

OBITUARY: *Maurice Stevenson Bartlett*



Maurice Bartlett

Professor M. S. Bartlett FRS died peacefully at his home in Exmouth, Devon, on 8 January 2002; he had been suffering from a cardiac condition for several years, and an excessive effort in handling some books appears to have been the immediate cause of his death. Bartlett was recognized as one of the great names of the twentieth century in probability and statistics. He was something of a general scientist, who spoke enthusiastically about the role of statistics in science to Ingram Olkin in [29, p. 162]. ‘... I have a wide interest in statistics,’ he stated, ‘... it’s such a wide subject and to some extent it trains one to try and see problems as a whole.’

Bartlett was born in Chiswick, London, on 18 June 1910, the third child of a family in humble circumstances; the family later moved to 100 Netherwood Road, near Shepherd’s Bush. Maurice’s two older siblings were his sister Connie and his brother Gerald. When his father William went off to fight in World War I, money became tight, and his mother Eva, who had a limited education, decided to let rooms in the home to a lodger. Maurice was thought by his family to be rather slow at elementary school, but succeeded in winning a scholarship to the renowned Latymer Upper School, where he completed his secondary education. In his article [24, p. 42], Bartlett mentions that his ‘interest in probability began at school with the chapter in Hall and Knight’s *Algebra*’. It was an interest that was to last a lifetime; like most boys, he also had sporting interests, and loved to play tennis and cricket.

In 1929, he was awarded a state scholarship to Queens’ College, Cambridge, where he read mathematics. In his final undergraduate year in 1932, he published his first paper [1], jointly with John Wishart, and achieved the rank of wrangler with distinction in Schedule B of the tripos examination. His scholarship was extended for a fourth year, and he continued at Cambridge as Wishart’s first mathematical postgraduate student, publishing a second paper [2] with him. He was awarded the Rayleigh Prize in 1933. During that year, he also managed to attend several lecture courses ‘for fun’, including Arthur Eddington’s lectures on relativity, Paul Dirac’s on quantum mechanics, Colin Clark’s on statistical sources and Udny Yule’s on vital statistics. The probabilistic ideas of statistical physics remained among Bartlett’s continuing interests.

At the Union Library, he discovered the book [30] by F. P. Ramsey, who had briefly lectured to him in analysis during his first undergraduate year. The book contained some remarks on

the nature of probability, which led Bartlett to write [3]. While at Queens', he became friendly with Bill Cochran, who had come to Cambridge a year after him. He also got to know G. Udny Yule, who directed his interest to time series, and encouraged him to enter the Royal Statistical Society's competition for young statisticians. His essay 'Mortality and the trade cycle' did not win the competition, but alerted him to some important problems in time series analysis. Somehow, Bartlett also found enough time to row for his college, and to win a competition for the design of the front cover of the college journal.

In 1933, Egon Pearson offered Bartlett his first job as Assistant Lecturer in the new Statistics Department at University College, London. These were exciting times: R. A. Fisher had just been appointed as the new Galton Professor, and J. B. S. Haldane was a frequent visitor to the Galton Laboratory. Jerzy Neyman had also joined Pearson in his department, so that Bartlett was able to hear their lectures on the new Neyman–Pearson theory of testing statistical hypotheses. Bartlett greatly admired Fisher's work, particularly his geometrical methods, but had a troubled relationship with him. On one occasion, Bartlett showed Fisher his paper [5], which he regarded as one of his best. His results clarified the existing discussion of the topic in the fourth edition of Fisher's book [26]; Fisher's dismissive response that 'a revision was already in hand for the next edition' proved disappointing. Bartlett commented on Fisher that '... at one stage, I might be ... in his good books; and another time, I'd be in his bad books because I was querying some point he had put forward' [29, p. 158].

Bartlett's relations with Haldane were much more cordial; Bartlett paid tribute to Haldane's generosity of spirit in placing his name first in their joint papers, although he was the junior author. They published two papers on inbreeding in 1934 and 1935, and Haldane in his capacity as Editor of the *Journal of Genetics* later accepted Bartlett's paper [6] for publication. Bartlett was able to visit Haldane and his wife in India, after Haldane had joined the Indian Statistical Institute in Calcutta on his retirement.

In 1934, after only a year at University College, Bartlett, who agreed with Fisher's 'philosophy of using statistics rather than just treating it as some academic subject' [29, p. 157], felt that he needed to gain practical experience, and took up the post of statistician at the ICI Agricultural Research Station at Jealott's Hill. His intention was to get to grips more directly with statistical methods applied to real problems. He characterized his four years at ICI as 'not only the happiest period (professionally) of my life, but also the most creative'. The atmosphere was very conducive to research, mainly because '... you had scientists of different disciplines—chemists, biologists and so on. We'd meet together every week to discuss the problems that were involved, and there would be cooperation. At the same time, you were free to develop your own ideas' [29, p. 163].

During his time at Jealott's Hill, Bartlett published some two dozen papers on a wide variety of topics ranging over the homogeneity of variances, the theory of inbreeding, the estimation of general intelligence, the statistical conception of mental factors, the effect of non-normality on the *t*-distribution, contingency table interactions, sufficiency, field and laboratory sampling errors (with A. W. Greenhill), correlations among genetic components of ability, multiple regression, the statistical technique of cotton experiments in Egypt, and the nutritive value of 'summer' milk (with J. C. Drummond *et al.*). Perhaps the best known of these papers is [4], in which he introduced the Bartlett test for the homogeneity of variances. These diverse works give a clear indication not only of Bartlett's originality, but also of the breadth of his scientific interests.

Bartlett's work in factor analysis was sparked by a correspondence with Godfrey Thomson on the analysis of human intelligence. Bartlett wrote a letter to *Nature* on the estimation of human

ability in 1935, and a paper [7] two years later. He welcomed the publication of Thomson's book [31] in 1939, although he disagreed with some of Thomson's views. He expounded his own position in the review paper [12], his main point being that the factors were perhaps statistical artifacts in a purely statistical analysis of the psychological data.

In October 1938, as a result of an unwelcome reorganization at ICI, Bartlett moved to a lectureship at the University of Cambridge. In 1940, at the beginning of World War II, he was allocated to a Ministry of Supply establishment in Kent, under the leadership of Professor Rosenhead, which was devoted to rocket research; he was later moved to Wales and then London. At one time or another, Frank Anscombe, David Kendall, and Pat Moran were his colleagues at this establishment. Shortly after the fall of France in 1940, he first met Jo Moyal, who had managed to escape to Britain through Bordeaux. They began to correspond, and Moyal's extensive knowledge of European work on stochastic processes proved to be a great stimulus to Bartlett's research. He familiarized himself with the work of Wold, Kolmogorov, and Khinchin, among others in the field.

On his return to Cambridge after the war in 1946, Bartlett immersed himself in the study of time series and diffusion processes, publishing the paper [8]. When he was invited by Harold Hotelling to visit the University of North Carolina at Chapel Hill for four months, with the prospect of a longer term appointment, he lectured on stochastic processes, producing a set of mimeographed notes which formed the basis of his later book on the subject. During this visit, he got to know Herbert Robbins, Pao-Lu Hsu, Abraham Wald, and Sam Wilks, whom he had met earlier in Cambridge, among many other American statisticians. He was to return to the USA on several later occasions, to Harvard in 1958, Chicago in 1964, and the University of California at Santa Barbara in 1987.

Following his return from the USA, Bartlett continued with his research on stochastic processes, publishing [11]; this opened up the field of inference on Markov chains. At about the same time, with David Kendall, he published [10]. Bartlett had long been interested in population problems with an age distribution, and had thought to break up the population into discrete age groups, but Kendall suggested the use of the characteristic functional, which gave beautiful explicit results.

In 1949, Bartlett collaborated with David Kendall and Jo Moyal in the Royal Statistical Society's Symposium on Stochastic Processes. At this ground-breaking symposium, he presented the paper [9], in which he first derived the equations for the general stochastic epidemic, among other results. Bartlett comments on the fact that he was unaware of McKendrick's earlier work on epidemics at the time. Kendall spoke on stochastic processes and population growth [27] and Moyal on stochastic processes and statistical physics [28]. To many students and researchers, these three important symposium papers opened new vistas of research in the area. At that stage, Bartlett and Moyal agreed to write a joint book in the rapidly evolving field of stochastic processes. However, after several delays on Moyal's part, Bartlett eventually decided to publish his contribution separately; the first edition of his impressive and influential book [13] appeared in 1955. There was no mention of McKendrick in this first edition, but the second edition of 1966 contains four references to him. The manuscript of Moyal's unpublished book, on which he continued to work for many years, is now in the possession of his one time student Peter Brockwell. Meanwhile, Bartlett also continued to publish in other areas of statistics such as time series and multivariate analysis.

In 1947, Bartlett accepted the Chair of Mathematical Statistics at the University of Manchester. For the next 13 years, he proceeded to develop modern courses on the subject in his Statistical Laboratory; he also launched a Diploma in Statistics and a postgraduate course in

operational research. It was in Manchester that he became increasingly interested in the study of epidemic models, leading to his important paper [14] and his two papers [15] and [16]. His second book [17] appeared in 1960.

In 1960, Bartlett moved to the Chair of Statistics at University College, London, vacated by Egon Pearson on his retirement. He continued to publish on the spectral analysis of point processes in papers such as [19] and [20]. He also worked on stochastic path integrals, statistical physics, spatial patterns, and multivariate statistics as well as epidemiology. His third book [18] dates from this period. In 1967, he was offered the newly created Chair of Biomathematics at the University of Oxford, a position which he occupied with distinction until his retirement in 1975. His fourth book [23] was published in 1975.

Bartlett found his position at Oxford challenging: he reported that ‘the Biomathematics Department and its staff ... were viewed suspiciously by the biologists as being too mathematical. The mathematicians seemed more generally ready to welcome me, but I had moved to Oxford to try to foster biological statistics and mathematics.’ This he successfully proceeded to do. His aim in research was to cover theoretical population biology, together with biometry on the statistical side. While continuing his work in time series, he began to study two-dimensional spatial systems, nearest neighbour models, and population models, and eventually published his research in several papers, such as [21], as well as his fifth book [22]. In 1973–74, he was invited by his old friend Pat Moran to spend a year in the Department of Statistics of the Institute of Advanced Studies at the Australian National University. While there, he underwent a prostate operation which was not entirely successful, and after his return to Britain, he had to be operated again. He came back to Australia for two happier visits in 1977 and 1980.

Bartlett remained active after his retirement, and continued to publish steadily on such topics as the Ising model, random walks, spatial patterns, spectral analysis, population models, doubly stochastic population processes, and birth–death and catastrophe models, among others. He also wrote obituary notices for Egon Pearson, Oscar Irwin, Hilary Seal, all of whom he had known well. A full list of his 167 publications (including his five books), and 12 letters to *Nature* from 1932 until 1989 may be found in Volume I of the three volume *Selected Papers of M. S. Bartlett* [25]. His contributions to probability, statistics, and stochastic processes have proved basic to the development of these fields. David Cox in his foreword to the *Selected Papers* states the case for the continuing importance of Bartlett’s contributions most compellingly; he writes that readers ‘... cannot fail to be impressed by the enormous breadth of the contributions involved, but it is perhaps only by thinking back to those earlier days that the deep originality and importance of the work can be fully appreciated.’ Cox also delicately points out another characteristic of Bartlett’s writing, namely the difficulty it presented to readers: ‘... it has to be admitted that many of the papers were not and are not easy reading ... primarily from the high density of ideas ...’

Bartlett was elected to the International Statistical Institute (ISI) as a Member in 1949, and an Honorary Member in 1980. He served as President of the Manchester Statistical Society in 1959–60, of the Biometric Society (British Region) in 1964–66, and of the International Association of Statistics in the Physical Sciences, a section of the ISI, in 1965–67. He was elected a Fellow of the Royal Society in 1961, and President of the Royal Statistical Society for 1966–67. He received many other honours and awards, among them an Honorary DSc from the University of Chicago in 1966, and a second one from the University of Hull in 1976. He was a Guy Silver Medallist of the Royal Statistical Society in 1952, a Guy Gold Medallist in 1969, and was awarded the Weldon Prize and Medal of the University of Oxford in 1971. He was elected a Foreign Associate of the US National Academy of Sciences in 1993.

Readers may be curious to know what Maurice Bartlett was like as a man. Under his quiet and reserved exterior, there was a sensitive and kindly soul, whose good will could always be relied upon. He was scrupulously fair to colleagues and students; many of them recall with affection his gentleness and kindness to them. I personally remain grateful for the many kindnesses which he showed my wife and myself when we first met him in Manchester in 1956. He had a marked artistic talent: about four years ago, he showed me in his home at Exmouth a very lifelike pencil sketch he had made of Egon Pearson. He appreciated paintings, and developed an enthusiasm for nineteenth century watercolours, often tracking them down in dusty sales rooms. He also loved music, and would often listen to records on his return from work. He rarely brought work home after office hours; he appeared to do most of his thinking in his head, and would often sit in deep concentration for long periods in his armchair, apparently doing nothing, but in fact quietly working out the problems that interested him: 'I like to have problems grow on one,' he stated in his conversation with Ingram Olkin, 'I don't really like to be in a particular hurry, necessarily, to solve them' [29, p. 163].

In 1957, Maurice married Sheila, daughter of C. E. Chapman, and sister-in-law of the film actress Margaret Lockwood; Sheila herself had at one time been on the London stage. The marriage was a very happy one, with Sheila's teasing ways acting as a light counterpoint to Maurice's fundamental seriousness. Sheila died of bone cancer on 23 November 1998, leaving a disconsolate Maurice in their home at Exmouth. They had a daughter, Penelope (Penny) Robinson, living close to them in Exeter, who survives them, as do her three daughters, Bartlett's grandchildren, Sophia Rosemary, Anna Louise, and Felicity Helene. Anna has two sons, Yussef and Solomon, and Felicity has one son, Joseph. Maurice always enjoyed the visits of his granddaughters and their families to his home.

Maurice retained his interest in science till the end of his life. He recently corresponded with me about an article in *Nature* which he had found stimulating. He would also recommend scientific books for me to read, and we would discuss them on my annual visits to him. He remained equally enthusiastic about sports, and in his letter of 3 July 2001 to me, commented on the tennis matches at Wimbledon which he had been watching on television. He then went on to complain jocularly that he was wearing himself out, merely watching the matches!

Maurice's ninetieth birthday was celebrated in his home by his daughter Penny, and a select gathering of his close professional friends: Peter Armitage, Vic Barnett, Michael Bulmer, David Cox, Robert Curnow, Richard Doll, John Kingman, Toby Lewis, and Peter Whittle. I was unable to attend, but phoned from Canberra to wish him a happy birthday; our last meeting was in May 2001. I was looking forward to my visit to Exmouth in May 2002, but it was not to be.

The statistical profession has lost a towering figure; in many respects, the subject would not be the same without Bartlett's major contributions to probability, statistics, and stochastic processes. He had a far-sighted view on the future of statistics: 'The use of the computer, of course, is very important and much changed the nature of statistics' he remarked to Ingram Olkin, adding further that '... the theory of stochastic processes has very much changed the attitude to statistics.' He saw statistics as '... a growing subject. I don't really see it as a closed academic subject.' In effect, in the wider context he saw it as '... all part of research' [29, pp. 162–3].

Bartlett was profoundly dedicated to research and scholarship, achieving his life's work with exemplary modesty, integrity and humanity. He was an inspiration to younger colleagues, and a revered role model to many. His death is a great loss, not only to his family, but to the entire scientific community; he leaves behind him an exceptional body of original work, and memories of kindness, thoughtfulness, and decency which we shall all treasure.

His daughter Penny has described Bartlett as a serene man; at his funeral, his granddaughter Anna read the following lines from William Blake's 'Auguries of Innocence', which was among his favourite poems:

Joy and woe are woven fine,
A clothing for the soul divine;
Under every grief and pine
Runs a joy with silken twine.
It is right it should be so;
Man was made for joy and woe;
And when this we rightly know
Thro' the world we safely go.

These lines seem indicative of his attitude to life.

I owe a great debt to Penny Robinson for her help in writing this obituary, and to Vic Barnett and Toby Lewis for their comments on an earlier draft. This biographical memoir is an extended version of the obituary in *J. R. Statist. Soc. D* **51** (2002), 399–402.

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