"The Big Bang Never Happened"

by

Michael B. Wisenbaker

Scientific Symposium III
July 5, 1994
Oklahoma City, Oklahoma

TABLE OF CONTENTS

"The Big Bang Never Happened"

I. <u>The "Big Bang" Cosmological Model Rests on Four Observable Facts:</u>

A. The Outward Motion of Galaxies, discovered by Hubble in 1929, was interpreted as evidence for the expansion and explosive beginning of the universe. Two kinds of measurements were needed in Hubble's analysis, the speed and distance of neighboring galaxies. Since the early 1900's it had been thought that neighboring galaxies were speeding away from Earth as determined by what is known as the "Doppler Shift," which is evidenced by the "redshift" of light waves.

1. **"Redshift of Waves"**

When a source of light is in motion, its colors shift, analogously to the shift in pitch of a moving source of sound. In light, the analogue of pitch is color. If a source of light is moving closer, its colors are shifted up in frequency, toward the blue end of the spectrum; if the source is moving away, its colors are shifted down, toward the red. From the amount of shift, the speed of the moving source of light can be inferred. (Figure 1)

2. **"Recession of Galaxies"**

Hubble discovered that the colors of most nebula were shifted toward the red, indicating that they were speeding away from us. This change in color of cosmic objects is known as "redshift."

If galaxies were flying away from each other, they would have been closer together in the past; thus it was felt that the universe was more dense at earlier times. If this backward extrapolation were continued, there would be some definite moment in the past when all matter in the universe was crammed together in a state of almost infinite density. From the rate of expansion, when this point in time occurred could be estimated: about 10 - 15 billion years ago. This concept of the beginning of the universe came to be called the "Big Bang" model, according to which the universe began in a sort of explosion, starting out from infinite density and temperature, and then expanded, thinned out, and cooled. The Big Bang model logically follows from Einstein's theory of gravity to provide a mathematical description of the universe.

The Big Bang was not like an ordinary explosion in which a localized region of flying debris spreads out into a surrounding region of non-moving space, but instead it was to have occurred everywhere. Under such a view there would be no surrounding space for the universe to move into, because any such space would be part of the universe; the concept of the individual particles in the universe flying away from one another is like marks on the surface of a balloon all receding from one another as the balloon is blown up. (Figure 2).

B. Age of Earth Determined by Radioactivity

There is a completely independent method for verifying the age of the Earth, radioactive dating of uranium ore. The approximate match between the age of the Earth as calculated in this manner, and the age of the universe according to the Big Bang model as gauged by recession of galaxies, is good. Radioactive dating of uranium ore suggests the age of the Earth to be 4 billion years -- as opposed to a million years or 10 trillion years -- relatively very close to the age of 10 - 15 billion years which the Big Bang model predicts for the universe.

C. The Overall Chemical Makeup of the Universe

In addition to providing an explanation for the observed expansion and age of the universe, the Big Bang model explains why the overall chemical makeup of the universe is approximately 25% helium and 75% hydrogen, and attempts to explain such chemical make-up in terms of atomic

processes of the early universe. According to the Big Bang model the universe was once so hot that none of the chemical elements except for hydrogen and helium, the lightest elements, could exist. All other elements consist of a fusion of two or more particles, which could not hold together under the intense heat of the very early universe as it expanded and cooled.

Calculations done by Hoyle and others in 1964 and refined by Peebles in 1966, and Fowler and Hoyle in 1967, showed that nuclear fusion in just a few minutes after the Big Bang should have converted approximately 25% of the mass of the universe to helium, the next lightest element after hydrogen. It is believed that all heavier elements are manufactured in nuclear reactions in the centers of stars; as a result of such reactions and subsequent stellar explosions, other chemical elements, (O_2 + C, etc.), make up only a trace of the mass of the universe. (Figure 3).

D. Cosmic Background Radiation

The other important experimental confirmation of the Big Bang theory is the "cosmic background radiation", the bath of radio waves from space, which first was predicted as a necessary remnant of a hot, younger universe and then was actually discovered in 1965.

The cosmic background radiation was first predicted by Gannow in 1948 and later independently predicted by Peebles, et al in 1965. Both groups contended that when the universe a few seconds old, a special kind of radiation would have been produced throughout space and then would have traveled freely throughout space, appearing today with a wavelength corresponding to radio waves and a temperature of about 3°K above absolute zero. According to such theory, when the temperature of the universe dropped to 3,000°K, at about 300,000 years ago after Big Bang, protons and electrons combined to form helium. At such time, all matter and radiation went separate ways and in the 15 billion years of universe expansion since, the radiation has cooled to 2.74°K.

In 1965 such background radiation was discovered by scientists at Bell Laboratories, and then in 1989 the COBE satellite was launched and confirmed that the spectrum of cosmic background radiation is very close to what was predicted by the Big Bang model: the cosmic background radiation was found to be a perfectly smooth 2.735°K in all directions of space (isotropic), to a sensitivity of one part in 100,000.

Using the Big Bang model as a predicate, comprehensive cosmological theories have developed of how the stars and galaxies were formed; how galaxies have taken on different shapes; and how they have aged. (Figure 4)[1]. By the early 1990's the Big Bang model of the universe had, in fact, become well-developed and so well accepted that it had in fact had become part of the public consciousness; as Figure 5 - the current cosmological world view as published by Astronomy Magazine in March, 1994 - attests.

At the beginning of the 1990's the Big Bang model was "alive and well".

II. Trouble in "Bang Land"

The Big Bang theory of the origin and evolution of the universe began to develop major problems throughout the 1970's and 1980's as new astronomical observations became inconsistent with more and more of its theoretical underpinnings.

A. Dark Attractors

During the 1970's as some astronomers mapped the velocities of wandering galaxies, Rubin and Ford concentrated on galaxies' spiral arms, reasoning that the way a galaxy was spinning would go a long way toward explaining its structure and movement: they used spectroscopy to determine whether light from the galaxies' arms moved toward the red or blue end of the spectrum. (Figure 6). Astronomers assumed that the largest

---

[1] Astronomy Magazine, "Seven Mysteries of Galaxies", Pages 39-40, March 1994.

concentration of a galaxy's mass was tucked around its core; thus, a galaxy should behave like a gigantic solar system. The great gravitational attraction of the galaxy's central mass should keep the outer objects in place and set their velocity according to Newton's inverse-square law; the close-in objects should speed around the center while the more distant objects would rotate at a slower pace. Since this is true of our solar system, it should be no different for any galaxy. (Figure 7). (Newton's law of gravitation in its most simple form, states that the mutual attractive force between two bodies is proportional to the product of their masses divided by the square of the distance between them.)

Astronomers used redshift calculations to determine that the outer stars in spiral galaxies moved as fast as those near the core; they were astonished. Unless something unseen was holding the galaxies together, Newton's inverse-square law would require that the outer stars and gases should have twirled off into space; the existence of extra mass in the form of some kind of matter was required. The second line of indirect evidence is that galaxies in clusters swarm around one another at speeds which are incomprehensible unless extra gravitational matter is holding the clusters together. (Figure 8,9).

Rubin and Ford analyzed over two hundred galaxies in the late 1970's and early 1980's and found there was extra unknown matter in virtually every galaxy they had examined which was at least ten times as massive as the visible luminous stars and dust. Somehow, over 90 percent of the matter in the universe had not been accounted for. This fact led astronomers to propose the existence of unseen "dark gravitational matter," composing 90% of all matter in the universe, in dark haloes around galaxies. (Figure 4b). As discomforting as it is to propose that 90% of all matter in the universe is unseen, it is far less discomforting as throwing out all of the known laws of physics.

B. The Horizon Problem

(In 1969, only four years the microwave background radiation was discovered, astronomers began wondering why the background radiation was so utterly smooth. The problem was that the radiation was smooth across distances that were too great to have allowed light to travel from a point on one side of the universe to a point on the other side within the age of the universe allowed by the Big Bang. Astrophysicists were able to look for the edge of the universe at the very limits of observability, at what they called the "horizon." If they looked at the horizon in one direction, then looked the other way, they found that the background radiation poured in at precisely the same temperature, 2.735 degrees Kelvin, from both directions. The problem was that the regions of the universe could only have reached the same temperature by having been in contact at one time.

If the universe had existed forever, there would have been plenty of time for any two regions of the universe, no matter how far apart today, to have exchanged heat and thus homogenized. But was not the case in a universe that supposedly had evolved from a Big Bang in which the horizon of the universe extended out only about 15 billion light-years in every direction. Such background radiation from a distant edge of the universe would have thus taken at least 15 billion years to reach Earth; the radiation from the opposite horizon also had taken 15 billion years to get here. This meant that the two regions of space had to be separated by at least 30 billion light-years. But if the universe was only about 15 billion years old, the question was how could these widely separated regions have ever been in contact with one another in order to share the same temperature. There simply was no way for a signal moving at the speed of light -- supposedly the maximum velocity attainable according to Einstein's theories -- ever to have traveled between the two points. (Figure 10).

C. The Flatness Problem

As well as the universe's beginning, theorists faced another big problem -- its fate. Generally, two kinds of universes predicated by Einstein's theory: one that would go on expanding forever, and one that would fall back on itself. In a universe which fell back on itself, there would be enough matter for the gravitational force acting on it to bring the outward expansion to a halt. How much matter was required for this to occur was calculated with great accuracy: about 3 hydrogen atoms per cubic yard of space (or 5×10^{-27} kilograms per cubic meter). Gravity acting on matter of this density, the so-called "critical density," eventually would cause a universe like this to begin falling back on itself; at last, in pure collapse, the entire universe would revert to a single point of nearly infinite density and heat.

There was a third possibility, too, that the universe was neither open nor closed, but rather was balanced precariously between a fate of grand contraction and infinite expansion. Astrophysicists assigned the Greek letter omega (Ω) to represent the ratio between the actual cosmic mass density as determined by observers and the critical density that would allow gravity to pull the universe back down on itself. If this ratio were equal to or less than 1, there would be too little actual mass density to halt the expansion, which would then go on forever. If omega were greater than 1, then the universe would be closed and the expansion would (or should already have) come to a halt. (Figure 11).

Using the example of an arrow shot by a bow and sent flying into the air, omega was similar to the ratio of gravitational energy to kinetic energy. If the archer were strong enough and shot the arrow skyward with more than the critical speed represented by the ratio, the arrow would escape Earth's gravity. If the arrow were shot at just the critical speed, the arrow would forever travel in orbit with gravitational and kinetic energies exactly balanced, their ratio equal to 1. (Figure 12). An astronomer would call this a "flat" trajectory.

Astoundingly, this seemed to be exactly the case with the universe under the Big Bang scenario; observational astronomers were unable to determine whether the curved space of the universe was open or closed. The reason appeared to be that the universe was precisely poised between the two states, its omega exactly equal to 1. Theoretical supporters of the Big Bang believed that how the universe appears today -- in terms of the number and distribution of the galaxies -- had been almost wholly determined by minute features in the earliest instant of the universe. These conditions were believed to have been set when the universe was at the early age of 10^{-43} second. There could have been almost no deviation in conditions in the universe then to allow for the conditions we see today. For omega to have remained so close to 1 -- that is, for the universe to be so incredibly flat today -- the difference between the cosmic mass density and the critical density must have been almost nonexistent in the earliest instants after the Big Bang: at 1 second after the Big Bang, it was calculated, the universe had to be fine-tuned to an accuracy of 1 part in 10^{15}, or to within 1 trillionth of 1 percent. (To help grasp the size of a number this large, if the universe had been formed 15 billion years ago, it would have been in existence for about 10^{15} seconds).

At 10^{-43} second, the universe would have had to have been fine-tuned to within 1 part in 10^{59}, a fraction so small as to be incomprehensible. Had there been less matter by so much as one of these minuscule fractions, matter would have expanded outward so quickly that gravity could never have condensed the hydrogen and helium gases enough to form galaxies and stars; with just a tiny fraction more matter, gravity would have been too strong, and the expansion would have been halted long ago.

Since only enough mass had been detected throughout the cosmos to bring

omega up to 0.1 -- one-tenth the requirement amount -- huge quantities of matter were still unaccounted for, meaning that almost the entire inventory of the universe or 90%, is unseen, undetected and unknown.

D. Quasars - Cosmic Relics

In late 1980's a series of observations occurred that added to cosmologists' concerns over the horizon and flatness problems; they found new celestial objects which appeared to be at an enormous distance from Earth and receding very fast. Unknown objects, they were so they were called "quasi-stellar radio objects," or "quasars." A quasar could be a hundred times brighter than the Milky Way but only about the size of our solar system and were at the most distant radius of the universe and moving away at 90% of the speed of light. It was initially believed, that if the red shifts analyses were correct, quasars were formed 10 billion years ago.

The discovery of a quasar, "PC1158+4635" in 1989 further shocked astrophysicists since it was found to be 14 billion light-years from Earth. A quasar so distant and so near the down of time should not exist: PC1158+4635 left too little time in the current model of the universe's evolution to get from the Big Bang to stellar structures such as galaxies. Even more disturbing, some such quasars which have redshifts so large that they appear to be on the edge of the universe have been found in the vicinity of nearby galaxies with small redshifts. If, as expected, such quasars are connected with the galaxy, then the two objects would be moving with vastly different velocities: this would mean that their red shifts -- perhaps even all redshifts -- result from a phenomenon other than rapid recession, as now believed.

E. Inflation: The Universal Cure-All

During the late 1970's - early 1980's, the subject of the extraordinary flatness of the universe, the unbelievable balance of the cosmos between runaway expansion and utter gravitational collapse, posed an incomprehensible problem. Then, in the late 1970's, Guth proposed a solution: that the entire infant cosmos could have slipped into an unstable state that physicists call a false vacuum and that this momentary state could cause the universe to experience a rapid change called a phase transition as it cooled in the instant after the Big Bang. (When water is chilled very rapidly, it can remain liquid far below its freezing point of 0 degrees Celsius; then it freezes all at once.) He proposed that as the universe cooled, the instantaneous false vacuum created by supercooling had driven the expansion: the universe would have done it all by itself; there would be no outside force; no hand of God; no divine creative power was necessary.

Guth calculated that inflation should have begun precisely at 10^{-35} second following the Big Bang when the hyper-dense conditions of the universe would have created the false vacuum condition at which time, according to the field equations of general relativity, a kind of anti-gravitational force would have pushed matter apart instead of drawing it together. Within the infinitesimal span of 10^{-32} second, the anti-gravitational repulsion would have made the universe expand in size by a factor of 10^{50} -- equivalent to a grain of sand growing bigger than our universe in the same span of time -- and then after such rapid expansion the universe then reverted to the rate of expansion of the standard Big Bang model. (Figure 13).

Inflation would solve the horizon problem: all the regions of the universe that we observe today would have been in contact with one another before inflation began at 10^{-35} second so that all the energy of the universe would have been evenly distributed before the exponential inflation of space itself.

More importantly, the inflation scenario would solve the flatness problem by reducing it to a simple exercise in geometry: whatever the curvature of space before inflation, it would have been flattened during the rapid expansion like the surface of a

balloon "flattens" as it is inflated.

A major problem developed with inflation: inflation predicted that the rapid expansion would have occurred in a number of separate spatial bubbles which should be observable today. Bubbles were a major problem for inflation because they are not observable.

Notwithstanding the bubble wall problem, the cosmology world was galvanized by the novel concept of inflation since it solved such difficult problems. One possible solution to the bubble problem was worked out which predicted that the observable universe would occupy but one billion-trillionth of a single bubble domain. This theory eliminated bubble walls as a major worry: the walls would be so far beyond our observational reach of about 15 billion light-years that they could never possibly become visible.

The non-verifyiability of the inflation theory has been a major flaw from its inception: throughout the history of science the best theories have always made verifiable predictions, which could be tested by experiment or observation. For example, Einstein's general relativity, predicted a number of phenomena that were later observed and Quantum Theory, envisioned numerous experiments at the subnuclear level that were then carried out in accelerators. On the other hand inflation cannot be tested. Guth's original theory of inflation made only one single prediction that could be considered testable: astronomers should be able to discern the walls of domains smaller than the observable universe which has turned out to be false; no hint of domain walls has ever been observed.

Another major problem with inflation is that it required that omega (Ω) equal 1 exactly and thus required the universe's mass to be 10 times the amount we can account for. To solve this problem, theorists, adopting inflation to cure observational problems with the Big Bang, proposed that 90% of the mass of the universe was missing; they proposed a "missing mass" to represent 90% of the universe. They called this missing mass "cold dark matter," which also has never been observed. [2] Moreover, the cold dark matter was required by the theory to consist of non-baryonic material, unlike any of the matter in the rest of the universe.

By the late 1980's the inflation theorists became to be perplexed by the basic dilemma that the inflation which would have smoothed out the inhomogeneities of the earlier universe would have left no fluctuations in the density of space capable of producing the giant galactic structures which were then becoming being observed. On the other hand, if inflation had not occurred they could not explain the flat universe.

F. <u>Big Attraction</u>

The background radiation that had been discovered in 1965 was considered the chief evidence for the Big Bang. In 1977 scientists sent balloons aloft equipped with the most sophisticated measuring devices that had yet been used to detect minute variations in this radiation. They found surprised results: the radiation was shifted slightly toward the red end of the spectrum on one side of the sky, and slightly toward the blue end in the other direction.

As a consequence the conclusion was inescapable that the Earth and the solar system were, in fact, moving rapidly in the direction of the blueshifted background radiation. (Figure 14). The entire Milky Way had a peculiar motion not related to the general expansion of the universe. Calculations undertaken soon afterward showed that not only the Milky Way, but that the entire local group of about thirty galaxies was moving in the same direction at about 700 kilometers per second (about 2 percent of the speed of light) in the direction

---

[2] (This "missing mass" which would represent 90% of the universe under the Big Bang model, is differentiated from the "dark gravitational mass" which is not visible but is observable gravitationally, as previously discussed.)

of Virgo; these galaxies exhibited what became known as a "streaming motion." Later astronomers found that our local group are being pulled not only toward Virgo but toward an unseen, unknown mass, in a direction which lay nearly perpendicular to the estimated position of Virgo.

In 1987 a group of seven astrophysicists analyzed the streaming motions of some four hundred galaxies in our region of the universe and made an announcement that shook the world astrophysics community: every nearby galaxy, including those in clusters and gigantic superclusters, was streaming at a rate of 600 to 700 kilometers per second toward a point in the sky that lay some 300 million light-years beyond Hydra-Centaurus, some 70 million light-years away. The unknown object toward which all the galaxies were streaming was named the "Great Attractor." The mass of this monumentally Great Attractor was calculated to be as that of tens of billions of galaxies. In 1989 astronomers announced that the Great Attractor appeared to be two extremely dense superclusters of galaxies stretching 300 million light-years across the universe beyond Hydra-Centaurus.

G. Then, The "Great Wall"

Until the 1980's, without the advanced computer technology then available to astronomers, astronomers were unable to undertake a meaningful survey of the universe using Hubble's concept of red shift. Until then, no one had the slightest idea what the actual structure of the universe might be.

In the mid-1980's Huchra and Geller of Harvard and Smithsonian Observatory built a red-shift map of the sky; instead of the uniform distribution of galaxies that they expected, astronomers begin finding great clusters of galaxies, superclusters and, eventually, the immense superclusters. Their study revealed that the universe consisted of a pattern of galactic structures that utterly defied existing theory, including one unusually large cosmic construction at least 500 million light-years long and 15 million light-years thick. Not able to tell its exact size because it ran off the edge of their survey, they named it the "Great Wall," and further speculated that it could be made up of walls of still larger galactic bubbles.

In between these gigantic new structures they surprisingly found great stretches of empty space nearly devoid of any matter at all. One of these voids was an estimated 300 million light-years across, far too immense a span of emptiness to be accommodated by existing ideas about how the universe had evolved; according to these standard theories, based on the Big Bang model the cosmic density should have been as quite smooth.

Big Bang theorists were stunned since the Great Wall was far too large and too massive to have formed by only the mutual gravitational attraction of its member galaxies, as should have been the case under the Big Bang scenario. Worse, indications that the Great Wall might be just a part of one of a series of gigantic galactic sheets lined up one after the other in a honeycomb structure with voids of 400 million light-years in between have been recently confirmed: an extension of the Great Wall has been found in the Southern Hemisphere, the "Southern Wall." The gigantic structure as now mapped consists of over 11,000 galaxies stretching over what is believed to be a billion light-years. (Figure 16). A current news release of the Southern Wall's discovery is presented here as Appendix "B".

III. The Current Crisis in Cosmology

In 1962 Thomas Kuhn revolutionized our concepts concerning the history of science: in his classic work The Structure of Scientific Revolutions Kuhn hit on the word "paradigm" to describe the world view of any specific scientific community. Kuhn proposed that science did not move forward by refining old views but rather by changing basic concepts; he described an old paradigm-anomaly-crisis-revolution-acceptance-new paradigm cycle. By the mid-1990's, it appears that cosmology is ready

for just such a paradigm shift.

The current crisis in cosmology generally is that the Big Bang model does not allow enough time to get the universe from its early state to one we are seeing now. The question is: how did the universe get to be as lumpy as it is given the COBE results, which would indicate that the universe would be smooth and homogenous from a Big Bang beginning.

In an atmosphere reminiscent of the last days of dying Aristotelian or Ptolemaic cosmology, Big Bang theorists would have us now believe that our universe is filled with an utterly smooth background radiation in a volume of space which is filled with galactic structures too large to possibly exist, which may themselves have sprung from quasars too old for the age of a cosmos in which at least 90 - 99% of all matter was supposed to be there and had never been seen.

IV. The Respiratory Universe Model

The problems of the Big Bang model can be solved, as well as its characteristics explained, by the "Respiratory Universe" model in which: seven super-universes circle the central universe in a counter-clockwise rotation; the first of the four outer space layers rotates around the central universe in a clockwise direction; the expansion-contraction cycle of the universe ("respiration") which takes approximately 2 billion years; and in which the various spheres of space consist of stars, dark islands of space, minor space bodies (such as comets, meteors, etc.), planets, and architectural spheres.

A. Horizon and Flatness Problems

The Respiratory Universe model would easily explain the horizon problem, since the universe, having practically existed for infinity, would have plenty of time to exchange heat and energy. The microwave background energy, or radiation, would appear to be practically the same everywhere.

Such a model, which would exhibit slow controlled epochs of fine-tuned expansion and contraction, would appear to be neither "open," flying apart, or "closed," heading toward the Big Crunch, but rather to be "flat". Critical mass, or omega, would not be a factor since forces other than gravity would come into play. The existence of these forces have been suggested by physicists such as the Swedish Nobel laureate Hannes Alfven, who contends that the universe is continually energizing itself by means of electromagnetic currents; Alfven contends such currents are as important to universe development as gravity. Alfven believes that magnetic fields and currents can concentrate matter and energy far faster and more effectively than can gravity. Also, theories by even Big Bang supporters such as Hawking, have been proposed stating that energy may continually be recycled in the universe by the explosion of black holes after gravity has completed its work of matter condensation. If this is the case, the energy-mass-energy conversion cycle could repeat itself endlessly allowing plenty of time for heat in the universe to equalize and requiring no "critical mass."

B. The Large Scale Structure of the Universe; "The Great and Southern Walls"

The increasingly comprehensive maps which show enormous structures consisting of galaxies located along the bubble-like surface of enormous "voids" are also explained by the Respiratory Universe model. The model contains four huge outer space levels which encircle the superuniverse clusters. Thus, the first outer space level could be what is now described as the "Great Wall - Southern Wall" complex.

C. Streaming Motions of Galaxies: "The Great Attractor"

In the Respiratory Universe model consisting of seven superuniverse galaxies moving in a counter-clockwise direction around a universal center, an individual superuniverse cluster of galaxies would exhibit an overall "streaming motion" associated with such a counter-clockwise rotational track. In addition, one's home galaxy would exhibit angular rotation associated with the rotation of the super-universe around its system axis.

The Respiratory Universe model which combines counter-clockwise and angular rotation would therefore explain the streaming motions which we actually observe toward what we now call the Great Attractor. (Figure 18).

D. "Dark Islands of Space": Dark Gravitational Matter

The "dark gravitational matter" comprising 90% of all matter in the universe is the matter which is required to be present from the laws of physics, but which is not visible. In an effort to explain its identity, astronomers have proposed that such matter consist of "dark haloes" of exotic kinds of particles.

Such matter is better explained by compact "black hole-like" objects; especially since the laws of physics would suggest that dispersed halo particulate should contract and condense to form sphercal bodies as a result of gravitational forces. We should attempt to make detailed studies of nearby galaxies to verify the existence of and locate such compact objects. (Figure 19).

Recently some confirmation of the existence of dark gravitational matter in the form of compact spheres, which astronomers call MACHOs (Massive Compact Halo Objects) has been reported; they have noticed a star slowly brightening and then fading again. Astronomers have proposed that this event, which occured in the Large Magellanic Cloud, a companion galaxy to ours, could be "microlensing" the gravitational focusing of a star's light by a large compact invisible object as that mass moved between us and the distant star. This microlensing event, discovered by Griest of University of California, San Diego, is the first direct evidence of dark matter.

E. Redshift

What has been perhaps the most troubling aspect of the Respiratory Universe model is the abundance of redshift in the cosmos. The Respiratory model predicts that much of the redshift is not actually real, but rather occurs because of the rotational direction of the first outer space level with reference to our superuniverse domain. Now that the Great Wall has been discovered, detailed study of it will no doubt display a preferential streaming direction due to such rotational direction. (Figure 20).

In the Respiratory model, redshift also is said to occur due to "angles of observation and other time-space distortions." (134) (Figure 21). Recently astronomers have concluded that redshifts occur due to just such phenomena, as follows: astronomers have recently used the Hubble Space Telescope to photograph what are believed to be black holes, including a massive black hole in the center of a giant elliptical galaxy, M87, located 50 million light-years from Earth in the constellation Virgo. The discovery is based on velocity measurements of a whirlpool of hot gas that is orbiting the black hole in the form of a disk. The presence of the disk allows for unprecedented, precise measurements of the object at the hub of the disk: it weighs three billion times as much as the sun is concentrated into a space no larger than our solar system. (Figure 22).

HST's Faint Object Spectrograph measured the speeds of orbiting gas on either side of the disk from regions some 60 light-years from the black hole at the center. The blueshifted and redshifted light indicate that the ionized gas is rotating at the speed of 1.2 million miles per hour. (Figure 23).

Since 1917 astronomers have suspected that unusual activity was taking place in the center of M87. In the 1950's they discovered a large flare of energy emanating from the nucleus; this made it clear that the bright optical and radio source were the result of energy released by something in the center of the galaxy. In high resolution images, the jet appears as a string of knots (some as small as the light-years across) within a widening cone extending out from M87's core. A massive black hole had been the suspected "engine" for generating the enormous energies that power the jet. The gravitational energy is

released by gas falling into the black hole, producing a beam of electrons spiraling outward at nearly the speed of light.

Surprisingly, this gas jet causes motions which apparently exceed the velocity of light. This extreme speed, or "superluminal motion", was reported by Dr. John Biretta of the Space Telescope Science Institute. According to Biretta the superluminal motion of 2 1/2 times the speed of light are observed, which are 'caused by angles of observation.' (Figure 24).
A press release describing the apparently superluminal motion is presented here as Appendix C.

V. Conclusion

Today, in a trend reminiscent of the methods of Ptolemaic astronomers until Copernicus came to the rescue, cosmologists are ignoring facts that fail to fit the Big Bang model. When the theoretical model first appeared, it was a reasonable and seemingly scientific explanation for a relatively small amount of astronomical data taken earlier in the century: it was consistent with the Hubble redshift of galaxies and large-scale expansion; it seemed to explain the observed abundances of light elements such as helium and hydrogen which had not been created in the fusion furnaces of existing stars, but created in the earliest moments of the Big Bang. In what probably was its finest hour, the Big Bang model predicted the microwave background radiation at about the temperature that was consistent with a creation explosion out of a formless nothingness 15 billion years or so ago.

However, the troubling observational and theoretical problems of the 1970's and 1980's increasingly have challenged the Big Bang model. The Big Bang model also began having more and more difficulty reconciling the latest observational details found by astronomers with the fundamental assumption that on the galactic and cosmic scales gravity was the major player. In other words, the theory failed to explain convincingly how matter had become organized in clusters of galaxies and superclusters in the time period allotted since the Big Bang.

Also for the universe to be structured in a manner consistent with current observations, more than 90 percent of its matter would have to be in the form of some unknown, unseen, but unbelievable massive dark matter which would not only have to be present in such a huge quantity that it would account gravitationally for the size and behavior of the new clusters and superclusters, but it also would have to be of such a bizarre quality that it could not possibly be detected by even the most sophisticated technology. For instance, gravity working alone would have taken something like 100 billion years to create the supercluster two and a half billion light-years across that was recently discovered by American and German observers. This was a time scale at least five times longer than permitted by even the most generous of the Big Bang models.

To salvage the Big Bang, theorists have brought in a number of ad hoc assumptions such as inflation, to supposedly cause the universe to expand exponentially, but which suffers from the same malady as the Big Bang, an inability to make predictions that can be tested.

Today the long odds are that the Big Bang never happened. Perhaps the Big Bang was just a "big spash" (Figure 25), a stellar disgorgement in our little neighborhood of the universe that was neither the beginning of time nor the creation of the cosmos.

How long will the Big Bang theory survive? Whether the Big Bang goes down in five years or twenty-give years, it appears inevitable that it soon will be overwhelmed by more and more uncompromising new observations and experimentation. In the next millennium scientists and other people looking back likely will regard it much the way we look back on the cosmology of Aristotle, a quaint theory that people believed in for a while.

VI. SELECTED REFERENCES

1. *Astronomy Magazine*, March 1994, Waukesha, Wisconsin.
2. Barrow, J. & Tipler, F. (1986). *The Anthropic Cosmological Principle.* Oxford University Press. New York.
3. Boslough, J. (1992). *Masters of Time.* Addison-Wesley Publishing Co., United States and Canada.
4. Boslough, J. (1985). *Stephen Hawking's Universe.* Avon Books. New York.
5. Calder, N. (1989). *Einstein's Universe.* Penguin Group. New York.
6. Carrigan, R. Jr. and Trower, P. (1989). *Particle Physics in the Cosmos.* W. H. Freeman & Company, New York.
7. Cohen, N. (1988). *Gravity's Lens.* John Wiley & Sons, Inc. Canada.
8. *Dallas Morning News*, June 13, 1994, Dallas, Texas.
9. Davies, P. (1982). *The Accidental Universe.* Press Syndicate of the University of Cambridge. New York.
10. Davies, P. (1983). *God & the New Physics.* Simon & Schuster, Inc. New York.
11. Davies, P. (1984). *Superforce.* Simon & Schuster, Inc. New York.
12. Davies, P. (1988). *The Cosmic Blueprint.* Simon & Schuster, Inc. New York.
13. Davies, P. (1992). *The Mind of God.* Simon & Schuster, Inc. New York.
14. Davies, P. and Gribbin, J. (1992). *The Matter Myth.* Simon & Schuster, Inc. New York.
15. Gribbin, J. (1986). *In Search of the Big Bang.* Bantam Books. New York.
16. Gribbin, J. (1988). *The Omega Point.* Bantam Books. New York.
17. Gribbin, J. & Rees, M. (1989). *Cosmic Coincidences.* Bantam Books. New York.
18. Hartman, W.K. & Miller, R. (1987). *Cycles of Fire.* Workman Publishing Co. New York.
19. Hawking, S. (1988). *A Brief History of Time.* Bantam Books. New York.
20. Kaufmann, III, W. (1979). *Black Holes and Warped Spacetime.* W.H. Freeman and Company.
21. Lerner, Eric J. (1992). *The Big Bang Never Happened*. Vintage Books, a division of Random House, Inc., New York.
22. Lightman, A. and Brawer, R. (1990). *Origins*. Harvard University Press, Cambridge, MA.
23. Malin, S. (1989). *The Greenwich Guide to Stars, Galaxies and Nebulae.* Press Syndicate of the University of Cambridge, New York.
24. Morris (1990). *The Edges of Science.* Prentice Hall Press. New York.
25. Penrose, R. (1989). *The Emperor's New Mind.* Oxford University Press. New York.
26. *Scientific American*, June 1994 Edition, New York.
27. Time-Life Books (1988). *Stars.* Time-Life Publishing. New York.
28. Wheeler, J.A. (1980). *Beyond the Black Hole. In Some Strangeness in the Proportion*. (ed. H. Woolf). Addison-Wesley. Reading, Massachusetts.
29. Wheeler, J.A. (1990). *A Journey into Gravity and Spacetime.* W.H. Freeman and Company. England.

APPENDIX "A"

List of Figures

FIGURE 1

RED SHIFT- WAVES OF LIGHT OR SOUND ARE STRETCHED OUT OR COMPRESSED BY MOTION:

STRECHING A WAVE MAKES THE WAVELENGTH LONGER; IN THE CASE OF SOUND, IT MAKES THE NOTE DEEPER; FOR LIGHT, IT SHIFTS THE WAVELENGTH TOWARD THE RED END OF THE SPECTRUM.

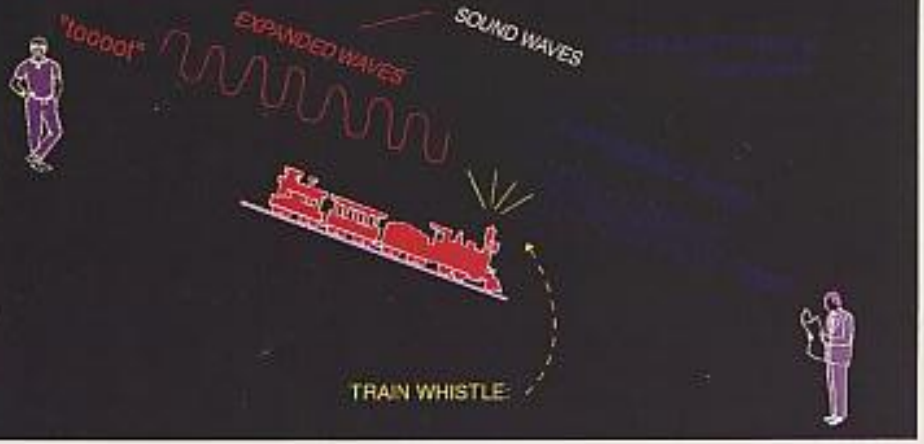


FIGURE 2

CLASSICAL "BIG BANG" EXPANSION MODEL:

According to the "Big Bang"expansion theory of the universe, the universe began in a sort of explosion, starting from infinite density and temperature, and then expanded, thinned out, and cooled, while being controlled by gravity. The appearance of its expansion can be likened to the surface of a balloon being blown up; the galaxies all recede from one another.

FIGURE 3

OTHER OBSERVATIONAL TESTS PREDICTED BY "BIG BANG" MODEL:

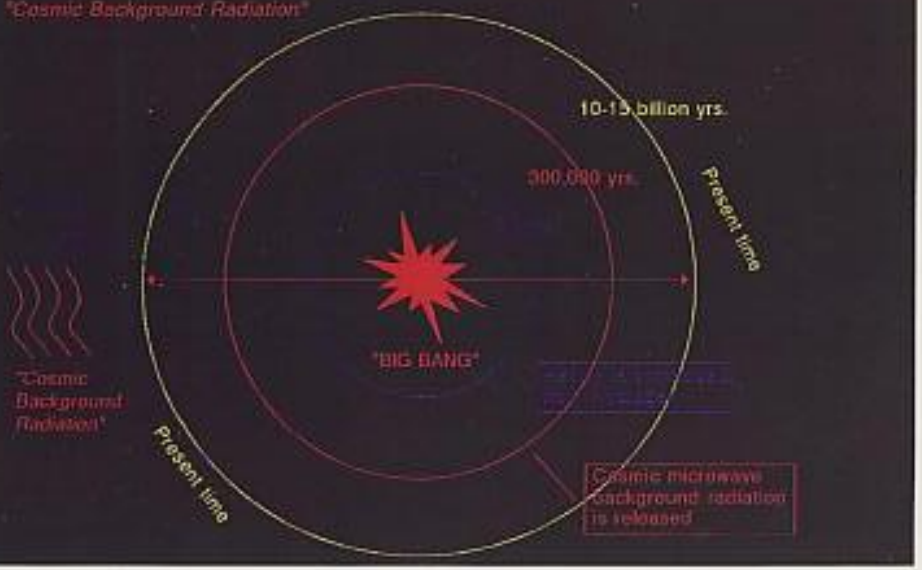


FIGURE 4

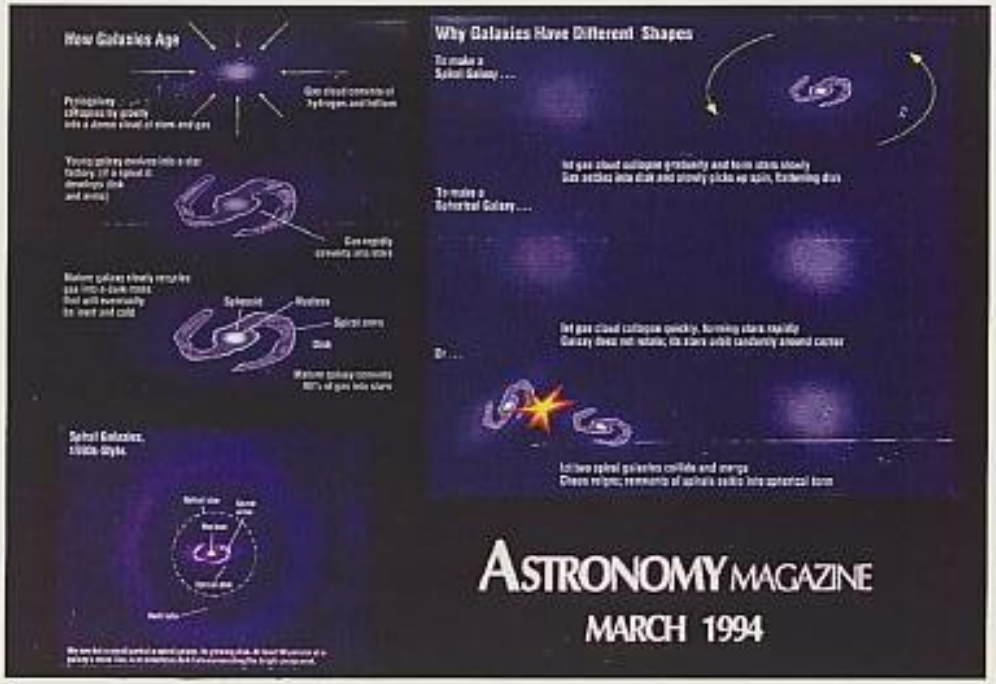


Figure 5

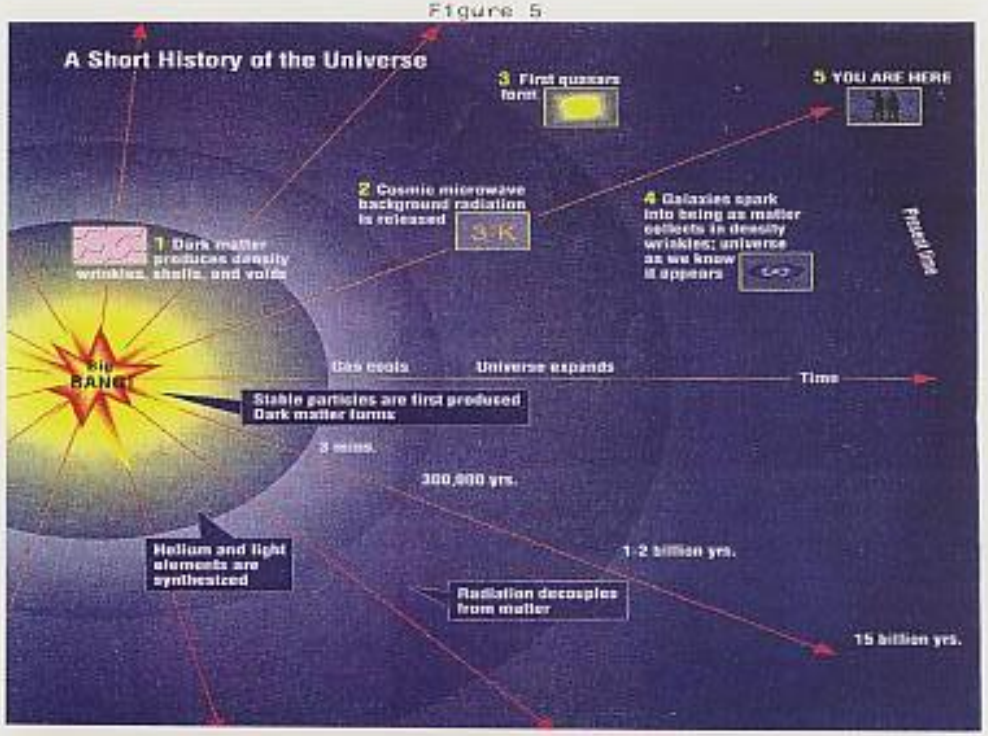
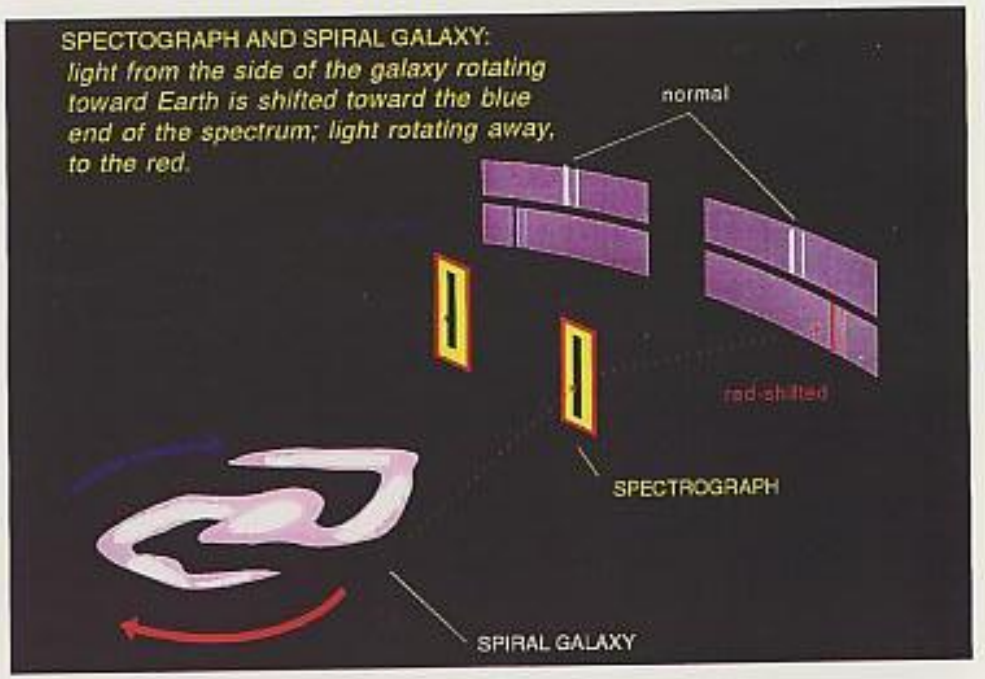


FIGURE 6



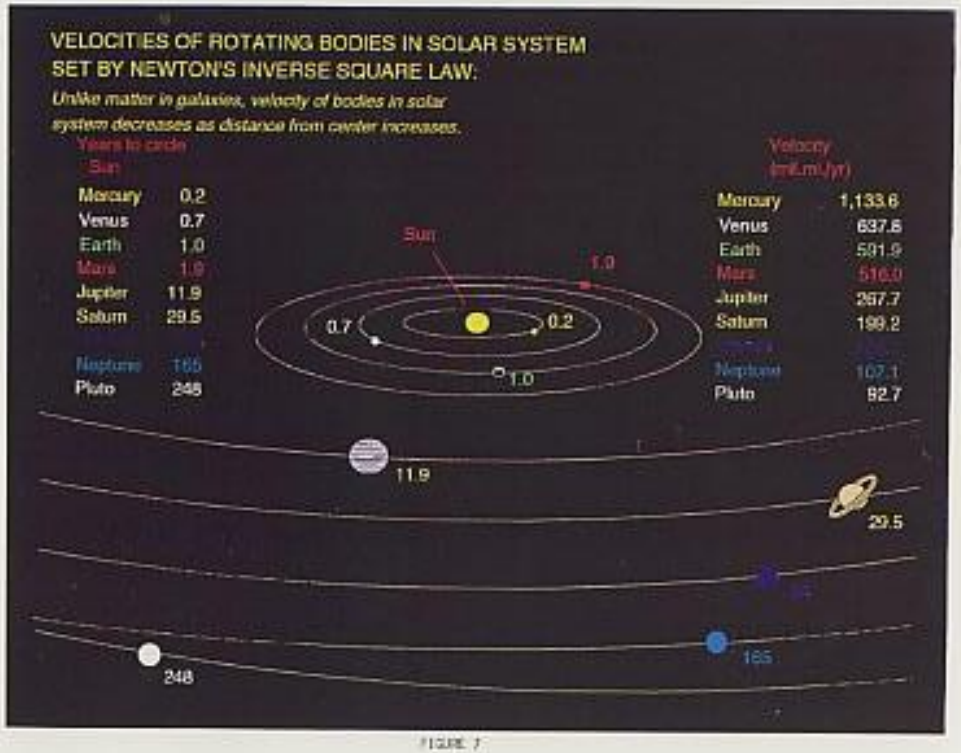


FIGURE 7

FIGURE 8

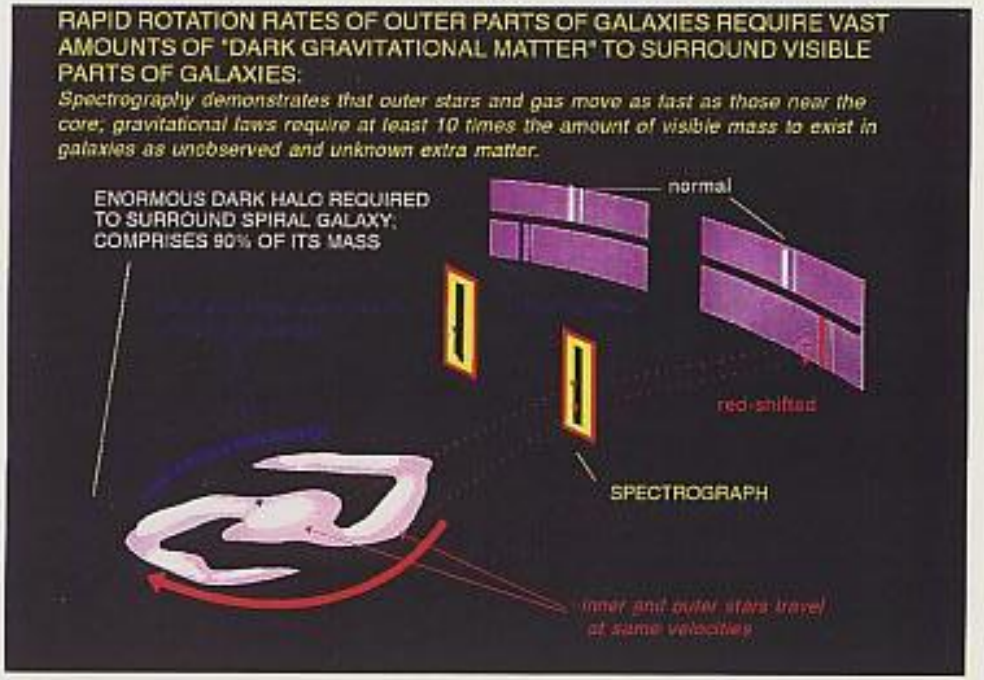


FIGURE 9

FIGURE 10

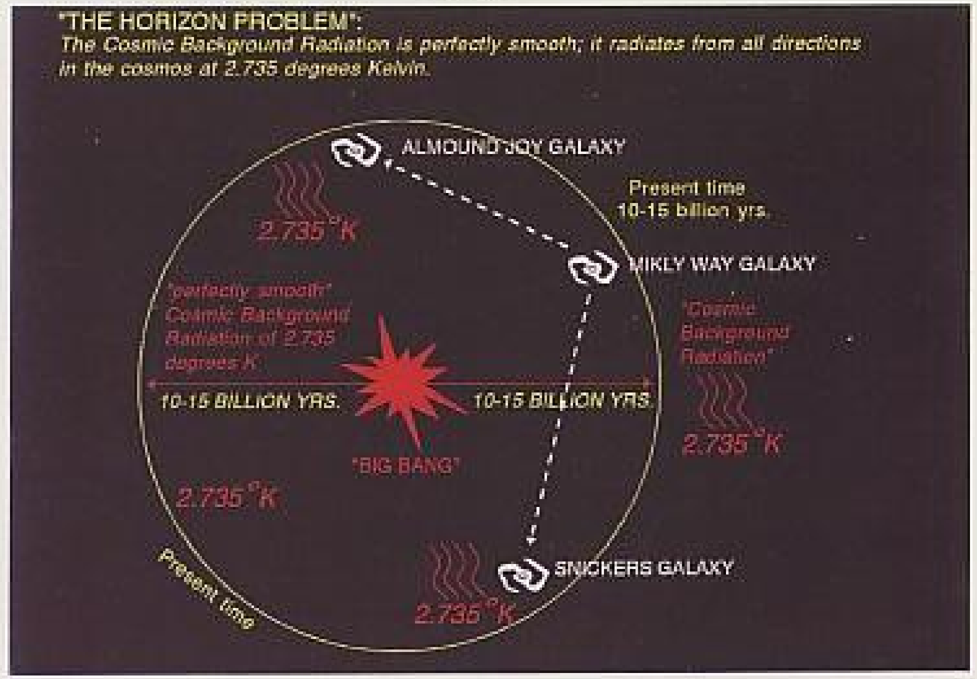


FIGURE 11

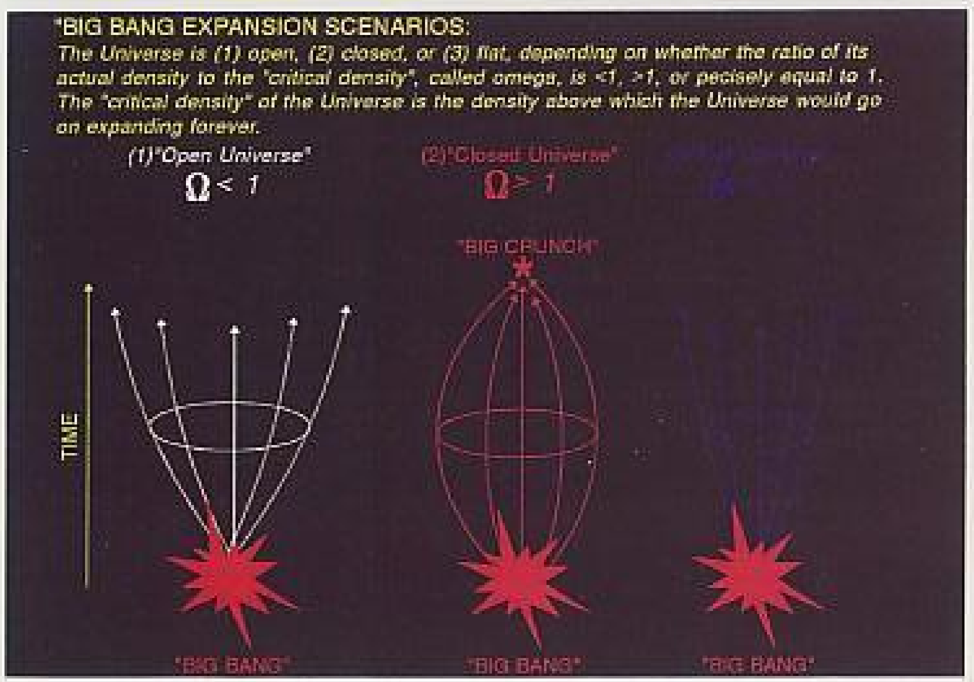


FIGURE 12

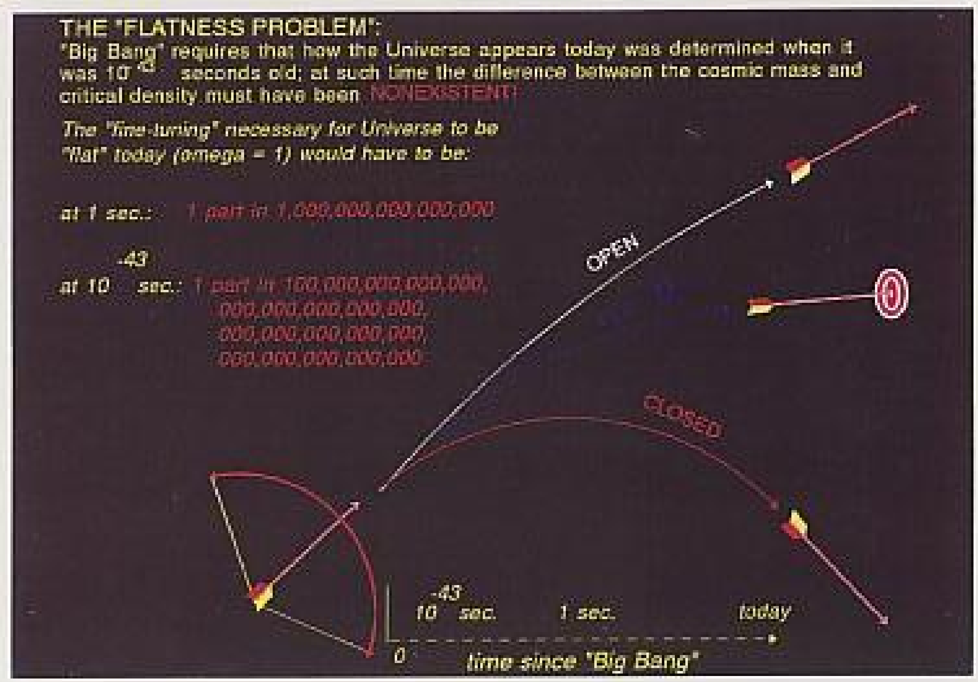


FIGURE 13

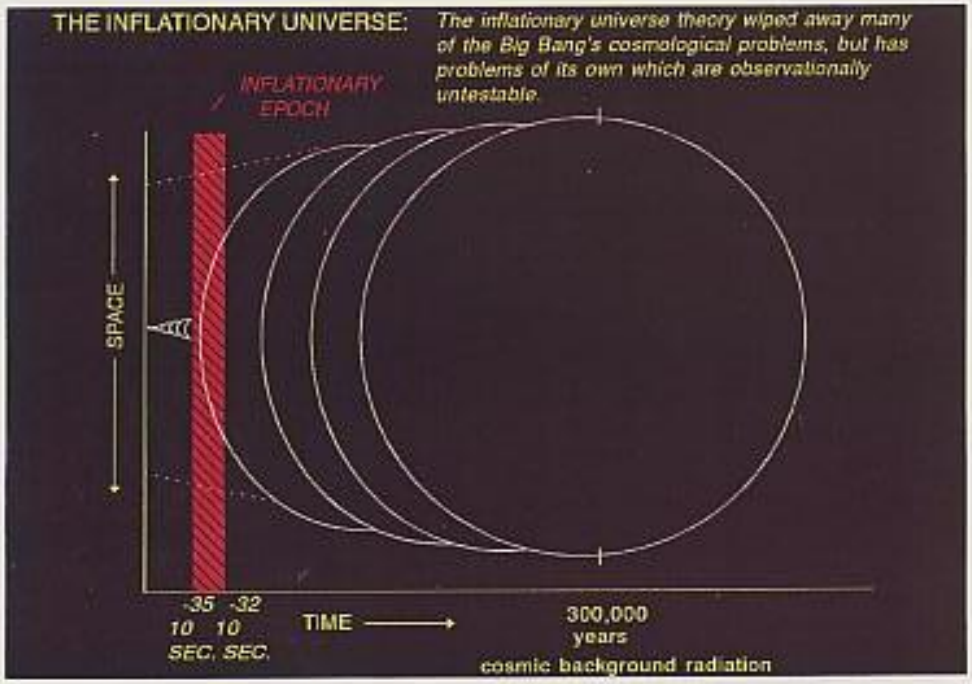


FIGURE 14

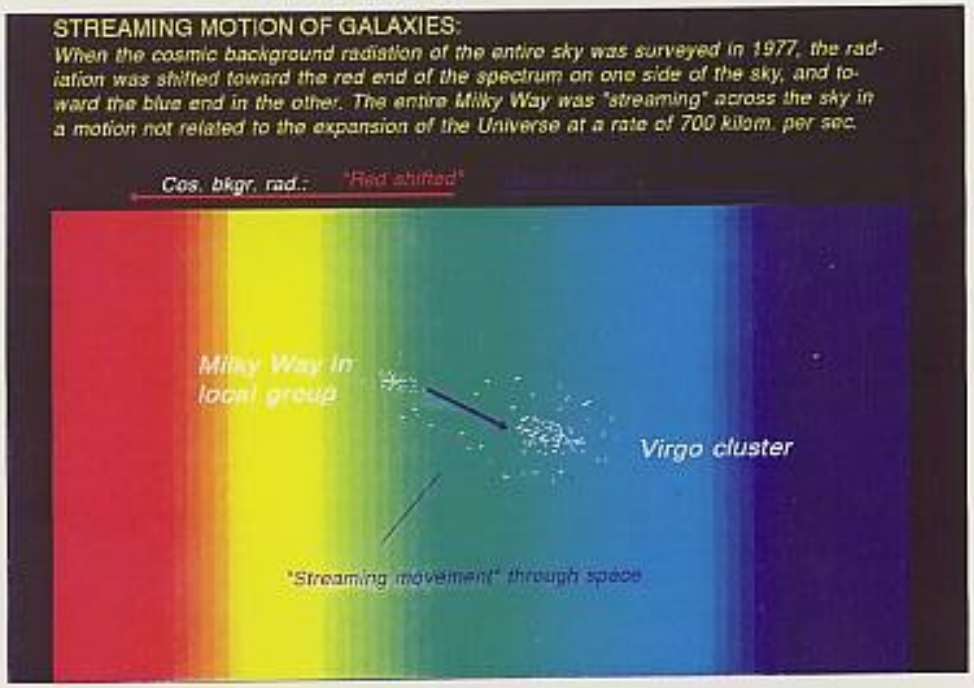


FIGURE 15

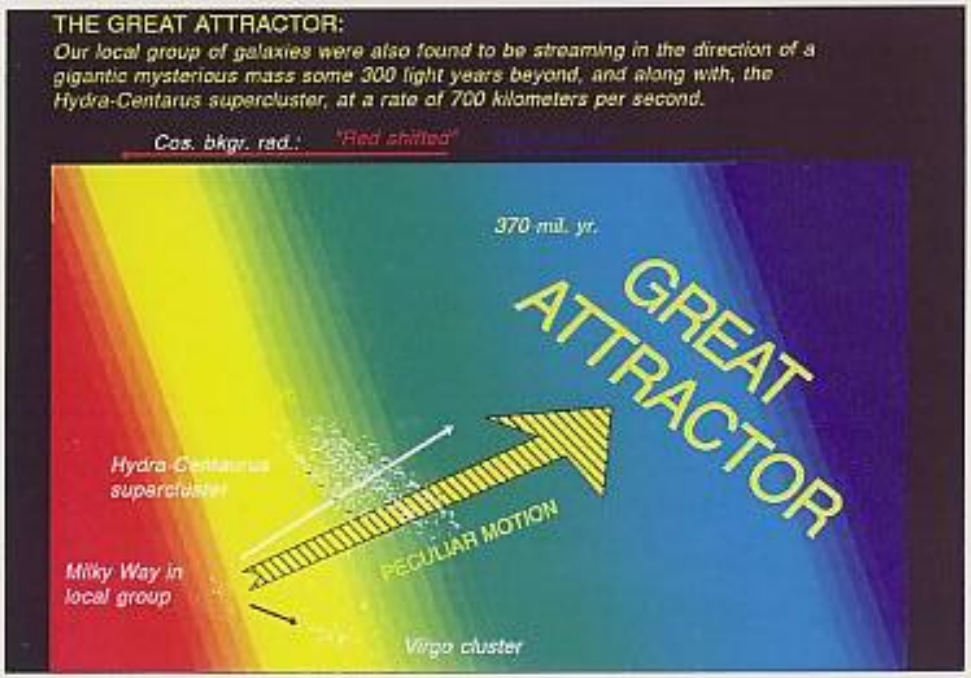
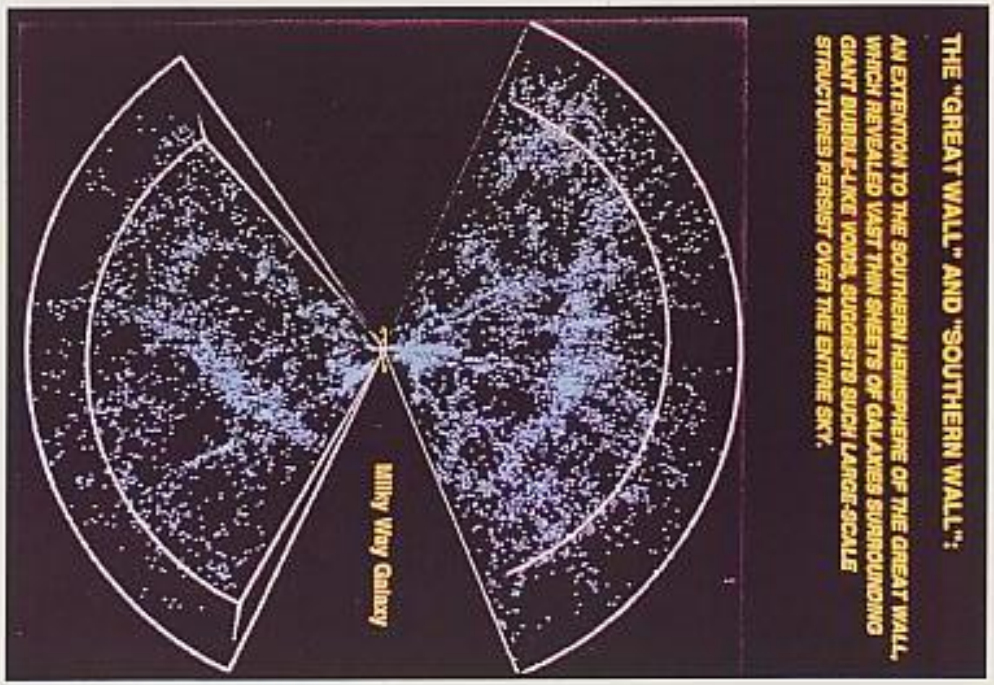


FIGURE 16



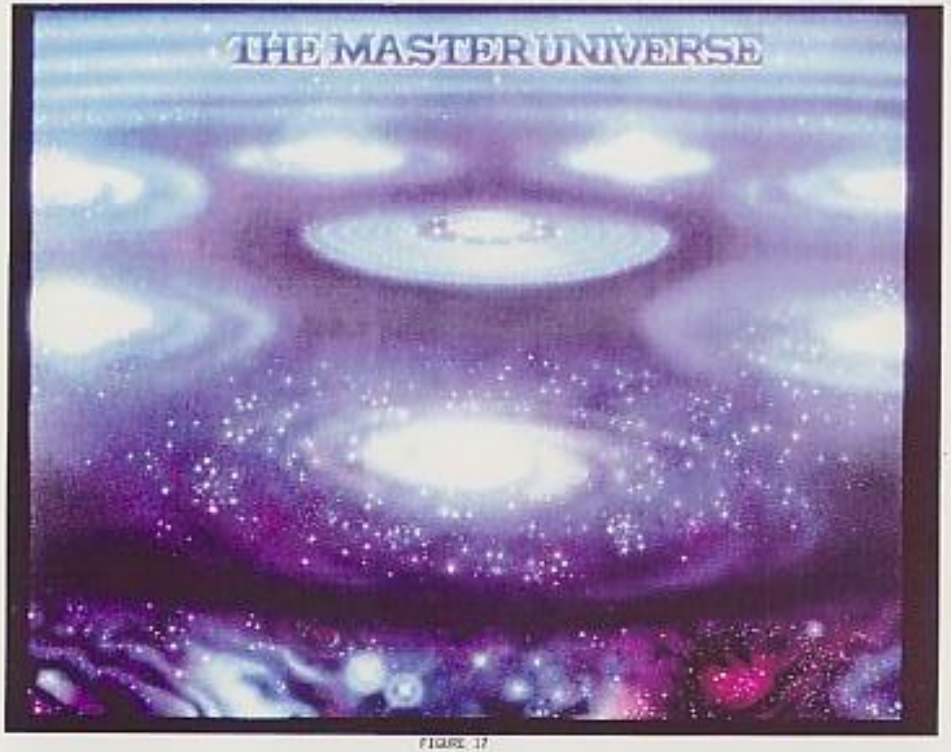


FIGURE 17

FIGURE 18

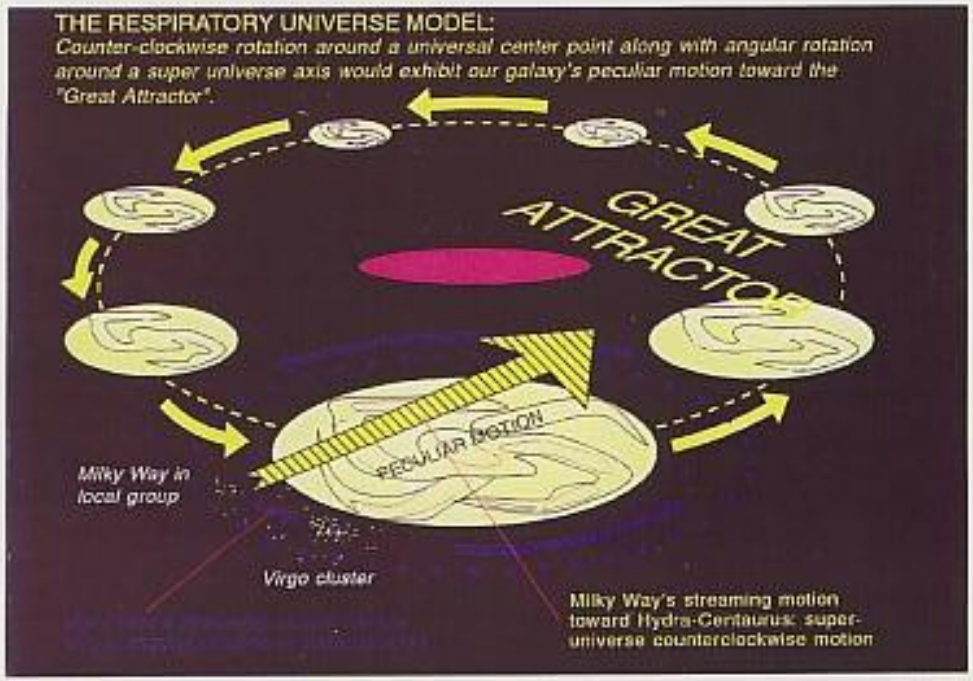


FIGURE 19

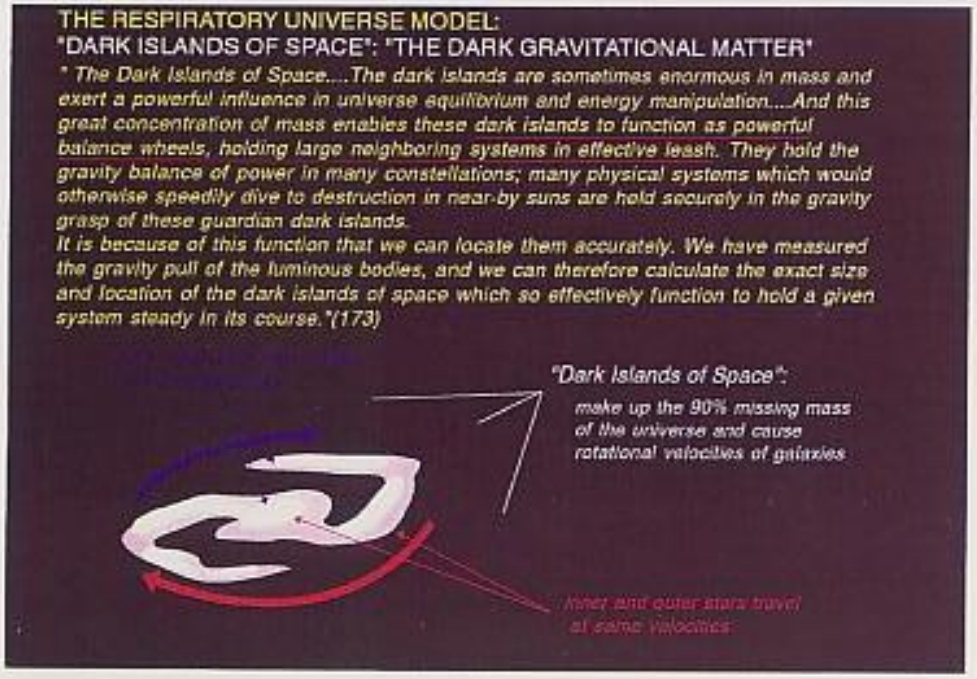


FIGURE 20

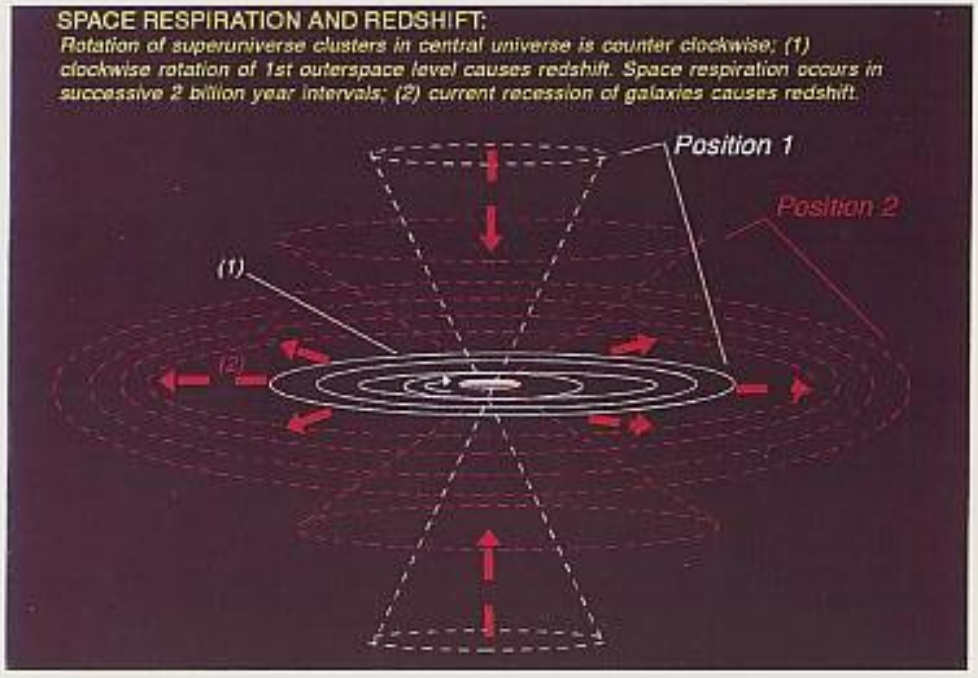


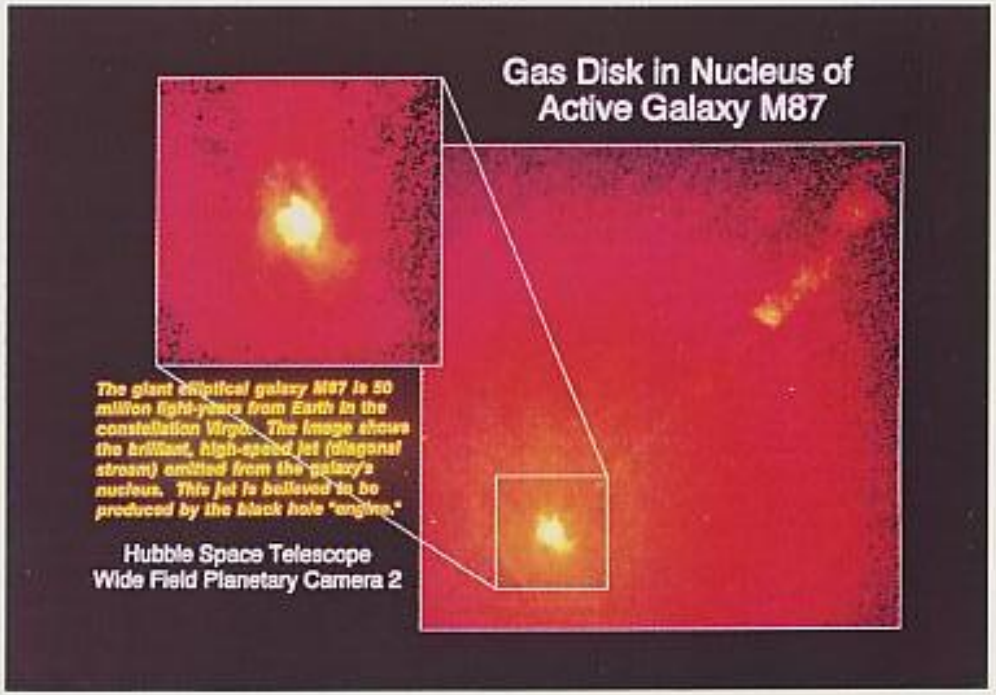
FIGURE 21

THE RESPIRATORY UNIVERSE MODEL: REDSHIFT

"Although your spectroscopic estimations of astronomic velocities are fairly reliable when applied to the starry realms belonging to your super universe and its associate superuniverses, such reckonings with reference to the realms of outer space are wholly unreliable....Many influences interpose to make it appear that the recessional velocity of the external universes increases at the rate of more than one hundred miles a second for every million light-years in distance....But this apparent speed of recession is not real; it results from numerous factors of error embracing angles of observation and other time-space distortions.

"But the greatest of all such distortions arises because the vast universes of outer space in the realms next to the domains of the seven superuniverses seem to be revolving in a direction opposite to that of the grand universe."(134)

FIGURE 22



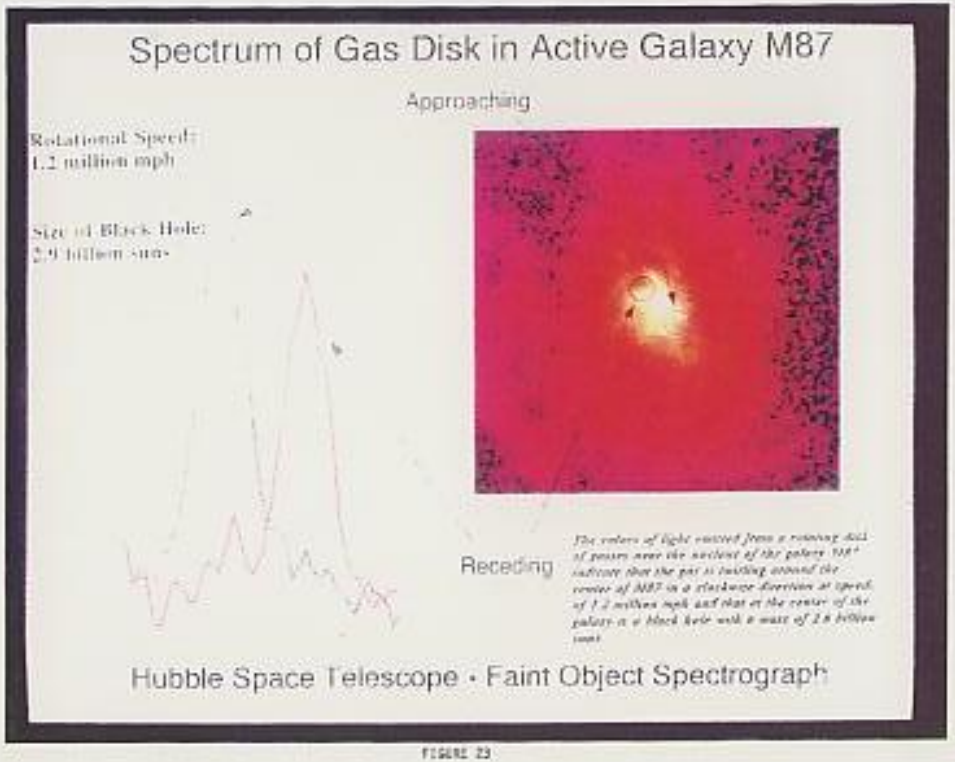


FIGURE 23

FIGURE 24

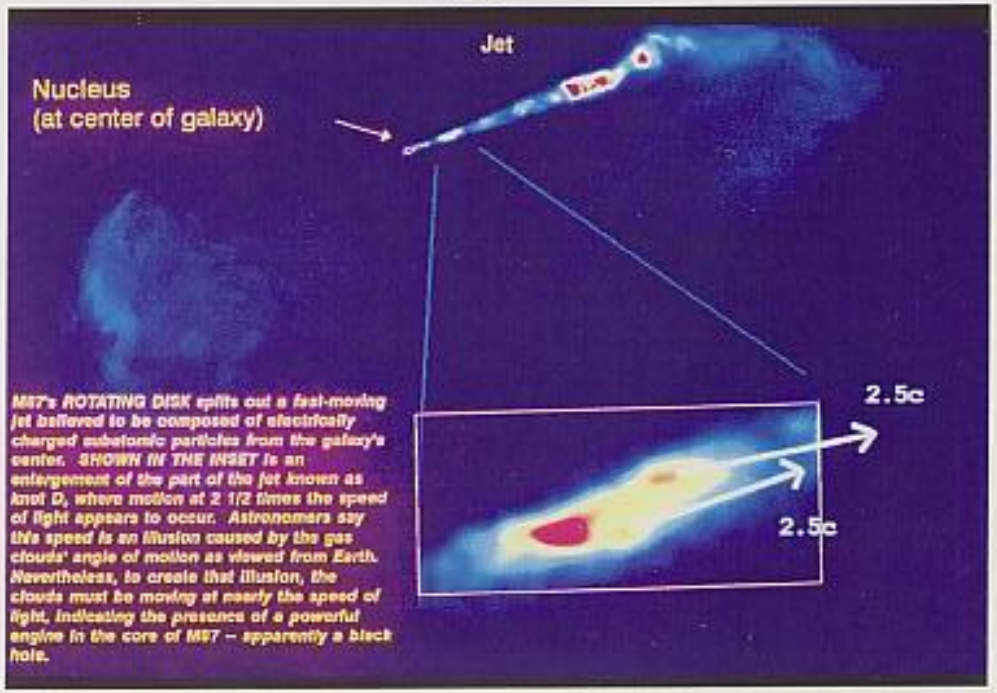
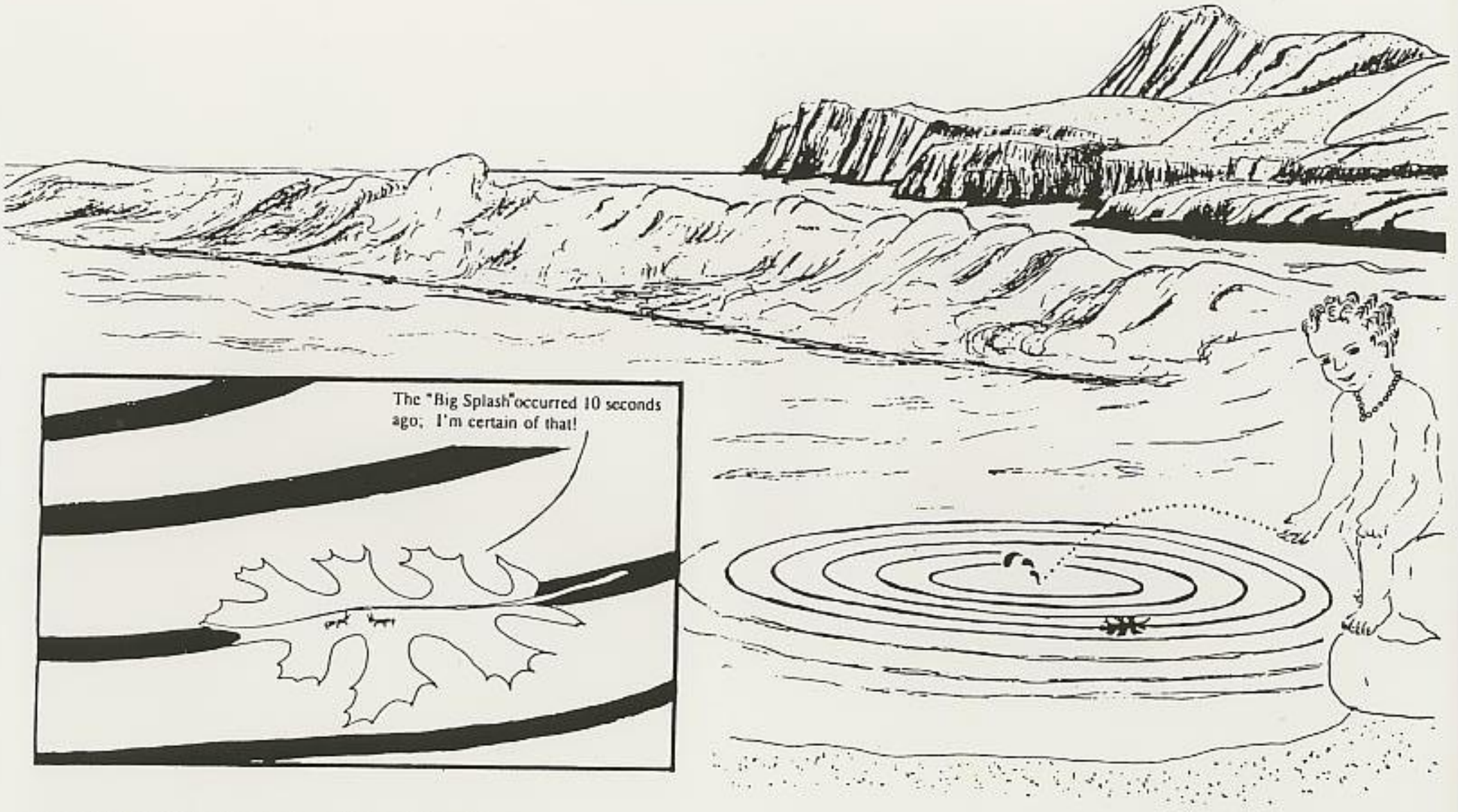


FIGURE 25



An Ant's Viewpoint of the Big Bang

Harvard-Smithsonian Center for Astrophysics

NEWS RELEASE

60 Garden Street • Cambridge, MA 02138 • 617-495-7461

Release No.: 94-06 For Release: Fri., March 18

APPENDIX "B"

GALAXY MAPPING EXTENDED TO SOUTHERN SKY: LARGE STRUCTURES CONTINUE

CAMBRIDGE, MA--An extension to the southern hemisphere of the landmark astronomical survey that revealed vast thin sheets of galaxies surrounding giant bubble-like voids suggests such large-scale structures persist over the entire sky.

In a truly international effort involving observatories on three continents, a research collaboration headed by Luis Nicolaci da Costa of the Brazilian National Observatory has completed mapping the distribution of some 3600 galaxies in a region centered on the South Galactic Pole.

When combined with the original Harvard-Smithsonian Center for Astrophysics (CfA) Red Shift Survey of over 10,000 galaxies in the northern hemisphere, the expanded map includes some 14,000 galaxies and represents coverage of about one-third the sky to a limiting magnitude of 15.5.

More important, the striking bubble-like patterns originally seen in the northern sample continue in the southern sky. Not only do both samples display apparent voids hundreds of millions of light years in diameter, but the southern sky also has its own version of the "Great Wall," a giant, continuous sheet of galaxy clusters stretching across the entire field of view--and presumably beyond. This feature is similar to one bisecting the northern map.

"We undertook the southern survey in order to test the data from our northern map," explains Margaret Geller of the CfA, one of the original survey participants and a co-author of a paper describing its extension to be published in *The Astrophysical Journal (Letters)*, March 20.

"One always worries that you've seen something unique or peculiar to one area of the sky," Geller says. "But aside from some small differences in details, the same basic features--great voids and sheets--are also found in the southern sky."

The survey, both north and south, measures the "red shift" in the light received from distant galaxies, that is, the displacement of the red portion of their spectra caused by their recession from Earth. The more distant a galaxy is, the more rapidly it appears to be moving away. Not only is this one hallmark of an expanding universe, but the recession velocity of a galaxy can be used to estimate its distance. These velocities, combined with positions on the sky, yield a three-dimensional map of galaxy distribution.

The painstaking individual measurements of thousands of relatively bright and nearby galaxies began more than a decade ago at the CfA's Fred Lawrence Whipple Observatory in Arizona, where a 1.2-meter (60-inch) telescope was devoted almost exclusively to the mapping project.

In 1986, Geller, John Huchra, and Valerie de Lapparent of CfA found the new map revealed that galaxies tended to cluster in vast sheets forming the relatively thin walls of immense empty "bubbles" in space.

Subsequently, Geller and Huchra described another extraordinary feature seen in this map: one continuous sheet of galaxy clusters, dubbed "The Great Wall," that extended some 150 million light years across the field of view and represented the single largest structure ever seen in nature.

As yet, there is still no good explanation of how these enormous features formed. No conventional models of cosmic evolution produce so many large-scale structures. Nor is it clear that these are the largest structures possible, since the surveys have only sampled a very small portion of the accessible universe. Still larger patterns may exist that have not yet been seen.

"We simply haven't sampled a large enough volume of space to know if the distribution of matter in the universe is really this inhomogeneous on all scales," says Geller. "We are still in our own astronomical backyard."

"New instruments, such as the faint-object spectrographs being developed for larger optical telescopes, will allow maps to reach deeper into space, perhaps back to a point when the universe was only 70 percent of its current age," she adds. "Then we may not only see larger structures--but we may see how these patterns change over cosmic time scales."

The new southern sky observations were made at the Cerro Tololo International Observatory and the European Southern Observatory in Chile, the Complejo Astronomico in Argentina, the South African Astronomical Observatory, and the CfA's Whipple Observatory.

The international collaborators included da Costa (who made the majority of the observations in Chile), P.S. Pellegrini, and C.N.A. Willmer of the National Observatory of Brazil; A. P. Farral of the University of Cape Town, South Africa; J. H. Calderon of the Astronomical Observatory of Cordoba, Argentina; Massimo Ramella of the Astronomical Observatory of Trieste, Italy; and, in addition to Geller and Huchra, David Latham, Ron Marzke, and Michael Kurtz of the CfA.

For more information, contact:

Prof. Margaret Geller, 617/495-7409
James Cornell, 617/495-7461
Luis da Costa, c/o Institut d'Astrophysique, Paris, 1-43-20-14-25

National Radio Astronomy Observatory

Array Operations Center P.O. Box O, Socorro, New Mexico 87801-0387
(505) 835-7000
FAX (505) 835-7027

VLA The Very Large Array VLBA The Very Long Baseline Array

For Release:

11:30 a.m., CDT, June 2, 1994

Contact: Dave Finley (505) 835-7302

APPENDIX "C"

Superluminal Motions Discovered In Jet Shooting From Nearby Galaxy

Astronomers today reported the surprising discovery of motions apparently exceeding the velocity of light in the nearby galaxy M87. The extreme speed, known as superluminal motion, was seen in a thin stream of gas or "jet" shooting out from the galaxy's center. The report was presented by Fang Zhou of New Mexico Tech in Socorro, NM, and the Space Telescope Science Institute; Dr. John A. Biretta of the Space Telescope Science Institute in Baltimore; and by Dr. Frazer N. Owen of the National Radio Astronomy Observatory in Socorro, NM. They presented their findings to a meeting of the American Astronomical Society in Minneapolis, Minnesota. "We see two clouds in the M87 jet which appear to be moving at about two-and-a-half times the speed of light. These are located about 900 light-years from the galaxy's center," said Biretta.

"What is really surprising is that we see superluminal motion in a radio galaxy which is so nearby. M87 is only about 50 million light years away. It's the second closest galaxy with a jet. We usually think of superluminal motion as being a rare phenomenon, seen in a few of the most distant galaxies and quasars. Here we are seeing superluminal motion in a galaxy which is, in cosmic terms, sitting right in our living room. This suggests that superluminal motion is maybe a much more common phenomenon than previously thought," Biretta said

The velocities were measured by comparing seven different radio images obtained with the Very Large Array (VLA) radio telescope between 1982 and 1993. The VLA, in west-central New Mexico, is composed of 27 dish antennas, each 25 meters (82 feet) in diameter, laid out in a Y-shaped pattern with arms 13 miles long. The observations were made at a radio wavelength of 2 centimeters.

Even though the clouds in M87's jet appear to move at several times the speed of light, their measured motion in the sky was extremely small, due to the large distance to M87. In fact, the motion measured over 11 years was only about one-tenth of a second of arc, or about the width of a human hair as seen from 100 yards away.

"This apparent faster-than-light motion does not really violate Einstein's theory of relativity," explained Biretta. "Our present understanding is that this phenomenon occurs when these gas clouds move toward Earth at more than about 90 percent of the speed of light. At these speeds

- more -

the clouds nearly keep pace with the light they emit as they move towards Earth, so when the light finally reaches us, the motion appears much more rapid than the speed of light." It's just an illusion created by the finite speed of light and rapid motion. Since the moving clouds travel a little slower than the speed of light, they do not actually violate Einstein's theory of relativity.

"According to this standard picture of superluminal motion, the clouds must be moving very nearly in the direction of Earth. And since we expect these jets to be randomly oriented in space, only a small fraction should point towards Earth. That's why we expect to see superluminal motion only in very distant objects, where we are sampling a huge volume of space. Finding superluminal motion in the second closest jet suggests this standard picture may need some modification. One possibility is that the motions within the jet are very turbulent so that material moves in a wide range of directions. We actually see some evidence of this in M87, too. Instead of moving straight away from the galaxy's nucleus, some of the clouds seem to move on bent paths. This would let some of the clouds move towards earth without actually having the entire jet pointed right at us," explained Biretta.

"Our basic understanding of these 'radio jets' is that they are streams of electrons (and positively charged particles) shooting outward from a mysterious object at the centers of some galaxies and quasars -- rather like a stream of exhaust from a very powerful 'central engine.' While no one knows exactly how the engine works, it is widely thought that a supermassive black hole lies at the center of the machinery. Finding superluminal velocities further supports the 'massive black hole' model, since few other objects could accelerate material to such speeds," remarked Biretta.

According to Owen, "M87 is the massive central galaxy in the local supercluster of galaxies in which we live. Thus, the object in the center of our local region of the universe appears to have a jet moving close to the speed of light, pointed, like a giant cosmic finger, almost directly toward us." Owen added, "The challenge to modern astrophysical theory is to understand this in a way which makes it more statistically likely. The alternative is to accept it as just an apparently unlikely property of our position in the universe."

The galaxy M87 is a faint (9th magnitude) object about 50 million light years distant in the constellation Virgo. Its jet was first discovered in 1918 by an optical astronomer, Heber Curtis, who noticed a very faint wisp of light extending outward from the center of the galaxy. Much later, radio telescopes were aimed at this object, and Curtis's faint wisp was discovered to be a blazing bright source of radio waves. Similar features, known as "radio jets," have since been found in hundreds of galaxies and quasars.

The Very Large Array is a facility of the National Radio Astronomy Observatory, operated by Associated Universities, Inc., under cooperative agreement with the National Science Foundation.

###

For more information:

Dr. John Biretta (410) 338-4955
Dr. Frazer Owen (505) 835-7000