

SCIENCE IN ARMENIA

Yervant Terzian, Cornell University, Ithaca, NY

Vatche Sahakian, Harvey Mudd College, Claremont, CA

Background

The history of Armenian science is that of remarkable resilience in face of seemingly insurmountable obstacles - faithfully mirroring the political and social history of the nation. This is not a coincidence for it may be argued that the political and social triumphs have their roots precisely in movements of scientific and artistic revivals. Three episodes stand out in this regard.

The development of the alphabet in 401 A.D. was staged at a time when Armenia is under occupation by two external forces, Rome and Persia. Divided into pieces and in ruins, the nation and the culture find themselves in danger of assimilation and oblivion. Remarkably, at this time of great despair, the response of the leaders of the nation - princes, businessmen, and religious figures - is to mobilize a cultural movement through the development of a unique new alphabet and the translation of works of science and art from around the ancient world. St. Gregory, the leader of this renaissance, is known to have traveled around the land, aggressively establishing institutions of learning and spear-heading - with the help of the church - the education of the populace. All this occurred at a time when many were worried about providing for the basic necessities of life. The result was the onset of a cultural Golden Age; and out of the ruins of a nation, kingdoms and dynasties were soon to rise while other nations of the times disappeared into the footnotes of history.

The second episode starts in the seventh century, in the works and personality of a scientist and mathematician known as Ananya Shirakatsi (610-685) - once again during a period of great turmoil when the country is overtaken by foreign forces, this time by Arab armies. Shirakatsi shadows St. Gregory's trek across the land, establishing numerous universities and training a whole generation of Armenians in modern analytical reasoning. Through remarkable physical intuition and critical reasoning, he embraces the spherical Earth hypothesis, proposes a correct explanation for the Milky Way pattern in the sky, and develops a good understanding of the Moon's structure as a heavenly body. He effectively pioneers the philosophy of balance between science and religion, centuries before Europe achieves this benchmark. His influence pervades history through his many disciples who, for the first time, establish a strong scientific tradition in the cultural identity of the nation. This leads to yet again another revival despite dire circumstances, with a powerhouse of philosophers and artists such as Naregatsi and Frig. These cultural icons hence form the intellectual scaffolding of a movement that eventually leads to the Silver Age of Armenian history in Cilician Armenia.

Modern times

The emergence of twentieth century science in Soviet Armenia through the leadership of astrophysicist Victor Ambartsumian (1908-1996) is our third episode of interest. Yet again this comes at a dark period, with two thirds of the nation devastated in Genocide and many living as refugees. Ambartsumian leads an active intellectual movement to establish modern scientific thought and logistics in a devastated country. In 1946, he establishes the world class Byurakan Astrophysical Observatory near the top of Mount Aragats, the site for numerous astrophysical discoveries to come. These include a detailed database of 20 million heavenly objects, including the famed Markarian, Arakelian, and Kazarian galaxies, and dozens of supernovae (exploding star remnants). These discoveries lead to a better understanding of activity at the center of galaxies and stellar evolution. Within a span of a few dozens years, Byurakan puts the new and small Soviet republic at the forefront of world class science. By the 1970s, Armenia becomes arguably the center of observational astrophysics in the Soviet Union, and generations of young Armenian scientists lead a cultural revival. By the 1990s, Armenian particle physicists are publishing the second greatest number of research papers per capita in the world, while other areas such as Condensed Matter physics and Material Science become the mainstays of scientific activities at institutes such as the Yerevan State University and the Yerevan Physics Institute.

By the 1990s, the National Academy of Sciences, founded in 1943, includes more than 50 scientific institutions and organizations, grouped in three main areas: the Division of Physical, Mathematical, and Technical Sciences (14 institutions), the Division of Natural Sciences (16 institutions), and the Division of Humanitarian Sciences (9 institutions). The Academy employs more than two thousand scientists, and is the hub for numerous international collaborations. At present there are 116 Academicians in residence and 22 Foreign Members (of which the first author of this article is one). The Division of Physical, Mathematical, and Technical Sciences involves: the Byurakan Astrophysical Observatory, the Engineering Center, the Garni Geophysical Observatory, and the Institutes of Applied Problems of Physics, Geological Sciences, Geophysics and Engineering Seismology, Informatics and Automation Problems, Mathematics, Mechanics, Physical Research, and Radiophysics and Electronics. The Division of Natural Sciences involves: the Biophysics Center, the Center for Ecological Studies, the H. Kh. Buniatian Institute of Biochemistry, the L. A. Mnjoyan Institute of Fine Organic Chemistry, the State Microbial Depository Center, the Molecular Structure Research Center, the L. A. Orbeli Institute of Physiology, and the Institutes of Botany, Chemical Physics, General and Inorganic Chemistry, Hydroponics Problems, Hydroecology and Ichthyology, Microbiology, Molecular Biology, Organic Chemistry, and Zoology. Finally, the Division of Humanitarian Sciences involves: the Sociological Research Center, the Hrachia Atcharian Institute of Language, and the Institutes of Archaeology and Ethnography, Oriental Studies, Arts, Economics, Philosophy and Law, Genocide, History, and Literature. In addition to these, the Yerevan Physics Institute - along with its Cosmic Ray Project division - conducts research at the forefront of physics and astronomy. Other notable centers of research and education include the American University of Armenia and the Engineering University.

The internationally highly respected National Academy of Sciences of the Republic of Armenia has had extraordinary leadership since its inauguration on November 25, 1943. Its Presidents have been as follows:

Hovsep Orbeli	1943 to 1947
Victor Ambartsumian	1947 to 1993
Fadey Sargsian	1993 to 2006
Radik Martirosian	2006 to present

ANSEF

In the mid 1990s, the demise of the Soviet Union brought upon the nation yet another crisis of historical proportions. Economic collapse and war lead to the destruction of much of what was so painstakingly built over the past decades in the scientific and cultural realms, accompanied by an exodus of scientists and artists to Europe and the Americas. The Diaspora, while ideally positioned to avert such a catastrophe, reacted too slowly and a great deal of damage was incurred on the cultural institutions of the nation. This period of uncharacteristic delay by the Diaspora public was probably due to other important pressures, but also the lack of appreciation of the basic sciences that is clear in the western cultures.

Despite these recent developments, progress is on the rise with the hard work of many brave scientists and scholars who remained in Armenia to continue their work in their country. It is imperative however that Armenians outside Armenia contribute both logistically and economically to such an operation, bringing their wealth and expertise in western institutions into the equation.

The desire of the Diaspora to assist the scientific enterprise in the Republic of Armenia has produced significant efforts. Late in 1999, in New York City, a group of Armenian academic and other intellectuals gathered and established an organization called the Armenian National Science and Education Fund (ANSEF) that operates under the umbrella of the Fund for Armenian Relief (FAR).

ANSEF's purpose is to assist in maintaining and strengthening the Armenian intellectual community by providing peer reviewed research awards to support scientific, technological and scholarly research. This passionate group included Tavit Najarian, Edgar Housepian, Mihran Agbabian, Vartan Grigorian, Aram Chobanian, Harut Barsamian, Anahid Kazanjian Longobardo, Tamar Hajian and Yervant Terzian.

In the last seven years, after establishing and describing the ANSEF process of competitive peer reviewed research awards, ANSEF has received between 200 and 300 research proposals per year requesting funding. It has been possible to provide funds for about 175 projects. Proposals have been received mostly from scientists and scholars who are associated with the various research centers of the Academy of Sciences and from faculty members of the Universities in Armenia. The general topics and percentages are as follows (see Figures 1 & 2):

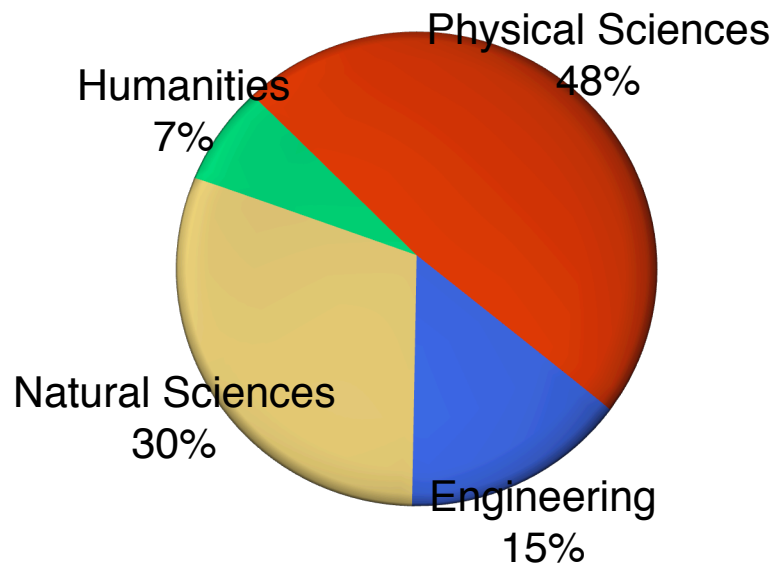


Figure 1: *Distribution of ANSEF proposals amongst the various disciplines.*

- 63% proposals in the Physical Sciences & Engineering, such as astrophysics, condensed matter physics, engineering, chemistry, mathematics and high energy and particle physics.
- 30% proposals in the Natural Sciences, such as biochemistry, biotechnology, microbiology, botany and zoology.
- 7% proposals in the Humanities including Social Sciences, such as history and archeology.

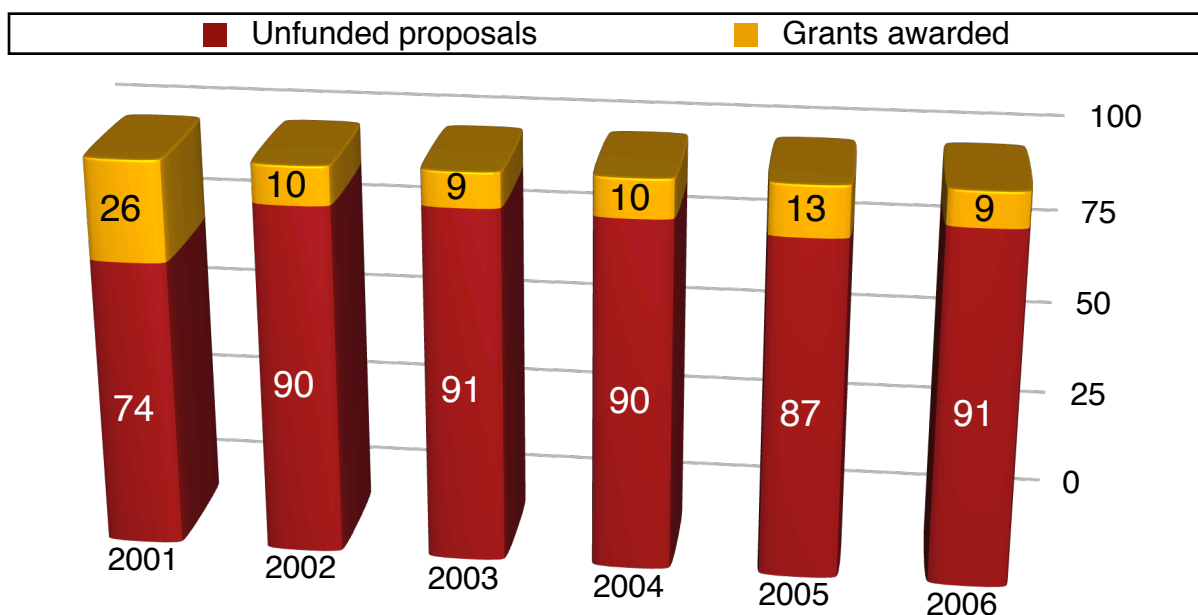


Figure 2: Percentages of funded and unfunded proposals submitted to ANSEF over the past six years.

Researchers in Armenia realize the importance of this new peer review system that serves as international validation of their work. Normally, the peer reviews indicate that about twice as many proposals should be supported every year, but unfortunately, ANSEF has a limited budget to provide for all. ANSEF's Research Council is Chaired by professor Yervant Terzian at Cornell University in Ithaca, New York. Other members are Professor Vatche Sahakian, Dr. Lilit Yeghiazarian, and Dr. Ashot Papoyan. To date more than 100 academic referees have participated in reviewing and evaluating proposals, including Nobel Laureates.

More than 500 senior and junior scientists and scholars have benefited from the support that ANSEF has provided. Their research work has resulted in at least 250 articles published in prestigious international academic journals, boosting the global reputation of Armenia's research community. ANSEF is assuring that Armenia stays at the forefront of exciting scientific and scholarly research.

Normally the annual ANSEF request for proposals is announced on the ANSEF website www.ansef.org every June 1st, and proposals are due electronically by August 30 each year. After the peer review process is complete, the ANSEF awards are announced late in December each year.



2004



2005



2006



2007

Figure 3: *ANSEF awardees.*

ANSEF is one example of programs enhancing the intellectual life of the Republic of Armenia. A few other programs, such as the Armenian Engineers and Scientists of America (AESAs), the National Foundation of Science and Advanced Technologies (NFSAT), and the U.S. Civilian Research & Development Foundation (CRDF) in Armenia have also been established and have been very effective.

Conclusion

Armenians and Armenia, as cultural, political and social entities have survived again and again because leadership has looked past grim episodes of crisis and planned the future like great nations do, boldly and ambitiously. Instead of focusing only on short term survival, crisis has often driven the nation to rise to grandeur, to aspire for things beyond the basic necessities despite the times, hence turning setbacks into opportunities for new advancements. Stubborn focus on the scientific and artistic development of the nation has kept Armenians from settling for mediocrity; instead reaching for and hence achieving world class cultural benchmarks. This spirit is in desperate need once again to tackle the obstacles of the modern age facing Armenians today, be they political, economic or social.