Report of 17 October 2013 Meeting
Royal Society
Southern Highlands Branch

Speaker: **Professor Peter Robinson**
School of Physics, University of Sydney
Deputy Director of the Brain Dynamics Centre at Westmead Millenium Institute.

Topic: **The Dynamic Brain**

In this lecture, Professor Robinson outlined how new insights into the operation of the brain can be obtained by applying ideas from physics in tandem with those from the biological sciences. An outstanding feature of the lecture was the frequently observed close correlation he was able to demonstrate between his quantitative modeling of brain dynamics and the actual behavior of the brain as seen in clinical data.

In this wide-ranging lecture, Robinson described how these new insights into the operation of the brain could be applied to phenomena as diverse as epilepsy, Parkinson's disease, fatigue, shift work, jet lag, and drug effects among others. His interdisciplinary work has led to numerous awards.

In 2012 he won the NSW Science and Engineering Award. He has also been the recipient of the Australian Academy of Science Pewsey Medal, the Bede Morris Fellowship, the Royal Society's Eureka Prize for interdisciplinary research, the Edward David medal and the Institute of Physic's Walter Boas Medal. Robinson works closely with organizations as diverse as the Westmead Hospital Brain Dynamic Centre, the Woodcock Institute (leaders in breathing and sleep disorders), and the Black Dog Institute. Overseas he is working with NASA on the current STEREO space mission.

While neural activity in the brain has been observed for over a century and is widely used to probe brain functions and disorders, the connections between stimuli, physiology, processing and measurements have until recently been largely qualitative. Robinson's research has now resulted in a quantitative multiscale model of brain stimulus-activity-measurement dynamics that includes key physiology and anatomy from synapses to the whole brain and from milliseconds up in timescale.

With the inclusion of measurement effects, the model successfully predicts a wide range of linear and nonlinear phenomena at many scales. These include time series, spectra, evoked responses to stimuli, seizure dynamics, visual phenomena during perception, arousal (sleep-wake) dynamics, and influences of pharmacology and aging. Fitting to

experimental data enables physiological parameters to be inferred in normal and abnormal conditions. Such multiscale modeling thus provides a framework within which to interrelate, predict and interpret diverse phenomena and measurements. The physiological basis of the model enables it to predict experimental observables such as electroencephalographic and functional MRI measurements, and the results have given rise to commercial applications.

At the end of this stimulating lecture, the 45 person audience asked numerous questions of the speaker. Due to time restraints, several had to bide their time until a little later when they could continue the discussion over the dinner table.

Anne Wood