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Alan Peters

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The IBRO History of Neuroscience Committee devised the following questions for Professor Peters.

1. Where were you born and raised?

I was born in Nottingham, England in 1929, and went to school there, much of it during the 2nd world war>

2. Where were you educated and which of your teachers had the greatest influence on you?

I attended grammar school in Nottingham. The school had some excellent science teachers, and after completing the sixth form, basically from 16 to 18 years of age, I did well enough in my higher school certificate examinations that the teachers suggested that I ought to go to university. Since no one in the family had attended university, that produced some questions, especially since my parents could not afford the university fees anyway. But one of the teachers at school persuaded my parents that I ought to stay on for one more year in the sixth form, because he thought that if I took the leaving examination a second time I could do well enough to get a scholarship to pay my fees, etc. Fortunately, he

was correct and I did get a scholarship to Bristol University to study zoology. I also obtained a scholarship to go to Cambridge to study medicine, but Cambridge told me that I could not take up that scholarship there for at least two years, since entry preference was being given to those who had served in the Forces during and just after the war. This was in 1948. Being impatient, I decided to forgo medicine and to do a degree in zoology instead. I completed my BSc in 1951, and completed my PhD in 1954.

3. When did you start your career in scientific research and in what area?

When I was at University all males in Britain had to do military service. Consequently, after I had completed my PhD I was conscripted into the Army. I became a 2nd Lieutenant in the Medical Corps, and spent the last 15 months of my military service in Germany. This was an important event in my career, since being in the Army and not in an academic environment it was difficult to see how I would be able to get a job in a British university, which was my goal. Fortunately, one of my fellow officers saw an advertisement in a journal stating that postdoctoral positions were available at Edinburgh University in the Department of Anatomy. Since I knew something of Prof. George Romanes' work on silver staining of nerve fibres - the topic of my PhD thesis - I applied and was awarded a postdoctoral position in the Department of Anatomy.

Initially I continued to do silver staining, which at that time was one of the most common methods of staining nervous tissue available. But as I became more familiar with the central nervous system I began to realize that silver staining was not the way to go about studying the nervous system. The silver stained almost every component of the tissue, but no nerve processes could be followed for very far in the light microscopic sections we were using, and so it was useless for determining connections between neurons. Fortunately, soon after I arrived in Edinburgh in 1957, Dr Alan Muir who was in the Department was awarded a grant to buy an electron microscope, and he offered to teach me how to use it. I could see the advantages of this new technique and so I started to examine the fine structure of nervous tissue.

4. What do you consider to be your most important studies and contribution to biology or medicine?

The most important event for me was interpreting the fine structure of myelin sheaths in the central nervous system. In the late 1950s, Betty Geren and others had figured out that a spiral wrapping of Schwann cell membrane produced the myelin sheaths of the peripheral nervous system, but attempts to unravel and understand the structure of central myelin had not been successful. This was largely due to the fact that the quality of

fixation of central nervous tissue that we were able to achieve at the time was so poor. But there was the added problem that the outsides of central sheaths were frequently apposed to each other, because central myelin sheaths are not separated as they are in peripheral nerves. I was fortunate in choosing to look at the optic nerve of the Xenopus tadpole, and this nerve is so small I was able to produce immersion fixation good enough to determine that central myelin is also formed by a spiral wrapping of membranes. I published the result in 1960, and this brought me to the attention of others interested in the fine structure of the CNS. Interestingly, my article was published next to a paper by Maturana, who arrived at the same conclusion about the structure of central myelin.

Another important event in my life was writing a book, Fine Structure of the Nervous System, with Sandy Palay and Harry Webster. I owe a lot to Sandy Palay who had extremely high standards, and during the year I spent with him at Harvard in 1963 we spent many hours pouring over electron micrographs, trying to interpret them and attempting to define the morphological features of profiles of the various components of the central nervous system. At the end of the year Sandy and I talked about writing a book on the fine structure of the nervous system, but decided to postpone this project until we had identified the initial segment of the axon, which at that time we had not recognized. By the time that I returned to Boston two years later, in 1966, to take up the Chairmanship of the Department of Anatomy at Boston University we had both, independently, recognized the axon initial segment in different parts of the CNS. Consequently, we now felt that we should go ahead and start writing the book. Since neither of us had much experience with the peripheral nervous system, we asked Harry Webster if he would join us in the endeavour and write the chapter on the peripheral nervous system. Harry agreed and so we set about writing the book, the first edition of which was published in 1970.

5. Have you invented any new techniques?

Yes, along with Alfonso Fairen, who was a visitor in my lab at that time, we invented the Golgi/EM technique in which we substituted gold for the silver chromate that filled neurons impregnated by the rapid Golgi technique. The substitution produced a fine deposit of gold particles. This was in 1977. Thus, for the first time we were able to take neurons that had been Golgi impregnated and showed good axonal plexuses, and then examine those same cells and their axons in the EM to unravel their synaptic connections. This provided answers about neuronal connections that not been obtainable until then. However, after a few years this technique was superseded by intracellular filling of neurons, which is much better and does not rely on the vagaries of Golgi impregnations.

6. What do you think about awards and, for you, which have been the most truly emotive?

I believe that awards are good for the ego. The award I most appreciated was the Henry Gray Award given to me in 1998 by the American Anatomical Association. It is the most prestigious award that this Society presents.

7. Can you sum up the attributes that you possess that have made you a successful scientist?

Obviously working hard, being compulsive and trying to determine which problems are the important ones. Worrying about how to solve the problems and eventually making sure that the data are presented in the best possible way and the results well illustrated. Although the latter becomes increasingly difficult as editors reduce illustrations to such an extent that few details, and sometimes even the labelling, cannot be properly seen.

8. What do you think about the use of the impact index to evaluate scientific performance? What do you think is the best way to evaluate a scientist?

I think that the impact index is overrated, and in the end only fellow scientists can make an evaluation of the quality of science produced by another scientist.

9. What suggestions have you regarding the best ways to support scientific research and to safeguard its integrity?

In the US the combination of federal and private funding works out very well, and as far as my own experience is concerned, no one interferes with data generated. Whether that is true of other fields, I do not know.

I do feel that some laboratories are much too large and that it would be more equitable if the number of research grants given to a particular scientist were limited to not more than two or three. That could make more funds available to junior scientists and give them more of a chance to develop their own research programs.

10. What in your opinion makes a review of a submitted paper of most value to the author and journal?

An honest review can be a value to an author, since it provides a dispassionate assessment of whether the work is clearly presented and whether there are obvious flaws in the work. On the other hand, the reviewer can only review the data as presented. There is no way to assess whether the data presented have been derived honestly, or whether they are false, and it is fortunate that in the vast majority of cases scientists are honest about their work.

I would like to make two comments, though. One is that it is unfortunate that some reviewers feel that it is necessary to find something to critique or they feel that they have not fulfilled their task. The result is that some of the comments by reviewers are niggling and it is increasingly uncommon for reviewers to state that an article is fine and needs no alterations. Second, I do not like the idea of selecting articles as being special or of greater importance than other articles in the same issue of a journal. Whether an article is considered to be especially important largely depends on the interests and views of the person making the selection.

11. What are your views concerning the balance between applied and basic research that should be considered by funding agencies?

I do not think that a rigid balance between the two can be set. It depends on the quality of the work being proposed.

12. What do you think are the neural substrates that make a human being human? In other words, what is special about the brain of humans and how does it differ from that of other species?

What makes us human is the development of the frontal lobes and the ability to communicate with each other via complex languages, both verbal and written. This allows us to pass on ideas and experiences, and to record those ideas and experiences and their results. Other animals also communicate with each other to a certain degree, and I have always supposed that this means that other animals must have some level of consciousness and an ability to comprehend. However, to return to humans, I have always been impressed that I have little idea of what people close to me, for example, people in my own family, are thinking and how they deal with their thoughts. Consequently since I cannot even delve into the minds of other people, I doubt there is any way that I can appreciate what goes on in an animal's mind.

I might also add that humans are unique in that they live so long, and consequently they can develop neurodegenerative diseases that do not seem in general to affect other animals.

13. Which are the three most important scientific questions that you would like to answer?

I would like to understand the connectivity between neurons in the cerebral cortex and how networks of cortical neurons function, but in the end I doubt that even this will tell us how we see, hear, initiate movements and, most importantly, how we think. The problem is that, even as individuals, we do know how our own brain functions, and this makes it extremely difficult to ask meaningful questions of others.

Fundamentally, I would like to understand how oligodendrocytes make myelin in the central nervous system. How they generate so much membrane and how the spiral wrapping is produced around the ensheathed axons.

Finally, I would like to know what happens to the brain during normal ageing. This is the subject on which I am presently working.

14. Do you think that there is life outside of our planet? If so, do you think that it is possible that a sophisticated brain like that of human beings exists?

I do think that there must be life on other planets. But I find the size of the galaxy to be incomprehensible, and most of the galaxy is so far away that I doubt we will ever be able to explore much of it and ever know if there are sophisticated life forms elsewhere.

15. Do you think that computers will some day be capable of simulating the human brain?

My understanding of computers is minimal, but I do appreciate that for the most part they can only deal with data we put into them and with things that we program them to do. So I think that computers will be able to simulate the activities of small networks of neurons, but that they will not be able to think and create. As I answered above, we do not even know how we ourselves think, react to situations and generate ideas, so I do not see how we can program computers to do those things.

16. Do you think that the development of neuroscience research and, in particular, the advances in our knowledge of the human brain will change the course of the history of humanity? In other words, do you think neuroscience will have a deep social, cultural and educational impact in the future?

I doubt that neuroscience will have a great impact on education other than to increase our understanding of the brain. But the explosion of information about the brain means that even very few, if any, neuroscientists understand and are familiar with all aspects of neuroscience. The most obvious way in which neuroscience can have a social impact on populations is through finding cures or means to alleviate neurological diseases, especially diseases such as Alzheimer's and Parkinson's, which are becoming more common as populations live longer and consequently affect an increasing proportion of our population..

17. What factors in your general life influence you most? How have your family influenced in your scientific work?

My family has not directly influenced my scientific work, other

than allowing me the freedom to do my work and providing me with a stable and loving environment in which I can function.

18. What are your hobbies?

Several years ago I realized that I spent most of my time working and reading about science, and that when I eventually retired I would potentially be at a loss to fill my free time. Consequently, I decided that I needed to develop some hobbies. After some thought I decided that I would start two hobbies. They are stamp collecting and model ship-building. Recently I have been spending most of my free time doing the model ship-building. I find it satisfying because there is some research necessary to learn about the ship you are building and a challenge in fashioning the parts in miniature.

19. What makes you feel most proud as a professor and scientist?

The fact that I believe I have accomplished something in my life. And the fact that I have been fortunate enough to have been paid to do work that I enjoy.

20. What is your advice to young researchers?

It is important to enjoy what you are doing and to find a research problem that you think is important: one that you want to solve, and not one that your advisor thinks you ought to do and in which you have no interest. Having decided on the problem, worry about it and put as much energy as you can into solving it.

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