**Egon Sharpe PEARSON**
b. 11 August 1885 - d. 12 June 1980

**Summary.** Egon Pearson continued and developed his father, Karl's, pioneering work in teaching and research in statistics at University College London and, with Neyman, made fundamental contributions to the theory of hypothesis testing.

Egon Sharpe Pearson, the son of Karl Pearson (q.v.), was born in Hampstead (London) and died in Midhurst, Sussex. His education took him from Winchester College to Trinity College, Cambridge where he graduated in mathematics. He then moved into his father's department at University College, London in 1921 and remained there, apart from wartime service in the Ministry of Supply, until his retirement in 1960. Advancement was rapid and he was promoted to Reader in 1933, when his father retired, and to Professor in 1935. From 1933 he was also head of one of the two departments into which Karl Pearson's department had been divided on his retirement; R.A. Fisher (q.v.) headed the other.

Like many sons who have followed in the footsteps of famous fathers, it could not have been easy for Egon to establish a distinctive academic identity. Indeed, there was a strong element of continuity between the old regime and the new. He took over the editorship of *Biometrika* from his father in 1936 and continued in that role until 1966 by which time the journal had been in the hands of the two Pearsons for the whole of the 65 years since its founding.

*Biometrika* has always been a vehicle for the publication of statistical tables, many computed at University College. In the pre-computer era, such tables were the essential infra-structure of practical statistics. They required an immense amount of calculation and Egon Pearson contributed extensively to this enterprise. The Biometrika Trust published many such tables and the most useful were brought together, and widely disseminated, in the two volumes edited jointly with H.O. Hartley: *Biometrika Tables for Statisticians* Volumes I and II.

Computation was also a key element in the Pearsonian approach to teaching statistics. The many hours spent with Brunsviga calculators left its mark on generations of students. Subsequent developments in computing soon made the skills it imparted obsolete, but first hand experience of handling data was a more durable element.

As a lecturer Egon Pearson was hesitant in delivery but his presentation

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was liberally illustrated with examples and enlivened with allusions to the historical origins of the methods he described. A particular feature, shared with his father, was the use of geometrical representations to reveal the essential structure of a problem. This was also the subject of his presidential address to the Royal Statistical Society in 1955.

Egon Pearson also shared with his father a deep interest in the history of probability and statistics. In *Biometrika* there was a long-running series of historical papers leading to a volume of collected papers, edited jointly with M.G. Kendall. Two major memoirs on his father were brought together in *Karl Pearson, An Appreciation of his Life and Works*, (CUP, 1938) while Egon's last publication, two years before his death, was an edition of his father's lectures on *The History of Statistics in the 17th and 18th Centuries*.

Egon Pearson's main contribution, however, owed little to the departmental tradition but followed the arrival, in 1925, of Jerzy Neyman (q.v.). By that time R.A. Fisher had laid the foundation of estimation theory and significance testing but Neyman and Pearson felt that more account needed to be taken of alternative hypotheses. Over the decade 1928-38 the Neyman-Pearson theory took shape, focusing on the concept of the power of a test. Pearson thought that the germ of this idea had been contained in correspondence with W.S. Gossett (q.v.) but he also remarked once that the concept of power had come to him while looking over a farm gate. Even to those who subscribe to other approaches to inference, this contribution remains one of the landmarks of statistical theory.

The 'Neyman-Pearson' theory of hypothesis testing was launched with two *Biometrika* papers in 1928 running to almost 100 pages. Five years later there followed a major memoir of 48 pages in the *Philosophical Transactions of the Royal Society* and a lesser, but still substantial, paper in the *Proceedings of the Cambridge Philosophical Society*. The tour de force was completed in a three-part contribution, in 1938, to the short-lived *Statistical Research Memoirs* published by the Statistics Department at University College. These papers are included in the *Joint Statistical Papers* of J. Neyman and E.S. Pearson published by Cambridge University Press and the University of California Press in 1966.

At the heart of the theory is the Neyman-Pearson lemma. This tells us how to find the most powerful test of a simple null hypothesis against a simple alternative. It shows that, for such a test, the critical region has a boundary on which the likelihood ratio is constant. The desired size of the test is then achieved by an appropriate choice of this constant. If the null and

alternative hypotheses are indexed by a single parameter for which a sufficient statistic exists, then the test statistic will be a function of that statistic. If the alternative hypothesis is composite, consisting of a set indexed by some parameter, and if the most powerful test for any member of the family turns out not to depend on which member is chosen, then the same test statistic will serve for all members of the set. In that case we have a uniformly most powerful (UMP) test.

Unfortunately UMP tests seldom exist, and much of the theory is concerned with how to obtain good tests in their absence. This is particularly the case when nuisance parameters are present. Neyman and Pearson introduced such notions as similar regions and unbiasedness to help deal with these cases, but their lasting practical legacy is to be seen in the so-called generalized likelihood ratio test in which unknown parameters are replaced by their maximum likelihood estimators. This includes, as special cases, most of the parametric tests in use today.

These results gave the likelihood function the central place in testing theory, which it already had in Fisher's point estimation theory. It also provided a link with Neyman's later work on interval estimation and, more generally, with Bayesian and likelihood approaches to inference.

A constant theme of the theoretical work of Egon Pearson and his students was the approximation of sampling distributions under both the null and alternative hypotheses. Often this was done within the framework of the Pearson family of frequency curves devised by his father. The common sampling distributions; normal, chi-squared, $t$ and $F$, were already members and many more, which could not be determined exactly, could be approximated by a Pearson curve by equating moments. The provision of percentage points for these curves as a function of their skewness and kurtosis provided a solution of the significance testing problem for a very large class of cases.

On the applied side, Egon Pearson made a major contribution to industrial statistics. This seems to have been stimulated by meeting W.H. Shewart (q.v.) and led to the formation by the Royal Statistical Society of its Industrial and Agricultural Research Section in 1933 and, most notably, in a handbook on statistical methods in standardization (BS 600) published in 1935. Wartime service in the Ministry of Supply gave an impetus to this interest which continued through membership of committees of the British Standards Institution.

Egon Pearson's importance in the development of statistics is to be seen, perhaps, not so much in his individual contributions to theory and prac-

tice but in the aggregate effect of his many-sided activities focused in the work of the Statistics Department at University College London. Its staff, students and publications had, and continue to have, world-wide influence and, significantly, Egon Pearson's leadership spanned the period when modern statistics was born. His was not the style of leadership exercised in the public arena but in the sustained and meticulous attention to the work of publication, teaching and supervision which underpins the statistical edifice. The regard in which he was held is reflected in the honours which came his way, most notably Fellowship of the Royal Society (1966), President of the Royal Statistical Society (1955-7), its Guy Medal in Gold (1955), and CBE (1946).

**Bibliographical Notes**
Obituaries by M.S. Bartlett are given in *Biometrika* **68** (1981), 1-7 and in *Biographical Memoirs of Fellows of the Royal Society*, (1981), 425-443. The former is followed by an appreciation by L.H.C. Tippett and both contain full list of publications. A further obituary is by N.L. Johnson in *Journal of the Royal Statistical Society Series A*, **144** (1981), 270-1.
An 80th birthday tribute by P.G. Moore is in *Journal of the Royal Statistical Society Series A*, **138** (1975), 129-30.
The key publications are reprinted in *The Selected Papers of E. S. Pearson*, Cambridge University Press, 1966 and *Joint Statistical Papers of J. Neyman and E.S. Pearson*, Cambridge University Press and University of California Press, 1966. Egon Pearson's own account of the collaboration with Jerzy Neyman is in 'The Neyman- Pearson Story: 1926-34', in *Research Papers in Statistics, Festschrift for J. Neyman*, ed. F.N. David, Wiley, Chichester, 1966, 1-23.

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