Prof. Dr. Russell Foster receives 2012 Holst Memorial Lecture Award

By Peter van den Hurk

Eindhoven, December 5 – On November 29, Prof. Dr. Russell Foster, Professor of Circadian Neuroscience at the University of Oxford, received the 2012 Holst Memorial Lecture Award – the 36th since 1977 – for his achievements in visual and circadian neurobiology and his research on the mechanisms whereby light regulates circadian rhythms. The Award, a bronze medal by Dutch sculptor Jos Reniers, was handed over in the Auditorium of Eindhoven University of Technology (TU/e) by Hans van Duijn, Rector Magnificus of TU/e.

During his well-attended lecture, entitled “Light and time: the discovery of a third photoreceptor system within the eye”, Dr. Foster presented an inspiring view on his groundbreaking research on the neural mechanisms that regulate and generate circadian rhythms and sleep, with a focus on how light is detected and interacts with these systems.

Our biological clock
Most organisms possess a 24-hour biological (circadian, ‘almost a day’) clock, which acts to fine-tune physiology and behavior to the varying ecological demands of the day and night cycle. This clock needs to remain synchronized to solar time, and the daily change in the gross amount of light (irradiance) at dawn or dusk provides the most reliable indicator of the time of day. In mammals, this ‘master clock’ is located within small paired nuclei at the base of the brain called the suprachiasmatic nuclei (SCN). To adjust the SCN to the light and dark cycle, they receive direct signals from the retina – eye loss in mammals blocks this signal path completely.

A new, third photoreceptor in the eye
In the early 1990’s, Dr. Foster found that visually blind mice, with genetic defects in the rods and cones, could still use their eyes to regulate the clock, so he suggested that there had to be another photoreceptor – but what was it? The reactions from the scientific community could not have been more ferocious: “Are you seriously suggesting that over a period of more than 150 years of research, we have totally missed an entire class of photoreceptors in the eye?”

However, subsequent experiments including studies in humans with genetic defects of the eye indeed showed that the processing of light information by the circadian and classical visual systems is different, and that the eyes of mammals contain an additional non-rod, non-cone photoreceptor based upon a small number of photosensitive retinal ganglion cells (pRGCs). Since then, investigations of Dr. Foster and his
fellow researchers have shown that these pRGCs do more than regulate the clock, and are involved in a host of other irradiance detecting tasks that regulate sleep, alertness, hormonal rhythms and even pupil constriction.

Consequences for diagnosis of blindness

“Visual blindness, as shown in a mouse and in a human, may not result in a loss of all light detection by the eye,” Dr. Foster explained. “This may have very important consequences for ophthalmology.” For example, people with eye diseases of the inner retina, which result in retinal ganglion cell death (e.g., glaucoma), are at particular risk of circadian rhythm and sleep disruption. Furthermore, individuals lacking eyes entirely because of trauma are unable to regulate their biological rhythms, which requires appropriately timed medications to help consolidate sleep timing. By contrast, eye diseases associated with rod and cone photoreceptor death need not result in the loss of pRGC photoreception. In these cases, individuals should be encouraged where possible to expose their eyes to sufficient day-time light to maintain normal circadian regulation and sleep-wake timing.

“Around 39 million people in the world have massive blindness, 285 million are visually impaired, and 246 million show low vision. The extent to which knowledge about these new photoreceptors will improve the quality of life of millions of people remains to be determined. Unless we get knowledge about this new system embedded into the mindset of our clinicians, we won’t be able to help them,” Dr. Foster concluded.

Holst Symposium ‘Light and the Rhythm of Life’

Preceding the Holst Memorial Lecture, this year’s Holst symposium – chaired by Sjoerd Mentink, Innovation Area Manager of the Lighting research program at Philips Research – brought together scientists, students and professionals from Philips Research, Philips Lighting, Philips Healthcare, TU/e and other institutions. Speakers from academic, industrial and architectural communities focused on how light via the eyes influences man, environment, health, and society.
Prof. Emeritus Dr. Serge Daan of the University of Groningen talked about the evolution in light and darkness, emphasizing that the 24-hour cycle of light and darkness is deeply embedded in life on earth. He explained that, as a result of evolution, almost every organism on our planet has a built-in biological clock, which can be synchronized to the night and day rhythm through various stimuli, in particular by using light. Dr. ir. Yvonne de Kort, Associate professor Environmental Psychology at TU/e, presented insights in the area of Light and Mind – where psychology and technology meet – that help us on our road towards intelligent lighting technologies and applications.

Dr. Anna Wirz-Justice, Professor Emeritus of the Centre for Chronobiology at the Psychiatric Hospital at the University of Basel, was happy to visit Eindhoven, “the Mecca for light addicts”. She shared insights resulting from more than 20 years of research on seasonal affective disorder and light therapy – she was the first to introduce light therapy to Europe. Taking a different perspective, Jos Stuyfzand, Global Director Ambient Experience Design at Philips Design, talked about meaningful, people-centric experience innovation with light in healthcare and beyond, and Francesco Veenstra, Partner and Associate Architect of Mecanoo Architects in Delft, presented a series of examples in architecture in which light plays a key role to create great spaces and experiences for people.

MORE INFO - History of the Holst Memorial Lecture
The first Holst Memorial Lecture was held in 1977 to commemorate the 21st anniversary of the Eindhoven University of Technology. With support from Philips Research, the Holst Lecture became an annual tradition. An eminent scientist is invited to deliver the lecture to an audience consisting of university staff, students, representatives from industry and other guests with a general interest in science and technology. The general theme chosen for these lectures reflects the important contribution of Dr. Gilles Holst to research and technology in the Netherlands: ‘the development of applied sciences, particularly mathematics and the natural sciences, for the benefit of industry on the one side and their implications for society on the other.’