Ain Shams University, Cairo, founded in 1950.

OSA FELLOW TRAVEL GRANTS PROGRAM

Optics Education and Research in Egypt

Barry R. Masters

I have always been fascinated by the scientific contributions that were made by scholars in medieval Islamic cultures. For example, Cairo is where Ibn al-Haytham, also known as Alhazen (his Latin name), did his seminal work in optics in the 11th century A.D. Ibn al-Haytham, a Persian mathematician and astronomer who worked in Cairo, wrote "*Kitab al-Manazir*" ("*Book of Optics*"), which described the laws of rectilinear propagation of light, the laws of reflection and refraction, and a theory of vision. Known as the "*Opticae Thesauris*" in Latin, this same volume was later known to Willebrord Snellius (the experimental re-discoverer of the law of refraction), René Decartes, Johannes Kepler and Christiaan Huygens in the late 16th and 17th centuries.

I traveled to Egypt wishing to meet and exchange ideas with the country's modern-day scientists and students. The first stop on my visit was to the department of physics at Cairo University. With 23 faculties and institutes, the university employs more than 3,000 faculty members who serve about 155,000 students.

My visit to the department was hosted by Professor Mohamed A. Zaki Ewiss, who works with laser spectroscopy and liquid crystals and oversees the work of two master's degree students and one doctoral candidate.

The National Institute for Laser Enhanced Science (NILES), located on the campus of Cairo University, offers advanced degrees in laser science. It is a multidisciplinary research center with five departments: laser systems; materials and industrial applications; laser reactions; agriculture and environmental applications; and medical and biological laser effects. NILES opened in 1994; Professor Mohamed Abdel Harith is the current dean.

Its excellent facilities include a library, laboratories, offices and a medical laser center. Research at NILES spans a wide range of topics, from genetic engineering of plants to laser Raman spectroscopy. The medical laser center supports laser-based research and treatment in ophthalmology, dermatology and dentistry. After receiving a personal tour of NILES with Dean Harith, I had the opportunity to present a seminar on confocal microscopy and nonlinear microscopy in biology and medicine.

Not far from Cairo University is the Agricultural Genetic Engineering Research Institute (AGERI), directed by Hanaiya A. El-Itriby. I had been invited to visit AGERI several years ago by its founder Magdy Madkour, whom I had met at the Egyptian embassy. Genetic engineering is critical in Egypt in order to enhance agricultural production so that the needs of a rapidly growing population can be met. Current research projects include the production of transgenic maize resistant to the corn-borer insects and production of transgenetic potato plants resistant to various potato viruses.

AGERI's central instrumentation facility is equipped with modern, laser-based instruments for molecular biology: gene chip array readers, synthesizers, sequencers and automated biochemical analyzers. Laser-induced fluorescence is an important analytical technique in molecular biology due to its high sensitivity and specificity. AGERI conducts collaborative research with researchers in the private sector as well as universities in the Middle East, Europe, Asia and the United States. It also functions as a training center for researchers from developing countries.

Professors Mohamed Ewiss (*left*) and Barry Masters with graduate students at Cairo University.

I spent the second part of my visit to Egypt at Ain Shams University. Founded in 1950, Ain Shams is the third university to have been established in Egypt. My host was Professor Hassan Talaat, director of a laser Raman spectroscopy laboratory in the physics department. Talaat's research focuses on the use of laser Raman scattering to investigate the structure and electronic properties of semiconductors. His laboratory has pioneered the use of photomodulation Raman spectroscopy to investigate semiconductor interfaces.

Professors Barry Masters (*left*) and Mohamed Abdel Harith, dean of The National Institute of Laser Enhanced Science, Cairo University.

Professors Abdel Sattar M. Sallam and Mahmoud El Sayed work in the area of biophysics; their research includes the study of optical and electrical properties of biological systems. I was pleased to learn that Sallam had worked with the first Nipkow disk-based confocal microscope, which had been invented a few years earlier by Professor Petran in Pilzen. As Petran's first graduate student, Sallam used the Petran confocal microscope to investigate the structure and electrophysiology of the *in vivo* retina and the structure of the *in vivo* cornea.

At both Cairo University and Ain Shams, I presented a series of lectures on biomedical imaging techniques. In addition to my presentation on confocal and nonlinear microscopy in biology and medicine, I gave talks on multiphoton excitation microscopy and spectroscopy, and three-dimensional confocal microscopy of the living human eye. Then I switched gears and presented a lecture on the scientist's role in society. This talk included how scientists could work together to preserve the process of science, to perpetuate science and to promote science. The audience took part in an interactive discourse on ethical considerations and the social consequences of science. Many points of view were expressed and all of us were stimulated by the level of the discussion.

I also participated in a workshop on laser chemistry and applications to materials and biomedical research, which took place at the National Research Center (NRC) in Cairo. It was jointly sponsored by the NRC and the U.S. National Science Foundation. The conference served not only as a forum to share new research techniques and results, but also to facilitate one-on-one communication between Egyptian and American scientists. The U.S.-Egypt Joint Science & Technology Fund sponsors competitive grants for collaborative research and visits for senior and junior scientists.

A session on biomedical applications included two widely appreciated lectures. Michael S. Feld of the George R. Harrison Spectroscopy Laboratory at the Massachusetts Institute of Technology presented a lecture titled, "The Color of Cancer: Spectroscopic Diagnosis of Disease." Bruce J. Tromberg of the Beckman Laser Institute and Medical Center at the University of California at Irvine presented on medical imaging in thick tissues using diffuse optics.

The NRC is the largest multidisciplinary R&D center in Egypt. It provides training and research that serve the industrial and agricultural sectors as well as the areas of health, the environment, genetic engineering, biotechnology and physics.

My visit to Egypt was greatly facilitated by Mustaffa A. El-Sayed, regent professor and director of the laser dynamics laboratory at the Georgia Institute of Technology. El-Sayed kindly gave me a letter of introduction and a recommendation for my application to the travel grants program. He also pointed me to Professor Hassan Talaat in the physics department at Ain Shams University.

I highly recommend the OSA Fellow Travel Grants program. My visit helped to bridge cultural differences, promote understanding and demonstrate how optics can improve our lives.

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