Report of September 2011 Meeting
Royal Society
Southern Highlands Branch

Speaker: Professor Michael Withford
Director Macquarie University Photonics Research Centre

Topic: Photonics and its impact on the community.

The Southern Highlands Branch meeting of 29 September was held at 6.30pm in the Drama Theatre, Frensham School, Mittagong on an extremely cold Southern Highlands evening. A hardy audience of 30 people arrived dressed for the near freezing conditions.

Professor Michael Withford presented an exciting lecture in line with his team's current research directions – astrophotonics, microphotonics, nanophotonics, biophotonics, optical sensing, photonic sources and ultrafast lasers. It is now 50 years since the first demonstration of a laser, a device which quickly evolved from a scientific curiosity to a tool declared to be "a solution looking for a problem". The rapidly growing field of photonics, the optical analogy of electronics, has been made possible by advances in laser technology.

Photonics has been defined as the use of light to obtain, convey or process information. "Light" here includes infrared and ultraviolet radiation, as well as the visible spectrum. Photonics is now used in important applications in areas such as engineering, surveying, defence communications, computers and medicine. A recent review by the European Commission also determined that "photonics technologies underpin at least 10% of the European economy, and that the reliance will increase as those technologies are further developed in the next decade".

Withford emphasised that photonics is still in its infancy, even though its significance is already clearly seen in the world community. The internet for example combines both photonics and electronics, the latter involving complications with high heat dissipation and air-conditioning issues. It is known that 70 Google searches generate approximately 14g of carbon dioxide, the same as boiling a kettle, and that the internet accounts for 1% of electricity usage in the USA. If the power drawn by the end-users is included, then electricity usage due to the internet rises to 10%, a remarkable statistic. It is clear that dramatic improvements must occur as the field of photonics is further explored and developed.

Nano-optics and nanophotonics are closely related, entailing interaction of light with tiny nanometre-scale structures (1 nm = one millionth of a mm). On this scale of length, phenomena are influenced by quantum size effects of matter, and by the near-field properties of light. Efficient control of light on this scale, for instance by plasmonics, is a promising way to miniaturise next-generation photonic devices (*e.g.*, thin metallic films

with apertures or periodic features, or particles on surfaces). This raises critical issues, such as how energy is transferred between photons and matter. Both theoretical and experimental nanoscale research is needed to understand light emission, propagation and interaction with matter, as well as optical properties of materials and structures. Techniques used in this context include optical microscopy, surface plasmon effects (including surface-enhanced Raman processes), near-field probes, and interconversion of optical excitation between propagating modes and localised light fields. This is widely regarded as fertile ground for significant future advances.

As the lecture was concluding, Withford passed around the audience Olympic torches from the 2000 games and the Athens Olympics, both of which relied on involvement by his research team. Production of these remarkable objects depended on lasers for the micro-machining of the fine apertures required to suit the project. The 2000 torch was one of the few torches to be passed between different runners: Raelene Boyle and Betty Cuthbert, Dawn Fraser, Shirley Strickland, Shane Gould, Debbie Flintoff-King, and finally Cathy Freeman who then ignited the cauldron. Michael Withford reported that the cauldron was running on fumes only during its spectacular lift!

Anne Wood