Asian Journal of Physics
Vol. 35, Nos 1-3 (2026) v - x
Available on: www.asianjournalofphysics.com

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Memories of Professor Gallieno Denardo

I first met Professor Denardo, Gallieno, when I visited ICTP during a Winter College on Optics in the early 2000s. I became Executive Director of The International Society for Optics and Photonics (SPIE) at the end of 1999, and learned that SPIE supported this Winter College annually with $5000 and the expenses of SPIE leadership who might attend. It became clear that Gallieno was the authority within ICTP who had fostered and sustained this annual event. The ICTP's activities in optics began in the 1970s when Alfred Kastler, 1966 Nobel Laureate in Physics, a friend of fellow Nobel Laureate, ICTP director and founder Abdus Salam, first introduced a biennial optics college there. At the time there were no other optical offerings at the center. In 1985, Professor Denardo became the organizer of the optics programs.

What I learned when I visited Trieste was that for the annual two week Winter College, ICTP funded 70-100 students from countries outside the scientific mainstream of the affluent west. At these schools I saw students from the Islamic Republic of Iran, India, Pakistan, Malaysia, Russia, Belarus, China, several Latin American nations, and several African nations, such as Ghana, Cameroon, Tunisia etc.

ICTP supported three school directors and other high level lecturers to come to Trieste for the main week of the school and provide an intense program for the students. Each year a particular scientific topic where optics played a major role was selected, and the lecturers exposed the students to what was currently happening on the research frontier. I recall Stefan Hell who won the Nobel Prize in Chemistry in 2014 "for the development of super-resolved fluorescence microscopy" as a teacher at more than one Winter College.

Photo 1. Professor Denardo (left) with Professor Rajpal Singh Sirohi (middle) from India and ICTP Director Professor Katepalli R Sreenivasan (right) at a Winter College on Optics.

Many scientific societies such as SPIE are based in the United States and most of the membership and membership activities take place there, even though these societies are international and membership is open to researchers and other technical workers from anywhere in the world. SPIE holds several meetings outside the U.S. each year, mostly in countries where optics is established and well funded, e.g. Japan, China, Australia, Germany, and other countries of the E.U. SPIE also has student chapters throughout the world with the highest number in my day, in India. It was always a highlight of my year at SPIE to meet with the student chapter representatives whom were funded by SPIE to come to its annual meeting in San Diego.

Photo 2. 2004 joint winners of the ICO/ICTP prize, (now the Gallieno Denardo Award) Imrana Ashraf Zahid (left) from Pakistan and Reveti Nitin Kulkarni (right) from India.

There are of course long established national optical societies based outside the U.S. and from 1991, the European Optical Society has co-ordinated some of the resources of the several national societies in Europe. The Italian optical society, Società di Ottica e Fotonica (SIOF), is one example of a national optical society and the energy and support provided by SIOF to ICTP's optics programs always impressed. Scientific society meetings catalyze advances and allow researchers and students to know of the latest developments and exchange ideas. Of course scientific publications provide a record of advances in research, but conferences bring another dimension, an exposure to the latest ideas and directions. Scientists in more economically challenged countries (Lower and Middle Income Countries (LMICs) to use one descriptor although some favor "developing") experience major disadvantages both in funding and in the opportunity to participate in the stimulating networking provided by meetings of the major international optics societies. Often scientists in LMICs do not have access to scientific publications in their field because of the notoriously high costs of access to the many commercial publishers such as Springer-Nature, Wiley or Elsevier. Even with the advances in open access publishing, the content of some key journals remains unaffordable and therefore inaccessible for aspiring scientists in some LMICs.

We in SPIE saw two entities that had much better connection with the optics communities in these LMICs. One was the International Commission for Optics (ICO) which was founded in Delft (Netherlands) in 1947, and which was in the early 2000s organized by Pierre Chavel from the Institut d'Optique in Paris. Pierre who represented ICO at many meetings was another extraordinarily dedicated and modest force for education and science. Maria Calvo from Universidad Complutense de Madrid took over as ICO Secretary general in 2002 and was very supportive of Gallieno's work at ICTP until his untimely death in 2007. (SPIE has been an Associate Member of ICO since 2000 and several other optical societies also have this status). ICO is now a full Member of the International Science Council (ISC). Although ICO too has held its Congresses and most meetings in more affluent countries, the ICO has emphasized contact with, and recognition of, optical researchers in LMICs. To its great credit it has done this better than the well funded major optical societies. Since 1994 ICO has presented the Galileo Galilei Award to "a person has made outstanding contributions to the field of Optics in countries where the development of Optical Technology is significantly below average, or where difficult economic or social conditions are encountered, and access to scientific and technical facilities or sources of information is lacking." The impressive winners over the years are all from LMICs.

Photo 3. (From left) ICTP Director R Sreenivasan, Reveti Kulkarni, Imrana Ashraf Zahid, 2004 ICO President Rene Dändliker, and Gallieno Denardo.

The other entity with strong outreach to the entire global scientific community in LMICs has been ICTP. Professor Abdus Salam noted that "The creation of physics is the shared heritage of all mankind. East and West, North and South have equally participated in it." And I have always believed in what another Nobel Prize winner, Irene Joliet Curie said, "Science is a universal language that transcends borders and unites humanity." ICTP, a UNESCO Category 1 Institute, has, with strong support from the Italian government, been a shining example of following Salam's dream and fostering science and relationships everywhere. Although its major interests may be in particle physics and theory, its efforts in optics have been exemplary. And again, those were largely developed and strengthened by Gallieno Denardo.

Since 2000, the ICO and ICTP jointly presented an annual prize to "an outstanding young researcher in the developing world". That award is now appropriately known as the Gallieno Denardo Award.

I quickly learned that Gallieno was sharply focused on fostering the development of science students in LMICs. His own scientific career in quantum gravity theory was more aligned with ICTP's traditional activities, but he correctly identified optics as an area of science that was universally accessible and which had proved crucial to advances across science and medicine. What would we know of the universe without optics? Where would medicine be without microscopes, and imagers of all types. And in the last century, particularly since the invention of the laser, fiber optics, and digital imagers, optics has pervaded science, industry, medicine and everyday life.

Advances in, and with optics, can be relatively low cost and therefore young researchers in LMICs have opportunities to be competitive. By relatively low cost, I mean compared to experimental particle physics or the computational power needed to be competitive in much theoretical physics. There are of course very expensive optical facilities such as the National Ignition Facility in the U.S., Laser Megajoule in France, and the Extreme Light Initiative facilities in Europe. The James Webb and Hubble telescope are other examples of multibillion dollar optical "devices". But optics also includes low budget fiber optic work, and instructive experiments such as those developed for ALOP, which I mention later. Although we lost Gallieno before the emergence of the smart phone, many in the LMICs now have handheld imagers and image processing computers in their smart phones with much much more power than the guidance computer in the Apollo spacecraft.

Photo 4. Dr Minella Alarcon (left) from UNESCO with Gallieno (right).

Gallieno was a wonderful diplomat and relentless in his educational aspirations for LMIC students. With his quiet but effective leadership style he pulled together the major optics societies. These well meaning entities were competitors in many ways, but their obvious respect for Gallieno overcame self interest. He established the Trieste System for Optical Science and Applications (TSOSA) Advisory Committee in 2003. (The Trieste System included ICTP, Third World Academy of Sciences (TWAS), and an independent laser

laboratory hosted by Elettra). The ICO, SPIE, OSA (now Optica) SIOF, IEEE Photonics Society and the EOS participated in the TSOSA Advisory Group, which helped co-ordinate optical activities at ICTP and improve outreach to the LMICs.

Photo 5. Organizational meeting for ALOP at ICTP. Gallieno Denardo (first from left) and Eugene G Arthurs (second from right)

With Gallieno's encouragement, SPIE and other societies made their digital library content available at no charge to the ICTP library as these on-line libraries became available in the early 2000s. SPIE's digital library now hosts well over 650,000 journal and proceedings papers. SPIE also began to makes its publications available to LMICs as part of the Programme for the Enhancement of Research Information/ International Network for the Availability of Scientific Publication (PERI/INASP).

It was a great pleasure for me to present Gallieno with SPIE's Educator Award (now called the SPIE María J Yzuel Educator Award) in 2005 (Photo 6).

Photo 6. Eugene G Arthurs (left) and Gallieno Denardo (right) with SPIE's Educator Award in 2005.

SPIE also worked with Gallieno and Minella Alarcon of UNESCO, the Asian Physics Education Network (ASPEN), facilitators from the Ateneo de Manila University, and a group of distinguished physics educators to establish the Active Learning in Optics and Photonics (ALOP) program. ALOP prepared teaching materials in English, Spanish, French and Arabic, and put together experimental kits. It organized and staffed 13 hands-on workshops for teachers in countries such as Tunisia, India, Morocco, Columbia, Pakistan, Rwanda, Nepal, Laos, Vietnam and so on before Dr Alarcon retired in 2010. After that the ALOP program continued out of ICTP led by Dr Joe Niemela who had joined ICTP in 2003 and who took over Gallieno's work with optics. ALOP added Indonesia, Mauritius, Mexico, Bolivia and other countries for about 30 workshops reaching well over 1000 teachers to date.

Gallieno also encouraged SPIE to establish and help finance the small educational laser and optical fibers laboratory he had set up with the help and encouragement from Ali Javan, inventor of the helium-neon laser optics laboratory at ICTP/INFI. ICTP did not historically provide opportunities in experimental physics in Trieste, but Gallieno managed to start this small laboratory in ICTP where LMIC students could gain hands on experience with increasingly sophisticated optical equipment. The students could conduct research with equipment not available in their home institutions and qualify for higher degrees. Dr. Humberto Cabrera Morales supervised the work after the laboratory was expanded, and his work with students led to a number of publications over the years.

In summary, Gallieno Denardo was an inspirational and much loved figure. He was driven to improve the scientific education and provide opportunities for young people in poorer circumstances in our world. He made a positive difference for many. He was a joy to work with and I learned a lot seeing him quietly, gently, and effectively influencing others into action. Not for himself, for young students. He took no credit, and was modest about his considerable achievements. He welcomed all to ICTP, especially diverse and sometimes bewildered students on their first trip outside their challenged homeland. It was an honor and pleasure to know Gallieno Denardo and I certainly was blessed by having this opportunity.

Eugene G Arthurs Ph D
CEO of SPIE 1999-2018
egarthurs@gmail.com