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*Editorial*

# Voyage of Science towards Light

Year 2015 is very special as it signifies *The International Year of Light* popularly known by the acronym IYL-2015. The topics selected for the award of Physics and Chemistry Nobel Prizes in the year 2014 were related with the features of light; thus, aptly 2015 is declared as the International Year of Light. A new global initiative has been adopted in this New Year by the United Nations Educational, Scientific and Cultural Organization (UNESCO) to raise awareness among the global citizens on the issues of how optical technologies can promote sustainable development and can provide solutions to worldwide challenges in energy, education, agriculture, communications and health. With this new worldwide initiative there is continuous effort being made to encourage and enlighten researchers and responsible citizens to act in unison for sustenance of this unique planet. At this interface let us embrace New Year 2015 in earnest with all enthusiasm for enrichment of our spirit with a fresh enlightened outlook and stride forward to cope with the scientific challenges faced by the human race.

We are very pleased to take this opportunity to wish our readership, members of the Editorial Board, all our independent expert referees a very happy New Year 2015. On behalf of the *Defence Science Journal*, we express our gratitude to all members associated either directly or indirectly for their valuable contributions to the success of *Defence Science Journal* in bringing out its publications since last 65 years continuously.

There is nothing permanent except change. George Bernard Shaw once said 'progress is impossible without change'. In corollary progress is a permanent phenomenon and natural force for the subsistence and sustenance of a dynamic society. This proposition is valid in all spheres of life as it always intends to grow with time. For obvious reason, traditional technology cannot always bring fruit to cope with each and every situation unless it is continuously upgraded in commensurate with the need of the time. In fact, the quest for invention and innovations of human race never stopped but continued to acquire success in the endeavor to proceed further through continuous effort to upgrade the scientific knowledge and try for new technological innovations. Thus, the call of IYL 2015 by United Nations is of the time to focus innovation and implementation of light based technologies to help mitigate problems of mankind.

Over the years, the pattern of research culture has changed enormously. As a result the trend of research has changed from individual's effort towards group collaborative activities. With the growing complexity and demand of lifestyle, the research is becoming more interdisciplinary in nature in the framework of multidisciplinary activities. Joint winners of Nobel Prize are more common these days in the field of science than earlier years.

The most recent Physics Nobel Prize 2014 was jointly awarded for the invention of efficient blue light-emitting diodes that led to creation of bright and energy-saving white light sources. Although today's efficient GaN-based LEDs result from a long series of breakthroughs in basic materials physics and crystal growth, the role of material chemistry cannot be ignored in the development of LEDs. Until this invention, emitting blue light proved to be a difficult task as it required the production of GaN-based alloys with different compositions and their integration into multi-layer structures. The invention of efficient blue LEDs has led to white light sources for illumination. Globally lighting accounts for ca. 30% of total consumption of electrical energy, and such new white light sources require ten times less energy than ordinary light bulbs; and these efficient blue LEDs can lead to significant energy savings to effect great benefit to the mankind.

On the other hand, The Chemistry Nobel Prize 2014 was also awarded jointly for the development of super-resolved fluorescence microscope. In the realm of microscopes, way back in 1873 Ernst Abbe derived the conclusion that resolution could never be better than 200 nm. Microscope that uses lense and light, anything below that limit is too blurry to the sight and as a result optical microscopes cannot resolve an object right down to that limit. Such microscope is very much useful to study the living things as it requires normal light such that the living object won't get destroyed. As a matter of fact, for long time since 17$^{th}$ century there was a deadlock; and researchers presumed that optical microscopy would never obtain a better resolution than half the wave length of light. But it proved untrue with the development of super-resolved fluorescence microscope. The ingenious effort of the Chemistry Nobel laureates 2014 with the help of fluorescent molecules circumvented this limitation. Their ground-breaking work has brought optical microscopy into the nanodimension; thus enabled researchers to visualize the activity of individual molecules inside living cells. Modern nanoscope can follow feature of protein in Parkinson's, Alzheimer's diseases and study drug interactions *in-vivo* to understand the process.

It is interesting to recall the fact that the first practicing physician and the first practicing engineer was the same person, Imhotep. It may sound funny but actually many times medicine can meet with the engineering where medicine could be explained or modified with the engineering principles.

Mathematical modeling is now emerging as an alternative approach which can in some cases be more efficient and informative. Mathematical approach in biology has started when Sir Alan Hodgkin and Sir Andrew Huxley performed their Nobel Prize winning research on nerve signaling, their experiments

are supplemented by mathematical equations, which predicted how ion concentrations would vary along the nerve axon. This approach, which was extremely useful at the time, has now fully come of age with a system perspective.

It may appear that nanotechnology, engineering and medical sciences are pole apart but actually they may be interdependent which can be understood from the fact that nanotechnology has made it possible to produce ultra-sharp diamond cutting edges with radii of curvature of $\leq 5$ nm to make it possible to realise ultra-sharp diamond scalpels for use in eye and neurosurgery purpose – thus it manifests an absolute example of application of nanotechnology to make subtle engineering material and devices for medical purpose.

Integration of nano- and microtechnology with biology is producing many medical breakthroughs in diagnostic, therapeutics and bioengineering. A relatively simple example is the ability to create nanoparticles in a bio-system and integrating its role with magnetic, optical, electronic and or allied systems. Nanoparticles can be chemically linked to bio-molecules for many possible applications like; (i) in-vivo optical and magnetic resonance imaging, (ii) smart carriers for drug delivery system, and (iii) structural scaffolds for tissue engineering.

In recent past there was a report from the Materials Engineering Department of Monash University that a 3-D polymer-based scaffold can potentially allow stem cells to repair damaged nerves in the human body more quickly and effectively. In fact, researchers are trying to develop such a scaffold that it can be injected into the body at the site requiring nerve regeneration. The interface of nanotechnology and stem cell research may lead towards a curing system for Parkinson's disease and spinal cord injury. Biodegradable fibers were commonly used in biomedical sciences and regenerative technologies.

Thus, with the emergence of new ideas and their cross-fertilization from different disciplines, the world has experienced tremendous advancements in the field of high-end technologies. It is worthy to note that the Nobel Prize 2014 selected for the subject of chemistry but its work content also rests on physics phenomenally. From the citations of Physics and Chemistry Nobel Prizes 2014, it implicates the subjects and disciplines are becoming more interdependent and getting themselves overlapped, if not amalgamated to such a degree that it is difficult to demarcate the disciplines in traditional manner. Particularly the Chemistry Nobel laureates 2014 have shown the path of success in research by combining the principles of physics, chemistry, molecular biology, and engineering. Clearly, the work of the laureates reminds the significance of interdisciplinary approach and collaborative research in science and technology (S&T).

Defence Science Journal prides itself on being one of the important multidisciplinary journals of research on Science and Technology in general and Defence S&T in particular. DSJ aspire to enhance the status of the journal and keep maintaining a leading position, but we believe that this can only be achieved with the continued cooperation of researchers and readership worldwide. The key to the success of this journal depends on the publication of quality papers from scholars and researchers across the globe. We promise to improve the journal further and reach out to wider sections of researchers and R&D professionals in 2015, *The International Year of Light* and beyond.

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