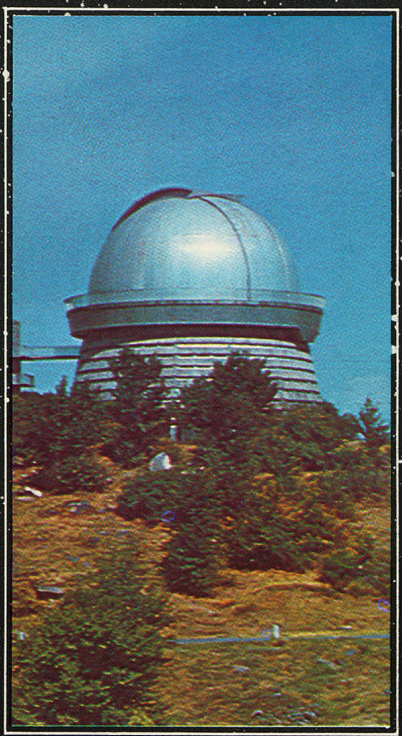
Ashot Arzumanyan

ENVOY OF THE STARS



Progress Publishers

This book is dedicated to the memory of Alla Arzumanyan, my wife, invaluable assistant and the first reader of my books.

Ashot Arzumanyan

ENVOY OF THE STARS

(ACADEMICIAN VICTOR AMBARTSUMYAN)

Progress Publishers
Moscow

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Ашот Арзуманян

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From the Author

Academician Victor Ambartsumyan, an outstanding astrophysicist, President of the Academy of Sciences of Armenia, director of the Byurakan Astrophysical Observatory, has twice been awarded the title of Hero of Socialist Labour, and is winner of the USSR State Prizes.

Ambartsumyan was elected President of the International Astronomical Union, and also President of the International Council of Scientific Unions. In recognition of his services to world astronomy, thirty foreign academies, scientific societies and universities have elected him as an honorary member.

In the course of the many years of work on this book, I consulted a wide range of documentary material, studied the archives of the Academies of Sciences of Armenia and the USSR, and also those of Leningrad University, the Pulkovo Observatory and the material collected by Amazasp Ambartsumyan, the father of Victor Ambartsumyan, as well as material from my own archives which I have been collecting for more than fifty years.

I met and talked with many people who know Victor Ambartsumyan: friends from his childhood and student years, his pupils and colleagues. They were all more than willing to help me, sharing their ideas and impressions. While not mentioning them by name, the author would like to express his gratitude to them all.

Artavazd's Behest

The pale, shimmering light of the stars lit up the slopes of the mountain named Byurakan because of the thousands of unceasingly bubbling streams. Here, more than a thousand years ago, the fearless warrior and scholar-monk Artavazd had lain dying on the charred and tortured soil of Armenia. Never had the starry sky seemed to him so infinite and majestic, never had the scattering of stars appeared so fanciful. And among them he could make out one that shone with purer brilliance than the rest. Was that not, perhaps, the legendary lamp lit by the Caesarean Bishop Gregory, supporter of Trdat the Great, which he had set above mount Aragats? Was that not, perhaps, the wondrous star seen only by those whose hearts were pure?

"...You shone down on us yesterday, when we still hoped for victory, and did not know that at midnight two traitors would open the gates of the Byurakan fortress to the enemy. You beheld the bloody battle at the beginning of that night, when the accursed conqueror, Beshir, ordered that everything that could burn be put to the torch so that Byurakan should be reduced to ruins. You will shine on tomorrow, when I shall be no more. Tell our descendants of our love for our native land and of how we gave our lives for it. Tell them how we defended our mountains, the graves of our ancestors, the sacred stones of the churches, the manuscripts—that repository of the wisdom and poetry of our people."

Books, manuscripts. How many he had read!

"You read too much, and pray too little," the abbot had once said to him, looking at the seditious lines: "Not finding in the Scriptures any detailed descriptions of the Earth, apart from rare, scattered, obscure and abstruse references, we had to turn to pagan writers who had founded the science of geography, basing themselves on journeys by land and sea, and then corroborated it by geometry, to which astronomy owes its origins."

"Who wrote that?" asked the abbot severely.

"The most wise and knowledgeable Anania Shirakatsi."

Artavazd's lips moved in a barely detectable smile. The abbot did not know that, sitting and reading those "seditious" pages, he had been pondering on some other words written by the renowned scholar in the seventh century, in his book *Cosmography and the System of Chronology*: "Emergence is the beginning of destruction, and destruction is, in its turn, the beginning of emergence."

"And now I am dying. This is destruction. Yet at the same time this is emergence..."

His thoughts pursued each other. Artavazd seemed to be in a hurry to communicate them to his descendants.

"My people know how to preserve the legacy of their ancestors in their hearts, in their memory. Everything would appear to have been destroyed time and again by fire and the sword, but behind the walls of the monasteries were those not afraid of labour, who took up the pen and continued the work of their forbears. And perhaps some hand will carefully remove the parchment concealed under my armour and say: 'He was not fated to finish his work. A pity! He was writing about the obliquity of the ecliptic.' If it had not been for that invasion by Beshir!...

"Farewell, stars! You are shining down on me for the last time, but you will see our descendants and, among them, learned men. And perhaps, here in Byurakan, where the wind blows away the ashes of burned books about the Universe, there will appear bright minds who will open up the way to you, the stars, in the limitless expanses..."

CHAPTER ONE

To Berkeley!

It was 1960. The city, wrapped in a pale, pearl-coloured mist, was still sleeping, but cars and buses were already hurrying along the Echmiadzin highway that led to Yerevan airport. We left behind them the walls of the Ararat wine factory, where for centuries had stood the tragically renowned Erivan citadel. Our ears detected the silvery sound of the Rasdan River, but after we had crossed the bridge, the sound disappeared. Ahead of us lay the motorway. Slender poplars lined the route as if forming a guard of honour. The car accelerated rapidly. However, it was still unable to overtake another car which swept up a cloud of dust and vanished in it.

"That's the Academy!" said Sarkis.

"What academy?"

"Our Academy. The president is off on a long journey."

"Where to?"

"To Moscow, and then on to America. He's heading a delegation of Soviet astronomers."

Sarkis was perfectly correct. Fellow astronomers from Armenia and elsewhere in the Soviet Union were to meet in Moscow to hold talks in connection with the forthcoming major event in world astronomy—the 11th Congress of the International Astronomical Union. Then they would fly to Paris, and then across the ocean to New York, and finally on to Los Angeles, where there were to be two preliminary symposia. After that the congress would hold its meetings in the small town of Berkeley near San Francisco, the home of the University of California. That was the location chosen for the astronomers' congress.

Just a few hours earlier our travellers had heard the sound of the Kremlin chimes, and now they had already touched down at the Orly Airport, just outside Paris.

And now Greenwich already lay behind. Far away to the right, on the banks of the Thames, was the bustle of London. The last Irish islands disappeared from view, and the

plane hung over the ocean. Only the sun towards which they appeared to be flying reminded them that this was still the same day that the Soviet astronomers had begun in Moscow, on the road to the Sheremetyevo airport. But now dusk began gradually to conceal the expanse of the ocean. And at that moment, as in the days of Columbus, came the excited cry:

"Land ahead!"

A scattering of lights could be seen through a porthole. A city, of course, but which one?

"Ladies and gentlemen, you can now see that this voyage across the ocean aboard an Air-France airliner is safe, and, I hope, not too wearisome. We have been in the air for nine hours. To the right you can see the lights of Boston."

Once more the melodious voice of the stewardess could be heard in the passengers' saloon:

"Ladies and gentlemen, we shall be landing at the Islewild Airport. You will be able to collect your luggage inside the airport. Passengers who are not citizens of the USA are requested to report to the immigration bureau to complete certain formalities..."

The astronomers aboard the plane were a little disappointed: the visit to New York did not take place. Their tickets were altered. A plane belonging to the Pan-American Airways Company was ready for the flight to Los Angeles. That same night they saw the lights of Los Angeles. At the airport the Soviet astronomers were met by the well-known American astronomer Professor Leo Goldberg, and his wife. Having arrived at their hotel, the travellers could congratulate themselves on having completed the first half of their trans-European–trans-Atlantic–trans-American flight.

We who inhabit the Earth measure in terms of the Earth. Thousands of kilometres across the surface of the Earth seem to us an enormous distance. Even astronomers feel this, although they work with the unimaginably vast distances of the Universe. They measure these distances in light years, that is, in thousands of millions of kilometres, the distance travelled by light in one year, moving at a speed of three hundred thousand kilometres a second. If one were to use that measure, our travellers had only flown a distance that light would cover in one-thirtieth of a second.

The symposium held in Santa Barbara on the eve of the

11th Congress of the International Astronomical Union was a kind of reconnaissance to determine the balance of forces on the astronomical front. Astronomers around the world adhere to different ideologies, support different ideas and hypotheses.

The astronomers studied that which for centuries had been considered sacred—the Sun, the Moon, the stars. Therefore attempts by scientists to explain astronomical phenomena from scientific positions often ended tragically.

Thus astronomy is one of those sciences whose development is accompanied by a long and continuous battle with religious prejudices and dogmas. This struggle dates back to antiquity, when such spontaneous materialists and naive dialecticians as Thales, Heraclitus and Democritus defended views of nature that were progressive in their day against the attacks of idealists and the ministers of worship.

The Ptolemaic system, in which the Earth is the centre of the Universe, was, in its day, a step forward in comparison with the conceptions of the Universe which until then had dominated beyond the Mediterranean, in Ancient India and China. Ptolemy's *Almagest* became, for the next fourteen hundred years, the textbook on astronomy. Mankind had traversed a long path in its quest to understand the sky before it had attained that level of knowledge which permitted Ptolemy to formulate his theory. Nor can one consider as wasted those fourteen hundred years which separated Ptolemy from Copernicus. The development of science progressed slowly, and it took the brilliant Polish scientist more than one day, of course, to produce the heliocentric system. This discovery had matured gradually, on the basis of facts accumulated over the centuries.

What rotates around what? Do the Sun, the stars and the Universe revolve around the Earth, or does the Earth itself—a speck of dust in the Universe—revolve around the Sun like any other planet. This question had long divided astronomers and religion into two hostile camps.

Galileo Galilei, who was not only a propagandist and continuer of the Copernican theory, but himself also a major scientist who laid the foundations of classical mechanics, was brought before the Inquisition. However, "To burn does not mean to disprove", to quote the words of Giordano Bruno spoken by him at the stake of the In-

quisition. These words were understandable to all those who believed in the final triumph of science and battled against the obscurantism of the Church, which upheld its "truths" by burning people.

The great scientific revolution which took place in the seventeenth and eighteenth centuries led not only to a correct view of the solar system, but also made it possible to explain the movement of the heavenly bodies on the basis of Newton's law of gravitation. Moreover, it enabled scientist to foretell with a high degree of accuracy what would happen in the solar system in the near and the distant future. However, the question of the stellar system that surrounds us, the Galaxy, of which our Sun is but one element, acquired its final shape only in the first half of the twentieth century.

Scientists showed that, in fact, our Galaxy is part of a triple system. It has two satellites: the Large and Small Magellanic Clouds, and this system contains billions of stars. Then there appeared the theory of galactic rotation, formulated by Jan Oort and Bertil Lindblad. Walter Baade and others produced a theory on different galactic subsystems. William Morgan studied the position of the spiral arms of the Galaxy.

Each of these major scientific discoveries was a victory for materialist science, whatever the philosophical views of the scientists.

Finally, scientists, in their research and theoretic work, moved beyond the confines of the Galaxy. The delegates to the Santa Barbara symposium waited with great interest for the arrival of the Soviet delegates and there was particular interest in Ambartsumyan's theory of the instability of many galactic systems.

Cosmogony is a science which studies the origins and development of celestial bodies. Astronomers, mathematicians, physicists and philosophers seek to unravel its mysteries. It is difficult to unravel the mysteries of the Universe without simultaneously solving the fundamental questions of the Universe. Science ousts and refutes religious systems, and therefore the proponents of the divine origin of the Universe find sophisticated ways to adapt themselves to the new conditions of the development of civilisation. As for the movement out beyond the confines of the solar system, into the Galaxy, supporters of religion tried to make wide

use of the question of the origin and evolution of stars to support their views.

All this is understandable. In the part of the Universe accessible to our observations the overwhelming part of all matter is concentrated in stars—gigantic, hot balls of gas. The bright band of the Milky Way is the light of tens of billions of stars located at vast distances from the Earth. All these stars, together with those observed separately in the sky, constitute a vast, single stellar system known as the Galaxy. The Sun—our nearest star—together with its planetary system, is but another member of this Galaxy. The Galaxy comprises around one hundred billion stars. Many, like the Sun, are orbited by cold, hard bodies or planets. Planetary matter accounts for a very modest portion of the Galaxy. Suffice it to say than 99.86 per cent of the mass of the whole solar system is concentrated in the Sun itself, which from this point of view, is a sole star. The Earth, and even such huge planets as Jupiter or Saturn, are but specks of dust in comparison with the Sun.

The question of the origin and evolution of stars soon became the main issue in the struggle between idealists and materialists in science.

The first estimates of the age of the stars, made by astronomers, were, of course, very inaccurate. Only twenty-five years ago it was still believed that they were billions of years old. On this basis the idealists concluded that all stars were of the same age, and thus had been created at the same time.

The age of people living on Earth is measured in decades, but this does not mean that people are all born at the same time. Nonetheless, modern fideists, supporters of the divine creation of the Universe, seized on this inaccurate estimate of the age of stars, which was inaccurate only because a detailed study of this question had only just begun. The study of the evolution of the Galaxy and its age is possible only with the help of extra-galactic astronomy, by comparing the characteristic features of our Galaxy and those of others.

More than a decade has passed since scientists began to study the difference in the age of stars. Over that period much has been done to investigate the amazing diversity of our Galaxy, the other galaxies and the visible Universe.

And then, at the Santa Barbara symposium, Academician

Ambartsumyan put forward his conception of galactic instability, thereby indicating that the world of galaxies is involved in a process of rapid change and constant evolution. In their reports and speeches, many scientists presented arguments in support of Ambartsumyan's theory, but there were also opponents.

The symposium came to an end. It was merely a prelude to the main event, the 11th Congress of the International Astronomical Union.

The Bolts of Heaven Are Broken

In the short break between the symposium and the congress, Ambartsumyan was told that the Armenians living in Los Angeles had asked to meet him, his wife, Vera Fyodorovna, and his other colleagues. Ambartsumyan agreed.

At the appointed hour a car from Santa Barbara drove into Los Angeles and stopped in front of one of the best hotels in the city. More than 300 people had gathered in the banquet hall. Questions came from all sides. From time to time the orchestra played. Then it began to play a piece from Aram Khachaturyan's ballet *Gayaneh*. The scintillating passionate sounds affected all present, and the melody and rhythm, so typically Armenian, caused many to remember days gone by on their native soil, and the treasured dream of returning, whatever the cost, to see once again the sacred land of their forbears.

Vera Fyodorovna attracted the attention of many of the guests.

"You speak excellent English," said a guest sitting beside her at the table.

"Thank you," replied Vera Fyodorovna in Armenian.

A conversation began, and the American Armenians discovered that the wife of the President of the Armenian Academy of Sciences, although Russian by origin, spoke fluent Armenian.

"Do you have any children?"

"Four—two daughters and two sons."

The words "a touching farewell" are inadequate to describe the scene at the doors of the hotel late that evening.

In San Francisco there were more bouquets, embraces and greetings. And that indescribable feeling of pride for a

compatriot. A complex feeling. Armenians living abroad, particularly the young, are well aware that they are not involved in the successes and achievements of the Soviet Union, but they view them as their own.

The concept of one's native land is a sacred concept. When the first artificial satellite was launched into space, and the whole world learned the Russian word *sputnik*, the majority of our compatriots abroad rejoiced as if each one of them was personally involved in the event.

It is said that San Francisco is the most beautiful city on the shores of the Pacific. And indeed the city is extremely beautiful. The ocean shore, the bay, the magnificent bridges, the attractive lay-out and architecture. San Francisco deserves to be studied in detail, but the visitors had to hurry on their way to Berkeley.

The old residents of Berkeley can name more than one famous sight their town has to offer, but undoubtedly the University of California is one of the largest. It is famed for its talented scientists and teachers. Although the Soviet delegates arrived late in the evening, virtually at night, their Californian colleagues were waiting for them. It turned out that the scientists and journalists who had arrived in Berkeley had spent the day chatting together on numerous topics, ranging from the naively amusing to scientific questions of astronomy.

"Gentlemen," said the French astronomer Leon de Debouray from the Sorbonne, "I am torn by doubt. Your compatriot Goethe," and he nodded in the direction of an astronomer from the FRG, "said that a mathematician who has risen to the cognition of the starry sky, resembles the 'divine'. I would like to see just one such 'divine' mathematician, but now there are so many hypotheses, theories, systems and classifications of every possible kind that one cannot but wonder how many of them are of any value?"

The scepticism expressed by the French astronomer provoked a deluge of responses.

"Similar doubts, so I've heard, were expressed four hundred years ago," someone said in English, but with a noticeable accent. Everyone laughed and turned to see who it was who had made this witty reply. It proved to be an Indian journalist, a man whose cheerful mischievous eyes belied his somewhat sombre expression.

"Well, what did you hear, my dear Raj Singh, four hundred years ago?" asked Leon de Debouray.

"Then there were doubts about the accuracy of Copernicus' hypothesis. Now your compatriot," and Raj Singh courteously bowed towards Leon de Debouray, "Urbain Jean Joseph Leverrier, met the famous astronomer François Arago, who advised him to undertake a study of the irregular motion of the planet Uranus. Leverrier followed this advice, and soon made the discovery that brought him immortal fame. He showed that the irregularity of the motion of Uranus was due to an unknown planet located beyond Uranus' orbit. That was in 1844. And then a year later your compatriot," and Raj Singh now turned to the German, "the astronomer Johann Friedrich Galle, directed his telescope towards the point in the sky calculated by Leverrier, and discovered the planet Neptune, thus also acquiring immortal fame.

"This proves convincingly that, within the confines of the solar system at least, astronomy has successfully studied the motion of heavenly bodies, their volume, mass and many other things.

"I can guess why there is a look of reproach in your eyes: yes, I forgot to mention that a compatriot of yours was also involved in the discovery of Neptune," continued Raj Singh, looking at the British radio correspondent who was standing next to him. "Excuse me. Services to science should be commented on objectively and impartially. I ought also to add that this same problem was solved independently and at the same time by the young British astronomer John Adams, who lived in the last century."

"Our respected colleague from India has modestly restricted the achievements of modern astronomy to the bounds of the solar system," said one of the delegates to the congress who was representing the famous Lick Observatory. "But my famous compatriot Albert Michelson invented an instrument for the study of spectra and an interferometer to measure the angular diameter of motionless stars. In other words, he measured the angles between the rays of light reaching us from two opposite points on the disc of the star."

"But that is only for gigantic and small stars."

"Yes. But at what distances? I believe this to be convincing proof that modern astronomy, astrophysics, has the

instruments and apparatus to make observations sufficiently accurate, to form a reliable picture of the Universe."

Scientists and journalists alike continued their attack upon Leon de Debouray. This time the one to speak was a journalist from Cracow, Broniewski, who had been in a concentration camp during the Second World War. It was clear that this taciturn man with greying hair was accustomed to weigh each word before speaking. As indisputable evidence of the enormous achievements made in the study of the sky, Broniewski cited the results of research conducted by Soviet astronomers.

"They have made a lengthy study of the so-called nova-type variable stars which flare up from time to time, and have determined a certain regularity: the more powerful the outburst, the more rarely it occurs. On the basis of this, Soviet astronomers calculated that in the Corona Borealis constellation there would soon be a second explosion of a nova-type star which flared up once before in 1866, and should do so again sixty to a hundred years later. And indeed the star did flare up in 1946—eighty years later, as had been predicted!" "I hope," went on the Polish representative, "that the burden of doubt weighing upon my French colleague has been lightened?"

"I thank you," replied the Frenchman. "But this is the question of doubts, not lack of faith. There was a time when our ancestors believed that spirits inhabited everything around them. They offered sacrifices to the spirits of their ancestors, the spirits of the woods and waters, the sky and the earth. And they believed that they would indeed, by doing so, free themselves from the wrath of these spirits. Then came doubts... The priests began to improve their religious conceptions. Many religious cults proved invalid in the new times, and they gave way to more sophisticated, improved religious systems. Four or five of these became world systems, including Christianity, which is a kind of synthesis of many ancient religions. Religious concepts, implanted by the priests and ruling groups firmly held the people in ignorance. For more than a thousand years the Ptolemaic system dominated among Christians. However, it is also true that four hundred years ago, the forbears of our colleague from Italy began to have doubts about the Ptolemaic system. They were burned at the stake, anathemised and forced to recant. I take pride in the fact

that my forbears, who brought about a revolution at the end of the eighteenth century, proclaimed religious freedom by a state act. In doing so they expressed their doubts in the Church's teaching on the Universe.

The Frenchman apologised for his lengthy tirade, but, encouraged by his audience, he continued:

"Gentlemen, does it not seem to you that both scientists and journalists are guilty of the same offence: only too often, and sometimes without any proof, numerous hypotheses are put forward. This completely disorients the masses who are seeking to follow scientific progress."

"You are not quite right," replied one of the scientists. "And this is why. We are living at a time of rapid technological progress. It produces scientific geniuses and their antipodes—schemers and mystics. It is difficult to imagine that scientific thought, experiment, research, could be directed along such a narrow, orthodox channel of axioms. Life follows a different course. Hundreds, thousands of tiny brooks of thought combine to create modern progress. I agree that our journalist-colleagues bear a share of the blame for not always precisely and comprehensibly informing their readers and listeners of scientific news. It's true, they, journalists, sometimes have difficulty sorting the cockle from the grain. Who can take it upon himself to determine which hypothesis will prove correct and which will prove erroneous?"

"You are quite right," remarked Paolo Tocarro, the representative from the Rome Radio. "But we are happy to have the opportunity to note that, within the confines of the solar system, and indeed our Galaxy, much is already being cleared. We know that the chemical composition of all stars is, on average, similar to the chemical composition of the Sun: about 70 per cent by weight consists of hydrogen, 28 per cent of helium, and 2 per cent of other elements. Other confirmed data about our Galaxy include the fact that it rotates about the centre, located in the middle of the Milky Way—a fact not known forty years ago. One could name many other facts about the Galaxy which have been recognised by the world of science, described in popular literature, and are now the basis of those conceptions of the Galaxy which are used by educated people. Of course, there is still a great deal that is unknown, but it is beyond the notions about our Galaxy that a veritable

chaos of hypotheses begins. And I can quite understand the doubts of our friend from France, who says that even he, who is well informed on astronomical and astrophysical matters, finds it difficult to distinguish between genuinely scientific and pseudo-scientific hypotheses."

The radio, television, press and telegraph agencies announced that, on August 15, 1961, in the town of Berkeley near San Francisco, the 11th Congress of the International Astronomical Union had begun. News, photographs and interviews were broadcast and published. All of this was lost amidst the news of major events in the current affairs of anxious mankind. However, in scientific circles closer to the study of the stars and the Universe, people waited impatiently for news from Berkeley.

One circumstance rendered this congress particularly important. It took place in 1961, which will always be associated in history with an exceptional event. In April 1961, mankind first went out into outer space: the Soviet cosmonaut Yuri Gagarin made his legendary flight aboard *Vostok I.* A new era had begun in the history of science, including astronomy.

During the three hundred years that had passed since the invention of the telescope, astronomers had looked at the sky through a hazy glass, as it were. They were happy when the sky was cloudless and they could observe the sky. But even on such cloudless nights the sky was misted by the atmosphere—dust and ice crystals.

Then came the age of radio-astronomy, which opened up regions of space hitherto inaccessible. It was as if a man had been watching a game of football through a spy-hole in a fence, and then a bulldozer came along and removed the fence. The radio signals arriving from space are strong enough to be picked up, and radio telescopes began to tune in to "cosmic radio broadcasts", and thus to discover what could not be seen through the optical telescope.

Nonetheless scientists dreamed and still dream of a time when they will be able to observe the Universe from beyond the Earth's atmosphere—from space, from artificial satellites, from observatories on the Moon and other heavenly bodies. The first manned flight into space further strengthened the hope that such observations would indeed become possible after a period of time still difficult to determine.

The congress of astronomers in Berkeley began its work on the morning of August 15—not in the main auditorium, not in the habitual sanctuary of science, but under the open skies of California, in front of the main university square.

The President of the IAU, Jan Oort, opened the first session. The prolonged applause was a deserved tribute to the man who had twice attracted the attention of the scientific world. The first time had been in 1927. By that time, the mathematical theory of the rotation of the Galaxy, elaborated in 1859 by the Russian astronomer from Kazan, M. A. Kovalsky (1821-1884), had already been forgotten. Specialists carefully studied the material on the rotation of the Galaxy presented by Lindblad in Sweden and Oort in the Netherlands. It was Oort who was judged to have first discovered this rotation. The second time Oort attracted the attention of the scientific world in 1952 with his radio observations of the spiral structure of the Galaxy.

Five pages of the calendar had slipped into eternity. Commentators and observers, summarising these first five days of work by the congress, had already emphasised its businesslike atmosphere, its spirit of cooperation, abundance of interesting reports and information. On August 21 a report on "The Problems of Extra-Galactic Research" was delivered by the Soviet Academician Victor Ambartsumyan, who had discovered stellar associations, groups of young stars which emerged simultaneously.

It turns out that the age of the stars which make up such associations is measured not in tens of thousands of millions of years, the age usually ascribed to the majority of stars in our Galaxy, but only in several millions of years. Further research had led to the discovery in these associations of objects whose age is evidently not more than a million years. The Mexican astronomer Haro and the American astronomer Herbig discovered even younger formations.

As a result of these discoveries it was concluded that stars are continuing to appear in our Galaxy to this day. The conception of the group formation of stars was also further developed. Over the last decade, in various observatories around the world, new and interesting properties of these young objects have been discovered on the basis of the vast amount of data on stellar associations discovered by Ambartsumyan.

On August 21, one glance at the audience in the auditorium where the plenary session was being held was sufficient to realise that an important report was expected.

"What do you think, colleagues?" asked a Danish astronomer sitting in the auditorium. "I can see that Ambartsumyan is trying to resolve a difficult problem: to identify the main point from among a multiplicity of hypotheses, theories, observations and research. Look at the first section of his report: 'The Most Important Facts Connected With the Distribution of Matter'; second: 'The Most Important Facts Relating to the Kinematics and Dynamics of Galactic Systems'; third: 'The Most Important Facts Relating to the Nature of Galaxies and Their Clusters'... It will be interesting to hear what our colleague Ambartsumyan will identify among these as being 'the most important'."

"Two days ago I had a talk with the Soviet delegates. You know, they described an interesting incident to me," a Canadian delegate asked the Danish astronomer.

"What?"

"Of course, you know about the Solvay Conference on Physics that was held in Brussels in 1958. Ambartsumyan delivered a report. He said that enormous explosions take place in galactic nuclei. As a result of these explosions, a huge amount of matter is expelled. And if that is so, these galactic nuclei must contain bodies of huge mass and unknown nature which are responsible for these eruptions.

"This conclusion by Ambartsumyan was quite unexpected for some conference participants. During a break in the session, the American astrophysicist Walter Baade went up to Ambartsumyan and said: 'Professor Ambartsumyan, you have come from the Soviet Union, and I from America. Logically speaking, you should be a materialist, and I an idealist. But what you have just said is nothing other than pure idealism! It's fantastic! You speak about some kind of "non-stellar" objects which no one has seen. So it must be something inexplicable, mysterious."

"And what did Ambartsumyan answer?"

"He said that what is inexplicable today becomes explicable tomorrow. And he added that materialists are interested above all in the processes that actually occur, and only thereafter in their explanation. The argument was dropped and the two men turned the conversation towards jokes. However, now, three years later, many realise that

the Soviet astronomer was correct. This is being confirmed by new observational data."

"Insofar as a correct idea of external stellar systems—galaxies—emerged only around forty years ago," Ambartsumyan began his report, "many fundamental questions relating to other galaxies remain unresolved. Basing ourselves on this, we shall attempt to formulate a number of problems which appear to be the most essential for further extra-galactic research. In so doing, we shall try not to wander too far from the facts, and to deal primarily with those problems whose solution appears possible in the forseeable future with the available means...

"As we know, extra-galactic astronomy borders on cosmology, that is, on theories which attempt to explain the laws governing the Universe as a whole. These theories are undoubtedly of some assistance, as they involve a study of certain questions following from Einstein's general theory of relativity, and raise the question of comparing these solutions with the properties of the visible part of the Universe. At the same time, however, they often become the arena for crude simplifications and unrestrained extrapolations..."

"That is not just an arrow but a spear hurled at those we were speaking about so much at our improvised press conference yesterday," commented an Australian astronomer, addressing Neville Grant of the Jodrell Bank Experimental Station in Britain. "I think that more than one such spear will be hurled at the authors of certain hypotheses!"

"I think so, too. The reference to crude simplifications and unrestrained extrapolations was not accidental."

"Excuse me, please, but what does 'extrapolation' mean?" ventured to ask a lady evidently accompanying her astronomer-husband but herself far removed from astronomy and mathematics.

"It's a mathematical term. Genuine extrapolation is a quite unexceptionable, perfectly legitimate mathematical method. Professor Ambartsumyan is talking about 'unrestrained extrapolations; that is, about those who try to explain everything on the basis of mathematical formulae, or tailor everything to fit those formulae. Such an approach inevitably leads to a divorce from the physics of phenomena, to the emasculation of the object of research."

In the meantime, Ambartsumyan was introducing certain reservations to his statement:

"In this present report we cannot undertake an analysis of the theories and extrapolations we have referred to, although we are of the opinion that a critical examination of the work being done in this area would be extremely valuable. I should like to emphasise that the facts and problems which we shall consider in five sections are also of no little importance for cosmological theories."

As, when reading an interesting book, people find themselves forgetting about what is going on around them, so in Berkeley the audience seemed to move in their imagination beyond the confines of our Galaxy. The details of this unseen picture gradually came into focus: there emerged a notion about the metagalaxy—the visible part of the Universe beyond our Galaxy.

Academician Ambartsumyan moved from one fact to another, from one conclusion to the next, summarising what was already known and indisputable.

"One of the properties of the world around us," continued Ambartsumyan, "is that the greater part of the matter that we observe in it is concentrated in stars. Other bodies account for only a small proportion of the observable mass...

"It is well known that each of the stars is a body of the same gigantic proportions as our Sun. Among the stars there are those which emit more light and heat than the Sun. And there are also those which are less powerful emitters. However, in terms of its mass and other characteristics, each star may be compared with our Sun. Therefore we can say that the Sun is also a star. The very same Sun which warms our Earth with just one two thousand millionth part of all the energy it emits. However, even if this share is divided among all the inhabitants of the Earth, each would receive an amount equal to the energy output of a large power station capable of meeting the energy requirements of a modern city. It is in such bodies as the Sun that the greater part of the matter we observe in the surrounding world is concentrated."

"Yes, madam," said a voluble, neat old man to the woman sitting next to him, "it seems that Ambartsumyan, although he realises that he is addressing an international scientific congress, is thinking about us, the laymen, unfa-

miliar with the secrets of astronomical wisdom and the precise meaning of scientific terminology. The first property of the surrounding world is now quite clear to me. Let's listen further!"

"The overwhelming majority of observed stars belong to gigantic stellar systems which are called galaxies. Their dimensions vary to an extraordinary degree. Super-gigantic galaxies are composed of hundreds of thousands of millions of stars (for example, the central galaxy in the Berenice's Hair constellation), while dwarf galaxies such as are to be found in the Sculptor constellation contain only several million stars. The diameters of the galaxies also vary considerably. It is important to note that they are isolated systems, located at considerable distances one from the other. The average distance between two galaxies is approximately ten times greater than the average size of the galaxies themselves..."

"If there are many galaxies, and they are isolated systems, then the Universe appears to be composed of a large number of islands composed of numerous stars and widely separated from each other," whispered the representative of a provincial American newspaper, William Gladhill, to his neighbour, Phemistoclus Pheodoridi, a taciturn, middle-aged man who was listening attentively to the report. "By the way, do you know—I mean, do you remember how many galaxies are known to date by the astronomers?" His companion finished writing something down in his notebook, and then removed his bifocal glasses in their heavy black frame.

"Fortunately for you, that information is still fresh in my memory, as I received it only recently. You may take a note: modern telescopes make it possible to identify by photographic means more than one hundred million galaxies."

"Thank you. You are listening with commendable interest."

A scientific congress is a forum for inquiring thought which is striving forward to the still unravelled mysteries of nature. The voice of the speaker could be heard, distinct, unhurried, calm. He had returned to the idea that the galaxies, as a rule, are isolated stellar systems. However, sometimes this rule is broken. Several types of exception to the rule had been discovered, but all of them, taken to-

gether, accounted for only a small percentage of the total number of galaxies...

"Was it worth paying attention to these exceptions, if they are so few in number?" commented a West-German astronomer sceptically. However, he immediately received a reply as Ambartsumyan continued:

"There are grounds for thinking that these exceptions only occur at a definite stage in the development of galaxies, and that is when new galaxies appear."

The journalists had already noted that the professor was particularly careful to validate his conclusions when showing that the Universe, or at least that minuscule part of it which is accessible to human observation, lives, develops and, like mankind, consists of members of various ages.

They had cause to glance at each other more than once during the report. One such time was when Ambartsumyan discussed one of the types of exception to isolated galaxies—the radio galaxies. It had been assumed earlier that they were the result of a chance collision between two independent stellar systems. In that case, the radio-frequency radiation could be the product of the collision of two gaseous masses that were each a component of the colliding galaxies. However, facts contradict this hypothesis.

An expectant silence descended on the auditorium: What would Ambartsumyan propose as an alternative to the wide-spread hypothesis?

"Evidently, the radio-frequency emission by the galaxies is closely linked to the emergence within them of new formations in the form of coagulations and streams expelled from the centre, spiral arms and even whole new galaxies." And, as if wishing to exclude the possibility of being misunderstood, Ambartsumyan added:

"In other words, in some cases there occurs the division of the nucleus of the galaxy, and the emergence of a new galaxy from the bowels of the old one. This is yet another argument in favour of a genetic process occurring in the Universe.

Some of those sitting in the auditorium, including the representative of *Osservatore Romano*, pondered on how to convey this argument to their readers. Three different types of listeners, three different ways of perception. The scientists were interested in the content and form of the

report. The representatives of the press were there in order not to miss any trifling sensation for their newspapers. The guests were happy to have been invited to the congress. The auditorium listened. Complex calculations were presented and references to catalogues made.

The Byurakan astronomer led his listeners along new, only recently opened pathways of the Universe. Each step was cautious and substantiated by weighty arguments that had been checked and double-checked. The laymen could feel this intuitively. They listened attentively, and as soon as they understood what had been said, they became full of admiration for the speaker, who had so perspicaciously unravelled the seemingly incomprehensible mysteries of the Universe.

"We have heard amazing information, gentlemen," said one Belgian astronomer during a break between sessions.

"I was struck by the analysis of processes of energy liberation observed in galactic nuclei. You begin to believe that it is indeed not thermonuclear, but of some other, as yet unknown nature."

There was much talk about the impression produced by the report delivered by the Soviet scientist, about his indisputable or controversial propositions, arguments, references. The scientists were captured by the force of the arguments supporting the continuing development of the Universe, and the birth within it of new heavenly bodies and systems.

Someone said:

"The Universe is infinite in terms of time and space; it has no beginning and no end. When you listen to Professor Ambartsumyan, you begin to believe in the eternal movement of matter about which Engels wrote."

Someone else recalled the words of Academician Mikhailov, an astronomer who worked at Pulkovo:

"Human thought has required only several thousand years to penetrate where light penetrates only after hundreds of millions of years..."

The Signs of the Zodiac Were Born Here

The press expressed its opinion of the report delivered by Ambartsumyan in various terms, but the meaning was

the same: a major scientific discovery.

"The Soviets have filled outer space and astronomy," joked newspaper readers and radio listeners.

In Berkeley itself there was a surge of interest in the Soviet scientist and in Soviet science. Soviet delegates were constantly beseiged by the curious.

"Victor Ambartsumyan is from Soviet Armenia? Can such a small nation produce men of such calibre?"

"If you wish to receive answers to your questions," replied the astronomers from the Byurakan Astrophysical Observatory, "we can tell you what you want to know in sufficient detail. Excavational material and written records indicate that in ancient times the Armenians had made major achievements in astronomy. In the seventh century, Armenian astronomers already imagined the Earth as a spherical body and knew laws governing the movement of the Sun, the Moon and the five planets visible to the naked eye. They made a model of a geocentric system of the world. They knew that the Moon is the celestial body nearest to the Earth, and that it shines by reflected light. They had arrived at the correct explanation for eclipses. Research by Alcott, Maunder, Schwarz, Flammarion and other scientists has confirmed the correctness of many of the ideas of ancient Armenian astronomers. They are prone to believe that the earliest astronomical knowledge, in particular, the division of the sky into constellations and the compilation of a stellar chart, originated on a territory which includes the Armenian plateau. In his book, the British scientist Alcott wrote that the data of astronomy are supported by historical and archaeological research, and indicate that those who designed the signs of constellations lived in the Euphrates valley and also in the Mount Ararat area."

"Has that been established only recently?..."

"That depends on what you consider to be recent. Alcott's work was published in English at the beginning of the century, and was brought out in Russian in St Petersburg in 1914."

"And this information has not been disproved since?"

"On the contrary, it has been further confirmed. For example, Maunder, who is the author of many interesting archaeological studies, and Schwarz called attention to the fact that the very earliest map of the stellar sky includes only a very small section of the Southern Hemi-

sphere. These scientists also conclude that the people who thus divided the sky into constellations would appear to have lived between latitudes 36° and 42° North. Thus neither Egypt nor Babylon could have been the birthplace of the signs of the zodiac, which appeared, very probably, in the year 2800 B.C."

"How interesting!"

"These scientists further established that the signs of the zodiac do not include an elephant, a hippopotamus, a crocodile or a tiger. This means that the idea of the signs of the zodiac did not originate in India, or Arabia or Egypt. Greece, Italy and Spain can also be excluded as the lion is not native to them. Thus, logically, we can assert that the birthplace of the signs of the zodiac may be Asia Minor and Armenia, that is, a region bordered by the Black Sea, the Mediterranean, the Caspian and the Aegean."

"But could such an ancient civilisation as that of Egypt not have known in that remote past the signs of the zodiac?"

"Alcott wrote that the Egyptians' ancient monuments bearing the signs of the zodiac contained an inscription which said that they had learned about the stars from the Chaldeans."

"And why the Chaldeans?"

"Some scholars confused them with the ancient Babylonians, distinguishing between the culture of the Chaldeans and that of Urartu. However, this does not diminish the role played by the ancient inhabitants of the Armenian plateau in the early development of astronomy, for these two countries were very close both territorially and in terms of their culture and science."

"If my memory does not fail me," added the visitor from Syria, who was attentively following the conversation, "Chaldeans was once a mistaken name, widely used by historians, for the people who lived in Urartu. It originated because of an inaccurate translation of the opening formula of Urartu texts, where there was a reference to the God Chaldi. The Urartians disappeared from the historical scene in the sixth century B.C., to be replaced by the Armenian state, which inherited Urartu culture.

"By the way," added the Syrian, turning to the Soviet astronomers, "I've discovered this in your *Encyclopaedia*. I read Russian a little."

"I must thank you, my dear Soviet colleague, for your very detailed explanation, but—and please forgive my curiosity—I'd like to ask a few more questions about modern times, indeed, about this century."

"I'll be only too happy."

"What is the present state of astronomy in Armenia? You have a famous observatory sited on a volcano, don't you?"

"This is not quite so. There is an astrophysical observatory located on the slope of a mountain that is an extinct volcano. This is the Byurakan Observatory, which was founded with the direct participation of Academician Ambartsumyan. One cannot speak of Ambartsumyan without speaking of the fundamental contribution which he himself and the team of scientists he heads at the Byurakan Astrophysical Observatory of the Academy of Sciences of the Armenian SSR, have made to the study of the origin of stars. All the latest ideas relating to the formation and development of stars and stellar systems have, in fact, emerged from this observatory. The cosmogony of stars sheds light on the evolution of the Sun and the cosmogony of the solar system, and therefore any major progress in this area helps to resolve a number of important questions."

"One may ponder on the continuity of generations of Armenian astronomers down the centuries, but how did this science develop if Armenia was constantly an arena of social conflicts and wars?"

"The monasteries were the centres of astronomy. Armenian scholar-monks preserved the works of their predecessors and added to them their own contribution. Often this was a genuine feat of heroism; frequently the walls of a monastery were unable to save the scientists, and they became soldiers and died, defending their native land."

The long shadows of the trees in the university park became barely visible. Berkeley is in the subtropics, and here the night falls quickly. Already the stars could be seen in the sky. First the large, bright ones appeared, and then the smaller ones. The conversation had continued for over a few hours. Foreign scientists had filled their notebooks as they listened to the compatriots of Artavazd.

As the day of the elections to the governing body of the International Astronomical Union approached, conversation turned more and more to its possible membership. According to a long-standing tradition, a new president is elected

every three years. Astronomers of all convictions were of the opinion that this time the post of president would go to Ambartsumyan. And so it was. The first to congratulate the scientist who had just assumed the presidential powers was Professor Jan Oort who had resigned his presidential commission. The stream of congratulations and greetings included several dozen telegrams. On August 29, the National Astronomical Observatory of Mexico University telegraphed:

"Dear Professor Ambartsumyan, I learned from the newspapers that you have been elected President of our Union. You can imagine with what pleasure, joy and enthusiasm we learned of this news in Mexico. I wish to convey my warm congratulations on behalf of our observatory's staff and also my own personal congratulations. We also congratulate ourselves on having acquired such a president as yourself. With good wishes from all Mexican astronomers, yours sincerely, Guillermo Haro."

"All Ambartsumyan's research," said Victor Sobolev, a Leningrader and one of the most talented of Academician Ambartsumyan's pupils, "is characterised above all by exceptional originality. Each of his works offers a fundamentally new point of view on the subject of research. Very often his ideas contradict generally accepted conceptions. However, in the end it is Victor Ambartsumyan who proves to be right. People come to him for help and advice, they discuss with him the results of their finished work and their plans for future research. He always delivers his lectures to overflowing auditoriums.

"This wide popularity and enormous scientific prestige are explained not only by the fact that Ambartsumyan is an outstanding astrophysicist. He has a very fine grasp of the most varied fields of astronomy."

When Ambartsumyan was elected an honorary member of the American Astronomical Society, one of the most prominent astronomers in the world, Nobel-Prize winner Subrahmanyan Chandrasekhar, an Indian who now works in the USA and maintains close contacts with the Byurakan Observatory, wrote in his congratulatory telegram that this election was the highest recognition the American Astronomical Society was able to confer and that he was happy that Ambartsumyan's brilliant ideas were universally acknowledged.

In one of its issues the American journal *Popular Astronomy* wrote that Ambartsumyan, an honorary member of the American Astronomical Society, is one of the greatest living astronomers. He possesses exceptional scientific insight, and has had an enormous influence on the work of other astrophysicists around the world.

During and after the congress, the American astronomers organised various excursions to astronomical observatories for the other delegates and the guests. They visited Lick, Mount Palomar and Mount Wilson, all excellently equipped scientific centres which have done important observational work and made major discoveries. These excursions were useful not only from a professional point of view, but also as a way of establishing closer contacts. Here, as in Berkeley, the Soviet delegates "came under fire": congress delegates, guests and representatives of the media constantly sought an opportunity to be with them, talk to them, and clarify certain questions. They were particularly interested in an aspect of the biography of the new president of the IAU that, for them, was highly intriguing.

"It was mentioned at the congress that Victor Ambartsumyan is an honorary member of many foreign academies and scientific societies... Can you say which precisely?"

"That would be a very long list," answered the delegates from Byurakan jokingly.

"You could continue it tomorrow."

"We'll answer you from memory, but on the condition that the answer is to go no further than your notebooks without verification. Do you agree, ladies and gentlemen?"

"We would just ask you to speak a little more slowly."

"We'll have to begin with 1948, when Ambartsumyan was elected vice-president of the International Astronomical Union."

"And why not with 1947?" asked an elderly gentleman wearing the badge of the American Astronomical Society. "It was in that year that Ambartsumyan first became an honorary member of a foreign scientific society."

The Soviet scientists thanked him for this clarification, and continued with their list:

"In 1953, Victor Ambartsumyan was elected a member of the British Royal Astronomical Society and a corresponding member of the Belgian Royal Society of Sciences."

"We British can say that a member of our Royal Astronomical Society is now the head of the International Astronomical Union," joked a representative from Jodrell Bank.

"We could say the same about a corresponding member of the Belgian Royal Society," exclaimed a woman, parrying the remark by the British astronomer.

"Ladies and gentlemen, we fear there may be too many such remarks. To continue: 1956—Academician Ambartsumyan was awarded the Prix Janssen by the French Astronomical Society.

"That same year," continued the speaker, "Ambartsumyan was elected a corresponding member of the Austrian Academy of Sciences. In 1957 he became a corresponding member of the German Academy of Sciences in Berlin. And a year later he was elected an honorary member of the American Academy of Arts and Sciences in Boston, and also a corresponding member of the French Academy of Sciences.

"The year 1959 was marked by several events. Academician Ambartsumyan became a member of the German Academy of the Natural Sciences in Halle, a foreign member of the National Academy of Sciences of the USA, and an honorary member of the Royal Astronomical Society of Canada. That same year, the Astronomical Society of the Pacific awarded him the Catherine Brousse Gold Medal for his outstanding services to astronomy.

"The year 1960. The Council of the British Royal Astronomical Society awarded Victor Ambartsumyan its Gold Medal for outstanding achievements in astronomical science..."

On the way back to Berkeley, the list was continued. Again there was a humorous argument among the representatives of various countries over who could consider the president of the IAU "his", and who could not, who had won the right to do so earlier, and who later. Many displayed a genuine interest in the details of Ambartsumyan's life and work.

"Could you tell us when Ambartsumyan wrote his first scientific works, and what the subject was?"

"Yes, I can. Victor Ambartsumyan wrote his first works in 1919-1920."

"How old was he at the time?"

"Eleven. Of course, he was still a schoolboy, and not an

academician. However, the subject of these early works is interesting: 'The New Sixteen-Year Period for Sunspots' (1919); 'A Description of Nebulae in Connection with the Hypothesis on the Origins of the Universe' (1919); 'The Evolution of Planetary Systems and Binary Stars (Cosmogony). A Critique and Analysis of Cosmogonic Theories. Certain Individual Cases of the Emergence of Worlds'. As you can see, his inclination to astronomy was apparent almost from childhood."

"I would say that his leaning to astronomy was noticeable in childhood."

Conversations between people who found themselves to be next to each other were held against the background of general chatter.

"I have learned a lot here in Berkeley about Soviet science and Soviet scientists," said a visitor from India. "It has just been said that while he was still a child and a youth, Ambartsumyan wrote works on astronomy. That is amazing. Do you have any books about him? It doesn't matter what language they're written in. I'll find a translator. It seems to me that biographies of people like Ambartsumyan must be very instructive."

The flight back across the ocean was like a film in reverse. However there was one noteworthy incident. Pilots around the world were then deeply impressed by the spaceflight of the second cosmonaut, Herman Titov. When the crew learned that the Soviet delegation was on board, returning to Europe from Berkeley, the captain came out into the passenger saloon and warmly welcomed aboard the compatriots of Herman Titov and congratulated them on this victory for Soviet science and technology. The Soviet citizens were invited into the pilot's cockpit and other service areas on the airliner.

"We are doing this especially for you, as a sign of our esteem and admiration. Send our best wishes to your cosmonauts, Gagarin and Titov," said the captain.

The flight passed slowly. Finally the shores of Europe appeared. The western departments of France flashed beneath the wing, and the airliner touched down on the concrete runway of the airport outside Paris.

The travellers spent thirty-six hours in Paris. Even for those who come to Paris for the first time, the city appears

familiar, as if you have been here before, so well-known is it from books, photographs and films. At the same time you find yourself listening to a guide explaining to a nearby group of tourists:

"...Work on the Louvre began on the orders of King François I in 1541, and it was finished in 1857. It was built over several centuries according to the designs of the architects Lemercier, Levau, Fontaine, Percier, Lefuel and Visconti. The building occupies an area of one hundred and ninety-five thousand square metres. Since the end of the last century the Louvre has housed the art treasures of France."

The Soviet delegates arrived at the Palais-Royal:

"Isn't that the tree from which Camille Desmoulins tore a leaf during the French Revolution and turned it into the cockade of the National Guard?" said our companion, speaking in French and a little more loudly than usual so that the people sitting on the bench could hear him. However, they only glanced at each other in surprise. Not every Parisian knows, of course, what Camille Desmoulins did in the Palais-Royal.

And there was the café De La Régence. On entering you pass a table with a chess-board under a glass cover: Napoleon Bonaparte used to play chess at that table. Visitors to Paris are informed of this fact in their tourist guidebooks.

The Eiffel Tower was a sight not to be missed. While the lift is taking the curious up to the souvenir stalls on the first tier, the guide has time to inform them:

"The tower was built by Alexander-Gustave Eiffel in 1889.

"There are a total of 1,792 steps leading to the top. The tower is 300 metres high, and it cost six million francs to build. From the top, where there are an astronomical and a meteorological observatories, opens a magnificent view for as far as 140 kilometres in any direction."

As the car drove once again to the airport, the travellers were prey to mixed feelings: they regretted that there were many things they had not had time to see, if only briefly, yet they also felt a certain relief: at last the dash across the French capital was over. As they came closer to home, impatience increased: they just wanted to get back as quickly as possible.

Nonetheless, their thoughts kept returning across the ocean, to the events they had just witnessed.

Victor Ambartsumyan was looking through his mail that had arrived en route. One telegram attracted his attention. He read through the text several times, and then handed it over to Vera Fyodorovna. The telegram was from New York and was addressed to both of them:

"Dear Mr Victor and Mrs Vera Ambartsumyan, we will never forget our memorable meetings at the airport with you and your friends... You are bringing honour to the world and to the Armenian people. May God bless you and keep you! I shall shortly send on to you the photographs we took at the airport. We send our love to you and the people of Armenia. Respectfully yours, Ervand and Khoren Asaturyan."

"We could weave a garland out of such manifestations of cordiality," said Vera Fyodorovna.

The three hours from Moscow to Yerevan seemed incredibly long.

"Ararat! Aragats!" came the happy cries as the plane approached Yerevan. The welcoming party was already waiting. To be elected President of the International Astronomical Union is not merely a personal matter.

During the emotional meeting with the large number of people at the airport, Victor Amazaspovich and Vera Fyodorovna barely managed to exchange more than a few words with their children and friends.

Once again a car bearing the number plate of the Academy of Sciences of the Armenian SSR overtook a bus driven by the unhurried Sarkis. This time, not waiting to be asked, Sarkis said:

"Do you know who has just passed us? The President. He's just come back from America. There he was elected to the most important international post. Have you heard?"

Ambartsumyan meanwhile was gazing out eagerly at the Armenian countryside.

"How I missed our mountains! Even in wonderful California I missed the air of Lake Sevan, the mountains and the sky of Byurakan!"

CHAPTER TWO

Troubled Celebrations

At the beginning of the twentieth century, major events were affecting the life of society in Russia. There was the war with Japan. The first Russian revolution of 1905-1907 was approaching. Political passions also seethed in Tiflis (now Tbilisi), where Amazasp Ambartsumyan arrived for his holidays in the summer of 1904.

Shortly after arriving he met his future wife, Ripsimeh Khakhanyan. They married in Tiflis on August 24, 1904, and in September 1908 their second child, Victor, was born.

At the beginning of the century, the city of Tiflis was virtually divided into two parts. In one part, the centre, people lived in comfortable, European-style districts where one could see the chic of the capital, Paris fashions, and hear people talking in various European languages. Yet not far away the style of life was very different. Nor was it different purely in the social sense of the word: the thickest wallets were to be found here perhaps, in this second part of the city, where the fashion was set by the commercial bourgeoisie and not by the aristocracy or high-ranking officials. It was the Orient that dominated in this second part of the city: in the appearance of the buildings, the courtyards, the roads and side-streets, exotic, full of life, bustle and noise; in the faces and clothing of the residents—a living ethnographic museum in which, at any corner, an artist could have as his model a typical Georgian, Armenian or Azerbaijanian, a Greek or Persian, or a representative of any of the other innumerable nationalities and ethnic groups of Transcaucasia and the neighbouring territories. The Orient could be heard in the language of the crowd, in the songs and melodies that issued from the houses, taverns and courtyards.

The unique appearance and atmosphere of the city were crowned by its two famous focal points—Erivan Square and Maidan. These two centres will forever guard their secrets. It was here that people met and talked about matters per-

taining to the government and the city administration, about fortunes and titles, about marriages and divorces, births and deaths. Here generations of artisans, of those tradesmen- and craftsmen-proletarians, who in Tiflis, had its own unique character, were born, grew up and died.

Old Tiflis also had its own sights: the famous sulphur baths, the Metekhi Castle, the ruins of a fortress, a church on whose porch the poet Sayat-Nova had been killed, the palace of the governor-general, with its magnificent park, the theatres. Away from the busy main streets, in the quiet of Eristavsky Lane, lived the barrister Amazasp Ambartsumyan and his family.

Exactly a year had passed since the birth of his son. The sound of the dinner celebrations filled the house, and the guests foretold a brilliant future for the little child. The faces of his parents glowed with happiness. Celebrations were in full swing. No one paid any attention to the sound of the doorbell, but it continued to ring more and more insistently. The special messenger handed over a packet.

"What is it, Amazasp?" asked one of the guests.

"A copy of the complaint lodged by Krasovsky, a member of the Kutaisi district court."

All remembered this infamous scandal. In a small place called Kvartskhana, in mountainous Ajariya, there were rich copper deposits that belonged to Ferdinand Takhtajan, a resident of Tiflis, and Yefim Chkharaitashvili, a resident of Chiaturi. They had concluded an agreement with the German firm Siemens and Company, which was to work copper deposits. Should it fail to meet this commitment, it was to pay compensation to the amount of 200,000 roubles. The time agreed upon had expired, but the engagements had not been met, and steps had been taken to obtain the forfeit. The firm had done everything it could to win the suit, including the payment of bribes to Krasovsky and other members of the court.

Ambartsumyan, who was the counsel for the plaintiffs, had made a fairly transparent reference to bribery. The accused set about covering their tracks. The firm bribed more and more "useful people" to save Krasovsky and the other from exposure.

Now one reference to the name "Krasovsky" was sufficient for Ambartsumyan's friends, well aware of the dispute

between these two men, to realise that their battle had moved into a new stage.

When their guests had left, Ripsimeh looked reproachfully at her husband and said:

"Leave it alone, Amazasp! You're more likely to lose your head than arrive at the truth."

"My whole life, my dear, consists in alternating harmony and disharmony," replied Amazasp with a sad smile. "How pleasant it was to sit with our guests and celebrate our son's birthday. We were as happy as we could be, but this packet has brought me back to less pleasant concerns. But I will continue to pursue the truth as long as I have the strength to do so. Let it be an example to the children—always love the truth and fight for it."

Father and Son

Perhaps humanity suffers its greatest loss from the fact that, at some point in childhood, the parents, for a variety of reasons—privation, family problems, lack of culture, education and others—are unable to see in their children that potential which needs to be patiently and sensitively developed.

In the Ambartsumyan family the parents carefully observed their children. Both the mother and the father, each in his or her own way, contributed to their upbringing. Ripsimeh Saakovna cultivated in them that spirit of patriarchal morality and traditional virtue which are handed down from generation to generation in those decent, hard-working families which live in modest sufficiency and enjoy the respect of their neighbours.

Such had been the family of the priest Ter-Saak-Khakhanyan, the maternal grandfather of the future astronomer. One must bear in mind the situation existing in the Transcaucasian region of the Russian empire at the end of last century, when many entered the priesthood not because they had a religious vocation, but because it was one of the ways to obtain an education. Those who could not hope to enter a university due to insuperable social and other obstacles, entered a seminary. Education abroad was accessible only to the children of the wealthy. Thus a seminary education

is mentioned in the biographies of many *raznochintsi** who eventually played an important role in the development of education, science and art in Russia at the turn of the century. Who knows what career Ter-Saak-Khakhanyan might have dreamt of? He became a priest and settled in Tshinvali—the centre of Southern Ossetia. His wife, Yelizaveta Georgiyevna, bore him five sons and a daughter. A polite and well-mannered man of impressive appearance, Khakhanyan enjoyed the respect of his parishioners and the local authorities. He was an interesting man to talk with about politics, literature and the nationalities question, an issue in which he took a particular interest, sympathising with the sufferings of the Armenians in Western Armenia, which had been under Turkish rule since the partition of 1828.

Ripsimeh Saakovna had learned a great deal at home, and when she married she retained a quite forceful and original character. Her gentleness, sensitivity and honesty helped her become a good mother and housewife.

In many respects Amazasp was the exact opposite of his wife. He was a man of fiery temperament, inexhaustible energy and an extremely talented lawyer. He closely observed his children from their early childhood, and gradually he developed what, in the family, was referred to as "his system", a system of considerable social interest. Amazasp himself first spoke of his system in 1911, in a circle of literary friends who included Hovannes Toumanian and Gazaros Agayan.**

The conversation once happened to turn to the subject of Homer and literary research into his works, a topic that was Amazasp's main interest. His friends knew that he had started on a translation of Homer from the original ancient Greek into Armenian.

Amazasp reminded his friends that the students of Homer often referred to the "theory of points". While invalid in its entirety, it is of interest from the psychological point of view.

"Archimedes asserted that, given a fulcrum, he could move

* *Raznochintsi*—in Russia, in the eighteenth and nineteenth centuries, this was a category of the population whose members came from various social estates (the clergy, merchants, petty bourgeoisie, minor officials, etc.) and who were mainly engaged in brain work. They were bourgeois-democratic and revolutionary-democratic in outlook.—*Ed.*

** Hovannes Toumanian (1869-1923), Gazaros Agayan (1840-1911)—writers whose works have become classics of Armenian literature.—*Ed.*

the world. One might paraphrase that and say: if one knows the distribution of psychical forces according to points, one can direct the development of the intellect. The whole of my educational influence as a father was then based on these prerequisites."

The Ambartsumyans had three children—the eldest daughter, Goar, then Victor and Levon.

Goar was equally attached to her father, her mother, her grandmother and her grandfather—to everyone. Her development proceeded smoothly. When she was just four years old she could speak fluently in Armenian and Georgian and was able to express herself accurately.

Two-year-old Victor was able to identify objects by their characteristic features. Even at this early age he was beginning to display an ability to visualise spatially and quantitatively. His father began to engage him in exercises in the form of an elementary game. The days passed and, while playing, or in the company of his sister, or in talking to his parents he revealed an aptitude for numbers. After exercises with numbers came logical exercises. His father was convinced that the logical functions of the mind arise and develop at a very early age. He believed that this encouragement of the psychical powers must have a beneficial effect and lead to the formation of an active, creative personality.

For Amazasp Ambartsumyan, these family concerns were a way of relaxing. They enabled him to forget for a while his problems at work. The affair of Siemens and Co. continued to worry judges and lawyers alike. A certain M. O. Kruzenberg, a leading light in the legal world of Tiflis in those years, said:

"Listen, colleague Ambartsumyan, what is this all about? The magistrates and the lawyers are all talking about it. Is it true that you have criticised the court and put it to shame? That's simply unbelievable! I have been practising for more than twenty years, but have never once permitted myself such a thing. No, not once! That's absolutely impossible!"

However, you can't use a sprat to catch a whale. A general meeting of the district court examined the complaint brought by Krasovsky and decided as follows: barrister A. A. Ambartsumyan to be debarred from legal practice for a period of one year for insulting a member of the court.

The verdict was protested, but without result.

Ambartsumyan's friends tried to cheer him up.

"You were quite right to act as you did," they said. "Quite right, Amazasp. Exposing the bureaucrats, the stiflers of freedom and other rascals with all their dirty tricks is the sacred duty of all honest folk. Don't lose heart, don't give way!"

The family remained in Tiflis, even though Ambartsumyan's lawyer's practice was now closed to him. They spent the summer of 1912 in a village near the town of Gori. There were plenty of opportunities for marvellous walks along the road that led to this popular summer resort.

Now the father could devote himself entirely to the upbringing of his children, and he was drawn more and more into the study of child "philosophy". He discussed various topics, and sometimes engaged in fierce arguments with Victor, Goar and Liza, a relative who was staying with them. The range of thought and the process of assimilating what was seen and learned were different with all of them.

Weary of the debates and worries in the judicial world, of his painstaking work for the newspaper *Zakavkazskaya rech* and of family concerns, Amazasp Ambartsumyan decided, in June 1913, to visit his native village of Basargechar. This journey proved exceptionally beneficial for children brought up in the city. They were able to see rural life.

In the village people had already heard of Victor's precocious knowledge, and he was sometimes called "the scientist" in jest. And indeed, his knowledge in geography and arithmetic, his reasoning ability, despite its somewhat childish nature, were surprising.

The children could read and write, and spoke with equal fluency in Armenian and Russian. Sometimes the curious villagers would gather together and Victor would hold improvised seminars of elementary education. He himself took the role of the "teacher", and the venerable men were his "pupils".

While in Basargechar, the father continued his logical exercises with the children.

Once when, many years later, someone asked Victor Ambartsumyan about the role his father had played in his life, he answered:

"The greatest service my father did for me was to train me to think logically from early childhood."

The political struggle in the country continued. In 1912 news came from distant Siberia, where workers had been shot for rebelling against the dreadful conditions of work on the River Lena. Disturbances began in Baku. In Tiflis too the political situation was coming to the boil. The celebrations to mark the third centenary of the Romanov's House had not lived up to expectations: they had not served to arouse sentiments of loyalty. The ruling family became the target of jokes and anecdotes. At the same time, more clear-sighted individuals realised that the situation in Europe was also disquieting: 1914, the year of the outbreak of the First World War, was approaching.

On returning to Tiflis, Amazasp Ambartsumyan plunged into the public and political life of the city, and also into his literary pursuits. Nonetheless he continued his daily studies with the children. The exercises went on as before. This was the period of the walks—unforgettable for the children—along Golovinsky Prospekt, down to Olginskaya Street and then back. Lively discussions were held during these walks, and Victor was usually the liveliest interlocutor. He was, of course, still only five years old, and his reasoning was still in many ways that of a child. However, so his father asserted, the development of the intellect does not depend on the seriousness or the naivety of the reasoning, but rather on the logical sequence of the cognitive processes. Victor was, on the children's side, the chief speaker, and his sister, more disciplined, usually contented herself with simply correcting some of the ideas expressed by her brother.

Discussions such as these continued within the Ambartsumyan family for more than ten years. Gradually the father's companions changed from children to young people. The subjects of these debates were extremely varied; and the children were able to ask and talk about anything that interested them. Their father used these "processions" to inform his children about anything that, in his opinion, was deserving of their attention and discussion.

This ambulatory "free discussion club", the "logical exercises", "arithmetical conundrums" and other methods of educational training were sometimes supplemented by the children's participation in the conversations of their elders.

In the winter of 1913-1914, the father's friends often

gathered and spent many hours at the Ambartsumyan's flat at 3, Erivan Square.

"We could do with having visitors not so often," said his wife. "The flat is full of noise from morning to evening. There are, after all, the children to think about."

This remark reminded the father of his family concerns. Then came another interesting encounter.

"Do you know who I saw today?" said Amazasp to his wife.

"Who?"

"Stepan Danielovich Lisitsyan and his wife. They run a private gymnasium in Bebutovskaya Street."

"So what?"

"Lisitsyan asked me if it was true that our son was as gifted as people say, and whether I would like to send him to his gymnasium."

"And what did you reply?"

"I said: 'Stepan Danielovich, he's not old enough yet.'"

"Not old enough for what? For their gymnasium?"

"No, in general he's still a little too young to go to school. But Lisitsyan insisted that I bring along what he called our 'Wunderkind'."

Three days after this meeting with Lisitsyan, Ambartsumyan set off with his son to the gymnasium. The principal welcomed them in the visitors' room, which was full of guests.

"Tell us, please, what is the largest figure of all?" the principal began his examination of the little boy.

"The largest? There isn't such a figure! If you name a number, you only have to add one to it and it will become even larger."

"How many days and hours are there in a year?"

"365 days or 8,760 hours," replied Victor, smiling.

"And can you tell us anything about history?"

"What, exactly? There are different histories: there's the history of the Earth, the history of the evolution of animals, the history of mankind. My father says that in the future science will create the most interesting history of all: the history of the Universe."

The replies of the little boy intrigued all those present and the principal himself. He asked:

"Perhaps you can tell us what holds the Earth in space, how many times larger or smaller than the Sun it is, and

how far away from it?"

"Nothing holds the Earth in space. And the Sun is a million times larger than the Earth, and is one hundred and fifty million kilometres away. That's why it seems so small."

"How do you know all of this?" asked the amazed principal. Then he added, turning to the father.

"The boy has unusual clarity of thought, independence and striking originality in his thinking. He is extremely receptive, I would even say, daring. Such exceptional gifts promise a great future."

This visit to the gymnasium was, of course, discussed at home, and both gave their impressions. In the judgement of an experienced pedagogue, the principal of the gymnasium, the father saw the triumph of his "system". Victor described it all without any sign of surprise. His mother, however, pointed out to both of them that one should not speak so boldly to one's elders, and looked reproachfully at the father. Amazasp sighed, but his good mood stayed with him for the rest of the day.

It was only occasionally that the routine of the studies with the children was broken. The reasons varied. In 1916, Amazasp's father died in Basargechar. There was also a memorable meeting with the renowned Russian poet Valery Bryusov, and a talk with him about little Victor. Anxiety increased: "How would the children fare in the whirlpool of impending events?"

The socialist revolution of 1917 and the events of the following years left their mark on the whole of the city. "Fragments of what had been shattered", including the reactionary section of the staff of Petrograd University, arrived in Tiflis. Amazasp Ambartsumyan kept running up against his former teachers. For the most part they were now people turned adrift. They thought of staying in Transcaucasia, for a while, to wait and see what the future would prompt them to do—to return to Petrograd, if the counter-revolution is successful, or emigrate, if the revolution wins.

In 1918 the united forces of counter-revolution and foreign intervention began to commit outrages in Transcaucasia. Studies continued in the boys' Gymnasium No. 3 where, in the spring of 1918, Victor Ambartsumyan moved into the third class. The school continued to provide general

education; in the junior classes, where social sciences were still not taught, the pernicious influence of the Menshevik regime was weak, and was completely counteracted by the atmosphere that reigned in the Ambartsumyan home.

The father continued to perfect his "system", and carefully observed the results. He came to the conclusion that 1918 would be a decisive year in the intellectual development of Victor and Goar. A gradual differentiation of their mental abilities, directed mainly towards mathematics and physics, began to be felt.

Indeed, the boy showed a clearly marked interest in these areas.

"You know, Daddy," Victor would say, closing his eyes, "I can make calculations. How convenient the numbers are. How easy it is to manipulate them!"

"Yes, my boy," his father answered. "Mathematics is an amazing subject. The possibilities for transforming figures are infinite."

Soon new books appeared on Victor's book-shelf: works by Camille Flammarion, two pamphlets about Mars, *L'Exposition du système du monde* by Laplace, *The Catalogue of the Sky* by Pokrovsky, *The Moon* by George Darwin, *The Sun* by Strato, and *The Sun* by Secchi.

The boy read avidly, and occasionally put questions to his father.

"Secchi was a brilliant scientist, wasn't he? He made a detailed study of sunspots, their periodicity and rotation.

"And George Darwin, like his father, adhered to the theory of evolution. He founded and substantiated the theory of the development of the Moon. Could not this theory also be applied to the Sun and the stars?

"Why are you laughing, Daddy? Have I said something funny?"

Knowing Victor's interests, neighbouring children sometimes asked him to help them, though this did not prevent the fights so typical among children.

Noticing a scuffle in the courtyard one day, Ripsimeh Saakovna had taken Victor home, his face scratched and his clothes torn.

"Who started it? What was it all about?" she asked.

"Goghi and Gurghen argued with me about a stamp. I said that it was Australian, and they said that it was Austrian."

"And that was the cause of the fight?"

"No, we began arguing long before that, and then..."

Fights occurred for various reasons, but in most cases they were over stamps. And this was not by chance. Victor's father had encouraged an interest in stamp collecting, believing it to be a "spacial factor". Victor now had a large collection, and his friends liked to look at it, but not all of them were careful when they did so. And then there was trouble. It was generally accepted that Victor was the greatest authority among the boys of the neighbourhood.

At the beginning of 1919, a teacher at the gymnasium, which Victor attended, told his father that Yuri Stepanovich Gambarov, a notable professor, was staying in Tiflis. Having been forbidden to teach by the tsarist government because of his free-thinking, Gambarov had emigrated to Paris, but following 1905 he had returned to Russia and had lectured at St Petersburg University. After the October Revolution he had moved to Tiflis, and did not return to Petrograd, although Lenin invited him to, explaining that his health did not permit it. This unexpected meeting was a pleasant surprise for both of them. They began to meet, talk and reminisce.

"How is it, Yuri Stepanovich, that Vladimir Ilyich knows you?" enquired Amazasp Ambartsumyan.

"When I was an *émigré* I lived in Paris. I received a letter from Switzerland in which Lenin requested permission to deliver a paper to the students of the Higher Russian School (I was the dean of the social science faculty). Most were against this proposal: 'What do you mean? Allow a well-known revolutionary within the walls of the school? What kind of paper can be presented by a man who seeks any cause to bring about a revolution?' I assumed all responsibility for the matter and sent an invitation to Lenin. He delivered an interesting in-depth report. That was how we met, and it was no doubt this incident that Vladimir Ilyich remembered when he sent me an invitation to return to Soviet Russia. Unfortunately, I am very old and in poor health, and I prefer to end my life here on my native soil."

In the spring of 1919 Victor moved into the fourth class at the gymnasium. His hopes of being able to spend carefree holidays in his father's company were frustrated. The disturbing events taking place in Transcaucasia had led to furious national enmity. The chauvinism and mutual ani-

mosity of the then rulers of Georgia and Armenia had resulted in armed clashes. This strife between fraternal peoples was seen in progressive circles as madness, and was indignantly condemned by the more forward-looking section of the Armenian and Georgian intelligentsia.

The Council of Fellow Countrymen's Unions which then existed in Tiflis convened an extraordinary meeting. The council was led by Hovannes Toumanian, a famous Armenian poet; the secretary was Amazasp Ambartsumyan. Toumanian's speech at the meeting was greeted with thunderous applause:

"The sun has once more shone down on us... The fraternal Russian, Armenian and Georgian peoples will continue to live in peace and unbreakable friendship. I feel as if I had been born anew, as if I were young and had appeared in this world to see the sun, goodness, love and creativity!"

The great poet was, of course, looking ahead and foreseeing the liberation of Georgia and Armenia with the help of Soviet Russia.

Amazasp was again able to return to his usual occupations and to follow his son's progress. Once, talking with his friends, he seemed to be waiting to hear someone criticise him for developing too early the intellectual abilities of his children. And when such a criticism came, he left the room without a word. A few moments later he returned, and they all noticed his triumphant smile, and saw that he was carrying some exercise-books.

"Here we are," said Amazasp solemnly. "I have nothing more to say."

The exercise-books contained essays written by the eleven-year old Victor. One of the titles read: "The New Sixteen-Year Period for Sunspots". The next title was: "A Description of Nebulae in Connection with the Hypothesis on the Origins of the Universe". This essay was divided into five sections, of which the first three were already completed: "Various Forms of Nebulae", "The Composition and Spectroscopic Investigation of Nebulae", "The Formation of Worlds". Once again there were formulae, special terms and symbols.

"Listen Amazasp! This is incredible! Ripsimeh Saakovna, do you know about these essays of Victor's?"

His mother, of course, knew about them. She glanced

meaningfully at her friends and at her husband. Her eyes were full of warmth for her husband who, although sometimes perhaps sternly and over-enthusiastically, yet nonetheless persistently worked with the children.

Feelings were once again running high in the Chashka Chaya (Cup of Tea.—*Ed.*) café. The noise from the café could even be heard as far as the nearby theatre of the Armenian Dramatic Society. As the heated debate continued, Hovannes Toumanian went up to a table at which were sitting some Armenian writers and other representatives of the intelligentsia. As he drew close he heard someone say:

"They say that the allies have decided to solve the 'Armenian question' positivcly... That's precisely what we're arguing about!"

"And no doubt it is Amazasp who started it all off?" smiled Hovannes Toumanian. "There's always an argument if Amazasp is anywhere around."

"No," answered Leo, a well-known historian and writer, "this time it is probably I who am to blame."

Toumanian listened to what was being said—some of those sitting at the table were expressing naive hopes regarding the Entente—and then he flared up.

"The imperialists are ready to drown the world in blood for their own ends. Was it not they who had so much to say about self-determination of peoples, about charters of freedom, about humaneness and brotherhood, and then actively joined in organising the intervention against Russia, drew up plans to divide the Russian state? No, my friends. I don't believe such declarations and promises.

"The Russian people have always come to our rescue. And that is understandable. Our two peoples have grown together. Our own culture is bound by fraternal links with Russian culture. Pushkin, Lermontov, Griboyedov, Lev Tolstoy—all of them nourished our centuries-old culture. And it is the Russian people, the great Russian state, which can and must come to our rescue. Some of us view the Bolsheviks and Soviet Russia with irony. But that is a great mistake! That very Soviet power which freed the Russian people from tsarist tyranny will also free us. Think as you like, but I place my hopes on the Bolsheviks."

The café fell silent as people listened to the inspired

speech of the venerable poet. Then, in the capital of Menshevik Georgia, such words sounded very bold indeed.

Wise truth also reigned in the Ambartsumyan family, and was absorbed by the daughter and two sons from their earliest years.

Later Amazasp Ambartsumyan wrote in his diary: "These were the first glowing days and weeks of the establishment of Soviet power in Georgia. The social and political atmosphere cleared to such an extent that it was possible to see the distant political horizon and feel an obvious expansion of the intellectual world. It was as if the mighty Caucasian Range had opened up its blossoming ravines in front of Soviet Russia so that it could move south, into the heart of Transcaucasia..."

The peoples of Transcaucasia began a new life.

An Irresistible Vocation

The new year of 1922 was welcomed in. It became memorable for its interesting events, one of which was the family's acquaintance with Gevorg Karajan. Many already knew his conspiratorial party name, Arkomed, and this is the name used by Lenin and found in his *Collected Works*. He was an educated Marxist who had spent many years abroad and had lived in Switzerland, where he had met Lenin and Lunacharsky. He took a deep interest in the education of young Victor. He said to Amazasp, his voice impetuous and sincere:

"Perhaps you will let me take him with me to Moscow, so that he can meet Vladimir Ilyich?"

"I am very moved, Gevorg, by your attitude to my son," answered the father. "However, I think that the efforts you are talking about are unnecessary."

During this conversation, Nvard, the daughter of Hovannes Toumanian, came into the room.

"Comrade Ambartsumyan, my father wants you to call and see him today."

Amazasp found the poet in his study, lying on the couch.

"Hello, Amazasp," said Toumanian, rousing himself. "I'm glad you've come. What a strange and amazing creature man is. Sometimes his soul bubbles like a caldron, and then he wants to convey all that mental hubbub to

others, tell them something new."

"I understand your constant desire to enrich people spiritually, to make them better. Thus has it always been with the best sons of the people, Hovannes."

"Tell me, how is your little boy getting on? For two days now I have been unable to get the thought of the stars out of my head. Can you send him to see me? I would like to talk with him about the starry sky."

Victor, of course, went to see the ailing poet, and shortly after this visit Hovannes composed his poem "Sirius".

The sky, the stars, eternity. Sad thoughts clouded the vision of this lover of life. When the prime of life is past, the gaze involuntarily comes to rest upon the colours of sunset, and the thought of eternal night comes into the mind unasked.

Victor's popularity in matters scientific grew, and Tiflis was filled with rumour:

"Have you heard? A thirteen-year old pupil from the Boys' Gymnasium No. 3 delivered a lecture on Einstein's theory of relativity."

"Isn't that the son of Ambartsumyan, the lawyer, poet and philosopher who was the secretary of the Council of Fellow Countrymen's Unions?" enquired the curious.

"The very same."

"How interesting!"

This exclamation of admiration could be heard time and again, and not only in Tiflis. Ambartsumyan went with his son to Yerevan, Baku and other cities, and not from vanity. He was convinced that, if his son was to develop his intellectual capacities, he must address adult audiences, presenting papers on mathematics, acquiring experience in communicating with the public, and perfecting himself in the art of disputation.

Those who came to listen to Victor were not surprised to see a long blackboard hanging on the wall. What surprised them was the long bench in front of it.

"It's for the lecturer!"

Victor appeared in a black velvet suit—a jacket and short trousers. The collar of his shirt gleamed brilliant white.

The lecture was usually followed by questions. The boy answered them briefly, accurately and pithily, supporting his replies with complex calculations and writing the for-

mulae and equations up on the blackboard.

Once, in Yerevan, following one such lecture, the audience was addressed by a well-known mathematician, Professor Ashot Ter-Mkrtchyan. A man of exceptional charm, he left the audience in no doubt as to the fact that they had just heard from Victor Ambartsumyan a brilliant lecture on one of the most complex questions of theoretical physics. Loud applause broke out. Victor was embarrassed.

...Brother and sister were already in the eighth class at the gymnasium, and their father was increasingly concerned about continuing their education. This became a frequent topic in his conversations with his wife.

"The children are doing well at school," said Ripsimeh Saakovna. "Now all that matters is that their heads should not be filled with other matters. Let them finish the gymnasium. By then we'll be able to decide where they should go next."

What did she mean: "not filling their heads with other matters"? Victor's scientific studies were advancing at a rapid rate. He had mastered mathematical methods and had studied in detail Einstein's theory of relativity. He required special literature. Such was his father's opinion. In this he was assisted by a happy chance. In the autumn of 1923 his friend, the well-known revolutionary Sako Ambartsumyan, arrived in Tiflis and they met in the Oriant Hotel.

"My son wants to continue his studies in Petrograd, at the university. I'm planning to go and stay there to see if his dream can be realised. But he already needs scientific literature that is difficult to obtain here."

"I'll write today to Comrade Saak Ter-Gabrielyan in Moscow," said Sako, "and ask him to help you obtain the literature you need."

Amazasp Ambartsumyan was delighted, but his joyful mood was soon darkened by unpleasant news. In the late autumn of 1923 bad news came time and again into the Ambartsumyan household. His brother Voskan died in Basargechar; from Moscow came the news of the death of the poet Hovannes Toumanian, that great son of Armenia, a man of generous soul and unusual sensitivity. The body of the dead poet was brought back to Tiflis. Its streets were packed with people. Hundreds of pupils from Armenian, Georgian and Russian schools carried wreaths

of live flowers. Tiflis was saying farewell to a great humanist. In such moments the bonds that link the poetic muse with the hearts of his innumerable admirers are particularly felt. People recalled the wonderful words of the Russian poet, Valery Bryusov, addressed to Hovannes Toumanian:

Let justice triumph o'er the ages
And sway our destinies and lives!
Like the majestic constellation,
You lit up in Armenian skies.

Let stars of every known dimension
Send down their blessing from the blue,
As lost in wondering contemplation,
We marvel at your work and you!

It was already December when Amazasp Ambartsumyan decided to go to Moscow. He immediately went to see Saak Ter-Gabrielyan, veteran Bolshevik-Leninist who later became the chairman of the Council of People's Commissars of Soviet Armenia. Ter-Gabrielyan had already been informed and had asked the bookshops on the Kuznetsky Most Street to help him find the works needed.

With his nephew, Tigran, Amazasp Ambartsumyan spent whole days looking through book-shelves. Finally he discovered that he had selected books to the value of 350 gold roubles. Ter-Gabrielyan ordered this sum to be paid to the bookshops.

On January 20, 1924, Amazasp and his nephew returned to Tiflis. As he looked through the books his father had brought back, Victor exclaimed:

"It's a whole treasure trove, Daddy! What a wonderful present!"

It seemed that their joy could have no end. But the next day, on January 21, 1924, the whole world heard the sad news of the death of Vladimir Ilyich Lenin in Gorki, just outside Moscow.

Victor and Goar completed their studies at the gymnasium, and that summer the brother and sister began to prepare for entry into higher school. Their neighbours were amazed at their diligence and industry.

On August 16 the parents began to pack the children's things for their journey to Leningrad. Ripsimeh, glancing

round their rooms, furtively wiped away a tear. The father thought it better to send Victor and Goar on ahead and then he and his wife would follow. Breaking their organic links with Tiflis was no easy matter.

"Well, that's all. We're ready to leave!"

When the parents returned from the railway station, they met a long-time neighbour, the elderly Oganjanyan. Good-natured and straight-forward, always attentive and polite, he knew more than many about life and people, although he had very little education. The old man now looked sympathetically at Ripsimeh and Amazasp.

"Science, art... Is it not perhaps folly to send one's children so far away to study?"

"No, the children had to go," replied Amazasp briefly.

The parents could not then know that still greater trials awaited them. The Neva overflowed its banks, and news of the floods in Leningrad was passed on by word of mouth. The newspapers reported that Leningrad was under water and that the Neva had flooded a large part of the city.

Ripsimeh and Amazasp fretted. They tried to find out all they could about the natural calamity. Three nightmarish days passed. Then, at last, they received a telegramme: Victor and Goar are alive.

Their son wrote his parents a letter in a humorous vein:

"We can more than understand your anxieties, we can imagine them, but your manner of thinking remains, for me at least, a mystery. In order to conclude that our death had at least a three per cent probability, one would need to know that three per cent of the population of Leningrad had perished. That is, around 40,000 people would have had to fall victim to the floods. However, as the newspapers reported nothing of the kind, and could not have done, you had no reason for concluding that the probability of our death was just such a big fraction. That, in my opinion, is the first irrefutable objection to your manner of thinking. Your other error consists in the following: let us assume that the probability of our death was three per cent, that is, we must imagine that of every hundred people, three died. What basis did you have for assuming that these three people included us? A probability of three per cent is a mere nothing, not worth thinking about. It is as if one were to assume that, out of 33 cards, it is pos-

sible to pick out a particular one at random. But I'll say no more. It turns out that you suffered more from the floods than we did."

The children wrote that they had settled in and that everything was fine. Nonetheless their mother decided to keep the promise she had made to herself in those days of anxiety. In November, together with her youngest son, Levon, she left for Leningrad.

The sphinx, which for several thousand years has sat meekly at the feet of the Egyptian pyramids, has a human face. This is not by chance. Man is the repository of mysteries of immeasurable depth. They are investigated by scientists armed with the most precise instruments and equipment. They are studied by all of us, as we grow up. And then there come surprising discoveries. It proves to be naive to believe that there is a clear boundary dividing childhood from adolescence, adolescence from youth, and youth from adulthood. The daring of youth leads the individual ahead along the path of life, and he reflects as an adult upon the new conditions of his existence, sometimes with the wisdom characteristic of the elderly.

Such was the case then, in August 1924, when the train bound for Leningrad drew away from the platform at the Tiflis railway station. Victor looked out of the window, but he was occupied with his own thoughts and feelings. He was going to Leningrad not merely because it was pleasant, on finishing school, to go on to a higher educational establishment. He studied a great deal by himself, but he also needed systematised knowledge, and this had to be obtained from true scientists. He needed to work in observatories, to have access to those treasure-houses where one could find the latest works on the newest issues and hypotheses. He was on a journey to meet his long-chosen science. The sky. The stars. The universe. These had become his true vocation.

He recalled lines from Heine:

> Sterne mit den goldnen Füsschen.
> Wandeln droben bang und sacht,
> Dass sie nicht die Erde wecken,
> Die da schläft im Schoss der Nacht.

Why "goldnen Füsschen"? Usually the stars are thought to shine with a silvery light... An analytical cast of mind combined with ... a poetic imagination. The young boy liked poetry.

Yes, he liked poetry, and his lips automatically whispered lines from a popular eighteenth-century Armenian poet, Sayat-Nova:

> Let no grief oppress you, heart!
> See, men of honour value bread and salt.
> Don't be a droll—in work exalt,
> Allow neither truth nor wit from you depart.

A love of learning and the arts in the home has a beneficial effect on the children. One can visit every theatre, concert hall, art gallery and museum, yet it is still difficult to acquire that cultural wealth which children get in their contact with people of broad education who love books, music, art and engage in interesting, informative conversations.

Living in Tiflis, the children had been encouraged to love their native people. They spoke, read and wrote in Armenian and Russian. They loved the long and eventful history of Armenia. They knew that history and its famous names. The whole of their childhood and adolescence had passed in a world full of characters from Armenian and Russian literature.

"You know, Victor," said Goar, breaking the silence, "it's a good thing we're going to study in Leningrad! Daddy so often speaks about that city and his own teachers at the St Petersburg University. Remember how he told us about the banquet at which the late Hovannes Toumanian had spoken, as far back as 1912, about the brotherhood of the Russian and Armenian peoples?"

The beginning of an independent life is almost always an attempt to understand oneself, test one's strength, one's potential. And all this is, as it were, weighed on the scales of timidity and self-confidence. Everything had appeared so simple, so clear, just a day before, and now, on arriving in Leningrad, no one came to meet them and they began to feel a little apprehensive.

"But we arranged to take the letter to the flat of Hovannes Adamyan first. Perhaps they will advise us what to do next," said Goar.

"Let's go then," agreed her brother.

It was a rainy day, a depressing drizzle. In such weather the lack of a place of one's own is all the more worrying. Brother and sister turned off Krasnykh Zor Prospekt into Lev Tolstoy Street. Now they only had to find No. 3, Flat 16.

The young man to whom the letter was addressed gave them a friendly welcome. They each had questions to put. In the meantime a middle-aged man came into the room. He was of small stature, and had a large-featured face.

"So, you have arrived from Tiflis?" enquired Hovannes Adamyan. "And where will you be staying?"

"We don't know yet," admitted Goar.

Adamyan looked with kindly eyes at the brother and sister, and then said decisively:

"We have a large flat. One room is empty. I propose that you move into it."

Several weeks passed before they discovered that Hovannes Adamyan was a leading expert on colour television. He possessed several foreign patents for his own inventions. Having received his education in Germany, he devoted all his efforts and free time to realising his idea of long-distance image transmission. Moreover, he had selected the most difficult variant—transmission of a colour image.

Adamyan's laboratory occupied the largest room in the flat. One day brother and sister glanced inside. Instruments and equipment stood on tables, and along the walls were cases full of books. Often the light in the laboratory was still burning after midnight. The scientist went to sleep in the laboratory, on a couch, fully dressed, particularly when he was pursued by failures. Then he would continue his efforts with increased determination. Other specialists often called to see him, and Hovannes Adamyan would tell them about his work. Sometimes, as he left the flat, he would say: "I'm off to deliver a lecture."

Adamyan proved to be a sociable man. In his leisure time he would gather together the neighbours' children and explain things to them. The flat was filled with children's shouts and laughter. Sometimes he invited young people round and endless discussions would begin on science and technology, on music and chess. In the evenings music could often be heard: they played Mozart, Beethoven,

Strauss, Tchaikovsky, Spendiarov.

Victor and Goar came to feel a deep respect for this sensitive, cultured man. When, in September 1932, they learned of his sudden death, they were deeply grieved. All their lives they remembered the man who had helped to form their characters and their views at this decisive moment in their lives.

The problems connected with settling down in Leningrad were now behind them, and Victor was preparing for the difficult competitive examinations for the Faculty of Physics and Mathematics at the Herzen Pedagogical Institute.

That was a time when acceptance into institutions of higher learning was regulated by social origin. These institutions accepted mainly workers' children. Victor Ambartsumyan was the son of a lawyer, and only his excellent marks at the entrance exams enabled him to enroll at the institute.

Correspondence

The correspondence between father and son presents a vivid picture of this period in the life of Victor Ambartsumyan. From the day of their departure for Leningrad, Amazasp had decided to use letters as the only reliable way of guiding his children's development. In a letter dated August 27, 1924, we read:

"All the information we have received till now has been extremely brief and laconic, so that it is very difficult to imagine the actual situation in which you found yourselves in Leningrad. I await a very detailed letter, or perhaps it would be better to say—a detailed account... If I have given you the opportunity to act independently, this does not mean that your actions are exclusively your actions. No, do not think that. In my absence you are doing that which I should have done. I repeat once again: write more often, and in greater detail."

As before, a large part of the correspondence is taken up with intellectual matters, with scientific and creative questions:

"Dear Goar and Victor,

"Three days ago, in the evening, my attention was ac-

cidentally attracted by two pieces of work—Victor's rough scientific notes, and Goar's work 'Women in Shakespeare'. I deliberately allowed myself to examine them critically, wishing ... to discover the level of the already mature creative thought of my children. In so doing I strove, as far as possible, to remain objective, as if I were examining work written by strangers. Although I did discover defects, I was nonetheless obliged to pass a verdict of 'non-guilty' on their authors, and to recognise that now they are sufficiently independent not only in their actions, but also in their reasoning.

"I am writing all of this in order to remind you that you are now quite independent citizens and people who are able to judge strictly their affairs and actions. Therefore, no temporary successes or setbacks, at least as regards entering the institute, should affect you, for you must be resolute and firm and at the same time move persistently to your goal...

"*P.S.* Yesterday evening Levon and I tried to see Mars through the telescope, but we had no success. We had to admit our own inability and recalled Victor: he knows how to do it so artistically."

En route from Batumi to Tiflis on August 21, 1924, Amazasp wrote that he had met Sudakov, one of Victor's schoolteachers, who had taught him astronomy. Thinking of his son's own interests, he added: "This summer Sudakov has been systematically observing Mars. 'As a result of these observations,' so he told me, 'I have managed to observe: (1) the rotation of Mars about its axis; (2) the polar caps; (3) seas, and something else...' Sudakov insisted that you should go to Pulkovo immediately."

Sometimes the father replied in detail to ideas which his son and daughter had set forth in their letters. Some idea of these conversations at a distance is given by the discussion on Euclid. "Your and Academician Uspensky's opinion that many of Euclid's axioms deliberately remained unformulated seems to me to be hasty, unfounded, if not, indeed, erroneous. In fact, a man usually expresses an unlimited number of various ideas about physical and mental phenomena. Of these, only a few are then found to be worthy of formulation. It is possible that among the mathematical (or, more precisely, geometrical) propositions expressed by Euclid there are those which can, accord-

ing to the rules of logic, be given a special formulation. But this does not mean that Euclid himself left them without any formulation."

Sometimes their father wrote to them every day, briefly or in detail, even when travelling, either on board a train or while waiting at a railway station, never losing the opportunity to send, via some third person, money, books and presents.

No less interesting are the envelopes and postcards with the postmark "Leningrad". They provide a vivid picture of how young Victor Ambartsumyan began his independent life in Leningrad.

This period in his life, it is true, passed in fairly favourable circumstances which helped to resolve many of the everyday problems of this young man. The Soviet government was already able to provide, for at least a section of the youth, the possibility of obtaining a good education. The Leningrad institutions of higher learning were famous for their teaching staffs, their equipment, libraries and residential facilities. The parents also took constant care to provide for their children. When one is young it is very important to feel that, however favourable the circumstances, one can rely on parental support, on parental advice and material assistance. Indeed, not everyone was fortunate enough to find, in a strange town, accommodation as good as that which Victor and Goar had at Adamyan's flat.

Nonetheless, life in a new place brings its concerns about those aspects of life which young people have never before had to think about.

"Dear Papa, we arrived in Leningrad on Monday morning and immediately set off for the Central Selection Committee. The scene there was unimaginable. A large number of students had come to complain about being refused by local selection committees. Everywhere we saw, written in large letters, the sign: 'Acceptance of applications stopped on August 15.'

"However, I did not panic, but got out my letter of recommendation and told the chairman, that as I had been sent from Tiflis to study in Leningrad, my place was reserved for me. He, however, pointed to the fact that my letter of recommendation stated: 'To a faculty of physics and mathematics in one of the institutes.' If I was being

recommended for a reserved place, then the name of the institute should be indicated. I answered that the institute concerned was the physics and mathematics faculty at Leningrad University. He then replied that admittance to that faculty had ended for this academic year.

"There are two other faculties of physics and mathematics here—at the Herzen Pedagogical Institute and the Nekrasov Institute. However, I was told that the second is no good, so that only left the Pedagogical Institute. The chairman of the committee wrote on my letter of recommendation: 'This comrade to be admitted to the entrance examinations.' I want, while studying at the Pedagogical Institute, to attend lectures at the faculty of physics and mathematics of the Polytechnical Institute.

"I like the city very much, and am already able to find my way around very well.

"Farewell for the moment. Victor. August 27."

His parents did all they could, but for a variety of reasons the money they transferred to Victor did not always arrive in time. Sometimes Victor was obliged to write home: "Today I received the 30 roubles you sent me. They came just in time. We had just 50 kopecks left, of which 30 I had to pay for the delivery of the money... Today I wanted to go to the Technological Institute to attend a lecture by Professor Koyalovich on analytical geometry, but I was unable to go. It's five *versts* from here to the Technological Institute, and I didn't have enough money for the tram fare."

Another time Victor wrote cheerfully to Tiflis: "Today I bought myself a new fur cap, because my old one was in a truly pitiable state. When I was walking over the bridge, I wanted to throw the old cap into the Neva, but I was afraid of being fined." Victor's letters also contain such lines as: "we buy cheap bread", "we are thinking of buying firewood, but as yet we have nowhere to put it—the cellars are full of water". At the same time, brother and sister often write that they have bought new books, that they are collecting a whole library of them. These books include, as well as works on science, their favourite authors: Toumanian, Goethe, Byron, Blok, Anna Akhmatova.

Once their father in Tiflis was told:

"Comrade Ambartsumyan, the secretary of the Trans-

caucasian Territorial Party Committee, Alexander Myasnikyan, wishes to see you."

Amazasp Ambartsumyan hastened to see him.

"You are moving to Leningrad, are you not?" asked Myasnikyan.

Amazasp Ambartsumyan replied in the affirmative.

"Could you give your flat to our mutual friend, Artashes Karinyan, and his family? I believe he enjoys the love and respect of us all."

"I should be only too happy."

Ambartsumyan thanked Myasnikyan for the meeting and was about to leave, but Myasnikyan detained him.

"And how are things with our little astronomer? Has he settled down well in Leningrad? We have decided to give your son a state grant. And your job is to keep an eye on him! He is not only your son. Tell him not to hesitate to write to me about his progress and any requests he might have. We will do all we can."

The grant was almost twice as much as the usual amount—50 roubles a month.

As a result of the damage caused by the flooding, the institutes in Leningrad opened their doors a little later than usual. All over the city one could see traces of the disaster. The inhabitants were doing all they could to get life back to normal. Victor took part in Saturday and Sunday work, pumping water from cellars. He was enthused by the scale of the repair work. "Our city is gradually being restored. Many districts already have electricity. We use either an oil lamp borrowed from our neighbours, or a candle. In a few days we, too, will have electric light." The prospective first-year student already felt himself to be a Leningrader: "I'm now so used to the city that it's like living in my native town... The streets, houses and roofs are being repaired, so it is hideously noisy, but everything is beginning to look more presentable."

Sometimes in their letters the children spoke of their regret at not having enough time to visit places just outside Leningrad. Their daily timetable was strictly planned. "Tomorrow morning we have to stack the firewood in the cellar, and then dash off to the institute. After that we have to go for something to eat, and then come home, study mathematics, and also go over the measurements of the photographic plate of the Pleiad."

However, there were days when everything was put aside in order to take part in traditional celebrations. Victor gave an excited description of the October holiday demonstration in Leningrad, in which he had taken part. And could he refuse when his sister invited him to go with her to a literary evening to be addressed by well-known authors? Or when the ballet *The Hump-Backed Horse* was being performed at the Mariinsky Theatre? On such occasions the "rigid" order was changed a little, but only on the condition that any work which had been missed would be caught up. Sometimes, quite unexpectedly, part of the evening was given over to chess. And how true were the words of their father: "It is by reading the classic specimens of poetry and prose that one attains aesthetic and civic maturity, boldness and a certain experience of life. Thus ... it is surely obvious that the positive effects of methodical, rational reading are indeed incalculable, and no one would venture to deny them."

The entrance examinations passed off successfully. Victor joyfully informed his parents:

"Half an hour ago I returned from the institute after the physics exam. It was a woman who took it. She asked me to write the formulae of the laws formulated by Boyle, Mariotte and Gay-Lussac. I not only wrote them, but also showed how they were arrived at. Then she asked me about Faraday's law, and the formula for a pendulum. I told her and explained. After a few more minor questions she let me go. Tomorrow we have exams in three subjects one after the other: political knowledge, social science (the Soviet system, political economy, history), and the Russian language. I'm thinking of taking them all on the same day, although you can take them on different days. They are difficult exams. The other students say that this is one of the hardest entrance competitions they have ever known anywhere."

Further on Victor added:

"I already feel quite at home here. All the old monuments have been preserved. Of the new monuments I have seen the one to the great Ukrainian poet, Taras Shevchenko. They have also erected a quadrangular granite wall on the Mars Field as a monument to the victims of the revolution. Yours, Victor."

Things were more difficult with mathematics. The ques-

tions covered every branch of the subject—algebra, geometry and trigonometry. The examination was taken by Professor Fichtengoltz, who gave the course on differential and integral calculus at the Herzen Institute and Leningrad University. He was known to be one of the best professors, and Victor was even glad that a scientist such as this should test his knowledge. Then he took and passed the examinations in the humanities.

Their hopes had been realised: Victor Ambartsumyan was accepted into the first year of the faculty of physics and mathematics at the Herzen State Pedagogical Institute.

CHAPTER THREE

Alma Mater

The new student went to see Comrade Svyatsky, the editor of the journal *Mirovedeniye* (Cosmology–*Ed.*). He had been advised to do so by some members of the Russian Cosmologists' Society, which he had already visited.

"I am Victor Ambartsumyan."

"Are you one of Sudakov's students?"

"Yes. I learned a great deal from him when I worked at the observatory of the Gymnasium No. 4 in Tiflis."

Svyatsky took Victor to see the observatory used by the Society. However, they were unable to conduct any observations as there was no electricity. Then Victor was introduced to the head of the department for the study of falling stars, Maltsev, who was interested to see the notes that Victor had made on his own observations. They returned to the observatory, where they talked for some time.

"Come on Saturday. We'll be having a meeting of the 'students of the sun'. For the moment you will have to join the Young Cosmologists' Club."

And Victor had to agree, although his mature scientific interests already attracted him to adult astronomers.

His father sensed this attraction and wrote to his son: "I support the need for a theoretical, creative expansion of your knowledge, and its methodical development to such a satisfactory level that you will indeed be able to work creatively. These clubs–this work on minor questions–are, in effect, shallow sailing. I have no objections to them, but I feel I must point out that it is psychologically inevitable that this will lead to the dissipation of thought."

"What do they say in the letter?" asked Goar.

"Father gives some good advice, but I cannot wholly abide by it: he warns me against becoming too interested in the work I do in the clubs of the Cosmologists' Society. He is even angry and asks whether such work can be called science. But in my opinion one can only learn to work

creatively in the daily process of scientific work. If I don't learn, in this work on minor questions, to identify the causes of some phenomenon that has arisen, and its periodicity, then I'll be unable to apply the methods of scientific investigation when dealing with major questions. In the process of resolving the questions that arise when working on some minor issue, the human mind is trained and becomes flexible."

"You're quite right."

"I'm glad you think so. One must sharpen the knife of one's scientific thinking, for, in the course of his difficult work the scientist often has to cut Gordian knots. What can I hope to achieve with a blunt knife? I'm afraid it will break at the first blow, for nature often hides its secrets behind a granite wall."

"In my opinion," Victor continued, "every scientist needs sharpness of vision, resilience, flexibility and boldness of thought. Insofar as I want to become a scientist, I must acquire these qualities, and they can only be acquired by experience in some scientific work. But this training, like any training, must begin with minor things. And so I must be patient and throw myself into work in order to emerge a steeled investigator. I don't see any other way."

"You have learned to talk in metaphors." Brother and sister burst out laughing.

"Yes, Victor, of course, you're right. So tell Papa."

"I will."

"...Papa," wrote his son soon after. "You warn me against getting involved in scientific trivia. But... these 'trivia' are a school in which the scientist receives his training. At the moment, for example, I am determining the photographic brightness of the stars of the Pleiad and calculating eclipses. I must, after all, learn to determine brightness, to work, talk or write about it, so that I know what I am talking about and what is an object of research. I will gradually go over to more important scientific work—and thus move higher and higher."

The Cosmologists' Society was some distance from the Adamyan's flat. Therefore, it was decided, after consultations with Svyatsky and Maltsev, that the young astronomer would not undertake observational work, which would require him to go to the observatory, but would engage

in calculations, which could be done at home.

"On Saturday I'll give you the material we have obtained on falling stars for you to work on, and then—our observations of the heliographic coordinates of sunspots. You will find there something of use for your own work on the periodicity of sunspots," said Maltsev, bidding a friendly farewell to Victor.

Encouraged by his first working contact with the astronomers of Leningrad, Victor picked up his pen to write home.

"For my work I need the following books that I have in Tiflis: Pokrovsky, *A Guide to the Sky*; Pokrovsky, *An Atlas of the Stars* (in folio); the issues of the *Mirovedeniye*, which I have at home; Ignatyev, *In the Kingdom of Stars* (two volumes); Tikhov, *Astrophotometry.* Please find these books among the ones I have at home and send them on to me straight away. I need them urgently for my scientific work."

On reading this last sentence, his father thought with satisfaction that the efforts he had made to develop his son's mental faculties had not been in vain. His mother, however, sighed to herself: "He has a hard course of study ahead of him."

A week later his parents received a letter with a detailed description of Victor's study programme. It is worth noting that the young student had not only thought out in advance his study plan for his first year at the Herzen Institute, but had also compared it with the first-year university course and had come to the following conclusion: "During the first year at the university, the students take three mathematical subjects—higher algebra, integral calculus and descriptive astronomy. These three subjects are taught at our institute during the second year. I am thinking of attending the university lectures, and then transferring next summer to the second year at the university."

Further on in the letter came interesting information on Victor's use of the public library. The library itself was still closed for repair work following the flood. Only the reading room, with its stock of three to four thousand essential books was open. In this reading room Victor read Morozov's *The Principle of Relativity in Nature and in Mathematics.* He explained to his parents that this "is not the

book I already have (*The Principle of Relativity and the Absolute*). In this book, Morozov also raised certain objections to Einstein, but they did not satisfy me. He admits the relativity of space and time, but as seen from his own point of view. However, the book itself is very interesting." Such was the literature that interested Victor at that time.

It was then also that he first read *Introduction to Non-Euclidean Geometry* by Academician Uspensky, *Theoretical Astronomy* by Gauss, and the three-volume *Theoretical and Practical Astronomy* by Delambre. In order to improve his knowledge of foreign languages, he read *Adventure* by Jack London, *Matelot* by Pierre Loti, and the works of Oscar Wilde in the original.

Sometimes Victor could be found in the Young Cosmologists' Club, or sitting behind a chess-board with Adamyan, or out on a walk, but even then his mind was occupied with his favourite science. While out walking on Nevsky Prospekt, his attention was attracted by an interesting novelty of the day—the Weather Kiosk set up by the Main Geophysical Observatory. He closely examined how it was arranged: "A hollow metal prism. It has windows in the four-side walls and through the windows one can see the recording instruments—a barograph, a thermograph and a hydrograph. In the fourth window is a meteorological map with a forecast for the following day."

"We had a marvellous time at Oranienbaum*," his friends told him. "Tomorrow we're going to Pavlovsk.* Won't you go with us? You'll be sorry if you don't!"

"I've no time," answered Victor. He wanted to go not to Pavlovsk but to Pulkovo, to visit the observatory. However, only guided groups were admitted into the observatory, so Victor sat with his books, waiting to receive from Tiflis a letter from Sudakov, his former teacher, requesting that he be allowed to visit the observatory.

Victor also pursued his study of foreign languages. In one of his later letters there are the following interesting lines:

"...I am still following a teach-yourself German course, and at the moment I am translating a book on astronomy.

* Oranienbaum (now Lomonosov), Pavlovsk—suburbs of Leningrad.—*Ed.*

In general, anyone who wants to study the sciences ought to translate some work in his particular field and give a skilful exposition of the contents, for every scientist requires, in addition to a 'school of thought', a 'school of language' in order to formulate, or, more precisely, photograph his thoughts exactly on paper. Because no matter how fruitful the work done by a scientist, no matter how high soars his scientific thought, it can be of no social value until it is converted into kinetic, rather than potential mental energy. And this conversion is possible only if he transfers his thoughts from the research laboratory—his head—to paper. And the more precisely, smoothly and distinctly he conveys that thought, the more value it has, for the more understandable it will be for those around him. Seen from this point of view, it seems rational and expedient to strive to develop, during those years that leave their imprint on one's future work, the ability to express oneself accurately in one's own field by making a translation of some model work."

Following this, Victor began a five-hundred page course on plane geometry by Shmulevich. Then came Gauss' spherical trigonometry, a course in physics by Khvolson, and analytical geometry according to a course by Mlodzeyevski. All of these were read with keen interest. Later, several pages of a letter were devoted to telling his parents how much he had enjoyed it all.

"Dear Papa ... I shall say a few words about my impressions of the book *The Fundamentals of the Theory of Determinants* by Kagan. First of all, this is not so much a text-book as a scientific monograph. I found it extremely interesting. There was no difficulty in understanding it as it captures your attention. Its introduction describes in brief the history of the theory of determinants. On reading it, you can imagine the enormous battle waged by such intellectual titans as Cauchy, Jacobi and Kronecker, who demolished the barriers to mathematical truth with their powerful blows. Nonetheless, however amazing their work may have been, new barriers rise up as if from under the ground; the truth is bound by new chains which must be removed, shattered, by new surges of the human mind. Gradually the truth will be set free.

"Perhaps mankind is unable to understand everything, yet the achievements of human thought are constantly

growing, and mankind takes pride in this, seeing in it the proof of its strength."

Such was this young student, an astronomer by vocation, awaiting the start of his studies.

The range of his interests was wide beyond his years, and his reasoning of unusual force. The All-Union Congress of Physicists took place in Leningrad. Victor was disappointed at not being able to attend. The delegates alone numbered seven hundred, with many foreign guests also present. Tickets were distributed solely via scientific organisations. However, it was possible to follow the work of the congress even if one was unable to attend, and this was what Victor did. He wrote a letter to his father (dated September 22) about two opinions of scientists regarding the nature of light, opinions that were mutually incompatible: "There was a long discussion on the theory of light, and both theories, despite their incompatibility, exist on a par—an unprecedented situation in physics."

At last, after the delay caused by the floods, Victor began his studies on the first-year course of the faculty of physics and mathematics at the Herzen Institute.

He not only pursued his studies at the Institute, but also continued his scientific work. In one of his letters he admitted: "In any case, I have a lot of work to do, and I am busy from morning to night, either at home or at the public library." His reward was the joyous feeling of acquiring knowledge he had not possessed before. The room next to Victor's was occupied by a third-year student at the polytechnical college. He was preparing for an examination in theoretical mechanics. When it was necessary to differentiate between certain complex transcendental functions, this student turned for help to the first-year student, and there was never an occasion when the latter was unable to help in a "difficult case".

Of course Victor, himself still only sixteen years of age, sometimes felt tired, sometimes felt homesick. He was the first to the door when the postman rang the bell, and was happy when he saw an envelope from Tiflis. His mother wrote less frequently than his father, but for some reason it was her letters, full of maternal concern, advice and recommendations, that returned him, in his imagination, to his home and his childhood.

Both brother and sister were economical, but vied with

each other in extravagance in the purchase of interesting books:

"Show me what you've brought," said Goar on meeting her brother and seeing a parcel of books under his arm.

"Two volumes by Professor Petrazhitsky entitled *The University and Science.* He was father's tutor. I must write home about my purchase. Then I found two books about new ideas in mathematics, and one about new ideas in astronomy. And what have you got?"

His sister, beaming with pleasure, showed her purchases.

"We're acquiring a whole library," smiled Victor. "Let's arrange it as follows: belles-lettres will constitute a common fund; that section can also include books in foreign languages. The rest we'll keep separately: my scientific works and text-books in one place, and yours in another."

Goar often noticed with what pleasure, indeed, with what joy and enthusiasm her brother read books that might have seemed extremely dry, peppered with formulae and figures. He would stand up from behind the table, walk quickly about the room, wipe his hands, and sit down again to continue his reading. In one of his letters he himself wrote about this:

"Yesterday, in the public library, I studied a book by Academician Gravé on algebra and, in the course of this, read the proof of Moivre's theorem and the method of solving binomial equations... I was so struck by the use of trigonometric functions in solving equations that I felt unusually excited. I stopped reading and began to fidget with my feet in an attempt to work off my excitement. When that did not help, I got up and ran to the cafeteria, where I had a cup of tea."

As time passed, his sister came to realise that her brother was particularly stirred by books which made him want to argue with the author. The smallest pretext was sufficient for Victor to start a harsh polemic, defending his view with inflexible confidence. Once the cause of such a dispute was a reference to a book by Foss, *La réalité des mathématiques.*

"Have you read it?" someone asked Victor.

"Yes, I have," replied Victor. "It's an interesting book, but it contains a number of propositions which, in my opinion, are completely erroneous."

"Indeed? But the author is a well-known scientist!"

"Foss divides all of mathematics into two groups: pure mathematics and its applied sphere..."

"And what is wrong in that?"

"That division does not, of course, in itself cause any objections, for every theoretical science has its parallel in the applied sciences. But later on Foss says that geometry and mechanics belong to the sphere of applied mathematics, pure mathematics being the science of numbers. There he is mistaken..."

"In what way?"

"First, both geometry proper, and also analytical geometry and differential geometry, that is, the whole body of teaching on spatial forms and their diversity, are excluded from the sphere of pure mathematics. However, insofar as geometrical images are the free creation of the human mind, geometry belongs to pure mathematics. In the same way that geometry which studies physical space is excluded from the realm of pure mathematics."

"As far as we know, Albert Einstein...", but Victor had already warmed up to his subject and continued enthusiastically.

"Albert Einstein? This view perfectly coincides with the clearly-expressed ideas of Albert Einstein," he continued. "According to Einstein, there exist axiomatics, the theory of possible spatial relationships, and there also exists, or, at least, there ought to exist, natural geometry, that is, a theory telling us which of the relationships indicated by axiomatics are found in the physical world. At present, axiomatics has proved that the construction of three geometric systems is logically possible, corresponding to three types of space. These are: space with a negative curvature (Lobachevsky, Bolyai); flat space (Euclid); and space with a positive curvature (Riemann). The geometries of these three types of space have been more or less elaborated by axiomatics. Now it is up to natural geometry to show which of these three geometries is to be found in the physical world, that is, to investigate physical space on the basis of theory."

"And which of these three geometries, in your opinion, is the most promising?" asked his interlocutor.

"Einstein showed that, in general, our space is that of Riemann," answered Victor, "but with a very slight positive curvature, and insofar as it is approximately similar to

flat space, it is termed quasi-spherical. Closer to gravitating masses the curvature increases and farther away from them it decreases. All of this is, of course, the domain of natural geometry, which is part of physics."

Gradually Victor's opponents became his audience, desirous of learning something new in the branch of science of particular interest to them.

"Thus," concluded Victor, "axiomatics, that is, the theory of geometrical abstractnesses, is part of mathematics. Natural geometry, on the other hand, as the application of axiomatics, is part of both mathematics and physics. To recognise, as Foss does, that geometry is an applied science is to recognise geometry as part of physics. Yet we have seen that axiomatics can never be a part of physics, as physics is the science of unorganised nature, while axiomatics contains nothing from nature."

"You know," continued Victor, "Foss sees as exaggeration the famous words by Laplace that a mind which, at a given moment, cognised the whole of the material world, would, with the help of the auxiliary means of mathematical analysis, be able to know the past and future of the world."

Victor's sister decided to consult cautiously with her mother, who had arrived in Leningrad with her youngest son, Levon.

"Mama, I often talk with Victor, watch him studying, and I can see that he works a great deal. To be honest, this does not worry me. He is absorbed in science, it is a scientific enthusiasm, the kind—do you remember?—that Papa used to talk about. What worries me is something else. His studies for the institute occupy barely one-third of his time and attention. The rest he devotes wholly and entirely to science: he undertakes very complex tasks, makes the acquaintance of various scientists in Leningrad. In my opinion, his studies and his scientific pursuits ought to take up at least an equal amount of his time."

"I don't know all that much about your affairs, Goar," answered her mother, "but I have been worried for quite some time about the fact that Victor mercilessly expends his energy and is prematurely exhausting himself with his scientific occupations. You must try, cautiously, to speak to him about it. Or let his friends have a word with him. His father will be coming soon. Though," Ripsimeh Saa-

kovna hesitated, "your father will probably not be of much help. Let us hope at least that he does not actually encourage him!"

Victor, however, rather like an athlete who is an expert at weight-lifting, drew pleasure from the difficult tasks that faced him in his studies and his scientific pursuits. Without waiting for the letter of recommendation to visit the Pulkovo Observatory, he began to work at another astrophysical observatory that he had discovered by accident.

He continued to attend the Young Cosmologists' Club. Once, in a conversation with other members of the club, he said with a sigh of regret that he would like to be allowed to visit an observatory as soon as possible.

"Why wait?" exclaimed a friend who had long since noticed that their comrade from Armenia was seriously interested in astronomy. "Didn't you know that the building which houses the Russian Cosmologists' Society also houses the Lesgaft Institute, which engages solely in research. It has several departments: anatomy, botany, zoology, microbiology, physiology, chemistry, experimental pathology, physical education... It also has an astrophysical department with an astrophysical observatory which is headed by someone you must have heard of—Gavriil Andrianovich Tikhov. You see?"

Shortly afterwards Victor made the acquaintance of Tikhov. He knew, of course, that Tikhov was a prominent scientist who, in 1909-1910, had used light filters to study Mars, and had discovered the selective inter-stellar absorption of light. He also knew that Tikhov was the founder of a new science, the science of astrobotany, and that he had elaborated a scale for measuring the intensity and colour of the aureole of the Sun. The scientist proved to be a sociable man who inquired in detail into Victor's work in the Tiflis Observatory with Sudakov.

"That experience will be useful to you here," commented the professor. "And now—on to work immediately. Here is an article I have written, 'The Use of the Prismatic Satellite in the Photographic Photometry of Stars'. Try to determine for yourself the constant of the prismatic satellite using the photograph of the Pleiad, which was taken with the help of the Bredikhin astrograph at the Pulkovo Ob-

servatory. Make a note of the reference number—plate No. 2278."

After Victor had read the article, he was given the plate, a magnifying glass with a support for the plate, and a map and catalogue of the Pleiad. The young man worked for two hours which he would remember for a long time thereafter. And no wonder: he was carrying out a major piece of work within the walls of a Leningrad scientific institution. The feeling that this was bringing him closer to major scientific work encouraged him enormously.

Tikhov came up to him and said:

"Everything seems to be progressing very well. You can take the data home with you to work on, and then present it to us in a week's time. Agreed?"

"...Today I visited the Lesgaft Institute," the young astronomer happily informed his parents. "I was determining the brightness of the stars in the Pleiad. The Institute is presently engaged in the precise photometry of 300 of the stars in the Pleiad, using various methods. I, too, am determining that brightness, using one of the methods. I have to take 300 measurements, of which I have already done 70. At the laboratory they were even surprised that I had gone over straight away to such a major work. The calculation of eclipses proceeds very slowly. Up to date I have calculated only ten."

A month passed. Frosty weather set in. In the mornings the temperature was as low as -15°C. The young southerner patiently accustomed himself to this harsh climate, which appeared to take pity on the youth. There was no wind, and the frost was easy to bear. On one such November day the long-awaited event finally happened: Victor visited the Pulkovo Observatory.

Founded in 1839, the Pulkovo Observatory was, in the nineteenth century, rightly considered to be the astronomical capital of the world. It was only towards the end of the last century that more modern observatories began to appear in America, equipped mainly to conduct astrophysical research. The Harvard Observatory was famed for its observations in the fields of astrophotometry and astrography; the observatory on Mt Wilson was renowned for its studies of the Sun and the nebulae; the Lick Observatory studied the planets. In the first decade of the twentieth century, the director of the Pulkovo Observatory, Baklund,

decided to open branch observatories in the south of Russia—in the Crimea, in Simeiz, and in the city of Nikolayev in the south of the Ukraine, where there were excellent natural conditions. The latest equipment was ordered in England, but it began to arrive only after the Civil War and the restoration of diplomatic relations.

"So, today I shall see this observatory," thought Victor, walking cheerfully down the snow-covered street.

Professor Sergei Kostinsky welcomed the young astronomer and, as it was already late, invited him to stay for the night.

"We can't let you leave at this hour. And in the morning we'll take a look at the observatory."

The evening passed in conversation, and then Victor, among others, heard a report made by Ivanov, director of the observatory, who had just returned from a trip abroad. Everyone wanted to hear about the latest work done by foreign astronomers.

Professor Ivanov informed them that he had the opportunity to learn about several scientific trends. A split had occurred in astronomy, and there was no single world centre. The French astronomers, still affected by an animosity to the Germans carried over from the end of the First World War, had refused to cooperate on the international astronomical journal published in Kiel, Germany. Together with the Belgians they had set up their own astronomical union and their own journal. Their example was followed by the British, and then by the Americans. Nonetheless, the Kiel journal was still the most authoritative. Only recently it had published its 5,600th issue. Among its contributors were astronomers from Germany, the Soviet Union, Sweden, Norway, Denmark and other countries. The most renowned astronomers of the nineteenth and twentieth centuries had published and were still publishing their works on its pages. Beginning with Gauss, among its permanent contributors were Bessel, Zöllner, Vogel, Scheiner, Schwarzschild and other foreign astronomers, including the Russian Struve brothers, Baklund, Bredikhin, Byelopolsky and many others.

"And here it is—the famous 5,600th issue," thought Victor, seeing the Kiel publication the next morning in the observatory library. That library contained a large number of books and journals which made him want to sit down

and begin reading them immediately in order to acquaint himself with the wisdom contained therein. A conversation on this topic took place with Kostinsky, and perhaps it was then that the young astronomer began to think deeply about certain aspects of his future scientific work.

Professor Kostinsky was happy to hear that Victor had read *The University and Science* by Petrazhitsky.

"Of course, you took note of the advice the author offered to young scientists?" asked Kostinsky.

"Yes, I even wrote it down," answered Victor, getting out a thick notebook.

The professor, taking the notebook, began to read outloud:

"The picture of a premature transition to independent scientific work without the necessary perfection of one's own scientific thinking and the sometimes pitiable consequences of this mistake are often to be met with at the university (and sometimes outside the university) in those cases where an individual, who has not completed his studies, plunges into independent scientific work and continues with it for a fairly lengthy period of time. This happens most frequently with particularly gifted and talented students who, attracted by some particular complex of problems and sensing the inborn 'Herculean strength' of their mind, set off, without having exercised themselves sufficiently in scientific thinking by reading and attending lectures, to swim in the ocean of scientific thought in the direction of their choice. The danger is aggravated by the fact that it is precisely the talented student with uncompleted studies who with extraordinary ease goes on to 'discover Americas', and this only draws him further on."

"A useful warning! I refer this comment to those who lightmindedly set off to explore the expanses of science," remarked Kostinsky. Then he continued: "Generally speaking, if independent scientific voyages, or attempted voyages, are to be successful and exert a beneficial influence, one must first work receptively, assimilate to some extent the appropriate techniques of thought so as to avoid the danger of wasting one's energy in vain on fruitless attempts, instead of assimilating the precious assets accumulated by other levels of thought, and even to avoid directly spoiling and distorting the mode of thinking, so that sometimes it is difficult to correct it later."

"I was guilty of this myself," confided Kostinsky, "and I know the meaning of the words 'sometimes it is difficult to correct it later'. My lack of interest in foreign languages cost me particularly dear..."

"Yes, yes, that's exactly what Petrazhitsky says:

'In order to have easy access to scientific literature of the quality indicated, and to be able to select from among it, it is essential to have a command of the corresponding language. Just as, in the Middle Ages, it was difficult to manage without a knowlege of Latin, the scholarly language of the day, so now it is difficult to manage in the world of science without a knowledge of German. In some areas a knowledge of English is necessary, in others–French...'."

"I strongly recommend that you study these three languages–German, English and French," added Kostinsky. "Spend the first two years on a fundamental study of languages, physics and mathematics. Only after that, having provided yourself with a solid grounding, can you begin a serious study of astronomy."

"Useful advice! Later I will think it over again. And now–let's concentrate on the equipment..."

The equipment in the Pulkovo Observatory was impressive, yet the overall impression was somewhat different. It seemed to Victor that the instrumentation available at the observatory was not quite adequate if one considered the problems that the Pulkovo Observatory dealt with.

More than once he looked back towards Pulkovo when he was walking not to the Alexandrovskaya Station, but to Detskoye Selo, so as not to freeze while waiting for the train, and also so as to calm his thoughts and feelings, stirred by the visit to Pulkovo.

It is said that one must stroll around the Summer Gardens or around the islands in order to gain some idea of a Leningrad winter. One should see the snow-covered trees set against the background of wrought-iron fences, statues fancifully powdered with snow, hoar-frost glittering in the light of the street-lamps, and in the distance, in the frosty haze, the spire of the SS Peter and Paul Fortress, the dome of St Isaac's Cathedral and the smooth surface of the frozen Neva.

That first winter in Leningrad was, for Victor, filled with events and emotions. He was, of course, taking only his first steps: both in his studies and in his scientific work.

At the Pedagogical Institute all was as it should be, and Victor particularly enjoyed the lectures by Professor Fichtengoltz.

The whole family was now living under one roof—Victor's father had arrived in Leningrad. He asked Victor to tell him in detail about his studies and scientific work.

"I'm glad that you are attending lectures by prominent professors," remarked his father. "I'm sure that you perfectly understand what is meant by an 'all-round, thorough scientific education'. To be a scientist does not mean to be a narrow specialist. The narrowness of specialised training fetters the cognitive process and blocks the way to broad scientific and philosophical creativity. Expanding one's knowledge requires great erudition and a wide range of information so that one's creative potentialities can develop and expand. The modern understanding of the world is marked by composite unity. Hence the imperative need to know all sciences related to one's chosen scientific field. My advice is as follows: as far as you can, listen to lectures in all the disciplines that might be related to the one you have selected. In particular, you need to know theoretical physics and all the branches of mathematics."

"I agree with you, Papa," answered Victor. "I have decided to attend all the basic courses on mathematics. What is more, I shall try not to miss the lectures on theoretical physics and other related disciplines, and everything else essential for a student-astronomer.

"As you know, I'm interested in cosmogony. It's a science that still has many unanswered questions, unanswered because of the weakness of the mathematical analysis. The difficulties experienced when attempting this mathematical analysis are described by Jeans as 'dreadful'. Here every possible combination of highly complex problems can be found, before which the greatest mathematicians have admitted themselves defeated. One must rise to the very summit of mathematical knowledge in order to resolve these problems. That is why I am hoping to follow so many mathematical courses. I must learn to apply mathematics in solving various problems."

Father and son often found time to talk together, and one such talk proved particularly memorable.

"Papa," said Victor, "I have written a work on mathematics myself, in several exercise-books. I would like to

show it to one of the professors of mathematics. What would you advise?"

"Which professor would you like to show it to?"

"I don't know. You choose."

His father immediately set off to see Professor Koyalovich.

"Professor, my son is a student at the Herzen Institute. They say he is not without mathematical ability. Here is a work he has done. Please, take a look at it and tell me if it is of any scientific interest."

The professor smiled:

"Very well. I'll take a look by all means."

He immediately began to read the work set out in the exercise-books, and soon afterwards said:

"It's a work on trigonometric functions. Of course, I cannot examine and evaluate it properly at this moment, but your son has a good head on his shoulders, and is well-read on the subject, although he is so young. Leave the work with me. I'll study it in greater depth and will let your son know my opinion of it. Please, tell him to come and see me in about five days' time."

On returning home, Victor's father described his visit to the professor. Victor waited impatiently and a little anxiously for the five days to pass. He returned from the professor's flat late in the evening in a sombre mood.

"Not a success?" asked him father, looking at his son.

"Koyalovich said that I had done everything correctly and elegantly, but there it is—it isn't a discovery."

Victor made a few such "false starts" during his student years. His father would comfort him.

"These failures, by restraining the impetuosity of your thought, are gradually tempering your method of thinking. You are acquiring caution, patience and the ability to remain calm."

Victor himself recalled the conversation with Kostinsky at Pulkovo and the advice given by Petrazhitsky in his book *The University and Science.*

The first year at the institute was rich in lessons to be learned. On the whole, Victor spent it finding his bearings in the academic world. He was convinced that he must transfer from the Pedagogical Institute to the University, where Tikhov and Gorshkov lectured. There he could obtain a fundamental knowledge of the theory of probability,

the set theory and mathematical analysis.

Victor began the new academic year as a second-year student at the faculty of physics and mathematics of the Leningrad State University. His sister Goar also became a student at the same faculty. The family settled down in Leningrad.

One day they read in the newspapers that Comrade Sarkisov was the secretary of one of the Leningrad district Party committees.

"I know him, and he probably knows me," said Amazasp cheerfully. "I'll call on him and speak with him about my work. It's boring to sit at home with only poetry to occupy my time."

So Ambartsumyan met Sarkisov, and not long afterwards he began work at the regional finance department, in the statistics bureau.

Amazasp Ambartsumyan's literary friends and Victor and Goar's friends from the university could be met at the flat, but usually, when the conversation turned to the humanities, and in particular to philosophy, Victor's father became somewhat heated and allowed himself rather sharp attacks on those who were "still green", "still wet behind the ears".

Yeropkin and Bystrov were clearly offended by this. Only Kozyrev remained politely attentive and flushed when his lack of knowledge was revealed.

Victor decided to have a serious word with his father.

"What is the cause of such criticism, Papa?" he asked his father one day.

"I can explain it only very briefly. Your friends like you, that is beyond question. But each one of them, and all of them together, are superior to you in practical experience of life. In this I see a decrease in your creative boldness."

"I don't quite follow your reasoning."

"My son could have achieved a great deal more in the field of scientific creativity if he had not let himself be distracted by other occupations."

"Very well, Papa. I understand your anxiety—you want me to concentrate all my attention on my studies and scientific work. But you yourself said that it is dangerous to shut oneself off in one's own chosen sphere. What is more, there is student life, there are student interests. How can

one live closed off from them? In any case, such an abrupt treatment of people is inadmissible in general!"

Victor managed to defend his friends, and they began to gather more frequently. His father noticed that their interests pivoted on solar faculae, and that they often discussed their brightness. His son was often to be found talking with Kozyrev, an unprepossessing youth at first glance, and with Matvei Bronstein, of whom it was said that he was a walking encyclopaedia, and that sometimes even the professors were wary of entering into a dispute with him.

Soon it became known that Victor and Kozyrev were finishing a joint scientific work entitled "A Method of Determining the Height of Solar Faculae by Variations in Their Brightness". His father was both happy and anxious. It was pleasant to know that his son had, with the help of one of his friends, completed his first scientific work on an important topic. Yet was it important? Would it not turn out to be another case similar to the work on trigonometric functions? Or the work on the theory of numbers?

Not long before, Victor had asked:

"Papa, do you know where Academician Uspensky lives—the specialist in the theory of numbers?"

"Why do you need to know?"

"I want to show him a work I have written."

His father found the address, and the next day Victor set off to see the academician. He returned disappointed.

"Once again you can 'congratulate' me on my failure. This proof has already been formulated in scientific literature."

"It's a good thing that these failures don't discourage him, and he continues his scientific pursuits," thought his father.

And aloud he said: "Don't lose heart. The important thing is that you posed the problem independently and solved it correctly."

However, shortly thereafter he was to receive news of a different kind about his son. He learned the details of an incident that had raised quite a storm at the university, and in which one of the main participants was Victor Ambartsumyan.

It all began when an eye-catching announcement was put up in the university: "A seminar is to begin work on

the astrophysical theory of the outstanding Indian scientist, famous mathematician and physicist, Badicharak Ramazatva." For several days the professors and students searched the university and public libraries for information on this "outstanding Indian scientist", but to no avail. They could find nothing. This only increased interest in the seminar, and at the appointed hour the auditorium was packed with people.

Finally Victor Ambartsumyan appeared. He said a few words by way of introduction, and began to write formulae up on the blackboard. When this lecture on the "divine theory" was over, the audience surrounded Ambartsumyan, Kozyrev and Bronstein and bombarded them with questions.

"What scientific discoveries can be expected from the practical application of this theory...?"

For almost a week the university could talk of nothing else but this seminar.

It was only gradually that the truth about the Ramazatva incident became known. It had been a joke, thought up mainly by Matvei Bronstein, assisted by Kozyrev and Yeropkin. Victor Ambartsumyan was commissioned to think up a "theory" and deliver a lecture on it at the seminar.

His father was upset by this incident:

"It was not nice, unethical. What did you do it for?"

"We decided to play a joke on the students and even on the professors. And can you imagine," Victor justified himself, "none of those present, when analysing our formulae, discovered the inaccuracies."

"There's a young scientist for you," thought his father. "Childish jokes and scientific work. Somehow they don't go together. One thing is clear—Victor should conduct himself more seriously at the university."

Things that happen to us in life for the first time are often remembered forever thereafter. It is said that, even after many of his works have been published, an author still treasures above all the first of his lines to be printed.

Victor Ambartsumyan read through his first scientific work to be printed. He was not ambitious, but it was agreeable to think that now his thoughts, his calculations, his proofs, would be in every public library and would be

known to astronomers around the world. True, it was only a small drop in the ocean of scientific knowledge, but it was the first he had contributed!

Already new ideas were brewing in his head, but they would have to wait. The senior courses at the university were becoming more difficult, and it was time to start preparing for the achievement of his long-cherished dream—post-graduate studies at the Pulkovo Observatory.

Victor was eighteen years old. He had come of age! The event had been celebrated by his family and friends. He had found the vocation to which he wanted to devote his life. He had already prepared himself well for his future scientific work. His first scientific work had been published, marking the beginning of the great road ahead. Now he could put his membership card for the Young Cosmologists' Club away in his personal archives...

In the circle of his father's friends, who gathered at their flat, the conversation often turned to "bygone days"—their student years, though these, too, contained words of praise for father and son: their Leningrad friends had already heard about the famous "pedagogical system".

"Is the system still operating?" asked Doctor Ter-Airapetyan one day.

"Yes," answered the father. "But it has been updated. It is, I would say, now going through its final period—the period of polishing."

"And successfully, it seems," remarked his friends.

"I leave that for you to judge," replied the father evasively. "However that may be, Victor has no respite from those who wish to talk with him. At this very moment Georgi Gamov is sitting with him. Have you heard of him? He is a physicist. Victor is reading and correcting a work of his on the nucleus, and giving him theoretical advice. He often comes here."

More new ideas were born in Victor's mind. There were many interesting topics he wanted to take up, many recesses of science that he was eager to peep into. He had already made rough notes for several scientific works. One of them, written for a collection of articles by students who were members of the mathematical club of Leningrad University, was almost complete.

In the winter of his third year at the university, hidden powers—the faculties of a polemicist—began to reveal them-

selves. These faculties developed in direct proportion to his life-long hatred for all kinds of idealism, particularly in astronomy.

The young astronomer had long since aimed at his ideological opponents. The first attack was made on the English astrophysicist, Edward Arthur Milne. The thirty-year old Englishman had already made a name for himself in the scientific world. Not long before, he had published a work on the radiative transport of energy in stellar atmospheres. This work was praised even in reputable scientiffic publications. Shortly afterwards there appeared in the journal of the British Royal Astronomical Society an article by the student Victor Ambartsumyan. One must assume that it was sufficiently well-substantiated if this reputable journal considered it worth publication. The article was directed against the speculations and mathematical formalism of Milne. A professor of pure mathematics, in whose hands a mathematical problem was sometimes stripped of all physical meaning, was given an object lesson to ponder.

It was not then known that Milne would finally arrive at the frankly idealistic conclusion that the world is finite in terms of time, and would take as an epigraph to one of his works the opening words of the Bible: "In the beginning God created the heaven and the earth." It is all the more noteworthy that the young student saw even then, in the 1920s, an ideological opponent in the future president of the British Royal Astronomical Society.

Many years later, Ambartsumyan resolved the problem of radiative transport of energy in stellar atmospheres, and subsequently Milne recognised the brilliance of his opponent of the 1920s. In the summer of 1950, the British journal *Observatory* published an article in which Milne wrote that he had never imagined that this theory, on which he, too, had been working, could have attained the level of development and beauty which it had achieved in the hands of Ambartsumyan.

"It's come out very well!" said Kozyrev to Victor, referring to his "duel" with Milne. "But isn't it time for us to return to these files?" And he nodded towards the material they had collected for their joint scientific works on the theory of radiative equilibrium in the outer layers of stars and on certain questions connected with the temperature of the outer layers of the Sun. "What is more, we

should continue our work on the temperature of the solar surface. You haven't forgotten that, have you, Victor?"

"Of course I haven't. And today we will decide on the size of the work and the time it will take, but in the meantime it might not be a bad idea to have a game of chess. What do you think?"

The Pulkovo Heights

The graduation festivities were over. Thereafter one may often find oneself within the walls of one's Alma Mater, but the first day and the last day will always be remembered.

Victor's university diploma opened the way to postgraduate studies at the Pulkovo Observatory, where he was warmly welcomed. Nor was this surprising! At Pulkovo they already knew about Victor Ambartsumyan. They knew that he had the equivalent of two degrees—one in astronomy, and the other in mathematics.

In the 1930s the whole astronomical world celebrated the centenary of the Pulkovo Observatory, which had been opened in 1839. In the speeches delivered to mark the occasion, reference was often made to the fact that, soon after it was opened, the observatory won the honorary title of the astronomical capital of the world. Built according to a design by the famous Russian architect, Alexander Bryullov, it had been equipped with the most modern instruments of the day, a task which had been supervised by its founder and director, Vassily Struve.

Here, on the Pulkovo Heights, the sky is clearer. Although the glow of the city lights sometimes interferes, usually the dusty, smokey haze is considerably lower than the towers with their telescopes, which stand at a height of 75 metres above sea level.

Victor Ambartsumyan was always excited when he crossed the threshold of the observatory, for he had a high regard for all those who had worked there in the past and were working there now. This was the cradle of Russian astrophysics. In the 1860s, the first astrophysical equipment was installed at the observatory, and this had enabled P. Rozen and E. Lindeman to make a large number of measurements of the brightness of stars, including variable stars.

In 1876 an astrophysical observatory was founded and housed in a special building. However, astrophysics did not receive "full citizenship" at Pulkovo until 1890, when the outstanding Russian astronomer, Fyodor Bredikhin, was appointed director after Vassily Struve. For the first time the annual reports of the observatory began to appear in Russian, and the doors were opened to talented young university graduates. Previously, they had either not been admitted at all, or had been allowed to do only the mechanical work of calculation.

However, Bredikhin's main service to astronomy was his outstanding scientific work. He elaborated a theory of comets and meteor showers, a theory of comet forms, and produced the first classification of comet tails. Young astronomers rejoiced at the opportunity to work under him.

Victor dreamed of such a teacher. When he went to do his post-graduate studies at the Pulkovo Observatory he knew that this dream was realisable. Aristarkh Byelopolsky, who, together with Bredikhin, was considered a pioneer of the new science of astrophysics, became his tutor.

To this day there hangs in the study of Academician Ambartsumyan just one portrait—that of his tutor, Academician Byelopolsky, one of the most prominent scientists of the nineteenth and twentieth centuries. It hangs on the wall alongside photographs of galaxies and nebulae, and in front of them is a bust of the very first Armenian mathematician, Shirakatsi, who lived in the seventh century.

Byelopolsky was known for the originality of his intellect and his progressive outlook. He hated dogmatism and blind reverence to foreign authorities. He would spend days on end inside the observatory tower, the laboratory or the workshop, where he helped to make delicate tools and precision instruments. On such days he would sometimes say: "The blue-collar workers of astronomy have no time to follow the work done by others." This, of course, was only said in jest. One of Bredikhin's oldest colleagues, he kept pace with all the events and discoveries of the astronomical world.

When the train arrived in the Alexandrovskaya Station, Victor decided to walk to the observatory on foot. He recalled, as if it were yesterday, the snow-covered road

on that evening of Novemeber 16, 1924, his meeting with Kostinsky, the lecture delivered by Professor Ivanov, and the jubilee issue of the Kiel journal.

Four years had passed. Victor had overcome more than a few difficulties in his studies and in his research work. Yet nonetheless, as four years previously, he felt rather timid, thinking about his forthcoming meeting with Byelopolsky.

A straight, smooth road leads to the south from Leningrad to the observatory along the famous Pulkovo meridian. Now and again a smile would appear on Victor's face. He was going to Pulkovo full of hopes, full of energy which he had finally decided to devote to science, astronomy, astrophysics.

"It's amazing," thought Victor, "almost two thousand years before Copernicus, the Greek scientists Heraclitus, Aristarchos Samos and others expressed views similar to those of Copernicus: they viewed the Sun, and not the Earth, as the centre of the Universe. That was in the third century B.C. Since then men have been studying the nature of the Sun and they will continue to study it, as it yields a great deal that is useful in unravelling the mysteries of distant stars. In the middle of the last century, here at Pulkovo, Otto Struve observed a total eclipse of the Sun and concluded that the protuberances and the solar corona were not optical phenomena, but parts of the Sun itself..."

In the autumn of 1928, Victor Ambartsumyan, postgraduate student at the Pulkovo Observatory, met Byelopolsky face to face. Perhaps the meeting was a mere chance. Or perhaps Byelopolsky remembered how Bredikhin, scientist and pedagogue, who had always looked for gift and talent among young students, had once invited him. That meeting with Bredikhin had marked an important turning point in Byelopolsky's life. If it had not happened, Byelopolsky might never have become an astronomer.

"Yes, I have heard about you." said Byelopolsky. "So, your chosen vocation is astronomy. You know, I became an astronomer by accident."

"But it seems to me you have no reason to regret having become an astronomer," said Victor. "Last year I read your autobiographical essay in the magasine *Ogonyok*.

"Sergei Kostinsky told me that while you were still a schoolboy you wrote a work entitled 'The New Sixteen-

Year Period of Sunspots'."

"Yes, although it can scarcely be called a 'work': I was only eleven years old at the time."

"There is a Latin proverb which says: 'Even if the strength was lacking, one should value the effort.'" Then, without waiting for a reply, Byelopolsky began to say how important it was to dedicate oneself truly, selflessly, to science, to ceaseless effort, to tireless search.

As he spoke, Byelopolsky was clearly warming to his theme, and Victor thought: "Not for nothing is he called 'the furious Aristarkh'. I can imagine how menacing he must appear when he is castigating the negligent!"

"Have you seen Aristarkh Apollonovich?" asked Kostinsky, who happened upon Victor just at that very moment. "Well, tell me all about it..."

Listening to Victor he nodded his head and then said:

"You should know that he places great value on a student's inclination to independent research. It was not by chance that he referred to your first work. He also began his career in astronomy with a study of the Sun. Do you remember the subject of his thesis? No? It was called 'Sunspots and Their Movement'. Byelopolsky has asked me on two occasions about the works you wrote while still a school pupil. "Is he that same Ambartsumyan who has published 'The Structure of the Outer Layers of the Stars', 'On the Temperature of Sunspots', and 'On the Integral Equation of Radiative Equilibrium'?"

"Once there were those at Pulkovo," continued Kostinsky, "who considered the Harvard Observatory in the USA to be the 'trend-setter'. They imitated the American astronomers not only in science, but also in the little things of daily life. Now things have changed. Our own scientific school reigns supreme on the Pulkovo Heights. But this does not mean that we are holding ourselves aloof from astronomers abroad. Not at all! Byelopolsky is a fine example for the young people. He is a true Russian, a man of wide-ranging intellect, witty and exceptionally noble. His students seek to assimilate not only his brilliant skills as a researcher, but also his personal qualities. Stay and work with us and you will come to know Aristarkh Apollonovich better; you will thank fate for having brought you here," concluded Kostinsky.

Victor often recalled the years he spent as a post-graduate

student working under Byelopolsky: he recalled them when he became a lecturer at the Leningrad State University; and when, after 1934, he was made a professor, and when, a young professor, he organised and headed the chair of astrophysics at the Leningrad State University, and much later. These memories contained much from which he was able to learn.

The fame of the Pulkovo Observatory is associated with the name of Byelopolsky. He was its deputy director from 1908 to 1916, and its director from December 1916 to June 1919. Then he resigned from the post of director in order to devote himself entirely to science. In the conditions of the day, this was an exploit in itself. Herbert Wells, who visited Russia about this time, wrote in his book *Russia in the Shadows* that, for him, one of the most unusual experiences in Russia was a meeting in the Scientists' Club with some of the most prominent representatives of the Russian scientific world, worn out by their worries and deprivations. The English author listed their names:

"Here were such men as Oldenburg the orientalist, Karpinsky the geologist, Pavloff the Nobel prizeman, Radloff, Byelopolsky, and the like, names of world-wide celebrity. They asked me a multitude of questions about recent scientific progress in the world outside Russia and made me ashamed of my frightful ignorance of such matters... Our blockade has cut them off from all scientific literature outside Russia. They are without new instruments, they are short of paper, the work they do has to go on in unwarmed laboratories... Yet they are getting work done..."

It was no coincidence that Wells named Byelopolsky among the scientists of world-wide renown. Byelopolsky had been granted three honorary titles by institutions abroad, and had been awarded the Janssen and Lalande medals.

While still a student, Byelopolsky had once met the famous Russian patron of the arts, Savva Morozov. On the Abramtsevo estate he made the acquaintance of Repin, Vasnetsov and other outstanding Russian painters, writers and musicians. This had helped to develop the wide range of interests in this young man. It is interesting to note that his love of music and good ear for music sometimes helped Byelopolsky in his research work. In 1900, in his famous experiment to check the Doppler principle, he determined

the number of revolutions made by wheels fitted with mirrors, from the pitch of the sound produced by the teeth of the gear-wheel on the paper. Sometimes he would jump up and go across to the clock on the wall to stop the pendulum, which was preventing him from listening to some music... Everyone knew that he loved the circus and amateur shows. He often held poetry evenings in his flat, where he read the verse by world-famous poets, which were always filled with confidence in the triumph of human reason and which called for unravelling the mysteries of nature.

Three of the post-graduate students who, having finished university together, went on to work under Byelopolsky—Ambartsumyan, Kozyrev and Ponomaryov—also remembered in particular another aspect of the rich personality of their teacher.

Byelopolsky was a model combination of kindness and concern for others on the one hand, and implacable exactitude on the other. A strict discipline was applied both to his students and to himself. This discipline was not the discipline of the parade-ground or the school-room. He saw his task as a pedagogue to be not the regurgitation of predigested material from books to be then fed to his students, but the encouragement in them of the ability for independent thinking. He gave them a broad latitude in the choice of themes to be studied, but demanded the internal discipline of the scientist. At the telescope he was a senior colleague, in the lecture hall he was the teacher who explained and advised.

At the end of 1912, at a meeting of the Academy of Sciences, Byelopolsky spoke of research into the distances and motions of stars. He concluded his speech with words typical of the man himself: "As you are able to see, some work has been done already, and a great deal still lies ahead, but astronomers look cheerfully at the path before them, believing and hoping that energy will overcome all difficulties and will, perhaps, in the distant future, crown their research with brilliant success."

"Prophetic words," said Kozyrev to Ambartsumyan. "You and I should bow down before Aristarkh Apollonovich for his contribution to science."

Victor began his first post-graduate holidays in Gori, Georgia. The autumn of 1929 was a fine one, and in the

mornings his father would set out on a walk, accompanied by Victor, Goar and Levon.

"I remembered our strolls along Golovinsky Prospekt, Papa," sighed Goar, "and I felt a little sad that they were so long ago."

However, the warm rays of the sun cheered their spirits, and a smile appeared upon their faces. The young people tirelessly made their way up the steep cliff-side and explored every cranny of the ancient fortress. Then they went on to the summit, where stood an ancient church. During their walks they would often talk of ancient monuments of Georgia and Armenia.

"We can safely assert, Papa, that our Armenia is no less rich in ancient monuments than Georgia," said Victor, "only many of them are over there," and he pointed towards Western Armenia, still part of Turkey. "And those that are here are either in ruins or buried under the earth. It will require enormous labour to find, escavate and restore them."

"You're right," said his father, "Our ancient monuments are unique in their nature and significance. Take Ani, for example, a major centre of ancient culture, or Gegart, the Echmiadzin Cathedral, the Gayaneh and Ripsimeh nunneries, the fortress of Ambert. They contain the rich history of our people."

A few days later Amazasp and the children saw Mount Ararat and spent several memorable days in the capital of Soviet Armenia.

The Erivan (now Yerevan.–*Ed.*) of those days! A pale shadow of the present capital of Armenia. Yet those who knew the pre-revolutionary city were even then amazed at the speed of its renovation. There was still much that was unattractive, still many wattle and daub buildings that were the inheritance from the unhappy past, but each could see the past receding, being swept away by the will of the new masters of life.

After visiting the Ararat Valley, the great Russian writer Maxim Gorky wrote: "A grey-stone city against the backdrop of the gloomy mass of silvery Ararat, capped in reddish clouds–from a distance this city gave me the impression of a prisoner inside a cage of scaffolding, on which the ant-like figures of workers are moulding new buildings directly from the stone mass of the biblical mountain.

This impression was due to the fact that the construction work is being done on the outskirts of the city, and you see it through the scaffolding. Within the city there is less building work being done than first appears from a distance: Armenia is poor, has been crushed many times beneath the hooves of the enemy and ruined by that bestial fury and thirst for blood which is so skilfully aroused by the servants of the god of gold, whose name is the Yellow Devil.

"Yes, Armenia is poor, but already new houses are being built for the workers... Everywhere one can feel the bold hand of an intelligent master, and movement in the city has the air of movement on the eve of some great holiday."

"It is Alexander Tamanyan, a graduate of the St Petersburg Academy of Arts, who is constructing the new Yerevan. In ten to fifteen years the city will be unrecognisable: its beauty will rival that of the fairest capitals of the world," said Amazasp Ambartsumyan, pointing to the old houses which were already being pulled down. And then he stepped forward to greet friends who had hailed him loudly from a distance away. He had scarcely had time to motion to the children to say that he would soon be back before his friends had taken him away.

Their father was absent for some time, but the two brothers did not waste their time. They met a group of chess-players and joined in the game.

"We are invited to Avetik Isaakyan tomorrow evening. Derenik Demirchyan, Misho Manavelyan and some other well-known writers will be there. Do you hear, children?"

The next day they got ready for the journey, which in those days was considered a difficult one: they had to travel from Erivan to Basargechar.

The horses pulled the phaeton. The travellers passed through the outskirts of the city and felt the cool air of this clear, early morning. To the right gleamed the snow caps of Ararat. Around them was the green of alpine meadows on which horses and sheep were grazing. However, trees were sparse.

"Surely it wasn't always only stones, stones and grass?" asked the younger son.

"No, indeed," answered his father. "In former times this whole area was covered in luxuriant vegetation. Even now I can imagine this place as it used to be then, when our ancestors worked the land."

"Tell us about them, Papa," asked Levon. "It all began in a country that was called Tsakhkotn—a flourishing land. Isn't that so?"

"Yes, my son," Amazasp. "Tsakhkotn lay on the banks of the River Aratsani with its four tributaries which flowed into the River Euphrates. This land was well known to the rulers of Assyria and Babylon, Urartu, Media, Persia and haughty Rome. Here, in the deep ravines and the luxuriant valleys, and on the mighty shoulders of the huge mountain ranges, Ancient Armenia sometimes smiled towards the sun, or waged fierce battles against its accursed enemies. Alexander of Macedon once came here, to the banks of the Aratsani. He ordered a bridge to be built so that his troops could cross the river.

"Tsakhkotn was also known to the kings of Armenia. According to the historians, the royal family of the Arshakids had a military camp at the fortress of Angkh. From there they had a good view of Npat—the summit of an extinct volcano mentioned in the essays of Strabo and by ancient historians.

"The country of Tsakhkotn stretched as far as the slopes of Mount Ararat and was famous not only for its scenic beauty, but also for its gold, silver, copper and iron. In the centre stood the city of Diadin with its impregnable fortress and three-towered church. Here lived your ancestor, Ambartsum-aga.

"Ambartsum-aga was born at the threshold of the eighteenth century. Having become a merchant, he made several long journeys—to Baghdad, Aleppo, Istanbul, Teheran, Tabriz and other cities in Asia Minor. He then went to Jerusalem on a religious mission, which won him the title of 'mekhtesi', and from then on he was known as Mekhtesi Ambartsum-aga..."

At this point the father's story broke off. What had happened? Only a short while before they had stopped in the small township of Akhta. Everything was in order—the horses and the phaeton. Soon the puzzle was cleared up—the travellers saw Lake Sevan, which appeared to possess an unearthly beauty. In the distant murmur of the waves it seemed they could hear the voice of their remote ancestors.

Everyone was silent, bewitched by the majesty of the legendary lake, raised like a bowl of ceremonial greeting

two thousand metres towards the sky.

The phaeton drove on towards Basargechar.

Before their eyes the travellers saw dream-like scenes from the tale of their ancestors. In their imagination they followed the route of the migrating Diadins, helped Ambartsum-aga in his battle against the treacherous Hassan Pasha, and drove around Lake Sevan in search of that very Basargechar where they were now awaited by their numerous kinsfolk.

And who can say whether or not it is just such moments that create in the mind of the individual that warm sense of the deep roots which bind him to his native land and people.

The road ran alongside the lake, and the phaeton moved slowly. Rocked by it, the travellers drowsed.

Only the driver remained fully awake, his mind concentrated on practical matters. "The horses are tired... Let's hope we'll arrive soon!" And then he shouted cheerfully on seeing lights ahead:

"I can see Basargechar!"

The travellers were greeted by a large crowd of people. Their relatives asked what the young astronomer was doing, and how he fared in Leningrad. Then they asked him to give a lecture, should he have the time. Victor referred to various reasons why this was not possible, in particular, that he would be obliged to make use of complex formulae. However, the local people asked him to read his lecture in as simple a language as possible. Not long afterwards Victor delivered the lecture, and it was a success.

Victor was enjoying his holiday. He wrote to his mother:

"I was obliged to read a lecture here. It seems it was a success. I'm having a marvellous time. Every day I eat *matsoni**, a good dinner, etc... I'm in the room we always used to have (the study). All your letters arrive regularly, as they did in Erivan..."

Then he added:

"At the moment I am reading *Vorlesungen über Thermodynamik* by Planck. I have already read the first part and one chapter of the second part. This book by the renowned scientist is skilfully written and very interesting."

...Once again the scenery of Georgia and Azerbaijan

* *Matsoni*–a kind of yoghurt.–*Ed.*

can be seen through the coach window. The eyes are dazzled by the sunlight reflecting on the waves of the Caspian Sea. To the left rise the mountains of Daghestan. Ahead lies the steppe of the Northern Caucasus.

The train is speeding north, towards Leningrad. Little by little the impressions of the journey to his native Armenia, to Lake Sevan and Basargechar give way to thoughts of the immediate future—of the work that waits him at the Pulkovo Observatory and at Leningrad University.

The winter of 1925 passed in the familiar round of work and daily concerns. The speeches made round the New Year table were full of good wishes for the future scientist. Victor and Dmitry Ivanenko were then busy preparing a series of works on theoretical physics. Victor also had several interesting talks with Byelopolsky on research into the spectra of extra-galactic nebulae, and about the fact that, as a result of his observations, he had been the first to determine the magnitude of "quantum ageing." Although this hypothesis did not provide a correct explanation of the so-called "redshift", it stimulated important theoretical research. However, the "major event" of that period was the news that there was to be a conference of physicists in Odessa that was to be attended by foreign scientists.

At the Pulkovo Observatory and Leningrad University famous scientists from abroad were named, whom it would be possible to meet that summer in Odessa: Sommerfeld, Pauli, Jordan, Dirac and many others.

"Victor Amazaspovich, you are going to the conference in Odessa. You will have to decide on the topic you intend to speak on," he was reminded one day at the university.

"The theme has been chosen: 'The Quantisation of Space'."

"Well, well, a very fashionable topic!"

"Why 'fashionable'?"

"Because, as you know, the World Power Congress was held in Berlin, and Albert Einstein himself made a report."

Victor realised that he must prepare himself thoroughly. In his student years, the dispute with Milne had taken place indirectly, but here in Odessa he would meet scientists from abroad personally for the first time.

At the conference, the report on Ambartsumyan's work "The Quantisation of Space" was read by Matvei Bronstein,

who spoke with enthusiasm. In the lobbies people joked that he had made "a triumphal entry into quantum mechanics". However, Pauli then unexpectedly got up to speak. He asked whether Einstein's principle of invariance had been adhered to in this work. This blow struck deep. "No!" came the answer.

All that remained was the consolation of a trip along the Black Sea coast in the company of the foreign participants in the conference. This, too, was not without its significance. On board the motorship Ambartsumyan met Pauli and his assistant, Peierls.

"Colleague Ambartsumyan," said Pauli, "at the moment the position of quantum electrodynamics appears hopeless. However, in a conversation with Mr Tamm I said that just a few ideas are needed like those of the English mathematician Ursell and yours to make the study of quantum mechanics possible again."

Peierls was equally flattering in his comments about Ambartsumyan's study. He advised him to work on the question of the quantisation of space, and told him some of the latest news from the world of mathematics and astronomy abroad.

Tamm and Leontovich praised Ambartsumyan's work and the elegance of the theory he proposed, but agreed with the author that it could not be published in its present form.

Victor regretted that Sommerfeld was not there to take part in the discussion of his article on the quantisation of space.

"Yet what would that alter? The blow struck by Pauli was an accurate one. So, how shall I assess the result of my first meeting with foreign scientists? A defeat? A success? Or a draw? Most probably, a draw. What I need is success!"

The conference in Odessa and the trip on the Black Sea were now behind him. His thoughts turned once more to the Pulkovo Observatory and the university. However, the Pulkovo Observatory had become associated more and more in his mind with its branch in Simeiz.

That winter there had been a great deal of talk at Pulkovo about the observatory in Simeiz. Kostinsky had once told the young students how astronomy had made itself at home in that charming corner of South Crimea.

"There was probably no site near St Petersburg more

convenient for an observatory than Pulkovo," said Kostinsky. "However, astronomy strives to take its telescopes up onto heights where the air is purer and natural conditions allow more time for observations. That was why the idea of branches of the Pulkovo Observatory had arisen. The first branch appeared in Odessa at the end of last century, and in 1909 this had been transferred to Nikolayev in the Ukraine, where there was a small observatory belonging to the Navy."

"They say that the branch in Simeiz also has a history?" said one of the post-graduate students.

"Yes," agreed Kostinsky. "It is associated with the name of the honorary academician N. S. Maltsev. He was in love with astronomy. In 1900 he built a small tower on the Koshka Hill at a height of 350 metres above sea level, and ordered a six-inch telescope abroad. One of the founders of the Simeiz Observatory was Alexander Gansky, a young and talented astronomer who unfortunately died prematurely. In 1908, Maltsev presented his observatory, together with the land on which it stood, to Pulkovo. From the very beginning the Simeiz branch specialises in astrophysical observations."

"That suits us," remarked Kozyrev cheerfully. "Ambartsumyan and I must definitely go there. And no doubt the locality is very picturesque..."

At last they arrived in Simeiz and went up the Koshka Hill. On every side they could see steep cliffs overgrown with junipers and thorn bushes. The path led to the Maiden and Monk rocks. Here, at both sunrise and sunset, in calm and stormy weather, one can admire the sea. However, astronomers are interested in the sky. Here that sky is higher than at Pulkovo, although in winter the ferocious wind sometimes sweeps down from the Yaila mountain ridge, uprooting trees and tearing off roofs. Then the astronomers are obliged to leave the tower. But now it was August. A light breeze was blowing in from the sea and the sky was cloudless. They could rest in the shade of a cypress tree and ponder on their impressions of their first visit to the observatory.

This first visit had brought them some new acquaintances. The director of the observatory, Grigory Neuimin, was the man they knew only be hearsay. This was an acquaintance dictated by protocol, so to say. But then there was

Shain! That same Shain about whom they had read and heard so much!

Victor recalled many incidents connected with the name of Grigory Abramovich Shain and his wife, Pelageya Fyodorovna.

"The glass library... The Pelageya Minor planet... The discovery of the rotation of the stars... The catalogues of the radial velocities of the stars... His visits to English observatories and the optical mechanics plant at Newcastle... How had he introduced himself?"

Shain was introduced as a senior research worker at the Simeiz branch of the Main Astronomical Observatory at Pulkovo. It would have been more accurate to call him the "spirit of the Simeiz branch". It was he who had set up at the observatory the large reflector-telescope, its miror measuring one metre across, which had been ordered in England. And then, during the first night he used the new telescope, he had discovered a comet which had subsequently been named after him. What a happy coincidence!

And the discovery of the rotation of the stars? True, this was not a mere chance, but the result of long and persistent work. Astronomical periodicals had for three years now discussed this discovery as an event which has amazed not only the layman, but even experienced astronomers. An article with the striking title "From Galileo to Shain" had described how Galileo had noticed the rotation of the Sun when looking through a simple spyglass. He had noticed it thanks to the displacement of the spots on its surface. Shain had discovered the rotation of the stars. How? Even seen through a powerful telescope they appear merely as dots.

Shain wondered why it was that the spectral lines of some of the hot giant stars had noticeably broadened. What was the explanation? Perhaps these stars rotated? If one edge of this distant disc is moving away from the observer, and the other edge approaching him, then the spectral lines would be shifted simultaneously to the left and right. However, other factors might be the cause. That meant he had to find proof to support his idea of rotation that would show that the extended spectral lines were not the result of other factors.

Shain set about deducing theoretically the exact changes in the spectral lines which would result solely from rotation. He then went further and calculated the rotational velocity

of many stars. These velocities proved to be enormous: from one to three hundred kilometres per second. Soviet and foreign authors noted that the work done by Shain and Struve had provided material allowing fundamentally important conclusions to be made concerning the evolution of stars.

"And all this has been discovered here," thought Ambartsumyan, looking around at the territory of the observatory. "Here is the famous glass library!" This library had long been spoken of in astronomical circles. In Pulkovo it was well known that as early as 1927 Shain and Vladimir Albitsky had decided to compile catalogues of the radial velocities of stars. They also remembered that this work was begun by Byelopolsky. However, at Simeiz it had assumed a far greater scope. Several thousand spectrograms had been made, each requiring an exposure time of one hour. And the work that had been involved! They had to watch constantly to make sure that the star did not move away from the spectrograph slit. And that slit was only 0.05 of a millimetre wide. Each spectrogram was then studied under a blink-microscope. Just how laborious this work was can be judged by the fact that the microscope had to be reaimed up to two hundred and fifty times to measure the different spectral lines in one spectrogram.

The star catalogues were then published—a wonderful gift to world astronomy. Meanwhile the unique "glass library" at Simeiz continued to grow. For some time no one had even suspected the second great service to science this library was to afford. Ambartsumyan already realised that the material it contained was of the utmost value for astrophysicists.

As evening draws on, the colours of the sea change ever more noticeably. The result is a bewitching spectacle from which it is difficult to tear the eyes. Sunset brings with it a feeling of peace and contentment, or sometimes a light melancholy and nostalgia.

Ambartsumyan decided that the next day he must try to get to know Pelageya Fyodorovna Shain better. She, too, was an astronomer. He had heard a great deal about her at the recent conference of astronomers in Kharkov. Neuimin had said that during her first years at Simeiz she had discovered twenty-three new minor planets. Couldn't Neuimin think up the story about the Pelageya planet? One could imagine how surprised some astronomers had been to

find, in an international catalogue of minor planets, the name of a Russian woman among the names of Greek and Roman gods and goddesses. Pelageya Fyodorovna herself had given Russian names to the planets she had discovered—Katya, Natasha, etc. And there was a girl called Vera, who lived in her family.

"Why," thought Ambartsumyan, "do both mother and daughter have the same patronymic? Why is the daughter's patronymic not 'Grigoryevna', as Shain's name is Grigory?" Sometimes life confronts the astronomer with enigmas no less intriguing than those of science.

Quite some time passed before Ambartsumyan received the answer to this question. It turned out that Vera was not the daughter of Pelageya Fyodorovna. She was born in the Urals and had lived in a village until she was eleven years old. When her mother died, her father had married again, and life had not been pleasant for little Vera. Her mother's sister, Pelageya—Shain's wife—had taken the girl to Leningrad to live with her. She loved her little niece, and did all she could to encourage her to study and to introduce her to the world of culture. After finishing school, Vera had gone on to study at an institute, she wanted to become a geologist.

Later, while still a student in her second year, Vera married Victor Ambartsumyan, and this put a stop to her "geological career". However, she then graduated from a foreign language advanced course and became teacher of English.

Meanwhile Victor's father read and reread a letter from his son and wondered what was the matter with him: Victor had written: "Life goes on as usual. Nothing out of the ordinary has happened... My work in astrophysics isn't making much headway. One reason is that I don't seem to be in the mood, and another is that I am not fully convinced of the physical interpretation of the results I have obtained. I hope I'll soon feel a bit more cheerful."

"A bit more cheerful...," thought his father. "And what was the cause of this depression?" He put the letter aside and then, after thinking things over for a while, said outloud: "At twenty-two he has already published scientific works, but he is still young, still green..." And he took up the letter again: "Kozyrev's family have left for Luga, and Kozyrev is trying to persuade me to go with him to the

Ussuri territory, saying that only a long journey will be able to bolster my spirits and raise my work productivity..."

"What's happened?" his father asked himself. "He never needed to boost his spirits before. Just a minute! I think I know the answer! Victor has fallen in love. That must be it!"

A few months later, in Leningrad, Victor's father was reading a letter his son had sent him from Simeiz. "We're having a wonderful time here, and relaxing a good deal. There is no fruit, but there are plenty of vegetables and we are consuming them in large quantities.

"Yesterday Vera and I weighed ourselves and discovered we had put on about one and a half kilos. Vera is always busy in the kitchen and she cooks delicious meals. Everyone is full of praise for them. She also breaks the hapless crockery, and has even managed to break the glass in the doors to the tower with the large reflector."

Not long after this Victor and Vera married.

"The only thing is, Victor doesn't seem to be publishing anything this year," sighed his father. And then he began to remember: "In 1929 he published five works, one of which was written with Kozyrev—'Comments on the Work of V. A. Kostitsyn *On the Question of the Radiative Equilibrium of Stellar Atmospheres*'. Then came his own independent works: 'On Methods of Determining the Numbers of Various Atoms in Stellar Atmospheres' ... Let me look at my notes. Yes! 'On One Question of the Theory of Eigenvalues' and 'On the Linear Geometry of Functional Space'.

"And last year there were three publications, all prepared together with Ivanenko: 'A Comment on the Single Field Theory from the Viewpoint of the Quantum Theory', 'On One Consequence of Dirac's Theory of Protons and Electrons' and ... something in a foreign language. But so far this year there has been nothing."

Amazasp Ambartsumyan pondered a while, but gradually his face brightened: "After all, Victor finished his post-graduate studies this year, and that is a weighty reason. He also got married, and that's another important reason."

The 1930s saw the substantiation of the modern theory of the atom. The young physicist Igor Kurchatov, later to win world renown, began his research into nuclear physics. Active research was also under way in other Soviet institutes and laboratories. It was well known that ques-

tions relating to the atom were being studied by scientists abroad. In Victor's chosen field of science, the "atomic course" being followed in scientific research paved the way for a rapid development of the still young theoretical astrophysics.

Ambartsumyan, then a research worker and lecturer at Leningrad University, conducted his research precisely in this area. This was an unerring choice. Developments in this field of science were to show that concentration on purely mathematical problems led in the end to work stripped of any physical meaning, even in studies by the most gifted of foreign scientists.

Ambartsumyan began his work at Leningrad University by founding a chair of astrophysics, thereby continuing the work of one of his teachers—Gavriil Tikhov. His works in astrophysics and stellar astronomy made Ambartsumyan the first Soviet theoretical astrophysicist and brought him world renown. In 1935 he became a D.Sc. (Physics and Mathematics).

The university Academic Council had the following to say:

"Of the many scientific works published by our esteemed colleague Ambartsumyan, we are all familiar with 'On the Radiative Equilibrium of Planetary Nebulae', which came out in 1932. This work was of an epoch-making significance for the history of the physics of gaseous nebulae."

This fundamental work by Ambartsumyan, the first in a series of works dealing with the physics of gaseous nebulae, attracted the interest of scientists abroad and at home. Numerous questions were asked about the new theory, and it became necessary to popularise it. The USSR Academy of Sciences made the following statement:

"A correct interpretation of nebular luminosity was first provided by Rosseland and Zanstra, the famous astrophysicists. However, only Ambartsumyan has been able to provide a precise mathematical substantiation of the accompanying processes. He has explained the important role played by light pressure in nebulae. It turns out, however paradoxical this might appear at first glance, that in some parts of the nebulae light pressure operates in the direction of the star. Ambartsumyan also investigated conditions in which it is possible for the so-called 'forbidden' lines to appear in the spectra of the nebulae. These lines are never

observed in the spectra of terrestrial light sources. The presence of certain spectral lines makes it possible to determine the physical conditions prevailing in the object under investigation."

Later only the most perceptive and sagacious minds will appreciate the discoveries whose significance was not noted by the majority of scientists. Ambartsumyan's works in 1930s might be compared to a series of lightning flashes. They attracted the attention of many scientists, particularly those who were interested in stellar dynamics and the internal structure of stars.

Shortly after that the famous astronomer Subrahmanyan Chandrasekhar, an Indian by birth, visited Leningrad. He always displayed an interest in new ideas by Soviet scientists, and Ambartsumyan's "radiative equilibrium" most definitely interested him.

Getting slightly ahead of the story, it is worth pointing out that many years later, in 1983, Chandrasekhar would be awarded a Nobel Prize for his work in physics (research into the evolution of stars). He deduced the mathematical formulae for the collapse of giant stars. His work gave rise to the conception of neutron stars and the so-called black holes. Chandrasekhar was born in 1910 in Lahore, and in 1936 he defended his doctor's thesis at Cambridge University.

Ambartsumyan had long since heard of his colleague and was glad of this opportunity to make his acquaintance. They met and talked in 1935 and discovered that both were interested in the same questions. The conversation touched upon their methods of research.

"In theoretical astrophysics there are two methods, two ways of doing things," remarked Ambartsumyan. "The first is to observe and then ponder on the results of these observations, and only afterwards deduce formulae; the second method consists solely in deducing mathematical formulae. We call the second method 'formalism', and it is alien to us. Nature cannot be put in the stocks of purely mathematical formulae."

"But I am, above all, a mathematician!" said Chandrasekhar, defending the second method.

Two years later Chandrasekhar left for Chicago and is now working in the USA. His visit to Leningrad had consequences that are of interest to us. To put it briefly, Chan-

drasekhar more than once discovered that he and Ambartsumyan were engaged in the study of the same scientific problems. Why, then, did they obtain different results? Chandrasekhar plunged into the world of equations, integrals and highly complex calculations. Soaring in the heights of pure mathematics, he finally lost his way in the problems of physics.

Many years later, when Ambartsumyan was sorting congratulatory letters from many countries, he came across a letter from Chandrasekhar congratulating him on his brilliant solution of a mathematical problem over which prominent scientists such as Schwarzschild, Lindblad and others, had been racking their brains for more than fifty years. However, on this occasion, too, Chandrasekhar failed to appreciate the physical significance of the work done by Ambartsumyan, its practical importance particularly at the time of the struggle against Nazi Germany. Yet it was precisely this aspect of the service rendered by Ambartsumyan that was taken into consideration when, in 1946, he was awarded a USSR State Prize.

"Once, Victor, when you were a student, you received telegrammes in which you were jokingly referred to as the 'professor'. Now you are indeed a professor, and head of the university chair of astrophysics. You are working at the Pulkovo Observatory," said his father, "and you have a family of your own. You have given me a granddaughter, Karineh. I would like to feel happy, yet my heart is heavy..."

"Papa, we are all oppressed by grief, but you must calm yourself. One cannot go on suffering endlessly."

The whole family was grief-stricken at the death of Levon. They had begun to worry about him as soon as he had left for Soviet Central Asia in May 1933 as the head of one of the groups in the Temir expedition. That September they had received a telegramme: "Levon Amazaspovich is seriously ill. Come at once." That same day their father left Leningrad. For three days he had not closed his eyes: how long would it be before they reached the Dzhurun railway station? How slowly the train seemed to travel! As soon as they arrived, Amazasp Ambartsumyan rushed to the nearest telephone to contact the head of the Embaneft geological prospecting office in Temir. It was then

that the blow fell.

"Would you please put me through to the local hospital?"

"The hospital has no telephone."

"Then put me through to the geological prospecting office."

"Their line is out of order."

"Perhaps you can tell me the condition of Ambartsumyan, the chief of one of the geological prospecting parties?"

"Ambartsumyan? He was buried three days ago."

Amazasp Ambartsumyan hurried to Temir. Fyodorov, the Party group organiser of the expedition, said:

"A man cannot always conquer death. We did all we could. We sent for a doctor from Aktyubinsk. Levon Ambartsumyan died three days ago, and we sent a telegramme informing you of the date of the funeral."

Amazasp looked at the room where his son had lived, and then went to his grave. The next morning he declared that he wished to look at the body of his son, and he managed to obtain permission for the grave to be opened.

"I did not concern myself enough about Levon, about his education, his future. I concentrated all my efforts on bringing up Victor, on developing his abilities. He is worthy of it. But I should have thought more about Levon."

And Amazasp's heart was unbearably heavy.

"I will take Levon back with me and have him buried in Leningrad," he decided.

The funeral took place on October 3. The children tried to comfort their parents. Victor had to leave Leningrad at that time, but he wrote to his parents almost every day. "I hope you are all well. Watch over each other so that our sorrow should not bring further griefs."

The death of those who are particularly close by blood or in spirit causes bitter pain. Then, while the wound has not healed, it is sensitive to the slightest touch. However, there is one positive aspect to this. It is as if someone had suddenly caught you by the sleeve, dragged you out of the tumultuous stream of life and said: "Stop! Think! A man who walked beside you, whom you could feel beside you, is no more. His burden is now on your shoulders." And the one thus addressed looks back over the road he has travelled and becomes more experienced in life.

Victor recalled the Englishman Edward Milne. Only several days previously there had been a conversation at the university that must be taken up anew. "To be taken up anew, by all means! I musn't forget!"

That conversation went as follows:

"Have you heard, Victor Amazaspovich, how your old 'friend' Edward Milne discussed the age of the Universe with his colleagues."

"No."

"Look here! From the post we have just received from abroad."

An English journal said that the Royal Astronomical Society had just held a conference in London. It has been attended by prominent figures from the astronomical world—Sir Arthur Eddington, James Jeans, Edward Milne. The Eddington's supporters and followers affirm that the Universe cannot be visualised; its properties can only be described in mathematical terms, for neither time nor space exist in reality, but are merely the forms of our intuitive perceptions. These philosophical views underlay Jeans' cosmogonic theory, imbued with belief in the "Great Architect of the World".

The famous English scientist James Hopwood Jeans, who lived a long life, was for many years the President of the Royal Astronomical Society, the leader of the so-called Cambridge School of physical idealism.

During the conference there was an exchange of views regarding the age of the Universe, and the respectable scientists came to a general conclusion: that moment at which the Universe was the most densely compressed in space should be considered "the beginning of all things". A difference of opinion emerged on one point: to adopt a "short" or a "long" scale in determining the age of the Universe: Eddington and Milne proposed an age of two billion years, while Jeans proposed an age of a thousand billion years or even tens of thousand of billions of years.

"Have you noticed, Victor Amazaspovich, how they refer to God?"

"Of course, they are afraid to do this openly but hide behind various terms: either the 'beginning of all things', or 'the natural zero-point in the time-scale'." "We are going to have to clash with them over this," thought Ambartsumyan.

Ambartsumyan had been following his ideological opponents in the field of astronomy for several years. He had long been thinking of making a statement, but for the moment he had to concentrate his forces. Although, following the conclusion of his post-graduate studies, he had published twenty scientific works, including the first part of the Pulkovo *Course in Astrophysics and Stellar Astronomy* with his chapter on certain information from the field of theoretical physics, he still had to complete a chapter for the second part—"Stellar Atmospheres". He and Kozyrev had to complete their work of evaluating the masses of the envelopes thrown out by new stars. Many other problems also awaited solution. In addition, there were his lectures, his work as the head of the astrophysics department, and constant university concerns.

Mentally, Ambartsumyan was once again surveying the astronomical front. "If it is still too early to engage in battle on the cardinal question, nonetheless battle can be waged in individual sectors, if only against the apologists of 'pure mathematics'."

He recalled the statement by James Jeans that today we can understand the Universe only if we think of it as the creation of a pure mathematician operating in the terms of pure thought. It becomes a pure paradox if an attempt is made to picture it in terms of a mechanical model.

"Of course, there are also very talented mathematicians among them," thought Ambartsumyan. He remembered the seminar in Kharkov in the summer of 1930, which had been attended by the young English mathematician, Ursell. He is amazingly gifted in mathematics. One extremely difficult problem he had solved on the day of his arrival, without even sitting down to tackle it; he had walked around his room, gone out and walked around the city, and had solved it! A pity that so many mathematicians-idealists proceed from mathematics to natural phenomena and life, and not from life to mathematics."

His thoughts, having completed a large circle, returned to tragic events. The death of his brother was his first loss among those closest to him. The second such loss was the death of Professor Byelopolsky. Both losses were hard to bear. But what could be done? While we live, we must busy ourselves with life.

CHAPTER FOUR

The Difficult Years

Two people were walking down the avenue that ran through Rumyantsev's Garden next to the Academy of the Arts in Leningrad. Together their ages added up to sixty years. She was three years old, he was fifty-seven. The granddaughter was talking with her grandfather. And few would have suspected the important consequences that could follow from this chat with a child.

How difficult it is to tell a child that "not everybody is as he or she should be", that "there are also bad people", why "not everyone is alike". The grandfather pondered for quite some time on how to explain this to his granddaughter.

"Listen, Karineh, we all wear clothes, but those clothes are different if only because men do not wear the same clothes as women, and children don't wear the same clothes as adults. Some people like one colour, some people like another. And that's a good thing. It would be boring if everyone wore a pink dress like yours. Or, for example..."

Grandfather made another attempt to explain the complicated using simple examples.

"For example, your daddy has a fine gold watch which your grandfather bought him. Your daddy likes it. But that watch would not do for your mummy or you because women wear a different kind of watch."

"Don't you know that daddy doesn't have that watch?"

Her grandfather looked at her in surprise.

"Daddy had the watch, but then it suddenly disappeared."

"You know, Karineh, I can't imagine how such a rare watch might disappear. And I was so happy when I found that watch as a present for your daddy."

"But it's a secret, Granddad. I told you because you're nice and I like you. And daddy said that I was not to tell you because it would upset you. Are you upset?"

The two walked along in silence. The granddaughter

looked at the sad face of her grandfather and said:

"Is it true, Granddad, that one can live without a watch?"

"Yes, it's true, Karineh."

Karineh was already asleep when Victor returned home late that evening... His father was waiting for him, and while they were having supper he asked, as if by the way: "Victor, what time is it? I want to check the clock against your watch."

Flushing, his son answered: "Papa, I lost the watch in Batumi, on the beach."

"He's as embarrassed as he was in his childhood," thought his father. And then other thoughts began to pass through his mind: "Only recently Oleg Melnikov told us how the young people, post-graduate students, lived and amused themselves in Pulkovo: they went skiing and skating, made up various stories and poems about Pulkovo, joked and invented puns. Yet at the same time they were also engaged in serious research. Well, it is a good thing that the joys and sorrows of life are accessible to him. Better for him to be a versatile personality and not a dry scholar." Victor himself, when with his friends, liked to recall the Pulkovo hill or Chukhryaevka hill, the summer spent at their country-house, picking up mushrooms and berries, swimming... It was there, at that summer house, that interesting ideas were conceived about the Wolf-Rayet or γ Cassiopea stars and others, articles on which then appeared in the journal *The Nature* in Britain, in *Astronomische Nachrichten* in Germany. Yet Ripsimeh and Goar were right—he didn't relax enough.

The clock on the wall chimed the hour. That same clock the accuracy of which he had been unable to check. "Two o'clock in the morning," thought his father. "And his light is still on. Working. Made some brief reference to a difference of opinion with some Englishman."

That "some Englishman" had been in Ambartsumyan's mind for several years already. It was James Hopwood Jeans. Jeans was of the opinion that all the stars had been formed out of a gaseous nebula thousands of billions of years ago. He called this hypothetical gaseous nebula the "primal chaos". According to Jeans, our Galaxy, having begun to condense in the form of a gigántic cloud, emerged from some primeval nebula as the result of some accidental kick. This cloud then, according to this hypothesis, gradu-

ally changed form, from the spherical to the elliptical, and then assumed a lentil shape. The nebula condensed further, and where matter was most compressed, stars were born which then moved away from the centre. The solar system, according to Jeans, arose as the result of the passage close to the Sun of some other star which then broke up into clots that eventually condensed to form planets. The Universe, having thus emerged from a "primal chaos", will finally end due to the "heat death".

The invalidity of Jean's theory on the origins of the solar system, and his cosmogonic theory was later proved by progressive scientists. Particularly convincing arguments were put forward by the Soviet astronomers N. N. Pariisky and N. F. Rein. Nonetheless, Jeans' hypothesis continued to exist, and the supporters of "physical idealism" sought to infuse it with fresh life.

The scientific dispute between Ambartsumyan and Jeans lasted from 1935 to 1937. It concerned the upper limit of the duration (life-span) of the present state of our Galaxy. In his statistical work on binary stars and open star clusters, Ambartsumyan achieved an important result. He proved that the age of our Galaxy is thousands of times less than had been previously thought, thousands of times less than Jeans had thought and tried to show. Ambartsumyan also showed that Jeans' erroneous conclusion was the result of an incorrect interpretation of the experimental data. These conclusions were later confirmed by further research and were recognized by the scientific world.

In the heat of this controversy, some of those following the scientific dispute among the astronomers would ask:

"What will be the result of this battle?"

"The battle will end in for Ambartsumyan's victory," his friends would reply with conviction. "But that is not what bothers Victor Ambartsumyan at the moment. He is engaged in work which promises amazing results."

"What work? On a new statistical mechanics for stellar systems?"

"He is studying the structure and physical properties of inter-stellar absorptive matter. When this phenomenon was discovered, astronomers faced, as you know, a new problem: they had to study the properties of inter-stellar matter because its absorption of star light results in signif-

icant changes in the observed brightness of stars and makes the study of the structure of the Galaxy far more complex."

"Has anything been discovered yet?"

"He's working with Sh. G. Gordeladze. They have already succeeded in investigating a link between diffuse dust nebulae and the stars that illuminate them. Calculations have shown that only a small part of the dust nebulae is illuminated. The phenomenon of light absorption in the Galaxy is evidently caused by the presence within it of numerous dust nebulae. Ambartsumyan is avoiding any hasty assessments and conclusions, but is tirelessly rechecking and analysing. He summarises his findings, and then looks again at the observational data. That is what he is working on at the moment."

The clock on the wall chimed three. The light was still burning in Victor's room. On his table lay a copy of the *Uchyonye zapiski* (Academic Notes) published by Leningrad University, which contained his article entitled "Cosmogony and Modern Astrophysics", a copy of the *Astronomical Journal* with his article "On the Statistics of Binary Stars". On the left was an opened volume of *Collected Works* by Marx and Engels. The volume lay open at the page where Engels had written that in the eighteenth century the cosmogonic ideas of Kant and Laplace had made a breach in the "petrified view of nature" based on belief in the divine act of creation. "And what," Victor asked himself, "happened next?" Then, answering his own question, he concluded: "Some bourgeois scientists of the twentieth century have not only failed to advance beyond hypotheses of Kant and Laplace, progressive for their time, but have, in effect, regressed to those naive religious ideas which were destroyed by the progressive thinkers of the eighteenth and nineteenth centuries. Of course, their number includes very talented men who have made major discoveries. However, taking science as a whole, the generalisation of the discoveries and data it has accumulated..."

Victor saw in his imagination the faces of those familiar from their portraits, and recalled names and events. In his mind's eye he saw Gustav Robert Kirchhoff—a stiff, thin figure, an irreproachable black suit, a monotonous voice. This was a man who had entered the annals of science by his discovery of fundamental physical laws. He was the founder of spectral analysis, one of the powerful means we

possess to explore and understand the Universe. It would seem that such a man should be a model scientist-innovator. Yet he had become an opponent of all that is new in science. Each new hypothesis appeared to him to be still-born. Kirchhoff had created for himself a complete, finished picture of the world, and believed that new research only undermined the foundations of science. There was the well-known incident when Kirchhoff, having heard of a certain important discovery, had enquired: "Is there really anything left to discover?"

It was said that his hatred for everything new was such that he even concealed his own discoveries if they went against his initial conceptions, although this often made Kirchhoff suffer himself. Alright, Kirchhoff was a man of the nineteenth century. And today?

Today James Jeans supports the idea of "annihilation", that is, the destruction of matter, a process supposedly occurring within stars. He asserts that "the conversion of mass into energy is encountered everywhere, but the reverse process is encountered nowhere". Thus matter, declares Jeans, cannot emerge out of energy, and destroyed atoms cannot be restored. Therefore the "mechanism" of the Universe is constantly breaking, and its reconstruction is impossible.

Ambartsumyan fell to thinking again. Then, having stretched to chase away approaching sleep, he picked up an exercise-book on whose oil-cloth cover were written two words in large letters: "Philosophy" and, below that, "Synopses". Having carefully smoothed out the clean first page of the exercise-book, Ambartsumyan began to write:

"The theoretical generalisation of new scientific data on the basis of Marxist-Leninist philosophy is essential not only for researchers in the natural sciences, but also for materialist philosophy itself.

"A particular relevance is acquired today by the words of Lenin, who said that without a solid philosophical substantiation no natural science, no materialism, can withstand the struggle against the pressure of bourgeois ideas and the bourgeois world outlook. In order to withstand this struggle and carry it through to a successful conclusion, said Lenin, the natural scientist must be a modern materialist, a conscious supporter of that materialism which was so brilliantly set forth in the works of the founders

of scientific communism."

The next morning Victor's father said to his wife and daughter:

"Our Victor seems to have taken up philosophy of late."

"Can't you guess, Papa, why?"

"Perhaps I can't."

"And perhaps you can?"

"Perhaps. Listen—the clock has just chimed eight. I have to go to work. We'll have another opportunity to continue this conversation, Goar."

Less than a month passed and what father and daughter had thought proved to be correct. Goar announced:

"Do you know, Papa, that Victor has become a member of the Party!"

"Well, well. He said last year that he had decided to join the Communist Party. In our age, politics is breaking down all barriers and surging into every area—into the mind of the scientist, the imagination of the poet, the thoughts of the artists."

These were anxious years. The Second World War was approaching. However, in the quiet of the towers and studies of the observatory, they continued to argue about inter-stellar space.

Ambartsumyan and Gordeladze stubbornly continued their research. Their families and friends became more and more interested in the results of these investigations. Victor several times promised to "initiate the uninitiated", but he never found the time. One day Victor Sobolev, one of the first pupils and friends of Victor, came to the Ambartsumyans.

"Victor Victorovich," Goar addressed Sobolev. "Could you explain to us in simple terms what Victor and Gordeladze are doing?"

"With pleasure. Until only recently, it seemed that we understood a great deal about the structure of the Galaxy. It was believed that the Galaxy was disc-shaped, and even the dimensions of that disc had been determined. But in 1931, Trumpler made an important discovery. He discovered the absorption of light within the Galaxy. As a result of this phenomenon, the stars appear farther away than they actually are. Earlier estimates of the size of our Galaxy were greatly exaggerated. In addition, certain dark

nebulae have been discovered which cause a considerable reduction in stellar luminosity in certain directions. As a result, determining the structure of the Galaxy has become much more complex. I hope I have made it clear?"

"Yes, thank you."

"Well, Victor Amazaspovich and Gordeladze have, by their research, lifted a corner of the veil over the mysteries of the Galaxy. Ambartsumyan has established that the bright diffuse nebulae, which can be observed in the Galaxy alongside the dark ones, are only accidentally connected to the stars that illuminate them. In actual fact, these objects are exactly the same as the dark nebulae. They appear bright only because they are near hot stars.

"According to calculations made by Victor Amazaspovich, there are two thousand times as many dark nebulae as the bright ones. An estimation of the number of dark nebulae has led to the conclusion that their presence in the Galaxy may fully explain the newly-discovered phenomenon of light absorption. Thus, the hypothesis that there exists permanent absorbing matter, formulated immediately after Trumpler's discovery, has now been overturned. This new point of view immediately received general recognition, and the astronomers faced a new problem: to investigate in detail all the properties of dark nebulae, in particular their number in a unit of volume, their dimensions and the degree to which they absorb light. Is that also clear?"

"Clear. Go on."

"Victor Amazaspovich has developed extremely sophisticated techniques based on the calculation of fluctuations, that is, divergences from the average luminosity values of the Milky Way and fluctuations in the observed quantities of extra-galactic nebulae. It would be no exaggeration to say that the development of these techniques constitutes a new chapter in stellar astronomy."

"Thank you, Victor Victorovich. Call and see us more often. We promise not to exploit you every time the way we have today."

"I will. Very soon perhaps. I can already foresee the occasion."

Such an occasion indeed soon presented itself. In fact, not just one, but two. In 1939, the USSR Academy of Sciences elected Victor Ambartsumyan as a corresponding

member, and Leningrad University put him in charge of the university observatory.

Far away in the West there appeared the first flashes of the Second World War. The peoples of Belgium, the Netherlands, Denmark and Norway were already groaning under Nazism. In enslaved Austria, Czechoslovakia and Poland, Hitler's "Neue Ordnung" was being brutally imposed. Every day the news evoked more anxiety.

In the quiet of the towers, at the telescopes, their inquisitive eyes gazing into the expanses of the Universe, Soviet astronomers hoped that the skies over their country would remain peaceful. However, news from the European fronts, appearing in the press, kept increasing their anxiety.

The newspapers set aside, they returned to their daily affairs: disappointments and sorrows, successes and festivities. At the end of December 1939, the Ambartsumyans had cause for rejoicing:

"Well, Ripsimeh," said Amazasp Ambartsumyan, "we now have four grandchildren—Victor's three children, and the one just given to us by Goar; and although Saadi said: 'If you acquire the whole Universe, do not rejoice, for it is nothing', I, having acquired a fourth grandson, rejoice."

At the beginning of 1941 Victor became the pro-rector of Leningrad University in charge of scientific affairs. This appointment worried his father.

"You will be occupied with administrative matters and have less time for astronomy," he said to his son. "And what is more, you won't even be of use in your new post, however much you might like to be. You're very trusting. What if there are those who will make use of your trust and favour for their own selfish ends?"

The son did not wish to contradict his father, but he could not agree with him either.

"You are wrong, Papa," answered Victor. "Yes, I am trusting, but that does not prevent me from understanding my fellowmen. As for the duties of the pro-rector, I think I can cope with them. I will be in charge only of scientific affairs. If it proves to be too much for me, I will resign. So don't get upset and don't worry. We'll see what we'll see."

Time seemed to hasten to provide that answer. On June 22, 1941, the radio broadcast the news of Nazi Germany's treacherous attack on the Soviet Union. The country was at war.

"I'm going to the district military enlistment office without waiting to be called up," said Victor resolutely. "I'll request to be sent to the fighting front. And you take care of the children. Take them to our country-house and stay with them there."

"I think," objected his father, "that you are acting wrongly. What will it look like? Don't forget that you are a corresponding member of the Academy of Sciences, and a professor at Leningrad University. Should such people as you be mobilised?"

"No, I cannot agree with you, Papa! One's duty to one's country comes first."

Amazasp Ambartsumyan gazed fixedly at his son.

"I can only admire your patriotism. But what will a man like you, a thinker and not a soldier, do in the army?"

However, the father's arguments were unable to influence the son. National tradition made itself felt; just as Artavazd before him, now Victor also showed that he was not just a scientist, but, first and foremost, a patriot. His country had once again been attacked by the enemy, and he must take his place in the ranks of its defenders.

The following day, at nine o'clock in the morning, Professor Ambartsumyan appeared in the office of the district military commissar. The military commissar had had many difficult questions to decide over the last day, but none like this. Persuasion was of no use. The military commissar gave way to Ambartsumyan's insistence, and sent him to one of the military units being formed just outside Leningrad.

Shortly afterwards Sobolev and Rusakov, Ambartsumyan's post-graduate students, were called up. They sent him a letter:

"Dear and respected Victor Amazaspovich, you are now serving in the fighting army, and we, your students, want to be with you in order to help you carry out any tasks which the Red Army command may give you. If our wish is appropriate and feasible, please send for us through the corresponding military registration and enlistment office."

Victor Ambartsumyan began to think: which military enlistment offices, and what should he write? However, at that moment fate made an unexpected turn of events. Who could tell at that time where he would be called upon to serve—in science or in the army?

Private Ambartsumyan differed in no way from his fellows. Once, however, a soldier who had a bunk next to him noticed a photograph in the *Leningradskaya Pravda*: "Who's that?" he asked himself. "Looks a bit like our Victor." He was surprised on reading the caption beneath: "Outstanding scientist and well-known astronomer, Victor Ambartsumyan." "It's him. No doubt about it—it's him!" The soldier went to a general and told him about his "discovery", and the general informed the Academy of Sciences of Ambartsumyan's whereabouts. Then it was suggested that he take off his soldier's uniform and leave as an evacuee for Elabuga.

In a small room in a totally unremarkable house a partitioned box stood on the table. It contained negatives and also milky-white, mat glass plates. Now, however, the box was not in the study of the director of the university observatory, but in a house in the small town of Elabuga. It had been brought here by the current of events of 1941.

As soon as the news of the outbreak of war became known, Ambartsumyan had immediately recalled the partitioned box. He had thought about that box, and the scientific conclusions connected with this experiment, quite frequently over recent weeks. In order to pursue his plans in this respect he wanted to call immediately for his postgraduate students, Sobolev and Rusakov. When he himself was suddenly demobilised, he returned to his research at once. However, that research had to be interrupted. At a brief meeting at the rector's office they had asked him:

"How can astronomy help the Red Army now?" Ambartsumyan thought: "Eight times a day astronomers broadcast signals giving the exact time. This helps aircraft navigators and pilots in blind flying, and all those who need to know their coordinates precisely. Astronomers have solved the enigma of the sudden interruption of radio communications, which are essential to the army and navy. What else?"

The astronomer's face lit up in a smile: his work with the partitioned box, his research into the diffusion of light in turbid media, might be of considerable importance for defence. That meant that he must complete this work as quickly as possible! Scientific material with abstruse titles

appeared on the table: "The Diffusion and Absorption of Light in Planetary Atmospheres", "On the Diffusion of Light by Planetary Atmospheres", "On the Diffusive Reflection of Light by a Turbid Medium", "A New Method of Calculating the Diffusion of Light in a Turbid Medium"...

It became easier to listen to the reports of the Soviet Information Bureau, knowing that his scientific work was helping the troops to achieve victory at Stalingrad, Kursk, and at sea. It became easier to bear personal sorrows and the difficulties of evacuation.

In the autumn of 1942 his daughter Karineh fell seriously ill. At first they thought it was a slight cold. Then her temperature reached a critical level, and the patient was delirious for two days. They had terrible difficulties obtaining medicine, the sulfanilamide that was still so rare in those days. Then, when Karineh started to recover, she had to keep to a strict diet. Ripsimeh Saakovna threw her arms up in exasperation: "We could get anything, but you know how scrupulous our Victor is." Grandfather frowned and then set off courageously in the autumn mud for the villages of Lekarevo, Tanaika and Maltsevo.

The thought of his sick daughter, of his father walking through the mud with his heavy bundle of provisions naturally worried the astronomer, but he concentrated his efforts and his will on continuing his research.

"Comrade Ambartsumyan, you have been appointed the head of the branch of Leningrad State University in the town of Elabuga, in the Tatar ASSR. All the staff, their families, equipment and property must be evacuated there immediately. You have an entire train—twenty-four freight carriages—at your disposal. You are in charge of the train."

"It's a good thing Sobolev is going with us," thought Ambartsumyan, having completed his inspection of the carriages prior to their departure on July 18. "A pity he has so much worry on his mind: his mother is in a Nazi-occupied area and his sister is in Leningrad."

Three days later, in Moscow, on a siding at the Kazansky Railway Station, all the passengers aboard the train strained their eyes towards the starry night sky. Flashes frequently lit up the darkness: the anti-aircraft gunners were driving away from the capital the airborne pirates with swastikas

on their wings. Sometimes the individual bursts of gun-fire merged into a furious cannonade. A command was passed along down the carriages:

"Everyone is to leave the train immediately and take shelter in nearby houses."

The man in charge, however, stayed with the train.

The roar of the anti-aircraft guns, the crying of children in the unfamiliar surroundings, the heated discussions with station managers, the need to provide the passengers with food, and the painfully slow journey to Elabuga—all these finally came to an end. Ahead lay a whole host of problems connected with setting up the branch of the university here in this small town. However, that was easier. At least here there were no anti-aircraft guns. And occasionally there was even time for him to sit at the table on which stood the partitioned box. If he altered the order of the glass plates in the two sections, strange transformations occurred. The mat, milky glass plates and negatives diffused and weakened the light according to various physical laws, and the degree of illumination depended on the order in which they were placed.

Sometimes even his closest assistants, Sobolev and Kovalyov, did not venture to disturb him. During the time spent in evacuation, these two became close friends of the Ambartsumyan family. Victor Sobolev enjoyed the privileges of an old acquaintance. He was welcomed on arrival, his arguments—original and profound—were listened to with great interest, his keen but tactful humour was appreciated. Maxim Kovalyov was liked for his kindness and cheerfulness, and as a man always ready to help in a moment of difficulty.

One day the father, noting that his son was entirely absorbed by his latest scientific work, turned to Sobolev and Kovalyov:

"Why is he so interested in the diffusion of light in turbid media? Is it something new?"

"No, it isn't," answered Sobolev. "The theory of the dispersion of light is an old theory. Originally it was developed for gaseous nebulae and the gaseous envelopes of stars, and many scientists dealt with it. They reduced it to a complex integral equation which was resolved by the method of successive approximations. As a result, only

an approximate solution of this equation was arrived at, and, moreover, in a rather clumsy form. Victor has adopted a quite different approach to this problem. As a result of major research work he has created an extremely effective method convenient for practical application."

"Where?"

"For example, in resolving the problem of visibility in the Earth's atmosphere or under water."

"And is that important now, in wartime?"

Victor's father received the answer to his question several years later, when the newspapers printed the decision on awarding State Prizes for 1946 in the field of science and technology. The list of prize-winners included the name of his son.

The inhabitants of Elabuga tried to make life easier for the scientists and their families. However, as soon as the reports issued by the Soviet Information Bureau began to speak more and more often of the liberation of towns, districts and regions, the Leningraders and others who arrived from other regions of the country started to talk about returning home. The possible dates of such a return changed, were postponed, but nonetheless they eventually came. Victor Ambartsumyan was already concerning himself with all that had to be done to return to Leningrad, but how could one not recall the Old Testament saying: "Inscrutable are the ways of the Lord!"

Even today, when Soviet citizens or foreign visitors read in the Moscow Underground stations inscriptions on marble plaques and learn that the stations were built during the last war, they cannot but ask themselves how the Soviet people found the strength to build such underground palaces during the harsh years of a bitter war?

And is it not just as surprising that during those same years, academies of sciences were founded in some of the Union Republics?

The founding, at the end of 1943, of the Academy of Sciences of the Armenian SSR was viewed by the Armenian people as a genuine national holiday. The academy was being founded not merely symbolically but as a major scientific institution with a network of research institutes and laboratories to be staffed by a large number of scientists. At the very beginning of its existence, this young

academy received a director of world fame—Academician Iosif Orbeli.

When, in 1935, the first steps were being taken to turn the Armenian branch of the USSR Academy of Sciences into the Academy of Sciences of the Armenian SSR, Iosif Orbeli was the director of the Leningrad Hermitage Museum. Having supervised the evacuation from this world-famous museum of its priceless art treasures, he remained in the besieged city. His versatile activity during that period deserves a separate book. It is sufficient to mention just one episode to picture this devotee of science.

...Opposite the Winter Palace, the steamship *Polyarnaya Zvezda*, once a pleasure yacht of the tsar, had frozen in the ice. In the winter of 1941-1942, the commander of a group of submarines, Hero of the Soviet Union, A. V. Tripolsky, arrived here. He went to the repair shop that had been set up on board the steamship and said to the electricians:

"I have an assignment for you, comrades."

The sailors stood up as if on command.

"You know the Hermitage Museum?"

"Of course, we do. This summer we crated up pictures and the sepulchre of Alexander Nevsky."

"So you should know the director of the museum, Academician Orbeli."

"Yes, we know him. A knowledgeable man," answered the sailors respectfully.

Tripolsky continued: "At the moment he's writing a scientific work, but in his office it's pitch dark. He's using a torch—on, off, on, off... He's got callouses on his hands. You must go there today and provide him with electric light directly from the ship."

"We'll have that done in no time, comrade commander," rapped out the sergeant-major. He remembered how, at the very beginning of the war, they had taken away from the Hermitage Museum more than a million exhibits. The crating of the paintings, sculptures and other treasures had been carried out by hundreds of people under the supervision of Orbeli. Among those who had helped had been cadets from the Frunze Naval School.

This meeting with Academician Orbeli had been remembered by the sergeant-major, and perhaps that was why he was so eager to carry out the assignment given to him by

Tripolsky. That same day the sailors rigged up an electric cable from the ship across the river bank to the cold study of the scholar. When they returned, the sergeant-major said:

"When we came, it was so dark in there you couldn't see a thing. We connected the wire up to the desk lamp. Academician Orbeli was so delighted he even clapped his hands. Then we all sat down, and smoked Armenian cigarettes. He complained of aching feet: we looked under the table and saw that the electric heater wasn't working. Well, we fixed that in a moment. Academician Orbeli didn't know how to thank us. He remembered that sailors had helped crate up paintings by Van Dyck during the evacuation. And we said to him: 'It was we who did it.' He was more pleased than ever. 'Well,' he said, 'I'm indebted to the navy. We'll square up after the war.' "

In the spring of 1942, Orbeli was sent to Yerevan where he was to take up his appointment as the President of the Presidium of the Armenian branch of the USSR Academy of Sciences. It was then that he began to feel the results of the deprivations he had suffered in besieged Leningrad. His health was poor, and on top of that he had to undergo a serious eye operation. However, Orbeli understood that he had an important task to do, an assignment that was to become a landmark in the history of his people. Therefore, regardless of the difficulties, he set to work.

He dealt with several major organisational problems: the number of post-graduate students was increased; scientists evacuated to Yerevan were also drawn into the work. The institutes attached to the Armenian branch of the USSR Academy of Sciences began to investigate problems connected with national defence. The *Wartime Exploits of the Sons of Armenia* series began to appear, a Great Patriotic War room was set up, etc.

One November day in 1943, Ambartsumyan arrived in his office with a beaming face, and, without waiting for anyone to ask him, said: "My dear friends, the Council of Ministers of the Armenian SSR has decided to set up in Yerevan its own Academy of Sciences on the basis of our branch. Academician Orbeli has done everything possible to unite the scientific resources of our republic."

Two weeks later the list of the first academicians was confirmed—twenty-three, including Victor Ambartsumyan.

This news soon reached Elabuga, and Ambartsumyan made hasty preparations for his journey. He was in a hurry. The first general meeting of the members of the young Academy of Sciences of Armenia was to be held on November 29.

The Battle of Byurakan

Mild winds were blowing, the snow was turning brown. Winter, as if ashamed of its dirty apparel, hastily withdrew north. Then came the spring floods, throwing up pieces of wood onto the river banks, scattering clumps of grass on the riverside bushes, and destroying fragile bridges. Then the grass started to grow, at first timidly, only in the sun, and then spreading more boldly. Dog-roses, honeysuckles and ledums were in bloom. From the fields and woods, particularly in the afternoon, came the heaty scent of grasses and fresh leaves. The whole of the Kama area was dressed in its summer best. Even the rocks looked more attractive as the moss and lichen became brighter in colour.

One can stand for hours on the deck of a boat and admire the severe beauty of the landscape. The steamboat was sailing down river. The Elabuga branch of Leningrad University was returning to Leningrad. That winter had been generous with good news from the fighting front. The Red Army was already approaching the western borders of the Soviet Union. Leningrad was beginning to heal its wounds. Ambartsumyan hurried back to the banks of the Neva.

"Well, Victor Victorovich, have you finished packing your things?" asked Ambartsumyan senior, who was standing next to Sobolev on the deck of the steamship.

"I don't have much to pack, Amazasp Asaturovich. One small suitcase, and that's all."

"Also all wrapped-up in science, like my Victor," thought Amazasp Asaturovich. He was glad to talk to a man valued by his son.

"Do you miss Victor?" said Sobolev, looking sympathetically at the older man.

"Yes," admitted Ambartsumyan senior. "I know he has to be in Yerevan. He has many things to do at the Academy. Have you heard? He's Orbeli's Vice-President. There is also a lot to do at Yerevan University. An astronomical observa-

tory was built there at the beginning of the 1930s, and before the war it was handed over to the Armenian branch of the USSR Academy of Sciences. Now he's thinking of setting up a new observatory. He says they will need specialists who will have to be provided by Yerevan University. In addition to being the Vice-President of the Academy, Victor is also the head of the chair of astrophysics at Yerevan University, delivers lectures and, on top of that, is also the director of the observatory. And, of course, he continues to write. As to what he writes—I have no idea! I now find it difficult to grasp all the various aspects of his scientific work. After all, I'm not a physicist or a mathematician. My calling is philosophy and literature."

"Even we find it difficult to grasp all the aspects of his scientific work, although we work alongside him," remarked Sobolev. "We know what he has done, we know less about what he is doing, and know almost nothing about what he plans to do."

"Yes, that's the way of it. The age of the Encyclopaedists is past. In our day it's necessary to know a little about everything, but everything about a little."

"I agree with you. And I think that it is logical," said Kovalyov, coming up to them.

Ambartsumyan senior and Sobolev agreed with Kovalyov. A silence descended. Another steamboat sailed towards them. Then the loudspeaker came on, and there was not a man aboard who disturbed the hush: all were listening, and gradually the expression of anxiety on their faces gave way to a contented smile. That spring there were gun salutes every day to mark victories at the front, and the ancient walls of the Kremlin were often lit up by the glow of fireworks.

The walks and conversations on deck allowed people to satisfy their need to socialise. It was a time when it was difficult to be alone with one's thoughts.

The scenery around them changed, villages and small towns passed by. Amazasp Asaturovich, Sobolev and Kovalyov were talking on deck. Knowing that the old man felt lonely, the two younger men tried to keep him company.

"Tomorrow we have to transfer to the train. That means that in three or four days we shall be having dinner in Leningrad. That, however, does not cheer me particularly, although I dream of seeing Leningrad again, the city of my

student days," said Ambartsumyan senior.

"But, I believe, you will soon be going to Yerevan?" suggested Sobolev.

"Yes, but even if that happens soon, I shall still have to wait. How are my grandchildren getting on?"

"They've already settled down in Yerevan."

"I'm not so sure. Last year when I visited them they were still living in the Intourist Hotel."

"But they will soon settle down in a flat of their own. And then you will be able to visit them in Yerevan."

"Victor is no doubt happy to have returned to his native land. He missed Armenia."

"Yes, he has lived for almost twenty years away from Transcaucasia," agreed the father.

"...Almost twenty years have passed!" thought Victor Ambartsumyan, looking at the photograph of the first members of the Academy of Sciences of the Armenian SSR, and comparing it with the photograph of the pupils at the Boys' Gymnasium No. 3. "Three of the members of the new Academy—the brothers Levon and Iosif Orbeli and myself—all attended, albeit at different times, the same Tiflis gymnasium."

The photographs were lying on the table in front of the window. A summer breeze was wafting in cool air from Mount Ararat. The peaks of the biblical mountain were bathed in the silvery light of the waning moon.

Four jagged peaks, almost always covered with snow, could be seen in the distance. The highest of these—the Northern Peak and the Western Peak—are over 4,000 metres above sea level. This is Aragats. Between the peaks is a bowl. Many rivers have their source here, and scientists discovered a hundred of lakes, the largest of which is called Karilich.

Who can say when the volcano became extinct, the rocks cooled and the water accumulated in lakes? It is said that a shepherd once threw his staff into lake Karilich, and when he went back down into the Echmiadzin Valley, he found it in Lake Aigerlich. "What is this?" exclaimed the shepherd. "Don't be surprised," replied the old men. "Don't you know that Karilich and Aigerlich are linked by underground streams? Have you heard about the Gyrgyrs, the underground caves? When you are inside them you can hear

the sound of underground streams."

"Let's go and look at the slopes of Aragats," said Victor. "I think we may find a slope suitable as a site for the future observatory."

"I'd like to go with you," replied Academician Iosif Orbeli, "A map tells you a lot, but you can still judge better on the spot. Besides, it's a long time since I climbed our Aragats."

Orbeli and Ambartsumyan set off with a group of specialists.

"Rocks! What wonderful rocks!" Orbeli could not but exclaim. "I can't be indifferent to them. When I was young I was apprenticed as a jointer, type-setter and stonemason."

"So, you are looking at them from the point of view of a specialist, a mason?"

"Yes, but also as a historian and archaeologist."

It is not far from Amberd to Byurakan—just ten kilometres. And there it is—the southern slope of Aragats. A magnificent view opens out from here: to the left—Mount Ara, and to the right—a plain that stretches to the slopes of Ararat. For the romantic, it is a picturesque scenery, for the farmer—excellent pasture and farmland, and for the historian—the scene of many past events reminded by the ruins of the ancient fortress.

Knowing that his companions were eager to hear, Orbeli did not wait for them to ask him, but began his account:

"Here was located the impregnable fortress of Byurakan. You can see its ruins. It was destroyed in the April of 924. The troops of the Caliph were led by his ruthless Beshir. His plan was to seize the Catholicos himself and plunder the cathedrals. However, the enemy did not succeed in terrifying the small number of defenders in the fortress. The arrogant and self-confident Beshir had been certain of an easy victory, and now—the green banner of Allah had been shamed. All the troop leaders under his command brought him one and the same report: 'Everyone in the fortress, young and old, is under arms. Arrows, spears and javelins hail down on us from the walls and towers, and boiling pitch is being poured down on the besieging troops from the tower over the gates.'

"Then Beshir ordered that the battering rams and other siege machines be brought up to the fortress. The huge,

three-storey structure collapsed after falling into a pit dug by the people of Byurakan. Shortly afterwards it burst into flames, and the air was filled with wild cries. The defenders of Byurakan had set fire to the terrible 'tortoise' from beneath, using oil mixed with wood shavings, and some of the attacking troops were caught in the blaze.

"Beshir, fearing the wrath of the Caliph, ordered that the fortress be taken at whatever cost. He sent wave after wave of soldiers into the attack, but without success, until finally two traitors were found. Lured by the gold promised by Beshir they opened the gates of the fortress at midnight. The enemy ran through the streets of the fortress with exultant cries and blowing on trumpets and horns. And then, as the chronicle recounts, 'there was no evil which the infidel did not commit'. Having murdered the people, they, drunk with blood, began to loot. What they could not take away they smashed and burned. Mountains of books and manuscripts from the monastery library were thrown into bonfires and went up in flames. The scholarly men, for whom the Byurakan Monastery was famed, perished defending the fortress.

"Time has effaced from these ruins the blood and the soot," continued Orbeli. "Time is all-powerful. But the glory of those who defended Byurakan is unfading. If you find here a suitable site for the observatory, that in itself will be a good sign."

"We have already chosen the site. Of course, we will have to verify and check everything again, and more than once, but our choice is already made," concluded Ambartsumyan when, a few hours later, they gathered by the fortress walls.

"Now all that is left to do is to bring fame to Byurakan by our work and our discoveries," added Orbeli.

And he looked warmly at his companions.

Then they returned to Yerevan. It was as if an invisible hand was changing the colours of the sky: first the rosy hues of sunset disappeared, then the sky in the west turned light blue, and almost dark blue in the east. Half an hour later, the dome of the sky glittered with innumerable stars.

The next morning the inhabitants of the village of Byurakan gathered on the small square. A young boy checked his shirt to make sure it was not creased, and adjusted his belt rather like a soldier going out on parade. He had in-

deed only recently returned from the army and was now the secretary of the Byurakan Komsomol organisation.

"Well, lads," began Sarkis. "Young and old alike have long been looking at the building work going on not far away from our village. Everyone wants to know what they are building."

"An observatory!" shouted out the black-haired Saak.

"Right," said Sarkis. "But not everyone knows what an observatory is, and what kind of observatory is being built next door to us. So our lads have decided to visit the building site."

"Let's move a little way away, Gaghik," whispered his companion, the fifty-year old Musheg. "Or else the villagers will say: 'Look at them, tagging along after the boys!'"

"And what's wrong in being curious?" answered Gaghik. "Such are the times we live in! Everything's new all around us, and one has to see and know everything." Then he added confidentially: "I've already been there. They've asked me to work for them."

Tents had sprung up like mushrooms on the building site—new living quarters for the scientists and the workmen. Mounds of earth, piles of building materials, stone and cement—a typical scene in the early days of construction work.

"Here they are going to build a complex of buildings for the astrophysical observatory. Telescopes will be installed in the towers. Scientists will begin to study the planets and the stars. Have you heard of the periodic table of elements compiled by the famous Russian chemist Mendeleyev?" asked one of those who had come to the site and who was probably a teacher.

"We were told about it at school," came the reply from the boys.

"Well, Mendeleyev, on discovering the periodic table, pointed to certain gaps which, he predicted, would be filled by elements that were still unknown. Time has confirmed his prediction. The gaps in Mendeleyev's table are gradually becoming fewer and fewer. Scientists have discovered, for instance, that element No. 43 in the table is a substance whose nuclei are unstable and which is not found at all on earth in its natural form. This element was given the name technetium. Then it was produced artificially in extremely small quantities. The scientific world was amazed when astrophysicists discovered that this unstable element

is to be found in large quantities in the atmospheres of stars known as non-stationary."

"And how did the astrophysicists discover this technetium?" asked Saak.

"That's difficult to explain in just a few words. I've cited this example so that you would have some idea of the importance of the science for which this astrophysical observatory is being built here."

"And why here?" Gaghik ventured to ask.

"The sky is not clearly visible everywhere. Visibility is reduced by clouds, and by the smoke and dust of large cities. So scientists try to build observatories in places where the air is purer, where there are more cloud-free days and nights. Last year Academician Ambartsumyan and his young assistants finally decided on a site near your village. And now, in 1946, work has begun on this important project."

"In front of you is the plan of the future observatory," said the architect, joining in the talk. "It is called an observatory precisely because it should have powerful telescopes. Here we shall build for them observation towers with movable domes. But the results of the observations have to be processed. So we have envisaged the construction of a main laboratory building. It will house a conference hall, studies, laboratories, a scientific library and administrative offices. The hotel, living quarters and other auxiliary buildings will be built here. All the buildings have been designed in the local style."

"And what material will be used?" asked Gaghik.

"Felsite," answered a man wearing a grey suit. "It seems we have met before? You called to see us a few days ago, and even said that you wouldn't mind working here. Am I not right?"

Saak's eyes lit up. The sky had long fascinated him, but he said nothing about his cherished dream. He called out like a little boy: "I know who you are!"

"Who?"

"You're the architect Samvel Safaryan. The Byurakan Observatory is being built according to your design."

"You're quite right. I'm the architect."

"And when will the astronomers arrive? When will the building be finished?" asked Saak, his curiosity irrepressible.

"My dear chap, they're here already. They've already

brought a double five-inch astrograph to conduct photographic observations of variable stars."

"And who's the top man?"

"What do you want to know for?"

"I want to be an astronomer," admitted Saak, growing bashful at his own boldness.

The other lads burst out laughing.

"Then you'll get the stars from the sky and give us all one each," joked Saanush.

"Oh, girls, we'll have a long time to wait!"

"We'll wait. We're in no hurry."

"Well done, Saak!"

"Good for you, Saak," said Safaryan. "And you should see the 'top man'. His name is Victor Amazaspovich Ambartsumyan, and he's already here."

Academician Ambartsumyan suggested that they all sit down on the grass in the shade of the trees—the talk would be a long one.

"Dear comrade construction workers and guests," said the "top man", addressing the group. "We are building an important scientific institution. The construction of such an observatory will give us, the scientists of Armenia, the opportunity to work fruitfully, using the latest equipment, and thus widen man's understanding of the world around him.

"Before the October Revolution, Armenian scientists could not even dream of such a thing; Armenia had no scientific institutions and no higher educational establishments. And now? There are about one and a half million people living in Soviet Armenia. In neighbouring Iran there are about fifteen million, and in neighbouring Turkey there are about eighteen million. However, Soviet Armenia has several times more scientific institutions than Iran and Turkey taken together.

"You want to know what our observatory will be like. That is a question that interests not only us, the scientists, and the builders, but also the local population. Among you there is a young resident of the village of Byurakan. He, too, is interested to know, and even, it seems, dreams of becoming an astronomer. Am I mistaken?"

The "top man" smiled at Saak and continued:

"We astronomers have long wanted to know the structure of our Galaxy. And what is galaxy? A galaxy is a

large stellar system. It consists of many thousands of millions of individual stars. The Sun is also a star. Together with the family of planets, it is a member of the Galaxy. To use a metaphore—a galaxy is like a large city. It also contains our home—the solar system... The question of the form, external appearance and internal structure of this 'city'— and there are innumerable such cities in the universe—is of great interest to scientists.

"However, this problem is difficult to solve. If you look at our Galaxy from the side, it appears disc-shaped. Between the stars that make up the Galaxy there is inter-stellar matter. This matter absorbs and considerably reduces the light of the stars in the remoter parts of the Galaxy. Scientists have concluded that the structure of our Galaxy can be studied by observing other galaxies which can be seen more clearly. To distinguish them from our own Galaxy, we call them the outer galaxies."

Saak was barely able to contain his excitement at what he had just heard—and heard from Ambartsumyan himself.

The "top man" continued:

"The fact that we observe the outer galaxies from without has proved to be useful: we can immediately determine their contours. We already know that some of the outer galaxies are spherical, others extended, and still others irregular in shape. Just like when you look at a large city from a plane you can immediately see the main features of its plan. However, if you are on the streets of that city, and, moreover, the ground is flat, then you cannot arrive at any idea of its overall shape.

"In order to get a better view of the outer galaxies, we need powerful instruments—telescopes. They are installed in towers with sophisticated equipment. But even that is not enough. We must also choose a site where the air is pure. This requirement is met on the southern slopes of Aragats, which is our building site..."

The Rome Radio, in its programme "In the World of Science", broadcast the news that "in the Soviet Union another astrophysical observatory is being built. It is reported that it is being erected on Mount Aragats in Armenia".

The cardinal in charge of the Vatican's scientific institutions was finishing his perusal of a thick journal when he was informed of the arrival of Paolo Bregetti, a ma-

thematician and astronomer.

"Anything new?" asked the cardinal.

"The Bolsheviks are building a new astrophysical observatory on Mount Aragats."

"Where's that?"

"In Armenia."

The cardinal, who had been mechanically leafing through the journal, put it to one side and repeated with obvious interest:

"In Armenia?"

"Yes."

"And you calmly say 'Yes'? God has not seen fit to grant you clairvoyance." Bregetti flushed.

The cardinal continued unhurriedly: "Mount Aragats is in Armenia. The famous astronomer Victor Ambartsumyan works in Armenia. It is he who is building the observatory." Then he ordered: "Compile a dossier. In ten days collect all the material about Ambartsumyan, his private life, scientific work and public activities. Give the dossier to me personally."

Then he added preceptorially: "One should always be prudent. Not allow oneself to be caught unawares. We will have to look into the business of the new observatory on Mount Aragats yet. I wait to hear from you, my dear Bregetti..."

People were walking towards the reddish-stone house with a tiled roof. It housed the flat of the director of the Byurakan Astrophysical Observatory. The evening September sun lengthened the shadows of the young saplings. From time to time a gust of cool wind blew down from the mountains. It was still light outside, but the windows of the house were already brightly illuminated as if to mark some celebration.

And, indeed, there was a celebration taking place in the house that evening. The director of the observatory was celebrating his forty-fifth birthday. That was the main reason for the festivities, but there were others, too.

Amazasp, as head of the household and also at the request of the guests, was the toast-master. His toast to the one responsible for the celebration was poetic and witty.

"The date of the birth of their children is always solemn and joyous for their parents. These dates remind them of

many past experiences. I do not doubt that everyone will join me in congratulating our dear new-born."

Amazasp patiently waited for the exclamations, congratulations and good wishes to die down.

"However, it has been rightly prompted to me that today we have the right to ask him to answer for all his misdeeds..."

The guests were confounded.

"We shall not rest simply on words. We shall list those misdeeds, and you will see that each time the 'accused' will be obliged to admit his indisputable guilt."

"First, Victor should have invited us all to mark the great trust shown to him when the USSR Academy of Sciences appointed him chairman of the Astrophysical Commission. Although this happened back in 1944, time is not an argument of justification."

The guests glanced across towards Ambartsumyan junior and smiled.

"Second. In 1945 he should have invited us to mark the fact that he had been awarded the Order of Lenin for his services to science and on the occasion of the 220th anniversary of the USSR Academy of Sciences.

"This year he should have marked his appointment to the post of director of the Byurakan Astrophysical Observatory. However, he did not...

"Who was it who was recently invited to London to take part in the celebrations to mark the 300th anniversary of the birth of Isaac Newton? He should have invited all his relatives and friends to share his impressions with them. He should have...

"Well, and all of you will understand that when my son was awarded a State Prize for the formulation of a new theory on the diffusion of light in turbid media, this was unquestionably an occasion for gathering around the festive table... I have finished..."

"Dear Amazasp Asaturovich, we respect the age-old tradition which says that the toast-master is infallible. However, it seems that today we have to break with tradition. We wish to learn about that of which the toast-master said nothing! Many of us were not invited to celebrate Victor's appointment to the post of editor of the journal *Transactions of the Academy of Sciences of the Armenian SSR.*"

"True! Quite correct!"

"Nor is that all. There was yet another occasion: many did not take part in the celebrations when Victor was awarded the Order of the Red Banner of Labour in connection with the 125th anniversary of Leningrad University."

"A fine for the toast-master! Hand him a horn of wine."

The toast-master smiled slily. Good cheer bubbles and foams at the table like new wine.

The father stood up in order to reply to these reproaches.

"You are right, my friends! There were some things I did not mention. Perhaps inadvertently, and perhaps deliberately. I foresee that after you have all left, my son will reproach me for allowing such a magnificent toast in his honour. However, you are right. I can only utter the well-known request: 'Judge me not according to my deserts, but according to Thy mercy!' In the meantime, in accordance with the accepted procedure, we must now listen to the 'final word' of the accused. Isn't that so?"

However, the "final word" was never uttered. The guests did not give Victor the opportunity to speak. He was noisily greeted and congratulated, and he smiled in embarrassment and thanked them all.

When the guests had left, Victor decided to read through his messages of congratulation. Among them he found a short letter written on a page from a school exercise-book, and a small bouquet of flowers. These were from the pupils of the Byurakan village school to the director of the Byurakan Astrophysical Observatory.

The construction of the Byurakan Astrophysical Observatory of the Academy of Sciences of the Armenian SSR began in the autumn of 1946. And in 1947...

No, it did not happen that quickly. Somewhere, a barely noticeable rivulet forms out of the tiny droplets of water beneath the moss. It becomes a little larger, more noticeable. It is already a small stream. Now it has already crossed a hundred kilometres and has been recorded on the map. Another thousand kilometres and poets devote poems to it. How amazing is the development from the first movement within the seed to the young shoot. It is hidden from the human eye, and only the scientists know what a complex mixture of substances, temperatures and moisture have acted together in this mysterious event. Some-

thing similar happens in science.

"People often ask: 'Who discovered it?' And rarely the answers are the same," said Academician Fersman. "A discovery is almost never a sudden event. It is merely the last step in that long staircase which has been created by the labour of many others... The final formulation is the last drop which has collected over many years in dozens of minds..."

Not long afterwards defects were discovered in the sixteen-inch telescope with an electrophotometer in its Cassegrain focus. What efforts had been made to obtain and install this telescope, and now it had to be dismantled and returned to the manufacturers to be rectified. Another piece of bad news arrived: a worker on the construction site had been seriously injured. Moreover, this incident was reported in dry, official terms—it was his own fault; he had fallen and broken his arm, and now it would have to be amputated.

"What do you mean 'to be amputated'? Who said that amputation was unavoidable?" "Our medical assistant had examined him. He says that things look bad. It is Gaghik, a collective farmer from the village of Byurakan. He kept asking to be allowed to come and work on the site. Well, now he's got it!"

Ambartsumyan grew angry. "This is just callousness! Where is the unfortunate fellow? He's already been taken to Yerevan? He asked to be allowed to come to us? We should appreciate that." Ambartsumyan rang through to the hospital in Yerevan. They assured him that they would do everything they can to avoid amputation. However, half an hour later the scientist was still disturbed. Yet there were so many things he had hoped to think over that day!

"Are you going out for a walk?" asked Benik Markaryan, one of the director's closest associates. "Allow me to keep you company."

"That would be a good idea, we need to talk..."

The staff of the observatory knew the director's habit of going for walks in the surrounding countryside in order to think by himself. He could pass many an hour admiring the scenery, the setting sun, the stars. And during that time he would be thinking. In this way he managed to combine work and leisure. At such moments it was pos-

sible to discuss a variety of topics with him. Quite often he himself would look for a companion, particularly when he was absorbed in work on a difficult problem. He was happy to find himself dealing with a persistent opponent. This enabled him either to verify the correctness of his own opinion, or recognise that it needed to be modified or, indeed, discarded altogether. Many knew of his habit of acting as his own opponent. He would criticise his own work and conclusions, and his companion would defend them.

Now, however, the topic of the conversation was not their scientific work, not the telescope—but people. Ambartsumyan had just expressed his indignation at the callous attitude of the work superintendent to the injured workman. "Tomorrow we must telephone the hospital!"

"Of course," said Markaryan. "And people like that work superintendent need to be taught to view things differently, and above all in cases such as this one."

The two companions were passing by a small copse. Near the path stood a leafy oak with spreading branches, which could have offered shady repose to a large group of people. This giant was surrounded on all sides by straggly undergrowth. Thin, twisted trees strove to vie with the great oak and find a way to the sunlight. Vain efforts!

"Passive scientists are annoyed by those who are actively creative, and they put all kinds of obstacles in front of them. They have a great deal of time in which to engage in such intensive 'labour'. It's disgusting! Just disgusting! A man who is unable to help his comrade and to rejoice at his successes resembles the raven."

Markaryan listened attentively and thought: "Leonid Leonov described such a type in his novel *The Russian Forest.* Who does he have in mind here?"

Meanwhile Ambartsumyan continued to reproach someone, but without mentioning any name:

"Science can only benefit if it manages to free itself from those who lack any talent. A wise leader must not only select talented, efficient associates, but also be able to free himself from those who are incurably idle and indifferent. Idleness and indifference must be rooted out decisively. Adhering to the main principle—love for one's fellow-men—one must avert catastrophes by not allowing people to succumb to idleness and passivity."

Wherever young people gather, there is noise and activity. Before lectures, between lectures, in the corridors and lecture halls of higher schools there is, perhaps, only a little less noise and laughter than in primary schools. Such is youth. Yet with what surprising speed does expectant silence descends on the lecture hall as soon as Professor Ambartsumyan appears...

On January 16, 1947, a general meeting of the Academy of Sciences of the Armenian SSR granted the request of Academician Iosif Orbeli to be released from his duties as president in order to devote himself entirely to his work at the Leningrad Hermitage Museum. He had made an enormous personal contribution to the creation of this leading scientific centre in the republic. After his request had been granted, new elections were held.

The new president, Victor Ambartsumyan, entered the lecture hall. Many were seeing him for the first time, but everyone knew of him. At first glance his face appeared harsh. From beneath his bushy eyebrows his intelligent, lively eyes gazed at those present.

He greeted the students and his eyes swept the room. They paused at the first desk on the right: "Who's that? Ah! It's Saak from Byurakan!" Ambartsumyan smiled at the beaming youth, and then began his lecture, speaking calmly and distinctly.

His lecture was on astrophysics as a science: the object of its study and its main aims. In just a few minutes the first-year students were wholly absorbed by this clear and precise description of a science called upon to deal with the physical phenomena taking place throughout the Universe. It was not necessary to convince them that such a science required wide-ranging knowledge.

A good scientific grounding would help them find the right path in their cognition of the world, would enable them to avoid falling victim to pseudo-scientific doctrines or inadvertent errors. But perhaps the most difficult problem of all was handling the vast amount of data accumulated by science, summing it up and opening the way to a gradual (for this could not be achieved during the lifetime of one generation), truly scientific cognition of the Universe and its development.

Many had visited Echmiadzin, continued the astronomer, and had seen the famous cathedral that was erected

at the beginning of the fourth century by our distant forbears. How did they build the entrance? They put down a huge flagstone, thoroughly shaped it and then carefully aligned it with the flagstones around it, while at the same time leaving small gaps. Now this method is called the expansion joint. No doubt it had a different name then. For more than fifteen hundred years people have been visiting the cathedral, their feet have all but worn down the flagstone at the entrance, but it still lies and will continue to lie there. What an instructive example it offers us. That is the way—carefully, conscientiously—each scientist should shape his contribution to the edifice of science.

The envelopes spot stamps of every colour. The letters had come from different countries. On each envelope was a résumé in one of the European languages which Victor Ambartsumyan could read with ease.

"I'm not disturbing you, am I?" asked Ludwig Mirzoyan as he came in.

"Not at all. Look, an article by our German colleague Weizsäcker. A lay reader might think that all we need is a couple more articles like this and all the problems of astrophysics will be easily resolved, after which astrophysics will have nothing more to do."

"Perhaps we do not even need to finish building our observatory?" joked Mirzoyan.

"No, Ludwig," replied Ambartsumyan. "It must be completed. There are still many mysteries of nature that are to be unravelled. Have you noticed how our ideological opponents are clearly trying to distract attention away from the genesis of the Universe and its development with articles such as the one by Weizsäcker, or by sensational predictions about the approaching death of our planet and the Universe. Heat will gradually turn into cold, matter will gradually expend itself on radiation. Such is the opinion of Maxwell, Bolzmann, Gibbs and other scientists-idealists. Bohr, who asserts that inside stars neither the law of causality nor the law of the conservation of energy are observed, appears an optimist. In his opinion, each star creates energy out of nothing. A star is an example of *perpetuum mobile*, such as is unthinkable on the Earth.

"And have you read what Norbert Wiener has to say?"

"He surprised me. In effect he is saying that what mat-

ters is the struggle to obtain knowledge, not victory. What does that mean? After all, if someone were to say, 'The important thing is to sow the seed—the harvest doesn't matter', people would think he was mad. Yet Wiener, a talented scientist, the man who laid the foundations of cybernetics, declares that, following each victory, that is, following everything which reaches its apogee, there immediately comes the 'Götterdämmerung'."

"That's an extreme form of pessimism!"

"Perhaps not quite extreme, but close to it. In any case, it's worse than the pessimism of Auguste Comte, who, just a few years before the discovery of spectral analysis, declared that there were no means by which we could learn the chemical composition of stars. And people would never know. That was the level of thinking of the people of that time. Yet we are approaching the middle of the twentieth century."

"No, Ludwig," Ambartsumyan continued, "not the destruction of matter, of which the honourable James Jeans speaks, but the extremely complex process of the development of matter, not the complacent-petrified view of the physical world that can be discerned in the articles by Weizsäcker, but a bold penetration into its secrets—that is what we need." Ambartsumyan fell silent, but it was obvious that the argument was continuing in his mind.

There was silence in the office.

"I was just thinking of Shain's 'glass library', because I was imagining the mountains of actual material already obtained through astronomical observations," said Ambartsumyan. "Of course, observations must continue, and the methods and techniques of observations must be improved. But are we not late with the foundation of a school of astrophysicists-theoreticians? What do we mean by the process of summing up the data of astronomy? First and foremost, that is theoretical work."

Ambartsumyan fell silent again.

"That means," he was thinking, "that I must resolutely remove myself from my external environment—from the Academy, from meetings and other such concerns. It's a pity that at the moment I can tackle such an important issue only in fits and starts."

CHAPTER FIVE

Eureka!

Biographers have worked hard to discover the hidden secrets of the creativity of outstanding people. However, no one can calculate how much creative energy the artist or scientist "burns up" as he moves from the original idea to its realisation, what depths of concentration or torturing doubt he must plumb and how much effort he must make to overcome courageously the obstacles he faces.

These attempts to "remove oneself" from the external environment were repeated time and again. However, it can happen that an idea, a guess or a vision comes not in moments of profound thought at all. It was at such a moment that an ancient Greek scientist exclaimed: "Eureka!" However, such a moment is preceded by painstaking work and long reflection.

The work that was begun in 1937 was completed in 1947 by a discovery... For ten long years Ambartsumyan had worked on generalising the achievements of cosmogony. He had collected a vast amount of observational data from various countries. The Byurakan Observatory was still under construction, but it already housed thousands of photographs and spectrograms of the stars which the astronomers there were busy studying.

To some extent the springboard for this fundamental discovery was provided by the works Ambartsumyan had written earlier—on the physics of gaseous nebulae, on the dynamics and statistical mechanics of stellar systems, on the nature of inter-stellar matter, on the theory of fluctuation, etc. It was precisely in his works on the physics of non-stationary stars and on the statistical mechanics of stellar systems that specialists detect the first indications of the changes later noted by Ambartsumyan in the state of stars and stellar systems.

A scientist has to possess that amazing ability about which the English poet William Blake wrote:

To see a World in a grain of sand,
And a Heaven in a wild flower,
Hold Infinity in the palm of your hand,
And Eternity in an hour....

The first indications of changes taking place in the state of stars and stellar systems were followed by a "chain reaction". Now Ambartsumyan thought constantly of these changes.

There began a long period of the search, in the stellar world, for unstable objects and examples of the transition of heavenly bodies from one state into another. He sought in direct observation, in photographs, spectrograms and stellar catalogues anything that was directly or indirectly connected with the evolution of stars.

Sometimes the astronomer would be gloomy and withdrawn for the whole day. It was obvious that certain theoretical deductions did not fit in with the mathematical groundwork, which meant that the secret of some phenomenon had not been unravelled. At other times he was satisfied with the progress of his research: he had moved forward. The calculations involved were incredibly complex. And how many "blind alleys" there were!

There was a moment when Ambartsumyan's attention was attracted by a phenomenon long since noted: in addition to heavenly bodies which are single stars, there are also so-called stellar clusters in the Galaxy. Some of them have dozens of members, others hundreds or even thousands. Each member of the cluster has two types of motion—around the centre of the cluster, and—together with all the members of the cluster—around the centre of the Galaxy.

Ambartsumyan studied both types of motion, using a new approach. This led him to two major conclusions.

First, the totality of stars in the Galaxy causes all the clusters to rotate around the galactic centre, at the same time being a force that seeks to disrupt it. What is the result of this complex interaction? It turns out that the disruptive effect is counteracted by the force of attraction of the stars in a given cluster. This attractive force is so great that the clusters remain relatively stable.

The second conclusion was as follows: if the density of a given cluster is very low, then the attractive force exerted by all its members on each must also be very low. What

does this portend? In this case the forces tending to disrupt the cluster prove the stronger. Then the cluster disintegrates. It would seem that the Galaxy should not contain clusters or star groups with a very low density. However, at Byurakan they had noticed that, despite these conclusions, the Galaxy contained two star systems with a very low density. They are located in the Perseus and Scorpius constellations.

Perhaps, in time, historians will refer to this discovery as a new stage in the development of astrophysics or an epoch in the science of the Universe. At the time, however, everything went on as usual. Ambartsumyan and his associates discovered that two scattered groups (associations) of hot stars were typical representatives of a broad category of stellar systems within our Galaxy. In fact, there are no less than twenty such O associations. Each has a dense nucleus which is an ordinary stellar cluster. It was then discovered that in some instances stellar associations may contain two or more such nuclei.

As they studied these O associations, the astronomers began to wonder whether, as such open systems are unstable, they would not disintegrate quite rapidly. Besides, these systems could not have existed in this form in the past. Therefore they had emerged only recently! Special theoretical calculations were undertaken. These showed that these systems had emerged no earlier than several tens of millions of years ago—a relatively short period compared with the life-span of a star. It was therefore concluded that stars in O associations are very young in terms of the cosmic scale of time.

The Byurakan astronomers also paid attention to another phenomenon, namely, that the brightness of certain dwarf stars varies in an "irregular manner". These were included in the category of variable stars. A typical example of such irregular variable stars is the T Tauri star. Dwarf stars form similar stellar associations that are called T associations.

So, O associations and T associations. And what next?

The watchman at the Byurakan Observatory had long since noticed that the lights in the windows of the main laboratory complex went out in a hierarchical order. First it was the windows of the auxiliary departments and servi-

ces that went dark, then those of the junior scientific researchers, then those of the senior researchers, then those of the close associates of the director, and, finally, the light in the office of the director himself. That meant that Ambartsumyan would now go home, and the watchman deliberately chose his route for his nightly round so as to meet him.

"Good evening."

Ambartsumyan went closer, looked at the figure opposite him and said, surprised: "Is that you, Comrade Gazaryan? Hello! How is your arm?"

"I still have it, Victor Amazaspovich, but I can't work as a builder. I've been made the night watchman. They said that my experience on the front-line would serve me well in this post. So I walk round and think: everyone says that you have discovered something, but no one knows anything about it. And then I took it into my head to boast to the lads on the construction site that I would ask you about it. The lads keep asking me about it. What shall I tell them?"

"Well, Comrade Gazaryan, you tell them that you have talked with me, and that I promised to have a talk with the builders. It's still a little early at the moment. I myself shall tell you when everything is ready. My best wishes to you!"

"Good night, comrade director!" replied Gazaryan in the clipped manner of his army days, and then wondered why he had spoken so officially.

The builders' meeting was announced in good time. The builders had been expecting it, and there was not a vacant place in the hall.

"They respect the working class: they're all here!" whispered the leading stone-mason, Papazyan, to his neighbour. Papazyan was an elderly man, but strong, and one with a sense of his own worth.

"Just look: Ambartsumyan, Markaryan, Mirzoyan, Gurzadyan and all the rest—the whole of our astronomy!"

"Yes, and our men are here, too," replied Gaghik Gazaryan. "All the bosses from the building site, and even the architect Samvel Safaryan."

Victor Ambartsumyan went up onto the podium. He said that it was becoming a tradition that, when the astronomers and the builders met, they told each other how

their affairs were progressing. They worked hand in hand, and each made his contribution to the common cause. He then turned to the main topic.

"And now, comrades, I'll tell you about the problems we are working on. Our Galaxy contains old stars and young stars.

"Star formation in the Galaxy is still continuing, literally before our eyes. Stars do not emerge singly, but in groups—in associations which contain small groups."

A drawing appeared on the blackboard.

"If that is so," the astronomer continued, "then the emergence of various members of the group out of the prestellar phase of the substance is reciprocally conditioned. Therefore here, as in many other natural phenomena, we are dealing with causal regularities. Thus the theory of the causeless emergence of stars out of nothing is disproved. These conclusions prove the invalidity of those schools of thought which have spread in the West over recent years.

"More than one hundred years ago Karl Marx said: 'Man, who looked for a superhuman being in the fantastic reality of heaven and found nothing there but the *reflection* of himself, will no longer be disposed to find but the *semblance* of himself, only an inhuman being, where he seeks and must seek his true reality.'*

"Our scientific research is a search to discover this true reality."

Someone asked a question:

"And are other scientists studying these same stars? What do they say?"

It was clear that Ambartsumyan liked this question. He said:

"Yes, they are. For example, the Soviet astronomers, Professors Melnikov, Sobolev and others. Their conclusions are the same as ours."

"Gaghik Gazaryan will now take the floor."

The speaker was not flustered. His age, experience and imposing appearance gave him confidence. There was a lot he wanted to say. "I am not an astronomer," he said, "but I know that our scientists have achieved a great deal. Now they can prove not by words but by scientific facts that stars are born before our eyes, and not created in biblical

* Karl Marx, Frederick Engels, *Collected Works*, Vol. 3, Progress Publishers, Moscow, 1975, p. 175.

times by God. And as this is so, we can say to our scientists: it seems that we, working people, have not laboured in vain when we built telescopes, towers and laboratories. And you, our respected scientists, are not sitting in them in vain."

In the days that followed, the astronomers had the feeling that, in having done something important in the field of science, they had, as it were, handed over their achievements to the working class. It was only a long time later that they learned that Ambartsumyan's work on a new type of heavenly bodies known as stellar associations had evoked enormous interest in world astronomy.

Many recognised the fundamental importance of the discovery made by Ambartsumyan: they said that the study of stellar associations would make it possible to investigate the laws governing the formation and evolution of stars and stellar systems.

The discovery of stellar associations faced astronomy with a number of fundamental questions. Out of what are stars formed? What is the nature of proto-stellar substance? Since, practically in all stellar associations, nebulae are found alongside stars, it was possible to suggest that groups of stars are formed out of these nebulae. However, the facts proved the contrary: many stellar associations eject into space a diffuse substance, and it is often possible to observe nebular masses moving away from the centre of their stellar association.

The attention of astronomers was attracted by the so-called phenomenon of continuous emission. A study of this phenomenon considerably modified views on the nature of the sources of stellar energy. The farther astronomers penetrated into this new phenomenon, the more far-ranging became the field of research they had to engage in.

When it became known that the 7th Congress of the International Astronomical Union would shortly be held in Zurich, Switzerland, it was clear that this world forum of astronomers would by no means ignore the discoveries made at Byurakan.

This was discussed by those working at the observatory:

"Who is going to represent us at the congress in Zurich?"

"No one knows exactly as yet, but Ambartsumyan has been included in the Soviet delegation. He's going to deliver a lecture on the structure of the inter-stellar absorb-

ing medium."

"And is he going to say anything about the study of stellar associations?"

"No. He thinks that would be premature. A lot still has to be done to thoroughly substantiate the main conclusion concerning the expansion and disintegration of stellar associations."

And, indeed, the question of stellar associations was not discussed as a separate topic at Zurich, but Ambartsumyan's work was indirectly recognized by his election shortly thereafter to the post of vice-president of the International Astronomical Union. The British journal *Observatory* then wrote, in its report on the congress, that the most important paper was perhaps the one which had nothing to do with the theme of the session, namely, the work done by Ambartsumyan on the structure of the inter-stellar absorbing medium.

After making a detailed report to his colleagues about the work of the congress, Victor, remembering the "accusations" made against him by the toast-master, found the time to share his impressions of his trip abroad with his family and friends.

He spoke very briefly about the scientific results of the congress, but pointed out that all progressive foreign scientists were very interested in the work being done by Soviet astronomers. He then described how he had been approached by a correspondent of a Swiss bourgeois newspaper, who had asked him which scientists he considered as his teachers. Ambartsumyan had named the great Russian astrophysicist Byelopolsky, and also Professor Tikhov. He had described the contribution being made to world science by Soviet scientists, and the enormous assistance being given by Russian scientists to develop science in the Union Republics. The interview was not published.

Gaghik Gazaryan looked once again at the solitary lighted window shining out into the night.

"I could do with going in to Victor Amazaspovich and telling him to have a rest. I could ask him what he is thinking about, what he is working on."

Ambartsumyan had, in fact, decided to rest for a while and was walking up and down his study; he went up to some flowers in a vase, and poured in some fresh water; then

his eyes rested on a portrait of Byelopolsky.

Byelopolsky... Pulkovo... Leningrad. He had been there not so long ago. He had visited the grave of Byelopolsky. Many things came back to his mind: new impressions of the Pulkovo Observatory were always linked with his memories.

During the war the observatory had been destroyed. Now the main building has been rebuilt on the old foundations; its classic design has been retained. Only the form of the domes has been altered: stone towers over the central section had replaced the former wooden, rotating towers with conical roofs. The new stone towers now have rotating metal domes in the form of hemispheres with sliding panels. Construction work was already nearing completion, but there were still many signs of Nazi occupation. On the northern slope was the cemetery of the defenders of Pulkovo Heights. In front of the main building was a stone memorial plaque in honour of the heroic defenders of Leningrad.

At the observatory work was underway to determine stellar coordinates. The astrophotographic material obtained by the Soviet astronomer Kostinsky over fifty years earlier proved very useful! Now they were taking the "second epochs" of photographs of the sky. The study of these photographs alongside those taken by Kostinsky made it possible to calculate the movement of thousands of stars in scattered stellar clusters and associations.

Recollections are sometimes rapid, and sometimes slow. Ambartsumyan recalled the Hermitage museum, his conversations with Iosif Orbeli about the Academy of Sciences of the Armenian SSR and affairs in his native land.

The stars captivated his attention, yet there is also a lot to be done at the Academy! Ambartsumyan looked at his watch and decided he could work for another hour.

However strict the rules to maintain peace and quiet on the territory of the Byurakan Observatory, the noise of life outside occasionally interrupts the calm. Cars arrived from Yerevan, bringing important visitors who wished to see the director. Some vehicles passed, loaded with crates on which were written the words "Handle with care!". They contained equipment for the new twenty-inch Schmidt telescope. The telescope was being mounted: soon they could begin to photograph selected sections of the Milky Way for stellar calculations... The builders created a lot of noise, but there

was nothing that could be done about it. They had their schedules, their dead-lines. More cars arrived, delivering greenery. This greenery was long awaited by the gardener, who quite rightly argued that the planting had to be done early so that everything would be ready for the official opening.

The mail delivered to Byurakan brought the news that Ambartsumyan's theoretical conclusions about stellar associations were being confirmed by research being done by Soviet and foreign astronomers. One article on stellar associations was published by Otto Struve, a prominent astronomer and the great-grandson of the founder of the Pulkovo Observatory, Vassily Struve. He referred to Ambartsumyan as one of the most outstanding scientists of the day. However, news of yet another discovery made at Byurakan had still not reached the United States, where Otto Struve lived and worked.

In 1949, basing himself on the concept of instability, Ambartsumyan had predicted the expansion of stellar associations. It would be difficult to name in the history of astronomy over the previous five or ten years a more striking example of a theoretical prediction concerning a hitherto unknown phenomenon. This prediction concerned new kinds of motion (the disintegration and expansion of stellar systems) which, both in their nature and in their causes, differ sharply from anything that had been studied up till then in stellar astronomy and stellar dynamics.

In connection with the theory of stellar associations, the astronomers at Byurakan had advanced a new conception of multiple Trapezium-type systems, which, in the opinion of scientists, is of particular interest both in terms of cosmogony and in terms of celestial mechanics. Even those who had reacted sceptically at first to Ambartsumyan's discovery began to undertake similar research. In less than two years the expansion of stellar associations was twice confirmed by indisputable observational data, by the Dutch astronomer Blaauw in Leiden, and Markaryan in Byurakan.

"Well, my friends, have you read the news?" the triumphant Saak asked his fellow students. "Ambartsumyan and Markaryan have become State Prize winners."

Many had already heard the news.

Gaghik Gazaryan had read about it in the newspaper *Aiastan.* He remembered the light he had seen burning in

the director's window in the evenings and during the night. "What else can you expect? He's writing the laws for the heavenly bodies..."

Time had shown who was right and who was wrong, had consigned erroneous conceptions to oblivion, and cooled passions; the fundamental proposition that stars are still being formed within our Galaxy was now accepted by all.

Many other questions were now discussed on the pages of the *Astronomical Journal* and other Soviet and foreign publications. Are stars formed within stellar associations? Or perhaps they are formed there and also by other means? Are they always formed in groups? Or may stars be formed singly? Out of what material are stars formed?

Among Soviet astronomers a single opinion gradually formed concerning these basic questions of astrophysics. We can now say that the main result of the heated discussions that then took place among Soviet astronomers was that the basic conclusions drawn by Ambartsumyan concerning the nature of stellar associations, the process of stellar formation and the group origin of stars were accepted. This was all the more welcome as the International Astronomical Union was about to meet in Rome.

Yerevan and Rome were founded around the same time. The traditional date for the founding of Rome is 754-753 B.C. Erebuni, the original name of Yerevan, was, judging by Urartu inscriptions that have survived to this day, founded a little earlier, in 782 B.C. However, what is thirty years on such a time scale? Let us give the laurels to Rome, as its history is incomparably richer in memorable events. The ruins of the Forum, the Coliseum, Trajan's Column, the Arch of Titus, the Triumphal Arch of Septimius Severus, the Pantheon and many other monuments carry us back to the days of the Caesars and the Gracchi, the emperors and Spartacus. Then suddenly you come across nuns riding bicycles, and you are back in the twentieth century again.

The Soviet astronomers had only a few days to look round the eternal city. Some of them were seeing it for the first time. And Rome is Rome! One can spend hours wandering over its famous hills and along the banks of the Tiber, or admiring Michelangelo's "Moses" in the Church of St Pietro in Vincoli, or visiting the Vatican museums, or walking along the city's magnificent streets.

However, "business before pleasure", as the saying goes. They are here to attend the 8th Congress of the International Astronomical Union, an honorary association of astronomers founded in Brussels in 1919. In 1935 the USSR Academy of Sciences became an official member of the Union. At previous congresses held in Stockholm and Zurich, Soviet astronomers had pointed out that not all the principles of the International Astronomical Union accorded with its purpose—furthering cooperation among astronomers from various countries on questions requiring international cooperation, and promoting the development of all branches of astronomy.

The Executive Committee of the IAU, with its president, five vice-presidents and general secretary, is in charge of a number of scientific institutions and also astronomical research being conducted on a global scale. These include the International Time Bureau in Paris, the Central Bureau of the International Latitude Service, which has a number of latitude stations, the compilation of a photographic map of the sky, the determination of the longitudes of major observatories, etc.

As was the custom, the organisers of the congress proposed that the most topical scientific questions be handed over to commissions. The Soviet astronomers were against this dissipation of forces.

"Fundamental questions of astronomy should be discussed at large meetings—symposiums. Let there be broad discussion. Science can only benefit from it."

"What a pity that Shain is ill and cannot be present. The reports of Shain and Fesenkov are notable for their analysis, argumentation and substantiated calculations, but the main speaker will be Ambartsumyan."

Victor Ambartsumyan, the head of the Soviet delegation, spoke of the fideist essence of certain hypotheses and models of the Universe. The Cambridge astronomers asserted that small coagulations—embryos of stars—were formed at some point from a primeval nebula. When they were asked, "And how did the embryos become stars?", they answered, "Accretion!" This then raised the new question of accretion. If one divests the answer of certain terminological superfluities and critically analyses the mathematical arguments and calculations, the essence of the reply can be expressed as follows: "The coagulation begins to swell

if it captures some of the gas and dust of the primeval nebula. It then expands to the size of our Sun, becoming a star of average magnitude. If, while it is moving within the Galaxy, it captures more gas and dust, it grows to the size of a giant star. However, that does not happen very often—only one in a hundred cases. One in a million of these coagulations may find itself a third time in the midst of inter-stellar gas and dust, and thus, by attracting yet more such material from the primeval nebula, become a hot super-giant.

"The question arises: Where can we observe such a process. Who is studying it, and how? What is the origin of the primeval nebula, and how does something emerge out of nothing?"

The report delivered by the Soviet astronomer M. S. Zverev on a model of a fundamental system of the position of stars in the sky further increased interest in Soviet astronomy.

Following the congress in Rome, on the suggestion of Soviet astronomers, the number of IAU commissions on various astronomical issues was increased to thirty-nine. Three of these were headed by Soviet astronomers. From now on Moscow and Leningrad astronomical institutions were put by the IAU in charge of major international research. The Sternberg State Astronomical Institute in Moscow is known to many for its precise time signals; together with the Astronomical Council of the USSR Academy of Sciences it is supervising the compilation of a catalogue of variable stars, a unique publication of world importance. The Institute of Theoretical Astronomy in Leningrad is in charge of work on the calculation of the ephemerides of minor planets. Various IAU publications have begun to print more frequently articles written by scientists from socialist countries. Such were the results of the Rome Congress of the International Astronomical Union.

The Stars Shine Down

In 1952 the Second All-Union Cosmogony Conference was held in Moscow. It approved Ambartsumyan's basic propositions on stellar associations and also requested the USSR Academy of Sciences to set up a commission on

cosmogony to take charge of all cosmogonic research throughout the USSR. The commission was created, and Ambartsumyan was appointed chairman.

That same year, Ambartsumyan was elected delegate to the 19th Congress of the CPSU. The *Atlas of Open Stellar Clusters,* prepared by the Byurakan Astrophysical Observatory, was also published around this time. A double astrograph was commissioned at the observatory, and work had begun on the construction of two new broadside arrays for the interferometer radio telescope. Preparations were underway for the forthcoming international astronomical conferences to be held in Gröningen (the Netherlands) on the coordination of research into the structure of the Galaxy, and in Paris—on the fundamental problems of stellar classification.

In 1952, Ambartsumyan prepared a major work for publication, entitled *The Phenomenon of Continuous Emission and the Sources of Stellar Energy.*

The year 1953 saw the publication of numerous Soviet and foreign reviews emphasising the topicality of the work devoted to the study of the processes occurring in the atmospheres of stars with continuous spectral emission. Ambartsumyan showed convincingly that the observed irregular variations in the quantity of energy emitted by T Tauri stars that form T associations, and certain neighbouring non-stationary stars, are in the majority of cases caused by the processes of the direct release of intra-stellar energy in the outer layers of these stars. The wish was expressed that Victor Ambartsumyan, while continuing his research, demonstrate in more detail that these processes differ radically from the processes of thermal radiation characteristic of "normal" stars, and that they are linked to the formation of new atomic nuclei out of material which the author named pre-stellar.

It is a pity that at that time the present building of Yerevan University with its spacious lecture halls did not yet exist. Radio was used, but being able to hear the lecturer and see him in person is one thing, and listening to him while sitting in the adjacent auditorium is quite another. The lecturer, knowing that his audience included not only students of the physics and mathematics faculty, but also "laymen", said:

"The picture of the starry sky always attracts people's

interest. Bright stars form constellations in the sky. The position of the stars in constellations appears invariable. In fact, however, the stars move, but the resultant changes take hundreds of thousands of years to occur. In the same way, it seems that the stars remain as bright as ever down the years. However, scientists observing the stars have found some whose brightness changes with time, sometimes quite considerably. Such stars are called variable.

"Soviet astronomers are making a close study of variable stars. The centre of their study is the Sternberg Astronomical Institute attached to the Lomonosov University in Moscow. Even before the Revolution, Professor Tserasky, Tseraskaya and Professor Blazhko were studying variable stars at Moscow University. Since then a great deal of work has been done at the institute in the study of many non-stationary stars which are distinguished by a very high temperature of their surface.

"Research into variable stars has today assumed such a scale that it has become necessary to coordinate it at an international scale. This coordination is the task of the commission on variable stars attached to the International Astronomical Union."

A short pause followed, and the students, as if sensing that the introduction had come to an end, prepared to start taking notes.

"The changes undergone by a star depend upon its origin and age. Some variable stars are dwarfs, that is, have a relatively low luminosity. A study of these systems has led us to the conclusion that they represent a group of young stars which appeared comparatively recently." As the professor said this, he seemed to expect that the listeners themselves would formulate the question: "Why should these young stars exhibit such irregularity in changing their brightness?"

"It turns out that in many cases, the brightness of such stars increases or decreases not as a result of an increase or decrease in their temperature, and not as a result of their expansion or contraction, but as a result of the appearance in the outer layers of the star of an additional radiation source of a non-thermal nature..."

Having turned the page, the students headed the next section of their notes: "The Additional Source of Non-Thermal Radiation".

"Typically, the release of additional energy in the outer

layers of the star frequently occurs over a relatively brief period of time. All the data indicate that the radiation energy thus emitted is drawn not from those energy resources which are found in the outer layers, but comes from the inner layers of the star.

"But how? By means of a mechanism, the nature of which is not yet quite clearly understood. Apparently scientists are dealing with the process of the liberation of energy from those sources which normally operate within the star, but which in this case are released.

"Thus it becomes possible to observe directly the process of the liberation of energy which, in other stars, takes place only in their central regions..."

The students went on to head the final section of their notes: "Conclusions".

"The first conclusion is as follows: the processes which liberate the energy, observed in the outer layers of non-stationary stars, are not thermonuclear. Therefore, contrary to what had been thought until now, it should be supposed that the internal sources of stellar energy also may be of a different nature.

"Second: the liberation of additional energy often occurs in large amounts over a very short period of time; in other words, is explosive by nature.

"Third: the process of the liberation of energy in the atmospheres of young stars is connected with the emergence of new atomic nuclei which are sometimes unstable and later decay."

These conclusions circled the globe. Once again envelopes arrived bearing stamps of every hue. Scientists around the world asked if this new work by Ambartsumyan could be sent to them. Nor did it attract the attention only of astrophysicists. The processes the author had described were also new for nuclear physicists. Research into non-stationary stars had gone a long way towards the solution of new problems facing modern physics.

In 1953 Ambartsumyan was elected a member of the USSR Academy of Sciences.

Academician... This title brings with it the image of a man of unusual talent and industry, with the gift of scientific prevision, and a bold innovator. Academician... This is someone who stands in the forefront of modern science, and leads other scientists forward.

The boundless Universe will confront us time and again, and for an immeasurable period into the future, with new problems. Thus man faces an endless path of scientific endeavour, of intellectual activity with all its cares and joys. This was the path followed by Ambartsumyan.

"Victor Amazaspovich Ambartsumyan," said Sergei Vavilov, President of the USSR Academy of Sciences back in 1939, "is a professor of the chair of theoretical astrophysics of Leningrad University. Despite his youth, he is one of the leading authorities in his field and is well known abroad. His very first works on the theory of the radiative equilibrium of stars marked him out as a talented theoretician well-equipped with the mathematical physics apparatus.

"Ambartsumyan's works in the field of theoretical astrophysics also include works on the structure of planetary nebulae. Ambartsumyan elaborated in great detail the theory of the radiative equilibrium of planetary nebulae, produced an improved formula for the degree of ionisation in cases of considerable dilution of radiation, characteristic of the radiation emitted by exciting star, and then applied his theory to extended stellar atmospheres. These works place Ambartsumyan among the leading astrophysicists of our day.

"Another series of works by Ambartsumyan concerns various questions of stellar statistics having cosmogonic significance. Ambartsumyan has shown that, contrary to the generally-held view, the distribution of the eccentricities of binary stars does not correspond to a case of the equal distribution of energy. On analysing this result and comparing a number of astrophysical observations, Ambartsumyan rejected the longer time-scale for stellar evolution in favour of the much shorter one.

"In the USSR, a considerable part of the work done in theoretical astrophysics was carried out, directly or indirectly, under the guidance of Ambartsumyan. Most of the research conducted at the observatories in Georgia and Armenia (Abastumani and Yerevan) is under his supervision. His discoveries have served as the starting point for many research projects to study the laws governing the origin and development of stars."

In the autumn of 1953, when Ambartsumyan was forty-five years old, a delegation from the Berlin Academy of

Sciences visited Byurakan. The visitors appreciated the work done by the director and his closest associates. Numerous messages of congratulation also arrived from Soviet scientific institutions, and from scientists working at observatories, including those at Pulkovo. Once again the former student recalled the banks of the Neva.

On the eve of the 250th anniversary of Leningrad, in an article entitled "A Glorious Anniversary", Ambartsumyan wrote:

"...St Petersburg-Leningrad has played an outstanding role in the development of science and culture in our country. Here, on the banks of Vassilyevsky Island, there sprang up, one after the other, the buildings of the Academy of Sciences, the university and other scientific institutions. Associated with this glorious city are the names of Lomonosov, Chebyshev, Struve, Mendeleyev, Pavlov and many other leading lights of world science. Many sons and daughters of the Armenian people also received their scientific baptism in Leningrad.

"I am indebted to Russia for all my scientific education."

And further on:

"...One cannot but emphasise an important feature that characterises major Russian scientists; they always see their work as a means of serving society, the people. It is this feature which gives Russian schools of science their particular attraction, and draws to them representatives of other nationalities of the Union and of the world.

"As the President of the Academy of Sciences of the Armenian SSR, I believe that the education of Armenian scientists in the finest traditions of progressive Russian science is the best means of ensuring the further development of scientific thought in Armenia.

"A very important factor in this respect is, of course, the constant link existing between Russian and Armenian scientists, major representatives of science, including our Leningrad colleagues."

There followed years of intense research work that covered stellar associations, cosmogony, non-stationary processes in stars, extra-galactic astronomy...

The early 1950s were marked by the discovery in astronomy of radio galaxies. These constitute a small number

of galaxies, the intensity of whose radio emissions is almost comparable to the intensity of luminous radiation.

It was proposed that radio galaxies were the result of the collision of two independent galaxies. This view originated in the USA and then spread to Western Europe. However, it soon became clear that this hypothesis raised serious objections. Research showed that all known radio galaxies are super-giants, and usually they are the brightest galaxies in those galactic clusters of which they are a part. On the other hand, the number of dwarf galaxies is considerably larger than the number of giants and super-giants. This raises the question as to where such collisions are most likely to occur—among dwarfs or among giants. In terms of probability, the number of collisions should be higher among dwarfs, but no radio galaxies have been discovered among them. Is it then possible, on the basis of this theory of collisions, to explain the absence of medium-sized or dwarf galaxies among the radio galaxies? It turns out that it is not.

Radio galaxies probably constitute a certain, perhaps very short, stage in the internal development of super-giant galaxies, for the clouds of high-energy particles which are responsible for their radio emissions very quickly lose their energy and are dissipated. This usually takes one million years (a very brief period in comparison to the life of the galaxy). Perhaps most of the galaxies, and possibly all of them, go through the stage of radio galaxy, and it is also possible that the phenomenon of radio outbursts recurs in them.

Until recently it was thought that the central concentrations—the nuclei of the galaxies—were composed almost exclusively of stars. The Byurakan astronomers have come to the conclusion that processes occur in these nuclei, which cannot be explained if they consist only of stars and diffuse matter. Since the processes that give rise to new galaxies and spiral arms cannot take place involving the usual kind of stellar population found in the nuclei, we are obliged to assume the possibility that these nuclei contain a considerable amount of pre-stellar material whose nature is unknown.

And just what is proto-stellar material? Thus there arose a new set of questions to which scientists had to seek the answers.

...Victor Ambartsumyan was a delegate to the World Assembly for Peace, which took place in Helsinki in 1955. It

so happened that two representatives of the Soviet intelligentsia found themselves sharing the same hotel room for a week. One was the head of the USSR Writers' Union, Alexander Fadeyev, and another a scientist working at the forefront of world astronomy, Victor Ambartsumyan. They often spent their free time together, talking and walking along the seafront.

Fadeyev was very interested in Armenia and its cultural life. He was also an attentive listener when the conversation turned to astronomy. His keen mind sought to follow questions of cosmogony, far removed from his world of literature. Ambartsumyan soon realised that his companion's attentiveness was not due merely to politeness, but to genuine interest in the subject Often these conversations ended in long discussions about the nature of creative work, be it literary or scientific.

They became a familiar sight together, talking about the life of different generations, and their country, the future awaiting the younger generation. One day, while walking along the sea shore, Fadeyev exclaimed:

"The Baltic holds memories for me!"

"What memories?"

"In March 1921, when we were suppressing the Kronstadt rebellion provoked by the White Guard, I was wounded during an attack."

Fadeyev did not say that he had taken part in the suppression of the rebellion as one of the delegates to the 10th Congress of the Communist Party, that he had crawled, wounded, for two hours over the ice until he was found by some of his own men. He only added:

"But I got off lightly. My cousin, Vsevolod Sibirtsev, died a year before that: the Japanese interventionists pushed him and Sergei Lazo alive into a locomotive furnace."

He also said nothing about the fact that, in April 1920, he had been wounded in a battle against the interventionists near Spassky-Dalny. He spoke of the duty of the present generation to save mankind from nuclear catastrophe.

Victor Ambartsumyan often attended various conferences, congresses and symposiums. There he met many prominent cultural figures of the world, but the meeting with Fadeyev, this wise and deep-thinking man and remarkable comrade, was one he always remembered.

CHAPTER SIX

A Light in the Window

The ceremonial opening of the Byurakan Observatory was drawing closer, and scientists from various parts of the Soviet Union and from abroad were expected.

How long was it since Academician Ambartsumyan and his pupils, sitting in the open back of a lorry, had made their way in rain and snow up the trackless slope of Mount Aragats? And the travellers, having loaded their instruments onto their shoulders, then made their way on foot from Agarak to the construction site. There was a shortage of building materials. These were the difficult post-war years when the country was engaged in rebuilding all that had been destroyed. Up till 1953, the astronomers at Byurakan got their drinking water from an irrigation ditch in the Amberd Ravine. In 1953, as a result of stubborn efforts, they finally managed to get water-pipes installed; such water-pipes had to be laid across cliffs, in difficult mountainous terrain. However, the most difficult problem of all was that of building a road to the observatory.

One day, Grigory Arutiunyan, First Secretary of the Central Committee of the Communist Party of Armenia, went with Ambartsumyan to the construction site. Having listened attentively to those at Byurakan, he jokingly replied:

"I cannot do much to help you in your difficulties with the Universe, but I can assist you in more earthly matters. The first thing I shall promise you is a road. I think that my request will be supported."

A little time passed, and major changes began to take place. Construction work proceeded apace. Arutiunyan was one of the first to drive along the new road to Byurakan.

"When I recall my meeting with Grigory Artemyevich Arutiunyan, a prominent Party and state figure in Soviet Armenia, I must say," remarked Ambartsumyan later, "that he was a man from whom one could learn a lot."

Major progress was achieved in industrial development and construction work during the 16 years that Arutiunyan

was the First Secretary of the Central Committee of the Communist Party of Armenia.

...The builders and the astronomers at Byurakan shouldn't have worried: the visitors praised the hotel, admiring its fine lobby, the interior decoration, the marble floor, the dining-room, the comfortable, light and well-furnished hotel rooms, of which there were, it is true, only ten. Someone remarked that over the entrance to the hotel one might write the motto: "The stars bring people closer together."

Ambartsumyan looked out of his study's window: they had many visitors, though not everyone had been able to come... He still had a great deal to think about: the opening of an observatory is not simply a noisy festivity, but an academic event.

A pile of letters lay before him. From Robinson, Schild, Schucking from Texas University in the USA; they were inviting him to the II Texas Symposium on Relativistic Astrophysics, which was to be an international gathering. Mr Luyten from the University of Minnesota (USA) requested him to take the chair at the opening of the symposium on blue stars and to express his opinion on the agenda. Besides, a conference on those same blue stars was planned to be convened in Strasbourg. And an international conference on physics was due to be held in Brussels.

The well-known astronomer Otto Struve, who was working at the Green Bank Radio Observatory in Western Virginia (USA), wrote to inform him that the Presidents of the Soviet and American Academies of Sciences had agreed to conduct a series of joint symposia on a number of questions related to radio astronomy. Struve wrote in his letter that he would like to invite Ambartsumyan, without upsetting his plans, to take part in the meeting of the International Astronomical Union.

One day in August 1963, several Western newspapers carried the striking headlines: "Fantastic Explosion of the Nucleus of the Galaxy". The newspapers referred to a report by United Press International correspondent from California Street in Los Angeles, not far from the Mount Wilson Observatory. Who could better comment on the report published by this American news agency than the director of the Byurakan Observatory, the author of the hypothesis on galactic nucleus explosions?

By 1963 his hypothesis had been generally recognised. The theory of galactic collisions as the supposed cause of increased radio emission had been finally rejected.

An important meeting was taking place in Byurakan, and Ambartsumyan was busy. Nonetheless he agreed to talk with the press correspondents, and this talk took an unexpected turn.

"Is the explosion of the nucleus of the M82 galaxy, which was observed and photographed by American astronomers, an exceptional event in the Universe?"

"First of all," answered Ambartsumyan, "let us note that the recent interesting observations made by the American astronomers Sandage and Lynds were not of the moment of the explosion itself, but only of its consequences. It was not the explosion that was photographed but the continuing expulsion of matter. This was, in our opinion, the explosion of a very massive body in the nucleus of the galaxy. Some astronomers call such a body proto-stellar, others call it super-stellar. Its mass must be approximately equal to several million solar masses. In other words, it is sufficient to provide material for several million stars. This explosion, which occurred about ten million years ago, could only be seen by us one and a half million years ago..."

"One and a half million years ago?"

"Yes," said Ambartsumyan. "As regards the United Press International report, saying that scientists have now obtained an amazing photograph of the most massive explosion ever observed in nature, let us correct that statement. American astronomers have taken a highly interesting photograph of the result of the explosion."

The talk continued, but the most important thing had already been clarified. The journalists put their next question: Were these observations by American astronomers of any value for astrophysics?

"Of course they are!" replied Ambartsumyan. "But their value does not consist in what United Press International thinks. According to the conceptions developed here, at Byurakan, powerful radio emission already testified to the fact that either the nucleus of that galaxy had divided, or matter had been expelled from it as the result of an explosion. The photographs of the M82 galaxy, taken by the American scientists, have made it possible to ascertain that the masses of gas at the periphery of that galaxy are moving

away from the centre at a velocity greater than that of detachment. Moreover, scientists have estimated the approximate mass of a part of the expelled matter and found it to be equal to the mass of five million Suns."

These words were followed by what appeared at first to be an unexpected conclusion:

"We can note with satisfaction that the work of Sandage and Lynds has provided further confirmation of the idea developed at Byurakan."

Letters from many countries arrived for Ambartsumyan, and he usually replied to them straight away. In reply to a New Year greeting from his French colleagues, he wrote:

"I send my sincere greetings to my French colleagues on the occasion of the New Year. I am far away in Soviet Armenia, but I remember with particular warmth my French astronomer friends and wish them success in the further development of our science.

"The genius of the French nation, embodied in the works of its remarkable mathematicians, physicists and astronomers—Alembert, Lagrange, Laplace, Ampère, Carnot, Cauchy, Leverrier, Poincaré—has played a major role in the creation of that foundation upon which now rests the edifice of modern science, that science which today can control nuclear energy, and has opened the pathway into space."

Byurakan, until only recently an unknown point on the map, now attracted many foreign scientists: Professor Bernard Lovell from Jodrell Bank in Britain; Jesse Greenstein, a member of the National Academy of the USA; H. A. Brück, director of the Royal Observatory in Edinburgh; W. H. McCrea, a professor at London University; Daniel Chalonge, a professor at the Paris Institute of Astrophysics; and Josef Smak, the Polish astronomer—all came to learn about the work being done at the Byurakan Observatory.

The exchange of scientific publications with other related observatories had long since been established, and Byurakan began to receive more and more frequently requests and invitations to take part in the work of various foreign observatories. As far as he was able, Ambartsumyan responded to these invitations, and he visited practically all continents. Many of his trips abroad were connected with his participation in congresses of the International Astronomical Union and sessions of its Executive Committee, and also with visits to major observatories round the

world. In 1957 he visited Pasadena, USA, and the famous Jodrell Bank Experimental Station in Britain. He also delivered lectures in university observatories in Vienna, Graz and Innsbruck (Austria).

In October 1961, Ambartsumyan visited Britain to attend a session of the International Council of Scientific Unions. Professor Lovell invited him to come to Jodrell Bank to discuss certain scientific questions. Professor Hanbury Brown also took part in these discussions.

Research into stellar clusters to determine the total amount of hydrogen they contained was conducted in Britain. This was very important in clarifying the way in which stars are formed—by the condensation of gas clouds or, as Ambartsumyan proposed, by the group formation of stars out of proto-stellar material. The results obtained from observations disproved the first hypothesis.

In March 1962, Victor Ambartsumyan became an honorary doctor of the Australian National University. In 1965, he was also awarded an honorary doctorate by the University of Paris. In January 1966, he was elected a member of the Executive Committee of the International Council of Scientific Unions in Bombay. In 1967 the title of honorary doctor of science was conferred upon him by the Liège University in Belgium, and also by the Charles University in Czechoslovakia. On July 20, 1967, Ambartsumyan became a foreign member of the National Academy of Sciences of Italy, the same Academy whose foreign members had included such prominent Russian and Soviet scientists as Mendeleyev, Chebyshev, Lyapunov, Pavlov, Mechnikov, Karpinsky, Vinogradov and Sobolev.

Pupils About Their Teacher

Ambartsumyan's pupils also came to visit many countries around the world. Professor Ludwig Mirzoyan, D.Sc. (Physics and Mathematics), deputy director of the observatory for science, visited France on many occasions. At the observatory in Haute Provence he worked with the best telescopes it had to offer. He also visited observatories in Marseilles, Lyons, Nice, Paris and the Pic du Midi. He went to the Paris Institute of Astrophysics where he was able to

see their instrumentation and the work being done to design new telescopes and spectrographs for astrophysical research. The visitor from Armenia learned much of interest from such prominent French scientists as Charles Fehrenbach, Pierre Connes, Daniel Chalonge, Georges Courtes and André Lallemand. Together with his French colleagues Daniel Chalonge and Lucien Divan, Mirzoyan studied certain non-stationary stars. He delivered four reports on the work being done at the Byurakan Astrophysical Observatory, speaking both at French observatories and at the Paris Institute of Astrophysics. He also gave public lectures for Armenians living in France on the progress in science being made in Soviet Armenia.

Let us pause to look at Mirzoyan's career.

In 1947 Mirzoyan was about to graduate from Yerevan University and prepared his thesis on mathematics. Although his work was entitled "Concerning One Problem of Astrophysics", it did not deal directly with astrophysics but treated of purely mathematical questions. His tutor happened to be Victor Ambartsumyan who, although he was a mathematician by education, was already a recognised leader of the Soviet school of theoretical astrophysics. A year earlier, Ambartsumyan had founded the Byurakan Observatory and, at the same time, the chair of astrophysics at Yerevan University. In fact, at the time the republic had no qualified astrophysicists, and the observatory was staffed by physicists and mathematicians. It was for this reason that Ambartsumyan suggested that Mirzoyan take a post-graduate course under his supervision. At first Mirzoyan refused. His field was mathematics, and he had only the vaguest knowledge of astrophysics. However, Ambartsumyan was persistent: "Well, what of it? You are young, you still have everything before you. You can learn!"

"Studying under Ambartsumyan was no easy task," recalled Ludwig Mirzoyan. "He is well known for his exactingness. Himself extremely industrious and purposeful, he required the same of others. Even while preparing to take the preliminaries in stellar statistics, I came across my first serious problems. The library contained only one work on the subject. But what a work it was! Almost a thousand pages written in German, a language in which I was very weak. 'You must learn German. You have six months at your disposal,' said Ambartsumyan, and there was nothing

left for me but to plunge into the dictionaries. When, six months later, I came to take the preliminary examination, my supervisor put me just one question: 'Well, did you manage it?' 'If you've read the work,' the strict examiner concluded on hearing me answer in the positive, 'it follows that you cannot but know it.' And he passed me.

"Shortly afterwards came the examination in a foreign language. In those days one had to pass in two languages, and in my case these were German and English. One of these was supposed to be my main language, and I, of course, opted for German. 'No, I don't think so,' objected Ambartsumyan. 'You already know German, and English will be more useful in your work.'

"In this case, as in all others, that, in some way or another, involve science, Ambartsumyan was insistent and consistent. At the international conferences which are organised in Byurakan, we manage without interpreters.

"However, despite his exactingness, Ambartsumyan is nonetheless very considerate. The Byurakan Observatory has become world-famous. In 1967 it was awarded the Order of Lenin. The decisive role in this was, of course, played by Ambartsumyan's personality, his scientific gifts, his organisational talent, and his ability to inspire others and to orient them towards the solution of particularly important scientific problems.

"There are observatories better equipped than the one at Byurakan, but it is rare to find a team of workers so united as the one at Byurakan.

"Ambartsumyan is very solicitous towards the work done by his pupils, and seeks to encourage them to think boldly.

"Despite his numerous awards and honorary titles, Ambartsumyan has remained a modest man, extremely considerate of those with whom he works and who surround him. Several years ago I fell seriously ill. I underwent an operation in Moscow, and spent about a year convalescing at the Moscow Burdenko Institute. Ambartsumyan rang through to Moscow almost every day to ask my wife how I was progressing. He also came to see me in hospital. He willingly attends family celebrations or simply calls in, and will sing and dance along with everyone else. For me he is a man rooted in life itself, and perhaps that is the secret of his personal charm."

"And now, Ludwig, tell us something about your meet-

ings with French astronomers. When I (the author of this book—*Ed.*) went to France in 1981, I was introduced to Chalonge. He spoke about you and Academician Ambartsumyan very warmly."

"With pleasure. But you will have to be patient.

"I first met the famous French astrophysicist, Daniel Chalonge, in 1954, in Leningrad, during the official opening of the restored Pulkovo Observatory. He was among the foreign guests attending the opening ceremony. Our common scientific interests drew us together and we became friends. He was already a famous man in his field, whereas I was only a beginner, but we were both working on the spectrophotometry of hot stars in the visible ultra-violet range of the spectrum. With the help of a spectrograph which he himself had invented, Chalonge and another well-known French scientist, Daniel Barbier, observed a large number of hot stars from an observatory in the Swiss mountains, and on the basis of the results of these observations, elaborated a special spectral classification of stars. This classification, which has now become standard, played an important role in the study of stellar atmospheres and inter-stellar absorption. Chalonge was assisted in this work by a pupil who later also became a well-known astronomer, Lucien Divan.

"I met Chalonge for the second time in 1958, at the International Astronomical Congress in Moscow. By this time we had already become good friends and corresponded with each other. In 1966, I was sent on an official journey to France and visited the National Observatory in Haute Provence. Here I met Chalonge quite by accident. He had already finished the work he had been doing there, but, on learning of my arrival, had stayed behind for a few days.

"Chalonge gave me a warm welcome and introduced me to all the scientists and members of the observatory's staff. Then he proposed that we undertake some joint project. He promised to help prolong my stay in France for another month so that we could carry out stellar observations using his spectrograph. (Time allotted for work using the telescopes in the observatory is decided six months in advance, and Chalonge's next period was fixed for three months later).

"I stayed in France for another month, and began observations with Chalonge and Divan. Taking into account the

general trend of research being followed at the Byurakan Observatory, we included spectrographic research into non-stationary stars in our programme.

"I visited France three more times and continued our joint observations of the spectra of particularly interesting stars, using the huge telescope at the Haute Provence Observatory and Chalonge's spectrograph. When I was absent, Chalonge and Divan continued the work, and they also came to Byurakan to conduct further joint research. From time to time we would discuss our work with Academician Ambartsumyan. Such discussions were particularly fruitful when Chalonge and Divan were in Byurakan. We published a resumé of the results of our research in a series of articles entitled "Spectrophotometric Research into Non-Stationary Stars", which was published in the journal *Astrofizika* (Astrophysics).

This joint work with Chalonge and Divan continued for a long time, though it was interrupted when I fell ill. The death of Chalonge, however, is a heavy loss both for us and for our work.

"When I was in France recently I found among Chalonge's papers some material on the work we had been doing together concerning an extremely interesting object that 'flared up' in 1970-1971, and can still be seen today. We now know of several such indisputably young stars, and they are of considerable interest. We began to observe this object in France, in the autumn of 1971, and continued up to 1974. An analysis of these observations yielded important results, and, in particular, the appearance of a gaseous envelope around the star during the 'outburst.'

"Chalonge was a sincere friend of the Soviet Union. I remember the speech he made just before I delivered my public lecture in Paris 'On the Development of Science in Soviet Armenia', which was organised in Paris for Armenians living in France. He spoke so warmly of present-day Armenia, from which he had just returned, about the scientific work being done at the Byurakan Observatory, about Armenian culture and about the capital, Yerevan, that many of those present were deeply moved.

"Another very interesting conversation took place in 1971 between Chalonge and the famous Armenian painter, Martiros Saryan, in Saryan's apartment. They spoke about the history of Armenia and the renaissance it is

experiencing today.

"To the end of his days Chalonge remained a true friend of the Armenian people."

"Which other French astronomers have you met?"

"Charles Fehrenbach. He was favourably disposed to our cooperation and, as the director of the observatory, was always ready to help us, providing us the opportunity to conduct our observations using the observatory's telescope. When he came to Armenia he delivered two lectures at a scientific seminar held at the Byurakan Observatory. The subject was the latest trends in making astronomical instruments and, in particular, the principles used in the construction of astronomical spectrographs. He displayed considerable interest in Armenia as a whole, its culture and scientific development in particular. He was deeply impressed by his meetings with ordinary people.

"Once, when we were driving from Echmiadzin to Byurakan, we saw people baking *lavash* bread in one of the courtyards in the village of Voskevaz. We stopped the car and sent the driver to buy a fresh *lavash.* When the people who lived there learned who we were, they came out and invited us into their home. We explained that we were in a hurry, and they immediately gave us, together with the *lavash,* fresh cheese and herbs, and categorically refused to take any money. Fehrenbach was very moved (he even asked us afterwards whether we had prepared it as a little surprise).

"When Fehrenbach returned to Marseilles, the local Armenians, learning that he had just come back from Soviet Armenia, requested him to be the honorary chairman at a meeting to be held in honour of the anniversary of Soviet Armenia. Fehrenbach not only willingly accepted the invitation, but also himself addressed the meeting, speaking enthusiastically of Armenia and the cordiality and hospitality of the Armenians.

"Jean Claude Pecker was the General Secretary of the International Astronomical Union when Academician Ambartsumyan was the President. Pecker visited Armenia for the first time in 1962, and was very favourably impressed by the work being done by Armenian astronomers.

"When I went to France in 1966, Pecker was the director of the observatory in Nice. He immediately asked me if Academician Ambartsumyan was also coming to Nice to

attend a meeting of the IAU Executive Committee. On learning that Ambartsumyan was ill, he booked a telephone call through to Byurakan and soon we were relieved to hear that Ambartsumyan was recovering.

"When I next went to France, Pecker was already the director of the Paris Institute of Astrophysics. He gave us every assistance in continuing our joint work, and sought to expand our scientific cooperation.

"In 1973 Pecker, then the President of the French Astronomical Society, came to Byurakan. The month that he spent with us helped to broaden our scientific cooperation, which also included the study of galaxies. Thanks to Pecker, a number of French astronomers came at different times to work at Byurakan. They included Heidmann, Milet, Terzan, Collin-Souffrin and Lelièvre. Two of our Byurakan astronomers, Oskanyan and Nikogosyan, worked in France.

"One interesting incident occurred during Pecker's stay in Armenia that I would like to tell you about. On May 9, 1973, Academician Ambartsumyan, Pecker and myself went to the memorial to the Battle of Sardarapat, in which the Armenians were victorious over the Turks. After looking at the memorial, which our visitors liked very much, we decided to have dinner. However, as the local restaurant was closed while repair work was being done there, we drove to Yerevan, and, knowing that all the restaurants in the town centre would be full at that time of day, we drove to the outskirts.

"When we were finally seated at our table, we learned that the faculty of the Yerevan Polytechnical Institute were celebrating V-Day. When they found out that Academician Ambartsumyan was there with guests from abroad, they came up to our table to greet Ambartsumyan and his guests, and thereafter continued to offer many tokens of their attention. For Pecker this was a pleasant surprise."

...In 1965, a Soviet scientist, Grant Tovmasyan, D. Sc. (Physics and Mathematics), was conducting astronomical and radio-astronomical research in various radio observatories in Australia, which has some powerful radio telescopes.

In Australia, a great deal of time was devoted to observing the nuclei of radio galaxies, using optical methods. These observations also confirmed Ambartsumyan's idea

concerning the activity of galactic nuclei and their major role in the formation and evolution of galaxies.

This is what Grant Tovmasyan had to say about his first meeting with Academician Ambartsumyan:

"I first met Ambartsumyan at Yerevan University, where he delivered lectures to our group of astronomy students in 1950. He was already a well-known scientist who had made an important contribution to the development of astrophysics. His lectures were very interesting, although he had no particular gift for oratory. Sometimes one even had the feeling that, while he was delivering his lecture, he digressed from his main theme and began to speak about something that interested him at that moment. But everything he said was marked by depth of thought.

"I have known Ambartsumyan for more than thirty years, but I never cease to be amazed at his capacity for work. During all those years, I never saw the windows of his study in Byurakan go dark before midnight except when he was not in Byurakan. And this was after a busy working day, whether in Byurakan itself, or in the Presidium of the Academy of Sciences, or at various sessions of the government, or the Central Committee of the Communist Party of Armenia. He didn't seem to know what tiredness was. He has the remarkable ability, after some exhausting meeting, to immediately turn to the solution of some astronomical problem, the discussion and editing of some scientific article by someone working at the observatory—it did not matter who it was: the head of a department, a junior researcher, a doctor or candidate of science, or a young post-graduate student. Victor Ambartsumyan is totally dedicated to his field of science. As I said before, he always finds the time to discuss a scientific question."

Then Tovmasyan recalled a sad yet amusing story.

"A few years ago Ambartsumyan received a letter from some schoolchildren—amateur astronomers—who wrote that they were amazed to learn that he was still alive! You see, he had done so much, made so many discoveries, that the children had decided he must be long since dead. Ambartsumyan would often recall this incident with a smile."

In answer to my next questions, Grant Tovmasyan continued:

"Astronomers from other observatories and from other countries come to Byurakan both to carry out observations,

using our telescopes (a Schmidt one-metre telescope, and now a 2.6-metre telescope), and, mainly, to exchange opinions, to learn in more detail about Ambartsumyan's new ideas concerning the formation and evolution of stars and stellar systems. Young astronomers from Hungary, Bulgaria, Yugoslavia prepared their theses here in Byurakan. Astronomers from France, Mexico, the USA, Italy, the FRG, the GDR and other countries came and spent several months at a time at Byurakan, carrying out joint projects."

My conversations with Ambartsumyan's pupils continued and they brought to my mind Victor Ambartsumyan's trips abroad.

Once, in answer to my question as to what he would like to wish young scientists, Victor Ambartsumyan replied:

"To work for the benefit of the people, to work tirelessly. Time is precious and must not be wasted. I would also like to warn those involved in creative work, particularly the young, not to rest on their laurels. Science does not tolerate pauses. I wholly disagree with those who believe that science has resolved all the fundamental questions relating to Nature, leaving now only a few enigmas to be cleared up. Therefore one must work without fear of the difficulties, work passionately and with genuine creative enthusiasm."

I continued to interview Ambartsumyan's pupils. Elma Parsamyan, D. Sc. (Physics and Mathematics), senior researcher at the Byurakan Observatory and head of the chair of astronomy and theoretical physics at the Abovyan Pedagogical Institute in Yerevan, began her reminiscences as follows:

"This is not the first time I have been asked to describe my first meeting with Academician Ambartsumyan, and this story, by virtue of frequent repetition, has become almost legendary for my friends. However, for me it remains an unforgettable episode in my life, and one that seems to have happened only yesterday.

"It happened in 1946, when I was still at school. Work on the Byurakan Observatory had only begun, and the staff were still working in Yerevan. Observations were being made from a small tower in a square between the University and the Polytechnical Institute. And I had dreamed of the

stars from early childhood, and that was why I went there one day with my mother, in the hope of meeting my idol. Ambartsumyan was still young, only thirty-six, but the aura of fame that surrounded him and the scientific prestige he enjoyed placed him, in my eyes, beyond reach. Nonetheless he treated me seriously and kindly. He asked me what marks I was getting in maths and physics, tested my memory for figures, and advised me to study English when he learned that at school I was studying German.

"I had my own astronomical ideas, and, plucking up my courage, I told him about them. It turned out that I was not the first to have these ideas, but Ambartsumyan approved them nonetheless. He asked one of his associates to let me look at the sky through a telescope and, as we said goodbye, he added: 'Many are filled with awe at the sight of the stars and often exclaim: "Oh, what a beautiful sky!" But only a few become astronomers. I believe you will become one.'

"He said this with such conviction that the next day my mother herself went to buy me an English text-book. That short conversation with Ambartsumyan, in which he asked me only a few questions, virtually outlined the whole programme of studies I had to undertake. And later, when I was a student and then when I began my scientific work, I felt his goodwill and support, and trusted in his pedagogical sense and scientific vision. Nor am I the only one indebted to Ambartsumyan, nor yet only those who studied under him."

"Ambartsumyan is a pioneer, blazing new trails for others to follow. That is true of almost every basic idea that he has put forward throughout his life: the discovery of the activity of galactic nuclei, the principles of invariance, the mechanisms of gaseous nebula luminosity, flare stars and stellar associations. As to this last discovery, for example, it can be safely said that today there is not an observatory in the world which is not dealing with this question.

"I have made three professional business trips to Mexico. While there, I was twice invited to work at major US universities—Cornell, Texas and others. I was also approached with other tempting offers. The reason for this attention is quite simple—everyone knows that I work in Ambartsumyan's observatory.

"At the American observatory at Mount Palomar (Cali-

fornia) there is a huge five-metre telescope. Not every American astronomer has the opportunity to work with this telescope, but astronomers from Byurakan have spent many hours looking through it. I believe that here, too, Ambartsumyan's name played a decisive role.

"In 1974 I went with Ambartsumyan to Argentina. We lived on the territory of the La Plata Observatory, not far from Buenos Aires. Each morning Ambartsumyan was greeted by all those working at the observatory. They would line up as if forming a guard of honour outside the door of his house. While in Argentina, he daily gave consultations on all questions pertaining to astrophysics, and an imposing queue would form outside his door at the appointed hour. Well-known scientists and those just beginning their career sought his consultations. I remember how one young American came out and, pointing to his file containing a manuscript which he had taken along to discuss, said: 'Starting from tomorrow, I will know my way in science.'

"Ambartsumyan's prestige as a scientist and organiser of science is recognised far beyond the borders of the Soviet Union. Suffice it to say that he was the first Soviet scientist elected President of the International Council of Scientific Unions, which unites the academies of sciences of 60 countries and 15 international scientific unions. He was also the first in the history of this council to occupy this post for two consecutive terms.

"From his childhood Ambartsumyan has been able to perform complex mathematical calculations in his head. He remembers by heart entire pages from the tables of logarithms. Sometimes we are still merely collecting together the material for the computer, and he is already moving on. He never wastes time.

"With others Ambartsumyan is always mild; he never raises his voice, and this does not always make things easier if you feel to blame for something. I know of only one flaw in his character—he is excessively kind. However, his tolerance of human weaknesses ends where science begins. Here he is implacable, and can be unusually harsh.

"All this in no way implies that Ambartsumyan lives only by science. His intellectual interests and pastimes are wide-ranging and diverse. He once amazed me with his knowledge of poetry. During our seven-hour flight to Argentina, I discovered that he knows by heart many of Push-

kin's poems. He also knows and loves many other poets, is very interested in history, is well-informed about art...

"It is true that Victor Ambartsumyan, one of the most outstanding scientists of our day, has been greatly endowed by nature, but it is also true that he is a self-made man."

Elma spoke warmly, enthusiastically about her teacher.

In the autumn of 1984 I spoke with another pupil of Victor Ambartsumyan, senior researcher Romella Shakhbazyan, at the Byurakan Observatory. In contrast to Elma, she strove to speak calmly, although she did not always succeed.

"I first met Victor Ambartsumyan," she began, "during my third year at university, when he was delivering lectures in astrophysics. I was impressed by his ability to set out even the most complex material simply, and very clearly.

"While I was still a student in my fifth year, I began my work at the Byurakan Observatory, and worked under Ambartsumyan for almost 15 years. In those years I worked beside him during many days and evenings up to midnight and later, and on weekends and holidays. I learned a great deal from him, and I owe a lot to him. It was he who taught me to love my work, my native land, and to be modest. Perhaps these traits already existed in my character, but it is thanks to my tutor that they were able to develop and become firmly rooted personal qualities.

"All of us who have studied under Ambartsumyan know the way he penetrates into the very core of the questions that interest him, how well he understands their essence, and how he is able to approach them from a new, totally unexpected angle. Ambartsumyan has never taken up so-called 'fashionable' topics, never followed the trodden path. He has an intuitive sense of the promise held by a given problem or line of research, is able to raise original, fundamentally new problems and questions, and to find a seemingly simple, natural, yet hitherto unsuspected explanation for the phenomenon under discussion.

"I do not wish to speak here of the accuracy of his scientific forecasts, which are almost always, sooner or later, confirmed by observations, of his scientific intuition, the originality of his thought, his enormous capacity for work, of science and, in particular, astronomy to which he is so

devoted, or about the fact that he is always able to attract and take with him those he associates with. And he associates with an enormous number of people from the most diverse spheres of life and with the most varied educational levels. He is able to make any achievements in science, and especially in astronomy, sound interesting and comprehensible, because he describes them vividly and clearly. I remember many trips we made together. He was always witty and was such an engaging speaker that I truly regret not having taped all these conversations.

"My tutor often said that we have a lot to learn, that we must never be conceited, and that science ends where conceit begins. He loves to joke that science is like a jealous mistress; she never forgives any betrayals and takes a harsh revenge for them.

"We, astronomers at Byurakan, and not only at Byurakan, are happy when Ambartsumyan looks through our work. He never makes any unnecessary corrections or major changes. However, sometimes just the addition of one relevant word, one brief line, makes the whole work better, clearer, more complete.

"Ambartsumyan is deeply attached to the Byurakan Observatory. A good piece of research work done there, a good photograph taken by the Byurakan telescope, a discovery made at Byurakan, a good thesis defended at Byurakan or a new telescope installed at Byurakan is always for him a source of inexhaustible joy and enormous inspiration.

"The people at Byurakan well remember his amusing interview on the topic of the astronomer's working day, which was written for the observatory bulletin:

'An astronomer must always come to work in the morning, develop the plates photographed during the nighttime observations, examine them carefully, note the results, ponder those results. After the dinner-break he must work to raise his own scientific level, read new scientific literature, prepare to make further observations, and then, during the night, observe the sky until the next morning. Only this organisation of the working day will permit him to hope that, with time, he may perhaps achieve something in his work.'

"He would often emphasise the importance of observations, always encouraging and welcoming such work; and his own ideas and conclusion, however much they might at first

appear to be purely intuitive and fantastic, were always based on thorough knowledge and the wealth of observational material with which he continually acquainted himself.

"During the first years of my work at Byurakan we had only just received a copy of the atlas compiled at the Mt Palomar Observatory in California, which contained photographs of the whole of the sky of the Northern Hemisphere. The photographs had been taken using a Schmidt 48-inch telescope. They were high-quality photographs, thanks to which we were able to identify thousands of new, very faint celestial bodies whose existence we had known nothing of until then. The maps in the Mt Palomar Atlas broadened our conception of the Universe. They contained a vast amount of material that was the fruit of lengthy observations. For days on end Ambartsumyan and I examined these maps centimetre by centimetre, using a tenfold magnifying glass and discovering new objects, galaxies and galactic systems. We showed each other those objects which we thought were the most interesting and unusual.

"When Ambartsumyan's first granddaughter was born, he said to me: 'Romella, now I have a granddaughter. You know, it's very interesting, almost as interesting as looking at plates and the maps in the Palomar Atlas—you're always finding something new, something interesting, something unexpected...' During those years, and later on also, first Ambartsumyan and then I, discovered several blue objects in the vicinity of elliptical galaxies, and we investigated binary and multiple galactic systems. Ambartsumyan noted that Trapezium-type systems are met with more frequency among galaxies than among stars, and he concluded that the members of these systems were unstable and therefore young, and that they were formed as a group. It was also then that he pointed to one very unusual compact cluster which, so we then thought, was composed of stars. Ambartsumyan told me to study the cluster and set forth the results. This work bore my name, because my tutor did not wish the work to appear as a joint effort, and, although the report said that the discovery itself had been made by Ambartsumyan, the cluster, which proved to be a cluster of galaxies and which attracted the interest of the whole of the astronomical world, was named after me on the

suggestion of the Italian astronomer Rosino. This has weighed on my conscience ever since.

"Ambartsumyan is always generous in giving advice, making suggestions and sharing his observations, but almost always refuses co-authorship, often crossing out the acknowledgement at the end of the article. The more we give, the richer we become ourselves; the more necessary we are to others, the better we ourselves feel, he says, and always reads our articles and patiently corrects our mistakes.

"However, we at Byurakan know Ambartsumyan not only as a scientist," continued Romella. "We also know him as an interesting interlocutor, a man able to share the joys of others, a man who sings and dances, rejoices and grieves together with us. I remember the funeral of Gurzadyan's father. Music by Komitas and Beethoven was played. Ambartsumyan also came to the funeral. We were both deeply moved. After the funeral he said to me: 'The Armenians are a good people, Romella, sensitive, helpful, sincere. It's very difficult when someone in the family dies. My brother died twenty-five years ago. It was dreadful, and I still cannot recall that day without emotion.' Ambartsumyan then appeared to me in a new light—mild, understanding. I will never forget the sensitivity, concern and attention he displayed to me in difficult moments, the way he did all he could to ease my grief.

"I will risk repeating myself and say once again that Ambartsumyan is a man of amazing mildness, goodness, tact and benevolence, always willing to help, a man of great learning and of great modesty. In the many years I have worked with him, I cannot recall him once raising his voice. He always finds the most tactful way to express any dissatisfaction."

I thanked Romella for a most interesting conversation, and then continued to ponder on Ambartsumyan's inner world.

In the autumn of 1984 Ambartsumyan celebrated his seventy-sixth birthday. There were no official speeches. Once again, as years before, all were busy at their work, and his pupils continued to please him with their achievements.

Academician Veniamin Markaryan, using a Schmidt telescope, discovered more than 500 galaxies emitting unusually strong ultra-violet radiation. They are now known as the Markaryan galaxies. The first detailed examination of these

galaxies, carried out in the USA by Eduard Khachikyan jointly with American astronomers, showed that they have very active nuclei and constitute some intermediary stage between normal galaxies and quasi-stellar objects. Convincing evidence of the high activity of the nuclei of the Markaryan galaxies was provided by the identification of the consequences of an explosion in the nucleus of the Markaryan-6 galaxy, a discovery made by Khachikyan and the American astronomer Weedman.

Arsen Kalloglyan and the French scientist Jean Heidmann discovered, in the course of joint work, interesting evidence of the dynamic instability of the systems composed of the Markaryan galaxies. This result can be seen as confirming the suggestion that they are of recent origin.

Detailed study of the spectra of the Markaryan galaxies, carried out jointly by Marat Arakelyan and astronomers in Moscow, has confirmed the high nucleus activity of such galaxies. Arsen Kalloglyan, Romella Shakhbazyan, Sophia Iskudaryan and Karineh Saakyan have published works dealing with galaxies belonging to various classes.

Grant Tovmasyan, a scientist at the Byurakan Observatory, carried out extensive research into galactic radio emissions, using huge radio telescopes in Australia and the USA. These observations showed, among other things, that certain galaxies in this class emitted not only strong ultraviolet radiation, but also a rather strong radiation in centimetric waves. Moreover, this radiation comes from the central regions of these galaxies, which is yet another indication of the high activity of their nuclei.

Once one of my Estonian friends asked me to tell him about Ambartsumyan.

"I've heard a lot about him, but I'd like to know what he is like."

"Surely you must have seen his photograph."

"What can a photograph tell you? It would be far better if you'd tell me yourself, in your own words, what he's like."

"Well, he's about average height," I answered. "At first glance his face appears somewhat harsh. Under his bushy eyebrows his eyes are lively and intelligent, and they gaze at you directly and attentively. As soon as he begins to talk, you imperceptibly fall under the spell of his charm. When he's thinking about something, he walks up and

down, taking small, rapid strides. He speaks calmly, as if taking care to be precise, but when he is carried away by the topic, he speaks with passion."

"Well, that's very different from just seeing a photograph. Now I've learned about Ambartsumyan and about you."

"About me?"

"Yes. You seem to be an observant man."

I then read to my friend from Tallin some extracts from the speech delivered by Academician Ambartsumyan at a meeting with US Congressmen about certain trends in modern astrophysics. That was in 1979.

"International symposia were held in 1966 at the Byurakan Observatory and in 1970 at the Pontifical Academy of Sciences to discuss various forms of the activity of nuclei, including the phenomena occurring in quasars and Seyfert galaxies as particular instances of such activity. Since then a vast amount of observational work has been carried out by various observatories around the world in order to understand these processes better. However, it must be admitted that there has been little progress to date in their theoretical interpretation. Although the observed forms of activity of the nuclei directly indicate explosions and expansion in the central regions of the galaxies in question, certain theoreticians still continue to produce models of these phenomena which present the expulsion of matter from the nucleus as preceeded by some collapse of a large mass of diffuse matter. According to such models, the expulsion of matter is merely a secondary effect caused by the process of collapse. There is scarcely any need for me to repeat that I am very sceptical about such speculative constructions. I know of no observational evidence in their favour. Here again we are dealing with old prejudices according to which processes in the Universe are reduced to various forms of compression and condensation, with the origins to be found in some diffuse matter."

"And what were Ambartsumyan's conclusions?" asked my companion.

"Rather than telling you myself, I shall read you the conclusion of Ambartsumyan's speech."

"In conclusion I would like to say a few words about the degree of success achieved in each of the lines of research discussed above.

"1. I am very pleased to note that, in the course of the

37 years that have passed since the publication of my first work on the application of the principle of invariance, a large number of results have been achieved. This research was further developed in the brilliant works by Victor Sobolev and his associates. The participation of Professor Chandrasekhar in the work done in this area is a source of satisfaction for me and for my young colleagues. I can foresee still further applications for the principle of invariance in many areas of mathematical physics, and even in other branches of the exact sciences.

"2. It is obvious that success in the area of the inverse problems in astrophysics has proved very modest. I was, in fact, at the beginning, more enthusiastic about this trend than others. This shows that success depends not so much on the wishes of the researchers as on the general state of affairs in the given area and the difficulty of the problem. However, even now I do not doubt that this trend is very promising for astrophysics. In particular, I am convinced that it will play a major role in cosmology.

"3. The approach to the study of evolutionary processes which was presented above as the third line of my research has become wide-spread in astrophysics over the last few decades. It has penetrated almost every branch of our science. Perhaps it would be no exaggeration to say that, in part thanks to this approach and the hard work done by a whole generation of astrophysicists, this discipline has become an evolutionary science.

"It is now clear to everyone that the totality of problems relating to the origin and evolution of celestial bodies cannot be solved on the basis of one or a few models. New discoveries are adding to the number of tasks facing us in this area.

"My sceptical attitude to many formal theoretical models is strengthened by the fact that almost all the new discoveries made by scientists in observational astrophysics have been unexpected for such models. The effect of such discoveries on these models is either destructive or involves major revision.

"Let me cite two examples.

"(a) Many theoreticians are of the opinion that we already possess a more or less consistent theory of stellar evolution. However, it was precisely this theory which was unable to foresee such an important phenomenon as stellar

outbursts. We are, of course, once again referring to the flare-ups of young dwarfs. Even now the majority of theoreticians ignore the fact that outbursts are just as important in the life of young stars as regular electromagnetic radiation is for all stars in general.

"(b) The stituation is even worse as regards fuors (the term used in the Soviet Union to denote FU Orionis stars). The realisation that this stage of development must play a major role in the life of at least a certain category of stars may prove fatal for a number of speculative theories. The position of these theories becomes even more critical if one remembers that there exists a whole series of different stars which, from the photometric point of view, behave like fuors.

"The P Cygni star is an example of just such a star, and we know that each spiral and irregular galaxy contains many similar super-giants. For this reason, processes similar to the ones which occur in fuors should be attracting greater attention.

"I place great hopes on observational research into such objects. This research ought to provide the good material which will enable us to construct a picture of stellar evolution on the solid foundation of observational data."

From the Scientist's Correspondence

The name and personality of Ambartsumyan continue to attract attention. Students at Leningrad University asked the Academician to answer four questions. The replies were published in the newspaper *Leningradski universitet* (Leningrad University).

Q. What do you consider to have been most important in your scientific work over the last two or three years?

A. My work in the interpretation of numerous and diverse facts relating to the structure and nature of galaxies. I set forth the results of this work in August 1961, in a report delivered at a plenary session of the 11th Congress of the International Astronomical Union in Berkeley.

Q. What was the most significant event in your life?

A. The decision to become an astrophysicist and to study at Leningrad University, a decision I took while I was still a pupil at secondary school.

Q. What are your plans for the future?

A. To continue my scientific work and try to attend fewer meetings.

Q. What would you like to wish the lecturers and students at Leningrad University?

A. I wish them new successes in their research and pedagogical work, I hope they will raise still higher the banner of one of the most famous universities in Russia, the banner of Soviet science.

...I was particularly interested to read letters sent by schoolchildren.

At the end of October 1972, a letter arrived in Byurakan from pupils in the tenth form at School No. 69 in Novosibirsk. The children asked Ambartsumyan to answer a few questions of particular interest to them. They wrote that they had been happy to learn that he was still alive, their contemporary. Although we have already referred to this comment, we shall now see what else they had to say:

"Dear Victor Amazaspovich,

"This letter is from a schoolgirl in the tenth form at School No. 69 in Novosibirsk.

"In order to increase interest in physics, we are holding a physics month at school, and have decided to devote a stand to famous physicists.

"I myself don't really know any physicists and imagine that they all lived in the last century (for the most part)... So I was very surprised to learn that you are alive today, that you are still working, although your name is already in the encyclopaedia and you have published dozens of works...

"On behalf of all our Young Pioneers and Komsomol members I would like to ask you to write to us. Please write just a few lines about your career in science and about the work you are doing now.

"Can you imagine the interest in famous Soviet people, in physics and astronomy (and I myself consider these two to be the most interesting sciences) that the pupils will display?!

"We should like to invite you to our school but we realise that this is not practically possible. However, if you should ever come to our Akademgorodok (Science Town.—*Ed.*), please call and see us. We shall always be happy to see the welcome guest.

"Well, that is all I have to say. I look foreward to receiving your reply,

"With Komsomol greetings,
Tatyana Moiseyenko.
October 11, 1972.

"P.S. I apologise for any mistakes or for expressing myself badly,

"Tanya."

A little while later they received the scientist's reply.

"Dear Comrade Moiseyenko and other pupils in the tenth form at School No. 69, Novosibirsk,

"I received your letter and apologise for the delay in replying to it. I have been ill, and a great deal of correspondence was waiting for me.

"You asked me to tell you about my career in science. That is a difficult thing to do. One thing is clear—I had to work, work, and work. If that was the right choice when I was still young, then it is even more so now. In the years that have passed since my student days, the edifice of science has been growing. The minimum of scicntific knowledge necessary to work fruitfully in science has also considerably increased.

"I can say the following: to become a genuine scientist today is a very difficult business.

"If there are those among you who want to become scientists, let them devote themselves to it entirely as of this moment. Science does not favour those who try to combine love of science with other pursuits.

"I wish you all success, whatever profession you choose in life. The important thing is to strive to benefit society.

"Sincere good wishes,
"Academician Ambartsumyan."

Lyudmila Pogosyan, Ambartsumyan's constant assistant, sometimes answers his letters for him at his request:

"Dear children,

"Academician Ambartsumyan has been ill, and therefore it was some time before he received your letter. Victor

Amazaspovich thanks you for your invitation to visit your town, and wishes the members of your club every success in their studies and their school life:

"I am sending you a copy of an article published in the journal *Zemlya i vselennaya* (The Earth and the Universe), in which you will find the answers to your questions about the Byurakan Observatory.

"We hope the members of the Young Columbuses' Club will make many interesting journeys.

"Happy sailing!"

And here is yet another letter sent to a schoolgirl in the ninth form at a school in Leningrad:

"Dear Natasha,

"Academician Ambartsumyan has received your letter. Victor Amazaspovich was happy to learn that you are interested in astronomy—the science to which he has devoted the whole of his life—and want to become an astronomer. The study of astronomy, like the study of any other science, requires talent and considerable knowledge, which cannot be acquired without persistent, hard work. That is why even now, while you are still at school, you must try to develop such qualities as perseverance, industry and a serious approach to your studies, and particularly such subjects as physics and mathematics, without which it is impossible to become an astronomer...

"Victor Amazaspovich wishes you good health, success at school. That will be your first step towards astronomy.

"We wish you a happy summer vacation,

"Assistant L. Pogosyan."

The next letter was written by a schoolgirl in the GDR. Academician Ambartsumyan asked Romella Shakhbazyan, senior researcher at the Byurakan Observatory, to answer it for him.

"Dear Annette,

"I am writing to you on behalf of Victor Amazaspovich Ambartsumyan. I have read your letter, and I am pleased to learn that already, at the age of fifteen, you have a particular interest. You know what you want to do in the future. I hope this interest will remain with you for the rest of your life.

"Astronomy is an extremely interesting science. It attracts young people by its romanticism, its relative accessibility

and its numerous interesting and unresolved problems. However, you have to realise that astronomy also requires hard and painstaking effort, night-time observations, the evaluation of these observations, and calculations. If one is to be able to understand the results obtained, one has to do a great deal of serious work, to know a lot and to study a great deal.

"At the moment you are a schoolgirl. Try to study well, to understand everything thoroughly, to get to the essence of what you are studying.

"Do you like mathematics and physics? You cannot become a good astronomer without a serious grounding in these subjects. Nor is it so easy to find the answers to such questions as how and from what stars and galaxies are formed, what quasars and compact galaxies are, etc. In order to find the answer to any of these questions, many scientists must invest their labour, effort, knowledge and talent, carry out new research, and solve a number of simpler and more modest tasks, each of which, if resolved, redounds to the credit of the scientist who solves it. Therefore to begin a study of astronomy with its most complex cosmogonic problems, to adopt the point of view of one or other astronomer without having sufficient knowledge, is rather like beginning the ninth form maths programme not at the first page of the maths text-book, but at the last, not by successively solving more and more complex problems, but by trying to solve the most difficult one straight away. The questions that interest you do, indeed, seem accessible and comprehensible, but behind this seeming simplicity there lies profound knowledge.

"I believe that each individual should choose the profession that he likes very much, that he would choose even if it were forbidden, or if he would be paid nothing.

"It would be a good idea if you could visit the Tautenburg Observatory and work there for at least a month. That would help you to appreciate better the daily work of an astronomer. Sometimes the impression formed by someone on the outside does not correspond to the reality, and I should not like you to choose a career with which you would become disillusioned later. You must realise that to be an astronomer is no easy thing. It is particularly difficult for a woman. You must think about this, and not forget that you will have to do this work for the rest of your life.

"April 20, 1977."

Here is the reply sent by Academician Ambartsumyan to a young soldier of the Soviet Army. He is full of concern and consideration for this young man.

"Dear Comrade Vybornov,

"I have received your letter in which you ask for my advice concerning a choice of career. Of course, to begin to specialise in astronomy at the age of twenty-two is a little late, and I would hesitate to recommend it. However, if you feel not merely an interest in astronomy, but also the ability to overcome the difficulties that will face you in mathematics and physics, that is, if you were very good at mathematics and physics at school and later, then you have the makings of a good astronomer. In that case I could advise you to study astronomy in one of the universities that offers this subject.

"If, however, you had not displayed great ability or interest in the subjects I named above, then I should not advise you to study astronomy. Write and tell me what you feel yourself to have a great ability in (apart from astronomy). Maybe in some branch of technology? Then we can perhaps advise you what to do in order to be able to work in an area that borders on astronomy (for example, astronomical instrument-making, etc.) and thus keep in touch with developments in astronomy.

"Whatever the case may be, remember that interest alone is not sufficient. In addition to interest one must also have the necessary abilities and industry.

"Wishing you every success,
"Academician Ambartsumyan."

It would not be possible to reproduce here even a fraction of the correspondence that arrives at Byurakan, and not only from schoolchildren and young people. An enormous number of letters arrive every day, addressed to the renowned scientist.

Scientists, newspaper and journal editors write to Ambartsumyan with various requests. Academician Ambartsumyan has become widely known as the founder of Soviet theoretical astrophysics and the head of a major scientific school. His research in a number of new areas connected with astrophysics and stellar astronomy is being continued by numerous pupils and followers not only in the USSR but also abroad. His work in stellar cosmogony not only confirms

the correctness of the main propositions of dialectical materialism, but also provides abundant material for new and important theoretical conclusions.

The expression "a sea of lights" describes accurately the impression created by one the largest cities in the world—Tokyo.

A small sign with the word *Sekai* hangs outside quite an ordinary building on a quiet street in the city. It is the name of a magazine that was founded during the Second World War.

Its editor-in-chief, Ebihara Mitsuyoshi, wrote to Ambartsumyan at the end of 1959 with the following request:

"...In our first issue for 1960 we should like to acquaint our readers with the prospects for the 1960s as seen by foreign scientists. We should be very grateful to you if you would agree to take part, and we enclose a letter written by a prominent Japanese astronomer and professor at Tokyo University, Hatanaka Takeo..."

An envelope addressed to the editors of *Sekai* left Byurakan for Tokyo: "...I think that your idea to publish the views of scientists from various countries in the form of an exchange of letters between them and Japanese scientists is a very good one..." wrote Ambartsumyan.

He then went on to reply to the question put by Professor Hatanaka Takeo, summing up the achievements of astronomy in the first half of the twentieth century and giving his opinion on its future prospects.

"The prospects as regards the study of the solar system in the forthcoming decade are enormous. Everyone is aware that each year will see the launching into space of increasingly improved flying vehicles which will provide us with reliable information on various cosmic bodies. The time is not that far distant when the first men will fly into space, though, of course, it is difficult to predict when exactly this will happen.

"It must be admitted that the science of the planets and their satellites, which had developed successfully from the moment of the invention of the telescope down to the beginning of the twentieth century, then found itself relegated to the background as a result of the incredibly rapid development of our knowledge about the physics of the stars and the structure of the stellar Universe. Those of us working in the field of stellar physics and stellar astronomy had the

impression that planetary astronomy was standing still. Thus, the trains and cars moving on the surface of the Earth seem immobile to a man flying in a plane.

"In fact, of course, planetary astronomy was moving forward. Yet the past decades brought no decisive successes, but now the photographs of the reverse side of the Moon obtained by Soviet scientists proved to be the herald of radical changes about to take place in this field. The study of planets and their satellites promises to resolve a number of questions.

"I should like to mention one aspect in particular, the question of the origin of planets and their satellites. Whereas the question of the origin and evolution of stars has been investigated in a very concrete and successful fashion over recent decades (though only a part of the question has been resolved to date), the problem of the origin of planets and their satellites remains an area of somewhat arbitrary and poorly substantiated hypotheses. The reason for this is that astronomers have studied a vast number of stellar states. By comparing stars at different stages of development we are able to determine the laws governing their origin and development.

"Enormous possibilities are, of course, opened up by the observation of celestial bodies from beyond the Earth's atmosphere. Artificial Earth satellites will play a major role as astronomical observatories located outside the Earth's atmosphere. At the moment it is difficult to make any specific predictions. Fifteen years ago no one could have foreseen the present achievements of radio astronomy. It is amazing that radio astronomy has begun to provide us with information primarily about non-stationary objects and phenomena in the Universe. Radio-astronomical observations select, as it were, these phenomena and it is first and foremost about them that we receive information. The scientific information obtained through optical observations is of a quite different kind. To put it very simply, they provide us with a more static picture of the Universe. Let us hope that the observations of the Sun, distant stars and nebulae to be made from artificial satellites will enrich our present knowledge as radio astronomy enriched the knowledge gained by optical astronomy.

"As regards the prospects for the development of the more usual mehods of observation from the Earth, I must

confess that I myself am a poor observer. Nor do I say this merely out of modesty. After graduating from Leningrad University, I worked at Pulkovo under Aristarkh Byelopolsky, an outstanding observer-astrophysicist, but even that did not help me to become an observer. It is worth noting that up till now the application of electronics in optical astronomy has progressed rather slowly. Yet the possibilities in this area are enormous. A powerful stimulus to progress in astronomy could be provided by increasing the sensitivity of modern telescopes with the help of electronic transducers. The number of objects accessible for study by modern optical methods is very great indeed. We are able to observe hundreds of millions of stars and many millions of galaxies. New techniques will increase this number immeasurably.

"The volume of astronomical information which we need to obtain is enormous. We, astronomers of the world, cannot cope with this. The solution is obvious. We need more large telescopes. These telescopes should be automated to the maximum, so that observations can be carried out according to a preset programme for each night. Fantasising a little, I could say that the programming itself should be automatic and continuously adjusted to both the weather forecast and the point reached in the given programme..."

The readers of *Sekai* read Ambartsumyan's answer with interest. Soon afterwards, a link was established between Tokyo and Byurakan: the post brought a copy of the New Year issue of the magazine *Sekai.*

CHAPTER SEVEN

Earthly Concerns

The telephone was ringing insistently in the main building of the Byurakan Observatory.

"A call from Canberra, Australia," said the operator.

It was Ambartsumyan ringing up to enquire how work was progressing on the tower for the large telescope with a mirror measuring more than two metres in diameter. He also enquired about Bagrat Ioannisyan, a Lenin Prize winner and the leading telescope designer, about his mother, who was ill at the time, and said something about his meetings with old acquaintances–Jan Oort from the Netherlands, Guillermo Haro from Mexico and other outstanding scientists attending the symposium. At the end he promised: "When I get back, I will tell you all about it in detail!"

A few days later, having returned to Byurakan, Ambartsumyan went up to his office on the first floor and found his constant assistant, Lyudmila Ivanovna, sitting there.

"Hello, Lyudmila Ivanovna," he said.

"Hello. How is your health?"

"Not quite as it should be. The trip was tiring, and no doubt it will make itself felt. But that doesn't matter! That's not the most important thing. The most important thing is our work. Is there a lot to be done today?"

"As usual, Victor Amazaspovich."

"As usual..." The chief engineer supervising the construction of the observation tower for the large telescope was already waiting to see Ambartsumyan. Engibaryan and Karachentsev, from the theoretical astronomy section, were also waiting. A seminar to discuss their reports had been scheduled for eleven o'clock. After the seminar, the others would have a break, but the director would have to receive the geologists.

At last, however, the director was about to go home. He had forgotten to have his breakfast. As he was leaving, he told Lyudmila Ivanovna: "Some visitors are due to arrive from Bulgaria. If I don't return before they arrive, would

you please give me a ring?"

"You haven't forgotten that there's a meeting of the observatory Scientific Council at four o'clock, have you? And the chairman of the housing commission is anxious to see you about an 'urgent' problem—the distribution of housing. He says he must have a word with you. And your deputy for supply also wants to see you."

"And what does he want?"

"Another 'urgent' problem. They haven't got enough transport to bring the staff from Yerevan to Byurakan and take them back. A second bus was sent, but it's too small. He says that if you 'have a word', they may give a larger one."

Ambartsumyan busies himself with the most diverse concerns, sparing neither time nor energy. Lyudmila Ivanovna makes heroic efforts to prevent Ambartsumyan from being troubled over trifles. She tactfully soothes the impatient, clears up misunderstandings, gives advice, answers queries, diverts the flow of requests along other channels. Part of this flow is dealt with by Ambartsumyan's closest associates. They are in charge of various departments and laboratories, supervise various branches of research and establish scientific contacts with astronomical centres round the world. However, if Lyudmila Ivanovna is convinced that the visitor has already tried in many other places, that he has received no help there and yet he needs that help and that only Ambartsumyan can provide it, then she would ask Ambartsumyan to agree to meet him, and he would invariably do so.

In Yerevan the working day at the Academy has scarcely begun, but the president is already dictating a letter.

"Take a note, please—at ten exactly—a meeting with the archaeologists excavating the Teishebaina fortress; at eleven —a trip to the computing centre, and then to the archaeologists."

The president's assistant enquires:

"Will you be answering your letters this evening?"

After this exchange of information, the typical working day begins. Only the faces and the problems differ.

One day a modestly dressed man arrived at the secretary's office.

"Who do you want to see?"

"I want to see..."

At that moment Ambartsumyan emerged from his office.

"Did you want to see me? What is it about?"

"Could I speak with you?" the visitor began timidly.

"Come into my office," answered Ambartsumyan.

"My son is eight years old. He can play by heart many of the works by world-famous composers of music for the piano. We live far away from Yerevan. But I would like the boy to have a proper musical education. I hope you may help..."

Ambartsumyan was in a hurry to attend an important meeting, but he realised that this request deserved expert consideration. He rang through to the secretary of the Armenian Composers' Union, Eduard Mirzoyan, who immediately agreed to receive the father. Then he had a talk with the young musician.

"And what can you play?"

"What would you like me to play?"

The boy began to play pieces by Haydn, Beethoven, Liszt...

Other music experts were invited. They were amazed at the young boy's talent. Some time later he gave his first concert at the Conservatoire which was filled to capacity. The president was informed:

"Everything's settled. The family has been given a flat in Yerevan, and the boy has begun his studies. He has a real gift for music."

For a long time Ambartsumyan has dreamt of cutting down the number of meetings he had to attend. But what can he do? Sometimes the meetings are very important.

In the spring of 1962, a meeting of the Presidium of the Academy of Sciences considered one of the designs of a solar power station to be built in the Ararat Valley. The idea was to use solar energy to generate electricity with the help of semiconductors. Scientists and engineers from Moscow and Yerevan took part in the discussions. The designers presented their calculations and drafts.

When the businesslike discussion was over, the president advised that they continue work on the project, as it contained serious miscalculations.

"And how much will this power station cost to build?" asked Ambartsumyan.

"Twenty million roubles."

"How much?"

"The construction can be financed out of the Union

and not republican budget," replied the supporters of the design.

Ambartsumyan was indignant. With one laconic phrase he swept aside all these arguments and explanations:

"Comrades, the money is public money. What difference does it make out of which budget it is taken?"

Then he added:

"If millions of roubles are to be put at our disposal, then we must think very carefully, calculate everything and find the most rational way to use them."

Iron logic, thriftiness and great concern for the latest and most progressive trends in science lay behind these few words by the president at the end of the discussion on the solar power station in the Ararat Valley.

At another meeting they discussed the question of whether the directors of research institutes should be scientists or good administrators. A concise and convincing answer had to be given that would express the view of the president. Ambartsumyan's reply was simple:

"Insofar as disputes in a team of scientists, and outstanding questions relating to scientific life and the activity of the institute have to be decided, in the final analysis, by someone who is a member of that team, then this person should be a director-scientist, preferably a scientist-organiser. An administrator can only be an assistant to the director-scientist."

However, circumstances sometimes compelled the president himself to become involved in administrative matters. Unfortunately, there were still difficulties in providing scientific institutions with equipment and material. Some institutes were lacking premises. However, all that is now in the past. Today the scientific institutions of the Armenian Academy of Sciences are housed in fine buildings and have the most modern equipment.

"There can be no denying," said the president, "that over recent years the Academy of Sciences of the Armenian SSR has grown into a major and rapidly developing centre of scientific thought whose importance, in terms of a number of problems it deals with and the significance of the results achieved, goes far beyond the borders of the republic. The work done by some of the scientists at the Armenian Academy has won wide, even international, recognition. However, we must work even harder, and not content ourse-

lves with what has already been achieved."

Once a conversation started among a group of research workers about the fact that renowned scientists had emerged from among the Armenian people in the past. It was then that Ambartsumyan said something which was later repeated in many variants:

"We should not always boast about what was achieved by our famous ancestors. Tell us rather what we have done to add to their immortal fame, to the fame of Armenia."

I cannot help remembering that unforgettable day in March 1965, when the Presidium of the USSR Academy of Sciences discussed the main lines of scientific research by the Academy of Sciences of the Armenian SSR. When Ambartsumyan had delivered his report, other scientists got up to speak.

"Armenia has the oldest culture in the Soviet Union. There is no people in the Soviet Union whose culture dates back farther," said Academician Pyotr Kapitsa. "I was sent a statistical review, and I've found some curious facts in it. Armenia has over two million inhabitants, of whom forty-nine thousand are students. Of these, twenty thousand are studying outside Armenia. What does this mean? A student studies for five years. That means that in a while 35 per cent of the population of Armenia will have a higher education. That is a fantastically rapid growth! At that rate the whole of Armenia will soon become an academy!"

A ripple of cheerful humour swept through the hall.

"What are the main tasks set to any national academy?" continued the speaker. "What can a national academy do that our main Academy cannot do? First of all, there is the question of interest in the national culture, the study of one's national culture and history. That is the first task of a national academy. The second task is a study of the region, the study and rational use of its resources and the aptitudes of the whole people. That is, not only natural resources, but also the cultural wealth of the people itself—educate the people better and develop in them those positive national traits that are inherent in them. And, finally, the third task—a fundamental and important one—the national academy of sciences should serve as a cultural centre for the country, maintain the proper cultural level—that is, prevent the development of pseudo-science..."

Kapitsa was followed by academicians Millionshchikov,

Artsimovich, Semyonov, Shemyakin, Sisakyan and others. Ambartsumyan also addressed the meeting.

"I would like our Academy to avoid becoming a copy of the USSR Academy of Sciences."

"What is to be done next? Should we encourage the creation of small institutes in the republican academies or restrict ourselves to the existing large institutes engaged in research along the main lines of scientific development, and allow republican academies to undertake research only in those areas that were best suited to the specifics of the local economy, natural resources and the availability of the necessary scientific personnel?"

"In what does the national spirit of a given local academy express itself?"

"Do we have the resources to put small institutes in charge of prominent scientists capable of guiding young people?"

"Will that not be a great deal more expensive?"

The discussion became sharply polemical. However, as is usually the case, one line of argument began to carry the day, and finally became the basis for a decision.

Academician Kapitsa concluded his speech with the following words:

"We are agreed that, for a scientist such as Ambartsumyan, it is necessary to provide the kind of institute or laboratory that he wants, and where he wants it. Nor can we determine how many people should work there—one hundred, or two hundred— on the basis of some plan. We must give him our total trust!"

The fruitful work done by Academician Ambartsumyan as the President of the Academy of Sciences of Armenia is so complex and wide-ranging that it could be the subject of a separate book. I have merely tried to sketch some of the aspects of his varied work as an organiser of science.

...In 1965, Ambartsumyan put forward a principle which provided the basis not only for solving the problems of the diffusion of light, but also for solving many other questions of mathematical physics. Ways were found of extending the range of problems in mathematical physics where this principle could be applied, and it began to be used successfully to accomplish tasks of vital importance for the country.

Mathematical methods were also extended to include other aspects of theoretical astrophysics. This science could,

without any exaggeration, be given the romantic name of "stellar mathematics"...

The International Astronomical Union decided to hold its twenty-ninth symposium on the theme "Non-Stationary Phenomena in Galaxies" at Byurakan in May 1966. This was an acknowledgement of the research done into non-stationary phenomena at the Byurakan Observatory, where Ambartsumyan had formulated the idea on the activity of galactic nuclei and the major role played by explosive, non-stationary phenomena in the life and evolution of galaxies. The organising committee included Ambartsumyan, Burbidge (USA), Vorontsov-Velyaminov (USSR), Lequeux (France), and Sandage (USA). In order to ensure the businesslike nature of the symposium it was decided to limit the number of people taking part. Fifty scientists from 12 countries, including the Soviet Union, were invited: from France, Italy, the USA, Britain, Hungary, Mexico, Argentina, Norway, Sweden, the Netherlands and the GDR. Many of those who attended the symposium were old friends of Byurakan scientists. Some headed entire lines of research or scientific schools and had made major discoveries.

The US delegates brought with them some very important observational results which were presented by Franz Zwicky, a huge man with a powerful voice, energetic and very sociable. Zwicky already had some knowledge of Armenia, but what he saw at Byurakan amazed him.

Jan Oort, a prominent astronomer from the Netherlands, had been presented the gold medal of Columbia University (USA) only shortly before the symposium. It was the first time this medal and award had been conferred upon an astronomer. Jan Oort, always cautious in expressing his opinion, also avoided expressing his profound ideas categorically at the symposium, but spoke in his own typical manner. He met at the symposium the young Byurakan astrophysicist Grant Tovmasyan, who had once worked under him in the Netherlands.

So the links and cooperation among scientists from various countries developed and strengthened. Ambartsumyan gave himself wholly to his work, with just the occasional "break" to be with his family. His children and grandchildren grew up. Karineh and Eghineh were candidates of science, while Rafik and Ruben—doctors of physics and mathematics. Victor Ambartsumyan's four children had

between them nine children. Sometimes Victor Amazaspovich would take one of his grandchildren out in the pram. Sometimes he would talk with his mother. And his father?

In 1965 Amazasp Asaturovich had died. The first grave appeared at Byurakan. The father left behind inspired lines about his son: "The peerless son was loved with a boundless love by the father whose idol he was, the object of endless concern."

Amazasp Asaturovich had loved to live in his son's house at Byurakan. They would usually talk together in the evening over a cup of tea, and then each would pursue his own interests until late at night. However, when the mistress of the house, Vera Fyodorovna, went to stay with her daughters in Moscow or Leningrad, their vigil at their desks would last till cock-crow.

At the beginning of 1965, Victor's father fell seriously ill. His daughter, Goar, a professor of physics and mathematics at Yerevan University, looked after him tirelessly. She lived in the centre of Yerevan, in a house opposite the public garden named after the chief architect of the city, the late Alexander Tamanyan. Not long ago the people of Yerevan set up a fine monument in honour of the man who was the first president of the Academy of Arts in Leningrad after the Revolution.

Every day, after work, Victor Ambartsumyan could be seen at the bedside of his beloved father. The sick man found it difficult to speak, but their eyes spoke of many things. I myself often visited that house in those days full of anxiety and worries. One day, walking home with Victor Amazaspovich, I involuntarily began to talk about the part his father had played in his life.

"Victor Amazaspovich, do you remember that day in May when Academician Kapitsa was your guest here in Byurakan?" I asked. "We came to your house just as Amazasp Asaturovich was busy with the flowers in the garden."

"I remember."

"Pointing to the beautiful flowers and then to you, Kapitsa said to Amazasp Asaturovich:

'Of course, all these flowers are your creation—just like Victor.'"

I then went on:

"I probably woudn't be mistaken if I say that from your childhood Amazasp Asaturovich taught you not only to

think logically and act independently, but also cultivated a sense of responsibility for your actions. Not every parent is capable of doing this."

Shortly afterwards I said goodbye to Victor Amazaspovich, whose eyes were filled with inexpressible sadness. As I walked along the streets of my native city, I kept recalling Amazasp Asaturovich:

"A diamond is beautiful in itself," he would say, "but only skilled hands can polish it and bring it to perfection. Only then does every facet shine and it becomes a product of the jeweller's art, attracting the eye. It's the same with children. You have to watch over them from infancy, and not just now and again. Daily observation, timely intervention and discussion of the child's faults must be the parental rule. Children endow their parents with wings only if those parents, sparing neither time nor effort, strive to achieve good results. In families like that, everything turns out well.

"One must always find the time to bring up one's children. It is difficult to make up for lost time, and sometimes it proves impossible..."

The reader is already aware that the son was Amazasp's creation not only in the sense that he begot him, but also as the result of thorough upbringing. Father and son were united by mutual respect and spiritual affinity, and by deep and tender affection.

> To him he devoted his heart, the constant care of his thoughts,
> He wanted his son to scale the peaks of science and win the laurel wreath of victory.
> He directed his gaze always upwards, towards the stars...

The endless succession of generations is inevitable. They disappear into infinity. The flights of fancy of the most talented minds of the past now lag behind the achievements of science.

In the capital of Armenia, in Matenadaran, the treasure-house of ancient manuscripts, there is an old parchment. It is a work on the inclination of the celestial ecliptic. Perhaps it is the unfinished work of Artavazd? Who can tell? But one thing is certain—it is the work of an enquiring mind.

The work of modern astronomers will reach their descen-

dants in a much more complete state, and it will not be necessary to guess the identity of the author. The names of devotees of science will be preserved, as will the memory of those who restored the glory of ancient Byurakan.

People are very similar. There are universal passions, sorrows and joys which they all experience. Yet among the more than four thousand million inhabitants of the Earth, there are no two people who are alike. And there still does not exist that book in which even the greatest writer has managed to describe the totality of one man, any man, be it the most ordinary or the most outstanding.

A popular saying goes: "The Sun can be seen in a drop of water." And although we know that only a two-thousand-millionth part of the radiation of the Sun reaches the Earth, and that not the whole spectrum of that radiation is visible to the naked eye, just one ray of sunlight reflected in a drop of water can tell us a lot.

At the Hospital

In August 1966, I visited Victor Amazaspovich at the Kremlin Hospital in Kuntsevo, on the outskirts of Moscow.

Ambartsumyan had come to Moscow to attend a session of the Supreme Soviet of the USSR and had fallen ill. The diagnosis was kidney stones. On the fourth day after the operation I visited him.

"I feel weak and I have no appetite at all," he told me.

Ambartsumyan asked me to call on Admiral Ivan Stepanovich Isakov, and ask him to convey through me orally all that he wanted to tell Ambartsumyan.

Once, speaking at a meeting of the Presidium of the Academy of Sciences of the Armenian SSR, Ambartsumyan had said that some of our scientists were sometimes fearful of handing over rare works from their personal libraries for the common use of the Academy. Insofar as our lifespan is limited by the laws of nature and people inevitably die, their heirs, sometimes not appreciating the true value of these libraries, often sell the books, thus scattering the entire intellectual legacy of the scientist—his books and his manuscripts.

Isakov is a man I like and esteem not only as an admiral, a scientist and a courageous man. In the end, these qualities

can be found to some degree or other in various outstanding people. I like and esteem him also because he is a true patriot and a generous man. The unique collection of atlases of the world that he donated to the Academy is proof of this. All those who will use these atlases will recall him with gratitude.

I went to see Isakov on August 22, 1966. He welcomed me warmly and said he was very glad that Ambartsumyan had asked me to speak with him. He was sorry to learn that an important letter he had sent to Ambartsumyan had still not been delivered. He then briefly recounted what I was to convey to Ambartsumyan. "I'm glad I now know why he didn't answer. He's been ill for a whole month. What a pity! That explains everything."

I carried out Isakov's request that same day: I went to the hospital and related to Ambartsumyan the content of our conversation.

On August 24, I once again visited Ambartsumyan in hospital and had a talk with him. Victor Amazaspovich was looking better than the last time. His temperature was normal and he was allowed to get up.

One day, when the patient was already able to go for a stroll in the park, I saw him with his wife, Vera Fyodorovna. Victor Amazaspovich was very pale and tired quickly when walking. He had to sit down on a bench.

"I must get back to Yerevan and Byurakan as soon as possible. I have so much to do there, but the doctors won't let me go. They are even insisting that, when I finish my treatment here, I go to a sanatorium in the Crimea. But I can't convalesce properly even now for thinking about the things to be done at the Academy and the observatory."

"You see," said Vera Fyodorovna, "he takes no care at all of his health. He's no longer twenty, after all. If you want to work well, you have to get well."

"And evening and night work at the Academy?" I added. "And the long meetings of the Presidium?"

"Those who don't do much work don't give much benefit," Ambartsumyan retorted. "You cannot stop making further progress just because you have a doctor's degree and occupy a high administrative post. Yet some people do just like that."

After six weeks absence, Ambartsumyan returned to Byurakan. The operation had been a success, the doctors

suggested a rest in the Crimea, but Victor Amazaspovich wanted first of all to call at Byurakan. Lyudmila Ivanovna, Ambartsumyan's assistant, describes this first working day after his illness:

" 'How are you feeling, Victor Amazaspovich?'

" 'Not bad, thank you. I may no longer consider myself ill. You know, everyone is enquiring about my health, and this illness is unpleasant precisely because it upsets so many people. I still feel very weak, and I can't move about a great deal. The doctors have forbidden me to work, and so for the first few days I shall come for only an hour or so. And what are those letters on your desk? Give them to me. They are about very important pieces of work.'

"Ambartsumyan then read with obvious pleasure the letter from Mirzoyan in Paris, where he had gone to work for three months.

" 'I should like to see Minasyan. Please ask him to come.'

" 'Victor Amazaspovich, you won't be dealing with any business today, will you?'

" 'Is there anything urgent?'

" 'Sanamyan wanted to see you. He has to leave on business and there are a few urgent matters to be decided. And Gurzadyan phoned from Moscow. He wants the vacuum apparatus from Alexeyevsky.'

" 'Very well, I'll tell Alexeyevsky, and tell Sanamyan, please, to come and see me.'

"I was telephoning Sanamyan when Elma Parsamyan came in. She had taken over the duties of academic secretary and was carrying a pile of papers in her arms. It was all urgent, and it all had to be shown to Ambartsumyan.

"A few minutes later Gurghen Minasyan arrived. He was the head of the laboratory of optical instrument-making. He waited in my office for Elma to come out, but Ambartsumyan heard his voice and himself opened the door:

" 'Come in, please. Hello.'

"Saakyan, the head of the group of astrophysicists-theoreticians, peeped his head round the door.

" 'I've not come on business, just to enquire about his health.'

"About ten minutes later Sanamyan arrived and went into the office. I looked at the clock. An hour had passed and Ambartsumyan was still engaged in his office. Then, fifteen minutes later, everyone at last came out.

"Ambartsumyan called over to me: 'Is there any urgent business? Is anybody waiting for me? Can I leave now?'

"I felt embarrassed at being asked such a question. Even if there were still some matters to be dealt with, he needed rest. He had undergone a serious operation and had spent six weeks in bed. As it was, we were criminally neglecting his health. On any day Ambartsumyan has to deal with a number of issues, large and small, without a break—scientific, administrative, supplies.

"As he walked past I gave him a fresh copy of the second issue of the journal *Astrofizika,* which had just come out. Ambartsumyan himself was its editor.

" 'Would you like to see the new issue of *Astrofizika*?'

" 'Of course, of course. I should not only like to, I must do.' He was at last moving towards the door, carrying the copy of the journal. Grant Tovmasyan was waiting in the doorway. He had brought his article.

"Grant Tovmasyan had spent nine months in Australia, where he had done a great deal of important observation work, and now he was preparing to publish the results of his observations.

"Ambartsumyan returned to the desk, looking through the article as he went.

"Then he put the article down on the desk, saying he would read through it carefully the next day, and went home.

"Thus passed the first working day, or rather the first working one-and-a-half hours after returning from hospital."

One last finishing touch to the portrait of Ambartsumyan the man.

A prominent scientist from Pulkovo, the inventor of the optical systems of the remarkable meniscus telescopes, Dmitry Maksutov, told me the following:

"If I am alive today and talking to you, it is thanks to a great man. In 1956 I had a very serious heart attack, and in 1958 I had a second one, which completely ruined my health. There was no hope for my recovery. It seemed I was doomed. This news reached the scientist of whom I am speaking. He immediately got hold of a special medicine, then still little known and produced by Armenian specialists, and sent it to me by plane.

"One may be an outstanding scientist, and yet a hard-hearted man: a scientist, one may argue, cannot be senti-

mental, he is dedicated to science, he has no time, he is busy... The man I am talking about carries an enormous burden of work, yet he manages to remain a simple man and a considerate colleague and friend."

"We still do not fully appreciate how much consideration and attention mean to people," Maksutov said in conclusion. "You wanted me to tell you about Victor Amazaspovich? Well, write what I have just told you. People should know about it."

Ambartsumyan is cordial and mild but as long as a violation of principle or fundamental scientific question are not involved. Then his principledness is expressed with iron force. He is uncompromising in his demand for scientific conscientiousness, but he acts in a way that does not injure the dignity of another. Here is the reply he sent to one research worker:

"Your letter concerning interaction in different fields reveals that you do not have a clear idea of the problem you are dealing with. You must realise that if you are to do independent work on the theory of gravitation, you must be familiar with the latest data on this question, with the methods of theoretical physics. Your letter, however, clearly illustrates the confusion that results when you do not know either..."

However, the reply did not end here. Another, very characteristic paragraph, followed:

"...Between ourselves, I, too, often ponder about questions on which I am poorly informed. But, of course, I don't write anyone about my reflections on these subjects. The results are just as unhappy as in your case..."

Once Ambartsumyan's attention was caught by a note lying on his desk:

"During archaeological excavations on the territory of Armenia, traces have been found of an observatory which experts date back to the middle of the third millennium B.C."

Soon an archaeological team from the republican Academy of Sciences began work in the vicinity of Metsamor. A figure in the shape of a trapezium, carved on one of the rocks, had been found earlier. Inside the trapezium were four carved stars. To all appearances, a certain heavenly body was observed from here, which, as calculations show, may have been Sirius.

"The arrows carved on the rock clearly point from north-

to south. From them another deep arrow points east. These ancient people could not, of course, but indicate the direction of sunrise. Seven other signs carved nearby probably represent seven heavenly bodies that were the object of worship."

Shortly afterwards Elma Parsamyan enthusiastically recounted all of this to Ambartsumyan. It all had to be studied, thought about, proved, of course. He listened to her attentively and was clearly interested.

"Next year a congress of the IAU is to be held in Prague. It will be wonderful if we are able to say that an observatory dating back five thousand years has been found in Armenia!"

It was clear that Ambartsumyan was very interested in this ancient observatory, otherwise he would not have asked while looking at the drawings:

"Elma, is it difficult to get up there?"

His legs still ached...

"What new information would these investigations provide for science?" thought Ambartsumyan. "The ancient and the modern live side by side."

The Byurakan Meridian

"The Byurakan meridian will always run across my heart," said my old friend Bagrat Ioannisyan, Hero of Socialist Labour, Lenin Prize winner, Doctor of Technical Sciences and the leading designer of Soviet telescopes.

"It is with heartfelt pleasure that I recall the years I spent working on the Byurakan telescope. The Byurakan Astrophysical Observatory, headed by Academician Ambartsumyan, one of the most outstanding astrophysicists of our day, who has twice been awarded the title of Hero of Socialist Labour, has become one of the leading scientific centres in the country and has received the Order of Lenin. Its renown is world-wide.

"When work to install the telescope began at Byurakan, Leningraders worked side by side with Armenian experts. Many specialists were impressed by the design of the dome. Its designer, Gurghen Minasyan, and research workers from the Byurakan optical mechanics laboratory never limited themselves to merely carrying out their own specific tasks. They were always ready to help their colleagues in

any way they could, and on their rare days off they tried to acquaint their friends with Armenia."

And here is what Professor Ludwig Mirzoyan had to say:

"The remarkable successes achieved by astrophysics were only made possible by the emergence and unprecedented development of astronomical-instrument engineering after the last war. Prior to that, observatories in the USSR, equipped with foreign-made instruments, were ranked in the second dozen in terms of the size of their largest telescopes. However, in just a short space of time, astronomical-instrument engineering in the Soviet Union made remarkable progress under the leadership of Bagrat Ioannisyan.

"As astronomy is a science based on observations, the creation of these telescopes was decisive in permitting the most varied observational work necessary to tackle urgent astronomical tasks.

"Many important results in the study of stars and stellar systems have been obtained using Soviet telescopes and have given the observatory its name in the scientific world."

Per ardua ad astra! This challenging phrase has come down to us from Ancient Rome. People have always been drawn to the unknown, and particularly to the stars.

Bagrat Ioannisyan is the designer of eleven large telescopes in use around the Soviet Union. Equipped with first-class instruments, Soviet astronomers are exploring the Universe.

Today the main instrument used at Byurakan is an optical telescope with a mirror 2.6 metres in diameter, one of the largest in Europe.

Ambartsumyan's dream has come true.

Anyone who knows the tragic history of Armenia will know that only Soviet power enabled the Armenians to live in peace and build a new life. Socialism opened up wide horizons for the development of culture, public education and science in Armenia. In 1985, for every 10,000 of its inhabitants there were 187 students, as compared with 95 in Britain, 96 in the FRG, 165 in France, and 149 in Japan.

Prior to the Revolution, Armenia had no scientific institutions. Now about 20,000 scientists are working there. Their work in astronomy, astrophysics, mathematics and mechanics, the physics of elementary particles, physical chemistry, biology, microbiology and geology is widely known.

Ambartsumyan's illness dragged on. Lyudmila Ivanovna recalled how, once, he carried on his work at home, in bed: "His leg was aching, and the doctors would not allow him to get up. He sent for Elma Parsamyan and myself to deal with his letters. We arrived and went upstairs where, while Ambartsumyan was ill, one of the rooms had been turned into an office. There was a divan, and in front of it a folding table and a couple of light armchairs. On the wall over the divan was a picture by Saryan presented to Ambartsumyan by the artist. The table and bedside tables were covered with journals, books and reprints... A state-farm worker, Voskeat Egiazaryan, had invited Ambartsumyan to attend his daughter's wedding. Ambartsumyan read the letter out-loud. Elma and I laughed, but Ambartsumyan was serious: 'What are you laughing at? I am very touched by the letter.'

"He then dictated a reply. He thanked the state-farm worker for the invitation, and expressed his regret that illness prevented him from attending. He wished the young couple every happiness.

"Another letter. This time it was a reply to an amateur astronomer, geologist Vostyakov, who had sent him a copy of some work he had done. It was of no scientific value, and Ambartsumyan told him tactfully about this. 'However,' he added, 'if you are dissatisfied with my advice, you may write to the astronomical observatory at Kharkov University, which specialises in the study of planets.'

"After this he dictated a reply to a professor in New York who had sent him an invitation to a symposium on astrophysics."

In Ambartsumyan's office there is a corner for informal conversation: a few armchairs and a coffee table with a vase of flowers. As the New Year approaches, Lyudmila Ivanovna usually puts a little pine branch in the vase. This is by no means out of place in this office, for New Year's eve has more than once found Ambartsumyan at his desk. One New Year's eve, Marat Arakelyan, who was then living at Byurakan, went out onto his balcony just a few minutes before midnight. He saw a light on in Ambartsumyan's office and ran to the observatory.

"What are you sitting here for? It's just a few minutes to the New Year!"

It turned out that Ambartsumyan's wife should have flown to Yerevan, but had been held up somewhere along

the way. There was no one at home, and Ambartsumyan had taken the opportunity to do some work. No one would come to interrupt him. However, Marat was insistent, and Ambartsumyan finally had to give way. In the company of others he is cheerful and sociable, and enjoys a joke.

Once Ambartsumyan returned from Kislovodsk, where he had spent his holiday at the Krasnye Kamny sanatorium. He had enjoyed it, had had a good rest and put on weight.

"I like Kislovodsk," he told Lyudmila Ivanovna. "That was the first time I have been there." "That means," she thought to herself, "that you have not taken many holidays in your life. Kislovodsk is a health resort that everyone concerned about his health visits at some time, and usually more than once."

When I asked Lyudmila Ivanovna why she had stayed at Byurakan, she told me:

"It's a great pleasure to work with Ambartsumyan. I felt that he needed me, and my decision was made. I find the work interesting. Just like him, I have never had Saturday or Sunday or holidays off. I rarely go on holiday, just now and again, when Ambartsumyan is away."

I left Byurakan, the astronomical capital of my native land, in a cheerful mood. This leading astrophysicist of our time has reliable, worthy assistants, and that is a fine thing.

Round-Table Meeting

This round-table meeting could have taken place, but due to various difficulties it did not. An improvised round-table meeting is a kind of literary device. I have used notes I have taken at numerous interviews but which have not been published, and also previously published statements made on various occasions by the people who are now my "guests". I have indeed met and talked with all of them at some time or other.

I should like to thank them for their helpfulness, kindness, consideration, for allowing me to use letters, various documents and photographs.

Imagine a gathering in Moscow on a June day in 1984, attended not only by Muscovites but also by guests from Leningrad, Yerevan, Tbilisi and elsewhere. They are all

people well-known in the Soviet Union.

The company sitting round the table is in good spirits. The guests are exchanging greetings and chatting with each other while waiting for the moment when they will begin to talk about Victor Ambartsumyan. They are colleagues who have known each other for a long time, but who meet only rarely. They are all busy men.

"Who is going to be the first to speak?" I asked.

Academician Shain was nominated as the first.

"Many of you no doubt know that I have been acquainted with Victor Ambartsumyan since he was a post-graduate student. I shall be brief. The personality of a scientist and his scientific work are always closely linked. In Ambartsumyan they are fused together.

"The importance of his work for the development of astrophysics in the Soviet Union is well known to us, and there is no need for me to dwell on it.

"Endowed with the rare ability to unite around him a team of young scientists, Ambartsumyan is undoubtedly the head of the Soviet school of theoretical astrophysics: every major astrophysicist-theoretician has felt his beneficial influence.

"He is an outstanding organiser who supervises the scientific work done by the Armenian Academy of Sciences. We all know him as the chairman of the Commission on Cosmogony attached to the USSR Academy of Sciences, and as a delegate to international congresses in defence of peace."

"At the beginning of the 1960s," said Professor Krat, director of the Pulkovo Observatory, "astronomers discovered celestial bodies of enormous mass—quasistars or, as they are often termed, 'quasars'. Quasars are a powerful source of radio emission, more powerful than the majority of giant stellar systems—galaxies—containing millions of stars.

"One cannot talk about quasars without mentioning the name of Ambartsumyan who, more than twenty years ago, put forward the bold idea that there existed bodies of gigantic mass in the Universe—superstars. At that time, many thought this idea to be unfounded as it was believed that the mass of gaseous bodies having the same weight—stars—could not be more than 100 times greater than that of the Sun. However, Ambartsumyan was talking about bodies

with a mass tens and even hundreds of thousands of times greater than the mass of the Sun. His scientific prevision proved more powerful than the then existing theories. It helped in the search for superstars and greatly facilitated the discovery of quasars.

"An equally important role was played by a work written by Ambartsumyan on galaxies and published in 1958. It was then that he predicted that the nuclei of galaxies contain a great mass in a small volume. Indeed, these nuclei can themselves, to some extent, be considered superstars.

"What is most interesting, however, is that Ambartsumyan's conclusions were not simply unconnected assertions, relating to different particular questions. They all flowed from his conceptions on the formation of stars or the disintegration of gigantic superstars.

"Today the study of galaxies has become one of the main lines of research being followed at the Byurakan Observatory, which he founded and runs.

"Academician Ambartsumyan became a world-famous astronomer while he was still at the Pulkovo Observatory. In those days astrophysics, as a new branch of astronomy, had only just emerged, and one of its founders, alongside such luminaries of Western science as Eddington, Chandrasekhar and others, was the young Pulkovo astronomer, Ambartsumyan. Even then he appreciated the prospects for the development of astrophysics and put forward as one of the major questions the problem of radiation transfer in stellar atmospheres. And indeed, unless an answer is found to questions relating to the emission and absorption of light in hot masses of gas, it is impossible to explain correctly the spectra of stars and the Sun, impossible to deal knowledgeably with such complex problems as the diffusion of light in the atmospheres of planets—Mars, Venus and, of course, the Earth. Light and radiation are the main and almost the only source of our information about outer space. Everything which emits radiation—stars, nebulae, and the planets that shine with reflected light—we study on the basis of data on the spectra of heavenly bodies, on their brightness, and on the various properties of light rays. Ambartsumyan developed new methods of solving theoretical problems, outlined the paths to be followed in the study of stellar and nebular spectra, and solved the main question about the diffusion of light in planetary atmospheres. On the bas-

is of the data obtained as a result of a theoretical analysis, it has become possible to deduce the structure of stellar atmospheres, the causes of nebular luminosity and the nature of planetary atmospheres.

"Ambartsumyan's predictions were truly amazing. Everything that he had written about in the 1930s has become central to astrophysics. I am happy to be able to call Victor Ambartsumyan my teacher and my friend."

"I had been fortunate enough to talk for about two hours with Victor Ambartsumyan," began the poet Aramis Saakyan. "His manner of thinking, his desire to penetrate the unknown depths of space, amaze and captivate human imagination. As to other matters that deeply concern him, this, for many, remains a mystery. I was interested to know how he views certain aspects of our life here on Earth. I wanted his ideas and opinions on this subject to be accessible to all, as are his scientific works.

"I should like my account of him to be a kind of dialogue. Let us now ask Victor Amazaspovich himself to come and sit with us at the table.

"In his manner, Ambartsumyan is simple and democratic. He speaks calmly, gently, pondering on his replies and selecting his words.

" 'Have you made mistakes? If you have, is there a particular mistake that you regret to this day?'

" 'In my youth I published three or four scientific works which I now regret. I was probably in a hurry. A man should so live his life that, when he dies, he had nothing to regret.'

" 'Why talk of death? Let's talk about life.'

" 'You know,' smiled Ambartsumyan, 'I have never feared death. I see it as a natural phenomenon and do not view it as a misfortune. Of course, life is very interesting, and I should like to live a long life, but I do not fear the end.'

" 'Are we alone in the Universe?'

" 'I'm certain that we are not,' replied Victor Ambartsumyan. 'The Universe is a vast organism, and it is naive to think that life exists only in that infinitesimally small part of it called the Earth. However it is also natural that the forms of life can be very different, even opposite. We still know very little about the Universe. Within it thousands of

millions of mysterious phenomena are occurring. It contains an innumerable quantity of unknown planets. We perceive the world and the Universe with the help of our five senses. However, there may exist phenomena for the detection of which we do not have the necessary organs of sense. Modern astronomical instruments are an extension of and an improvement on the human organs of sense, and we must expect to discover new heavenly bodies and cosmic phenomena as yet unknown to science.

" 'What is man in the Universe?'

" 'I shall answer as follows: man himself is a micro-universe within the Universe. This is both poetic and scientifically accurate.'

" 'What do you think about the immortality of the soul?'

" 'I believe in the immortality of thought and deed. Newton has long since died, but his ideas live on. Mashtots* is no longer with us, but his effort is immortal.'

" 'What is the meaning of life?'

" 'To be useful through one's ideas and one's activity. Those people are unfortunate who are incapable of doing good, who live according to the principle, *'Après nous le déluge.'* Those who think only of their personal advantage. The life of such people lacks the great purpose contained in the meaning of the word 'life'. They do not enjoy the respect of society. There are those who see themselves as the centre of the world, who do not notice any of those around them. However, one should have an honest and noble purpose aimed at the good of society. Art has many ways of expressing the meaning of life.'

" 'And what branch of the arts do you feel to be the closest to you?'

" 'Poetry. I revere our Armenian poets—Sayat-Nova, Hovannes Toumanian, Peshiktashyan, Teriyan and Charents. Of the Russian poets I like Pushkin, Tyutchev and Blok. Their thoughts and words come from their hearts. Those who succeed in doing this are always remembered.'

" 'Incidentally, which usually triumphs in you—the heart or the intellect?'

" 'I should like the intellect to triumph, but it is usually the heart that dominates. Very probably this is due to the

* Mesrop Mashtots (361-440 A.D.)—Armenian scholar and enlightener. He devised the Armenian alphabet, the introduction of which helped to preserve Armenian culture.—*Ed.*

powerful influence of the arts–literature, painting, music... I like Ulanova and the paintings of Martiros Saryan, and Minas.'

" 'Are you interested in sport? Do you play chess, for example? How do you spend your free time?'

" 'To tell the truth, I don't have enough time. I don't play chess. My leisure time is spent in walks, reading fiction and conversations. In the morning I do a few excercises. I wake up at seven.'

" 'Are you a good sleeper?'

" 'I'm usually restless. At night I like to think. If I arrive at some interesting results, I get up the next morning in a good mood, ready to face the day. If not, then I feel depressed and tired.'

" 'Have there been many unexpected results and discoveries in your career as a scientist? Do you have any opponents?'

" 'Many. When a new idea is born, it has at first only one supporter–its author. When the theory on the activity of galactic nuclei was formulated at Byurakan, many scientists around the world rejected it. Recognition came later. In short, he who has no opponents in science has no individuality.'

" 'You began your career as a mathematician. At the age of 26 you already became a doctor of physics and mathematics thanks to your works in mathematics...'

" 'Yes. That reminds me of one curious incident. Not long ago in Moscow I was introduced to a mathematician from Canada. On hearing my name, he nodded: 'I know, I know. You are, no doubt, the son of the mathematician Ambartsumyan. I have read many articles written by your father.' Soon the misunderstanding was cleared up, and we laughed about it for some time.'

" 'How do you feel about your own fame?'

" 'Irrelevant,' Ambartsumyan dismissed the question. "One has to get on with the job...'

" 'And what about smoking, drink?'

" 'I don't like either. I don't smoke, and as for alcohol, I only have a drink if I have a cold, or in the company of old friends.'

" 'Do you enjoy humour?'

" 'Yes, I do, but I don't consider myself an authority in this area. I don't like it when jokes go beyond the limit.'

" 'What traits in people do you find unacceptable?'

" 'Envy, laziness and immodesty. Incidentally, these traits are closely related. I don't like self-interest and the pursuit of material prosperity. Some people view the accumulation of material goods as the sole aim in life. I detest bribe-takers. I hate those who betray their country for money or material advantage. They deserve only contempt and themselves destroy their own home. I only regret that they also ruin the life of their own children.'

" 'And what do you think about love? May I ask you when you fell in love, and who was your first love?'

" 'Don't be surprised,' Ambartsumyan suddenly became very serious and concentrated, 'if I tell you that my first love was ... science. And that is how it will always be. Of course, I am devoted to my family, my wife, my two daughters, my two sons and my grandchildren. I was born and grew up in a family which taught me to love my own people and all people in general. Fortunately, my parents did not spoil me. Children need to be loved, that's only natural, but they should not be spoiled. I couldn't name one father or mother who subsequently gained any benefit from spoiling their children; only disappointment. My wife is a teacher, and she brought up our children very well. As for a scientific definition of love, I shall not make so bold as to attempt any such formulation. Probably only the heart knows what love is. Human thought cannot give a comprehensive answer to this question.' "

"I read in a book," the poet Aramis Saakyan continued, "that several years ago you sent the famous scientist Dmitry Maksutov in Leningrad a rare medicine which saved his life. Later he said of this: 'Ambartsumyan's heart saved my heart.' "

"I don't know, I never heard of it..." said Ambartsumyan, trying to avoid the subject. "I only know that human warmth is as necessary to us as the vital warmth radiated by the Sun. Unfortunately, however, people are increasingly unwilling to share the warmth of their hearts. And when hearts grow cold, wars begin..."

"Are you sure there will be no war?"

"Let us hope that common sense will win the day, and that the threat of war will vanish forever."

"If wars do not destroy our planet, how much longer, in your opinion, will it exist?"

"You need have no worries on that score! Millions of years!"

The poet was followed by Professor D. Martynov, director of the Sternberg State Astronomical Institute:

"I first met Victor Ambartsumyan forty years ago when he was a post-graduate student at the Pulkovo Observatory. He had just graduated from Leningrad University, where he had studied together with Lev Landau, Matvei Bronstein, Nikolai Kozyrev, and Dmitry Ivanenko.

"I shall not enumerate all the services Victor Ambartsumyan has rendered to science. Most of them are described in text-books, and there are few educated people in the Soviet Union who have not heard of his name. He is just as well-known among astronomers round the world, and it is not surprising that for three years he was the president of the International Astronomical Union.

"That is why we astronomers hope that Victor Ambartsumyan will continue his work for many, many years to come."

"It would be difficult to name an astronomer or astrophysicist who, over the last forty years, has had such an influence over the development of these sciences as Ambartsumyan," said Academician Severny, director of the Crimea Astrophysical Observatory.

"Himself an outstanding theoretician who grew up at a time when new ideas of quantum mechanics and astrophysics were making enormous headway, he was amazingly quick to formulate a series of major propositions concerning the interaction of atoms and radiation in those fundamentally different, extra-terrestrial conditions which exist in outer space.

"During the war (in 1941-1943) his fundamental theoretical research into the problem of radiative transfer was completed, in which he succeeded in solving a number of extremely difficult mathematical problems. This was of great importance for national defence and connected with long-distance visibility. As a result, the practical application of Ambartsumyan's discovery enabled Soviet aircraft and submarines to 'see' through thick clouds and through water. Ambartsumyan's next series of works (1944-1955) was directly connected with the evolution of the stellar Universe."

"Victor Ambartsumyan," said Professor E. Mustel, Chair-

man of the Astronomical Council of the USSR Academy of Sciences, and a corresponding member of that Academy, "is the author of many brilliant research works which proved to be landmarks in various branches of modern astronomy.

"These include: the elaboration of the theory of the radiative equilibrium of planetary nebulae; the creation of a new theory of the absorption of light in turbid media, for which he was awarded a State Prize for 1946; the elaboration of the idea of stellar associations, for which he was also awarded a State Prize and which led to the extremely important conclusion about the group formation of stars, a process still occurring today; the elaboration of the equally promising idea that the nuclei of many galaxies are extremely active, and that these nuclei play a very important role in the development of the galaxies themselves. Many more important research projects could also be named.

"A distinguishing feature of the research done by Victor Ambartsumyan is that it focuses not on the further elaboration or clarification of some previous ideas or theories, but on the development of his own, wholly original ideas which sometimes appear a little extraordinary, even strange at first, but which later win recognition from astronomers around the world.

"However, Victor Amazaspovich is not only an outstanding scientist but also an organiser of science. He was in charge of the construction, and is now the director of the Byurakan Observatory, which has become famous throughout the world. He willingly assists other Soviet observatories, and some of his pupils have become prominent scientists themselves."

"Victor Ambartsumyan's field is astronomy," said Igor Shklovsky, a professor at Moscow University, a corresponding member of the USSR Academy of Sciences, "which has always attracted the interest of thinking people, however remote they may be from science. The founder of the Soviet school of astrophysics has made his own major contribution to this, one of the oldest of the sciences.

"Victor Ambartsumyan has always been concerned with the fundamental questions of astronomy. In the 1930s, this was the question of the transfer of radiant energy in space. In this area Ambartsumyan achieved outstanding re-

sults. It was also in the 1930s that he carried out his remarkable research into the statistical mechanics of stellar systems, as a result of which (and on the basis of his other previous research), he came to an extremely important conclusion: the Universe is only ten thousand million years old—a thousand times younger than was believed by the majority of scientists at that time.

"This major conclusion concerning the age of the Universe received further confirmation in the course of the next few decades, and is now recognised by all.

"The post-war period in Victor Ambartsumyan's scientific work was opened by a series of major works on stellar cosmogony. These works, like all his other research, were characterised by originality, boldness of thought and, at the same time, simplicity. The main result of this series of works is the conclusion that the stars in our Galaxy (and in other galaxies) constantly form unstable groups which he termed 'associations'.

"Over the last decade Victor Amazaspovich has devoted his enormous energy to the solution of fundamental questions pertaining to metagalactic astronomy. Here his outstanding contribution to science is his theory of the activity of galactic nuclei, of the explosive processes of unimaginable dimensions which take place there. It would be no exaggeration to say that this is now the main topic of research in astronomy.

"It must be emphasised that, in his outstanding research work in the post-war period, Ambartsumyan has relied on the observational work carried out by the team of astronomers working at the Byurakan Observatory under his supervision. The work done at this observatory under his guidance has won world-wide recognition.

"It is difficult even to list all that Victor Ambartsumyan has done for the ancient science of the sky, to which he has devoted his life.

"In addition to his enormous scientific work, Academician Ambartsumyan is also the President of the Academy of Sciences of Armenian SSR, which guides the scientific work being carried out throughout the whole of Armenia, so rich in talented people."

Yevgeny Kharadze, President of the Academy of Sciences of Georgian SSR and director of the Abastumani Observa-

tory, joined in the round-table discussion.

"To meet and talk with Victor Ambartsumyan," he said, "is an enormous pleasure for his pupils and followers, his colleagues and friends, for all those who know him from scientific work, his text-books, reports and lectures.

"The Georgian astronomers at the Abastumani Observatory are always happy when Victor Ambartsumyan comes on a visit. His reports, his advice and recommendations are of invaluable assistance to the observatory as a whole, and, in particular, to its young research workers desirous of expanding their knowledge and elaborating new and interesting ideas.

"Cooperation and contact with Ambartsumyan's pupils, the astrophysicists of fraternal Armenia, is a source of great satisfaction to Georgian astronomers.

"We watched with admiration not only the rapid growth in the international prestige enjoyed by the Byurakan Observatory, but also the development of the whole of the Armenian Academy of Sciences where, as President, Academician Ambartsumyan shows himself to be a brilliant organiser of science.

"A true patriot of Armenia and one of the most renowned scientists of the USSR, Ambartsumyan has won universal respect and indisputable authority in international astrophysics. More than once, when attending international scientific meetings and listening to his reports and speeches, we have felt genuine pride in this Soviet scientist, this great son of the Armenian people, this deeply respected and beloved colleague."

I then read out an extract from a letter which had recently arrived in Yerevan from D. Sedrakyan, a physicist-theoretician and a corresponding member of the Armenian Academy of Sciences. Incidentally, his doctor's thesis touched upon questions of theoretical astrophysics and the theory of gravitation.

"I believe," wrote professor Sedrakyan, "that Victor Ambartsumyan belongs to that small group of astronomers in the world who are extremely well versed in the fundamentals of mathematical physics and theoretical physics. Although Ambartsumyan considers himself to be only an astrophysicist, he is also a talented physicist-theoretician and mathematician. I have become convinced of this while attending various meetings of physicists and mathematici-

ans, where his profound, original and bold ideas amazed many reputable physicists-theoreticians and mathematicians."

Three hours of the round-table discussion had passed almost unnoticed. My respected companions could see that I was moved by their active participation in the discussion, and was very grateful to them.

"My dear friends. Before we part, I should like to recall one particular episode:

"Academician Nikolai Vavilov was once asked: 'What would you like to accomplish in your life?'

"He answered jokingly:

" 'Put the globe in order!'

"How would you answer such a question?"

"Save the world from a thermonuclear war, thwart the evil plans of US imperialism to unleash Star Wars and start the arms race in space. Consolidate the international unity of scientists in the struggle for peace."

The Universe is boundless. The process of learning about it is inexhaustible. As we ended our "discussion", I once again thanked my companions and wished them success and good health.

Academician Ambartsumyan Takes the Floor

On his birthday on September 18, 1984, Academician Ambartsumyan delivered a speech to prominent Soviet scientists who had come to Yerevan to attend a session of the Coordinating Council of the USSR Academy of Sciences.

The first part of his speech he devoted to research into non-stationary phenomena in the Universe.

"It is well known that astronomical phenomena, which men have studied since ancient times, amazed people for many centuries by the simplicity and regularity of their operation. Can one imagine anything more regular and orderly than the visible daily motion of the firmament with all its stars, with the absolutely rigorous—so it seemed to our forebears—maintenance of the relative position of all stars? Or the movement of the Sun along the ecliptic in the course of one year, or the sequence of the phases of the Moon? In ancient times, this harmonious picture of strictly periodical movements was disturbed only by observed strange irregularities in the movement of the planets. However, thanks to Ptolemy and his followers, these visible move-

ments of the planets could be reduced to overlapping circular and epicyclic movements. Of course, as observations became more numerous and precise, the number of overlapping epicycles that were needed in order to explain the observed motions of just one planet increased, and this brought dissatisfaction with the Ptolemaic system. However, the Copernican system of the Universe that replaced it correctly reflected the structure of the whole system of celestial bodies—the solar system, and the laws formulated by Kepler made it possible to replace the whole system of epicycles of each planet with one regular, periodical movement. Order, it might be said, had been restored.

"Only the outbursts of Novae, which testified to enormous cosmic explosions, and the extremely irregular, although invariable distribution of stars visible to the naked eye insistently pointed to far more complex laws operating in the far reaches of the Universe, in the world of 'motionless' stars.

"The triumphant march of the Copernicus-Kepler-Galilei-Newton system seemed reassuring and allowed people to believe that, in the future, we would discover relatively simple and comprehensible law-governed regularities. This mood among astronomers-theoreticians was reflected in the title of a work by Laplace—*L'Exposition du systéme du monde*—a system, and not disorder. A similar attitude among naturalist philosophers was reflected in the 'Prolog in Himmel' to Goethe's *Faust.*

"And, as an almost ideal order prevailed in the Universe, it was necessary to formulate the hypothesis that, in one way or another, this 'order', that is, a system with law-governed and periodic movement, must be the result of previous development. Hence the desire to prove that even extreme disorder must, at some point, finally give rise to an ordered Universe. The ideal would be to prove that order must emerge even from chaos. Thus there arose the 'nebular' cosmogonic hypothesis of Kant-Laplace, according to which the planetary system formed out of a 'primeval nebula', i.e. out of a huge cloud of diffuse material. The invaluable achievement of Laplace was that he appreciated the importance of the initial "torque" for the emergence of such an ordered system as our planetary system. It is only now that we are beginning to understand the entire significance of this postulate by Laplace for the whole of the Universe, and in particular for all galaxies. However, in his

cosmogonic hypothesis, Laplace combined this idea with the process of the gradual contraction of gas into dense bodies.

"Although the nineteenth century saw the discovery of numerous phenomena concerning to the diversity and variability of movements in the world of stars, attention continued to be focused on the study of regular, periodic processes. Astronomers concerned themselves with determining the orbits of binary and spectroscopic binary stars. One of the great astronomical discoveries made at the end of the nineteenth century was the discovery by Academician Aristarkh Byelopolsky of periodic changes in the radial velocities of Cepheids, which was later correctly interpreted as the spherical-symmetrical pulsations of the outer layers of these variable stars.

"The twentieth century opened with the outburst of Nova in Perseus (1901), and observations showed that the outburst had ejected a nebula which began to expand around the Nova with enormous speed. We now know that the outburst of a Nova is a process which involves the ejection of the outer layers of the star which, as they are thrown off, form an expanding nebulous envelope around the star to which it will never return. An excellent example of an irreversible and non-periodic process! It was probably the outburst of the Nova in Perseus which caused Poincaré to say that no one had ever yet seen a nebula turning into a star, as Laplace maintained, but, on the contrary, people had more than once witnessed a star turning into a nebula. An accurate interpretation of the spectral observations made it possible to determine that the outer layers are ejected at velocities of around 1,000 km a second, and even higher.

"The first quarter of the twentieth century saw two more major discoveries, one of which was the rapid expansion of the Crab Nebula. It is expanding at a rate of over 1,000 km per second. This subsequently made it possible to assert that this nebula is the result of the outburst of a Supernova. The second discovery was variability in time of the forms of so-called cometary nebulae.

"In the 1930s specrophotometric research made it possible to establish that the Wolf-Rayet-type stars, (the hottest stars, with a surface temperature of the order of 100,000° K) have been continually emitting huge gaseous masses of gas for tens and even hundreds of thousands of years.

The total mass of gas ejected by each star of this kind over this period is thought to equal or exceed the mass of the Sun. Interpretation of the spectrum of another, slightly less hot star, P Cygni, which burst out in 1600, revealed a still more powerful ejection of matter. The fact that this star had not been observed prior to 1600 (it is true, though, that until the beginning of the seventeenth century observations were made only with the naked eye), indicates that the ejection of matter is, in this case, connected in some way with changes in the star leading to increased brightness. It was probably at this stage that there emerged the conception of the possible non-stationary processes continuing over many tens of thousands of years.

"A short while earlier, on the basis of the development of the theory of the radiation transfer and the theory of the process of fluorescence in gaseous nebulae, and of observational data, it was ascertained that planetary nebulae are expanding objects approximately one hundred thousand (10^5) years old, and that, therefore, they were formed as a result of the ejection of the outer layers of the corresponding central stars. However, this process is more spectacular, albeit slower, than the outburst of a Nova.

"It was around this time that the class of Super-novae was discovered. These, as they flare up, attain a maximum luminosity that is hundreds of millions of times greater than that of the Sun. Such Super-novae appear in our Galaxy roughly once in a century. One such outburst in our Galaxy, which was observed by Chinese astronomers 930 years ago, gave rise to the famous Crab Nebula. As we now know, the Crab Nebula proved to be a powerful source of radio emission, that is, a radio nebula. Let me point out here that another radio nebula having the most powerful flux of radio emission, is in the Cassiopeia constellation, and is also the remnant of the outburst of a Super-nova in our Galaxy, which occurred around 300 years ago.

"The 1930s also saw the emergence of a new line of research—the statistical mechanics of systems of gravitating particles. This made it possible to determine that:

"(a) the age of our Galaxy does not exceed one hundred thousand million (10^{10}) years;

"(b) the so-called open star clusters 'evaporate', that is, disperse over a period of just hundreds of millions of years, and their component stars become part of the general

stellar field of the Galaxy;

"(c) broad stellar pairs break up quite frequently on encountering field stars, but the reverse process of the emergence of such pairs from field stars almost never happens. All these theoretical results were arrived at first in the Soviet Union. It took several years for them to be correctly understood in the West.

"From what has been said above it is clear that, even prior to the Second World War, the picture of a calm Universe had been replaced in the eyes of the then young generation of astronomers by a picture of a restless, variable and, as they now sometimes say in the West, 'exploding' Universe.

"The phenomenon of receding distant galaxies, interpreted as a universal phenomenon of an expanding system of galaxies, completed this picture of ubiquitous explosions, the ejection from stars of streams of gas and nebulae, and of the disintegrating stellar pairs and star clusters.

"The end of the Second World War, marked by the victory of progressive forces over Nazism, saw the birth of radio astronomy.

"What has radio astronomy given to us? New radio-astronomical methods of research have made it possible to begin a thorough study of phenomena which are difficult to observe using optical methods. A fan-like network of antennae picks up data on what is happening in the depths of the Universe.

"It is worth pointing out here that these methods proved particularly sensitive to the non-stationary phenomena that are of interest to us. Observation by optical methods makes it necessary to conduct a long and painstaking search for these non-stationary objects among the far more numerous stationary objects. In the radio-frequency range stationary objects are almost always 'silent' or, as they are usually termed, 'quiet', while non-stationary heavenly bodies are far more powerful radio sources, particularly the radio galaxies, that is, galaxies that are powerful sources of radio emission.

"In the 1950s two American astronomers, Baade and Minkowski put forward a hypothesis, that soon became wide-spread, that radio galaxies are the result of a collision between two ordinary galaxies. Soviet astronomers advanced the opposite theory, namely, that a radio galaxy is the result of an enormous explosion which has occurred in the nucleus of the galaxy, that is, it is the consequence of the internal

development of the galaxy. This idea radically changed the face of extra-galactic astronomy. Today more than half the work being done in the field of extra-galactic astronomy is directed at investigating the various manifestations of this activity and determining its nature.

"A major stride forward in our understanding of non-stationary objects was the conception of stellar associations as groups of stars which had formed together, and, moreover, comparatively recently. Of particular importance in this connection is the study of members of T associations, which include the variable T Tauri stars. These stars are about a million years old. The extremely non-stationary atmosphere of these stars causes rapid changes in the intensity and composition of their radiation. Very often the total radiation energy of the T Tauri stars undergoes considerable changes for a period of just a few days. The atmospheres of these stars, in addition to ejecting a constant stream of matter, also eject discrete clouds which Soviet astronomers have called Herbig-Haro objects. These formations, observed in the vicinity of T Tauri stars, have an age measured only in thousands of years, and possibly contain, together with rarefied gases, denser components which are the sources of their energy supply.

"Another class of stars related to the T Tauri stars, is the class of UV Ceti flare stars. These usually inactive objects occasionally increase their brightness dozens of times for several seconds. A major contribution to the study of UV Ceti flare stars has been made by Soviet astronomers. The astronomers at Byurakan have discovered many more flare stars in open clusters. These discoveries have made it possible to establish that every dwarf star passes through the flare stage while young. Astrophysicists in the Crimea have made a thorough study of their spectra, while astronomers in Tashkent, working with other astronomers, have discovered a number of specific features in the changes of the brightness of these stars, using multicolour electrophotometry.

"And what can we learn from the data provided by radio astronomy? Here it is worth emphasising the wealth of information gained from the observation of emission radio lines which correspond to various frequencies in molecular spectra.

"Optical investigations of the ionised plasma in inter-

stellar space are carried out by observations conducted in the various lines of hydrogen and helium. If clouds composed of cosmic dust impede observations in the optical region of the spectrum, then it is possible to study the lines of these same elements in the infra-red region of the spectrum, where absorption by cosmic dust is small. The distribution of cooler neutral gas in inter-stellar space and in other galaxies may be studied by observations in the 21-cm line of neutral hydrogen. However, even cooler gases, which are often found together with dust in regions surrounding cold stars, are already being studied with the use of observations carried out in molecular spectral lines. Thus it became possible to make a detailed study of movements in cold, non-luminous molecular clouds which, as it was later discovered, sometimes have a mass one hundred thousand times greater than that of the Sun.

"Observations have also led to the discovery of cosmic masers which, having formed in the regions where young stars are now born, move at enormous velocities within these regions and rapidly change their intensity. An excellent example of a non-stationary phenomenon is an entire system of masers scattering from one centre in the famous Orion nebula. This centre is located not far from the equally well known multiple star, Trapezium (Θ^1 Ori).

"Soviet astrophysicists from the Institute of Cosmic Research and the Special Astrophysical Observatory of the USSR Academy of Sciences, in cooperation with astronomers from the Byurakan Observatory, have studied systems of H_2O and OH masers, carefully observing their considerable changes with time.

"It turned out that the system of dispersing masers is a source of information about physical conditions in the areas of star formation.

"Today we can speak not only of stellar associations and the gigantic molecular clouds they contain as special systems, but we are also sometimes able to distinguish within associations far smaller volumes where the age of the stars does not exceed one or two million years, a system of the Trapezium (Θ^1 Ori) type, that is, *areas of relatively recent star formation.* Finally, we are also able to distinguish in associations areas that are smaller still, where the stars are even younger, where the processes are occurring even more intensively and where the situation determined by

an intensive ejection of stellar matter changes over a period of less than one hundred thousand (10^5) years. These, even more compact areas are referred to as areas of *contemporary star formation,* with all the appropriate features: cosmic masers, intensive outflow of matter from young stars and ejection of Herbig-Haro objects. At the present time, the study of these areas in stellar associations is one of the most amazing branches of astrophysics, as this study is helping to unravel the great mystery that surrounds the process of star formation.

"We may summarise this brief review relating to young astrophysical objects as follows:

"1. We already know how nebulae of a number of categories are formed.

"2. We have discovered where stars are formed and what the earliest stages in their development following their birth are like. It has been ascertained that they are highly non-stationary by nature and have the capacity to energetically eject streams of matter. And although we still do not know exactly how and from what stars are formed, we have come considerably closer to an answer.

"And how do stars die?

"The opportunity we now have to study non-stationary pocesses that accompany the stages of stellar death has proved no less interesting. These processes involve the condensation of matter to produce super-dense bodies—white dwarfs and pulsars.

"It is worth noting in this connection the enormous importance of a new field of astrophysical observations—X-ray astronomy. This branch of astronomy emerged when satellites and spacecraft were equipped with sensitive X-ray receivers, and then rather complex X-ray telescopes. X-ray astronomy, like radio astronomy, is a powerful method of observation, which is selectively sensitive to non-stationary phenomena, and particularly to those which appear in the final stages of the normal lifespan of a star.

"Typical discrete sources of X-ray radiation are the X-ray pulsars, which emerge as a result of the outburst of Supernovae. Pulsars are now believed to be super-dense configurations of stellar masses, or, as they are sometimes called, neutron stars. Here we are dealing with colossal acceleration, gravitational and magnetic fields of enormous intensity.

"It must be remembered that the gravitational fields in

classical astronomy were always weak, and could be dealt with adequately by Newton's law. However, in the case of super-dense configurations we are dealing with just the opposite extreme where the difference between the potentials approaches the square of the light velocity. Here we have to analyse questions of the validity of the Einstein-Gilbert law of gravitation as applied to very powerful fields, the possibility or impossibility of black holes, etc.

"I have already spoken about the radio galaxies. We still do not have an adequate theory on radio galaxies, that is, we still do not know the causes of the explosions that transform an ordinary galaxy into a radio galaxy, but many years passed before astrophysicists finally rejected the hypothetical picture of colliding galaxies and arrived at a correct interpretation of the observational data—the picture of clouds of relativistic electrons ejected from the nucleus. We now understand that the cause is to be sought in the nucleus of the galaxy, but as regards the mechanism operating in that nucleus we can still only make rather arbitrary assumptions.

"In the interpretation of observational data Soviet astrophysics occupies a leading position. Nevertheless it must be emphasised that the vast amount of observational material accumulated by modern astrophysics requires a more detailed and thorough analysis than was made previously, and that, alongside traditional methods, new approaches must be found and developed.

"In astrophysics, the basis of all work is, of course, *observation* and the competent analysis of the observational data. An example of such analysis is densitometric or positional measurement on astronomical photographs. Essentially this consists in presenting the results in the form of figures. It is precisely by this method that new and more interesting objects and phenomena are being discovered and their quantitative characteristics established.

"As regards astronomical discoveries, in particular the discovery of non-stationary objects, the Soviet Union occupies an outstanding position. It was in the USSR, for example, that the majority of galaxies with more active nuclei were discovered, galaxies of the Seyfert type. Soviet astronomers have discovered approximately one-third of all known flare stars, around one-half of listed cometary nebulae, and many Herbig-Haro objects, as well as certain other unique

phenomena.

"In order to explain the progress that has been made in the study of faint stars and galaxies, I shall make a slight digression.

"Using our pre-war telescope, Soviet astronomers photographed stars with a magnitude of up to 16; they were able to make a mass study of the spectra, with a small dispersion, of objects with a magnitude of up to 9; a detailed study of stellar spectra enabled Academician Shain and Albitsky to investigate stars with a magnitude of only 7.

"In the post-war period considerable advances have been made in this field. In the 1960s Soviet scientists were already photographing stars of a magnitude of up to 21 (that is, stars one hundred times fainter than those photographed earlier), they began to obtain the spectra of stars of a magnitude up to 16.5 (a thousand times fainter than those observed previously), and for a detailed study they obtained the spectra of individual objects of a magnitude up to 15.0, that is, approximately a thousand times fainter than before.

"The study of objects was facilitated by new telescopes and more sensitive light detectors. The importance of this lies in the fact that, if we can now study objects a thousand times fainter, we get access to approximately ten thousand times more objects (as there are far more fainter objects than bright ones in the Universe. We are, of course, referring to visible brightness and not to absolute luminosity).

"Today, and more specifically by 1980s, thanks to the use of a six-metre telescope, it has become possible to study stars 10 to 30 times fainter.

"If by 1990 we advance by yet another two magnitudes in this direction, a wide field will open out before us. However, this will not eliminate the need to create a series of new large instruments.

"To return to our main theme, it must be pointed out that the study of many non-stationary processes requires major advances in radio astronomy based on the observation of molecular radio lines. Today these are the radio lines of CO, and also the H_2O, OH and SiO masers; tomorrow it will be other radio lines. And it is highly desirable that observations be made on the basis of radio interferometers.

"I am afraid that the urge to pursue various grandiose

projects may somewhat distract our radio astronomers from the problems of millimetric molecular radio astronomy problems which could, in all probability, be solved using less spectacular equipment, but with sufficiently accurate mirrors. I may add that the radiophysicists of the Academy of Sciences of the Armenian SSR already have considerable experience in constructing highly sensitive radiometers for this band.

"In conclusion I should like to say a few words about a problem which is only just beginning to emerge out of a small number of known facts. The solution of this problem lies, of course, in the distant future, but the very fact of the appearance of such problems indicates that in the area of non-stationary phenomena, we still know very little, despite our remarkable achievements and therefore we can expect amazing new discoveries.

"I have already referred to such non-stationary phenomena as the outbursts of Novae. Normally this phenomenon consists in the fact that a star, previously so faint that it had not been detected or studied, suddenly, in the space of one or two days, becomes tens of thousands of times brighter, and then, far more slowly, in the course of several years, diminishes in brightness till it reaches its initial level. Such outbursts, as was stated earlier, mean the ejection of the outer layers of the star, and the birth of a small nebula.

"However, in 1600, in the Cygnus constellation, a Nova appeared which reached a visible magnitude of 3 and then, after a period of fluctuation, dropped to a magnitude of 5, a magnitude considerably greater than it had had originally, and thereafter remained at that level. This star is known as P Cygni and its visible brightness is now practically constant. If the ignition had occurred in our time, we would look at earlier maps or photographs and determine the brightness of the star prior to the ignition. However, in 1600 there were neither photographs nor telescopes, and the only thing that can be said is that prior to 1600 this star was not visible to the naked eye, that is, was fainter than magnitude 6. Nonetheless, there was undoubtedly a leap from one state with a low level of brightness to another state with a high level of brightness, that is, with a considerable emission of energy in the visible region of the spectrum. The star was transformed, and for a long period of time. It is as if someone had 'switched on' inside the star a powerful source of

optical radiation, and this source then remained 'switched on'. There was indeed ignition, a switching on, and not an "outburst", such as occurs with other novae.

"In 1934 a star flared up in the Orion association, which was given the name FU Orionis. In this instance, of course, there were earlier photographs at observatories. It turned out that the star had increased in brightness more than one hundred times. This was the first time since the ignition of P Cygni that astronomers had witnessed a similar phenomenon. After minor fluctuations, FU Orionis maintains a practically steady level of brightness for fifty years already.

"Subsequently two more such stars were discovered. This gave rise to the conception of a new class of non-stationary objects which were labelled fuors (after the FU Orionis star). There is a photograph of the spectrum of one such star prior to its ignition. And we now know that prior to ignition at least some fuors are the T Tauri stars, which belong to stellar associations. After ignition, the spectrum of such stars ceases to resemble in features the T Tauri spectrum and acquires, although to a small degree, the features characteristic of the P Cygni spectrum.

"The astronomers at Byurakan then discovered yet another star which, more than ten years ago, underwent a similar 'switching-on' of new sources of optical radiation, after which its brightness increased approximately ten times. In this instance, after ignition the star possesses a T Tauri spectrum with the marked chromospheric activity typical of the stars of this type.

"For these reasons we may conclude that we are dealing not with one class, but with an entire series of classes of objects which display the phenomenon of ignition over a long period of time. Statistical arguments indicate that this state of increased luminosity cannot continue, on average, for more than several thousand years. In other words, some time after the ignition there must occur the total or almost total 'switching-off' of the additional and powerful source of radiation. How quickly such a 'switching-off' occurs we do not know, as no such assumed 'switching-off' of an optical object has ever been thoroughly investigated. However, there are isolated, tentative indications of such protracted reduction in brightness of one or two objects.

"There has been, it is true, recent evidence of the 'switching-off' of several X-ray sources.

"The example of fuors, or stars with 'switching-on' sources of radiation, gives us grounds to assert that astrophysics will soon come across even more remarkable non-stationary phenomena.

"One can only hope to live long enough to witness the unravelling of the essence of these unusual processes."

There Were Many Meetings...

I met Ambartsumyan many times in the course of forty years. Once, when I asked him how he achieved his successes in science, how he went about his work, he answered:

"I think, I think all the time."

"But you are the President of the Academy of Sciences of the Armenian SSR, the director of the Byurakan Observatory, a deputy to the Supreme Soviet of the USSR, not to mention your duties in various top international astronomical organisations, and you also have to find the time for your pedagogical work, for your family... How do you manage?"

"While I am engaged in all these varied and vital matters, I simply never lose sight of the main object of my research... The work of the mind goes on continually. It captivates you, and in the end the difficulties and doubts that arise turn into the joy of creativity."

"When do you publish your conclusions?"

"When the work done has 'settled'. When I and my pupils have subjected a new piece of work to strict examination and verification and carefully analysed the point of view of our opponents. Only then, and without undue haste, do I publish the final results."

"It is by no means rare for your new works, because of the unexpected arguments and conclusions that they contain, to provoke strong criticism both at home and abroad. Do you reply to your opponents?"

"No, I don't reply. Years pass. Time provides the answer. Those same critics verify my conclusions in their own observatories and arrive at the same results that were first obtained at the Byurakan Observatory."

At that point I remembered how once, in the press, a whole section from the works of Ambartsumyan had been

attributed to one of the opponents of Byurakan ideas. I myself had witnessed the indignation of Ambartsumyan's pupils. They asked, even demanded, that their teacher expose and refute what had been printed. When he discovered what had upset them so much, the astronomer replied humorously: "What is so bad about our opponents wishing to become our coauthors?"

Of course, I thought, one has to have steady nerves to continue to research into a theory that has been rejected. One has to have faith in one's own correctness.

"It is sometimes said that creative work is painful. Can the process of search and discovery of the truth be really described as painful?"

Ambartsumyan answered the following:

"Yes, it can. If the researcher does not know what he is trying to achieve, what he is searching for, then, of course, it is a painful process. If, on top of that, he has taken on a work that is too much for him to cope with, without taking account of the actual possibilities and, what is still more important, of his own abilities and those of his associates, then his 'creative work' is doomed to failure. It is simply a waste of time and resources. And time is beyond price."

"Those who are dedicated to science," said Ambartsumyan once, "always have a great respect for time, constantly study and seek to improve themselves. I hate the upstarts, but I always welcome a thirst for knowledge, a desire to learn and teach all one's life."

"People say that you are always generous in sharing your ideas in your works, in lectures, during consultations and in written comments on work done not only by your own pupils, but also by colleagues whose views are very far removed from your own scientific ideas."

"In life as in science I value the saying of Shota Rusthaveli: 'What you give remains yours; what you keep is lost.' What could be more valuable than generosity of soul? He who does not know this pleasure can only be pitied."

Victor Ambartsumyan's spiritual make-up has won my respect and admiration. I recalled the words of the celebrated Armenian painter, Martiros Saryan, spoken on Ambartsumyan's sixtieth birthday, on September 18, 1968: "Men are born who become the prototype of the nation that gave them birth. Such were Mesrop Mashtots and Movses Khorenatsi, David the Invincible and Ananiya Shirakatsi, Toros

Roslin and Grigor Narekatsi. Such also is Victor Ambartsumyan."

My book is drawing to its end. I know that there is a great deal I have not said about its hero and the complex times he has lived through, that sometimes the colours have been applied unevenly, and that in places they are insufficient. I have written as best I could, and with great affection.

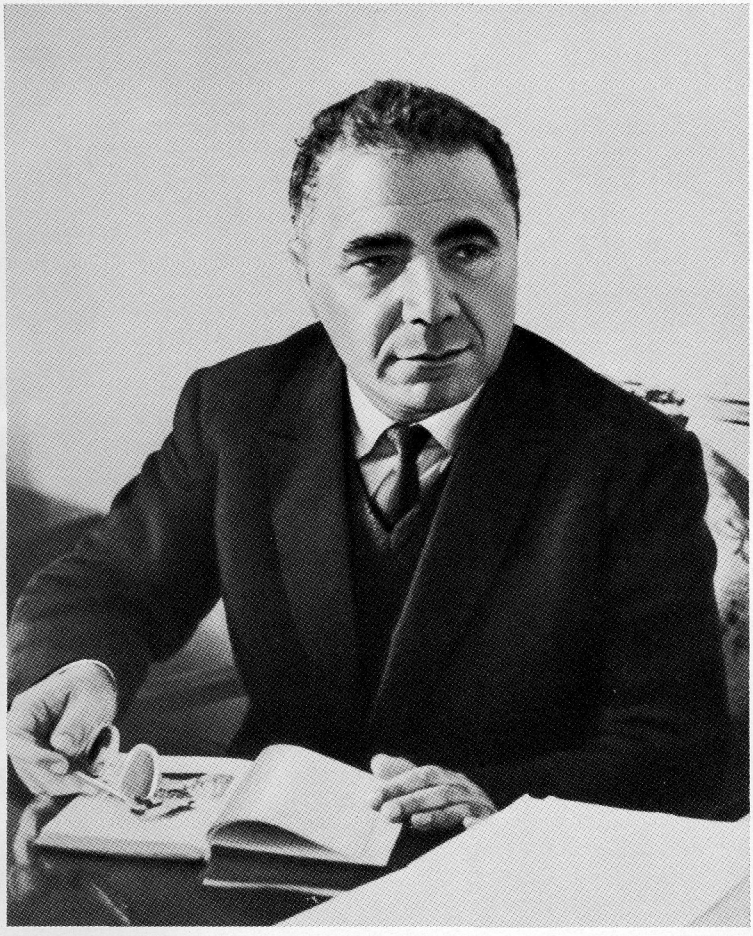
Any age is rich in outstanding minds, but only few have succeeded in winning immortality for their ideas. Only a few have been able to transcend the boundaries of their own day and, drawing on the experience of the past and the present, influence the development of science and illuminate the future.

Among such people, possessing sensitive intuition and precision of thought, one may name Victor Ambartsumyan, whose fundamental works have played an outstanding part not only in the astronomy of the twentieth century.

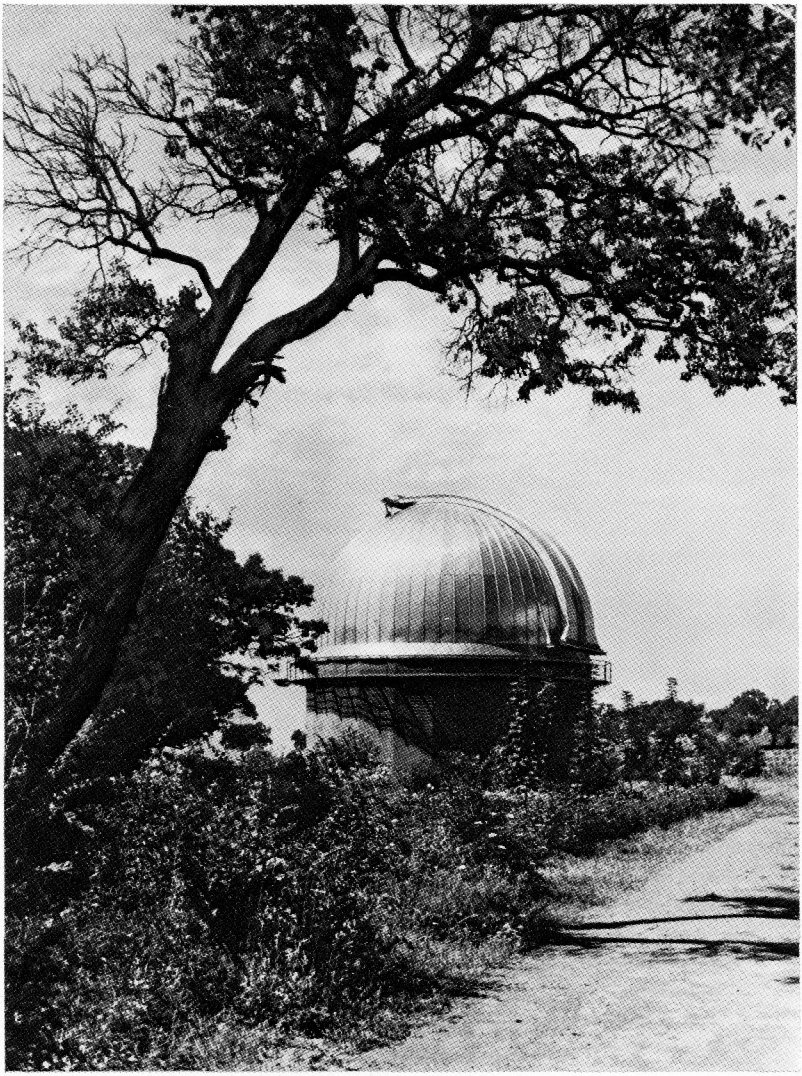
Whatever period we take in the scientific career of Victor Ambartsumyan, he has always been a bold innovator broadening our view of the Universe by explaining the complex processes occurring within it.

Ambartsumyan once said that he would like to live long enough to witness the unravelling of the mystery of the unusual processes occurring in the Universe.

Science still has a long road to cover. May we wish you a long life, great astronomer of Byurakan, envoy of the stars!



The Byurakan Astrophysical Observatory of the Academy of Sciences of the Armenian SSR.



A meeting on the Erivan (Yerevan) Square in Tiflis to mark the anniversary of the establishment of Soviet power in Georgia (1922). Victor Ambartsumyan is in the bottom right-hand corner.

Victor, Goar and Levon Ambartsumyan. Leningrad, 1929.

Victor Ambartsumyan (first from the right) with his friends. Pulkovo, 1928.

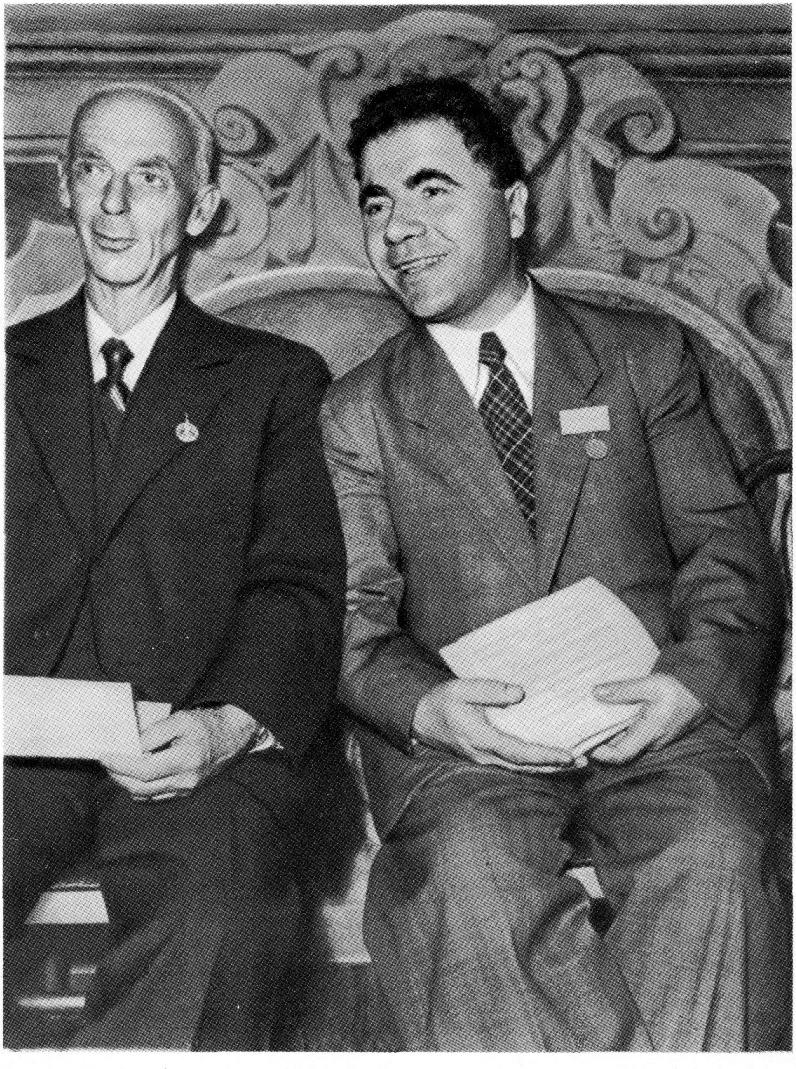
Victor Ambartsumyan with his colleagues, young Leningrad scientists.

At a scientific conference. Victor Ambartsumyan is in the first row at the table. Leningrad, 1929.

The Byurakan Observatory will be built here. 1946.

The Ambartsumyan family. Leningrad, 1936.

Between sessions at an International Astronomical Congress in Zurich, 1948.



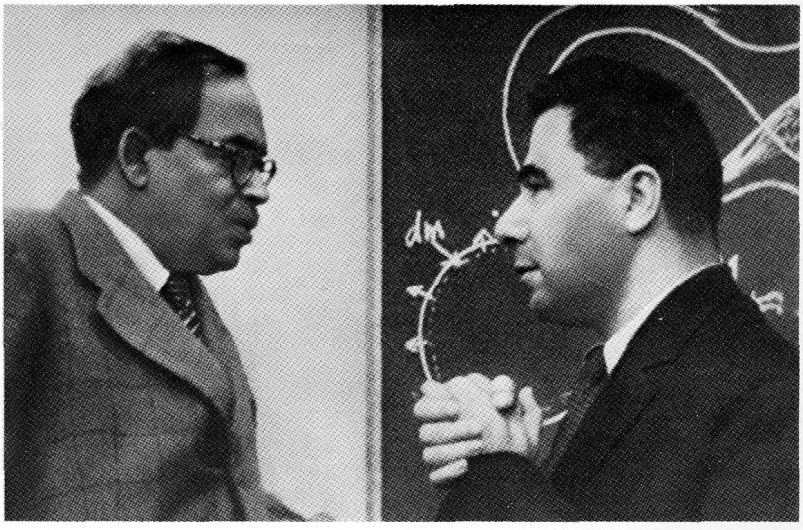
The diploma certifying Ambartsumyan's election as a corresponding member of the Royal Society of Sciences. Liege, 1953.

Left to right: Kirill Ogorodnikov, Victor Dombrovsky, Victor Sobolev, Vsevolod Sharonov, Oleg Melnikov. Victor Ambartsumyan is in the centre. 1947.

Victor Ambartsumyan talking with Jan Oort. Byurakan, 1956.

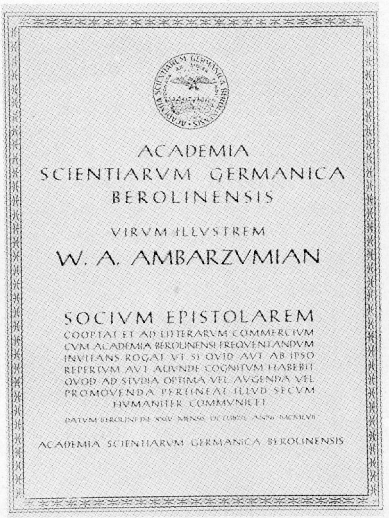
Victor Ambartsumyan addressing a forum of peace champions. Moscow, 1953.

The Indian physicist Meghnad Saha and Victor Ambartsumyan in conversation during a conference on cosmogony. Moscow, 1954.

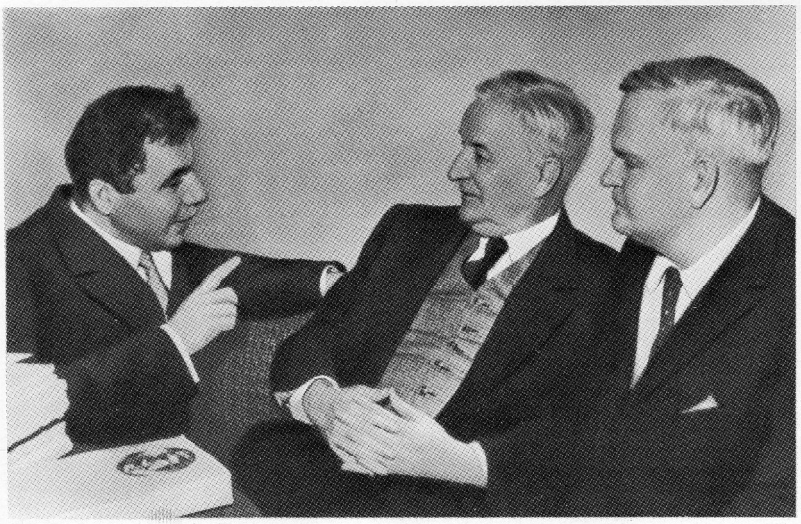


The diploma certifying Victor Ambartsumyan's election as a member of the Academy of Sciences of the USSR.

The diploma certifying Victor Ambartsumyan's election as an honorary member of the Berlin Academy of Sciences. 1957.

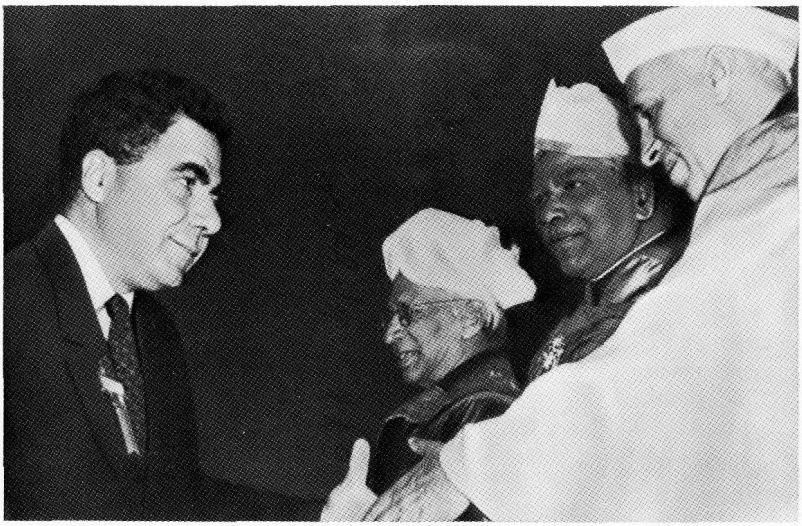


Victor Ambartsumyan talking with Professor Frings, President of the Saxonian Academy of Sciences. Leipzig, 1955.

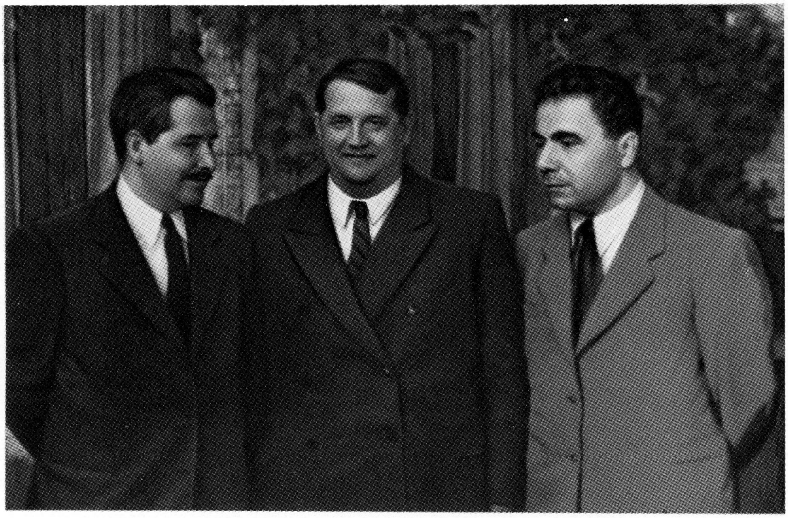


Victor Ambartsumyan and writer Ashot Arzumanyan during a stroll. Byurakan, 1960.

Victor Ambartsumyan is being received by Jawaharlal Nehru in India. 1959.

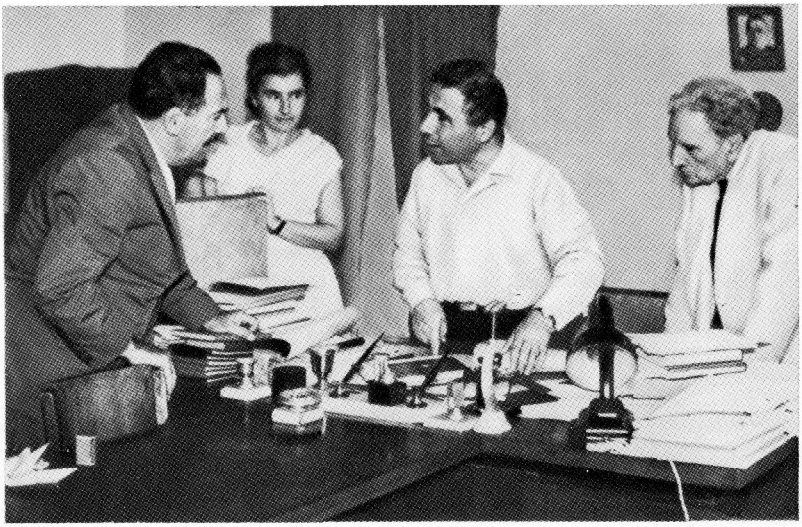


Victor Ambartsumyan, Oleg Melnikov, and Guillermo Haro (Mexico). Byurakan, 1960.



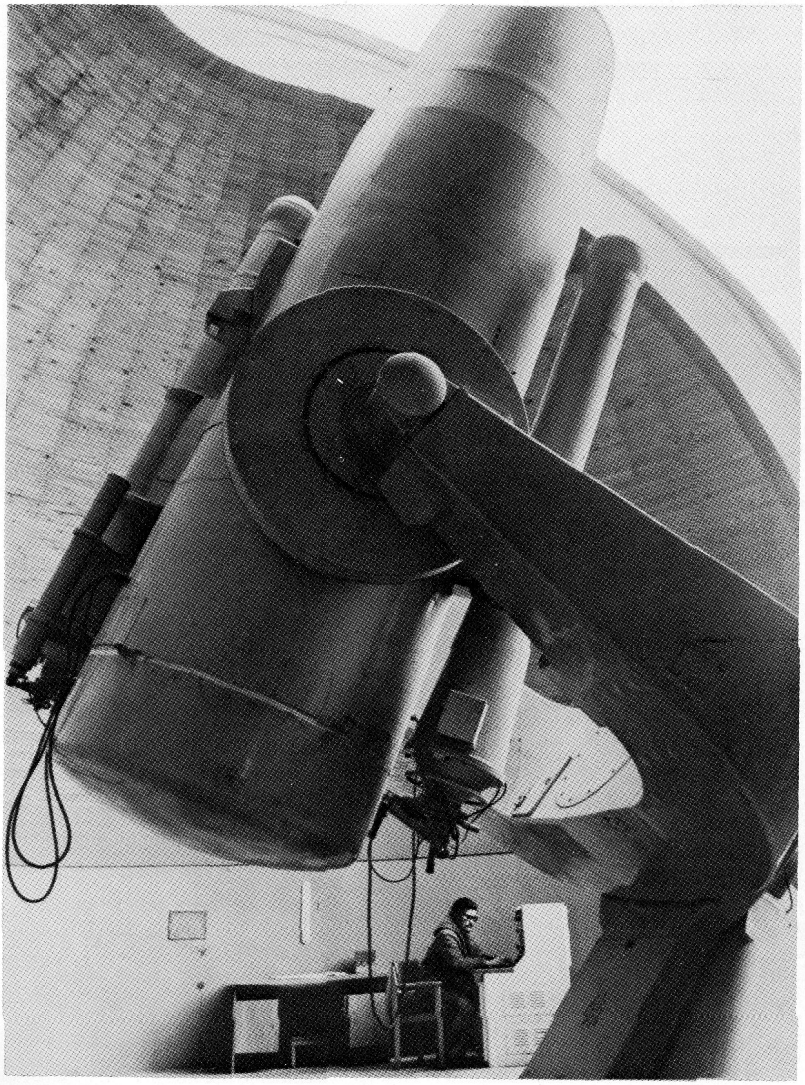
Dmitry Maksutov and Bagrat Ioannisyan, designers of Soviet telescopes, with the author of this book (in the centre). Pulkovo, 1959.

The Armenian painter Martiros Saryan (on the right) and the American writer William Saroyan visiting Victor Ambartsumyan. Byurakan, 1960.



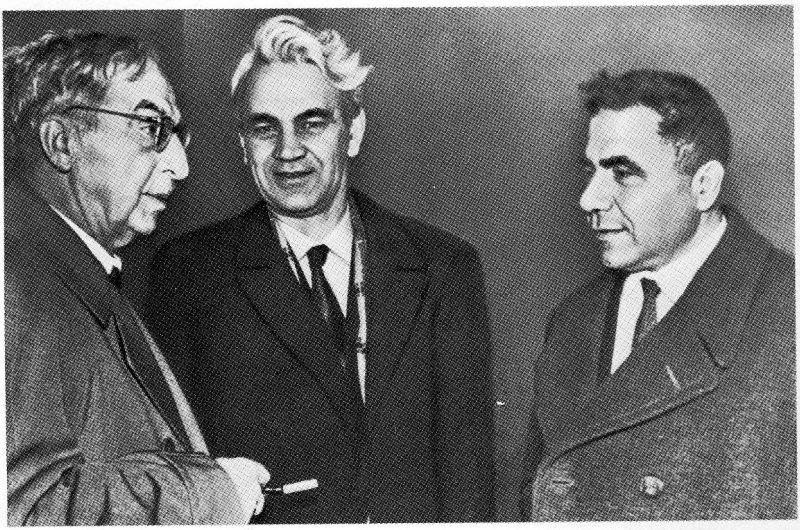
Victor Ambartsumyan with students of astrophysics at Yerevan University (first graduates). 1961.

One-metre Schmidt telescope.
Byurakan, 1961.

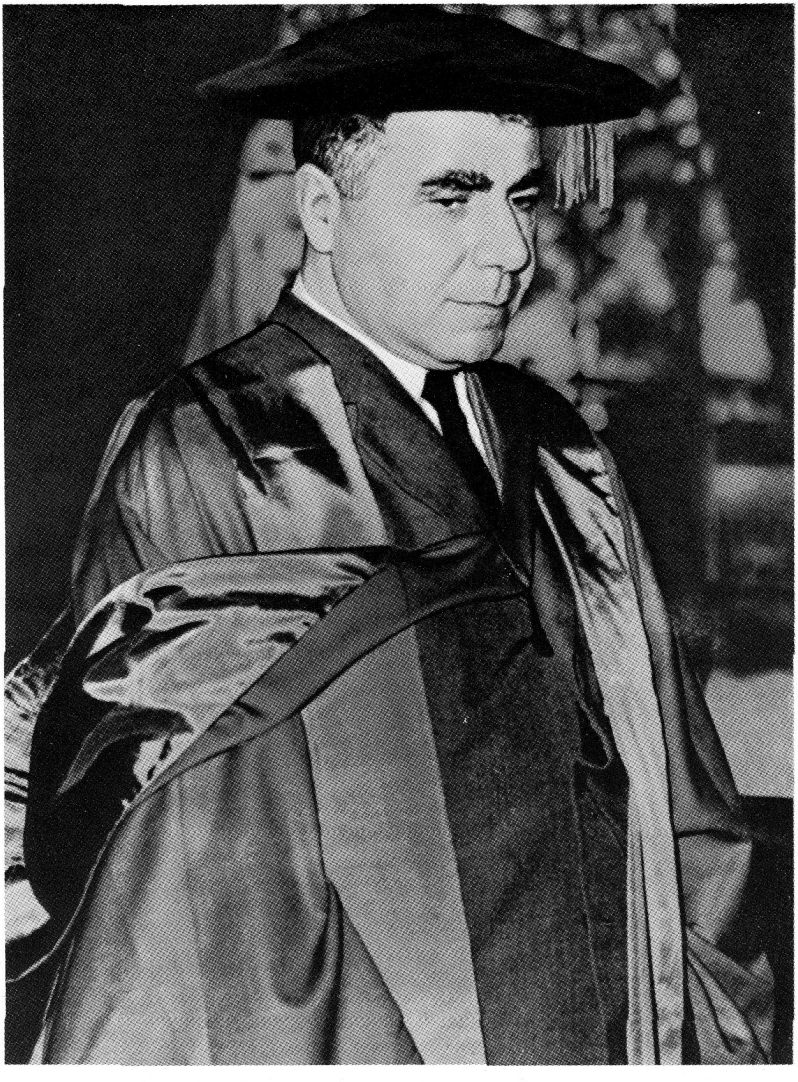


Mstislav Keldysh, President of the Academy of Sciences of the USSR, visiting Academician Victor Ambartsumyan, President of the Academy of Sciences of Armenia. Yerevan, 1961.

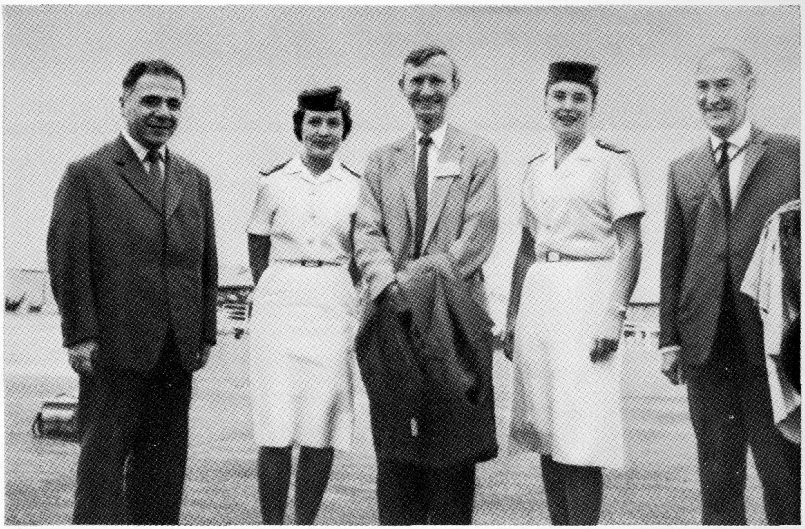
President of the Academy of Sciences of Georgia Nikolai Muskhelishvili, President of the USSR Academy of Sciences Mstislav Keldysh, President of the Academy of Sciences of Armenia Victor Ambartsumyan.



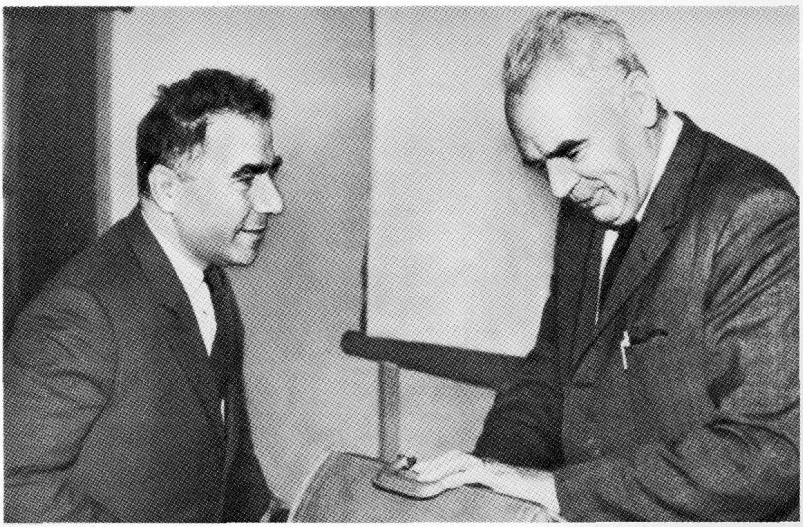
During the ceremony at which *Victor Ambartsumyan was made an* honorary doctor of the University of Canberra (Australia).



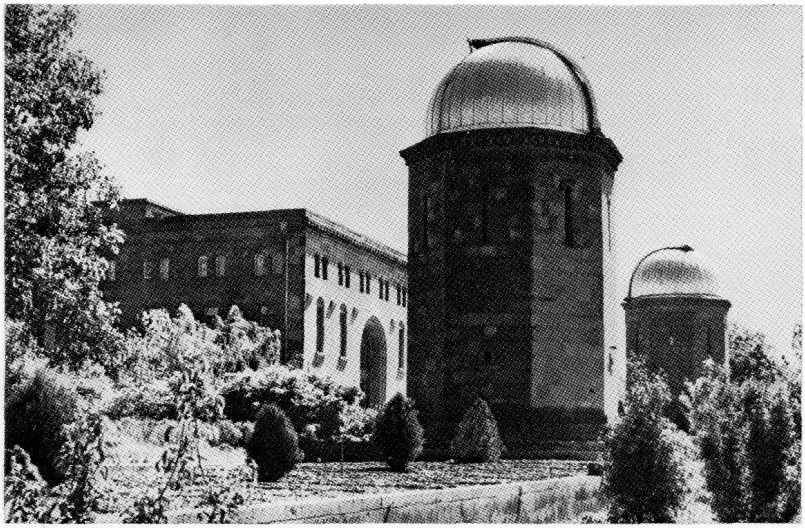
Delegates to the international symposium in Australia at the Narrabran airport. 1963.



Bart Bok, Director of the National Observatory of Australia at Mount Stromlo, and Victor Ambartsumyan. Byurakan, 1964.



The main building of the Byurakan Observatory.



Happy grandfather and grandmother. Byurakan, 1965.

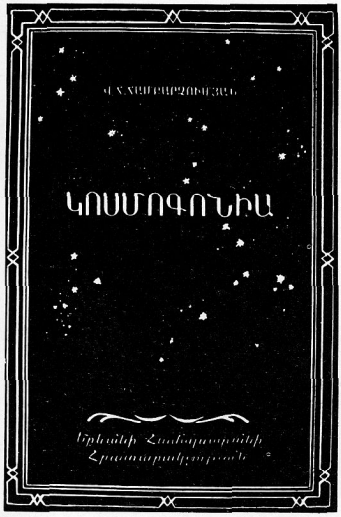
Academician Victor Ambartsumyan and Doctor Nikolaus Richter. Byurakan, 1969.

Academician Charles Fehrenbach, Director of the National Observatory of France in Haute Provence (second from left). Byurakan, 1970.

At the symposium on "Non-Stationary Phenomena in Galaxies" held by the International Astronomical Union. Victor Ambartsumyan and Jan Oort are in the centre. Byurakan, 1966.

The first Soviet-American Conference on Communication with the Extra-Terrestrial Intelligence, with the participation of scientists from other countries. 1976.

The cover of the book *Cosmogony* by Victor Ambartsumyan (in Armenian).



A message addressed by the President of the International Astronomical Union, Victor Ambartsumyan, to the National Academy of Sciences of the USA on its centenary.

TO THE NATIONAL ACADEMY OF SCIENCES
OF THE UNITED STATES OF AMERICA

THE **INTERNATIONAL ASTRONOMICAL UNION** IS SENDING ITS SINCERE CONGRATULATIONS TO THE **NATIONAL ACADEMY OF SCIENCES** OF THE UNITED STATES OF AMERICA ON THE OCCASION OF ITS GLORIOUS CENTENNIAL.

THE ACTIVITIES OF THE NATIONAL ACADEMY OF SCIENCES INCLUDE, AMONG OTHER FIELDS, ASTRONOMY AND ASTROPHYSICS. MANY GREAT AMERICAN ASTRONOMERS OF THE PAST HAVE BEEN MEMBERS OF THE ACADEMY. THE MEMBERSHIP OF THE ACADEMY NOW COMPRISES A SPECIAL SECTION OF ASTRONOMY WHICH INCLUDES A LARGE NUMBER OF BRILLIANT SCIENTISTS. THEY HAVE ENRICHED THE SCIENCE OF ASTRONOMY WITH MANY SPLENDID DISCOVERIES AND ACHIEVEMENTS. MANY OF THEM ARE ACTIVE MEMBERS OF THE INTERNATIONAL ASTRONOMICAL UNION AND PARTICIPATE IN DIFFERENT INTERNATIONAL ASTRONOMICAL PROJECTS.

AS AN INTERNATIONAL BODY REPRESENTING THE FIELD OF **KNOWLEDGE,** WHICH IS IN ITSELF GENUINLY INTERNATIONAL, OUR UNION IS FIRMLY CONVINCED THAT, APART OF ITS PRACTICAL AND SPIRITUAL VALUE, **SCIENCE** CAN SERVE TO ESTABLISH AND STRENGTHEN FRIENDLY RELATIONS AND PEACEFUL COOPERATION AMONG ALL NATIONS ON OUR **PLANET.**

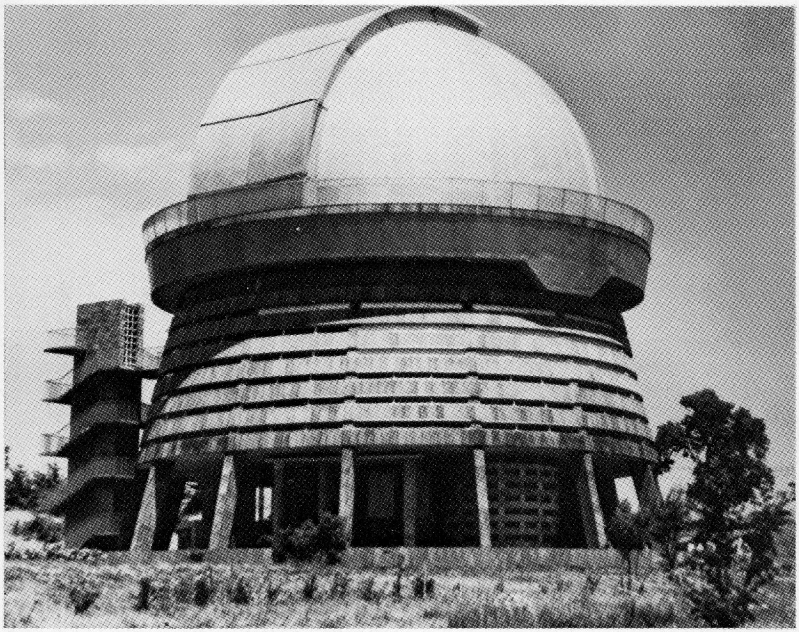
WE LOOK FORWARD FOR THE FUTURE GROWTH OF SCIENTIFIC ACTIVITIES OF YOUR ACADEMY AND FOR YOUR FURTHER PARTICIPATION IN INTERNATIONAL SCIENTIFIC COOPERATION, INCLUDING THE **SCIENCE OF ASTRONOMY.**

IN BEHALF OF THE INTERNATIONAL ASTRONOMICAL UNION
V. Ambartsumian PRESIDENT

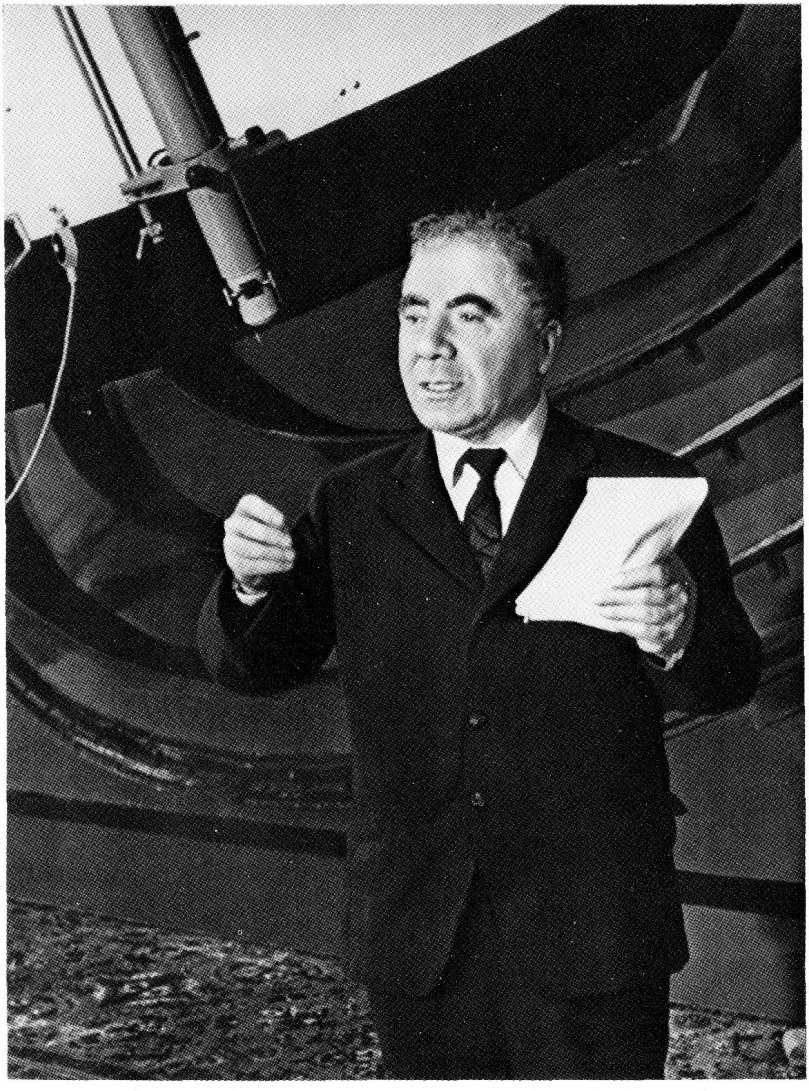
The scientific library at the Byurakan Observatory.

An international symposium on "Flare Stars". 1976.

Reflecting telescope with a 2.6-metre mirror. Byurakan, 1976.



Victor Ambartsumyan addressing the ceremonial commissioning of the 2.6-metre telescope.

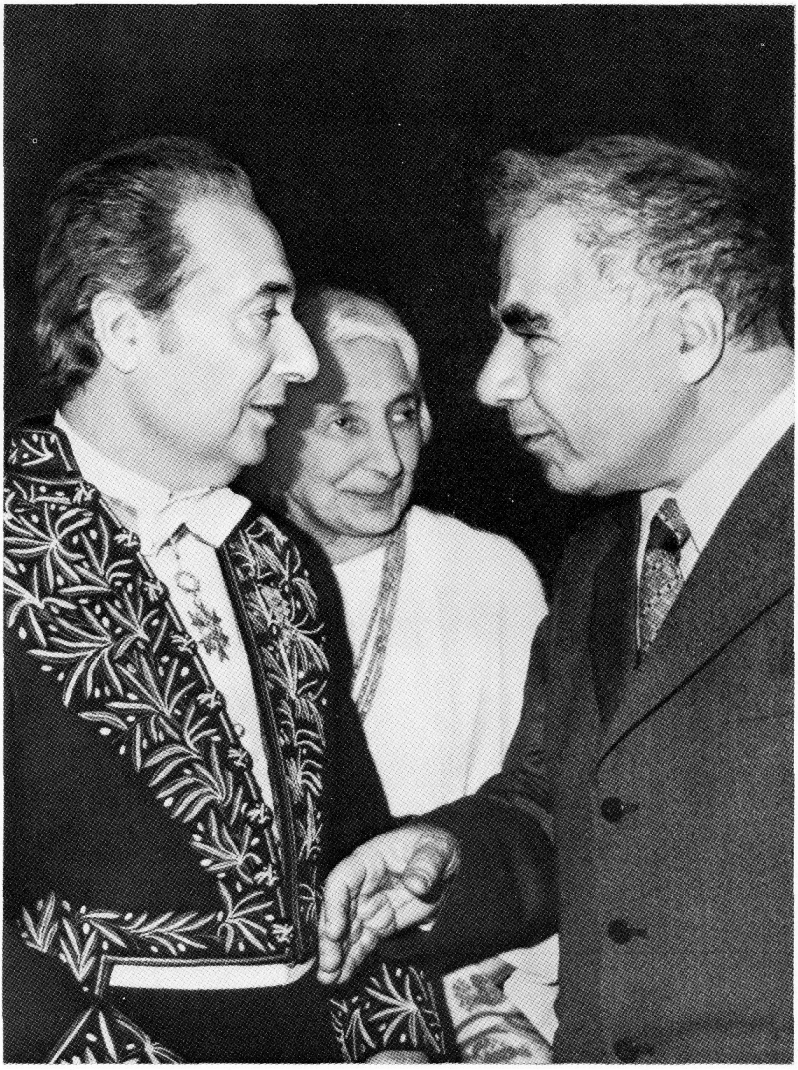


Victor Ambartsumyan, the American scientist Charles Grieg Panau Ludwig Mirzoyan. Byurakan.

The year 1980 was the hundredth anniversary of the birth of Amazasp Asaturovich Ambartsumyan, father of Victor Ambartsumyan. The academician and his friends on the way to the cemetery to honour his memory.

Victor Ambartsumyan with his pupils: Grant Tovmasyan, Elma Parsamyan, Robert Sarkisyan, Arsen Kalloglyan, Rena Mnatsakanyan, Ludwig Mirzoyan. Byurakan, 1980.

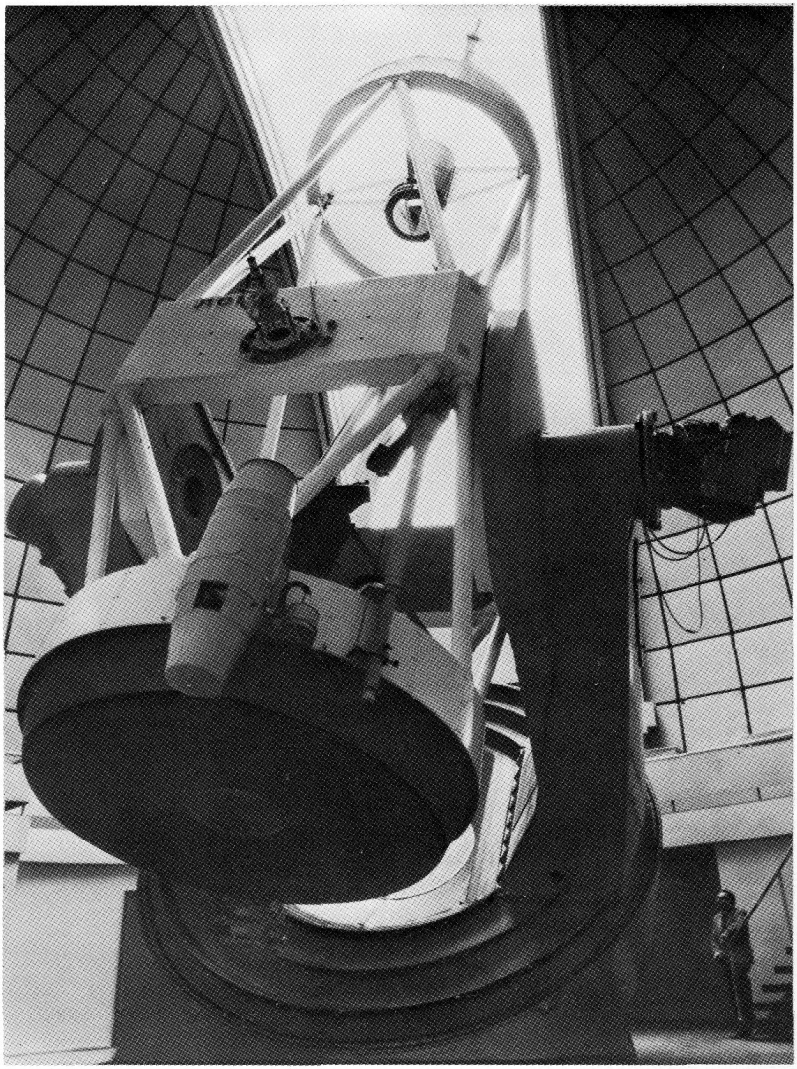
Victor Ambartsumyan congratulating Garzu (Garnik Zulumyan) on his election as a member of the French Academy of Arts. Paris.

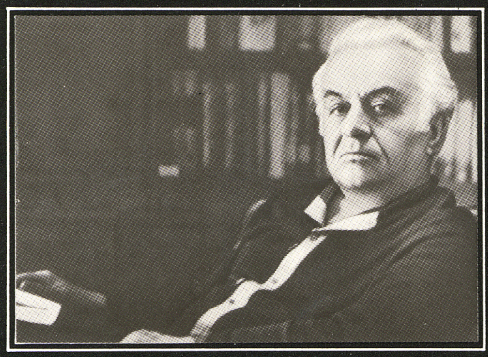


Left to right: Subrahmanyan Chandrasekhar (USA), Victor Ambartsumyan, P. Zweifel (USA), during a symposium on "The Principle of Invariance and Its Application". Byurakan, 1981.

Left to right: Andranik Petrosyan, member of the Academy of Sciences of the Armenian SSR; Academician Victor Ambartsumyan, Academician Nikolai Bogolyubov.

One of the Byurakan telescopes.





Ashot Arzumanyan was born in 1913 in the town of Shusha. He graduated from the Yerevan Polytechnical Institute where, still a student, he began his literary work. He is the author of numerous novels and tales. His books *The Boy from Sanain, The Secret of Steel, The Admiral, Typhoon, A Galaxy on the Palm of One's Hand* and others have been published in Armenian, Russian, and French.

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