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There were some minor changes made prior to final publication

CURRENT BIOLOGY Q&A

What turned you on?

I work on fossils but my first love was living plants. As a child I spent months on the Gower Peninsula where we had a bungalow. My father was a keen bird watcher and, I suppose to keep me occupied, encouraged me to collect and identify flowers. I kept notebooks with sporadic records of flowering times, drawings etc. and supplied the nature table in my primary school in Manselton, Swansea with flowers. My father was very much an amateur who had left school in his early teens – I wish he had introduced me at this age to Latin names. Incidentally my first encounter with rocks resulted in a drawing of what I thought was a fossil in the Carboniferous limestone at Pwlldu, but now suspect it was an artefact. I became more geologically informed later at secondary school when I joined the Swansea Scientific Society on Saturday mornings under the leadership of Dick Owen.

Best advice

When it became apparent after O levels that I had the ability to attempt Oxbridge entrance exams, my father took me to visit the mycologist Ivor Isaac, then professor of botany at the University of Swansea for advice. They had been friends at primary school, when introduced to birdwatching and egg collecting by a 'Mr Webb'. Both

passed entrance exams to grammar school, but my grandparents could not afford the uniform. I remember Prof. Isaac asking me what newspapers I read, and on discovering that they were the Daily Express and Sunday tabloids (hidden when entertaining Baptist ministers) recommended the Guardian and the Sunday Times. In the absence of television, they did indeed widen my horizons. I don't remember any life changing advice during my subsequent career.

Early influences

Relatively recently I came across the term 'role model'. In retrospect I would have to include my secondary school teachers Elizabeth Bremner (Botany), Eluned Leyshon (Chemistry) and Eileen Jones (Maths). They were incredibly supportive in preparing for the Oxbridge exams – the first girl to do so in sciences from the school, my only reservation now being that they did not encourage me enough to question. Miss Leyshon in particular tried to make me more worldly with loans of books, both scientific and non-fiction, helped me to gain a part-time job in a market garden and much to the consternation of my parents showed me how to preserve fruit in various forms of alcohol. At University, most influential were Janet Harker my director of studies and Enid MacRobbie who as a biophysicist introduced me to the quantitative aspects of botany. I suppose now in an era of Athena Swan initiatives, then in the shelter of an all girls school and Girton College, I never realised that women were disadvantaged and more recently with one exception (from an unmarried woman who felt that a man with a family was more deserving of a job), I have never experienced prejudice.

Why palaeobotany

Even before University, I had a romantic idea of a research career, and later in Cambridge because this was my aim and I realised that to achieve this what I lacked in intellect I could compensate by hard work – a sort of educated parrot.

In my final year, I was influenced by two external speakers – a female Prof. on carbohydrate biochemistry and then Prof. Harlan Banks from Cornell who was an inspirational, arm-waving lecturer and leader of a very active research group. This was the beginning of a major research period on early land plants led by north American palaeobotanists. Banks invited me to join his group and with a NATO studentship spent the first year of PhD research in his department learning techniques, there being no appropriate supervision in Cambridge at the time when Bill Chaloner in London led research on Palaeozoic palaeobotany. Later in the year after graduation I attended my first conference – the tenth International Botanical Congress in Edinburgh. Logistics were horrendous, I lodged in a seedy tenement and seemed to spend more time rushing between lectures than listening to them. It did, however, give an opportunity to glimpse the “big names” in contemporary palaeobotany. I still dislike large conferences with numerous parallel sessions but enjoy more intimate interdisciplinary and themed ones – those organised by the New Phytologist Trust come to mind.

Who dead would I like to meet?

Only in writing this did I realise that I was most influenced by female scientists and this leads me to Agnes Arber. As only the second female president of the Linnean Society, I began to look into the struggles of early female botanists in gaining recognition in the academic world. Arber was amongst them. She was a botanist as well as philosopher with wide cultural interests, who although the first female botanist to become a fellow of the Royal Society, and who lived and worked in Cambridge, never held a University appointment. At one stage she was offered accommodation in the Botany School, but she declined this as it was in the Botanic Gardens at the end of the city to her home on Hills Road and would have been logistically inconvenient as a widow with a small daughter. Instead, she worked at home where she converted a maid's bedroom into a laboratory. Her brilliance had been recognised when she was still at school by another pioneering woman botanist fellow at Girton, Ethel Sargent. The Girton archive holds a series of fascinating letters sent by Sargent to Arber, and kept by Arber (the remainder of her archive was sadly sent to the Hunt Botanical Library in Pittsburgh). Sargent had destroyed all her replies but from the letters we get a glimpse of the struggles of a married female scientist and the hostility of the male community. This was particularly apparent when Arber was nominated as President of Section K (Botany) for the British Association for the Advancement of Sciences annual meeting in Edinburgh in 1921, when a group of male botanists (some of my botanical heroes among them!) united to oppose her. There are records of letters with comments to the effect that 'it would be an insult to Balfour and Edinburgh to have to deal with a woman with inferior academic

qualifications', while Bower wrote of the dangers of a 'female gynocracy'. We would have a lot to talk about not the least her interests in plant morphology and development. If I had to choose a man to meet then that would be John Lubbock, but that is another story.

Is there too much emphasis on big data collaborations as opposed to hypothesis driven research?

There is a need for both and in particular in this genomic phase of molecular biology big data collaborations are the obvious way forward as indeed they are in my own field where assembled data can be effectively used to answer the big 'sexy' questions. However in my own research funding requests are not so much via testing of hypotheses, but in the generation of data. This is where I would make a case for up front funding for fundamental discovery science per se (not dressed up as futile hypotheses) to finance the data gatherers and particularly for technical support and basic infrastructure. As an example in Devonian palaeobotany, in Munster a technician has been employed over tens of years to produce thin sections of fossiliferous chert which have led to major advances in the understanding of early terrestrial ecosystems, including the life cycles of tracheophytes, and plant symbiotic relationships with lichens, mycorrhiza as well as terrestrial and aquatic arthropods. In my own case, I cannot overestimate the SEM technical support from Lindsey Axe, a school technician available even when I had no grants, and without whom my career would not have been as productive or successful. Finally big data analyses are only as valuable as the quality of the data they rely upon. What is the use of

sequencing an organism of dubious identity?

Is there a need for more cross talk between biological disciplines

Attitudes are changing fast. While a primary concern for me is the description of the nature of early vegetation, a major aim to reconstruct their activities as living organisms requires collaboration with neobotanists and in particular plant physiologists – this having been done at a personal level with John Raven, but attempts to seek funding from the BBSRC have been unsuccessful, because I work in fossils, which is NERC territory. The advent of genomics and its application to consideration of physiology, development and phylogeny of early land plants is already building bridges, as demonstrated, for example by Liam Dolan and his research group in Oxford. There is also the need for access to equipment for both imaging and chemical analyses.

But there remain problems of attitudes within the biological community itself – particularly as biomedical disciplines merge with more traditional biological ones and organismal biologists sometimes appear to be fighting a rear-guard action against molecular colleagues. Such conflict is fuelled by the use of bibliometrics in assessment of research quality and a lack of recognition that one size does not fit all when evaluating small communities, where outputs may be better suited to low impact journals. I (perhaps naively) have been astounded when sitting on various award committees at the ignorance of some, usually younger, members who still equate excellent science with high incomes and h indices – an attitude now very

much in evidence at University level as they cherry pick for REF returns – now there's another hobby horse!

What would I most want to know.

Of course I want to find out if life exists elsewhere in the universe, but despair when I read time and time again in grant applications that we seem to need to justify fundamental research on life on this planet to facilitate evaluation or detection of life on Mars, which at best will be at microbial level. I want to know about the origin of life on Earth and, closer to home, the nature of land vegetation before the dominance of vascular plants (through the discovery of megafossils yielding anatomical as well as morphological information) and its impact on lithosphere and atmosphere.

What advice would you give to young biologists?

Keep your options open as long as possible. Never choose a pathway where you have doubts or dislikes. Keep up with the physical sciences and maths. Enjoy your PhD. Read Jane Austen for succinct prose.