# Viktor Amazaspovich Ambartsumyan (on his seventieth birthday)

A. A. Boyarchuk, O. A. Mel'nikov, L. V. Mirzoyan, É. R. Mustel', V. V. Sobolev, and E. K. Kharadze

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September 18, 1978 was the seventieth birthday of Viktor Amazaspovich Ambartsumyan, an Active Member of the USSR Academy of Sciences, one of the leading astrophysicists of the modern age, and an outstanding scientific organizer.

His exceptional ability and broad interest in the study of nature became evident during his schooldays. The young scholar Ambartsumyan spent most of his time on mathematics, physics, and astronomy and had already in his school years mastered the theory of relativity.

After graduating from Leningrad University, Ambartsumyan was a graduate student at the Pulkovo Observatory under the supervision of the noted Russian astrophysicist A. A. Belopol'skiĭ. He then returned to Leningrad University, where he organized the first Department of Astrophysics in our country. There, with his students, he continued his work in the field of theoretical astrophysics, contributing in many ways to the rapid progress that it made under the influence of the new quantum mechanics. It also heralded the birth of a Soviet school of theoretical astrophysics, of which Ambartsumyan is the acknowledged leader.

VIKTOR AMAZASPOVICH AMBARTSUMYAN

During the early years of the Second World War, Ambartsumyan was in charge of the Elabuga Branch of Leningrad State University (LGU), where he carried out important defense-related work. While there, he developed a theory of light scattering in turbid media. At the LGU, he was also Director of the Astronomical Observatory and its scientific Vice-Rector.

Since 1943, Ambartsumyan has been associated with the then newly created Armenian Academy of Sciences, of which he was a founding member. He held the post of First Vice President at the Academy until 1947, and has since then been its President.

In 1946, the Byurakan Astrophysical Observatory was founded under Ambartsumyan's direction. In the same year, he founded the Astrophysics Department of Erevan University, which he still heads. Deliberately designed studies aimed at solution of particularly important scientific problems that were carried out under his supervision at the observatory, which was staffed almost entirely by his students, won it wide recognition within a comparatively short time, and it was awarded the Order of Lenin in 1967.

The first major series of Ambartsumyan's scientific papers pertains to the physics of gaseous nebulae. He was the first to solve the problem of transfer of ultraviolet radiation from the star through the nebulosity by separate analysis of the radiation field of the latter in the $L_\alpha$ line, and beyond the limit of the Lyman series. He gave an exact formulation of the conditions necessary for the appearance of forbidden lines in the spectra of gaseous nebulae. He developed methods for determination of the electron temperatures and masses of the nebulae that are even now widely used in astrophysics.

In another series of studies, Ambartsumyan addressed himself to the problem of radiation transfer. The problems of radiation-transfer theory usually reduce to solution of certain integral equations that determine a function characteristic of the emissivity of an elementary volume of the medium. Ambartsumyan took a totally different approach to these problems, reducing them to functional equations that directly determine the intensity of the radiation escaping from the medium, with the aid of which it is easy to find the radiation field within the medium. In deriving these functional equations, Ambartsumyan used methods based on the "invariance principles" that he was the first to enunciate. In the simplest case of a semiinfinite medium, one of these principles states that the reflectivity of a medium will not change if a layer of finite optical thickness with the same optical properties is added to it. It is an analysis of process in this layer that leads to the functional equations for the intensities of the radiation leaving the medium.

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Ambartsumyan's methods and equations have an important role in contemporary multiple-scattering theory. The invariance principles have also been used extensively in mathematical physics, radiophysics, geophysics, and nuclear physics to solve various problems of practical importance.

Ambartsumyan obtained important results in stellar astronomy. He was the first to suggest that the interstellar absorbing matter in the Galaxy has a floccular structure. On the basis of this concept, he developed the theory of the brightness fluctuations of the Milky Way and a theory of the fluctuations of the numbers of extragalactic nebulae across the sky. Comparison of this theory with observations made it possible to determine characteristics of the absorbing clouds.

Ambartsumyan achieved remarkable results in stellar dynamics. He laid the foundations for a physical statistics of particles interacting with one another in accordance with Newton's Law—a statistical mechanics of stellar systems. According to Ambartsumyan, each star is subject to the action of two forces in its motion within the system: the attractive force of the entire aggregate of other stars (the regular force) and perturbing forces set up by passages close to other stars (the irregular force). The action of the irregular forces becomes equal to the action of the regular forces during the relaxation time of the system. For the Galaxy, this time is much larger than its age. We may therefore assume for the Galaxy that the stars move as free material points under the action of regular forces alone. In more compact stellar systems (multiple systems, star clusters), the irregular forces play a significant role.

Application of the new statistics to double and multiple stars and star clusters led Ambartsumyan to fundamental results. In particular, he showed that the orbital elements obtained from observations for double stars indicate that they are not yet in equilibrium. Then, studying the decay of star clusters as a result of escape from them of stars which have acquired high velocities during close passages, he established that this process has not yet advanced very far. These results indicated that the Galaxy has been in existence for no more than $10^{10}$ years. Yet it had been believed that the life scale of the Galaxy was much longer—$10^{13}$ years. Ambartsumyan in a polemic with the noted British astronomer Jeans conclusively established the "short scale" for the life of the Galaxy.

Ambartsumyan obtained fundamentally important results in studies of the evolution of stars and galaxies. These studies, which were begun back in 1937 and turned up the first signs of stellar evolution, resulted in 1947 in the discovery of stellar systems of a new type that are dynamically unstable and decaying and have come to be known as stellar associations. This discovery was one of the most important made in astrophysics during recent decades and is of enormous significance for cosmogony.

Study of these systems led Ambartsumyan to the conclusion that the process of star formation is still continuing in the Galaxy. The indications that we have of a genetic relation between stars and diffuse matter gave him grounds to advance the hypothesis of simultaneous genesis of stars and diffuse nebulae from dense (and possibly superdense) bodies of nonstellar nature—from protostars. Under this hypothesis, the evolution of cosmic matter is presented in the form of successive transitions from denser states to less dense states. In particular, the formation of stellar associations is conceived of as conversion of protostars into unstable, decaying star groups and diffuse nebulae.

On the basis of research on stellar associations, Ambartsumyan advanced the idea that matter in unusual and as yet unknown states may play an important part in certain cosmic phenomena, such as star formation. In this context, he developed a theory of superdense baryon configurations with densities equal to or greater than the nuclear density.

Study of recently formed stars led Ambartsumyan to new views as to the sources of stellar energy. Analysis of data on the emission of T Tauri and UV Ceti stars produced evidence in favor of a nonthermal nature of the continuous emission that is sometimes observed in their spectra. In view of the youth of these stars, Ambartsumyan conjectured that the continuous emission is produced by upwelling from internal layers of the star into its surface layers of bunches of prestellar dense matter—sources of intrastellar energy that differ in nature from the traditional thermonuclear sources. This concept was confirmed to some degree when Ambartsumyan showed that the flare-star state is one of the normal states in the development of dwarf stars and comes after the T Tauri stage, and predicted the existence of two types of stellar flares: "fast" and "slow", which were later discovered by observation.

A new trend in the study of star and stellar-system evolution that formed as a result of Ambartsumyan's study of stellar associations and nonstationary stars was developed further after the discovery of nonstationarity on a grand scale in the universe of galaxies.

Ambartsumyan was the first to show that radio galaxies (i.e., galaxies with unusually high-powered radio emission) are not the result of an accidental collision between two galaxies, as was assumed after their discovery, but are an active stage in galactic evolution. In his view, the strong radio emission is one of the activity forms of the galactic nuclei that play a decisive role in the formation and evolution of galaxies. Of special interest among the various manifestations of nucleus activity are those involving enormous releases of energy: radio flares, explosions accompanied by ejection of large extended masses of gas, eruption of great streams of matter and of whole compact galaxies, and anomalously strong ultraviolet and infrared emission. Since there is good reason to believe that neither stars nor diffuse matter present in the nuclei of galaxies can account for their observed activity, Ambartsumyan assumes that the nuclei contain massive bodies of as yet unknown nature with fantastic reserves of energy.

The idea of galactic-nucleus activity came as such a surprise that it was received for a long time with a hostile or at best a skeptical attitude. Only many years later, after it has been confirmed by observations (discovery of quasars, numerous examples of ejection from galactic nuclei, etc.) did it, and especially the interpretation of radio galaxies based on it, find acceptance. It was therefore quite to be expected that Ambartsumyan's research on the activity of galactic nuclei and the process of star formation in expanding stellar associations should be recognized in the words of the prominent Dutch astrophysicist Jan Oort, as "the most important contribution of Soviet scientists to astronomy". It was also logical that Ambartsumyan's ideas as to the role of galactic nuclei in the colossal nonstationary phenomena that determine the evolution of these systems should be set forth in the Copernicus collection prepared by the United States National Academy of Sciences among the ideas that brought about the modern quasi-Copernican revolution in our scientific concepts.

One must, of course, take note of Ambartsumyan's deep and justified confidence in the ability of astrophysics to reveal new physical relationships in the world that surrounds us.

Ambartsumyan has rendered a great service in building up a large school of Soviet astrophysicists, who are now working successfully both directly under his supervision at the Byurakan Astrophysical Observatory and at the Leningrad and Erevan Universities and at various other universities and observatories.

Ambartsumyan has been Editor-in-Chief of the journal "Astrofizika" since the day of its inception and Chairman of the Editorial Staff of the "Armyanskaya Sovetskaya Éntsiklopediya" (Armenian Soviet Encyclopedia)—the first Armenian-language encyclopedia, and a member of the editorial staffs of many scientific journals.

Ambartsumyan's great organizational gifts were seen in action at the Leningrad State University and later at the Byurakan Astrophysical Observatory and the Armenian Academy of Sciences. Under his direction, the Academy has made great progress, primarily in the physicomathematical and physicotechnical sciences, which were practically nonexistent in Armenia before the Academy of Sciences was founded. Fields of knowledge concerned with the discovery and exploitation of mineral wealth, with the Republic's power engineering resources and industry, with development of the biological and chemical sciences, and with study of the long history and rich cultural heritage of the Armenian people are flourishing. Direct results of this have been the rapid development of the Armenian machinery, electronics, and chemical industries, the design of new electronic computers, etc.

Ambartsumyan has been an effective promoter of international scientific collaboration and Vice President (1948–1955) and President (1961–1964) of the International Astronomical Union. In 1968 and 1970 he was twice elected President of the International Council of Scientific Unions, which brings together the Academies of Sciences of 60 countries and 15 international scientific unions.

Ambartsumyan participates actively in the social and political life of our country. He has been Chairman of the Armenian "Znanie" society since the day it was founded, a member of the Central Committee of the Armenian Communist Party, and a deputy of the USSR Supreme Soviet since 1948. He was a delegate to the Nineteenth, Twentieth, Twenty-Second, Twenty-Third, Twenty-Fourth, and Twenty-Fifth Congresses of the USSR Communist Party.

Ambartsumyan's work is held in high esteem not only in the Soviet Union, but all over the world. His outstanding contributions have been recognized with USSR State Prizes (1946 and 1950), the M. V. Lomonosov and S. I. Vavilov Gold Medals, and the title of Hero of Socialist Labor; he has received four Orders of Lenin, two Orders of the Red Banner of Labor, Bulgarian, Hungarian, and Polish Orders, Gold Medals of the Slovakian Academy of Sciences and the British Royal Astronomical Society, the Jansen medal of the French Astronomical Society, the Helmholtz medal of the German Academy of Sciences in Berlin, and others.

Ambartsumyan is an honorary or foreign member of the academies of sciences of many other countries (Great Britain, the German Democratic Republic, Italy, India, the United States, France, Czechoslovakia, and others) as well as an honorary member of the Royal Astronomical Societies of Great Britain and Canada, the American Astronomical Society, and others, and holds honorary doctorate degrees from several foreign universities.

Viktor Amazaspovich Ambartsumyan, one of the leading Soviet scientists, is still full of creative plans and energy. As we congratulate him on his birthday on behalf of his numerous friends and students, we wish him rugged good health and new successes for the benefit of our Motherland.

Translated by R. W. Bowers