

translated into the more precise language of physics. In fact, they represent vernacular statements pertaining to the seeming violation, at the beginning of the universe, of two of the most fundamental laws of physics. The no free lunch argument claims a violation of the first law of thermodynamics in producing the universe. The argument from design asserts that the second law of thermodynamics must also have been broken at the beginning of time.

Despite this intuition, the fact that organized matter and energy are now distributed throughout billions of light-years of space does not imply a violation of either the first or second law of thermodynamics. The inflationary model, together with Einstein's general relativity, shows how a quantum fluctuation at the Planck time, allowed by the uncertainty principle of quantum mechanics and violating no principle of

physics, would take only  $10^{-42}$  of a second to grow to a sphere the size of a proton containing a vacuum energy equivalent to all the visible mass in the current universe.

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**“Far from demonstrating the need for a creator, the results from COBE provided support for the decade-old extension of the big bang theory called ‘inflation.’ ”**

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Likewise, the organization of matter into galaxies and planets does not require a violation of the second law of thermodynamics—now or in the past. Though the universe starts as a black hole of maximum entropy, or maximum disorder, it explodes into an expanding relativistic gas having less than its maximum allowable entropy. Thus the microwave background is easily able to

absorb the entropy from any localized structure, like a galaxy or a planet, that spontaneously forms—induced by random statistical fluctuations of the type observed by COBE.

Far from providing the evidence for a creator sought by believers, any observations that support the inflationary big bang theory, such as the data from COBE, make the existence of a creator that much more unlikely. The currently existing structure of the universe, including the laws of physics, could very well have been spontaneously generated after the Planck time, by the natural processes of self-organization and perhaps even a kind of Darwinian natural selection from among a random sample of all possibilities. Those who look to science to bolster their faith in the fantasies of a creator and an invisible world of the spirit won't find it in the ripples of the big bang or any other scientific observation. ●

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## Pseudo-Creation of the ‘Big Bang’

### Adolf Grünbaum

The international press has recently widely reported the discovery, by means of satellite data, of strong new observational support for the “big bang” origin of the universe. The so-called big bang refers to a cataclysmic explosion

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*Adolf Grünbaum, the Andrew Mellon Professor of Philosophy and Chairman of the Center for Philosophy of Science at the University of Pittsburgh, is the author of Philosophical Problems of Space and Time. He is a laureate of the Academy of Humanism. His latest book, Validation in the Clinical Theory of Psychoanalysis, will be published this fall by International Universities Press (Madison, Conn.). This article originally appeared in Italian translation in the Milanese newspaper IL SOLE-24 ORE (May 3, 1992, p. 24).*

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followed by the expansion of the universe ever since. As a theoretical model of cosmogony, the big bang theory has enjoyed the endorsement of a majority of astrophysicists since the mid-1960s. But the new findings are being celebrated as representing one of the most important advances in cosmology during the current century.

In fact, the headline of the April 24, 1992, front-page article in the *New York Times* characterizes the new scientific results as providing “Profound Insight on How Time Began.” Even more ambitiously, under the headline “Big Bang Theory Ties Scientists, Theologians,” American Associated Press writer David Briggs claimed that “The momentous findings supporting the ‘big bang’ theory of creation provide common ground for two old antagonists—religion and science—in the eternal

debate over whether the universe is the work of a majestic guiding hand” (*Pittsburgh Post Gazette*, April 25).

In this vein, it has even been asserted that the big bang theory vindicates the Christian doctrine of creation out of nothing, which is familiar since the second century. Thus, in 1951, Pope Pius XII claimed such vindication in a famous address to the Pontifical Academy of Sciences. More surprisingly, in a 1980 book *God and the Astronomers*, the astronomer Robert Jastrow expressed the same view. But, more cautiously, in his contribution to the 1988 Vatican Observatory volume *Physics, Philosophy and Theology*, Pope John Paul II recommended that at least some theologians become scientifically literate, because “Such an expertise would prevent them from making uncritical and overhasty use for apologetic purposes of



such recent theories as that of the 'Big Bang' in cosmology."

I believe that the current pope's advice was very good. Indeed, it is incorrect to claim that the big bang model based on Einstein's general theory of relativity features a first instant or a "beginning of time" at which the big bang occurred. Nor does that astrophysical model justify the idea that there were times when there was absolutely nothing at all, and that an external divine cause was required to produce the transition from this alleged temporal state of nothing to the big bang cataclysm. Furthermore, the incorporation of quantum theory into the model does not support the notion that, before the big bang, there was absolutely nothing at all in the theological sense: True enough, in the quantum version, the so-called quantum vacuum is hypothesized to precede the big bang in time. That sort of "vacuum" differs radically, however, from the vacuum of classical physics, and even more so from just nothing at all.

Worse still for Pius XII and the astronomer Jastrow, the Einsteinian big bang theory lends no support at all to Saint Augustine's doctrine that God created both matter *and time* out of nothing. In fact, Augustine's version of creation *ex nihilo*, either with or without the big bang theory, offers only a *pseudo*-explanation of the existence of the universe.

But why is it misleading to speak of the big bang model of Einstein's theory of general relativity as featuring a "beginning of time"? The reason is a subtle one, which is unproblematic for mathematical physicists, though difficult from the standpoint of ideas drawn from ordinary life: in that cosmogony, there simply does not exist a first instant of time, although the age of the universe, as measured in solar years, is only finite, circa 15 billion years.

Thus, although the duration of the past in years is only finite, the temporal ordering of the instants of time in that finite past contains no instant at which the past, or time itself, might be said to have begun! Mathematicians say that such a past time is finite but "unbounded." But this situation has the crucial significance that at every actual past instant of time, physical processes

already existed in some form or other, because there simply was no time at all before the finite past during which the physical world did not exist *yet!*

Therefore, it is ill-conceived to ask the big bang theorist, "What earlier external cause, either natural or supernatural, made the world come into existence out of a temporally prior state of nothing?" This question presupposes some com-

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**"The theological hypothesis of creation *ex nihilo* surely adds no understanding to the big bang model."**

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pletely fictitious super-time for which no evidence at all has been given. Furthermore, the question overlooks unjustifiably a major lesson that the big bang model teaches to philosophy: it is illegitimate to assume *a priori*, independently of the scientifically discovered structure of cosmological time, that there were earlier times at which the external cause could have been operative. Clearly, the same philosophical lesson would apply, if the Einsteinian big bang model had actually featured a *bona fide* first instant of time, that is, an instant having no temporal predecessor.

In Book XI of Augustine's *Confessions*, he considers a challenger's question, "What did God do before He made

Heaven and Earth?" And he rejects the answer of someone who answered that God was busy preparing hell for those who would ask this question. Instead, Augustine tells us that there simply was no time before creation, because God created *both* time and matter. One contributor to the aforementioned 1988 Vatican Observatory volume, C. J. Isham, regards Augustine's reply that "time itself was made by God" as "profound." Yet it is very unsatisfactory. The notion that time itself "was made" along with matter presupposes a fictitious super-time. And it makes no sense to treat time itself as being on a par with objects like stars or atoms that come into existence in the course of time. On the other hand, the concept of temporally simultaneous divine creation of time itself is either nonsensical or uselessly circular.

In a 1990 article in the journal *Theological Studies*, the well-known American Roman Catholic theologian Michael Buckley makes the following admission concerning the hypothesized process of divine creation: "We really do not know how God 'pulls it off.' Catholicism has found no great scandal in this admitted ignorance." But if so, the theological hypothesis of creation *ex nihilo* surely adds no understanding to the big bang model. ●

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