

2013 PSTA WINNER CITATIONS

PRESIDENT'S SCIENCE AND TECHNOLOGY MEDAL 2013



Professor Barry Halliwell
Deputy President (Research & Technology) and Tan Chin Tuan Centennial Professor
National University of Singapore

“For his outstanding contributions to development of the research landscape in Singapore and his excellent research on the role of free radicals and antioxidants in human health, nutrition and disease”

Professor Barry Halliwell, the Deputy President (Research and Technology) and Tan Chin Tuan Centennial Professor at the National University of Singapore (NUS) has played a pivotal role in developing research excellence in Singapore in his capacity as Deputy President at NUS and as a role model in conducting excellent personal research and training local manpower.

Prof Halliwell has occupied important roles at NUS and in national bodies that support research in the past 15 years that he has been based in Singapore. In particular, he has played a key role in the development of Singapore's R&D landscape, particularly in the biomedical sciences area but also way beyond that. As co-chair of the NUS Life Sciences Curriculum from 2004 to 2008, Prof Halliwell helped to steer the introduction of an integrated life sciences curriculum at NUS, which trains graduates to contribute to the manpower required for Singapore's initiatives in Life Sciences. He is currently the Deputy President in charge of Research and Technology (DPRT) at NUS, a position that was newly created in 2006 to help NUS increase its research quality and productivity to aid Singapore's transition to a knowledge-based economy. Prof Halliwell is responsible for driving the University's research agenda and promoting a broad base of globally competitive quality research from which peaks of excellence can grow. Prof Halliwell was involved in the recruitment and mentoring of many excellent researchers at both junior and senior levels. His office steered the development of a detailed and effective research policy framework at NUS which helped to enable NUS researchers to compete successfully for 3 of Singapore's 5 Research Centres of Excellence (RCEs), plus a fourth RCE in partnership with NTU. Several other peaks of research excellence in a broad range of areas have also developed at NUS, with the result that NUS is now globally ranked very highly for its achievements in research across a broad range of topics relevant to Singapore, from Asian studies to membrane technologies to cancer biology. NUS competitive research grant income during his tenure as Deputy President has tripled.

By working closely with government agencies and industry, Prof Halliwell promoted the development of core new intellectual activities in Singapore in fields including ageing, clean energy, sustainability and interactive and digital media. The NUS “Virtual Institute for the Study of Ageing” has achieved high visibility and attracted funding from government and private donors. Prof Halliwell has also worked closely with the Singapore Economic Development Board in facilitating the growth of strong University-Industry partnerships in Singapore, e.g. the Solar Energy Research Institute of

Singapore (SERIS) in NUS. He continues to be actively involved with SERIS in his role as DPRT and also as Chairman of the Supervisory Board of SERIS. Prof Halliwell has also assisted the National Research Foundation (NRF) in its mission to promote research in Singapore. One example is in CREATE (Campus for Research Excellence and Technological Enterprise). Prof Halliwell provided most of the input for the research and education components of the document proposing location of CREATE and the Singapore-MIT Alliance for Research and Technology (SMART) on the NUS campus in 2006, which has led to many exciting synergies in research and technology. Prof Halliwell was involved in in-depth discussions with overseas Universities including ETH Zurich, Hebrew University of Jerusalem, Technion-Israel Institute of Technology and Cambridge (UK) which have since set up CREATE centres in Singapore.

Prof Halliwell has been a member of several boards which make strategic decisions on the development of R&D sectors in Singapore. On the biomedical front, Prof Halliwell sits on the National Medical Research Council (NMRC) panel evaluating proposals from the Translational and Clinical Research (TCR) Flagship Programme. He was the co-chairman of the research grant evaluation panel of the National Medical Research Council (NMRC) from 2007 to 2011. He was also actively involved in the research grant evaluation panel of the Biomedical Research Council (BMRC) as Deputy Chairman from 2001 to 2008. Prof Halliwell sits on the executive committee on Environmental and Water Technologies (EWT), providing input on the development of the EWT sector in Singapore, an area in which NUS has been ranked among the best in the world. Prof Halliwell is also widely sought as a consultant and advisor on research strategies to industry, public bodies and other organizations in Singapore and internationally. Prof Halliwell was also the Founding Executive Director of the NUS Graduate School of Integrative Sciences and Engineering (NGS) from 2003 – 2008. Established in 2003, NGS offers scholarships to bright students to encourage them to undertake Ph.D. education that transcends traditional disciplinary boundaries, encouraging interdisciplinary research. NGS has built up an internationally diverse Ph.D. talent pool with over 700 graduates and current students, 46% of whom are Singaporean citizens or Permanent Residents. NGS rapidly built up strong links with relevant NUS Faculties/Schools/Research Institutes and especially with the Agency for Science, Technology and Research (A*STAR). NGS has also built up synergistic, complementary partnerships with a select number of world-leading overseas research institutes and knowledge organizations in the USA, UK, Continental Europe, Japan, Australia, and China. Thus, NGS is able to offer gifted students the opportunity to engage in globally progressive research in superb research facilities both within Singapore and further afield. Although Prof Halliwell stepped down as Executive Director in 2008, he still has oversight of NGS in his role as DPRT.

Despite his heavy administrative duties, Prof Halliwell has been a role model by maintaining a strong personal research reputation. He is a world-leading expert on the role of antioxidants and free radicals in living organisms and their participation in human disease and nutrition. He began his work in 1976 by elucidating a key antioxidant defence mechanism (the ascorbate-glutathione cycle, now often called the Halliwell-Foyer-Asada cycle) that is used by plants to remove peroxides and protect the chloroplast against damage. This cycle has taken on a new importance recently because enhancing it allows crop plants to resist environmental changes such as increased temperature and drought stress. In later work Prof Halliwell was a pioneer in establishing the key role of transition metal ions in catalyzing free radical reactions in vivo. In particular, his work showed the importance of “mal-placed” iron and its ability to promote oxidative damage in several human disorders, including iron overload disease, problems of premature babies, cancer chemotherapy, rheumatoid arthritis and atherosclerosis. Prof Halliwell is also renowned for his development of robust methodology for measuring the oxidative damage caused by free radicals and related species in vivo. These methods helped to establish the mechanism and significance of oxidative damage to key biomolecules in cancer development resulting from chronic inflammation, and in the affected brain regions in sufferers from Alzheimer or Parkinson diseases. In the field of molecular nutrition, Prof Halliwell has shown, using direct measurements of oxidative damage in the human body, that in

well-nourished individuals the “important” diet-derived antioxidants are not vitamins C, E and β-carotene as commonly supposed, in that supplements of these agents do not generally decrease oxidative damage in vivo. This helps to explain why many of these antioxidants are showing limited efficacy in human intervention trials testing for disease prevention. His laboratory has now identified more important antioxidants in the human diet. Prof Halliwell has also made substantial contributions to our knowledge of the biological role of reactive nitrogen species such as peroxynitrite and to our fundamental understanding of the mechanisms by which oxidizing air pollutants (especially ozone, nitrogen dioxide and PM2.5) damage the human body.

Prof Halliwell has published 225 papers in leading international journals since he joined NUS in 1998. He has trained multiple research assistants, fellows and students, over half of whom are Singapore citizens. The textbook *Free Radicals in Biology and Medicine*, where he is the lead author, is in its fourth edition (published Jan 2008 by Oxford University Press; fifth edition in preparation), and is used worldwide (cited over 19,000 times to date) and regarded by many as the “bible” in the field. Thomson Reuters identified Prof Halliwell as a highly cited scientist in three areas, indicative of the broad relevance of his research contributions, namely Biology and Biochemistry, Neuroscience and Behaviour, and Pharmacology and Toxicology. His Hirsch index is 139. Prof Halliwell has received numerous awards, including the Lifetime Achievement Award by the Society for Free Radical Biology and Medicine in the USA, Ken Bowman Research Award from the Institute of Cardiovascular Sciences (Canada), Fellow of the Society for Free Radical Biology and Medicine, Fellow of the American Association for the Advancement of Science and the NUS Outstanding Researcher Award 2012. He received Singapore’s Public Administration Medal (Silver) in 2010.