The Accidental Statistician

During his long and distinguished career, **Sir David Cox** has played a substantial part in the development and growth of the discipline of statistics, but, as he tells Helen Joyce, he very nearly specialised in mathematical physics or analysis instead.

"I studied mathematics at Cambridge during the war, and at that time you had two years of exemption from military service—in certain subjects it was one year; in mathematics it was two years—and you had the right to go back and finish your studies after the war. At the end of the two years a group called the Joint Recruitment Board told you what to do and in my case I was sent to the Department of Structural and Mechanical Engineering, RAE [Royal Aircraft Establishment] at Farnborough."

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During his two years at Cambridge Cox had studied practically no statistics. "I did go to one short course which I didn't understand at all and I wasn't the slightest bit interested in!" But it was statisticians the government was looking for. "At that point there was an enormous shortage and it was assumed—wrongly—that anyone who did reasonably well at mathematics could pick up statistics in a couple of months or so."

Cox was at Farnborough for two years until 1946, when he was free to return to his studies. However, rather than go back to Cambridge, he chose to go to Leeds to do textile research with the Wool Industries Research Association. Why?

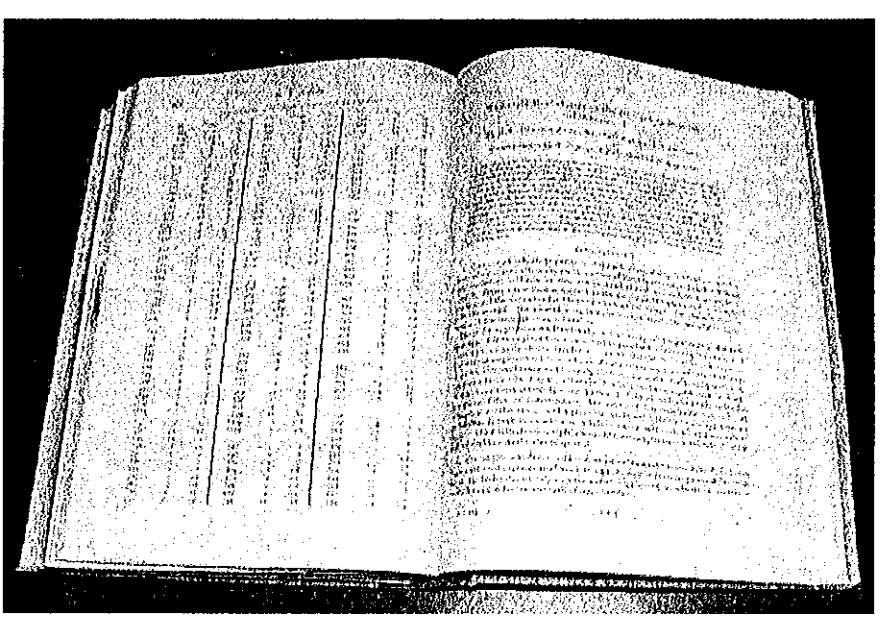
"Well, it's an involved story. There was one interesting thing I got involved with in Farnborough—something about spot-welded joints in aircraft—and I was in the library reading and I came across a paper by Henry Daniels[1] who had solved the same problem I had solved. He had done it very beautifully where I had been primitive and clumsy. As I walked out of the library, I saw an advertisement for a job to go and work with him, and I was so impressed with his paper that I immediately decided to apply for the job."

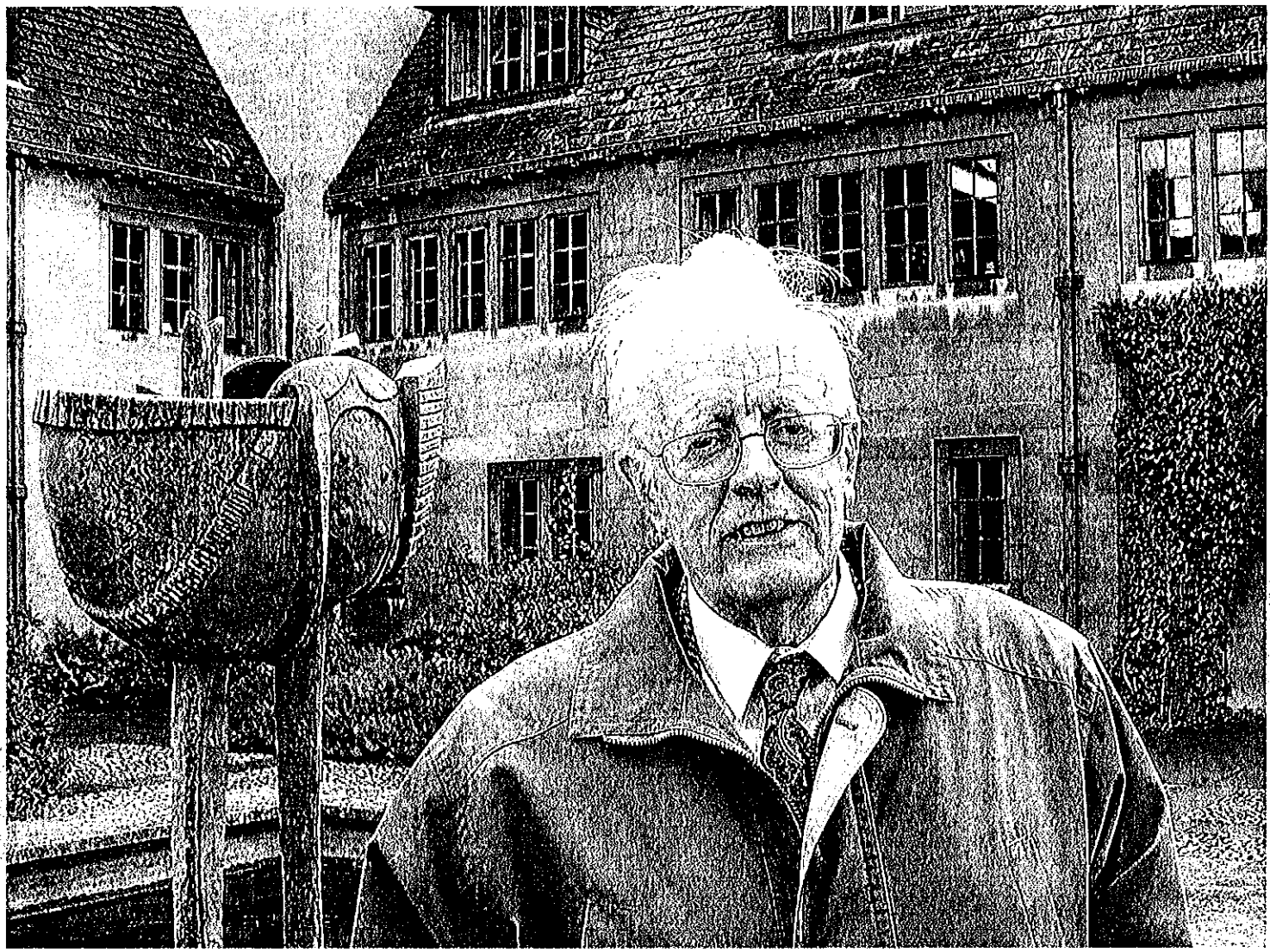
It was an impulsive decision, with far-reaching consequences. "It changed my whole life. Otherwise I would have gone back to Cambridge, and gone into either mathematical physics or into analysis." Cox worked at the Wool Industries Research Association for five years, during which time he was awarded his PhD, and, though the work was only partly statistical in nature, his career path now seemed set.

Theory and application

So why, after coming to statistics almost by chance, did Cox decide to stay? "I think its variety,

A life-changing read, by Henry Daniels





Sir David Cox at Nuffield College, Oxford

partly. There is the mixture of theory and application, and so many different fields of application." He points out that one of the most interesting aspects of the study of statistics is the possibility of switching between theory and application, and also of switching between radically different spheres of application, with relative ease. "With statistics, many people, as they get older, become relatively more interested in applications than theory. I started in applications, and then became more interested in theory, and then became more interested in applications, although I don't separate the two, really."

Indeed, for Cox, maintaining a good balance between theory and application is paramount. "There is a place for pure theoreticians, and obviously there's an enormous place for people who specialise in applications, but the subject as a whole needs some interplay. It is very difficult because, if it doesn't happen, it's not easy to see what to do about it. About 25 or 30 years ago, almost all the best students wanted to work on theory. If it was theory that could be applied, great, but application was not primary in those days. Now it's very rare to get a student to come along and say, 'really, I'd like to do a PhD on theory'. They all want to do medical statistics, finance or whatever, partly because they'd like to do something useful, which is wholly admirable, and partly because they feel they can see a career path, which is wholly natural. It would be good if there were a few more doctoral students saying that they'd like to continue for a while to do some theory."

This leaning towards one aspect or the other, although relatively recent in the UK, has long been more common in mainland Europe. "All these subjects are wholly international, but there are special flavours in different countries. And the tradition in British statistics has always been, throughout the previous century, to have some blend of theory and application, whereas in Europe it has been either relatively descriptive—in economics or medical data processing, for example—or very high powered theory, but little middle ground.

"It's possible it goes back to when Newton and Leibniz quarrelled. That led to, up until the 20th century, British pure mathematics being virtually isolated from continental pure mathematics. People like Cayley, Sylvester and so forth did a lot of work in algebra in the 19th century, but you don't find an analyst or topologist in this country.

"On the other hand, British applied mathematics, i.e. classical mathematical physics, was enormously strong. Now there you have a mixture of a certain kind of theory and applications. And I think that from there came the tradition of British statistics. Or you could say there's an empirical British

tradition, as compared with, say, the French or German more academic, more philosophical, tradition."

Looking to the future

Moving back, then, to the 21st century, there are several pressing issues facing statisticians today which Cox feels have a direct impact on the future of the subject. "The thing that has had the biggest impact, and that I have had the least to do with, is computers. I would like to think it has not changed the principles much. On the other hand, of course, it does change data collection and storage and has totally altered the tactics of data analysis as well as leading to many fruitful new ideas." Does he feel worried by the ubiquity of computers? "Purely personally, yes, because I feel so helpless! One more general aspect that worries me is that some people talk about the information explosion, because they've got lots and lots of data...but it's not an information explosion; it's a data explosion, which is not necessarily the same thing. I think that can get overlooked."

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Another major issue that statisticians have to deal with—and this is, unfortunately, nothing new—is the problem of image. How do you convince the public that statisticians are not simply dry, colourless number-crunchers but dynamic, creative scientists in their own right? Cox's answer is straightforward and prosaic. "Do good work and make sure people know about it. Just press on. A big advertising campaign on the telly wouldn't do the trick. It's not a question of evangelising; it's a question of working quietly with people, implicitly persuading them to incorporate statistical thinking."

It's also a question of introducing students to statistics in the right way. "The first thing must be to make sure that the first course in statistics that a student gets at university is really bang on. But that is very difficult. What do you emphasize? Do you emphasize the mathematics, which will attract some people and put off others? Do you emphasize the applications, which will attract many people? Do you emphasize the computing, which will attract some people? Do you emphasize the philosophy, which will attract other people?

"My own feeling is that you should think about the particular group of students you have and tailor something to them. But, also, have the first course taught by enthusiasts. It's a long haul, but I think there is a determination in the UK to do this. The pernicious system you sometimes find for example in the United States, where these large introductory courses are given to inexperienced teachers, and the senior people teach the specialised courses—that's often the wrong way round. By and large the young people should teach the specialised courses and the more experienced people should teach the first courses, because, if the students start badly in any system of options, they may never get to the second course."

Life as a statistician

Assuming, then, that budding statisticians do make it through to the second, and subsequent, courses, what should they be doing once they've qualified? "I think the most important thing is for statisticians to work with very good scientists, or more generally with very good people in whatever field." But working how? Cox makes a distinction between collaborating and consulting. "Consulting can mean somebody comes in and you say, 'why don't you try this or that?' and they go away and you never hear from them again. Now, that might have been very helpful to them, but that's very different from collaboration, which is finding out quite a lot about the field yourself so you can have a discussion on the scientist's terms. There is, of course, a strong tradition of exactly this in medical statistics.

"There is some pressure, and it's almost a moral obligation, to help people out a bit if they've got in a mess. If someone's done a poorly designed experiment and has to be semi-rescued, some people see a statistician as a resource to go to. Okay, there is some obligation to help, but I suspect too much time of university statisticians goes into that, rather than finding the best people to set up collaborations with."

So the status of statisticians should be such that they naturally work as equal partners with other scientists right from the start, rather than being brought in only when things are looking bad. It is an attractive riposte to an attitude among some scientists that Cox describes as "'If I need statistics, I've done my experiment wrongly'—that kind of thinking is still around."

If we are ever to see the science of statistics taken as seriously as it should be, not only must those who need statistics, and those who need statisticians, understand its value, but so must statisticians themselves. By way of example, Cox tells the following story: "We had a visitor years ago, a very famous decision-theory-oriented statistician, and he had to decide what accommodation to choose from what he was offered. Somebody said to him, well, you are an expert on decision theory; does not that help, and he said something like: 'Oh, I don't use decision theory on anything as important as where I'm going to live!' I don't think he was joking either...."

Sir David Cox during his presidency of the Royal Statistical Society

Reference

1. Daniels, H. E. (1945) The statistical theory of the strength of bundles of threads. *Proceedings of the Royal Society*, A, **183**, 405–435.

Sir David Cox is currently based at the Department of Statistics and Nuffield College, Oxford University. During his career he has been awarded numerous honorary doctorates, and has an honorary fellowship from St John's College, Cambridge. He has been awarded the Guy Medals in Silver (1961) and in Gold (1973) by the Royal Statistical Society and was President of the Society from 1980 to 1982. He was elected a Fellow of the Royal Society in 1973 and was knighted in 1985. In 1997 he was elected an Honorary Fellow of the British Academy.