

Ambartsumian's Greatest Insight - The Origin Of Galaxies

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Abstract.

From simply looking at pictures of galaxies Ambartsumian realized that new galaxies were formed in ejections from old galaxies. In the ensuing 40 years, observations have supported in increasing detail his original insight. We can now empirically outline the development of compact objects emerging from the nuclei of active galaxies into young star forming galaxies and finally into aggregates of old stars.

The observations actually require galaxies to continually originate in a low particle mass plasma which has remarkably similar properties to the "superfluid" which Ambartsumian foresaw. He had the courage to present these conclusions to influential astronomers who still today reject any origin of galaxies other than in the Big Bang. In this most important subject of science, the nature of our universe, Ambartsumian's revolutionary insights are now increasingly vindicated by observation.

1. Looking at Galaxies

In order to communicate a feeling for how my appreciation of Ambartsumian's work grew over time, I wish to recount a series of seminal events roughly in chronological order:

In 1949 I came to Cal Tech. My first job as a graduate student was to pick guide stars for the Palomar Schmidt Sky Survey (PSSS). In the following years the Sky Survey was carried out. Famous astronomers such as Hubble, Baade, Zwicky, Minkowski and Abell noticed peculiar and unusual galaxies from time to time. But I felt that in order to understand their physical nature one had to classify their properties and particularly to study the possible causes of the continuity of change of these properties. Between 1961 and 1965 I finally got the opportunity to do systematic photography of the 333 most peculiar galaxies with the highest resolution telescope of that era, the 200-inch at Palomar. After assembling the Atlas of Peculiar Galaxies my conclusion was clear: Galaxies could eject material which resulted in the birth of smaller galaxies!

Then a shocking event occurred in my young researcher's life. I realized that I had forgotten that Ambartsumian had come to exactly the same conclusion about eight years earlier. What impressed me the most was that he had come to this conclusion by just looking at the Schmidt PSSS prints which had much less detail than my reflector plates. When I asked some of the older scientists, they told me that he had presented his conclusions at the prestigious Solvay

conference in about 1957. They also related that this select group of the best known scientists in the world had either been completely baffled or laughed privately at these crazy ideas.

At that point I recognized that Ambartsumian would be one of the few people in the world who would really understand and appreciate the peculiar galaxies classified in my Atlas. Some of them were Ambartsumian's original objects now viewed with higher resolution. So I determined to travel to Armenia and present him with the first copy of the Atlas. I wrote to the Russian Embassy informing them that Ambartsumian had invited me and requested a visa. It was delivered to me as I was going up the steps to the airplane to fly to Europe. Only when I was on my out of Russia did I learn that I was in the disturbingly irregular position of being neither Intourist nor a guest of the Academy of Sciences. Ambartsumian's influence had apparently secured a singular visa for me at the last moment.

I remember walking up the steps of the Byurakan Observatory where Ambartsumian met me and took me to his office. There, together with the staff of the Observatory, we first looked at the birds nesting outside his window and then proceeded to go through the Atlas of Peculiar Galaxies, photograph by photograph, discussing and commenting on each one. Later walking in the garden with him he said to me, "Well you don't need to come all the way to Armenia to talk to me when you have so many famous astronomers in Pasadena to discuss these matters with." I was startled and quickly looked at him. He was smiling and I knew that this was a private joke that referred to the enormous schism that had developed between the majority of astronomers who were sure galaxies all were born at the same time in the beginning of the universe and that small minority who believed galaxy creation was continually going on.

2. The Theory Freezes

Four years earlier, in 1961, the International Astronomical Union (IAU) had met in Berkeley, California. Ambartsumian assumed Presidency of the Union at that time and was also present at IAU Symposium 15 at Santa Barbara California. That symposium brought together all the reigning experts in extragalactic astronomy. Among them were Sandage, de Vaucouleurs, Zwicky, Abell, Vorontsov-Velyaminov, Holmberg, Minkowski, Hoyle, Ryle and most prominent of all, Jan H. Oort, the retiring president, and the astronomer credited with the discovery of galactic rotation and the Oort cloud of comets.

Because Ambartsumian gave an invited discourse at the General Assembly which followed some days later in Berkeley, he gave only a minor talk in Santa Barbara. In his Berkeley talk the summary was exciting and masterful but many of the audience did not understand it. An example from his printed discourse, however is clear "...the jet joining the dwarf galaxy to the large one...there remains no doubt that the dwarf galaxy has been detached from the principal galaxy...the bridges and the filaments as resulting from the formation of two galaxies from one." Geoffrey Burbidge knew well the proposals of Ambartsumian, and in his summary talk in Santa Barbara, reviewed the evidence for young galaxies. The opinion of the conference was swept, however, by Jan Oort. It is not evident from his printed paper, but from his oral presentation and many

comments to informal discussion groups it was clear that he stressed arguments supporting the "all galaxies are old" school of opinion. That turned out to be the defining event of the conference. Even to this day, it is the unshakable belief of official astronomy that no young (newly created) galaxies can exist.

The reason that this assumption cannot be questioned is that the Big Bang theory of the creation of the universe requires that all galaxies formed at the same time about 15 billion years ago. This was basically the argument that was used at the Santa Barbara conference in 1961 and it has somehow come to be regarded as proof that the many observations of young and forming galaxies are not what they seem. It is therefore extremely important for all astronomers, now and in the future, to realize that they must make a conscious choice in their basic assumptions in extragalactic astronomy. If they choose the hypothesis that galaxies are not being created today, and if this is not true, then their research efforts will be, for the most part, wasted and their entire cosmology embarrassingly incorrect.

3. What do People Really Think?

In 1973 the IAU was held in Australia. Because that was so distant for Europeans, exceptionally a second section was convened in Krakow. Due to the fact that I returned from Australia via the Tata Institute in Bombay to see Narlikar, I was able to also attend the Polish part of the meeting. One moment of that latter meeting stands out vividly in my memory. Ambartsumian was chairing a session of contributed papers and I happened to be sitting next to Jan Oort. I knew Oort fairly well by then. Looking at Ambartsumian he leaned over and whispered in my ear:

"You know, Ambartsumian was right about absolutely everything."

I was rather stunned, and I have been thinking about that remark ever since. I finally have concluded that Oort must have wavered from time to time in his opinions in spite of his having such strong control over the adherence of the community to the orthodox doctrine. It also serves to highlight the paradox which Ambartsumian represented to the established paradigm. It was unanimously agreed that Ambartsumian was a great astronomer. At the same time his statements about the most important fundamentals in astronomy were not believed. This is even more true today. Is this another example of people thinking they believe one thing and then acting in a completely opposite manner? Is there an insincerity or inconsistency in the higher levels of astronomical theory?

Ironically, as the evidence has grown in favor of continual creation of galaxies, the data has been increasingly criticized and rejected from main stream journals. In all honesty, of course, there has arisen a complication in that some researchers, including myself, feel that when matter is created it has high intrinsic redshift. Then, as it ages and evolves, the redshift falls to more normal values. This enables quasars to be low luminosity, nearby proto-galaxies and to evolve into second generation companion galaxies with slightly higher redshifts as observed. Up until about the middle 1980's I know Ambartsumian did not believe in the existence of non-velocity redshifts. I have no reason to believe he changed his mind after that. But it is true that what kept the establishment from believing the evidence for non-velocity redshifts was fear for the expanding

universe hypothesis. That same fear kept them from believing Ambartsumian's evidence for new galaxies. Put another way, Ambartsumian's arguments had already contradicted the Big Bang so it was no longer necessary to save it by rejecting the existence of non-Doppler redshifts. But there was another amazing link between quasars as high redshift proto galaxies and Ambartsumian's picture of the creation of new galaxies.

4. Ambartsumian's "Superfluid"

It was clear that in order to "detach" a new galaxy from an old galaxy that it would have to emerge from the very small active nucleus and then expand into a normal appearing galaxy with apparently normal stars. Ambartsumian apparently had the physical intuition to realize that this would be impossible to do with an ordinary hot plasma. Therefore he proposed that the galaxies emitted a "superfluid". In conventional plasma this would imply a superdense state. It was the obvious difficulties with this high density which, I presume, prevented him from going farther with the model.

Having to account for the high intrinsic redshifts of the new galaxies, however, cast a startling new light on the nature of the emerging material. The only way matter could be understood to emit redshifted photons which was not due to recession velocity was if the constituent particles of the matter were of low inertial mass. Narlikar in 1977 showed that a *general* solution of the General Relativity field equations required just that - particle masses changing with age since creation and hence intrinsic redshifts initially high and decreasing with time. But with particle masses low and interaction cross sections high, this was a more or less perfect description of a fluid. Moreover it could emerge as a very small object with nearly zero mass from the small active nucleus. As time passed it would then develop into a more normal mass plasma.

More details of this galaxy forming process are considered in my paper in the this symposium. But here it is appropriate to emphasize that more than 30 years ago, from just the small telescope observations which were available, Ambartsumian foresaw the essential physical processes which would be required to account for the most fundamental entities in cosmology - the galaxies. Still today the vast majority of astronomers have not been able to reconcile the observations with a simple, understandable picture of how the universe works. Ambartsumian was, in my opinion, a Copernican man in Ptolemaic times. With such huge changes in concept about the most fundamental aspects of nature the paradigm takes a very long time to shift. From the common sense of Aristarchus and Eratosthenes there was the interregnum of Ptolemy for 1800 years before the clarity of Copernicus. I would hope, with the light of Ambartsumian shining ahead, that today's astronomers would more quickly relinquish their concentration on epicycles required to shore up a theory of everything created instantaneously out of nothing and follow the observational path to a more profound understanding of how the universe really works.

The following picture shows a galaxy with conspicuous jet activity which was originally noted by Ambartsumian. (Photograph taken by Arp with the 200-inch Palomar telescope).

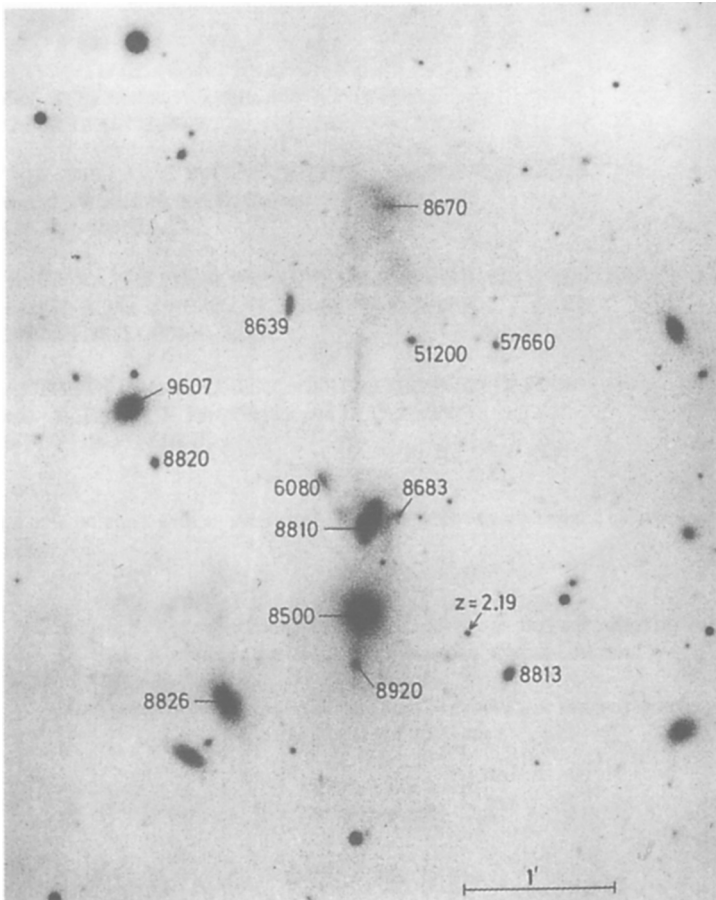


Figure 1. "Ambartsumian's knot" is shown being ejected directly southward from the giant E galaxy NGC3561B (also known as Arp Atlas No. 105). This small companion as well as 12 out of 13 of the surrounding companion galaxies have higher redshifts than the parent galaxy. In this single picture one can view the evolution from the young, high redshift quasar ($z = 2.19$) through to the oldest second generation galaxies of only a few hundred km/sec higher redshift.