

# COMPETITIVE SPIRIT

## SARAH SPRINGMAN CBE FREng

A pioneer of triathlon, Sarah Springman received a CBE earlier this year for her services to sport. She has combined her international athletic achievements with a distinguished career as a civil engineer, working on projects around the world, and is renowned for her research and teaching in soil mechanics. Michael Kenward OBE talked to her at Gatwick airport as she flew back to Switzerland, having given a series of talks in the UK.



Sarah Springman with the centrifuge at the Swiss Federal Institute of Technology, 1999

Sarah Springman has managed to combine a passion for international sporting competition with a distinguished engineering career. A civil engineer by training, she started out working on the design and construction of dams in the Pacific, spent time at Cambridge as a young academic before joining the respected civil and environmental engineering departments at the Swiss Federal Institute of Technology in Zurich. She has been Head of the Institute twice and is currently on sabbatical.

### EARLY INSPIRATION

The discovery that engineering was for her came after O Levels during a school visit, at Marconi Elliott Automation Systems. "I came back from that absolutely convinced, aged 15, that I wanted to be an engineer."

A pre-university job with Sir Alexander Gibb & Partners (now part of Jacobs) introduced Springman to the world of heavy civil engineering, which was to dominate her early career. As a Cambridge University student, she continued to spend her vacations working at Gibb on international

projects – ports in Mombasa and sugarcane sheds in Mauritius as well as the Kiri dam in Nigeria and the Monasavu dam in Fiji.

It wasn't until her second year at Cambridge that Springman found her true vocation. An undergraduate project in soil mechanics that won her an award and alpha plus marks in soil and geotechnical engineering persuaded her to change the direction of her career. "I discovered soil mechanics and that was it. It was the only subject area that I mastered instantly."

On graduating, Springman headed for Australia. Her student employer, Gibb, invited her to Adelaide to work on a novel diaphragm wall system for cooling culverts for a local power station. After more travelling, she reached Canberra, headquarters of Gibb Australia, where she worked on the Monasavu dam again, this time on the cost-benefit analysis of the project.

After coming back to work for Gibb in Reading for a year, she returned to Australia as quality control engineer for the Monasavu project making sure that the dam was built according to the spec.

The project was an unusual one for a young engineer, with an exotic location and fascinating technical challenges. It was a

great opportunity to develop her practical experience in soil mechanics. The dam was built with an unusually soft clay core made from halloysitic clay. The Monasavu halloysitic clay, she explains, had much more water in it than a typical clay core owing to the 5 m rainfall a year. This required the contractor to use especially light compaction techniques.

During her time off, Springman found excellent sports facilities in the construction camp, where she could hone her squash skills and go out running.

When her job came to an end, Springman stayed on in Fiji, working for the public works department and moving into the capital, Suva. There, she restructured the local soil testing laboratory and led site investigations on a couple of Fiji's 600 or so outlying islands, travelling out by steamboat and sleeping on the beach.

In 1982, after Fiji, Springman, still just 26, returned to the UK. Back with Gibb again, she knuckled down to prepare for her chartered professional review. While many people would celebrate completing their exams with a night on the town, Springman competed in her first triathlon, a sport that she had discovered from reading a running magazine.

She represented Great Britain in the triathlon at an elite level between 1983 and 1993, competing in the 1990 Commonwealth Games triathlon in Auckland. Career prospects were not, though, racing ahead quite as quickly as Springman's burgeoning athletic career.

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### BACK TO THE SOIL

A chance meeting with Professor Andrew Schofield FREng, who knew of her undergraduate work, brought a dramatic new opportunity. Professor Schofield, then head of the civil engineering group at Cambridge University, had pioneered the use of centrifuges in research in soil mechanics. Within a week, Schofield had raised a grant from the Science and Engineering Research Council and Springman soon found herself back at the engineering department, this time as an MPhil student where she quickly had to become an expert in modelling the influence of soil movements on structures using the university's 4 m-radius centrifuge.

One advantage of academic life soon became clear: it was much easier to fit in her parallel career as an elite athlete. Springman was European Triathlon champion in 1985, 1986 and 1988. "By the time I went to Cambridge I had been the top European finisher in the Nice International triathlon." This was probably the leading triathlon in the world at that

time. "So I had gone from being fourth in my first race to beating the woman who had won it."

Springman has fond memories of her time at Cambridge. She was appointed a research fellow at Magdalene College, a considerable achievement, as she recalls: "not many research fellowships were awarded to engineers at that time. Colleges mostly gave them to applicants from the arts or natural sciences."

### LOST IN TRANSLATION

In the early 1990s, her sporting activities raised a new challenge that Springman wanted to tackle. "When I was coming to the end of my time as an elite triathlete, I spent some time in Europe between two European championships and went to Switzerland. I was training from there and felt very embarrassed that I couldn't speak any German." This sparked off what Springman considers to be one of her most creative ideas about language teaching for engineers that came to her, as she says, "on a bicycle in between Switzerland and Germany".

Cambridge was about to start a new four-year engineering degree course. Springman went to Dr Ann Dowling, then deputy head of the engineering department, and suggested that the course should include languages for engineers. "She was very positive", Springman remembers, "and Professor Alec Broers, who was about to become head of the department, was instantly enthusiastic."

Springman was asked to sort it out. "I worked with Anny King and Edith Esch from the University Language Centre, who were great experts. We had a really fascinating project to manage." Cambridge University's engineering languages initiative continues to this day, with many more languages added to the original roster of German and French.

### SWISS OPPORTUNITY

Her next career move came through attending a conference in Denmark. Keen to promote the idea of women in engineering, the organisers had invited several women to chair sessions. "They paid our way and our conference fees. It was wonderful." Someone in the audience was sufficiently impressed – Springman had put in a lot of preparation, another constant in her career – he suggested that she apply for the position of Professor of Geotechnical Engineering at the Swiss Federal Institute of Technology (ETH) in Zurich.

Springman embarked on a bout of due diligence and careful preparation. She dropped in to the ETH on her way to a conference at Davos. The facilities impressed her. "They had none of the Portakabins in the courtyard that we had in Cambridge at that time and really fantastic facilities, masses of laboratories and all sorts of great opportunities and resources to do imaginative research."

Her application letter to ETH was, she admits "too long and a bit forthright", but it sparked off what turned out to be a protracted, but successful, process. Speaking to the selection panel briefly in German helped as did her preparation.

After a period of silence, with one of her contacts confidently predicting that he would get the job, Springman heard that she was on a shortlist of one. "I was invited to go for negotiation and that went well. I presented my plans for my lab and they gave me twice as much money as they had originally intended. That meant that I absolutely had to go, really."

A move to Switzerland meant giving up her lectureship at Cambridge for a short term contract in Zurich. "That was a bit of a leap of faith," she admits. But then professorships were few and far between at Cambridge.

In the event, in comparison with Cambridge's famously flat landscape, Switzerland, with its mountains, glaciers and rivers, offered some very different challenges in soil mechanics.

### VARIED PORTFOLIO

Today, Springman's team is actively involved in both local and international projects. She talks of having innovative ideas about how



At the Rüdlingen monitoring site in the Zurich Canton an instrumented test field has been established to create and measure landslides. In this picture a Geobrug net has caught an induced landslide



Sarah Springman CBE FREng on the Rüdlingen monitoring site by the River Rhine. Photogrammetry cameras and lights are mounted in the trees with water supply and sprinklers providing 24-hour rainfall

to learn more about the coupled processes in some gravity-driven natural hazards, for example the link between rainfall or freeze-thaw cycles and alpine landslides. These are topics where civil engineers with expertise in soil mechanics can play an important role in tackling the effects of climate change. Her team's work on alpine permafrost – combining the mechanical response to thermo-hydraulic stimuli – is well regarded. The wetter winters and warmer, drier summers that we can expect from climate change can create the right conditions for triggering surficial landslides by heavy rainfall, and thawing permafrost.

Springman's team has investigated rock avalanche and rockfall dynamics, improved cushion design for rockfall protection galleries and explored the effects of climate change on river levees - they also advise on flood defences for the Rhône. They have also undertaken significant work with geotechnical design in soft ground. This is important for piled bridge abutments, shallow foundations on layered soils and ground improvement with stone columns.

She has brought together multidisciplinary teams, for over half a dozen large field characterisation and

monitoring projects. These projects have produced valuable new insights into how we can identify and manage the risks from gravity-driven natural hazards such as landslides, debris flows and rockfalls.

Springman's research mixes field work on projects such as these with laboratory testing and computer modelling, in particular, centrifuge experiments. On her arrival at the ETH, Springman established a centrifuge team and helped to build a new centrifuge in the Institute for Geotechnical Engineering, which she ran for two spells between 2001 and 2011.

"Centrifuges are a great way of modelling the strains on scaled models of structures, trying out severe conditions without risking damage to structures or to the people working on them. Soil is a non-linear stress-dependent material, and so tests carried out on the laboratory floor on a model of a soil structure, like a dam, will not be representative of what happens when you build the real structure many times larger because the stresses in the model and in the field are not the same." Placing a model in a centrifuge means that you can replicate the stresses that affect full size structures. "You can fail a model to your heart's content

and no infrastructure is damaged, nobody gets hurt."

Springman warns that, like all forms of modelling, centrifuge modelling has its challenges, stressing the importance of linking centrifuge model test results with numerical modelling and real-world experience.

ETH's expertise in all aspects of soil mechanics attracts a steady flow of excellent PhD students, especially women. This is not, says Springman, a deliberate strategy on her part. "They just choose me." She says. "There is even an Olympic silver medallist (from the Beijing Games) in the team, Emma Pooley, who has taken time off her research for the London 2012 Games and she has achieved far more than I ever did!"

## DIVERSE TEACHING APPROACHES

Flexible teaching is a part of Springman's approach. She has encouraged this through further development of online teaching resources at ETH, something that she first worked on at Cambridge. "The idea was that students could use a blended learning approach. If they wanted to come to my lectures they could. If they wanted to watch my lecture videos or read my notes or a parallel textbook, written by the other lecturers, they could." And all this is done in German, which she learned as a beginner at the Cambridge engineering department and in the early months after arriving in Zurich. And there are now podcasts in English too.

Apart from the language, is ETH very different from Cambridge? Cambridge tends to have small teams with very few staff for each professor where the individual researcher at Cambridge will supervise their PhD students and then the infrastructure and associated staff are provided centrally. At ETH "professors have base-level funding to employ senior scientists, assistants, technicians and administrative people. I have a group of between 20-25."

Professors at ETH have to raise money to fund, particularly, research students and postdocs. "You're operating as an academic entrepreneur, doing your teaching, bringing in research funds, supervising your PhD

students, who are also earning a little bit more money and helping with the teaching." ETH also differs in being more practically focused, she adds. "The students are more useful to industry on their graduation than I was immediately after Cambridge, although Cambridge students catch up pretty quickly."

## IN THE NEWS

Throughout her time at the ETH, Springman has continued her sporting life and has developed stronger and stronger connections with the world of international triathlon. Her colleagues in Zurich knew little of this other world, however, and it was only when a local newspaper wrote about her recent CBE "for services to triathlon" that news of her international sporting life emerged. "I don't talk about it," she explains. "When I am at ETH I do my engineering. But when you are presented with a CBE by the Queen, you do have to tell them."

The coincidence of a sabbatical spell and the London 2012 Olympics has given Springman the opportunity to spend more time on her roles as President of the British Triathlon Federation and as Vice President of both the European and the International Triathlon Unions. When we spoke she was engaged in a concentrated bout of networking as a part of her campaign to get a new variation of the triathlon, a mixed relay, recognised as an Olympic sport and included in the Glasgow Commonwealth Games.

Does this sporting eminence have any impact on Springman's engineering career?

The sports world is very public, which means more media attention, for example. And unlike the academic world, with its individualistic style and small teams, in sports you need big-team leaders.

Springman has been a leader in that domain for some time. The organisation she is President of, the British Triathlon Federation, has won the Sports Governing Body of the Year Award twice during

her tenure, in 2010 and 2012. "At British triathlon level, I have been fortunate to have been able to put together a competence-based team and to practise my ideas on leadership and team building! A team of engineers isn't quite the same as a team of athletes, but both need this kind of clear-headed, goal-oriented management if they are to perform at their best."



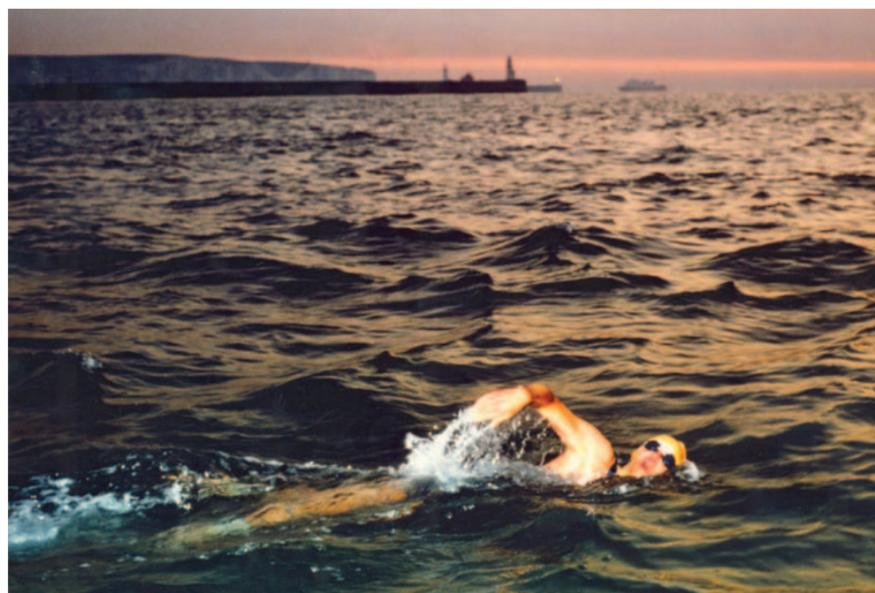
Sarah Springman (centre rear), is President of the British Triathlon Federation. The federation received the award of Sport Governing Body of the Year in May 2012

## BIOGRAPHY

Michael Kenward OBE has been a freelance writer since 1990 and is a member of the *Ingenia* Editorial board. He is Editor-at-Large of *Science|Business*.

## CAREER TIMELINE AND DISTINCTIONS

Born, **1956**. BA in Engineering Sciences Tripos, **1978**. MPhil, **1984**. PhD in Soil Mechanics Cambridge University, **1989**. Placements, **1975-1978**. Graduate Engineer, **1979-1983**. Sir Alexander Gibb & Partners, Reading, Adelaide, Canberra, Fiji. Commissioned Territorial Army, **1978**. Captain in Royal Engineers (V), **1983-1986**. Research Fellow, **1988-1990**. Assistant Lecturer at Cambridge University, **1990**. Lecturer, Cambridge University, **1993**. Professor of Geotechnical Engineering, ETH Zurich **1997**. Awarded OBE for services to sport, **1997**. Member of 'Geodesign' Commission: 'Swisscode', **1999-2003**. Head, Institute for Geotechnical Engineering, ETH Zurich, **2001-2005** (and again **2009-2011**). Member, Swiss Science and Technology Council, **2000-2007**. Member, EPSRC Peer Review College, **2006-2009**. Member, Swiss Platform for Natural Hazards, **2008-2015**. Elected Fellow of The Royal Academy of Engineering, **2009**. Awarded CBE for services to triathlon, **2012**. Research Committee and Search Committee for the Queen Elizabeth Prize, **2012**. Awarded Honorary Degree from the University of Bath, **2012**. Also: Chair, Technical Committee on Physical Modelling, International Society for Soil Mechanics and Geotechnical Engineering, **2005-2010**. Conference Chair and (Co-)Editor *Proceedings on Constitutive and Centrifuge Modelling*, **2001**, *Permafrost*, **2003**, *Physical Modelling*, **2010**.



Sarah Springman swimming the starting leg of the English Channel (13°C) during a 4-woman triathlon relay between London and Paris with Dover, England in the background, 1985 © Robert Garvey