical style. But if we are truly to move beyond the architectonics of modernity, then perhaps the language of stiff rationality that "walks in step" will have to be supplanted by a style closer to natural language, one that "leaps and dances" (p. 67). If Serres's aim was to match content with style, the rich, bubbling cauldron that is *Genesis* has succeeded.

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Bangs, Crunches, Whimpers, and Shrieks: Singularities and Acausalities in Relativistic Spacetimes. By JOHN EARMAN. Oxford: Oxford Univ. Press, 1995. vii + 257 pages. $35.00.

Do not be misled by the facetious title. This is a book of detailed seriousness about the singularities and acausalities that may plague spacetimes deriving from the general theory of relativity (GR), Albert Einstein's formulation of the modern theory of gravity. No concessions whatsoever are made to the reader, who is expected to be fully at home in the mathematical formalism and fully alert to fine distinctions in the detailed definitions that discriminate one kind of option from another. This reviewer did not fulfill this demanding prescription, so that his comments relate to what a scientifically informed reader, who is not a professional relativist, might glean from the text.

GR is based mathematically on the notion of general coordinate invariance, permitting a vast range of different representations of the same intrinsic geometrical state of affairs. One of the first results obtained from the GR equations was Schwartzchild's spherically symmetric solution corresponding

to a point mass. It appeared to exhibit two singularities: one at the point mass itself; the other at the "Schwartzchild radius," a sphere surrounding the origin. It took several years to realize that only the first is intrinsic; the second is an artifact of the particular form of the coordinates chosen. This cautionary tale illustrates the care and subtlety needed to elucidate what is actually going on in GR. The book under review abundantly shows the scope of that problem and offers many refined insights for its solution.

For forty years or so it was hoped that problematic singularities might be due to the practical necessity of discussing only highly symmetric solutions, which were easiest to handle but which, it was thought, would concentrate trouble that otherwise might be smeared out and rendered harmless. This blithe view was killed in the 1960s by the celebrated singularity theorems of Stephen Hawking and Roger Penrose, which established that singularities are to be expected in all physically reasonable circumstances. Penrose went on to express the hope that GR would not allow "naked singularities," so that real trouble would be decorously concealed. (John Earman gives five different approaches to defining what such a principle of "cosmic censorship" might mean.) Whether this conjecture is true is still not known.

Earman says that Hawking and Penrose showed that "singularities cannot be swept under the rug; they are, so to speak, woven into the pattern of the rug" (p. 65). Nevertheless, his attitude is pretty relaxed: "If asked to say briefly what is wrong with singular spacetimes, my short answer would be: nothing per se. . . . I certainly do not think that the problem of singularities is a signal that the theory [GR] self-destructs" (p. 59). However, Earman concedes that some singularities "do pose troublesome questions for physics" (p. 59).

For example, naked singularities, if they exist, would produce a breakdown of determinism, since "anything" can emerge from them. Another problem arises from the fact, first shown by the logician Kurt Gödel in 1949, that there are solutions of the GR equations that generate closed timelike curves, that is to say, paths in spacetime along which an observer would always be moving toward the future, but that observer would eventually return to the initial starting point. Spaces of this kind obviously pose critical problems for causality and chronicity. The discovery also raises the question of time travel, to which Earman devotes a chapter of careful and interesting discussion. He is untroubled by the "grandfather paradox" (an observer traveling back to kill his maternal grandfather before the observer's mother has been born), because he believes that spacetimes possessing such closed paths will also require the imposition of consistency constraints on their physical laws that will prevent contradictions of this kind.

Inside this technically demanding book, there is a more slender volume, tailored to the needs of the general reader, which it would be a great advantage to release. It would be a generous act of Professor Earman were he to make this text available. The present book will be of great service to the expert, but it is too hard for many who would be interested in the issues that it raises.

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The Undivided Universe: An Ontological Interpretation of Quantum Theory. By D. BOHM and B. J. HILEY. London and New York: Routledge, 1993. xii + 307 pages. $18.95 (paper).

Quantum mechanics is an extremely successful theory and has no serious rival for the calculation of atomic and nuclear phenomena. And yet, in spite of its practical success, there is continuous debate about its interpretation. That of the Copenhagen school, particularly associated with Niels Bohr and Werner Heisenberg, is generally accepted and is found in most textbooks, and yet it is now widely regarded as unsatisfactory. Several alternative interpretations have been proposed, and among these is the pilot wave theory originally due to Louis de Broglie and subsequently developed by David Bohm and B. J. Hiley. De Broglie presented his ideas at the Solvay Conference in 1927, but they were so strongly criticized by Wolfgang Pauli that he abandoned them and only took them up again when Bohm showed how Pauli's objections could be overcome.

The different interpretations may be illustrated by the double-slit experiment. A collimated beam of electrons hits two narrow, closely spaced slits and subsequently is recorded on a screen. An interference pattern is observed, and this persists even if the electrons pass through the slits one by one. Each electron is a particle and so must go through one slit or the other, and yet interference is a characteristic wave phenomenon that occurs when a wave passes through both slits.

According to the Copenhagen interpretation, quantum mechanics is concerned only with the results of actual measurements, and since it is not possible to determine whether the electron went through one slit or the other, questions about its path are meaningless. This avoidance of the question is found to be unsatisfactory by many physicists, who persist in asking what seems to them to be a perfectly reasonable question, namely, How can an interference pattern be formed if each electron passes through just one slit: Why do we not see the superposition of two diffraction patterns? In other words, Why is the motion of the electron affected by whether the other slit is open or not?

Many physicists, including Albert Einstein, maintained that quantum mechanics is incomplete and looked forward to a new theory that would answer these and other questions in terms of parameters at present unknown, the so-called hidden variables. The Copenhagen interpretation received strong endorsement when John von Neumann, a distinguished mathematician, proved that hidden variable theories are impossible. In 1952, however, Bohm did construct a hidden variable theory, to the astonishment of physicists and the chagrin of Copenhagen supporters. Some years later, J. S. Bell found the flaw in von Neumann's argument: he had made a very plausible mathematical assumption that is in fact incorrect. There were several subsequent attempts, notably by Gleason and by S. Kochen and E. P. Specker, to reinstate von Neumann's argument, but Bell showed that they ruled out only certain types of hidden variables. This made it possible once more to consider alternative interpretations.

According to the pilot wave theory, the electrons are guided by waves; the waves go through both slits and interfere while the particles go through one slit or the other and are guided by the waves to produce the observed interference

pattern. It is as if the particles are surfing the waves. The interaction between the wave and the particle occurs through the quantum potential that is itself defined in terms of the wave function. This gives a clear and intuitively appealing picture of what is happening that is much more satisfactory than the Copenhagen interpretation. There are other interpretations such as that provided by stochastic electrodynamics, where the electrons are guided by the stochastic field, which depends on the configurations of both slits. The pilot wave theory has been described in many articles, and it is a great benefit to have a comprehensive book-length account. In a work of this length it is possible to give a full derivation of the theory, together with associated philosophical discussions. After comparing ontological and epistemological interpretations of quantum theory, the authors show how the pilot wave theory can be applied to give a causal deterministic account of one-body and many-body systems.

One of the most puzzling quantum phenomena is the penetration of a potential barrier such as occurs in alpha decay. The mathematics is clear, but it implies that the particle passes through a classically forbidden region. The pilot wave theory is able to explain this quite naturally, as the quantum potential modifies the potential barrier.

The argument of Einstein, Boris Podolsky, and Nathan Rosen for the incompleteness of quantum mechanics led to the formulation of Bell's inequalities and a series of experiments to see if they may be violated. The results are generally held to show the presence of nonlocal interactions, that is, interactions that link instantaneously spatially separated events. The pilot wave theory, through the quantum potential, is an essentially nonlocal theory. There are two reasons against nonlocal interactions: since science proceeds by analyzing isolated systems, if everything affects everything else, the whole enterprise becomes impossible. Second, such interactions seem to violate special relativity. Bohm and Hiley discuss these objections in detail and show how they may be overcome. They also discuss the connection between the classical and quantum worlds, the role of statistics in the ontological interpretation of quantum theory, the ontological interpretation of the Pauli equation and of boson fields, the relativistic invariance of the ontological interpretation, and the many worlds interpretation.

One of the outstanding problems in physics is the unification of quantum theory with relativity, In several respects these theories are quite different, as relativity requires strict continuity, causality, and locality, whereas quantum mechanics implies the opposite. Such contradictions often provide the stimulus for a breakthrough to new ideas, and a clue is provided by what the theories have in common, namely, unbroken wholeness, though in different ways. Bohm has developed the concept of implicate order to describe this wholeness in nature, comparing it to a hologram. Each region of the hologram contains the image of the whole object, though this is seen only when it is suitably illuminated. Each part of the hologram contains an enfolded order essentially similar to that of the object but different in form. This concept of implicate order can serve as a corrective to the descriptions in terms of interacting particles that are usually characteristic of theoretical physics.

The pilot wave theory is valuable in providing a logically coherent alternative interpretation of quantum mechanics that gives a clear picture of what is

happening, without the pseudo-mysticism of the Copenhagen interpretation. It must be said, however, that the pilot wave theory has not found favor among working physicists. Not only do they want to get on with their calculations without bothering about philosophical subtleties, but also the pilot wave theory seems contrived, and in particular it relies on a view of quantum potential that is highly structured in a way that seems to be nonphysical and without physical basis. In this respect stochastic electrodynamics is certainly preferable. It may also be true, however, that objections to the pilot wave theory are attributable to the long-term dominance of the Copenhagen interpretation. If the pilot wave theory had been proposed earlier, it might well have become generally accepted. Since the pilot wave theory is causal and deterministic, there would have been no reason to suppose that nature is indeterministic, and we would have been spared the confusion of the quantum paradoxes. If subsequently the Copenhagen interpretation had been proposed, it would have been greeted with incredulity.

One might well ask what all this has to do with religion, as the discussion seems concerned entirely with various interpretations of physical theories. The connection is important, though negative. The Copenhagen interpretation has led to many books devoted to the mysteries of the quantum world, the essential indeterminacy of nature, the limitations of measurement, and the action of the observer. Heisenberg's uncertainty principle has been used to provide a loophole for the action of free will. The action of the observer in collapsing the wave function is hailed as the humanization of physics and is quoted in discussions of God's action in the world. The existence of an alternative ontological interpretation, even if it is not the final word, removes the support from all these otiose speculations.

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