Interview with Alan Finkel
on the Handover of
The Australian Course in Advanced Neuroscience
to
The Australian Neuroscience Society
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- Would you consider the brain to be the last great frontier of scientific research?

Last? That's too strong a statement. I'm a science fiction buff so I still hope that one day several centuries from now we will be tackling faster than light travel, or antigravity. However, I do indeed consider the brain to be the biggest research challenge for the 21st century. The brain is extraordinarily complex, much more so than the genetic code that carries the basic instructions for its formation. We know a huge amount about the brain already, but probably less than 5% of what we will know 50 years from now. The parallel application of neuroscience research techniques and computer modelling will one day help us to understand the operation of the complete brain from the ground up. Today, most of what we know about the higher functions of the brain are correlations (such as identifying the parts of the brain that use more oxygen during arithmetic calculations or when listening to music) but we know virtually nothing about cause and effect for higher brain functions. It's a massive challenge that will keep neuroscientists busy for decades, perhaps centuries.

- Why does this complex organ hold so many mysteries that are yet to be unravelled by medical research?

I assume you are not looking for a metaphysical answer! The answer is embedded in your question – complexity. The brain exhibits characteristics such as creativity, love and self-awareness that cannot be predicted by extrapolating the characteristics of several or even thousands of neurons. When hundreds of billions of neurons communicate with thousands of neighbours, behaviour emerges that cannot be predicted. Consider an analogy. Complex computer programs are written in modules, each of which has a stand-alone capability and a set of input-output relationships. These modules are written as robust, almost self-sufficient objects, very much like a neuron. When combined into a fully functioning program these objects exchange data and respond to the other objects in the program, with the result that new characteristics of the software emerge that were not predicted by the designers. If the software modules were well designed the emergent characteristics are most often a bonus.

- What are the compelling reasons for wanting to know more about the mechanisms that regulate brain function?

Three out of four Australian families are affected by disorders of the brain. As our population ages, brain disorders are becoming more prevalent. There is an urgent need to understand the mechanisms that regulate the brain so that we may develop therapies and cures for brain disorders.

- What are the new technological breakthroughs that provide new powers in studying the brain e.g. the human genome project and new imaging techniques?

There are many, but new imaging techniques stand out because they are so information rich and stunning. Tractography is a recent variation in magnetic resonance imaging that provides detailed images of the connection pathways between regions of the brain, many of which are disrupted by injury or disease. At the cellular level, array tomography enables the structure and function of millions of neurons and synapses to be reconstructed in three-dimensional computer images that might one day allow the operation of the brain to be simulated in computer models.

- What are the potential outcomes of spectacular advances in neuroscience? Not only in terms of understanding diseases and neurological disorders - and potential new treatments - but perhaps also in understanding the biological basis of emotion, motivation and thought?

The ultimate goal beyond the treatment of diseases is to understand the higher level functions of the brain. There is a long way to go in this endeavour, but once we get to the point that we can reproduce the connectivity and function of substantial regions of the human brain we should be able to study their operation in computer simulations. From these we will identify the requirements that underpin the emergence of higher order functions from the interconnection of the neuronal building blocks of the brain.

- Acclaimed British scientist, Baroness Susan Greenfield, says that "anybody who has a brain is interested in the brain." What type of people carry this interest into the study of neuroscience? What would you say to young people interested in this field of research?

Elucidating the mechanisms of brain function is the biggest challenge for biological scientists in the next fifty or one hundred years. Achieving this goal will be the outcome of a multidisciplinary effort involving neuroscientists, geneticists, molecular biologists, mathematicians, computer scientists and others. Young people interested in a research career should follow their passion into the discipline that fascinates them, then look for the opportunities to participate in research related to the brain.

- Why did you become a neuroscientist?

I actually think of myself as an electrical engineer who has a strong interest in neuroscience. I did my PhD in Electrical Engineering at Monash University. Professor Steve Redman was my supervisor. He guided me into a project that involved looking at neurotransmission at the single-cell level. Much of what I wanted to achieve required equipment that wasn't readily available, so I designed what I needed. This ultimately led me into a business career in which I established a company that made electronic and software instrumentation for neuroscientists.

- Your career has spanned medical research, and the global corporate sector. My understanding is that this provided you with the opportunity to contribute something special to the Australian neuroscience community? What did you note about the value of summer neurobiology courses for students in the United States, and why did you consider this concept to be of value in Australia. How did this concept get off the ground?

One of the biggest challenges for young, early stage career scientists is to learn the laboratory tools and techniques that will make them efficient. How do they do that? The traditional way to learn advanced research techniques is by laboriously reproducing them from the methods sections of published papers. Alternatively, some young researchers are fortunate enough to spend a few months or years in labs where these techniques are pioneered.

In the US, for more than thirty years PhD students and postdoctoral research fellows have been attending summer schools at which they learn the latest research techniques from experts in the field. I was familiar with the Woods Hole and the Cold Spring Harbour summer neurobiology courses because the company I founded – Axon Instruments – had supported them for more than twenty years by lending them voltage clamp and patch clamp apparatus and software. There are very few student places available in these residential courses, thus very few Australians had the opportunity to participate.

After Axon was acquired in 2004 I had the time to reflect on life beyond the 24/7 demands of running a business. In discussions with my wife and Professor David Copolov, and subsequently with Professor Steve Redman, it was clear that Australian neuroscience would benefit from its own summer course, a kind of "Woods Hole down-under". Further discussions rapidly revealed broad support for the concept among leading Australian neuroscientists and very quickly the Australian Course in Advanced Neuroscience (ACAN) was born.

`- Why was North Stradbroke Island chosen as the venue?`

The Course Management Committee decided early on that ACAN should not be associated with a single university or research institute because its intention was to serve young Australian and New Zealand researchers without any selection bias. To emphasize that point, we were determined that ACAN not be located on or adjacent to a particular university campus. We considered several sites, but there were not many sites remote from a university or research institute that had the required laboratory facilities. We were very fortunate to find that the University of Queensland has excellent facilities on North Stradbroke Island and that the University was willing to rent this space to us on an annual basis for our course.

Being on a lovely island like this is a major plus. When you get on the ferry to travel to the island, the day to day distractions of home are left on the wharf on the mainland. The students and instructors arrive with clear heads and a strong inclination to focus on the course. Which is important, because the course is demanding, with lectures and lab sessions morning, afternoon and evenings for six days a week. Nevertheless, squeezed into the schedule there is sufficient time for the students to socialize, to discuss their career aspirations with the instructors, and to explore parts of the island. The overriding message from the environment and the schedule is that hard work can be simultaneously productive and enjoyable.

`- How would you rate the success of the course to date?`

The feedback from the students, from their supervisors or principal investigators, and from the neuroscience community has been very positive. The instructors from around

Australia, New Zealand, the US and UK volunteer their time and come back year after year. They wouldn't do that if they didn't find it personally rewarding and see the value for the students. The contributions of Professor Redman and Dr. John Bekkers as Course Directors has contributed immeasurably to the success.

- Why is it now time for ANS to take responsibility for the course?

Perhaps one could invoke a strength-in-numbers argument. ACAN is a single course with a strategy of continuous improvement but no plans to expand into other disciplines. By becoming part of ANS, the course will benefit from continuity, mentoring, networking, awareness and prestige. Since the course exists for the benefit of the Australian neuroscience community it makes sense for that community, through ANS, to be given ownership of the Course.

- What impact do you feel the course may have on the quality of neuroscience in Australia and its contribution to the world?

ACAN enables a step increase in the research productivity of the young scientists who attend as students. Further, it gives them an opportunity to discuss their projects and careers with twenty or more neuroscience experts in a setting that allows time for a meaningful dialog. Better-trained scientists whose ambitions have been sharpened by dialogs with international leaders will be more effective throughout their careers, thus ACAN helps to raise the productivity and quality of Australian neuroscience research as a whole. Our research is already world class, ACAN will help to make it even better.