profile: Diana Bailey

PhD takes historic test

Ayala Ochert meets a physicist who takes motherhood and a career in her stride.

Greg Smolonski

Diana Bailey with Elinor, who at five days old accompanied her to a viva.

As I sit talking to Diana Bailey about the use of optically stimulated luminescence (OSL) in archaeological dating – the subject of her recently completed DPhil at Oxford – she chats effortlessly while alternately bouncing, patting and breastfeeding her five-month-old daughter, Elinor.

Towards the end of our conversation we're joined by her four-year-old daughter, Imogen, and she carries on while fielding questions from the older girl. It should come as no surprise that she manages it all so skilfully – she is, after all, the only person in Oxford's history to have taken her viva with a five-day-old baby in her arms.

Bailey has never settled for doing just one thing at a time. "I like to go in more than one direction," she says, explaining why she chose to study archaeology and Celtic civilisation as part of her MPhys at Edinburgh while most of her contemporaries chose related subjects such as meteorology or geophysics. "I always wanted to do something totally different and use different skills."

While physics was her main passion, archaeology held an interest for her from the start: "I've always been fascinated by the actual artefacts. I remember my geology teacher at school bringing in a flint arrowhead, and it was just mind-blowing to think that you were picking up this thing that someone made so many years ago. I think it's that actual physical connection to the past that fascinates me."

She began a PhD in luminescence at Lancaster. Then, one day while flicking through a copy of *New Scientist*, she came across an advert that read as though it was written for her. It was for a DPhil studentship at Oxford's Research Laboratory for Archaeology and the History of Art, developing the new technique called linearly modulated OSL for dating archaeological finds. Having studied physics, archaeology and luminescence, she was uniquely qualified for it. At the same time, things were not really working out at Lancaster. Switching PhDs was tricky, but she navigated the bureaucracy, and in October 2002 she left for Oxford with her soon-to-be husband Alun Morgan, a physicist whom she met at Lancaster. "It was a really good year personally but not particularly academically," she laughs.

OSL works by measuring the amount of radiation absorbed by quartz crystals, which are found in all soil samples. Defects in the crystal structure act as electron traps, and these fill up over time unless they are exposed to sunlight. When they are dug up and exposed, the traps are emptied, emitting photons, which can be used to measure how long the sample has been buried. Linearly modulated OSL is a new technique that breaks down the signal into fast, medium and slow components. Bailey worked on a programme to automate this method so that it could potentially be used for more accurate dating than is possible with standard OSL.

Just as she was settling into the second year of her PhD she discovered she was pregnant. She took eight months' maternity leave then went back full time, but was reluctant for Imogen to go into a nursery. "I really didn't like it when she was that young. I had this overwhelming feeling that she should be brought up by me."

Luckily, both she and her husband, who works at Harwell's new Diamond Light Source, had completely flexible jobs. Alun worked three long days while she looked after Imogen, and he worked two short days when the baby was in nursery. Bailey worked two days in the lab and fitted the rest in during evenings and weekends.

Illness pushed back her thesis deadline to the end of February this year, then Elinor was due to be born on 11 May. Bailey put in a request for early examination so that she could sit her viva before this happened. "Time went on and I didn't hear anything. Then I got a call on 21 April saying: 'We can offer you a viva on the 30th'." She called back to accept. However, at 5.00 am on 23 April the initial stage of birth began. "I couldn't even think about the viva; I had to focus on what was happening with the baby first," she recalls.

"I was in that superwoman phase that you get after a good birth."

Elinor was born on 25 April, and on Monday 28 April Bailey called the internal examiner to tell him the news – and to say that she wanted to keep the date for the viva two days later. "I was in that superwoman phase that you get after a good birth. I thought to myself it's going to be so much harder to do in a month than it is in two days. I'll be a month more tired and the baby will be a lot more demanding. So I said to him: 'We do it this week or we do it in six months'."

She went along in her *subfusc* – the black formal attire that Oxford DPhil candidates must wear during their viva – with her five-day-old baby in a sling under her gown. "It all worked out fine. It was a three-hour viva and she slept for two hours, fed for a bit and then she just sat on my lap and had hiccups. It was a totally surreal day – it was her first weigh-in and then my viva in the afternoon. It'll be a good story to tell her one day."

Bailey plans to stay at home longer this time to look after her second daughter but is not sure of her plans beyond that. "I've never had a career plan. I've been really lucky in that I've always been able to do what's interested me – from the physics degree to doing the right PhD, to being able to spend time with the children."

OBSERVATIONS

Paul Campbell, a reader in physics at Dundee University, describes what happened when a sixth-former came to his department to do a project on ultrasound.

Winter 2007

I get an unusual enquiry from Grant McAllister, a teacher at nearby Bell Baxter Academy in Fife. One of his sixth-form students, Megan Griffiths, is looking to undertake her advanced higher physics (AH) project somewhere with a distinctly medical feel to it. Can I help? In previous years, the answer might have been a polite "No" based on the available manpower and time constraints. However, my biomedical physics research group has swelled significantly, and the opportunity to engage with school outreach activities has significant appeal on multiple fronts. So I request some guidance on the project requirements and assessment criteria because it is the first time that I've been involved with one.

January 2008

Having read the criteria, I try to level these against my research area (the application of ultrasound to deliver drugs into tissues). There's a need to optimise exposure so that any damaging effects from excessive heating are avoided. I figure that using thermal imaging to monitor heating could make for a neat, self-contained study, embracing the various wave phenomena outlined in Megan's AH physics syllabus. I e-mail copies of some relevant papers to her with a request to mull them over. We also arrange our first meeting – ostensibly a "hello there", but also to ascertain her aptitude and aspirations so that the objectives can be pitched sensibly.

Early February 2008

Megan turns up right on time, and is clearly *au fait* with the literature I'd e-mailed. Moreover, she has several further considerations, which we discuss at length. Her heart is set on reading medicine at university, and I'm impressed with her confident attitude towards the achievement of that goal. We agree to an initial week of familiarisation exercises before the real experiments begin. This will allow her to get to know the kit, my team and the various safety issues.

Late February 2008

I'm approaching the laboratory to check on progress, but stop short of the open entrance when I hear voices within. The main one issuing instructions is Megan's. Operating the kit and synchronising data acquisition is a three-person job, and she is informing both my senior technical assistant and a PhD student that her way is best. Her authoritative tone suggests that I should leave them to it. At the end of the day, Megan drops by to bring me up to speed with progress, and to discuss a few extra potential experiments. The rest of the project runs smoothly, with plenty of quality data generated for analysis downstream. The unique and exciting nature of our new interaction, which would normally be conducted solely at the student's school, is captured by the photographer of a local newspaper, which also runs a short yet informative piece on the science involved.

March 2008

A copy of Megan's project report arrives. The presentation is superb and the treatment of errors is especially thorough. An accompanying thank-you note says: "I absolutely enjoyed the project – it has been a fantastic experience." This is a very rewarding personal moment for me.

August 2008

With examination results announced, I hear that Megan has aced her project with an incredible score of 25/25 – the first time that anyone from her school has achieved a maximum. Moreover, she's off to read medicine at Edinburgh University as planned – the icing on the cake. For me the experience has been just as rewarding and it has underscored the power of outreach activity to effectively help youngsters to achieve their dreams. Future activities are being planned to approach and engage with schools in a much more proactive way.

If you would like to contribute to **OBSERVATIONS**, e-mail your idea to interactions@iop.org.