



BEAUTIFUL MINDS

New chief scientific adviser on releasing children's power of reasoning

By William Peakin

In that enduring parlour game of nature versus nurture, Muffy Calder might at first blush fall into the latter category. Calder's father was an engineer: "He couldn't pass anything by without thinking - and discussing with me - how it worked. He was a chemical engineer and he would talk about creating things that would mimic nature."

When she was 10 they built a computer together. But there is something that suggests nature could have an equal claim; as a baby she would take great joy in unscrewing the bolts of her cot. And, a little reluctantly, Calder offers an anecdote which underlines an early determination to follow a scientific path.

"When I was about 9, I had a couple of terrapins and they died. I thought I was going to be really scientific; I would bury them and conduct an experiment to record the rate of decomposition. I had my 'lab book' and this idea that I was going to be a scientist."

Calder buried her former pets in a plastic bag, marking the spot with stones painted with glow-in-the-dark paint. Perhaps expecting to witness a gradual and elegant biological process, 24 hours later she disinterred the terrapins: "It was just revolting; two shells and the feet and the head swimming around in liquid. An amazing amount of decomposition in such a short space of time!"

Eschewing a career as a biologist, Calder became entranced by calculus: "To be honest, I didn't care what anything meant; I just wanted to push symbols around. It was the power of being able to compute, regardless of what they meant; it was a process I absolutely loved."

Calder shined at the comprehensive school she attended, taking her first Higher equivalents at 14 and continuing to amass a series in both the sciences and the arts over the next few years. At Stirling University - chosen for its location more than anything else - she did maths and computer science.

This being 1976, computing was still a rudimentary process: "A man would arrive with a suitcase, take all our punch cards and cycle across the campus to another building and our programmes would be run overnight. I didn't quite get what compile time was!"

But as computing power followed Moore's law, Calder embraced the rapid workflow that came with digital experimentation: "It was this instant feedback; you could construct this wonderful thing in your head and you didn't have to wait two weeks for a result. And we were doing all these things from scratch."

Writing her first interpreter - a programme that executes computer code - Calder saw the beauty of programming language, marvelling at the brilliance of Alan Turing's eponymous machine and the notion of a computer as "just a big mathematical function; it takes an input and produces an output. Brilliant!"

With a BSc in Computing Science from Stirling, Calder went on to gain a PhD in Computational

Science from St Andrews University. "That was the making of me," said Calder. "My supervisor was just superb and he drummed into me the importance of rigorous thinking. He taught me to think about my arguments and that every word counts."

With cleaning and shop jobs to pay her way, Calder had also begun to build the early stages of her private sector technical career; working for the British Ship Research Association, located in Newcastle's Swan Hunter shipyard, and Burroughs, the computer company which became Unisys, in Cumbernauld. There were stints too with BT Research Laboratories and - in Palo Alto, California - DEC (Digital Equipment Corp) Research Labs.

By this time, Calder had embarked on what has been a 20-year career with Glasgow University, culminating in her becoming Professor of Computing Science and Dean for Research in the College of Science and Engineering.

Her research has focused on modelling and reasoning about the behaviour of complex software and biochemical systems using

computer science, mathematics and automated reasoning techniques.

She has developed and used a variety of process algebras, temporal logics and model-checking techniques to solve problems in a range of systems, from telephone networks and communications protocols, to domestic home-care systems and intracellular signalling transduction pathways that contribute to diseases such as cancer.

Calder has collaborated with scientists and engineers from a wide range of disciplines, from electrical and aerospace engineering to cancer and cardiovascular medicine.

On her recent appointment, Glasgow University's principal Anton Muscatelli said: "Professor Muffy Calder is an outstanding scientist and brilliant communicator, and she is an excellent choice as Chief Scientific Adviser for Scotland."

Calder said: "The world faces many scientific challenges in areas such as environment, software systems, and health and wellbeing.

"In Scotland some of the world's best scientists and engineers are working to tackle these problems, and I am proud to be part of the country's thriving scientific community. I look forward to ensuring our scientific research and industry continues to flourish, and that the Scottish Government gets the very best advice."

She said she wants to "put science at the heart of government. By that, I mean recent advances in science and potential advances; making sure that government knows where science is going and what the policy implications might be. But as well as scientific knowledge, I want to see scientific method at the heart of government also; using evidence and using reasoning."

Calder's other key ambition is for science as a driver of the Scottish economy. From that, she said, many other issues flow, such as education. This prompted me to ask her whether she felt a tension between her professional discipline and her wider role to promote the sciences in general: "I do. You can tell I'm passionate about computing and there is so much to be done. But all sciences need care and attention; I'm very aware of that.

"But the one area where I believe there is a difference is computing science in schools; it is just not represented properly alongside the other sciences. There is serious work to be done, but this is the time to do it; the Curriculum for Excellence is just a fantastic opportunity."

She is optimistic about new computing science resources for teachers and pupils, to be unveiled this autumn, which have been developed under the auspices of the Royal Society of Edinburgh and the BCS Academy of Computing: "The work that has been done is fabulous."

Calder said: "I don't have any qualms about wanting to elevate computing science to the status of maths or history."

With that, she readied for a flight to London - for a meeting with the UK's chief scientific adviser Sir John Beddington - during which she intended to continue reasoning: "I've got a problem that I'm working on; I scribbled it down this morning and I'm going to work on it during the flight. That's the beauty of computer science; a lot of it's in the head."

ABOUT MUFFY

- Calder is a Royal Society Leverhulme Research Senior Fellow and Royal Society Wolfson Merit Award Holder.
- She has been an academic at Glasgow University for over 20 years, and previously worked at the universities of Stirling and Edinburgh.
- Her career has involved collaborations with many world-leading companies.
- Previously, she was head of department, chair of UKCRC (UK Computing Research Committee), member of EPSRC TOP (Technical Opportunities Panel) and the Scottish Science Advisory Committee, and senate assessor on court.
- Currently, she is chair of the BCS Academy of Computing Research Committee and MSc external examiner at the University of Manchester. She is a past external examiner for degrees at the universities of Warwick, St Andrews, Edinburgh, and NUI Cork.
- Calder has over 75 scientific publications and has been awarded 18 external research grants. She has supervised 13 PhD students and nine postdoctoral research assistants.
- She is a Fellow of the Royal Society of Edinburgh, a Fellow of the British Computer Society, a Fellow of the Institution of Engineering and Technology, and was awarded the OBE for services to computer science in 2011.