MEMORIES – AN APOLOGY

Once, while I was talking to my astronomy class in Northern California, I asked them, "How many of you have run into Einstein's famous equation in which what we call matter – mass – is set equal to energy?" Mrs. Banks said that she had not run into that equation; so I asked her where she had gone to school. When she told me that she had gone to Stanford University, and that she had done Graduate work there, and yet had never run into that famous equation, I said to her, "Stanford owes you." Well, that was nearly 30 years ago.

Unfortunately Einstein's equation has been wrongly represented, worldwide, to mean that mass can be *converted* into energy. But that is wrong. If mass could be converted into energy, like kinetic energy can be converted into gravitational energy on the up-swing of a pendulum, then that equation would have been E+m=K, or, the *sum* of mass and energy is a constant. But Einstein never interpreted his equation that way. He referred to it as "the equation in which energy is set equal to mass." There is only energy. And towards the end of his life he wrote that matter had fallen out of the physics as a fundamental concept. In his life he probably never noticed the usual misinterpretation of his equation because no one would have written it down as E+m=K.

This usual misinterpretation is probably responsible for the fact that even our educated public is unaware that the Universe is made of energy, not matter, and that it is wound up to some 500 atom bombs per pound against gravity by the dispersion of the particles through space, and to the same 500 atom bombs per pound against electricity because the particles are so minute. I'll explain.

The gravitational field is *condensational*. It tends to bring things together, and we wind things up against gravity by pushing things apart, like pushing a car uphill. And things are wound up to some 500 atom bombs per pound just by being separated, in the gravitational field, from *all the rest of the matter* in the entire observable Universe. We are only a little bit separated from the Earth, but we are a great deal more separated from all the rest of the matter in the observable Universe and that is what winds us up to 500 atom bombs per pound. The *energy* of 500 atom bombs weighs only one pound on Earth. It is that simple, but not so easy to see.

Unlike the gravitational field, the electrical field is self *dispersional*. It tends to push like charges *apart*. And we wind things up against electricity by pushing like charges together. If we push 2 electrons together they will weigh more together than they weighed apart because the energy of pushing them together is still in there, and it is *only energy* that is heavy. As is turns out, the energy required to make the charge of one electron as small as one electron *is its mass*, because you would be pushing negative charge against negative charge and thus winding it up. Once again, it is that simple, but not easy to comprehend.

This sort of information was salted away in my early education more than 70 years ago but still, until now, it is difficult for me always to remember that the rest of the American public was not so lucky. We live on a small planet where the gravitational field is so tender that these energy relations are anything but obvious. If we lived on a neutron star it would be a very different matter and a great deal easier to see. I'll explain.

A cubic inch of a neutron star weighs as much as a cubic mile of iron. If we lived on a neutron star where the mountains were only half an inch tall, and where it would still take several generations just to climb one, even if every speck of our biological energy was used in the climb, then these energy relations would be more obvious. It is a bit more difficult to see them here on Earth.

If you dropped an old fashioned 10-gram marshmallow on to a neutron star the splash created would be enough to vaporize a town. That would be a 1-gram splash. But if you dropped it onto a black hole with all the rest of the observable Universe inside it, then it would be a full 10-gram splash. A 10-gram marshmallow *is* the energy of 10 atomic bombs. I know, it doesn't look like that, and they will sell you a whole bag of them at the grocery store for $1.19. But they have no idea what they are doing. And almost no one sees this as it really is.

Because all of this information was dumped on me so long ago I tend to see the world this way and I don't always remember that most people do not even smell it. It is for my failure to remember this that I apologize.

The energy of the explosion that blew Crater Lake in Oregon long ago was only 42 pounds. Yet it blew some 35 cubic miles of rock into powder and put it up in the stratosphere at 80,000 feet. That was just 42 pounds. The energy which the Sun releases, *each second*, is 4,500,000 tons. It has been doing that for 5 billion years of seconds and it will continue to so for another 5 billion. But when one of these iron core stars goes supernova (collapses into a neutron star) in ¾ of second it releases 100 times as much energy as the Sun releases in 10 billion years. And that is still only 10% of the mass of that star.

It is for not bearing all this in mind when I talk to my friends that I now belatedly apologize.

The world is made of energy, and energy is the Underlying Existence showing through in space and time. Gravitational energy is the Undivided showing through, electrical energy is the Infinite showing through, and Inertia is the Changeless showing through.

John L. Dobson, February 10, 2006, Hollywood, California

MEMOIRES

AN APOLOGY

Once, while I was talking to my astronomy class in Northern California, I asked them, "How many of you have run into Einstein's famous equation in which what we call matter, mass, is set equal to energy?" Mrs. Banks said that she had not run into that equation; so I asked her where she had gone to school. When she told me that she had gone to Stanford University, and that she had done graduate work there, and yet had never run into that famous equation, I said to her, "Stanford owes you." Well, that was nearly thirty years ago.

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This usual misinterpretation is probably responsible for the fact that even our educated public is unaware that the Universe is made of energy, not matter, and that it's wound up to some five hundred atom bombs per pound against gravity by the dispersion of the particles through space, and to the same five hundred atom bombs per pound against electricity because the particles are so minute. I'll explain.

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The energy of the explosion that blew Crater Lake in Oregon, long ago, was only forty-two pounds. It blew some thirty-five cubic miles of rock to powder and put it in the stratosphere at eighty thousand feet. That was forty-two pounds. The energy which the Sun releases, each second, is four and one half million tons. It's been doing it for five billion years of seconds, and will continue for another five. But when one of those iron core stars goes supernova (collapses to a neutron star) in three quarters of one second, it releases a hundred times as much energy as the Sun releases in ten billion years. And that's only ten percent of the mass of that star.

It's for not bearing all this in mind, when I talk to my friends, that I now belatedly apologize.

The world is made of energy, and energy is the Underlying Existence showing through in space and time. Gravitational energy is the Undivided showing through, electrical energy is the Infinite showing through, and inertia is the Changeless showing through.

John L. Dobson, February 10, 2006, Hollywood, California

NAMES

If we hadn't named things before we knew what was going on, we might not be so confused.

Although it may be a mistake, let's keep the names for time and space but drop the names for gravity and electricity. Then let's ask how we see what we see in time and space.

If the underlying existence is *really* not in time and space, it follows from the geometry that it must be Changeless, Infinite, and Undivided. And, since it is the underlying existence that we *see* in time and space, the Changeless, the Infinite and the Undivided must show through in what we see. Let's call the Undivided showing through in time and space the *condensational energy*, the Infinite showing through, the *dispersional energy*, and the Changeless showing through, the *inertia*, because that time we got the right word. And we have it from Einstein that they're all the same thing, E = m, where E equals energy and m equals inertia. (In India, long ago, they had a word, *Shakti*, which includes both the E and the m. They saw *Shakti* as the underlying existence showing through in time and space. And they saw the whole Universe as made of this *Shakti*, this energy.)

Now, since the money that one earns in a dream never gets in the bank and, since seeing the underlying existence in time and space must be due to a mistake, it would seem to me that neither the condensation, nor the dispersion nor the inertia should succeed. From first principles it would appear that the Universe must have frustration built in. Inertia is frustrated by both the condensational energy and the dispersional energy, because they both promote change. And those two energies frustrate each other, because, to the extent that the condensational energy produces condensation, it gets converted to dispersional energy, and to the extent that the dispersional energy produces dispersion, it gets converted to condensational energy. And the standard illustration is the pendulum and, of course, the planets orbiting around a star. As a comet falls in, it speeds up and coasts away.

As the condensational energy causes the hydrogen to fall together to galaxies and stars it gets converted to the kinetic energy of orbits and heat which prevent the further collapse. And some of it gets converted to radiation which looses its energy to the cosmological expansion (by red shifting) and further prevents collapse.

The dispersional energy of the proton's charge is frustrated by the opposite charge on the electron, and the dispersional energy of the cosmological expansion is frustrated by recycling the particles from the border. Even the entropy doesn't go up.

-John L. Dobson July 21, 2002

NOT TWO

Most of the modern scientists have misunderstood Einstein's 1905 equations, and many of the modern Vedantins have misunderstood Vedanta

Einstein's 1905 geometry puts time in as anti-space so that the time interval between two events must be subtracted from the space interval to get the total space-time separation, which alone is objective. But the total space-time separation between the events stands at zero if the space and time intervals between the two events are equal. Now Einstein didn't like that the space-time separation between two events could go to zero, and he said that the only thing we can understand by its going to zero is that a light beam could get from one event to the other "in vacuuo." But the equation says that the separation goes to zero, and it's the equation that we test.

The mathematician, Minkowski, didn't like the minus sign on the square of the time interval under the radical in Einstein's Pythagorean equation for four dimensions, so he changed it to a plus sign and then put the square root of minus on in front of the time interval. Gerard Pardeilan said that we owe that extravagance to the "First Church of Minkowski." That was very confusing, and the square root of minus one ran through the books for decades on end. And Einstein said, "Since the mathematicians have got hold of relativity, I myself don't understand it."

But if we're going to measure both time and space intervals for our separation equation, we need to find commensurate units, like years and light years. And what is known in the trade as the speed of light is not the speed of anything at all. What's called the speed of light is simply the ratio of space to time. Thirty billion centimeters is equal to a second, and one light year is equal to one year. If you see an explosion a light year away, you'll see if also as a year ago, and the separation between the two events is zero. The separation between us and what we see, and between us and what affects us by gravity, has always been zero.

Now I have met only one physicist who takes that separation equation as Einstein wrote it in 1905, and he says there are no "photons." That's because, for what are know in the trade as "photons" and "gravitons", there is no separation between their emission and absorption events. The objective space-time separation goes to zero. They simply don't exist.

Let me continue with a quote:

"Quantum mechanics, the double slit experiment and Feynman's "sum over histories" are the observational evidence that the geometry of what is known in the trade as the real world is four-dimensional, and that space and time come

into that geometry as a pair of opposites so that the space-time separations between the emission and absorption events for what are know in the trade as "photons" and "gravitons" are zero. That allows us to see, by mistake, a Universe as if spread out before us, yet with zero separation between us and what we see, and with zero separation between us and what affects us by gravity. It's like a dream.

"Gravity, electricity, and inertia are the observational evidence that we are seeing, in time and space, an Underlying Existence which is not in time and space, and is therefore Changeless, Infinite, and Undivided. The Changeless shows through in the misperception as inertia; the Infinite shows through as the electrical energy of the minuscule particles; and the Undivided shows through as gravity and the attraction between opposites."

That's a quote from the Little One in the science fiction story, *The Moon is New.* The Little One has presented the evidence for Einstein's geometry, and she has added the suggestion that there might be an Underlying Existence showing through in our physics.

First we need to understand that if we have mistaken the Underlying Existence for what we see in time and space, we *must* have seen the Underlying Existence, because you can't mistake your friend for a ghost without seeing your friend. And if your friend is tall and thin, the ghost will be tall and thin, and if your friend is roly-poly, you'll see a roly-poly ghost. So the Little One has said that the Changeless, which *must* show through, shows through as inertia, and the Infinite and the Undivided show through as electricity and gravity.

Einstein's famous equation, $E = mc^2$, says that there's no such thing as matter. There's only energy, which those ancient physicists in India said, long ago, was the Underlying Existence showing through. This famous equation has been misinterpreted over the whole planet as meaning that mass could *be converted* to energy. But that would be different equation, $E + m = K$, where K stands for a constant. And since in Einstein's day we were measuring mass in grams and energy in ergs, we had to now how many ergs make a gram. That's the c^2, in that equation. It simply says that the number of ergs that make a gram is the square of thirty billion.

Einstein took *that* equation the way he wrote it, that there's no such thing as matter, and referred to that equation as "the equation in which energy is set *equal* to mass." And toward the end of his life he wrote, "Matter had fallen out of the physics as a fundamental concept." He never made that usual mistake. Most probably he never even saw how it was taught in school.

So much for where our modern scientists have slipped up. How about our modern Vedantins, where have they slipped up?

First we need to go back to those *early* Vedantins, the early physicists, a few thousand years ago. They saw that the Universe is made out of energy, and they even had Einstein's E=m built into their Sanskrit language. Now *their* word for the Universe was *Jagat,* the changing. But they were smart enough to see that change is seen with respect to something else. If you're going down the highway at sixty milers per hour, it's with respect to the highway. So those early physicists saw that there must be, underlying the Universe which we see, an existence not in time and space and therefore neither changing, finite, or divided.

Their question then was, "If what exists is changeless, how do we see change?" And they saw that it *must* be due to a mistake. So they studied mistakes. Now the notion that we have mistaken that Underlying Existence, *Braham*, for the world which we see, and that the Underlying Existence shows through in what we see, is the root of Advaita Vedanta. That's why those early Vedantins studied mistakes.

And they pointed out that in order to mistake a rope for a snake, there are three things that one must do. First, one must fail to see the rope rightly. That they called the veiling power of *Tamas*. Then, one must jump to the conclusion that it's a snake. That they called the projecting power of *Rajas*. And finally, one must have seen the length and diameter of the rope, in the first place, or one never would have mistaken it for the length and diameter of a snake. That they called the revealing power of *Sattva*. You can't mistake your friend for a ghost without seeing your friend. The Underlying Existence *must* show through.

This is where the Sankhyans slipped up. They failed to notice that the first cause of our physics is a mistake and that the Underlying Existence must show through. Then, of course, they also failed to notice that the three *Gunas,* i.e., *Tamas, Rajas,* and *Sattva* are related to three aspects of that mistake. That was their big slip. Nature, *Prakriti*, the first cause, was said to be made of the three *Gunas*, but it wasn't thought to be a mistake. *Prakriti* was said to be active but insentient. And that's another slip. Nature is sentient. Protons discriminate protons, electrons, neutrons, spin up, spin down, gravity, electricity, and inertia. None of our physics would work if matter were insentient. *Prakriti* was said to dance for the *Purushas,* which are sentient. And the name of the game was isolation from the Prakriti. This is very different from Vedanta.

Many of the modern Vedantins have slipped up here, by going along with the Sankhyans in *their* use of the Gunas, and thus, overlooking the importance of the revealing power, they tend to see *Maya*, nature, as a "thing" like the *Prakriti* of the Sankhyans. They fail to see that there is only the Underlying Existence showing through in the revealing power. They don't even mention the revealing power, and they attribute the veiling and projecting powers to ignorance.

This is Sankhya, not Advaita Vedanta, not even Vedanta. Advaita Vedanta says there is only the Underlying Existence. There is nothing else to see. This whole

Universe is nothing but that Underlying Existence, Brahman, as seen in space and time. And the name of the game is to see through the mistake.

Again I quote the Little One in *The Moon is New.* She often referred to Sri Ramakrishna as the Old Man in J.D.'s shrine, and she said, *"The life of the Old Man in J.D.'s shrine is the observational evidence that the underlying existence may be addressed as Mother, and that it's possible to reach Her through many different paths."*

-John L. Dobson Hollywood March 20, 2004

For Swami Swahananda

NOT TWO

By John Dobson
Published 2004-10-22 13:59:57
From 2004
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John L. Dobson Hollywood March 20, 2004 For Swami Swahananda

OBSERVATIONAL COSMOLOGY

Can we, strictly on the basis of observation and without the introduction of singularities, find a cosmological model capable of explaining the red shift, the background radiation, the origin of the hydrogen, and the existence of galaxies and stars?

It was on a paucity of observation that most of the ancient peoples put the center of the Universe within their own domains. Only the people of the Indus Valley Civilization, whose trader carried antimony to Egypt and brought back tin from Western Europe, put it far outside, some 2,000 miles to the west. Four thousand years later, Copernicus, on the basis of night-time observations far more careful that those of Ptolemy of Alexandria in the second century A.D., put the center off the Earth entirely. But even he put it only 93,000,000 miles away, on our own Sun.

Early in this century, on the basis of much more sophisticated observations, Shapely and Trumpler had pushed the center some 30,000 light years farther out, to the center of the galaxy. But Hubble by then had found that galaxies, much like our own, were flung about in space as far as the 100-inch telescope could see. Only then did it cross our minds that perhaps the Universe has no center at all.

By now our observations are far more extensive and by now we understand that the entire Universe consists primarily of hydrogen which seems to be falling together in its own gravitational field to galaxies and stars. But by now our understanding of physics has also gravely changed and new problems undreamed of in those old days have arisen.

The physics of the last century, what we call "classical" physics, has died, although the corpse still lies in state. The old physics of an actual, objective Universe, independent of the observer, has now given way before Relativity Theory and Quantum Mechanics to the physics of an observable Universe in which the point of view of the observer must always determine what he sees.

We now understand, from Quantum Mechanics, that the very existence of the hydrogen atom rests on an uncertainty. We now understand from Heisenberg's Uncertainty Principle, which is the root notion of Quantum Mechanics, that the behavior of matter is governed by an unavoidable uncertainty in our measurements arising from the fact that the measurement itself necessarily disturbs what it measures. We now understand that only this uncertainty "explains" why the hydrogen atom exists. It explains why the electron won't sit down on the proton so that only this uncertainty "explains" why we don't fall through the floor or why the planets and the white dwarf stars don't collapse in their own gravitational fields.

We now also understand, from Relativity Theory, that space and time are opposites and that the observer sees events away from him in space only by seeing them back in time in just such a way that the space and time separations are equal. Thus the total separation, the four-dimensional separation, between the event of perception and the event perceived is zero.

We also understand from Relativity Theory that mass and energy are one and the same (as in $E=mc^2$). And that what we have been calling the mass of the hydrogen atom is simply its electro-gravitational rest energy. That is, we see a Universe consisting preponderantly of hydrogen atoms spaced out from each other against their mutual gravitational attraction in such a way that the gravitational energy represented by the dispersion is equal to the rest mass of the particles. But at the same time we see that the hydrogen atoms consist of electrical charges squeezed down against their own electrical repulsion to minute particles in such a way that the electrical energy represented by their smallness is, again, equal to the rest mass of the particles.[1]

These notions arising from Relativity Theory and Quantum Mechanics have brought a sea-change in our physics. It is against the background of this sea-change that we must now understand the observations, the problems, and the suggested solutions which form the subject matter of modern cosmology.

The Observations and the Problems:

As mentioned earlier, what we see now when we look into the far reaches of the observable Universe, is that the Universe consists primarily of hydrogen which seems to be falling together in its own gravitational field into galaxies and stars. What we don't know is whence came, or whence comes, the hydrogen? And we do not know why it is made up of discrete electrical particles showing gravity and inertia, or when it first fell together into galaxies and stars.

We also see that in the radiation from the distant galaxies the spectral lines, as seen by us, are displaced towards the red end of the spectrum. It is from this evidence that it is usually inferred that the Universe is expanding. What we don't know is whence comes this expansion – if it is an expansion – and, if not, whence comes the red shift?

We further see that from all directions in space we receive a great deal of radiation in the microwave region, an isotropic background radiation which has the form of a black body radiation at about 2.7^0 Kelvin. What we do not clearly understand is how, or from what regions of deep space, this background radiation arises?

From these four observations: that the observable Universe consists largely of galaxies and stars; that the galaxies and stars consist primarily of hydrogen; that the radiation from the distant galaxies is red shifted; and that from

some unexplored regions of space we receive an isotropic background radiation, have arise four of the great questions facing the modern cosmologist.

We must now examine several recently fashionable cosmological models with an eye to determining whether or not they can satisfactorily answer these questions: Whence the hydrogen? Whence the galaxies and stars? Whence the red shift? Whence the background radiation?

Three Models of the Universe:

Out of an effort to explain the red shift arose the Big Bang hypothesis. It was inferred, by George Gamov and others, that the red shift was simply a Doppler Shift occasioned by the recession of those galaxies from us. On the basis of this understanding it was suggested that some 15,000 million of our years ago all the matter of the observable Universe was collected in a very small space, and that from this condition of compression it exploded outward, giving rise to the now observable recession.

Several problems have arisen in connection with this interpretation of the red shift. First, according to our current understanding, if all the matter of the Universe had ever been confined to such a small space its subsequent expansion would have been forbidden by its own gravitational encapsulation to what is now referred to as a Black Hole.

The second and third problems have to do with the temperature of the fireball. At the required temperature, according to our current understanding, the fireball in its early stages must have been smooth, i.e. without density fluctuations, and composed almost entirely of radiation. As the fireball expanded and cooled it is suggested that the radiation itself gave rise to the electrical particles of which the Universe is now seen to be composed. But radiation, cooling to electrical particles, is known to give rise to equal numbers of particles and anti-particles. And there is no evidence that the observable Universe is so composed.

Finally, if the Universe expanded some 15,000 thousand million years ago from a fireball of the required smoothness, then our current understanding is unable to account for the gravitational condensation of galaxies and stars within the still expanding gas in so short a time.

To obviate this last difficulty, as well as to avoid the necessity of introducing a singularity into the cosmological model, it was pointed out by Hoyle and others that even assuming the expansion to be real, we are not required to assume that it had its beginning in an explosion. Instead it was proposed that a continuous expansion without decreasing density could be maintained by a continuous creation of new hydrogen throughout the expanding spaces.

However, the recent observational discovery of the quantitatively important cosmic background radiation has thrown this second suggestion into disfavor. It is generally considered that the Steady State model cannot account for the existence of this 2.7^0 Kelvin background radiation, which is usually interpreted as the "echo" of the "Big Bang", i.e. the brightness of the fireball is seen Doppler shifted by 15,000 thousand million years of expansion. This is often referred to as the "proof" of the Big Bang model and the "tombstone" of the Steady State.

This interpretation, however, leaves unsolved all the problems of the Big Bang model mentioned earlier, which it was hoped that the Steady State model would obviate.

Thus, conceding the necessity of fitting our theoretical models to the observational constraints, rather than to the conceptual constraints arising from classical physics, Sir Fred Hoyle has recently called in question the interpretation of the red shift as evidence of expansion. "Expansion with respect to what?" he asks. Obviously it is with respect to the sizes of the atoms. But if we look at this the other way around it is tantamount to the suggestion that the Universe is not expanding at all but simply that the atoms are getting continually smaller.[2]

It is the same as the problem of whether the largeness of the elephant is due to the smallness of the mouse or whether the smallness of the mouse is due to the largeness of the elephant. Now if we look at the red shift the other way around and consider that the atoms are getting smaller, it will, as Hoyle points out, have consequences which we can examine theoretically.

Since the electrical rest mass of the particles is related to their sizes (i.e. work must be done to make them small), it is clear that a decrease in size would entail an increase in rest mass. Hoyle's suggested explanation of the red shift, then, is simply that as we look far away from us in space, and therefore far back in time, we are seeing the radiation from the atoms at a time when they really were much larger and less massive. The question is: What governs the change in size and rest mass of the particles? His answer is gravitational interactions. He suggests that the gravitational interactions which have given rise to the present rest mass of the particles began some 15,000 thousand million years ago, at a time singularity which the proponents of the Big Bang theory refer to as "the beginning of the Universe". But instead of considering the time singularity as the beginning of the Universe we need only consider it, he points out, as a cross-over from a time of minus-minus gravitational interactions to a time of plus-plus gravitational interactions.

Here he seems to regard electricity and gravity as opposites in the sense that whereas like <u>electrical</u> charges repel and unlike <u>electrical</u> charges attract, like <u>gravitational</u> charges attract and unlike <u>gravitational</u> charges repel. Then, at times greatly in excess of 15,000 thousand million years ago – that is, far from

the singularity on the far side, when the gravitational interactions were predominantly minus-minus, the rest masses of the particles would have been much as they are now when the gravitational interactions are predominantly plus-plus. But close to the singularity, on either side, when the plus-minus interactions (repulsive) were nearly equal to the sum of the plus-plus and minus-minus interactions (attractive), the rest masses of the particles would necessarily be less, approaching zero at the singularity.

At the cost of introducing this time singularity Sir Fred is then able to explain not only the red shift, but the background radiation and the existence of galaxies and stars as well. The red shift, as mentioned earlier, is explained as the radiation from atoms that really were larger and less massive. The background radiation is explained as the radiation from stars and galaxies in the time before the singularity thermalized to a 2.7^0 Kelvin black body radiation by its interaction with particles of low rest mass at time close to the singularity. Finally, since the Universe is not considered to be expanding the problem of how galaxies arose within the expanding gas in so short a time does not arise.

It will be remembered that none of these models has a satisfactory explanation for the origin of the hydrogen. And even at the cost of introducing a singularity the Big Bang model failed to explain the existence of galaxies and stars. It will also be remembered that the old Steady State model failed to explain the background radiation. Hoyle's new cosmological suggestion is able to explain the red shift, the background radiation, and also the appearance of galaxies and stars, but only by introducing a singularity that was not found necessary in the old Steady State model.

The question is: can we avoid the singularity and yet find solutions for the four problems of modern cosmology, including the origin of the hydrogen? Can we, confining ourselves to the observational point of view of modern physics, avoid the difficulties facing the three models discussed above in the construction of a fourth?

A Fourth Model of the Universe

Without the introduction of the gravitational singularity suggested by Sir Fred, we (the authors) have already understood electricity and gravity as opposites, but in a somewhat different sense (see endnote 1 below). Also, since we understand the smallness of the proton as appearing by contrast to the overall largeness of the observable Universe, rather than by contrast to the distances between the clusters of galaxies, we choose to go along with the older interpretation of the red shift. That is that it is due to a cosmological expansion. But what is the driving mechanism for this expansion? The Steady State had no answer and we cannot accept the mechanism suggested by the Big Bang theory since it is beset by too many problems. Rather than seeing it as arising from a

sudden, inexplicable explosion, we see the expansion as arising from the continual gravitational condensation of the hydrogen into galaxies and stars.

When we take a close look at what we know about the overall flow of energy in the Universe as a whole we find an odd thing. We find that the energy is being converted primarily from gravitational energy to radiation. As gravity condenses the hydrogen to galaxies and stars they radiate away this energy into the expansion of the space. And even if, after several thousand million years, the radiation is absorbed at all, (which is an unlikely event) it is absorbed with an energy far less than the energy of its emission. Now where does all the radiation go? Where does the energy go which the radiation loses in its long traverse of the vast, expanding spaces of the Universe? It is lost in the expansion. If the Universe did not expand the energy would not be lost and the night sky might not be dark.

Now in an internal combustion engine, when the energy of the expanding gases is lost to the expansion of the chamber, we say that the energy of the expanding gases is the cause of the expansion of the chamber. Can we not say then, in the same sense, that the energy of the radiation that is lost to the expansion of the Universe drives that expansion?

The observable Universe must have a boundary imposed by this expansion, since objects receding from the observer faster than the speed of light cannot be seen or gravitationally felt by him or her. The greater the rate of expansion, the smaller the Universe enclosed within the boundary because the greater the rate of expansion, the nearer to the observer will be the points at which the receding objects will appear to approach the speed of light. Conversely, the lower the rate of expansion, the larger the Universe enclosed within the boundary. And if the expansion were to stop, the Universe might conceivably be infinite, and the brightness of the night sky might rival the sun.

Now if our understanding of the rest mass of the proton is correct, that is, if really it is gravitationally determined, then the greater the rate of expansion, the smaller would be the rest mass of the protons, and vice versa. This follow because the expansion rate governs the size of the observable Universe and therefore the number of protons from which each proton sees itself dispersed.

Curiously enough this gives us a governing mechanism on the expansion rate. The larger the expansion rate, the smaller the observable Universe which determines the rest mass of the particles. The lower the rest masses of the particles, the slower their rate of gravitational collapse and, therefore, the lower the radiation rate which drives the expansion. The smaller the expansion rate, on the other hand, the larger would be the observable Universe which determines the rest mass of the particles. And the greater the rest masses of the particles, the faster their rate of gravitational collapse and, therefore, the greater the radiation rate which drives the expansion.

It is in light of these considerations that we suggested earlier that the smallness of the proton is ***exactly*** the same thing as the largeness of the Universe. Changing one changes the other. It is the ratio of the smallness of the proton to the largeness of the observable Universe that determines the local rest mass of the protons.

The boundary imposed on the observable Universe by this expansion is of the nature of an event horizon and no observer can see anything disappear beyond it. This is because as something is seen to approach the boundary its speed of recession is seen to approach the speed of light. As such its radiation will be seen to be red shifted toward zero energy and its clocks (that is, all its internal motions) will be seen to be red shifted toward a stop. Its progress toward the boundary, along with the motion of its clocks, will also be seen to be red shifted toward a stop.

Now if, as seen by us, the energy of the radiation from distant particles appears red shifted away, then, as seen by us, the energy of those particles themselves (and therefore their rest masses) must likewise appear red shifted away. This apparent loss of rest mass by particles near the boundary clears up our understanding of the boundary in two important ways. First, the radiation reaching us from the region of the low rest mass particles must come in thermalized to a black body radiation at a very low temperature, just as we find it in the observed 2.7^0 Kelvin background radiation. Second, the particles themselves may be recycled back into the observable Universe through the Uncertainty Principle.

Heisenberg's Uncertainty Principle relates the observer to the observed through a necessary uncertainty in the position and momentum of the observed particles. If the uncertainty in the momentum of the particle approaches zero, the uncertainty in its position must approach infinity. As the mass of a particle approaches zero our uncertainty in its momentum must also approach zero because that momentum itself approaches zero. But if the uncertainty in the momentum approaches zero as the particle nears the boundary then the uncertainty in its position must approach infinity. Thus we can no longer say that it is near the boundary – that is, we can no longer determine by any measurement that it is "there".

From this standpoint we can understand the "continuous" creation required by the old Steady State model as not creation at all, but simply the material from the boundary being recycled back into the Universe. It is recycled back in through the Uncertainty Principle in the form of "new" hydrogen, with possibly some helium, and reappearing anywhere in the observable Universe.

In the first three models sketched earlier the Universe is taken to be "actual" and "objective". Only in the fourth model are actuality and objectivity called into question. It may seem at first sight that this runs counter to the whole trend of modern physics, but that is far from true. It runs counter only to the point of view of *classical* physics, but we now know that *that* physics was wrong.

We assumed, long ago, that the Universe had a center which could be objectively located. Ptolemy put it on the Earth. Copernicus put it on the Sun. Others, more recently, have put it elsewhere but always under the same assumption that the Universe is "***actual***" rather than "***observational***". However, if, at Einstein's suggestion, "we confine ourselves to observables", then we see that regardless of the interpretation of the apparent expansion that the red shift imposes a boundary on the observable Universe. This boundary is such that ***all*** observers, no matter how far apart they may appear to be, *always find themselves at the center of the Universe.*

What is seen in the first and third models as an objective singularity is seen in the fourth as an observational boundary to an observable Universe. It is, at once, a boundary of mass, of energy, of space, and of time. But it is not a boundary which can ever be visited. It is not a boundary which can ever be reached by an observer. The observer is always remote from the boundary by a distance which is the same in all directions and which is determined by the expansion rate.

Seen from this standpoint we can, without the introduction of a singularity, explain the red shift, the background radiation, the existence of galaxies and stars, and even the origin of the new hydrogen suggested in the old Steady State model.

One problem, however, remains. It is probably the greatest problem in Astronomy and the greatest problem of all physics.

Whence This Hydrogen?

By now it must be obvious that none of the three cosmological models discussed above is in a position even to attack the problem of the origin of the hydrogen. The Big Bang model has no source for the fireball. The old Steady State model had no source for the continuous creation. Hoyle's new cosmological suggestion simply pushes the problem to a remote past.

It is only from the standpoint of the fourth model suggested above that the problem can be attacked. But since a detailed discussion of the nature and origin of the hydrogen would be lengthy we are forced to leave it for another article on "apparitional geometry".

Before concluding, however, we would like to point out the nature of the problem. Hydrogen is made of energy, primarily electro-gravitational energy. Now if all we mean by "causation" is the transformation of that energy from one form to another then we have effectively "thrown in the sponge" on the problem of the origin of the hydrogen. That is because energy cannot arise from a transformation of energy. Nor can the Conservation Laws which govern "transformational causation" arise from such a transformation. As we see it the problem really arises from rejecting the root notions of Relativity Theory and Quantum Mechanics and simply falling back (at the prompting of our genes) to the old but classical notion that the Universe is "actual". That is, to claim that whatever exists arises by transformation.

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[1] See Dobson, "The Electro-gravitational Rest Energy of the Primordial Hydrogen", Publications of the Astronomical Society of the Pacific, Volume 88, p. 606.
[2] See Hoyle, "Highlights in Astronomy, pp. 164-169

OBSERVATIONAL COSMOLOGY

Can we, strictly on the basis of observation, and without the introduction of singularities, find a cosmological model capable of explaining the red shift, the background radiation, the origin of the hydrogen and the existance of galaxies and stars?

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It was on a paucity of observation that most of the ancient peoples put the centre of the universe within their own domains. Only the people of the Indus Valley Civilization, whose traders carried antimony to Eygpt and brought back tin from Western Europe put it far outside, some two thousand miles to the west. Some four thousand years later, Copernicus, on the basis of night-time observations more careful than those of Ptolemy of Alexandria in the second century A.D., put the centre off the earth entirely. But even he put it only ninety three million miles away, on our own sun. Early in this century, on the basis of much more sophisticated observations, Shapely and Trumpler had pushed the centre some thirty thousand light years farther out, to the centre of the galaxy. But Hubble, by then, had found that galaxies, much like our own, were flung about in space as far as the hundred inch telescope could see. And only then did it cross our minds that perhaps the universe has no centre at all.

By now our observations are far more extensive, and by now we understand that the entire universe consists primarily of hydrogen which seems to be falling together in its own gravitational field to galaxies and stars. But by now our understanding of physics has gravely changed, and problems undreamed of in those old days have now arisen.

By now the physics of the last century, what we call classical physics, has died, though the corpse still lies in state. By now the physics of an actual, objective universe, independent of the observer, has given way before relativity theory and quantum mechanics to the physics of an observable universe in which the point of view of the observer must always determine what he sees.

By now we understand, from quantum mechanics, that the very existance of the hydrogen atom rests on an uncertainty. We understand, from Heisenberg's uncertainty principle, which is the root notion of quantum mechanics, that the behavior of matter is governed by an unavoidable uncertainty in our measurements arising from the fact that the measurement itself necessarily disturbs what it measures. We understand now that only this uncertainty "explains" why the hydrogen atom exists, why the electron won't sit down on the proton, and that only this uncertainty "explains" why we don't fall through the floor or why the planets and the white dwarf stars don't collapse in their own gravitational fields.

By now we also understand, from relativity theory, that space and time are opposites and that the observer sees events away from him in space only by seeing them back in time in just such a way that the space and time separations are equal and the total separation, the four-dimensional separation, between the event of perception and the event perceived is zero. And we also understand from relativity theory that mass and energy are one and the same. ($E = mc^2$). And that what we have been calling the mass of the hydrogen atom is simply its electro-gravitational rest energy. That is, we see a universe consisting preponderantly of hydrogen atoms spaced out from each other against their mutual gravitational attraction in such a way that the gravitational energy represented by the dispersion is equal to the rest mass of the particles. But at the same time we see that the hydrogen atoms consist of electrical charges squeezed down against their own electrical repulsion to minute particles in such a way that the electrical energy represented by their smallness is, again, equal to the rest mass of the particles. (See Dobson, "The Electro-gravitational Rest Energy of the Primordial Hydrogen", Publications of the Astronomical Society of the Pacific, Volume 88, p. 606.)

These notions, arising from relativity theory and quantum mechanics, have brought a sea-change in our physics, and it is against the background of this sea-change that we must now understand the observations, the problems and the suggested solutions which form the subject matter of modern cosmology.

The Observations and the Problems

As we mentioned earlier, what we see now when we look into the far reaches of the observable universe, is that the universe consists primarily of hydrogen which seems to falling together in its own gravitational field to galaxies and stars. What we don't know is whence came, or whence comes, the hydrogen or why it is made up of discrete electrical particles showing gravity and inertia, or when first it fell together into galaxies and stars.

We also see that in the radiation from the distant galaxies the spectral lines, as seen by us, are displaced toward the red end of the spectrum. It is from this evidence that it is usually inferred that the universe is expanding. What we don't know is whence comes this expansion, if it is an expansion, and if not, whence comes the red shift.

We further see that from all directions in space, we receive a great deal of radiation in the microwave, an isotropic background radiation which has the form of a black body radiation at about 2.7^{o} Kelvin. What we do not clearly understand is how, or from what regions of deep space, this background radiation arises.

From these four observations, that the observable universe consists largely of galaxies and stars, that the galaxies and stars consist primarily of hydrogen, that the radiation from the distant galaxies is red shifted, and that from some unexplored regions of space we receive an isotropic background radiation, have arisen four of the great questions facing the modern cosmologist. And we must now examine several recently

fashionable cosmological models with an eye to determining whether or not they can satisfactorily answer these questions: Whence the hydrogen? Whence the galaxies and stars? Whence the red shift? Whence the background radiation?

Three Models of the Universe

Out of an effort to explain the red shift arose the big bang hypothesis. It was inferred, by Gamov and others, that the red shift was simply a Doppler shift occasioned by the recession of those galaxies from us. On the basis of this understanding it was suggested that some fifteen thousand million of our years ago, all the matter of the observable universe was collected in a very small space, and that from this condition of compression it exploded outward, giving rise to the now observable recession.

Several problems have arisen in connection with this interpretation of the red shift. First, according to our current understanding, if all the matter of the universe had ever been confined to such a small space, its subsequent expansion would have been forbidden by its own gravitational encapsulation to what is now referred to as a black hole.

The second and third problems have to do with the temperature of the fireball. At the required temperature, according to our current understanding, the fireball, in its early stages, must have been smooth, i.e. without density fluctuations, and composed almost entirely of radiation. As the fireball expanded and cooled it is suggested that the radiation itself gave rise to the electrical particles of which the universe is now seen to be composed. But radiation, cooling to electrical particles, is known to give rise to equal numbers of particles and anti-particles. And there is no evidence that the observable universe is so composed.

Finally, if the universe expanded, some fifteen thousand million years ago, from a fireball of the required smoothness, then our current understanding is unable to account for the gravitational condensation of galaxies and stars, within the still expanding gas, in so short a time.

To obviate this last difficulty, as well as to avoid the necessity of introducing a singularity into the cosmological model, it was pointed out, by Hoyle and others, that even assuming the expansion to be real, we are not required to assume that it had its beginning in an explosion. Instead, it was proposed that a continuous expansion, without decreasing density, could be maintained by a continuous creation of new hydrogen throughout the expanding spaces.

However, the recent observational discovery of the quantitatively important cosmic background radiation has thrown this second suggestion into disfavour. It is generally considered that the steady state model cannot account for the existance of this 2.7° Kelvin background radiation, which is usually interpreted as the "echo" of the "big bang", i.e. the brightness of the fireball seen Doppler shifted by fifteen thousand million years of expansion, and which is often referred to as the "proof" of the big bang model and the "tombstone" of the steady state.

This interpretation, however, leaves unsolved all the problems of the big bang model, mentioned earlier, which it was hoped that the steady state model would obviate.

Thus, conceeding the necessity of fitting our theoretical models to the observational constraints, rather than to the conceptual constraints arising from classical physics, Sir Fred Hoyle has recently called in question the interpretation of the red shift as eveidence of expansion. 'Expansion with respect to what?' he asks. Obviously, with respect to the sizes of the atoms. But if we look at this the other way around, it is tantamount to the suggestion that the universe is not expanding at all but simply that the atoms are getting continually smaller. (See Hoyle, Highlights in Astronomy, pp. 164-69) It is the same as the problem of whether the largeness of the elephant is due to the smallness of the mouse, or whether the smallness of the mouse is due to the largeness of the elephant. Now if we look at the red shift the other way around, and consider that the atoms are getting smaller, it will, as he points out, have consequences which we can examine theortically.

Since the electrical rest mass of the particles is related to their sizes (i.e. work must be done to make them small), it is clear that a decrease in size would entail an increase in rest mass. His suggested explanation of the red shift, then, is simply that as we look far away from us in space, and therefore far back in time, we are seeing the radiation from the atoms at a time when they really were larger and less massive. The question is: What governs the change in the size and rest mass of the particles? His answer is gravitational interactions. He suggests that the gravitational interactions which have given rise to the present rest mass of the particles began some fifteen thousand million years ago, at a time singularity which the proponants of the big bang theory refer to as the "beginning of the universe". But instead of considering the time singularity as the beginning of the universe, we need only consider it, he points out, as a cross-over from a time of minus-minus gravitational interactions to a time of plus-plus gravitational interactions.

Here he seems to regard electricity and gravity as opposites in the sense that whereas like electrical charges repel and unlike electrical charges attract, like gravitational charges attract and unlike gravitational charges repel. Then, at times greatly in excess of fifteen thousand million years ago, that is, far from the singularity on the far side, when the gravitational interactions were predominantly minus-minus, the rest masses of the particles would have been much as they are now, when the gravitational interactions are predominantly plus-plus. But close to the singularity, on either side, when the plus-minus interactions (repulsive) were nearly equal to the sum of the plus-plus and minus-minus interactions (attractive), the rest masses of the particles would, necessarily, be less, approaching zero at the singularity.

At the cost of introducing this time singularity, Sir Fred is then able to explain not only the red shift, but the background radiation and the existance of galaxies and stars

as well. The red shift, as mentioned earlier, is explained as the radiation from atoms that really were larger and less massive. The background radiation is explained as the radiation from stars and galaxies in the time before the singularity, thermalized to a 2.7° Kelvin black body radiation by its interaction with particles of low rest mass at times close to the singularity. Finally, since the universe is not considered to be expanding, the problem of how galaxies arose, within the expanding gas, in so short a time, does not arise.

It will be remembered that none of these models has a satisfactory explanation for the origin of the hydrogen, and that even at the cost of introducing a singularity, the big bang model failed to explain the existance of galaxies and stars. It will also be remembered that the old steady state model failed to explain the background radiation. And Hoyle's new cosmological suggestion is able to explain the red shift, the background radiation and also the appearance of galaxies and stars, but only by introducing a singularity not found necessary in the old steady state model. Can we avoid the singularity and yet find solutions for the four problems of modern cosmology, including the origin of the hydrogen? Can we, confining ourselves to the observational point of view of modern physics, avoid the difficulties facing the three models discussed above in the construction of a fourth?

The Fourth

Since without the introduction of the gravitational singularity suggested by Sir Fred, we (the authors) have already understood electricity and gravity as opposites, but in a somewhat different sense (See Dobson, cited above), and also, since we understand the smallness of the proton as appearing by contrast to the overall largeness of the observable universe, rather than by contrast to the distances between the clusters of galaxies, we choose to go along with the older interpretation of the red shift. That is, that it is due to a cosmological expansion. But what is the driving mechanism for this expansion? The steady state had no answer, and we cannot accept the mechanism suggested by the big bang theory since it is beset by too many problems. Rather than seeing it as arising from a sudden, inexplicable explosion, we see the expansion as arising from the continual gravitational condensation of the hydrogen into galaxies and stars.

When we take a close look at what we know about the overall flow of energy in the universe as a whole, we find an odd thing. We find that the energy is being converted primarily from gravitational energy to radiation. As gravity condenses the hydrogen to galaxies and stars they radiate away this energy into the expansion of the space. And even if, after several thousand million years, the radiation is absorbed at all, (which is an unlikely event) it is absorbed with an energy far less than the energy of its emmission. Now where does all the radiation go? Where does the energy go which the radiation

loses in its long traverse of the vast, expanding spaces of the universe? It is lost in the expansion. If the universe did not expand the energy would not be lost and the night sky might not be dark.

Now in an internal combustion engine, when the energy of the expanding gases is lost to the expansion of the chamber, we say that the energy of the expanding gases is the cause of the expansion of the chamber. Can we not say, then, in the same sense, that the energy of the radiation that is lost to the expansion of the universe drives that expansion?

Now the observable universe must have a boundary imposed by this expansion, since objects receding from the observer faster than the speed of light cannot be seen or gravitationally felt by him or her. And the greater the rate of expansion, the smaller the universe enclosed within the boundary. Because the greater the rate of expansion, the nearer to the observer will be the points at which the receding objects will appear to approach the speed of light. Conversely, the lower the rate of expansion, the larger the universe enclosed within the boundary, and, if the expansion were to stop, the universe might, conceivably, be infinite, and the brightness of the night sky might rival the sun.

Now if our understanding of the rest mass of the proton is correct, that is, if really it is gravitationally determined, then the greater the rate of expansion, the smaller would be the rest mass of the protons, and vice versa, since the expansion rate governs the size of the observable universe and therefore the number of protons from which each proton sees itself dispersed.

Curiously enough, this gives us a governing mechanism on the expansion rate. Because the larger the expansion rate, the smaller the observable universe which determines the rest mass of the particles. And the lower their rest masses the slower their rate of gravitational collapse and, therefore, the lower the radiation rate which drives the expansion. The smaller the expansion rate, on the other hand, the larger would be the observable universe which determines the rest mass of the particles. And the greater their rest masses, the faster their rate of gravitational collapse and, therefore, the greater the radiation rate which drives the expansion.

It is in the light of these considerations that we suggested earlier that the smallness of the proton is <u>exactly</u> the same thing as the largeness of the universe. Changing one changes the other. It is the ratio of the smallness of the proton to the largeness of the observable universe that determines the local rest mass of the protons.

Now the boundary, imposed on the observable universe by this expansion, is of the nature of an event horizon and no observer can see anything disappear beyond it. Because, as something is seen to approach the boundary, its speed of recession is seen to approach the speed of light. Then its radiation will be seen to be red shifted toward zero energy, its clocks (that is, all its internal motions) will be seen to be red shifted toward a stop, and its progress toward the boundary, along

with the motion of its clocks, will also be seen to be red shifted toward a stop.

Now if, as seen by us, the energy of the radiation from distant particles appears red shifted away, then, as seen by us, the energy of those particles themselves, and therefore their rest masses, must likewise appear red shifted away. Now this apparent loss of rest mass by particles near the boundary clears up our understanding of the boundary in two important ways. First, the radiation reaching us from the region of the low rest mass particles must come in thermalized to a black body radiation at very low temperature, as we find it in the 2.7° Kelvin background radiation. And second, the particles themselves may be recycled back into the observable universe through the uncertainty principle. Heisenberg's uncertainty principle relates the observer to the observed through a necessary uncertainty in the position and momentum of the observed particles in such a way that if the uncertainty in the momentum of a particle approaches zero, the uncertainty in its position must approach infinity. Now as the mass of a particle approaches zero our uncertainty in its momentum must also approach zero because that momentum itself approaches zero. But if the uncertainty in the momentum approachs zero as the particle nears the boundary then the uncertainty in its position must approach infinity; so that we can no longer say that it is near the boundary, that is, we can no longer determine by any measurement that it is there.

From this standpoint, then, we can understand the "continuous" creation required by the old steady state model as no creation at all but simply as material from the boundary, recycled through the uncertainty principle, in the form of new hydrogen, with possibly some helium, and reappearing anywhere in the observable universe.

In the first three models sketched above, the universe is "actual" and "objective". Only in the fourth are actuality and objectivity called in question, and it may seem at first sight that this runs counter to the whole trend of modern physics. But that is far from true. It runs counter only to the point of view of classical physics, and we know that that physics was wrong.

We assumed, long ago, that the universe had a centre which could be objectively located. Ptolemy put it on the earth. Copernicus put it on the sun. Others, more recently, have put it elsewhere, but always on the same assumption, that the the universe is actual rather than observational. But if, at Einstein's suggestion, "we confine ourselves to observables", then we see that, regardless of the interpretation of the apparent expansion, the red shift imposes a boundary on the observable universe such that all observers, no matter how far apart they appear to be, find themselves at the centre.

What is seen in the first and third models as an objective singularity is seen in the fourth as an observational boundary to an observable universe. It is, at once, a boundary of mass, of energy, of space and of time. But it is not a boun-

dary which can be visited. It is not a boundary which can be reached by an observer. The observer is always remote from the boundary by a distance which is the same in all directions and determined by the expansion rate.

Seen from this standpoint, we can, without the introduction of a singularity, explain the red shift, the background radiation, the existance of galaxies and stars and even the origin of the new hydrogen suggested in the old steady state.

One problem, however, remains; probably the greatest problem of astronomy and the greatest problem of all physics.

Whence this Hydrogen?

It must by now be obvious that none of the three cosmological models discussed above is in a position even to attack the problem of the origin of the hydrogen. The big bang model has no source for the fireball. The old steady state had no source for the continuous creation. And Hoyle's new cosmological suggestion simply pushes the problem to a remote past. It is only from the standpoint of the fourth that the problem can even be attacked. But, since a detailed discussion of the nature and origin of the hydrogen would be lengthy, we are forced to leave it for another article on apparitional geometry.

Before concluding, however, we would like to point up the nature of the problem. Hydrogen is made of energy, primarily electro-gravitational energy. Now if all we mean by causation is the transformation of that energy, from one form to another, then we have thrown in the sponge on the problem of the origin of the hydrogen. Because energy cannot arise from a transformation of energy. Nor can the conservation laws which govern transformational causation arise from such a transformation. As we see it, the problem really arises from rejecting the root notions of relativity theory and quantum mechanics and falling back, at the prompting of the genes, to the old, classical notion that the universe is actual, that is, that whatever exists arises by transformation.

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	BIG BANG	STEADY STATE	HOYLE's C S	THE FOURTH
Singularity required?	yes	no	yes	no
Beginning required?	yes	no	no	no
Creation	? sudden	? continuous	? remote	apparitional recycled
Origin of hydrogen	big bang	continuous creation	? remote	apparitional hydrogen recycled from boundary
Origin of galaxies	?	continuous	remote	continuous from recycled hydrogen
Interpretation of red shift	expansion	expansion	contraction of atoms	expansion
Driving mechanism	explosion	?	gravitational interactions	radiation from gravitational collapse
Entropy	increasing	steady	increasing	steady
Background radiation	"echo" of big bang	?	old radiation thermalized through singularity	radiation thermalized at observational boundary

OBSERVATIONAL EVIDENCE

Quantum Mechanics is the observational evidence that the geometry of what is known in the trade as the "real world" is four dimensional, and that space and time come into that geometry as a pair of opposites, so that the space-time separations between the emission and absorption events for what are known in the trade as "photons" and "gravitons" are zero. That allows us to see, by mistake, a Universe spread out before us with zero separation between us and what we see, and with zero separation between us and what affects us by gravity. It is like a dream, but the separation is *objectively* zero.

The existence of gravity, electricity, and inertia is the observational evidence that we are seeing, in space and time, an Underlying Existence which is *not* in space and time and is therefore Undivided, Infinite, and Changeless. The Changeless shows through in the misperception as inertia; the Infinite shows through as the electrical energy of the miniscule particles; and the Undivided shows through as gravity and the attraction between opposites. That allows us to see a Universe of hydrogen, falling together by gravity to galaxies and stars, planets, and people. It is like a dream, and the notion that we are made out of meat is part of the dream.

Sri Ramakrishna is the observational evidence that this Underlying Existence may be addressed as "Mother", and that it's possible to reach Her. That allows us to understand that it's even possible to see *through* this misperception.

All this is Mother. Had there been anything else, I'd have written it down.

-John L. Dobson, February 26, 2003