

Ambartsumian, Arp and the Breeding Galaxies

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Two exactly opposite views about the origin, the evolution and the formation of galaxies in the universe are discussed. The first one, which is mainly based on mathematical idealism and is generally accepted, views galaxy formation as deterministic and an essentially unidirectional condensation of diffuse matter created through a single primordial explosion (The Big Bang) about fifteen billion years ago. The second view, based on (limited) observational and empirical evidence asserts a rather intrinsic origin of galaxies, where new galaxies are formed from material ejected and/or dissipated from the core of existing galaxies. A dialectical perspective in support of the second view is presented.

Keywords: Galaxies, “Big Bang” theory, dialectics, condensation, primordial gas, ejection/dissipation, gravitational relaxation, appearance/disappearance, annihilation, matter/antimatter.

One major characteristic of an invariable truth (scientific truths included) is that, it makes its appearance at a certain time in history, but nevertheless it lays claim to unconditional validity for the past, the present and the future. Once it is extracted from the real world, it becomes an alienated subjective force and assumes an independent

entity of its own as if coming from outside. It then sets itself to control its very creators—religion, state, capital are a few examples. Another important aspect of such a truth is that it has its origin in a “first cause”—a mystery, which has to be accepted as an article of faith; the rest follows from it in a deterministic way, obeying the laws of cause and effect. Any new fact or phenomena must fit in the scheme of this truth. If it fails to do so then secondary, tertiary, *etc.* mysteries have to be incorporated to make it fit in the larger scheme.

The General Theory of Relativity is such an invariable truth. Matter and space-time is engaged in a sterile and eternal love embrace, and this describes the architecture and the geometry of the universe. Albert Einstein himself claimed that one can only prove or disprove this theory, but any further improvement of it is impossible. The world then follows from this truth obeying the laws of causality. The Big Bang theory, inflation, dark matter/energy, black holes, *etc.*, are secondary, tertiary mysteries that need to be invoked to bring the new cosmic phenomenon in line with the primary truth.

The Big Bang theory claims to be an invariable truth on its own merit specially, after the rival Steady State theory lost much of its appeal. Both of these theories were proclaimed as corollaries to the General Theory of Relativity. If the Big Bang theory required of God to create the universe at one stroke and then either forget about it or follow on an eternal cycle of Big Bang and Big Crunch, the rival theory obliged Him to keep an inventory and keep on creating matter where and when necessary for all eternity.

According to Big Bang theory, the universe came into being with a primordial explosion no-where and no-when and is destined to follow a predetermined course set out as a mathematical plan. Starting from the size of a proton and undergoing an initial unimaginable rate of inflation, the universe is continuously expanding ever since. All matter/energy, space-time or anything else in this universe including

us, are shards of a ten or twenty-six dimensional reality of Plato's ethereal realm of perfect symmetry, exquisite beauty and absolute order. This ethereal realm is not given to our senses. We can reach it only through the power of thought and by following the logical consistency of mathematics. We can possibly get a glimpse of the original reality by piecing together the shards that are strewn around us in this universe and putting them in their place in the puzzle. The task of physics and cosmology is to reveal the image of the original reality in the details of the cosmos. Dark matter/energy, black holes, *etc.* are mini-mysteries needed to explain the dynamics of the galaxies. After completing the "theory of everything" (which is not far off) we will "know the mind of God," and can live happily ever after.

The textbooks and professional articles on astrophysics, astronomy, cosmology, *etc.* start their deliberation assuming Big Bang theory as granted. Any meaningful or at least rewarding research, studies, *etc.* in this area must be concerned in finding the glory of this truth in heaven and nature. At stake are generous research funds, lucrative positions and most of all instant fame & glory. Only positive results are worthy of publication or discourse, the negative ones are of no importance or consequence at all. In the jungle of electronic noise in the spectra or pictures, one must hunt for positive signs of this truth.

There is no doubt that controversies, debates, *etc.* exist regarding the cosmos and volumes are written and spoken. But all these are involved with what happened *after* all matter/energy burst forth from the single act of creation, or on the precision of the measurement of certain cosmological parameters, or the formulation of various mathematical models, *etc., etc.* But there is absolutely no doubt that the galaxies condensed from the fixed amount of gas formed during the act of the creation. "Fierce" debate is raging on whether the gas

cloud broke into huge chunks, which later fragmented to form stars, galaxies, cluster of galaxies (top down) or whether smaller chunks of the initial gas cloud condensed first and then grouped together to form galaxies, *etc.* (bottom up). Except for a few minor details, Big Bang cosmology is a satisfactory description of the universe, thereby bringing astrophysics and astronomy to a close. The non-conformists to this paradigm and critics, who undertake investigation of the universe just as it is, or on a different premise, are but “gadflies” who only cause vexing and unnecessary irritations.

Let us briefly recount the history of our invariable truth of the universe and official observational cosmology of the recent past. The invariable truth started in 1916 with an all-inclusive equation. But a solution of this equation showed that the universe should be unstable (expanding or contracting) which was contrary to the conventional perception, so a fudge factor was put into the equation to keep order and peace in the heavens. A proof of this “now invariable” truth was needed and it came soon enough. An experiment in 1920 led by Arthur Eddington (a mystic of numerology) measured the bending of starlight by the gravitational power of the sun. The bending was exactly what was predicted by the theory! But soon that particular experimental proof was also found to be a fudge factor, which Stephen Hawking described as “a case of knowing the result they wanted to get, not an uncommon occurrence in science”. Edwin Hubble’s discovery in 1929 that the galaxies seem to be flying away from each other at a rate proportional to their distance, also discovered the “the greatest blunder” of a life time, the fudge factor in the original equation was un-necessary after all. Now that we have got back our invariable truth in its original form, an unlimited extrapolation of Hubble’s finding must mean that everything in this universe was at one point in the past, from which it started off with a bang, giving the result we see today. The discovery of the microwave

background radiation in 1965 *sealed the deal* forever. It showed a *perfect* isotropic picture of the universe that it was supposed to be. But there were minor glitches and irritations from the “gadflies” like Gerard Henri Vaucouleurs, George Abell, Vera Rubin and others—observations revealed that the universe was not homogeneous at all as far one could survey (more than 15% of the supposed universe!) with the most sensitive tools of astrophysics. Instead matter is seen to be clumped progressively into stars, galaxies, groups of galaxies, cluster of galaxies, clouds, super-clusters, super-cluster complexes that can span hundreds of millions of light years and so on, often linked together in filament-like strings that border vast region of empty space where there is almost nothing at all.

Well, not to worry, we can now let quantum mechanics into the picture to create some minor fluctuation in the primordial atom. These fluctuations must survive the super-bang explosion, separation of the various forces, separation of matter and radiation, the incredible super-luminal inflation of the early universe and so on to form the clumpy structure of the cosmos. And one must now look for this in an anisotropy of the cosmic microwave background (CMB) radiation that was already found to be isotropic. Sure enough, experimental evidence came handy in 1977 when George Smoot and co-workers detected the CMB anisotropy in an experiment conducted from a U-2 aircraft. The “final proof” came on April 23, 1992 in the COBE (Cosmic Background Explorer) satellite experiment again under the direction of Smoot (who else?). A lot of drama, tension, expectation prevailed during the two years of data collection. There was a lot at stake! Instead of devising or doing their own experiments, scientists all around the world were all hushed up in breathless anxiety and expectation about what this new Messiah was going to pull out. Some of them were saying, “You could say we’re close to a crisis, but the truth is, we’re getting down to the point where we should see

fluctuations. We are now positioned to see them—and boy, we’d better see them...” [Quoted by T. Ferris, *The Whole Shebang*, Simon & Schuster, 166(1977)]. As expected the result came out positive — sigh of relief, the invariable truth survived yet another big test. It was greeted with comments like, “The scientific discovery of the century—if not all time,” “the Holy Grail of cosmology” and so on. COBE must finally put an end to the torture of the gadflies or any doubt as to the absolute truth of the Big Bang! But of course the COBE results had to be positive like Eddington’s experiment, amid all this hype, expectations, browbeating, *etc.* A negative result would have necessitated “further” experimentation until we got a positive one. In science as in life, we eventually get what we are looking for, because we already *know* that the thing exists! Nevertheless this episode speaks a lot about a science and its invariable truth when you have to hold your breath on the outcome of a single experiment. It is all the more remarkable that neither the invariable truth of the Theory of Relativity, nor any aspect of astrophysics, cosmology related to Big Bang genesis so far merited for a Nobel Prize.

But what happens if we try to look at the cosmos, stars, galaxies, *etc.* in this universe as they actually are, free of any preconceived idea or without the lens of an invariable truth and then form theories, intuition, *etc.* based on these observed facts? Viktor Ambartsumian tried to do exactly this in the 1950s. He insisted that observation must take precedence over speculation in the study of the cosmos. He had found “stellar associations”—groups of ten to a thousand stars within the Milky Way apparently of a common origin but they were moving too fast for their gravity to hold them together permanently and to stop their slow dispersion. Ambartsumian saw similarities between the dispersion of stellar associations and other cosmic phenomena such as the ejection of matter/energy from dying stars, the gradual break-up of binary stars and later extended it to include the more

catastrophic ejections in radio galaxies, quasars, *etc.* in which he found the same dispersive process in action. Ambartsumian suggested that material is dispersed/ejected from the galactic nuclei variously producing the intergalactic gas, the feature such as the spiral arms and/or giving birth to new galaxies or clusters of galaxies. Dispersion from compact (super-dense) sources at the galactic core for him, therefore, represented the fundamental dynamics of the universe. This is exactly the opposite of the view that the galaxies condensed from the diffuse clouds of gas produced from some events in the past as Big Bang and Steady State theories proposed. Ambartsumian of course was humble enough not to theorize about the nature of the compact source or how catastrophic ejection of matter/energy could take place, simply noting that there was no known physical process that could cause such enormous events. He probably did not want to minimize the great significance of these observations and his intuition about them, by invoking some fearful and cheap cosmological beasts or monsters like black holes, dark matter/energy, *etc.*

But Ambartsumian's work received little attention or at best met with dismissing skepticism. The two camps of theorists were beating their war drums and were busy collecting only those evidences in the cosmos that would support their respective invariable truth about the creation of the universe. For both of these camps the study of galaxies was of secondary interest, since it was generally assumed that galaxies were formed by the condensation and contraction of diffuse matter. With the discovery of the microwave background radiation the drum-beating of the Big Bang camp became so loud that it drowned out not only the Steady State camp, but everything else—Ambartsumian included.

In the midst of this deafening sound of the Big Bang, very few non-conformists like Halton Arp were trying to bring back “observation” at the center of astrophysics. Arp was carrying on with

his tenuous attempts (opportunity permitting) to study the so-called peculiar galaxies, Active Galactic Nuclei, quasars, *etc.* During his long career in astrophysics, Arp along with others have collected spectacular images of the cosmos that show a dynamic process of violent ejection and dispersion of matter/energy as an important aspect of the universe. They found evidence of systems of galaxies linked by jets of nebulosity showing the track of ejection of objects from a parent source where an ejectum may have totally different red shift from its parent. Even without going into the controversy of the intrinsic nature of red shift and variable mass theory, these images and studies themselves confirm the validity of the great insight of Ambartsumian i.e., the dialectical evolution of the universe. Not only is there clustering of galaxies on the largest scale (which is now reluctantly accepted as a fact), in the small scale also, family like groupings of a high concentration of dwarf irregular galaxies, a host of small dwarf elliptical galaxies, distant globular objects, *etc.* that cluster around large spirals like Milky Way and Andromeda were studied in detail by the Estonian astronomer Jaan Einasto. These groupings, known as the local groups now seem to be a general pattern in the cosmos. The giant elliptical galaxies such as M87, possess a population of globular clusters extending at large distances in space. These observations suggest the intrinsic origin of the satellite galaxies and the globular clusters i.e., ejection from parent galaxies as envisioned by Ambartsumian.

All these tedious and painful efforts of the non-conformists could do is to earn them the honour title of “gadflies”. But it seems that these non-conformists should rather be called “fireflies” instead, because they provide the only dim light in this dark cloud from the Big Bang that threatens to become more and more “dark”! Observational astrophysics, which like natural science in general started off as a tool for free and open inquiry of the cosmos, and

which made great strides at its onset, now finds itself progressively being appropriated by a monopoly economic power and an interest group that use it in support of their pet theories. The fierce conflict between the paradigms of dialectics and causality that raged in the field of terrestrial nature and which was won decisively by the former with the discovery of the theory of evolution and quantum mechanics has now shifted to the field of the cosmos.

But how things stand if in our search of the cosmos we follow the dim light of these “fireflies” (rather than the intense “dark” beam of an invariable truth) guided by the insight of Ambartsumian and the views of dialectics. According to dialectics, nothing can exist without its opposite residing in its own element at the same time (the *unity of the opposites*). The impetus for any development, change, evolution—in one word *motion* in a thing or a process is due to the conflict of the ever-present opposites residing in the very elements of the thing or the process itself and not because of an “impulse” from outside, as causality believes. For dialectics *motion is the mode of existence of matter. There can be no matter without motion and no motion without matter.* This motion is mediated by blind chance and iron necessity that is inherent in chance. Quantum mechanics also has reached the same conclusion. So, the notion of the existence of a primordial entity of perfect (ten or twenty-six dimensional) symmetry, of absolute order, *etc.* that burst forth into this universe through a single event such as the Big Bang is a myth created by our mind and our mathematics. And so must also be the notion of a creator who pushed the button to trigger the Big Bang explosion, since there was no mechanism within the primordial entity of *absolute order* to trigger itself or to come to itself in the first place. According to dialectics *there is no leap in nature*, precisely because *nature is composed entirely of leaps!*

In the case of terrestrial nature we observe that matter, life, history and thought evolve through a series of revolutionary changes (qualitative leaps) according to the dialectical law of *the negation of the negation* or a triad of thesis—antithesis—synthesis mediated by chance and necessity, and brought forth through the conflict of the opposites or the contradiction of heredity and adaptation in its very own units. Chance is blind only when it is not realized in a necessity. If a seed from a plant falls on a stone or by chance carried to the moon, it will not grow there, because there is no necessity for it, *i.e.*, no scope of its further development. So this chance is sterile and things end there. But when a chance brings the same seed into a fertile soil, it develops due to the exacerbation of the conflict of the opposites within the seed, it *negates* itself into a plant, which in turn negates itself (*the negation of the negation*) to give an increased quantity of the seed itself. All change, motion, development in this view proceeds through *nodal points* or leaps (governed by specific laws) where dialectical opposites either mutually annihilate each other or are sublated (*aufheben*) into a new synthesis and so on (*the negation of the negation*) and where changes in quantity leads to a qualitative change and vice versa. It is the task of natural science to discover these specific laws and not to impose laws on nature created in the brain of man.

In the realm of the cosmos too, the galaxies (the units in the cosmos) must develop dialectically due to the conflict of the opposites residing in themselves and mediated by chance and necessity. But while in the case of terrestrial nature a definite proportion and amount of atoms were given from which everything else evolved (within a relatively short time in cosmic scale) new matter has to come into being for the proliferation of the galaxies and the universe itself! But how could new matter come forth and how could such enormous amount of energy as manifested in the quasars for example, be

generated? The “compact source” of Ambartsumian and the “white hole” at the core of the galaxies suggested by Arp fall into the same trap of causality like the Big Bang! These must have come into being and scattered around in the cosmos through some casual relationship originating in a “first cause” like the Big Bang. Very large-scale matter-antimatter annihilation processes are the only possible known sources of energy that can trigger the catastrophic events like quasars. But none of the theories and hypotheses mentioned above (including Big Bang) allows such a possibility.

A dialectical view of the universe as proposed recently (*Apeiron*, Vol 10, No. 2. 165-173(2003)) can provide a plausible basis for an understanding of the evolution of the galaxies in particular and the phenomenology of the cosmos in general. According to this view, matter in the form of elementary particles comes into being and passes out of existence (with a finite amount being present at any particular time) as a dialectical and quantum mechanical necessity in the universe, which is void and infinite in space and time. Persuasive evidence from quantum electrodynamics suggests that virtual particles inhabit empty space with an increasing concentration close to an atomic nucleus. Some of these virtual particles can become real (and the real pass back to virtual) as chance events and necessities, by tunneling effects, and/or as pair production by quantum fluctuation in the vacuum and so on, to give rise to both matter and antimatter. Out of the innumerable possibilities, the law of chance and necessity determines which particles eventually prevail. Chance accumulation of matter and/or antimatter at certain points can then provide the seeds for further growth and development of galaxies, following physical laws. Since the appearance/disappearance of matter is enhanced where mass concentration is high, the galactic centers form the most active sites where new matter accumulates and these centers become the theatre where other random and periodic cosmic events can

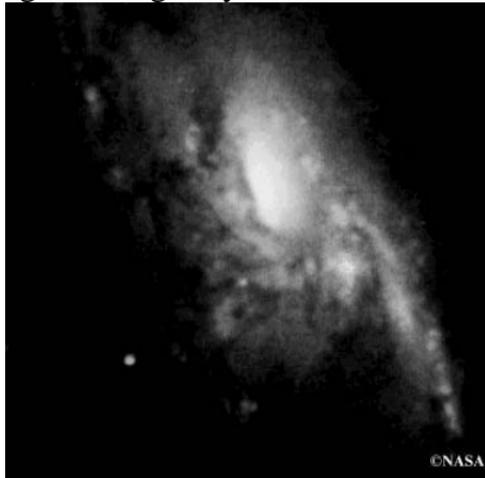
manifest themselves, such as those that we see as the Active Galactic Nuclei (AGNs), quasars, *etc.* This basic process then can form the fundamental dynamics through which the universe evolves.

Everything in this universe from the galaxies to man are therefore, temporary and dynamic structures governed by physical laws and by the interplay of chance and necessity. Chance accumulation of matter at certain points in the infinite space and their evolution can give rise to the island universe around us, because new antimatter that forms is annihilated by reaction with existing matter giving gamma rays. These gamma rays along with other sources of energy degrade through their interaction with matter to give a quantum mechanically necessary zero-point energy—the observed cosmic microwave background radiation. The chance accumulation of antimatter in variable quantities and its inevitable interaction with matter can explain the origin of gamma and X-rays in the galaxies, the gamma ray bursts, active galactic nuclei, quasars, and other catastrophic events in the cosmos, for which no other source for the outpouring of such enormous amount of matter/energy is known.

Also such large scale catastrophic reaction of matter and antimatter can provide the energy necessary to eject the globular clusters, or large chunks of matter from the mother galaxy that later either grow on their own and/or accumulate by gravitational attraction to form satellite galaxies, *etc.* The Seyfert Galaxy NGC 7603 and its smaller companion provide a dramatic example of such a possibility. The minor axis of the flat spiral galaxies provides the most convenient route along which matter/energy can be ejected out in opposite directions. More limited scale of these random and catastrophic events may lead to the less dramatic effects such as the deformation or limited fission/elongation of symmetrical galaxies to form barred structures.

The morphology of the various galaxies, such as spirals, ellipticals, irregulars *etc.*, must be looked at as the various stages, following one another (and not existing alongside of each other since their simultaneous creation, as official cosmology proposes) in the process of their evolution, dissolution or their transformation into each other, determined at any particular time by the net result of the random processes of appearance/disappearance or matter/antimatter production/annihilation, the collision/interaction of the galaxies with each other, ejections from the core, *etc.*, which are governed by chance and necessity and the physical laws.

As suggested by Arp, it is possible that linear ejections of pairs of objects along the minor axis of the parent galaxy give rise to the companion galaxies, quasars, *etc.*, while ejections along the major axis are stopped close to the ejecting parent which then may form the spiral arms as Ambartsumian envisioned. Evidence for such a transformation had already been found in 1961 when the French astronomer G. Courtès discovered that proto-spiral arms seem to have been ejected from the center of the Seyfert galaxy NGC4258. A more recent NASA image of this galaxy is shown below:



It is entirely possible to speculate that some of the ellipticals transformed into spirals by forming proto-arms through ejection from the core, because unlike the case with the spirals, ejection along any direction will be slowed down by the existing bulk of matter. The spirals then slowly convert back to the SO or E type galaxies through gravitational relaxation. The different types of galaxies are dynamic structures in the various stages of formation/ dissolution, succession/inter-conversion to each other (and not structures “perfect in themselves” since their formation after the Big Bang). It is however, obvious that the shapes of some of the galaxies were determined by the random collision and/or close encounter with another galaxy

The morphology of the galaxies is therefore, mediated by the dialectical process of dispersion/ejection/deformation initiated by the catastrophic events of matter/antimatter annihilation and the regularizing effects of gravitational attraction.

Time is an intrinsic and a relative characteristic parameter for a particular particle or a unit of assembly. It begins when the unit comes into being and ends with its passing away out of existence or with the dissolution of the unit. This view is the exact opposite of the notion of the creation of space-time and all matter/energy in the finite past. If stars, galaxies like humans are temporary entities, “coming into being and passing out of existence” as dialectics asserts, then we cannot measure the age of the universe at any particular moment by measuring the lifetime of the longest living star or galaxy, anymore than an extraterrestrial can determine the age of the earth by measuring the lifetime of say the longest living human being on earth. He will get a ridiculous value of 100 years!

So far astrophysics has helped us to have a general understanding of the evolution of the higher atomic number chemical elements in the cosmos as a dialectical process. Only a similar understanding of the

nature of the large-scale distribution of the galaxies, their origin, morphology, evolution, dissolution, *etc.*, the energetics and the dynamics of the cosmos, the evolution of hydrogen, and other very low mass unit particles that are not created by the fusion reaction in the stars and so on, guided by a consciousness of the laws of dialectical thought, will link us up with our understanding of terrestrial nature. A cosmology built on the fantastic notions of a first cause, mathematics and a creator, a cosmology perplexed to explain how there can be galaxies even at 17 billion light years away, far beyond the limit of the universe it predicts, or how the ratio of heavy elements like iron in the intergalactic space and in the quasars (which are supposed to contain only primordial hydrogen and helium) can be as high as that in the galaxies, *etc.*, a cosmology that gives spurious explanation for the formation and the structure of the galaxies, or invokes mysterious monsters like dark mass/energy, black holes *etc* to explain the energetics/dynamics of the cosmos, and above all a cosmology that titters to the brink with nervousness on the outcome of a single experiment, will finally be done away with.

Ambartsumian's revolutionary insight marks a point of departure (a nodal point) for further progress in cosmology. It is a dialectical opposite of the paradigm of causality and of the single act of creation of all things that natural science fostered so long—a paradigm that has decidedly been proven wrong in the case of terrestrial nature. A paradigm that has progressively been built on professional careerism, conformity to the tradition and a sense that going against the trend is equivalent to cutting at the very branch of the tree you are sitting on. Only practicing visionary astrophysicists like Ambartsumian and a Darwin of the cosmos can rescue us and can help us out of the black hole that official cosmology has led us into. The rest of us can only hope and wait in anticipation, like the poet Rabindranath Tagore:

*Oh the fresh, the raw, the breaking light!
Save the half-dead with thy fatal strike!*