Cosmology Confronts the Creator

by Hugh Ross

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One of the most persistent traits of man is his belief in the reality of a Creator-God. Attacks on this belief have arisen from time to time and from place to place, none posing serious threat. None, that is, until the assault mustered in Europe during the eighteenth and nineteenth centuries. Through those years scientific and philosophical forces allied to proclaim the universe infinite.

The shock waves still reverberate. In an infinite universe, depending on the nature of the infinity, almost anything is possible. It may be that everything simply is. Any value or meaning-or God-may just emanate from the minds of men.

Science did not stop, however. The twentieth century, in fact, brought a veritable explosion of inquiry and discovery, all of which began to blow holes in the models of infinitude. Reluctant to relinquish apotheosis, many scientists suppressed or wrestled against their findings. Ironically, by the 1980s, their struggle brought forth the most powerful evidence yet for God's existence and the accuracy of the Biblical account of creation. What follows is an account of this dramatic story.

Agnostic Cosmology

Borrowing an argument from Giordano Bruno, the German philosopher Immanuel Kant presumed that experience of either a void time or a void space is impossible and that the universe must therefore be infinitely large and infinitely old.[1,2] On this basis, he proceeded to work out a strictly mechanistic model of the universe. For him, everything could be accounted for by the laws of mechanics newly described by Sir Isaac Newton. Thus, God became unnecessary to explain such a universe. Since Kant also presumed that knowledge is limited to that which comes through the five senses, he concluded that God's existence necessarily lay beyond the reach of man's knowing.[3]

The leap-frog advances in astronomy during the nineteenth century seemed to validate Kant's agnosticism. Larger telescopes revealed an ever multiplying number of stars and nebulae. No matter how far the newer telescopes penetrated, the universe appeared the same-no hint of boundary, no hint of change. When many faint nebulae were resolved into stars, infinitude seemed certain. Billions of stars and thousands of nebulae stretched imaginations to the breaking point. This mind-boggling universe powerfully suggested countless stars spread throughout limitless space.

Early Objections to Agnostic Cosmology

Throughout the nineteenth century the reliability of Newton's laws of mechanics and Maxwell's equations for electromagnetics was demonstrated so repeatedly and widely that scientists believed them applicable to all natural phenomena. Toward the close of the century many physicists became even smug. They voiced the opinion that the only work left for their successors was merely to make measurements to the next decimal place. No significant cosmological developments were anticipated, and the Newtonian infinite universe model was cast in concrete.

However, the concrete began to crack almost before it dried. The disturbance came from three unexpected developments in physics and astronomy:

1. Discovery of heat transfer by radiation. In 1879 Josef Stefan's experiments showed that for any given body the rate of energy radiated from all wavelengths combined increases proportionately with the temperature of the body to the fourth power ($W = \sigma T^4$). Five years later, Ludwig Boltzmann, working independently, derived the same conclusion from statistical mechanics. In general, radiant energy is both emitted from and absorbed by the surface of a body. The difference between the rates of emission and absorption is simply the rate of heat transfer. It then follows from the laws of thermodynamics that a body eventually will assume the temperature of its surroundings and, therefore, radiate as much energy as it receives.

This finding should have destroyed the long-accepted proposition that an interstellar medium absorbs the excess light from infinitely distant stars. In the process of absorption this medium would reach a temperature at which it radiates as much light as it receives. Thus, the mere fact that the night sky is dark indicates that a universe governed by Newtonian mechanics could not have had an infinite number of evenly distributed stars over an infinite period of time.[4, 5] Unfortunately, this explanation was not applied to the infinite universe model until 1960,[6] though its principles were routinely taught in undergraduate physics courses from the 1890s onward.

2. Gravitational potential paradox. Not until 1871 did anyone attempt to calculate the gravitational potential within an infinite Newtonian universe. In that year, Johann Friedrich Zöllner presented proofs that the gravitational potential becomes infinite at any point within an infinite homogeneous universe-a conclusion clearly at odds with all observations. Despite Zöllner's fame as professor of astrophysics at Leipzig, however, his objection to the infinite Newtonian universe was ignored. Only when his objection was independently raised by Hugo Seeliger in 1895 and by Carl Neumann in 1896 did astronomers acknowledge a significant problem.[7] Ironically, rather than abandon the Newtonian model, Seeliger and Neumann sought to save it by introducing *ad hoc*[a] an exponential factor to generate cosmical repulsion at large distances.

3. Results of the Michelson-Morley Experiment. In the 1880s physicists were convinced, on the basis of Maxwell's equations, that light propagates with a fixed velocity relative to an all-pervading æther.[8] The aberration of starlight (slight cyclical shift in apparent star positions caused by the earth's orbital motion), first observed in 1728, proved that this æther cannot travel with the earth.[9,10] In 1887, two American physicists, Albert Michelson and Edward Morley, took up the challenge to determine the absolute velocity of the earth in the æther by measuring the speed of light in different directions and at different positions of the earth in its orbit about the sun. To their astonishment, the experiment failed to reveal any motion of the earth at all.

It was immediately obvious that the Michelson-Morley experiment posed a severe threat to any kind of Newtonian universe model. But, for almost twenty years physicists attempted to patch up the classical theories. They proposed all manner of hypotheses. One suggested that all material bodies contract in the direction of motion. Another that the velocity of a light wave remains associated with the velocity of its source. Various experiments and astronomical observations, however, forced the rejection of all these desperate stabs.

Any one of these new developments should have been sufficient reason to discard the infinite Newtonian universe model. However, such was the attachment of most scientists to Kantian philosophy and their confidence in Newton's gravitational theory, that the century closed with the infinite Newtonian universe model still reigning supreme.

Special Relativity

As the twentieth century dawned, the only conclusions consistent with all observations of the velocity of light were these two:

1. There is no absolute reference system from which absolute motions in space can be measured.

2. The speed of light with respect to all observers is always the same.

In 1905, Albert Einstein, who was employed as an engineer in the Swiss patent office, but worked on physics in his spare time, formally conceded these conclusions in his paper on the theory of special relativity.[11,12] Further, he derived equations which revealed exactly how much two observers moving with respect to one another would disagree on their measurements of length, velocity, mass, and time. Typically, the equations of classical physics would need to be multiplied by the dilation or expansion factor,

$$\Delta=1/(1-v^2/c^2) \qquad (1)$$

where v is the velocity of one observer with respect to the second, and c is the speed of light.[b] In other words, length, velocity, mass, and time are unaffected by velocities under classical physics, but change according to the observer's velocity under relativistic physics.

Applying this dilation factor to the classical expressions for momentum and to Newton's law of force, we can easily derive the famous equation governing the conversion of matter into energy:[13]

$$E = mc^2 \qquad (2)$$

Einstein should probably be credited more with audacity than genius. The theory of special relativity should have followed within months-or at most a year or two-of the Michelson-Morley experiment. However, the old cosmology held such sway that to suggest an entirely new way of thinking about the universe was considered impudent. In short, emotional resistance kept special relativity at bay.

Convincing Experimental Evidence

Resistance to Einstein's theory abated only when experiments and observations repeatedly confirmed all of its dilation predictions. Even before the theory of special relativity emerged, an increase in mass for moving electrons had been observed.

In 1909, the dependence of electron mass on velocity according to equation (1) was verified for electron velocities from 0 to 0.7c, and since then it has been verified up to 0.99c. In 1921, during the first experiments in artificial radioactivity, Earnest Rutherford confirmed the validity of equation (2). Further testing showed the lifetimes of unstable particles, such as mesons, to be dilated in perfect agreement with equation (1). Much better known are the measurements of mass conversion into energy in nuclear reactors and bombs, as well as the publicized clock experiments on orbiting space craft.

The success of Einstein's equations in predicting all manner of observations and experiments was overwhelming.[14, 15] In fact, one experiment in 1986 successfully demonstrated the accuracy of the relativistic dilation factor (equation 1) to within one part in ten.[21,16] These confirmations have led to virtually universal acceptance of the validity of special relativity.

General Relativity

The triumph of special relativity gave Einstein the boldness in 1915 to extend his theory beyond the velocity effects and on to the acceleration effects between observers.[17,18] Widely considered to be beyond the comprehension of all but a few brilliant scientists, general relativity, nonetheless, has cosmological implications that can be understood by all. To be sure, the foundational equations of general relativity may seem intimidating. But, if one is willing to put aside his/her fears for the moment and plunge ahead, an amazing simplicity appears.

Given that matter spreads uniformly (at least roughly so) throughout the universe, the behavior of the universe over time (including its origin and termination) is described by the following equations:

$$2(d^2R/dt^2)/R + [(dR/dt)/R]^2 + kc^2/R^2 = -8\pi Gp/c^2 \qquad (3)$$

$$[(dR/dt)/R]^2 + kc^2/R^2 = 8\pi Gr/3 \qquad (4)$$

where **R** is the scale factor for the universe (basically its length or diameter), **t** is time, **k** is a constant describing the geometry of the universe, **c** is the speed of light, **G** is the constant of gravity, **p** is the pressure within the universe, and **r** is the density of matter and radiation within the universe. The terms **dR/dt** and $\mathbf{d^2R/dt^2}$ simply represent velocity and acceleration in calculus notation.

A surprising physical consequence results from merely subtracting equation (4) from equation (3):

$$2(d^2R/dt^2)/R = -8\pi G(\rho + 3p/c^2)/3 \qquad (5)$$

The left hand side of equation (5) is essentially **2/R** times the radial acceleration for the universe. Since the constant of gravitation expresses a force of attraction, it is positive. Hence the equation shows that the universe is decelerating.

Another important consequence follows from noting that for any but very small values of **R** the pressure in the universe is very much smaller than the density. Therefore, the pressure term can be ignored. Straightforward calculus solutions of equation (5) then yield the result that **R** either increases indefinitely with time or increases to a maximum value and then decreases. In other words, the universe must be expanding or it has been expanding in the past.

Through the years the general theory of relativity has been confirmed by observable effects to a precision of better than one hundredth of a percent. A summary of results from observational tests is given in **Table 1**. Needless to say, so much evidence now has accumulated that the validity of the general theory of relativity is now firmly established.

Theological Implications

While the character of the general relativity observed in the universe implies an age for the universe far beyond a few thousand years,[f] it also implies that there is, indeed, a definite creation date. Expansion, coupled with deceleration, indicates a universe that is exploding outward from a point. In fact, through the equations of general relativity, we can trace that explosion backward to its origin, an instant when the entire physical universe burst forth from a single point of infinite density. That instant when the universe originated from a point of no size at all is called the singularity.[g] No scientific model, no application of the laws of physics, can describe what happens before it. Somehow, from beyond itself, the universe came to be. It began. It began a limited time ago. It is finite, not infinite.

The implications only can be described as monumental. Atheism, Darwinism, and virtually all the isms emanating from eighteenth-, nineteenth-, and twentieth-century philosophies were built upon the incorrect assumption that the universe is infinite. The singularity has brought us face to face with the cause-or causer-beyond/behind/before the universe and all that it contains, including life itself. Simply put, according to the centuries old cosmological argument for Gods existence:[39]

1) everything that begins to exist must have a cause of its existence,

2) the universe began to exist (now scientifically verifiable),

3) therefore, the universe must have a cause of its existence.

What, then, has been the response of the scientific community?

Quest for Loopholes

1. Einstein's cosmological constant. To escape the philosophical and theological implications of general relativity, Einstein introduced a cosmological fudge factor to get his equations to yield a static, i.e. eternal, model for the universe.[40] Einstein postulated a cosmical force of repulsion to canel off exactly the attractive force of gravity. However, since the effects of such a force had never been observed, Einstein had to further postulate that this force would only take on significance at extreme and, at that time, unobserved distances. Unlike all other forces, this force would mean that the farther apart two bodies are from one another the more strongly they would repel.

One year after the publication of Einstein's brainstorm, the 100-inch telescope on Mt. Wilson began its service. By 1923, Edwin Hubble's photographs through this telescope had proved that many of the enigmatic nebulae were galaxies just like the Milky Way system. Hubble next set about measuring the velocities and distances of these galaxies and, by 1929, was prepared to announce the law of red shifts: the more distant a galaxy, the greater, in direct proportion, is its velocity of recession (determined by the shift of its spectral lines to longer, or redder, wavelengths).[41] This observation by Hubble was exactly what Einstein's original equations of general relativity would predict.

At the same time, Arthur Eddington and other theoreticians found that Einstein's static universe could not be kept static. The formation of galaxies would upset the stability, and result in a quick collapse.[42,43,44,45] Further, the observation that the emission of radiant energy in any part of the universe is far in excess of the absorption of energy means that the universe departs too radically from thermodynamic equilibrium to remain static.

As early as 1919, Einstein admitted that his cosmological force constant was gravely detrimental to the formal beauty of the theory.[46] Following the publication of Hubble's law of red shifts, he finally discarded the factor from his equations. Conceding that its introduction was the greatest mistake of his life,[47] Einstein eventually gave grudging acceptance to the necessity for a beginning and to the presence of a superior reasoning power.[48]

In an expanding universe, the galaxies (and other objects within it) move farther and farther away from one another. Galaxies that are more distant from one another will appear to move more rapidly away from one another. As time goes on, all the galaxies will move faster and faster away from one another. The spectral lines of galaxies moving away from ours will shift, owing to the doppler effect, to longer, or redder, wavelengths. Because all galaxies exhibit random velocities due to their gravitational interactions, a few blue shifts for the very nearby galaxies (where the recessional velocities from the expansion of the universe are relatively small) are expected and observed.

2. The hesitating universe While the general expansion of the universe was no longer questioned, a Belgian priest, Georges Lemaître, sought to lengthen the age of the universe by proposing in 1927 that the general expansion had been interrupted sometime in the past by a near static phase. In Lemaître's model, the universe expands rapidly from a singularity, but the density of the universe is such that gravity slowly brings the expansion to a halt. Then, through a judicious reintroduction of Einstein's cosmological constant and a careful choice of its value, just when gravity is taking the steam out of the cosmic explosion, the repulsive force builds up to cancel off the gravitational effects. Expansion is slowed almost to a standstill yielding a quasi-static period. Eventually, the cosmic repulsion begins to dominate again, producing a second phase of general expansion.

Eddington expressed his irritation that Lemaître's model still required a sudden and peculiar beginning of things.[48] Unwilling to face the theological implications of a beginning for the universe, however, Eddington devised his own loophole. He stretched Lemaître's quasi-static period to infinity, putting the repugnant beginning point all but out of the picture (to allow evolution an infinite time to get started [49]).

Not until the 1970s was enough evidence marshaled against Lemaître's, Eddington's, and others' hesitation models to eliminate them from contention. Vahe Petrosian theoretically established that if the universe hesitates, the galaxies and quasars would be confined to more restrictive limits than for an uninterrupted expansion.[50] Observations now show that those limits are exceeded.[51,52,53] Further, theoreticians have proved that if the quasi-static period exceeds a trillion years, galaxy formation during that period is guaranteed, but so is a subsequent and relatively immediate collapse back to the initial singularity.[45] A summary of evidence against the hesitating universe models appears in Table 2.

3. The steady state universe. In 1948, three British astrophysicists, Herman Bondi, Thomas Gold, and Fred Hoyle, attempted to circumvent the beginning by proposing continual creation.[54,55] In their models, the universe, though expanding indefinitely, takes on an unchanging and eternal quality since the voids that result from expansion are filled by the continual spontaneous creation of new matter. Their proposal made the creation of matter no longer a miracle from the past, but an ongoing law of nature that can be tested by observations.

Right from the beginning the steady state proponents made their intentions clear. Bondi stated that the problem with other theories was that creation was being handed over to metaphysics.[56] Hoyle in his opening paper confesses that he has aesthetic objections to the creation of the universe in the remote past. Later, he objected to the Christian view of creation as offering to man an eternity of frustration,[58] and in 1982 unveiled his pantheistic colors: The attribution of definite age to the Universe, whatever it might be, is to exalt the concept of time above the Universe, and since the Universe is everything this is crackpot in itself." [59] (Capitalizations in the original.)

During the 1960s, 70s, and early 80s a series of highly complex observational and theoretical tests were developed to prove or disprove the steady state model. But the simplest test, applied last of all, was proposed by Sir James leans in the 1920s: a universe that has no beginning and no end should manifest a steady population. The number of stars and galaxies in various stages of development should be proportional to the time required to pass through these stages. That is, there should be balanced numbers of infants and elderly, as well as middle-aged, stars and galaxies.[60]

While it is true that stars with ages all the way from just a few days to billions of years can be seen, no star has ever been measured with an age exceeding 18 billion years. As for galaxies, all are middle-aged. We see no newly formed galaxies. Neither are there any extinct varieties. In fact, in 1985 Donald Hamilton determined that all the galaxies were formed at approximately the same time.[61] Table 3 contains a summary of evidence against the steady state models.

4. The oscillating universe. Yet another challenge to a universe of finite age arose in the oscillation model. This model actually had its roots in ancient Hindu and Roman beliefs. Restated in the 1930s[62,63] and revived by Robert Dicke and his colleagues in 1965,[64] the universe is presumed to have enough mass to bring the expansion to a halt (via gravity) and subsequently cause the universe to implode back on itself. However, rather than crunching itself into a singularity, the universe somehow bounces back and expands again, thereby repeating the cycle. An infinite number of such cycles is thought to relieve us of the necessity of understanding the origin of matter at any finite time in the past.[64]

Since 1965, when the oscillation model first became popular, astronomers have been engaged in a tireless effort to find sufficient mass to halt the observed expansion of the universe. So far, however, all the evidence points the opposite way.[65,66,67,68,69,70,71,72,73]

In 1983 and 1984, Marc Sher, Alan Guth, and Sidney Bludman[74,75] demonstrated that even if the universe contained enough mass to halt its current expansion, the collapse would yield not a bounce, but a thud. Because of the huge entropyh of the universe, any ultimate collapse would lack the energy to bounce. In other words, the universe more closely resembles a wet lump of clay than a basketball. The universe either expands continuously or goes through just one cycle of expansion and contraction. A summary of evidence against oscillation models is given in Table 4.

5. Quantum tunneling. In 1968 and 1970, three British astrophysicists, Stephen Hawking, George Ellis, and Roger Penrose, extended the solution of the equations of general relativity to include space and time.[76,77] Their papers showed that if these equations are valid for the universe, then, under reasonably general conditions,[i] space and time also must have an origin, an origin coincident with that for matter and energy. In other words, time must have a beginning. In 1970, general relativity still had not been overwhelmingly established by observations. But, by 1980, as Table 1 indicates, observations removed any doubts.

Three independent lines of research yield a definite and consistent age for the universe. The results, summarized in Table 5, reveal that the universe is 20 ± 3 billion years old.

Still fighting, some physicists, notably Paul Davies, equate time with cause-and-effect relationships. Claiming that God could only create through cause-and-effect, Davies uses the evidence for the origin of time to argue against God's agency in the creation of the universe.[83] Then, noting that virtual particles can pop into existence from nothingness through quantum tunneling,[j] he employs the new grand unified theories to suggest that in the same manner the whole universe popped into existence.

Davies' God was a straw man. To say that God cannot act beyond the four dimensions of the universe is to neglect the possibility of such extra dimensions.[84] Ironically, the theory of superstrings, now very popular with theoretical physicists, is founded upon the evidence for dimensions beyond the four we experience.[85]

While God is not limited, quantum mechanical processes are. Quantum mechanics is founded on the concept that there are finite probabilities for quantum events to take place within certain time intervals. The greater the interval of time, the greater the probability. But, without time no quantum event is possible.[k] Therefore, the origin of time (and space, matter, and energy) eliminates quantum tunneling as Creator.

To his credit, Paul Davies has publicly relinquished his atheistic position. He recently argued that the laws of physics seem themselves to be the product of exceedingly ingenious design: the universe must have a purpose.[86]

6. The anthropic principle. Now that the limits and parameters of the universe have come within the measuring capacity of astronomers and physicists, the design characteristics of the universe are being examined and acknowledged. Anything but the slightest disturbance in the values for the constants of physics and for the parameters of the universe would yield a universe unsuitable to support life. Some examples are given in Table 6. One astrophysicist likened the coincidental nature of these constants and parameters to the chance of balancing thousands of pencils upright on their points.

Some of these parameters are more narrowly confining than others. For example, the first parameter would eliminate only half the stars from candidacy for life-supporting systems, whereas parameters five, six, and seven eliminate more than ninety-nine in a hundred star-planet systems. Not only must the parameters for life support fall within a certain restrictive range, but they must remain relatively constant over time. And we know that several, such as parameters fourteen through seventeen, are subject to potentially catastrophic fluctuation. In addition to the parameters listed here, there are others, such as the eccentricity of a planet's orbit, that have an upper (or a lower) limit only. Complications aside, one can say that the universe contains too few stars and planets to explain by natural processes the existence of even one habitable planet.

These lists, each of which grows longer each year, provide additional evidence for a Creator. Yet, for whatever reasons, a few astrophysicists continue to contest this conclusion. The evidence for design is compelling. There must exist a designer. But, if God is not the designer, who is? The only alternative, some say, is man himself.

The evidence proffered for man as the creator comes from an analogy to delayed-choice experiments in quantum mechanics, where it appears that the observer can influence the outcome of quantum mechanical events. However, quantum mechanics merely states that in the micro world of particle physics man is limited in his ability to measure quantum effects (the Heisenberg uncertainty principle). If the human observer pushes against those limits he will disturb the particle(s) and thereby lose information about the original state of the system. Both relativity and the gauge theory of quantum mechanics, backed by much experimental evidence,[107] state that the correct description of nature is that in which the human observer is irrelevant. Hence, this version of the anthropic principle fails in its attempt to deify man.

Conclusion

This review by no means addresses all attempts to avoid theistic implications about the origin of the universe. Rather, the focus has been to examine those theories for the origin and development of the universe that are subject to observational tests. A new set of models, mostly variations on themes introduced by Richard Gott.[108] and by Francois Englert and his colleagues,[109] seek to escape the singularity by postulating special conditions during the period of ignorance between what most would be willing to call the creation event and 10^{-43} seconds. Their postulations, however, are simply speculations about things we cannot confirm or deny.[110] For the sake of integrity, we should restrict our arguments to those things which can be observed and measured.[111]