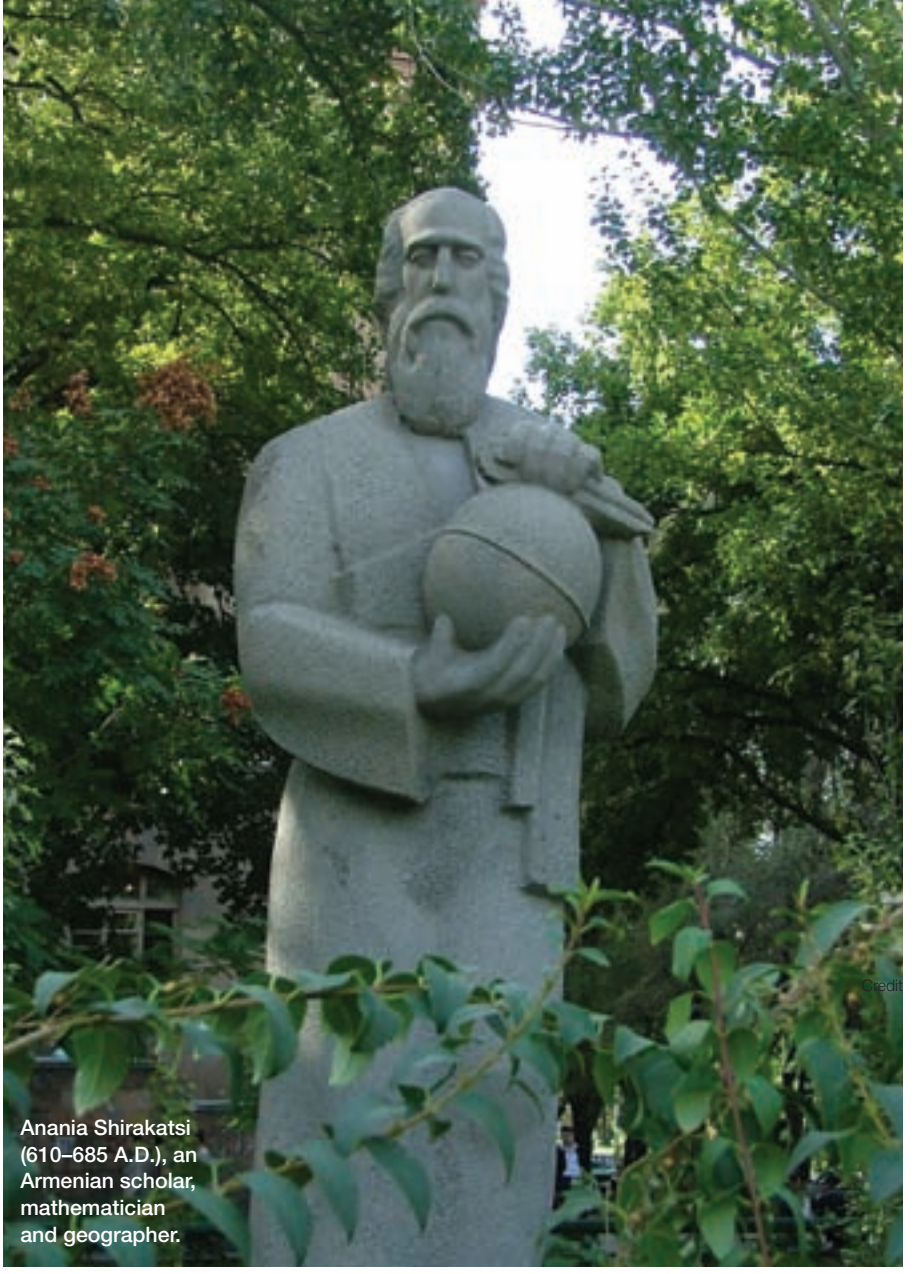
Optics in Armenia

Konstantin Vodopyanov

The Republic of Armenia is a landlocked mountainous country in the Southern Caucasus, between the Black Sea and the Caspian Sea. It shares borders with Turkey, Georgia, Azerbaijan and Iran. Despite a population of only 3 million people and a tenuous economy, scientists in this former Soviet republic are conducting world-class optical research on a broad scale.



Anania Shirakatsi (610–685 A.D.), an Armenian scholar, mathematician and geographer.

Courtesy of Konstantin Vodopyanov

In October 2006, I made a trip to Armenia supported by the OSA Fellow Travel Grant Program, which is intended to encourage optical scientists to visit developing nations, promote global interaction and increase awareness of optics and photonics activities worldwide. The travel grantees accomplish this through lectures, seminars—and simply by meeting people and talking to them.

It was hard for me to accept the label of "developing nation" with regard to Armenia. After all, it is one of the oldest civilizations in the world and one with a rich cultural and scientific heritage. For example, Armenia was the first nation to adopt Christianity as its official religion in 301 A.D.

Scientific traditions in Armenia can trace their roots back more than 1,000 years. Anania Shirakatsi—the so-called Newton of early Armenia—was a 7th century scholar, mathematician and geographer, known for his works *Geography Guide* and *Cosmography*. His greatest claim to fame was his recognition that the Earth was round at a time when the prevailing view was otherwise.

In more recent times, Viktor Ambartsumian (1908-1996), another Armenian scholar, became a pioneer of theoretical astrophysics and discoverer of stellar associations. He started his career in the 1920s in Pulkovo observatory near Leningrad (now St. Petersburg) and later became the founder of Byurakan Astrophysical Observatory, which I briefly visited. (The observatory, which is located on the slopes of Mt. Aragats near Yerevan, the capital of Armenia, now houses a 2.64-m telescope.)

Courtesy of Konstantin Vodopyanov

Radio-astronomy telescope at the Institute of Radiophysics and Electronics in Ashtarak.

Ambartsumian argued that the processes involved in the origins of galaxies were connected with explosions in which the matter of new stellar systems arose from prestellar material in regions with unusual topological properties (i.e., non-Euclidean geometry). Some scholars have argued that Ambartsumian's theory inspired John A. Wheeler to point to the possibility of "worm holes" in space-time.

As part of my program, I gave a seminar on new methods for generating terahertz (THz) waves using optical pulses to the radiophysics faculty of Yerevan State University. My host Yuri Avetisyan is a world expert in the field of microwaves and terahertz-wave generation and co-author of several original works on surface-emitting THz devices using ferroelectric crystals with periodically reverted orientation.

As an optical physicist, I found it very stimulating to talk to specialists in radiophysics, who had a slightly different perspective on THz phenomena. Among the interesting projects I learned about were Anahit Nikoghosyan's experiments with THz waveguides, which are partially filled with a nonlinear optical medium to allow an efficient exchange of energy between optical and THz fields when their propagation velocities are matched. The department is engaged in collaborations with Japan, Germany and the United Kingdom.

Another institution I visited was the Institute for Physical Research (IPR) at the National Academy of Sciences of Armenia. It was built in 1967 on an abandoned stony lot about 30 km from Yerevan, near the small town of Ashtarak. The founder of the Institute was M.L. Ter-Mikaelyan (1923-2004), a prominent theoretical physicist who also contributed much to the development of solid-state lasers, nonlinear and quantum optics.

Indeed, his team's work on ruby lasers resulted in the fabrication of the first commercial laser ("optical quantum generator") in the former U.S.S.R. in 1965. The laser was nicknamed "Arzni" because it was manufactured at the factory for precise technical stones in the Armenian town by that name.

In collaboration with A.L. Mikaelyan and Yu.S. Turkov, M.L. Ter-Mikaelyan wrote the 1967 monograph *Solid-State Optical Generators*, which enjoyed great popularity in the U.S.S.R. as a textbook on solid-state lasers. (I used it for my own studies when I was a student.)

Through his work, Ter-Mikaelyan laid the foundation to make IPR one of the

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leading research institutions in Armenia. The Institute's research topics include laser physics, laser spectroscopy, nonlinear and quantum optics, interaction of radiation with matter, crystal growth and characterization, solid state physics, high-temperature superconductivity and scientific instrumentation.

Many of the research groups from IPR have collaborated with European and U.S. research organizations and foundations. At the time of my visit, IPR hosted an International Conference "Laser Physics 2006" with roughly 80 participants—one-third of which were from other countries. During my talk, I looked out the window of my conference room to see a magnificent view of the snowy twin caps of biblical Mount Ararat. At the Conference, I was fortunate enough to meet with the members of the newly created (2004) Armenian Student Chapter of the OSA.

Next, I visited the Institute of Radio Physics & Electronics, which was only a five-minute walk from IPR. I had a very useful discussion on microwave and THz generators and detectors with Arsen Hakhoumian, who recently became director of the Institute. The Institute of Radio Physics & Electronics develops and manufactures low-noise microwave and millimeter-wave receivers for remote sensing, radar, communication and earthquake forecasting purposes. Researchers there also do work in solid-state and plasma physics. In addition, the facility has several telescopes for radio astronomy and is involved in a number of international programs.

The author in front of biblical Mt. Ararat.

Courtesy of Konstantin Vodopyanov

Members of the newly created OSA student chapter in Armenia: Hrant Hakhumyan (left), Armen Sargsyan, Nikolay Balasanyan and Hrayr Azizbekyan. The Tektronix oscilloscope was a present to the chapter from OSA.

Armenia is a remarkable country with a rich past and bright future. After recovering from severe economic hardships in the 1990s, the country is poised to renew its world-class scientific standards and restore its intellectual glory. ◭

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