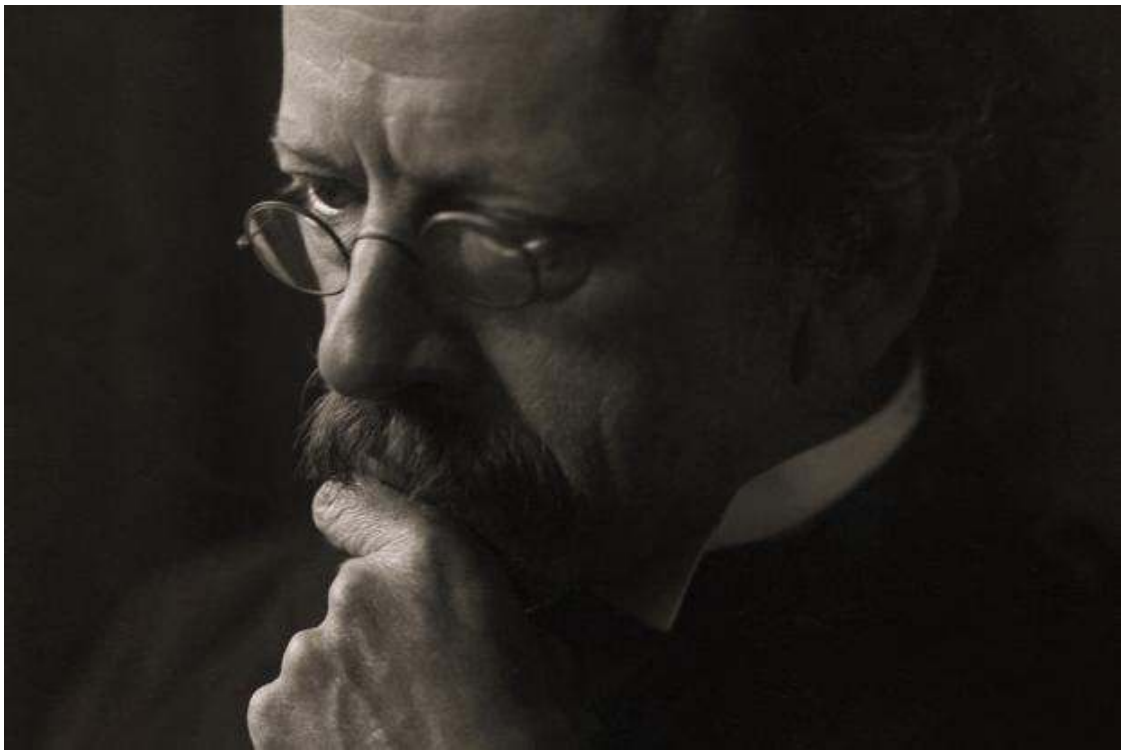
THE TIMES

The Cavendish and me: a Nobel tradition



Sir Joseph (J.J.) Thomson, 1924 E.O. Hoppé/CORBIS

Alice Thomson
Published at 10:00AM, September 1 2011

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Beside my bed sits a small glass dog, a Dalmatian puppy, with a mournful expression, brown floppy ears and a matching tail. He is only an inch long but perfect in every detail. My mother has a menagerie of these glass animals — penguins, cats, lions and dolphins, all delicately blown from glass. As a child she would go to the Cavendish Laboratory in Cambridge after school where her father was Professor and the glassblower would keep her entertained creating these miniature creatures.

Other people's families have houses, heirlooms or histories that bind them together; my family has a science laboratory.

I would never have been born without the Cavendish. My great-grandfather on my father's side, J. J. Thomson, became Professor at the Cavendish in 1884 while in his twenties. There he met my great-grandmother, Rose Paget, one of the first female students allowed to attend lectures. While he was encouraging her in her research on the stationary vibrations of soap films by audible sound waves, they fell in love.

They had a son, G. P. Thomson, who also became a scientist and worked at the laboratory. His colleague at the Cavendish was a man called W. L. Bragg who eventually took over the Cavendish professorship (after winning a Nobel prize with his father, W.H. Bragg, who was not a Cavendish member). Their families became great friends and their youngest son and daughter married each

other. David and Patience were my father and mother. They spent their childhoods running between benches and Bunsen burners, the pews at their wedding were filled with Cavendish researchers.

Yet, until this year, I had never been to the Cavendish. Most people have never heard of it, yet it's the most successful lab in the world, producing 29 Nobel prizewinners — more than Russia, Japan or Sweden has in every field. It was there that J. J. Thomson discovered the electron and Ernest Rutherford artificial nuclear fission, Francis Aston worked on the isotopes of the chemical elements, James Chadwick discovered the neutron and John Cockcroft and Ernest Walton proved experimentally that E=mc 2. My grandfather, W. L. Bragg, was Cavendish Professor when Francis Crick and James Watson determined the double-helix structure of DNA in 1953.

The Cavendish is still creating Nobel prizewinners, pushing forward boundaries, establishing new records, but it doesn't promote itself. It has no press office, spin doctors or lobbyists. It seems quaintly British, almost embarrassed by its success. The only time the laboratory is mentioned is in the obituary columns — most of Britain's greatest scientists have used its facilities. When I rang to arrange a visit, they sounded surprised, but warm. My parents decided to come, too.

Professor Malcolm Longair, who looks after the historical artefacts in the laboratory, offered to take us on a tour. Wandering around the buildings, the first piece of equipment that we stumbled across was the perfectly blown glass apparatus that allowed J. J. Thomson to discover the electron. Standing at the end of another corridor was the original double helix, the foundation of life, looking like a Damien Hirst sculpture. You wanted to stroke it, admire it, take it down and rebuild it, protect it from the students swarming around it on their way to lectures.

The current Cavendish Professor, Sir Richard Friend, is working on the development of polymer field-effect transistors, light-emitting diodes and photovoltaic diodes. More tangibly his research has been used to develop flat panel displays and screens that can be rolled and transported, and he has founded companies, including Cambridge Display Technology, to market his technology.

He is not a precious or pompous scientist and he thinks that the Cavendish should cover everything, from grand projects to the very small. "Physics is about picking up almost anything, looking at it differently and making connections you can quantify because you can do the mathematics and get a secure level of prediction." His leaning is towards more sustainability. "There is no research topic called 'green' but it now informs everything we do. We do try to apply our science to the conundrums of day-to-day life, too."

In my grandfather's day, he was asked to find a scientist who could create a drip-dry, non-iron material. It took him ten years. Sir Richard approves: "There is nothing wrong with commercialisation. We have seen huge benefits from pooling resources with industries; we can give them patents, they can give us machinery. It's the intellectual engagement and cross fertilisation that makes it work, rather than the money."

This is partly what makes the Cavendish attractive to the stellar graduates. They are allowed to roam as they please across disciplines and given time to think. "This is a safe place to take big risks. I believe that passionately," says Sir Richard. He is more worried that the public have been left behind. "The scary thing is that most people don't know much about physics because it is too complicated, and we need to take them with us."

There are 65 teaching staff, 150 postdoctoral fellows and 250 undergraduate students at the Cavendish. The graduates are the most highly sought-after in Britain, attaining almost full employment every year — everyone wants a Cambridge physicist. According to The Times Good University Guide, the Cavendish ranks the highest in overall performance.

The Cavendish was opened in 1874. At the University of Cambridge it was only after the Great Exhibition in 1851 and the advancement of the Industrial Age that they decided they needed a

dedicated experimental physics laboratory, and the Chancellor, William Cavendish, the Duke of Devonshire, gave £6,300 to build it.

James Clerk Maxwell, the first Cavendish Professor of Experimental Physics, had been appointed in 1871 and the lab soon became known as the nursery of British genius.

Now, the laboratory covers high-energy physics; astrophysics; atomic, mesoscopic and optical physics; biological and soft systems; material physics; optoelectronics; microelectronics; quantum matter; semi-conductor physics; the theory of condensed matter; nanotechnology; cold atoms and ultra-low-temperature physics.

Dr Mete Atature, a Turk, is one of its most promising stars. Feted by every university, he chose the Cavendish because "it is incredibly supportive to the youngest scientists, they let us excel. We don't feel we have to negotiate what we do. We are trusted to do our best."

He has managed to calculate the spin of an electron at the time it was emitted by spinning it himself. This takes a vast room full of equipment and is at the forefront of quantum physics. "Instead of trying to observe the dynamics, I can now control and enforce certain dynamics. I want to see if we can tailor materials to behave in a certain way."

The Cavendish has always been an international group. My grandfather was from Australia; Lord Rutherford was a farmer from New Zealand. Now, the best brains are coming from Eastern Europe and Asia, and the Cavendish is worried that government visa restrictions will hamper its gene pool by preventing scientists coming here from India and China.

Girls have belatedly been included — Dorothy Hodgkin, a one time member of the Cavendish, won the Nobel Prize for Chemistry in 1964 for her work on Vitamin B12. Today, Professor Val Gibson of the high energy physics group and Dr Erika Eiser of the biological and soft systems sector, both brilliant scientists, meet us for lunch. They agree that it is still hard for women in physics. "Some researchers get so involved in their work they have to be prompted to eat. They just forget dinner. You can't do that with small children," says Professor Gibson. "It's still a struggle to outperform at the top end if you want a family too."

Dame Athene Donald, Professor of Experimental Physics, is acknowledged as one of the world's top scientists for her work in unravelling the mysteries of the physics of "messy materials", as she calls them. She studies soft materials, from plastics to cement, starch and ice cream. "I was the first female lecturer, the first female reader, the first female professor, so in some senses I am slightly odd," she explains. "My husband had to be a very hands-on dad.

"But the biggest difference hasn't been the arrival of women, but the size of the new Cavendish [it moved into this concrete labyrinth in 1974]," she adds. "It's too big now to bump into each other in the canteen and the increased specialisation means it's almost impossible for me to go into another lab and make a constructive comment. We all work in our own little worlds."

The Cavendish, however, mustn't become too cut off, according to Sir Richard. "We should make more of our alumni who have used their physics training elsewhere, such as David Harding [a Cambridge graduate, who is the highest-earning man in the City running one of the most successful hedge funds]."

But the institution has always tried to be open, even if it doesn't promote itself. In the 1950s, it held open days for the public. "I remember going to one where the chemist Max Perutz explained glacier flow using a huge pink blancmange," my mother told me. Now the Cavendish brings many hundreds of GCSE students from local schools to the annual Physics at Work event.

The decline in numbers of those taking Physics A level is a real concern. "The combined science GCSE has not helped physics," says Sir Richard. "You can't roll biology, chemistry and physics into

one. It's like asking the English teachers to teach French and Latin as well."

Science in Britain, he continues, relies far too much on the independent schools sector, which can teach the subjects separately. "The country needs more physicists, and to get them we need to offer full access to physics and maths A levels for all students."

But the Cavendish is still producing some of the best work in the world. "We don't employ anyone full time who isn't a potential Nobel prizewinner," admitted one of the professors. "You need to wake up every day wanting to discover something new."

Money, of course, is the question that hasn't been raised yet. The Cavendish couldn't command the same kind of money as CERN or Harvard until last year, when David Harding decided to donate some of his money to his old university to back research into sustainability, including new energy-saving materials and energy storage, and "to create a new generation of Nobel prizewinners".

Last year, Harding explained his motives. "I asked them how much it would cost to do a start-up programme and they said it would be £2 million for a world famous professor, his lab and four students. I said, 'I'll take ten'."

It is still cheap physics compared with CERN's £6.2 billion Large Hadron Collider near Geneva, but the Cavendish has repeatedly proved that it is ingenuity rather than money that counts most.

A huge new Physics of Medicine building is being built to house researchers from across the physical and biological sciences, clinical medicine and engineering.

At the end of the day we return to the workshops to watch the technicians. My mother explains that she used to love to collect glass animals. Now, the glass vacuum pumps are made of stainless steel and the mercury has been swapped for silicon oil. But there is a man who worked with my mother's friend, the glassblower — and yes, he admits, he can still blow a perfect giraffe.