Optics in South Africa

Johannes I. Markusse
Eloptro
Institute of Atomic Physics
P.O. Box 869
Kempton Park 1620, South Africa

Maurice W. McDowell
CSIR/Production Technology Division
Productiontek
P.O. Box 395
Pretoria 0001, South Africa

It is indeed a pleasure to have this opportunity to present some of South Africa's achievements in the field of optics. The papers appearing in this special section represent a fair cross section of South Africa's activities, with the possible exception of defense sector work. This sector is currently undergoing rationalization and restructuring and we hope that some of their work may be published in future editions of *Optical Engineering*. Although this is not the first time that articles from South Africa have been published in *Optical Engineering*, and indeed the country has been represented at many of SPIE's excellent conferences, it is the first time that we have been personally invited to contribute. As the world spotlight is currently upon this country it is perhaps appropriate to introduce this special section with a condensed history of optics in South Africa.

As in many countries the initial interest in optics arose from the activities of astronomers. During the last century this country's southern location, its access to major sea routes, and its almost ideal viewing conditions led to the establishment of several famous observatories including the Royal Observatory in Cape Town, the Radcliffe in Pretoria, Boyden in Bloemfontein, and the Republic in Johannesburg. This century brought with it pollution from industrialization, a major expansion in city boundaries, and eventually a decrease in overseas astronomical funding and support following the imposition of sanctions. This led in 1972 to the consolidation of all astronomical activities in a national facility, the South African Astronomical Observatory, whose viewing site is located at Sutherland, some 350 km to the northwest of Cape Town.

Optics in its own right became of interest during the Second World War with the establishment of a small repair facility for use by the navy. Following the war the South African government established the Council for Scientific and Industrial Research (now known as the CSIR), which, from a small beginning, today employs close to 3500 people. From its inception, the CSIR included optics in its skills portfolio, but major expansion in this field only occurred in the 1960s following the development of the laser. The boom period for optics in South Africa occurred during the 1970s and 1980s following the imposition of sanctions. This boom was driven by the electro-optical needs of our defense community. The creation of our own optical industry came in 1974 in the form of a company known as Eloptro, whose original mission was to satisfy the armed forces' needs for sophisticated optical and electro-optical systems. Besides developing and manufacturing such systems, Eloptro also produced optical glass and image intensifiers and established a highly sophisticated thin film coating facility.

Today Eloptro manufactures and exports many products including laser rangefinders, thermal imagers, night vision systems, and other military optical hardware. Commercial activities include the development of optical observation systems for satellites, and optical attitude sensors for these platforms.

In the immediate postwar years, nuclear research in South Africa was carried out at the CSIR. The importance of nuclear power for both commercial and defense applications was soon realized and by the early 1960s a separate research council had been established. The successor to this council today is the Atomic Research Corporation (AEC). Part of the current research program of the AEC is the investigation of the possible use of lasers in the uranium enrichment process. More specifically this involves an in-depth study of molecular laser isotope separation, and as part of this program a 2-kW laser has been developed that can be pulsed at 2000 Hz. Some other optical activities of this group are covered in this special section.

The increased interest in optics led to the formation of the South African Optical Society (SAOS) in 1979. SAOS is affiliated with the International Commission for Optics and has also maintained a close liaison with SPIE, mainly through personal contact with the now retired Executive Director Joe Yaver. The 17th International Congress on High-Speed Pho-

tography and Photonics was held in Pretoria in 1986 under the auspices of SAOS and SPIE.

As a result of the high incidence of lightning strikes on conventional copper cable, South Africa was a natural candidate for the use of optical fiber telecommunications. The first fiber optic link was established in 1981 and today all major cities are linked using single-mode fiber, as is the intercontinental telephone link between Cape Town and Europe. A local company, ATC, opened a state-of-the-art optical fiber drawing facility in 1985, and today satisfies all local demand while exporting both single-mode and multimode fiber and cable. ATC also sponsors research into the theory and applications of fiber optics.

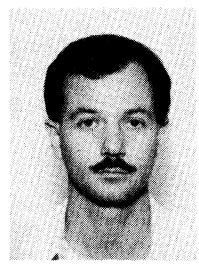
A specific area of South Africa's world-leading expertise is in radiometry. A standard radiometer developed by CSIR during the 1980s is in use today in several national laboratories throughout the world, including Spain, Argentina, New Zealand, France, and Taiwan. This expertise in radiometry and photometry has been applied in the commercial area with South Africa's largest manufacturer of luminaires making use of an automated light-measuring robot/goniophotometer developed by CSIR and installed in 1987.

Apart from optical fiber, lighting, and the Armscor affiliate, Eloptro, South Africa's photonics industry is composed of about a dozen companies. These are primarily electronics based and manufacture everything from high-power searchlights to sophisticated electronic zoom lenses and optically guided air-to-air, ground-to-air, and air-to-ground missile systems.

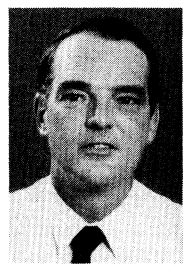
High-speed photography is a special area of interest. As a manufacturer of both advanced weapon systems and munitions, one of South Africa's main applications of this technique is obviously in the ballistics area. The export of minerals is currently one of this country's major means of foreign exchange and mining is one of the largest industries. High-speed photography is used extensively in mining to study detonators, in both static and sequential operation, optimization of the removal of material during blasting, and the study of rock bursts. The latter is a phenomenon peculiar to South Africa's deep-level mining operations (which extend to several kilometers underground) and refers to the explosive nature of rocks under extremely high pressure.

From the papers in this special section it is clear that research in various aspects of optical engineering is carried out at several of our 15 universities. Of the universities not represented here the University of Natal (Durban and Pietermaritzburg campuses) and the University of Pretoria also carry out research in aspects of optical engineering. Popular research topics are the development of laser systems and applied laser techniques, including holography and the interaction of laser radiation with new materials. Other research topics of interest are new optical materials, optometry, and solar power. Most universities are also active in the teaching of optics, mainly as an extension of their electronics curriculum and primarily at the postgraduate level. However, the country does not possess a center of excellence in optics equivalent to those existing in the United States, and several of our current practitioners, as a result, have undergone postgraduate training at the Optical Sciences Center in Tucson, Arizona, and other institutions in the United States.

We hope that this special section will provide some insight into optical engineering as it is currently practiced in South Africa. We thank the authors for their contributions and the referees for their time, useful criticism, and comments. A special word of thanks is due to Joe Yaver of SPIE for originally suggesting this special section during a visit to this country.



Johannes I. Markusse received a BSc in 1981 and a BSc Hons in chemistry in 1982 at the Rand Afrikaans University in Johannesburg. He joined the Uranium Enrichment Facility of the Atomic Energy Corporation in 1983 where he was involved with matrix isolation infrared spectroscopy and the development of fluorinating agents in the fluorine chemistry department. In 1987 he moved to Eloptro where he was involved in the establishment of an infrared thin film research and production facility. In 1993 he started a small business in the computer industry. He has been a member of the South African Optical Society since 1987 and chairman of the society for two periods of one year. He is a member of SPIE and was a negotiator for the first memorandum of understanding between SPIE and the South African Optical Society.



Maurice W. McDowell received his BSc in 1967 and his PhD in 1971 under the guidance of Prof. D. J. Bradley. He emigrated to South Africa in 1971 and joined the CSIR in Pretoria, where he established an optical design and evaluation facility. He became head of CSIR's Optical Sciences Division in 1983 and director of the Division of Production Technology in 1987, after spending part of that year with American Banknote Holographics of Elmsford, New York. He was a founding member of the South African Optical Society, chairman for three periods of one year, and a recipient of that society's award for outstanding achievements in the field of optics. He was chairman of the organizing committee of the 17th International Congress on High-Speed Photography and Photonics, held at Pretoria in 1986. He is a member of SPIE, has presented papers at several SPIE conferences, and is the author of some 30 refereed papers and published conference proceedings, together with more than 60 popular articles on optics. He is currently a consultant in optical engineering, particularly its application in manufacturing, and is consulting editor to the South African Technews publishing group.